IN ASSOCIATION WITH

abbvie

2019 Sligo Engineering & Technology Expo

Knocknarea Arena - IT Sligo
Thursday 2nd May 2019

Event Catalogue

IT Sligo
An Institiúid Teicneolaíochta, Shligeach

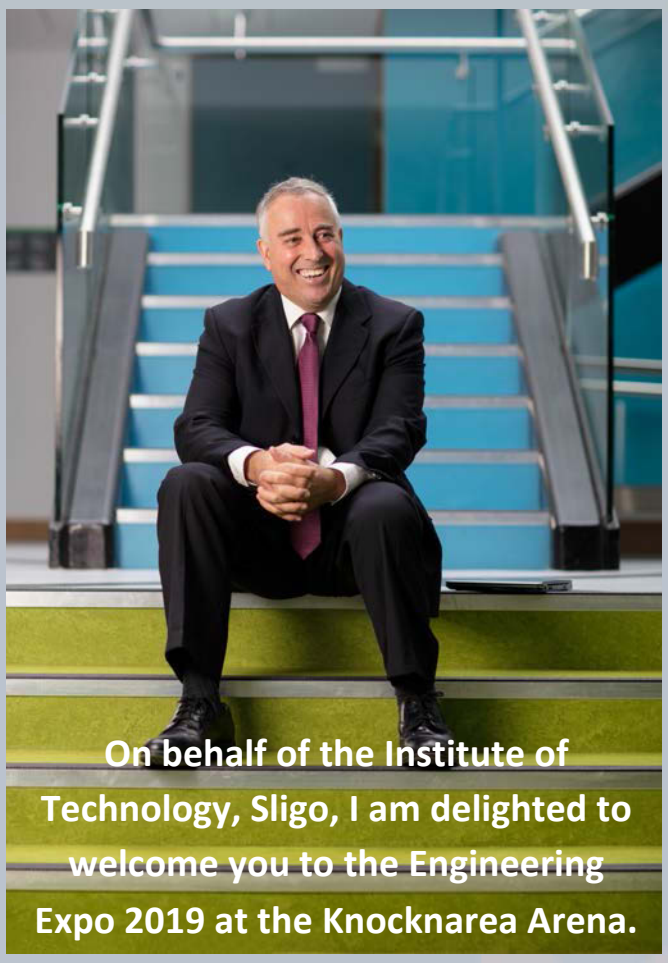
Welcome from the President of IT Sligo

Engineering is the heartbeat of Irish Industry and it is central to the contribution that IT Sligo is making to the growth of the economy here in the North-West. Throughout its 48-year history, engineering has been an integral part of the Institute's education offering. We are deeply proud of that heritage and are fiercely ambitious to grow and develop the role that IT Sligo can play in the engineering sector, both educationally and as a collaborative partner with industry.

This special event is a collaboration between industry, educators and innovators, bringing together some of the best talent and expertise across Ireland. The Expo reflects the close working relationship between IT Sligo and employers in all aspects of engineering across the region and provides a real opportunity for forthcoming graduates to meet, discuss and engage with their future employers.

Engineering is a creative enterprise, one that requires intense imagination and taps into our everyday curiosity about how the world works. You'll get a sense of that when you browse the truly diverse range of exhibits featuring some of Ireland's leading engineering companies alongside innovative projects developed by students and graduates from IT Sligo's School of Engineering & Design.

You will also get to see the range of engineering programmes on offer by the Institute, provided on campus and online, which might stimulate you to continue your studies in Engineering.



On behalf of the Institute of Technology, Sligo, I am delighted to welcome you to the Engineering Expo 2019 at the Knocknarea Arena.

As a qualified engineer myself, I am passionate about helping others to develop their engineering careers through education, which is why I fervently hope that this Engineering Expo at IT Sligo is a source of inspiration and motivation for the future generations of engineers.

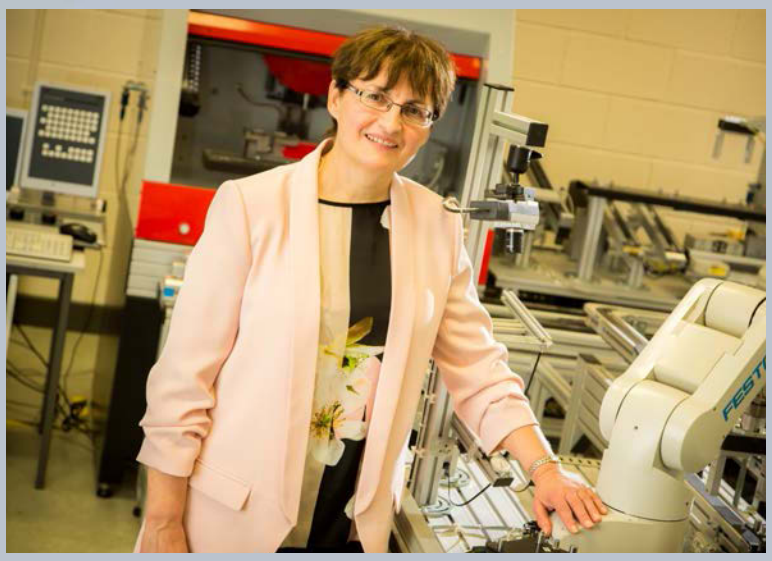
For students and jobseekers, the Engineering Expo provides a good insight into what a career in Engineering is really like. It is particularly gratifying to see so many employers from the North-West at the Expo, all of whom wanting to employ our graduates – we are seeing employment opportunities fo engineering graduates in the North-West at a very high level this year.

Discover and enjoy.

Dr Brendan McCormack President IT Sligo.

Welcome from the Head of the Faculty of Engineering & Design

Welcome to our 5th Engineering & Technology Expo.



At the Engineering & Technology Expo you will see an extensive range of activities on show that include student projects, industry exhibits and guest speakers and – all aimed to inspire future engineers, showcase our graduates, promote engineering in the Northwest and to open up engineering conversations and connections.

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Over fifty of our final year students will showcase their projects that are the culmination of their education in IT Sligo. We are proud that we educate students that satisfy the needs of industry across a broad range of programmes including; civil engineering, mechanical engineering, precision engineering & design, mechatronics, electronic & computer engineering and a broad variety computing programmes. The industry selected awards for the top student projects is a great highlight at the event each year. Many of our graduates have gone on to leadership positions in some of the top companies in Ireland and around the globe.

We have 36 great companies showcasing the leading edge in engineering and technology, many with jobs on offer. Prospective job hunters and those interested about roles in engineering are invited to attend. We hope that primary and secondary students along with the teachers and parents will come along and be inspired about the potential of a career in engineering.

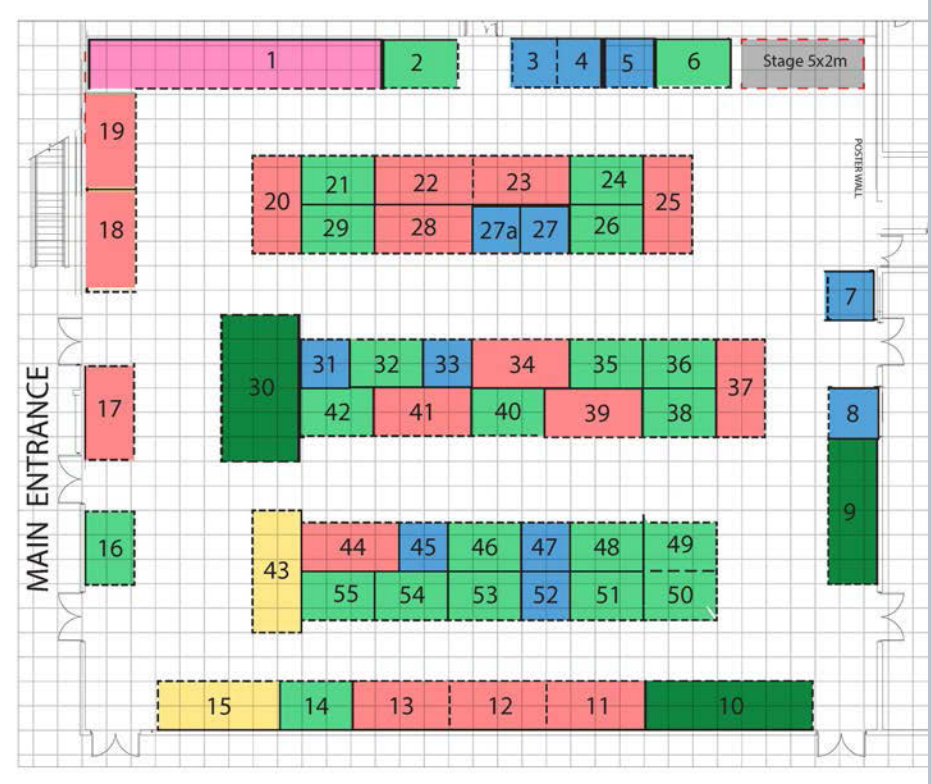
We are also promoting all our fulltime, online and apprenticeships courses we offer for the manufacturing, technology and construction industry sectors – including our new suite of masters research programmes.

An event like this would not happen without a great team of people on board. I would like to thank everyone who contributed across many organisations and within IT Sligo. A special thank you to the industry steering group, our academic and technical staff who supported the student projects, our core IT Sligo organising team, our event manager Oli Melia, logistical partner Ocean FM and our key industry sponsor AbbVie.

I hope you enjoy Engineering & Technology Expo 2019.

Úna Parsons, Chartered Engineer, FIEI
Head of Faculty of Engineering & Design, IT Sligo

Exhibitor List



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2	IT Students - Electronics
3	IT Students - Electronics
4	IT Students - Electronics
5	ATS
6	Where There is No Engineer Jennings
7	O'Donovan & Partners Limited
8	Meusburger
9	IT Students - Mechanical Engineering
10	IT Students - Mechanical Engineering
11	IT Students - Mechatronics
12	IT Students - Mechatronics
13	IT Students - Mechatronics
14	INBLEX Plastics
15	SL Controls
16	IT Students - Mechanical Engineering
17	IT Students - Mechanical Engineering
18	Dolmen Engineering
19	IT Students - Electronics
20	Abbott
21	IT Students - Civil - CPM
22	IT Students - Computers
23	IT Students - Computers
24	Tool & Guage
25	Ballina Beverages
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27	Northern & Western Regional Assembly
27a	I T Sligo Courses
28	Pharma Stainless
29	Ward Automation
30	AbbVie
31	Collins McNicholas Recruitment & HR Services Group
32	First Polymer Training Skillnet
33	Irish Medtech Association & Polymer Technology Ireland
34	SF Engineering
35	Mergon International
36	Suir Engineering
37	Avenue (GW Plastics)
38	Social Robotics
39	Hollister
40	Ball
41	MSLETB Training Centre, Sligo
42	Litec Moulding
43	Local Enterprise Office Sligo
44	MCi Ireland Ltd
45	Ash Vision
46	Phillips Medisize, a Molex Company
47	Hasco
48	PEM Technology Gateway
49	IT Students - Mechanical Engineering
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51	Careerwise
52	EPS Group
53	Shareridge Civil Engineering
54	IT Students - Mechatronics
55	Kilcawley Construction

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56	IT Sligo- PLC Controlled Assembly Line
57	IT Sligo- Railway Barrier System
58	IT Sligo- Robotic Barman
59	IT Sligo- Smartphone Controlled RC Car
60	IT Sligo- Ball Balancing Table
61	IT Sligo- Awareness & Time Reaction Test
62	IT Sligo- Automated Meal Dispenser
63	IT Sligo- Biometric Security System
64	IT Sligo- Automatic Solar Tracker
65	IT Sligo- LED Turn Signal Vest
66	IT Sligo- MPS Rig
67	IT Sligo- Motion Detection Turret
68	IT Sligo- Pick and Place Robot
69	IT Sligo- Real Time Clock
70	IT Sligo- Home Automation System
71	IT Sligo- Automated Staircase Lighting IT
72	Sligo- Autonomous Crash Alerting IT
73	Sligo- Automated Fertiliser Spreader IT
74	Sligo- Exoplanet Detection
75	IT Sligo- Fire Fighting Robot
76	IT Sligo- Smart Mirror

abbvie

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AbbVie combines advanced science, expertise, and passion to solve serious health issues and have a remarkable impact on people's lives.

AbbVie is a global research-based biopharmaceutical company formed in 2013. It delivers world-class discovery, production and supply of critical medicines. A modern biopharmaceutical business, AbbVie has a significant footprint in Ireland that's focused on novel and breakthrough therapies for tough-to-treat diseases and unmet medical needs, with a reputation for quality.

The company employs more than 29,000 people worldwide and markets medicines in more than 170 countries. In Ireland, AbbVie employs more than 700 people at five different manufacturing and commercial sites across the country. The company's commercial headquarters is based at Citywest in Dublin with a separate international manufacturing and engineering services centre also located in the capital at Santry. AbbVie has two manufacturing plants in Sligo, one of which is a global centre of excellence for medical devices. The company also has a third manufacturing centre in Cork.

AbbVie is committed to developing and manufacturing the cutting-edge therapies and innovations that hold the potential to improve health care worldwide. Meeting these ambitious health goals involves combining advanced science with deep knowledge of diseases and Ireland plays a central role across all stages across this process.

AbbVie has invested more than €300 million in Ireland since 2013 and each of our uniquely focused production sites here manufactures portions of AbbVie's top 20 global products. In 2018, AbbVie announced a €113 million expansion in oncology-focused manufacturing technology at the company's site in Ballytivnan, Sligo. The investment will create approximately 100 new jobs over the course of three years in a variety of technical and manufacturing positions.

AbbVie also believes strong local partnerships are crucial to achieving the best outcomes for patients as we seek to make a remarkable impact on people's lives. In the company's core areas of immunology, cancer, neurology and virology, AbbVie works with patient groups, caregivers, health providers and policymakers. This community focus is what drives AbbVie to deliver new best-in-class therapies with life-changing impact for people in Ireland and beyond and the company aspires to do this in a way that is sustainable for society.

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SL CONTROLS
THINKING AHEAD

Who are we?

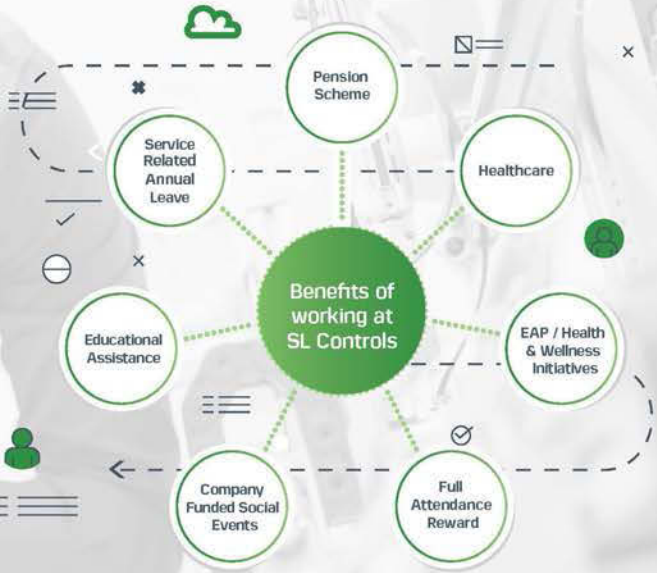
Established in 2002, SL Controls has evolved into an internationally recognised industry leader in Equipment System Integration and System Support. We work with companies in the Pharma, Medical Device, Healthcare and Food and Beverage Sectors who require high level expertise in industrial IT integration and regulatory compliance. SL Controls has the capability to offer companies innovative and cost-efficient solutions in relation to automation, process analysis, validation and serialisation. Solutions are driven by tailored programmes of work to meet each client's needs.

Careers at SL

The next step in your career could be a position with SL Controls. Our team includes controls engineers, automation engineers, systems validation engineers, project managers, and support staff.

What we do?

SL Controls provides automation, controls, and validation solutions to manufacturing facilities across Ireland, Europe, and beyond. As we are involved in implementing Industry 4.0 and Smart Factory technologies, we are in a rapidly growing, exciting, and fast-moving sector.



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Join Us On Our Journey!

About Us

EPS is a water infrastructure specialist with a workforce of over 500 people across Ireland, the UK and the Middle East. As a family business with over 50 years' experience, our products and services form part of your everyday life.

EPS works with water companies such as Irish Water in delivering and maintaining the country's water and wastewater infrastructure, ensuring that Ireland has safe, clean, drinkable water and treating wastewater before it reaches our rivers and streams.

We offer a broad range of water and wastewater treatment services across the industrial market, with customers in the beverage, dairy, pharmaceutical and meat processing sectors. EPS is also one of Europe's largest independent pump distributors.

What We Offer

- If you want to work in an environment that is fast-paced, continually evolving and will challenge you, where each day is different, and your learning never ends, then EPS is the place for you.
- The chance to innovate in a collaborative environment, using the latest digital engineering technologies as well as continuous training and development throughout your career.
- Our €4.5m Centre for Design and Manufacturing Excellence and Assembly in Cork provides the opportunity to work on live multi-million euro projects that have a genuine impact on our environment.
- Hands-on experience from the off, autonomy and responsibility within a supportive team structure.

Take a look at our various career opportunities available for students with diverse academic backgrounds.

We are always seeking students & graduates to join our team in:

- Engineering
- IT & Support Services
- Business Development
- Apprenticeships
- Accountancy & Finance
- Laboratory Testing & Analysis
- Sales & Marketing
- Logistics & Distribution

> "I was in my 4th year studying Mechanical Engineering in college when I did summer work in EPS. After graduating, the company approached me and I started in the Tendering Department as a draughtsperson. I got to see the workings of water and wastewater treatment plants from start to finish, which was invaluable experience."
>
> **Michelle Murphy**
> *Project Manager*


epswater.ie/group/careers

Rethinking Water

FIRST POLYMER TRAINING SKILLNET

First Polymer Training (FPT) Skillnet operates as a training network for Irish Industry and is funded by Skillnet Ireland. While they specialise in specific polymer programmes for the plastics and medtech industry, many programmes are aimed at the wider manufacturing sector, including a wide range of practical maintenance programmes.

Initiated and promoted by Polymer Technology Ireland (Ibec) since 1999; First Polymer Trainings objective is to provide subsidised technical training to industry, both at their technical training centre in Athlone or in-company as required. The centre in Athlone is a state of the art facility with 4 injection moulding machines, an extruder, a thermoformer and purpose built maintenance training boards.

FPT is a QQI validated provider for a number of technical programmes and has developed a series of polymer processing and design awards since 1999. A range of free e-learning programmes are also available, which are used to complement existing programmes.

FPT initiated a series of online polymer programmes with IT Sligo and is also involved in the delivery of a number of modules on these programmes. Skillnet Ireland funding is also available to subsidise the fees on this programmes.

Level 6 Certificate in Polymer Technology
B. Eng. Level 7 (Ord) Degree in Polymer Processing
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Lindal's relationship with Sligo commenced in 2000, when a wholly owned subsidiary of **Litec Moulding Ltd** was created as the center of excellence for the LINDAL Group's injection moulded technical components. By creating high value return for our customers, through the generation of innovative, technically advanced solutions **Litec Moulding** has continually grown year on year for every one of its' 18 years to become a global producer of thin wall, high precision and fast cycle time products. The company now operates on a 24/7 basis, employing 70 staff, producing 5 Billion parts per year.

This success has been made possible by **Litec Mouldings'** highly skilled specialist team dedicated to exceeding customer expectations from design concept to customer dock in an environment focused on achieving Zero defect. The company philosophy is to seek excellence through continuous improvement of all our activities, products and services. This is encouraged through employee engagement, involvement, empowerment and a process of lifelong learning. The company actively support and encourage personal development and educational advancement.

Litec provides undergraduate placement opportunities and a graduate development programme. The company is actively involved locally with Sligo IT and also further afield with University of Limerick, NUI Galway and Ulster University.

Lindal groups' confidence in the diverse team based in Sligo has been expressed in investment of over €11m over the last 5 years and further planned investment in 2019 in State of the art processes and equipment to meet the demands of today and tomorrow.

Litec Moulding part of Lindal Group is constantly on the lookout for new talent to become part of the team to ensure the continuing future success of the company both in Sligo and globally with opportunities for significant career development and progression.

If you are interested in a position with Litec Moulding please send a Cover Letter and Curriculum Vitae to G_LIE-humanresources@lindalgroup.com

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9
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About Us

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- Safety Officers
- Graduates
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- Electricians & E&I Technicians
- Chargehands & Foremen
- Mechanical & Electrical & Civil Engineers
- General Operatives
- Planners
- BIM Technicians
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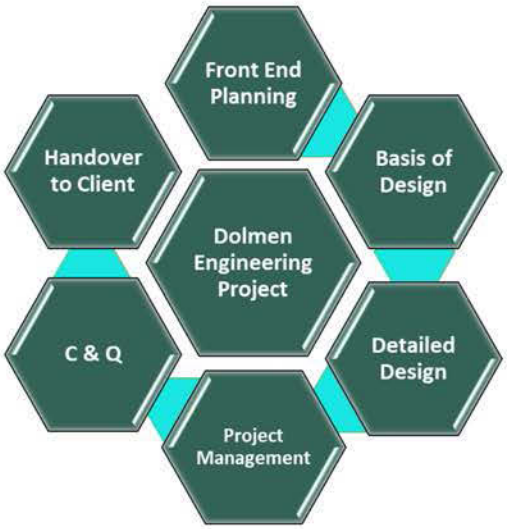
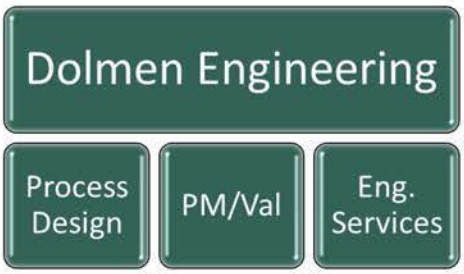
Dolmen Engineering are process design and build specialists in the Pharma, Biopharma & Medical Device sectors. We are an Irish owned company with offices in Maynooth and Castlebar. We also have a UK base in London.

We offer a full EPCMV package (Engineering, Procurement, Construction Management & Validation) for small and large projects for clients based in Ireland and across Europe.

Our Engineering Services function places technical resources across the Life Sciences sector utilising a significant database of candidates across all disciplines.
Dolmen is an owner-led and managed company with established Process Design and Project Management & Validation teams. We have the capability, agility and flexibility to adapt to clients ever changing needs.

Our success is based on trust, respect, repeat business and establishing long term partnerships with companies whose capabilities enhance our own.





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CONTACT US

http://dolmenengineering.com

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00353 (0)1 541 3769

UK Office.
Dolmen Engineering,
Kemp House,
152-160 City Road,
London, EC1V 2NX
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iNBLEX
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WHAT WE DO

- Manufacture of blow moulded bottles, containers, hollow items, 5mL to 10L in size
- Manufacture of injection moulded closures / vials / lids / devices to 100g
- Value added activities including labelling / assembly / heat staking / packaging / printing
- New product project management, delivery and scaleup

SECTORS SERVED

- Medical devices
- Diagnostics
- Pharmaceutical
- Veterinary

KEY SKILLS / COMPETENCIES

- Extrusion blow moulding
- Injection moulding
- High / low volume production
- Prototyping of injection moulded and blow moulded products
- Cleanroom manufacture (ISO Class 8)
- New product introduction
- ISO 9001 2015 registered

DESIGN TO DELIVERY, END TO END, ONE STOP SERVICE

- Innovation
- Product design - design from scratch / reverse engineering
- Prototyping
- Testing
- Tool design and build
- Validation
- Full scale manufacture

INHOUSE RESOURCES

- 3d Scanning
- FDM 3D / Stereolithography 3D printing
- Subtractive milling rapid prototyping
- Product design
- DFM Design For Manufacture
- Functional prototype manufacture
    - Tool design / Toolroom / Product testing

iNBLEX Plastics Ltd. Mc Guinness Technology Park, Aclare, F91 HC62, Co. Sligo.
p 071 9181402 f 071 9181404 e info@inblex.ie

Who is Ash?

Ash Technologies is an Irish company established in 1994 specialising in digital magnification and imaging solutions designed for industry. Our award winning, internationally recognised product design has affirmed Ash Technologies as an innovation leader in product design, development and image quality.

Our Inspection solutions can improve production process quality and fault detection, provide better cost efficiencies, increase operator performance and productivity, aid training and offer a cost effective alternative to traditional methods.

Flagship Product: **Omni core**

The Omni core platform has a powerful image processing and control engine that delivers superb full HD live video image quality at 60 frames per second enabling it to be utilised as a solution in a broad range of quality control, testing, rework, assembly, inspection, and documentation tasks. The Omni GUI (Graphical User Interface) is a custom designed mouse controlled Interface delivering intuitive and efficient operation and control of the full application suite. The Omni core is configurable to suit user's individual inspection and analysis requirements with advanced inspection & our patented measurement applications.

omni core

powering potential from the core

Not all inspection needs and requirements are the same. That's why we have developed a platform to suit a multitude of needs. Start with the core – then add your apps

Apps:

2D Measurement & Graticule, Automatic Measurement, DXF Import, Image Stacking, Image Comparator Side by Side, Image Comparator Overlay.

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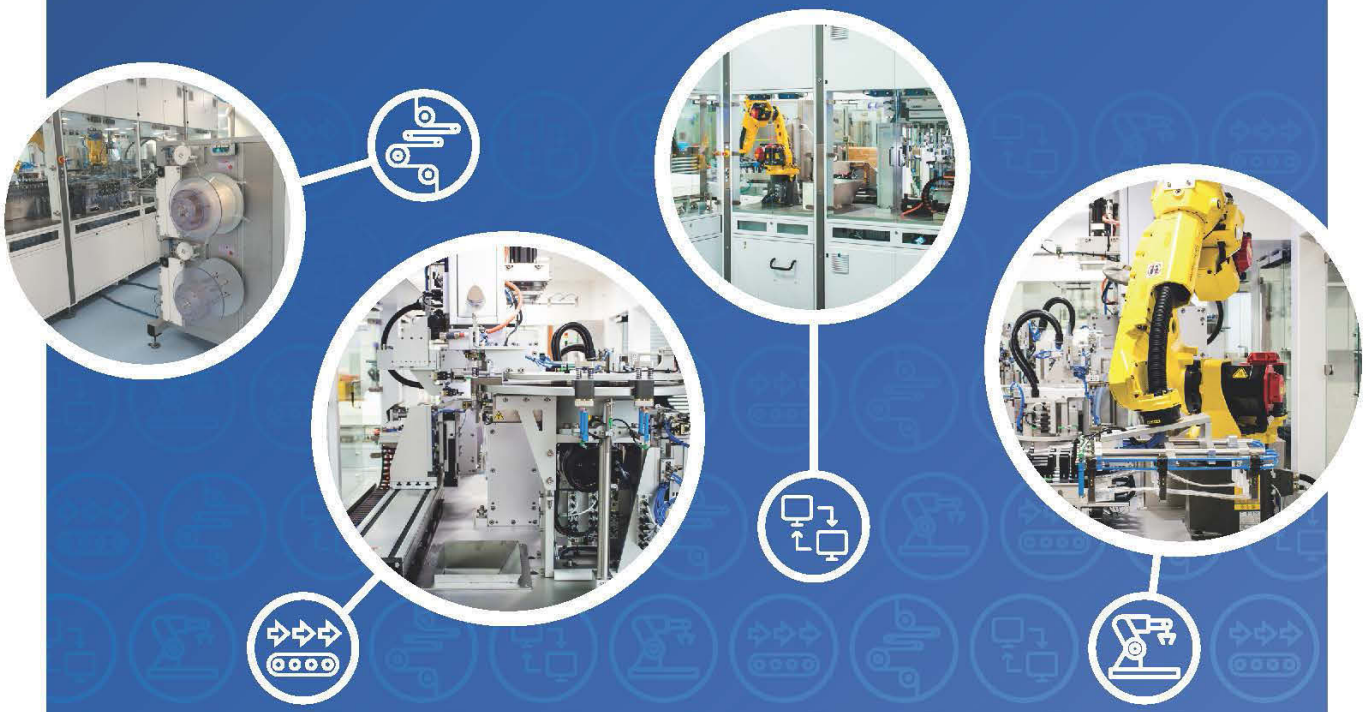

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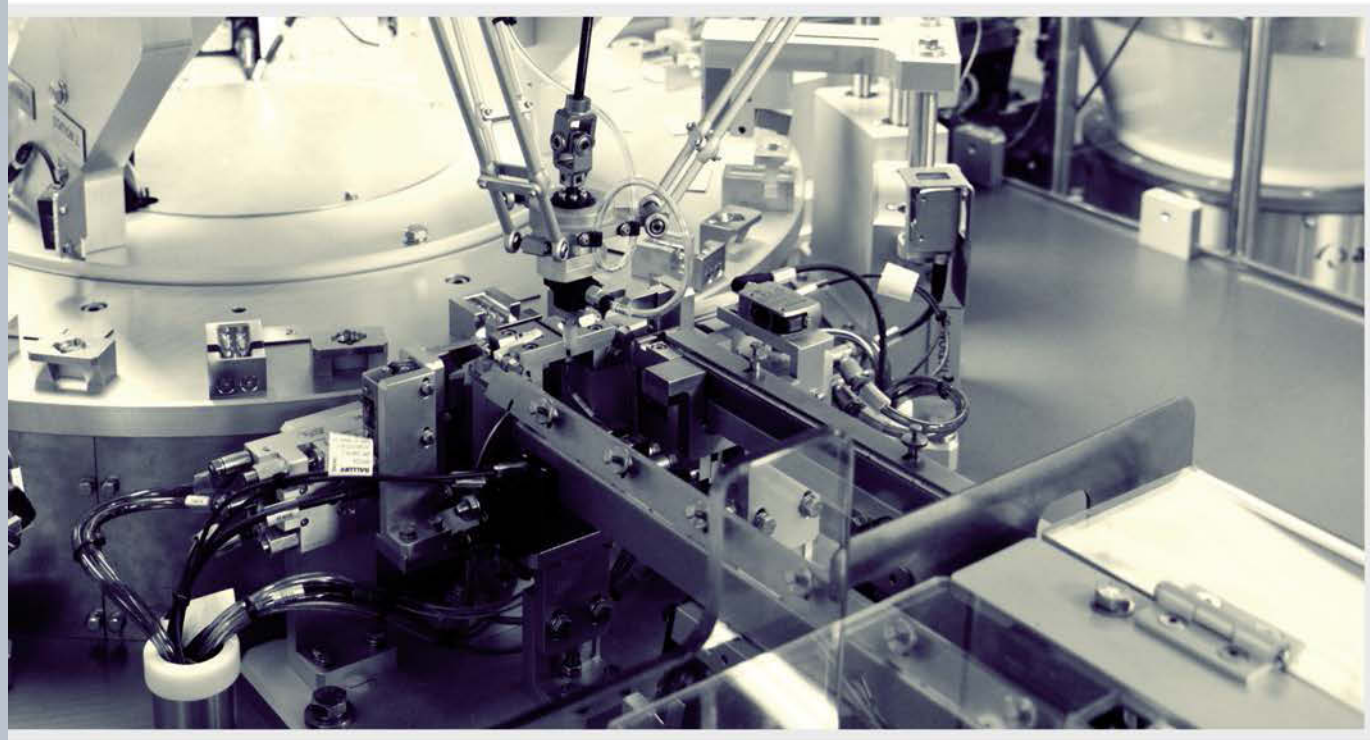

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Youthreach is a 2-year full-time programme for early school leavers aged between 15-20 years of age. Programmes can include QQI certification, Junior Certificate, and Leaving Certificate Programmes.

Vocational Training Opportunities Scheme (VTOS) provides a range of courses to meet the education and training needs of people who are unemployed. It gives participants opportunities to improve their general level of education, get a certificate, develop their skills and prepare for employment and further education and training. They are usually delivered over two academic years on a full-time basis of 30 hours per week.

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€ 1.39 M ERDF

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Rehab Data Control System incorporating Mirror Therapy

Adam Killeen

Introduction

The team chose this project due to the rapid growth in world population and the adverse affects this is having on a struggling health care system. Implementing the technological advances of the last decade, it is possible to facilitate many of the health care services remotely through wireless, mobile and cloud technologies.

Aim of Study

The aim of this project is to design and build a prototype exercise unit. This unit will log the patients vitals and exertion during the exercise routine and relay the data by Bluetooth to cloud storage. The consultant can then access and assess the patients data on demand, removing many of the restrictions encountered with on-site services.

Methodology

Research

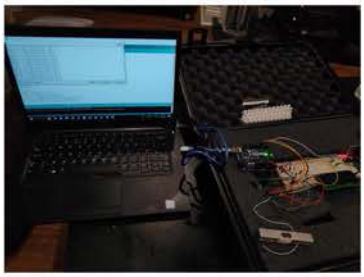
Research began by investigating what data was necessary for a physician to make an assessment of the patients progress from a distance. The data chosen for this analysis was:

1. Heart Rate
2. Time to complete a full cycle
3. Force exerted in grams

Design/Planning:

The design process involved:

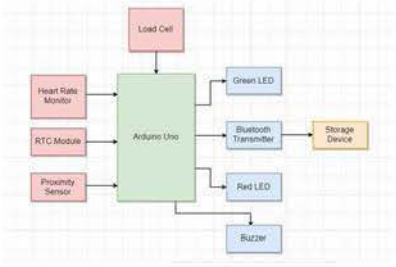
- Selecting suitable technologies
- Develop project schedule
- Test each element of the project individually
- Link individual elements to achieve overall concept



Circuit Components

Arduino UNO microcontroller board.

Heart Rate Monitor monitors patients vitals,
Load Cell records patients exertion during exercise.
RTC tracks time lapse on an exercise cycle
Green LED indicates 'ready' status of unit
Red LED indicates exercise cycle in progress
Buzzer indicates exercise cycle completion



Results

Design

After reviewing existing technologies that could be implemented in this application, a concept was developed. The concept comprised of the following steps using an Arduino microcontroller:

- Monitor the patients heart rate during exercise routine
- Measure the force exerted by the patient via the output voltage of the load cell
- Measure the time lapse of patient completing each cycle
- Transmit all acquired data through Bluetooth transmitter

Physician Defined Goals / Android Data display

- Exercise accepted or rejected based on Physician predefined weight tolerance using a load cell.
- Android receiver provides live user feedback by displaying current user output onscreen.
- Data recorded and available to Physician on demand through wireless access.

Conclusions

- Overall the project was a success and challenged my knowledge in electronics.
- The objective to transmit the patients rehabilitation data wirelessly and allow on demand access to the Physician was achieved.
- The project schedule did not run according to plan due to external factoring but the final result was achieved with these set backs.
- The main limiting factors of this project included:

1. Time allocation
2. Budget and resources available e.g. Rx Tx component out of budget for this concept. Bluetooth data transfer used as proof on concept.

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Automated Guided Vehicle

Iolanda Nilluti Collis Department of Electronic Engineering Institute of Technology Sligo

Introduction

Automated Guided Vehicles (AGV) are becoming a common feature in most sectors of the industry. They are driverless vehicles that travel carrying merchandise from a starting point to a selected depositary within the storehouse. They usually navigate by following a magnetic tape on the floor. Their implementation has the effect of improving the transport efficiency and reducing cost.

The purpose of this project is to realize an AGV prototype based on a different technology from those generally used.

The vehicle is able to follow a path marked on the floor thanks to a fixed camera on the AGV that takes pictures at regular intervals. From the picture, it extracts the orientation of the path and follows it until it reaches its final destination.

Aim

The purpose of this project is to prove that the theoretical knowledge about image processing is applicable in a real world utilization, such as AGV.

Method

The hardware utilized for the realization of the AGV are a Raspberry Pi (small computer), motors drivers, DC motors and a raspberry camera.

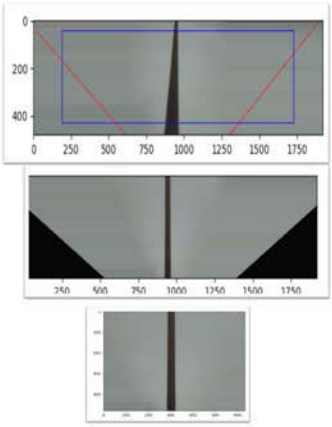
The first part of the project includes the following:

- Building the circuit
- Connecting Raspberry Pi to the motors drivers
- Writing a program in Python programming language for the motors operations of going forward, backward and turning right and left.

Method

The software utilized is called OpenCV (Open Source Computer Vision Library), which is a library of programming functions used in computer vision. The second part of the project involves image processing techniques to extract the path lines from the picture and modify them with the following OpenCV functions:

- Canny Edge Detector function extracts line from the picture
- Perspective transformation changes the lines that do not appear straight due to the effect of perspective into straight lines
- Hough Transform algorithm finds the position of lines, by calculating the angle formed between the distance of the line from origin and the x-axis for the vertical line, y-axis for the horizontal line.



Results & Discussion

The algorithm calculates correctly the position of the both the straight and horizontal lines. If the line is on the right hand side of the AGV, the machine turns to the right until it meets the line.

If the line is on the left hand side of the AGV, the machine turns to the left until it meets the line. Then it follows the straight line until a bifurcation, the horizontal line is detected and the AGV turns right to find its destination marked with colour red. The machine can be stopped any time by presenting it with any object coloured red.

If the AGV does not find any line in front of it, it turns around clockwise until it finds a line.

Conclusions

The camera takes pictures at intervals and the Raspberry Pi elaborates them to figure out which direction the AGV should take. Then it controls the motors by sending them signals to activate them to move in a certain direction.

The AGV works as it is supposed to do.

All the objectives have been achieved.

The implementation of this project gave me the opportunity to learn new skills such as using Linux shell bash commands for installing OpenCV on Raspberry Pi; programming in Python; learning and applying OpenCV functions; utilizing the theoretical knowledge of image processing in a practical task.

So far, the AGV moves from one starting location to another one, but in a real world situation it should be able to reach other destinations; to improve its performance, additional arrival points should be added in the future

Iolanda Collis
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Self-Parking Car

Summary:

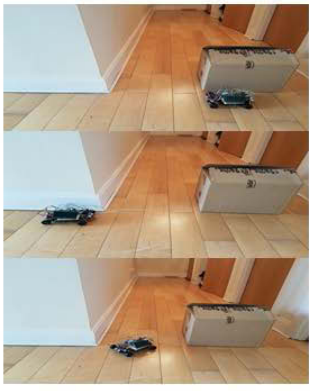
With the rapid advancement in technology in the world, Cars are getting smarter and smarter by the day!
Nearly every new car has a parking assist system included. But with self-driving cars looking like the next step, how about taking just a bit of that and putting it into the parking system.

Aim:

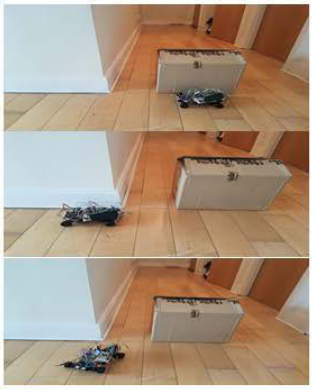
To take in distances using the Ultrasonic Sensors, take that data to the Arduino, it then decides if the space is appropriate, then choses a parking position.

Method:

While vehicle is driving, Ultrasonic Sensor measures distance of object to its right. If distance is greater than a set value for a large certain amount of time, Arduino knows there is space for car to parallel park.



If the distance is greater than the set value for a small certain amount of time, Arduino knows there is space to reverse perpendicular park.



Conclusions:

The self-Parking Car is just a taste of the next step in the advancement in technology of the automotive industry.
The Ultrasonic Sensors communicate with the Arduino, which then communicates with the servo and DC motors to adjust accordingly.
I have completed the building of my project to a satisfactory level.
From here I would like to go on and implement this into a real life system as they are doing here in IT Sligo.

Paul Talbot (S00182781), Department of Electronic Engineering, Institute of Technology Sligo, Ash Lane, Sligo, Co. Sligo.

Collision Avoidance System Using LiDAR

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Introduction:

An EU proposal published in 2018 suggests that mandating the implementation of autonomous emergency braking in all vehicles, along with some other safety measures such as an alcohol interlock mechanism, could decrease fatalities by almost 25,000 and serious injuries by over 140,000 over a 16 year period. With the social cost due to road casualties estimated to be in the order of €100 billion each year, it is hardly surprising that research into and design of automotive safety systems is a hot topic.

The proposed goal for this research is the development of a collision avoidance system using a reasonably priced LiDAR sensor. To this end two devices were chosen, the YDLiDAR X4 2D Scanning LiDAR at €130 and the Benewake TFMini Micro LiDAR module at €40, for an initial feasibility study which informed the final decision on which sensor should be used.

Criteria:

The criteria examined for the initial prototypes were:

- The feasibility of the mechanical build bearing in mind that it must be mounted in a model vehicle.
- The speed of data acquisition from the LiDAR sensor.
- The complexity of the LiDAR sensor and its API.
- The ease with which the acquired data may be converted to a 3D point cloud for analysis, and extracted for visual display.
- The overall cost of the components required for the completed system.

The design scope for the prototype was to develop a system that could acquire distance measurements from the LiDAR module over a 40° horizontal range to the front of the prototype and 16 evenly spaced vertical "stripes".

Methodology :

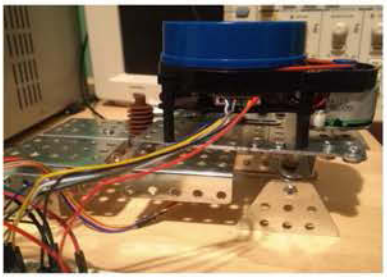
The YDLidar X4 is a 2D scanning LiDAR device which measures approximately 100mm x 66mm x 51mm and weighs in at 200g.

YDLidar X4

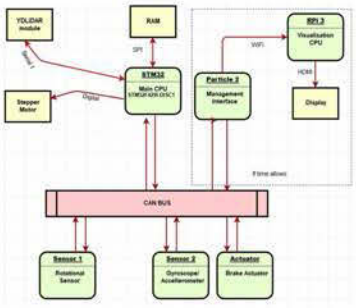
Methodology :

It consists of a Laser transmitter and receiver mounted in a rotating head driven via a belt by an attached motor. It also contains a control board containing a serial interface. The device ships with a C++ SDK for Windows and Linux. Documentation detailing the raw data communication protocol is also provided.

The prototype consists of the YDLiDAR module mounted on top of a platform whose pitch can be altered by means of a worm screw attached to a stepper motor. It was not possible to use an STM32 MCU to control both the YDLiDAR module and the pitch stepper motor so a windows PC was used.



Processing the incoming data to extract the distance and corresponding rotational angle required a significant amount of code.
Getting the data processed in a timely fashion so as not to lose incoming packets was an issue as is the coordination of the change in the vertical alignment with a suitable rotational angle of the LiDAR. The size and weight of the finished prototype is also of concern given that the finished item needs to be mounted in a model vehicle.
A block diagram for a complete collision avoidance system that utilises the YDLiDAR device is shown below.

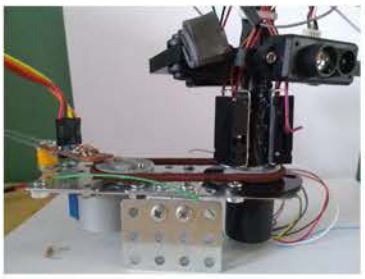


The Benewake TFMini is a one dimentional LiDAR sensor measuring approximately 35mm x 10mm x 10mm and weighs approximately 5 grams.

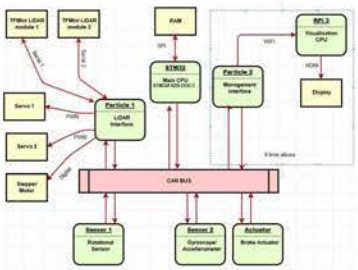
Benewake TFMini

Methodology (Continued):

The module uses a serial data protocol to receive commands and return measurement data.
The prototype design involves mounting two TFMini sensor modules on a rotating platform. The platform will mounted on a slip ring to allow for continuous connectivity to the main CPU and will be rotated via a belt by means of a stepper motor. The pitch of the sensors will be modified by means of a linear actuators.



While the mechanics of the TFMini prototype are more complex by far than those of the YDLidar prototype however the comparative ease of acquiring the data make it a compelling option.
An issue that came to light during prototype testing was that the TFMini sensor has a maximum scan rate of 100Hz meaning that even with 2 sensors, acquiring a a full dataset over the 40° horizontal range x 16 vertical stripes may be too long for a collision avoidance application.
A block diagram for a complete collision avoidance system that utilises the TFMini device is shown below.



Conclusion :

Although the mechanical aspects of the YDLidar X4 solution are simpler than those proposed for the Benewake TFMini solution, failure to interface the YDLidar sensor to the STM32VLDiscovery board means it is not viable to use it for this application. Therefore, the selected design will utilise the Benewake TFMini sensor.

Person Detection

Using RGB Camera and Thermal Imaging Module for Search and Rescue

Introduction:

The idea for this project came about to try and solve the problem of search and rescue missions for missing persons being called off due to bad weather conditions or loss of daylight. This lead to the idea of using Thermal imaging in conjunction with regular RGB cameras, allowing a search to continue at night or in areas, such as mountains with foggy low light conditions.

Aims of Study:

To demonstrate the theoretical knowledge gained over the course of our study and apply it in a practical way to a real world application.

Methodology:

Research:
A large amount of research was completed as part of the project. How RGB cameras take and process images was researched. How thermal imaging works and how thermal imaging cameras process images. The vast area of machine learning for object detection was looked at under the following headings:

1. Artificial Neural Networks.
2. Convolutional Neural Networks.
3. YOLO Objection Detection System.
4. Tensorflow Object Detection System.
5. Open CV.
6. Sensor Fusion.

Hardware Used:
The hardware used in the project included:

- The Raspberry Pi 3 B+ was chosen to be the computer, or brain, of the project. In total there will be two Raspberry Pi's used in the project.

- The Raspberry Pi Camera V2.1 was chosen as the RGB camera used in the project.

Methodology (Continued):

- The MLX90640 Thermal Camera Breakout was chosen as the thermal module to be used in the project.

Software Applications Used:

- The Python 3 IDE was used writing and editing the programs for both the RGB camera and the thermal module. It was chosen because it is pre installed on the Raspberry Pi, and it can be used for programming in Python and C++. Python was used to program the person detection on the RGB camera and C++ was used to program the thermal module.
- The Tensorflow Object Detection API was used as the method for implementing the person detection.
- Tensorflow needs the ability to display images, the software chosen to do this task was Open CV.
- For the MLX 90640 thermal module the mlx90640-library needed to be installed on the Raspberry Pi.

Safety:
Safety was paramount in the design of the project. The project includes two Raspberry Pi's. The risk of injury from them is minimal, the voltage outputted from the Pi's ranges from 0 – 5v, which is extremely unlikely to cause injury. The only other safety risk to due to overheating of the PCB's themselves. Again there is minimal risk of injury. As a precaution both Raspberry Pi's have been enclosed in a stackable case where the GPIO pins and PCB's are covered.

Results:

Design/Planning:
After reviewing existing solutions, a concept was developed for the Person Detector. The system comprised of the following steps:

- Run an RGB camera from one Raspberry Pi with the capability to detect a person in its frame of view.
- Run a thermal module from another Raspberry Pi with the capability to detect if a person in its frame of view.
- Design a GUI which will alert a user if a person is detected from either the RGB camera or the thermal module.
- Have the ability to remotely connect to the video footage from both the RGB camera and the thermal module.

Results (Continued):

Test setup:

- A test bench was setup with two monitors, one for each Raspberry Pi.
- The RGB camera and the GUI will run from the first Pi, and the thermal module will run from the second.

RGB Camera Person Detect testing:

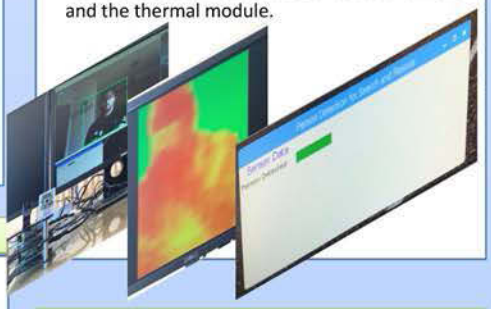
- The RGB camera was put through a number of tests to check its reliability.
- The results showed that the camera detected a person in daylight without any issues.
- But at night or in low light conditions it did not detect a person.

Thermal module Person Detect testing:

- The thermal module detected a person in both daylight and at night time and in low light conditions.
- But the results showed that it only worked reliably at close proximity to the sensor module.

GUI Person Detect testing:

- The GUI worked well with both the RGB camera and the thermal module.



Conclusions:

- This project provided an opportunity to display skills and knowledge gained from the course in a practical way. Overall the project was a success and was an excellent learning experience.
- The objective to detect a person using both an RGB camera and a thermal imaging module was achieved.
- A GUI was successfully created to alert a user that a person has been detected.
- Remote connection to the system was achieved.

The main limiting factor of the project included:

- High quality thermal modules are extremely expensive, the module used in this project was a budget model which greatly inhibited the testing process.

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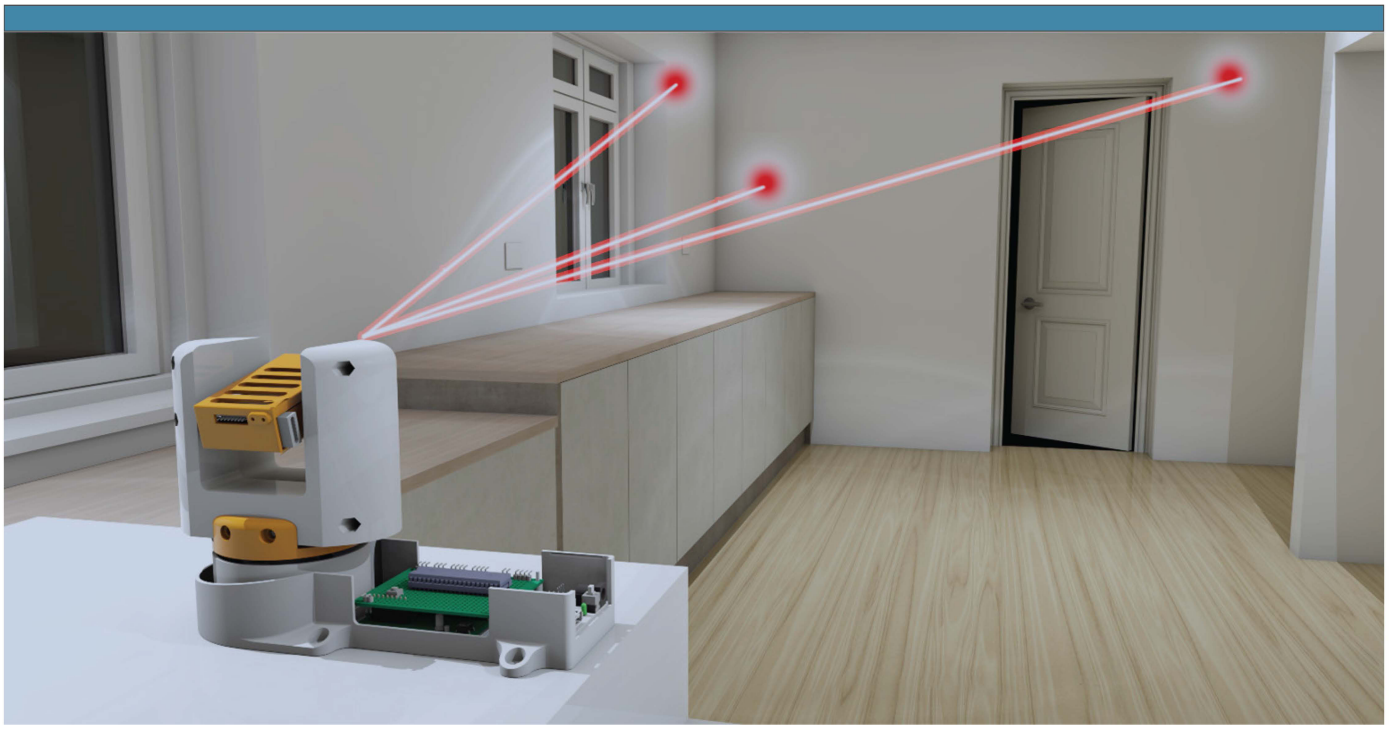
Laser Room Scanner



Introduction

This project is coming from my personal experience in interior design, kitchen and wardrobe business. Producing a 3D model of a space is the first brick in any interior design. Manual measuring is a complex and tedious task even when it is done wiht a laser rangefinder.

A 3D laser scanner would do a better job and make a designer's life easier: it can take thousands of measurements, with an accuracy of modern laser rangefinders.

Objectives

The target of this project is to design and build a 3D laser scanner whicn can take measurements from one point to any obstacle in a given area (walls, floor, ceiling, doors, windows, etc).

The device's measuring block is a Laser Rangefinder with a serial communication capabilities. It is rotated by two stepper motors about X-axis (horisontal) and Z-axis (vertical).

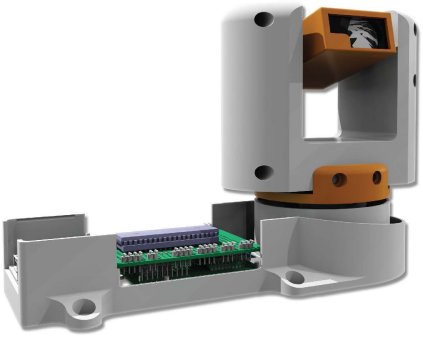
It is control from a Host computer or an Android device via Bluetooth. The data from the laser block is transferred into the Host Computer where it is stored as a point cloud. It can be further processed in a CAD software.

Methodology

Research, Development and Challenges:

1. Firstly, a laser rangefinder with UART communcation capabilities had to be found. These devices use different methods of distance calculation (Time of Flight, Phase Shift and Triangulation). They act differently, have different accuracy and vary in price.

2. An extensive research was undertaken in order to find necessary components, develop a project plan and acquire skills needed.



Workflow

Schematic and PCB Design	*- Labcenter Proteus - Autodesk Eagle*
Acquiring components and board assembly	*farnell.com, rs-online.com, amazon.co.uk, ebay.ie, alibaba.com, ...*
Programming PIC microcontrollers	*C programming. MPLAB-X IDE*
Programming Host Computer	*Java (IntelliJ IDEA)*
Device's Body Design & Print	*Autodesk Fusion 360 3D Printer Qidi X-Pro*
Assembly and Testing	*Soldering Testing with a multimeter Testing with an oscillo-scope*

Conclusion

The project required knowledge and skills from different areas. Nearly all subjects studied contributed into completion of this device. Udemy course of Java programming, webinars on Autodesk Eagle and Fusion 360 were also a of a great help. And, of course, advises from tutors and project supervisors as well as from students are much appreciated.

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https://a360.co/2Ktmt99

Vision System Technology in Stroke Rehabilitation

Student Number: S00166322
Project Supervisor: Sean Mullery

Peter Murphy

Introduction

According to the Irish Heart Foundation, 'One in five people will have a stroke at some time in their life'. A stroke causes damage to the brain and the effects depend on the part of the brain that is affected.

Every stroke is different.' What isn't different however is that the recovery is very important to every person that suffers a stroke so we decided to concentrate this project on the concepts of using Vision Systems to aid in Stroke Rehabilitation.

Technology is evolving and with the advancements in camera systems, video streaming, virtual reality, fiber speed internet and pose/facial recognition it could now be feasible for a system that can help a patient use technology to aid them in their recovery. Using vision systems also offers the opportunity for the stroke patient to work from home, interact and update their doctors remotely and even make it a cost-efficient way to receive better care no matter where you live.

Project Objectives

The main objectives of this project are to:

• To research existing technology used for stroke rehabilitation.

•Define and design a portable vision system that can be computerized and at the same time be effective in helping stroke patients with their recovery..

• Build a demo of a system that merits further research that would be viable for stroke patients to use.

•Demonstrate the knowledge gained over the course of the authors study into real world vision technology and machine learning system aimed at stroke patients.

Project Benefits

Benefits for stroke patients include:

•No specialized training or knowledge of expensive equipment required.
•Low-cost and available to patients of all income levels.
•The vision system programs/exercises are monitored and deployed remotely by the patients doctor/physio.

•Highlighting the benefits of college projects that focus on real-life problems like health using current and developing technologies.

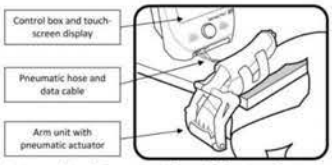
Methodology

Research: Research began with a study into strokes and then into existing stroke rehabilitation systems using technology.

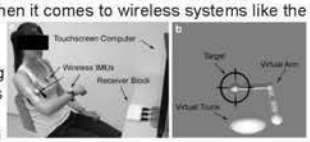
Strokes: Strokes in most cases lead to severe long-term disability if effective post-stroke rehab interventions and treatments are not included. Patients affected with stroke after six months are unable to engage the affected hand in daily activities that require distal control. Shockingly, this has been seen in about 65% of the stroke survivors. Many patients after a stroke are unable to access the quality rehabilitation programs and intervention that is needed to recover from the condition.
Treatment Limitations include patient location (distance to rehab facility/doctors), cost, lack of stroke rehabilitation programs in Ireland and general low support to this rising number of injured people.

Technology: As treatments above are usually short term and difficult for patients to access due to the different limitations it is critical that the tech based systems that are in place are used to their full potential and focussed on the patient's needs.

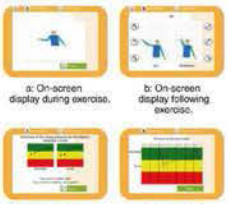
Methodology



Robot assisted therapy (Hand Mentor Pro robotic) is effective but very expensive. This is an option where a patient would need to travel to use the specialized equipment. When it comes to wireless systems like the armeoSenso System it works by using inertia sensors that transmits the data which then converts it into a 3D representation (virtual arm).



Rehab through gaming was another avenue of research explored where virtual reality like systems and gaming consoles like Microsoft Kinect use a pose tracking technology for interactive games by using different types of cameras for detection.
The pose tracking technology seemed to hold some merit especially where a user could interact with an environment or be guided on screen definitely helped with the system being more user-friendly and give feedback screens.



This promising research was a reason to devise a portable computer vision therapy system that can incorporate a pose tracking system that allows for patient feedback and is accessible to patients.

Design Decisions and Build:

Equipment & Technology:

Machine learning Vision systems don't work without the use of a camera. The type of camera selected determines the level of detail that can be extrapolated from any given vision system. As the concept for this project is mobility the most portable camera you can get is to use a user(patients) own camera at home. Most phones/laptops/tablets etc all have built in web-cams so by using this cut out the need for expensive equipment.

Software:
TensorFlow and PoseNet are part of an open-source Google library that are used for machine learning operations. As programmers we can use different languages (C++/Python/Java) to carry out very complex functions using these models. Understanding and implementing PoseNet was the main part of getting this system to work.

PoseNet has an extensive dataset of images which is used to calculate a confidence score to determine if the image is a particular part of the body.

The mobile part of this project was important and by using a patients web-cam the easiest way for them to access the system was to do it through a webpage. JavaScript was used to implement this functionality into a browser based webpage. Tensorflow.js was used along with the web design library p5.js which web app designers use to add animation etc to websites. Within p5.js,ml5.js is used to access machine learning models like PoseNet.

Build/Test Progress

Build & Testing: Using the P5.js library to write interactive JavaScript code that integrates machine learning functions like PoseNet allowed for the project design to become an interactive reality.

p5.js ml5

P5.js is a user-friendly way to use your browser as a sketchbook and by starting with basic functions to draw circles/squares and then start to use a web-cam the author added basics features until competent enough to add machine learning functions. Ml5 is a library that provides access to machine learning algorithms and models in a browser, building on top of Tensorflow.js. Initial tests were to confirm that PoseNet would recognise the person standing in front of the camera. Once this was confirmed, the information had to be dissected so that certain areas could be picked pout and use. The areas being body parts. PoseNet divides the body into 17 main key points which are number from 0 to 16.

Id	Part
0	nose
1	leftEye
2	rightEye
3	leftEar

These key points allow for the selection of a body part or parts to be tracked live. The key point will only be shown provided it is 'confident' that is the correct body part.
Initial tests were successful to track the eyes and nose and using JavaScript code we could do experiments where we could draw a nose on our webcam feed that would track your nose on the screen. This successful action became the basis to the project working. From this we could then draw all 17 key points and join them to form a moving skeleton that was reactive to your movements.

Creating an interactive exercise game allows for more regular patient participation.
The final version now tracks both of the patients wrists.
Once the wrists enter the green box areas, a counter records this and does a running total how many exercises you have done.

Developing this system further could allow for remote monitoring or data logging by a doctor/physio.

Conclusions

A computer vision system for stroke rehabilitation should be feasible, user-friendly and at the same time cost-effective. The system designed and built by the author involved a web-cam , JavaScript language, Google's pose tracking algorithm 'PoseNet' for monitoring the posture and movement of the stroke patients. PoseNet looks to have great development potential for a stroke recovery vision system when integrated into a browser that is accessible by patients of all ages and technology knowledge.

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A Speaker dependent Limited vocabulary Speech recognition system For machine control.

Graham Sales

Introduction.

It is considered that, with the advances in microprocessor technology, especially in the area of embedded systems, the time is right for the implementation of a speech recognition system, for simple machine or system control, based on a single platform microcontroller.

Project objectives. The major objective of this project is to create an efficient algorithm that requires minimal system resources, to provide a single speaker, limited word, determinate speech recognition system, to be used for machine control.

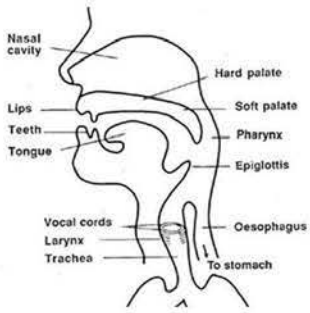
The technology.

Useful speech recognition systems, with adequate performance, began to appear in the 1980's when desk top computers, with just a single processor, reached speeds of 100MHz. These systems offered limited word recognition with reasonable success. Today, single board computers far exceed this performance, suggesting that a simple off-line, speech recognition system, giving real time control of a number of machine functions is a reasonable proposal.

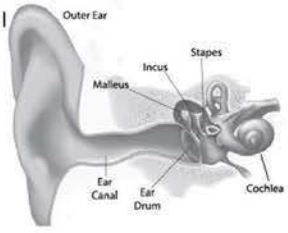
Target Market.

Such a recognition system is aimed at a number of markets including, disability assistance and simple machine control.

The problem



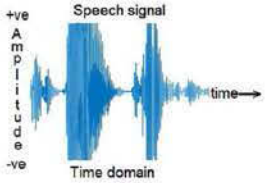
Nature of speech, [1]. A speech signal begins as a single frequency in the larynx. Harmonics are added as the signal passes up through the oral cavities and the mouth, that together act as a filter. Each phoneme of speech is defined by its unique set of frequencies. In the ear, the cochlea, [2], detects these frequencies and sends signals to the brain that allow us to identify the particular word. This incredible process by the brain, of filtering the very subtle differences in speech, is the task required by a speech recognition system.

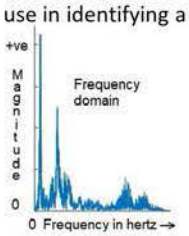


The Solution

Time domain.

A speech signal from the speaker travels through the air to the ear as a signal with an amplitude that varies continuously with time. This is a time domain signal. The recognition system receives the signal via a microphone and converts it to a discrete digital time domain format ready for processing. This format has little use in identifying a word.

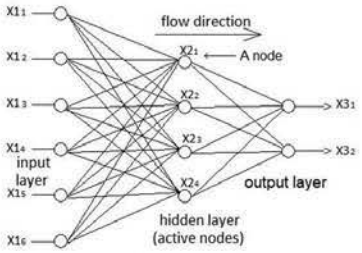


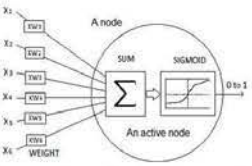


Frequency Domain. Before any information can be gained, the signal must be converted to the frequency domain using the Fourier Transform. This gives the magnitude of the frequencies that are the features that define the word.

Compression. [3]. The frequency domain signal is now dramatically compressed in a filter termed a Mel Filterbank. This attempts to replicate the response of the ear. The filter output, a set of 20 coefficients, is fed into a neural network. Its compares this unique pattern with a know pattern.

Neural Network. This unique set of input signal coefficients from the filter is derived from the frequencies defining the word. The neural network, built from layers, takes these 20 filter outputs into the 20 network inputs. It gives an output that is an estimation of the word uttered, [4].





The multiple network inputs are then weighted, summed and then fed to an activation function that acts to provide each network node output. This is repeated for each layer, [5]. The probability factor found, the network output, is effectively a comparison with a predefined output, derived from words used in network training. This is the estimate of the uttered word.

Implementation. The algorithm for this system, to prove the concept, has been built and written using Octave.

References:
[1] Vocal tract http://thesingingvoice.com/about/vocal-technique/jo-estill
[2] The ear – https://www. *nidcd.nih.gov/health/how-do-we-hear*
[3] The Mel scale - https://en.wikipedia.org/wiki/Mel_scale
[4] An introduction into artificial networks –Monash University
[5] MATLAB Deep Learning – Apress – Phil Kim – ISBN 978-1-4842-2845-6

Conclusions.

Conclusions to be added on completion of the project analysis

Lane Departure Warning System

Stephen Sweeney

B.Eng (HONS)Electronic Engineering

Introduction:

In an aim to reduce road traffic accidents, car manufacturers have introduced a host of advanced driver assistance systems (ADAS) to assist the driver. There were 1.25 million road traffic deaths globally in 2013 according top the World Health Organisation. The aim of this project was to design an algorithm that takes in images from a camera whilst driving. It recognises road lines and warns the driver, thus preventing inadvertent lane departure.

METHODOLOGY:

1. **INPUT IMAGE**
   - Image is taken in from a camera mounted in the centre of the car

2. **PROCESS IMAGE**
   - Image is transferred to birds eye view using perspective transform
   - Edge detection to detect sharp changes in pixel intensity
   - Mask applied to isolate the white and yellow lane pixels
3. **LANE DETECTION**
   - Left and right hand lanes are detected and position of the vehicle in relation to these is calculated
4. **LANE DEPARTURE WARNING**
   - A visual warning is displayed if the driver departs a lane

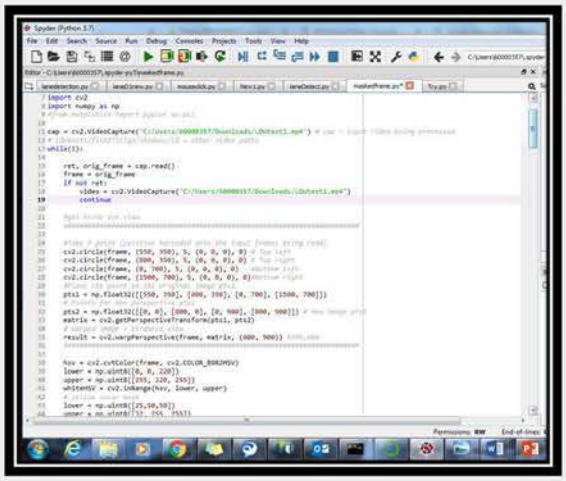
PROGRAMMING:

This project was programmed using Python. This is one of the major languages that can be used for performing various operations on image or video.

Spyder is the Scientific Python Development Environment which is an integrated development environment (IDE) that is included with Anaconda. This was the software used to complete the project.

I utilised OpenCV (Open Source Computer Vision) functions library to perform many of the operations required to successfully create this code such as warp perspective, colour transform and canny edge detection.

Here is a sample of my code using Python;



python ANACONDA SPYDER OpenCV

RESULTS:

- At the end of this project I have programmed a successful piece of code. Once images and videos were captured, the correct thresholds set, the road lanes were detected.
- The driver was correctly alerted with a visual warning if they had inadvertently crossed the lane line.

CONCLUSION:

This project has given me a means to apply knowledge and skills learned throughout my educational journey so far. I feel I succeeded in developing a project that could be utilised as a tool to prevent road traffic accidents in the future. It was apparent throughout this project that whilst we get good results under known conditions, if our set thresholds fail under difficult conditions (for example, shadowing, worn or missing lane markings or adverse weather conditions) it will lead to poor results as the lane will not be detected. To tackle this in future work, a CNN (Convolutional Neural Network) could be employed to make lane detection more robust under variable conditions.

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V2X - Vehicle To Infrastructure

Introduction

The aim of the project was to put into place a representation of what V2X can be, in the eyes of one person. V2X has a myriad of functionality but also has core principles ansd a means of operation. V2X uses communication technology as the platform for it's operation. This project sets out to show a real world scenario where the power of V2X can be displayed. This will not utilise the current dedicated frequency band due to hardware costs so a more cost effective solution will be implemented using a more common 2.4GHz frequency band.

Methodology

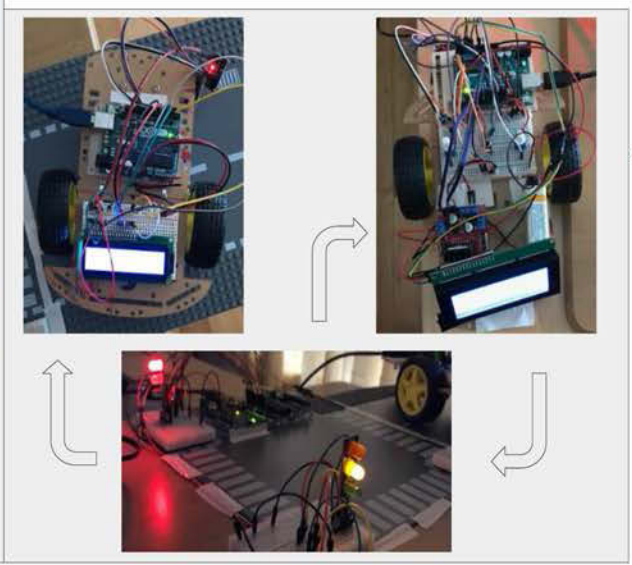
For this project, the functionality is based off of a mobile unit that relays its telemetry information to the intersection which in turn responds with intersection information in real time. This intersection response is done to provide the mobile unit with traffic light information so the vehicle can make the best decision upon its approach. The intersection also relays information to a stationary unit, this information is correlated so that a prediction of the mobile vehicles actions can be garnered and relevant warning provided to the stationary vehicle. This predictive nature is done using the vehicles motor rotations, utilising this information to determine the vehicles movement and projected movement. This allows for intersection warnings to the stationary unit as data packets are analysed when received and the relevant information used to determine whether the mobile vehicles movement and projected movement will result in a dangerous environment for other vehicles at the intersection.

Implementation

This concept was implemented using the Arduino Uno as the main control to all aspects. Wireless communication and hardware control was done via the Arduino Uno. This was possible by utilising the Arduino IDE which allowed for software control and it was within this IDE that the functionality was dictated. The hardware aspect was developed using Arduino compatible modules which allowed for complete control via a single IDE. Each of the 3 separate modules required independent Arduino's and utilised the NRF24L01 modules to provide the means of communication via the 2.4GHz frequency band. The layout resembled a 3 way intersection with both the mobile and stationary units built on dedicated chassis, the mobile vehicle was mounted on an elevated frame to allow for motor control variation. All real time information and automated responses are displayed on dedicated LCD display's that are mounted on both the mobile and stationary units.

Results/Conclusion

Communication was paramount in this project, the design relied heavily on periodic communication. The vehicle information that depicted a version of a vehicle's telemetry data was the initial packet sent and the intersection status was sent in response. This aspect worked in most cases but communication stability was an issue. Communication to the stationary unit was one way so communication stability was less of an issue in this scenario. With the limitations in wireless stability, the project sufficed to provide a working model for a conceptual take on V2X.



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Agri-Easy-Lift

Introduction:

The theme of the project came about when team members expressed and interest in keeping with tradition of the college and designing an agricultural themed project. The final decision of a crane was decided when the group discovered the alarmingly high rate of musculoskeletal injury experienced in the farming community both here and abroad.

Design Brief

To design, build and test a prototype for a hydraulically operated crane attachment for the back of a tractor with its own dynamic 3 point linkage.

Methodology:

Research:
Research was conducted by visiting farms and speaking to farmers to get insight possible improvements that would aid there everyday lives and reduce the chances of musculoskeletal injuries from various tasks completed on a day to day basis. A number of websites and medical journals were also researched to get a better understanding of various issues facing farmers.

Design/Planning:
The design process involved:
- Selecting the project.
- Develop project management/schedule.
- Carry out an objective tree analysis.
- Develop concepts and initial ideas.
- Analysis possible health and safety issues .
- Assign tasks among project members .
- Model design in Solidworks.

Fabrication:
- Most of the parts were fabricated in the GEW.
- Materials and bending out sourced from local suppliers and C&F Tooling.
- Parts fabricated include 3-point linkage, outriggers, crane arm and universal attachment.

Hydraulics:
- Purchased required cylinders from flowfit.
- Measured and purchased pipping.
- Selected and purchased required check valves.
- Calculated amount of hydraulic fluid required to run the system.
- Sourced tractor in order to run the cranes hydraulics.

Methodology (Continued):

Quality check:
- Gem Hydraulic Oil H46AW was selected as it is compatible with a wide range of hydraulic systems, its main application is with static industrial and mobile earth moving machinery.
- The hook acquired was surface hardened with a safe working load of 2 ton (SWL) which surpasses the lift expectation.

Safety:
In order to ensure safety in this project, check valves were implemented in order to keep the cylinders stationary in the event the hydraulics are shut off or hydraulic pipe is damaged.

Results:

Design/Planning outcome:
Satisfied with the individual elements from the different concepts a final design was drafted with thought to:
- An adequate scale through mechanical analysis and lifting capacity agreed to satisfy the intended tasks.
- Inclusion of universal attachment joint that allows for the future designing of accompanying attachment elements.
- Design oversight when the spec of the hydraulic cylinders ordered differed from those that arrived but was easily rectified during fabrications stage.

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Results (Continued):

Fabrication outcome:
- 60% of fabrication was completed in GEW.
- 20% was fabricated away from GEW (testing occurred at one of the team members home).
- 20% bought-in parts.
- Industrial standard pins and materials were used throughout.
- CNC machinery was utilized to ensure accuracy and precision on certain parts.

Testing outcome:
Final assembly and testing took place off campus and the optimism and confidence attained from a successful build. Kept spirits high when it came to the first lift and subsequent lifts.
- Hydraulic levers allowing full motion at all expected moving parts.
- Raised trailer weighing 600Kg arm fully raised and secondary arm fully extended.
- Raised trailer including round bail weighing approximately 1.5tonne.

Conclusions:

- The project in its entirety was a success, both disciplines were equally utilised in the design and the manufacturing process.
- The objectives set in the brief where achieved with exception to the budget which was exceeded by €400.
- The schedule set, experienced some set backs in it's infancy but completion arrived on the day set

The main limiting factors of the project Included:
- Budget.
- The available workable foot print of the G.E.W.
- Availability of The CNC machines.
- Reliance on external suppliers.

Improvements:
- Design method analysis Skills.
- Project/ Budget Management Skills.
- Quality Assurance skills.
- External Sourcing Skills.

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Electric Quad

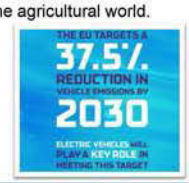
Introduction

The purpose of this project was to build and test a prototype electric quad. The Project will be in response to the "2020 Energy Strategy" and "2030 Energy Strategy" as the project will have zero carbon emissions. The project is designed for a single domestic user.

Standard parts along side custom fabricated parts were used to create this project.

A 1kW Electric D.C motor combined with a EM-282C-48V speed controller were used in creating this project.

This quad is only a prototype, but hopefully will be a guide to the conversion of electrical machinery being used in the agricultural world.

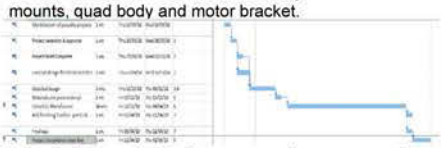


Methodology

Research began by observing how a conventional quad worked. After reviewing this we started deliberating over the best ways to power the unit and any upgrades we could implement to the current quad form to improve the safety for the single occupant.

In order to do this we knew an electric motor would be needed. We were kindly donated a 1kilowatt motor from M&H Forklifts.

All parts of the quad were Fabricated in the GEW. These included the anti-roll bar, battery mounts, quad body and motor bracket.



The design and planning process began once the correct motor was located. This included selecting the correct technology, developing a project schedule, developing initial concepts, reviewing available resources, assigning tasks among project members and modelling designs on SolidWorks.

Circuit Components

There are three key components used in the operation of the prototype:

1) A 1KW electric D.C Series Motor
2) A 48V D.C Motor control
3) 4x 12V Batteries

The motor ran at a max 1800RPM, at 42Ah. Using a speed controller allowed the amounts of amps drawn from the batteries to the motor to be varied allowing different speeds to be achieved.

The motor is connected to the speed controller and from there the speed controller is connected to the batteries. The four batteries are wired in series, to allow maximum power to the motor.

Analysis

The torque in DC Motors is obtained by getting the *quotient* of its *horsepower*, by its *maximum RPM*. It's the multiplied by a conversion factor of 1000.

The horsepower can be calculated, using the rated kW reading on the motor. 1kW = 1.34HP.

For example, for a motor 4.5kW 1500RPM:

4.5kW = 6.04 HP ➔ $\left(\frac{(6.04)(1000)}{(1500)}\right)\left(\frac{60}{2\pi}\right)$

Torque = 38.9Nm

This shows that the higher horsepower and lower RPM reading, the higher the net torque will be.

$$\therefore Power \propto Speed$$

Towing Capacity:

$$= \frac{T \times R}{r}$$

Battery life:

The life span in batteries vary, depending on its capacity, and the load applied.

➔Battery Life: $\frac{Battery\ Capacity\ (mAh)}{Load\ Current (mA)}$

So the higher battery capacity, or the lower current applied to the circuit, the longer the batteries will last.

Battery output power:

Maximum output power from batteries is the product of its Current & Voltage.

The higher Current or Voltage reading, the more power obtained.

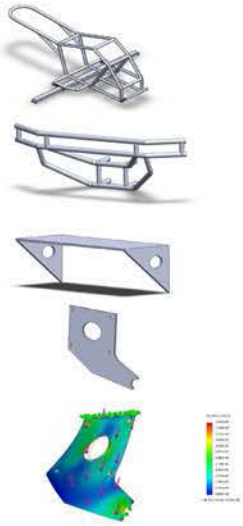
More battery power ➔ Higher Torque / Speed.

Design

Before the fabrication stage, various parts needed to be designed, using the CAD package Solid works. Finite Element Analysis allowed the group to see the maximum forces that would be applied on each part showing weak points and flaws in designs.

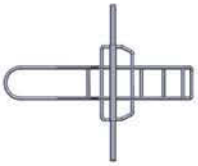
3-D Sketching and Sheet metal add-ons were predominantly used in the design phase on SolidWorks.

Main factors that needed to be considered when designing included safety, reliability, cost, durability and the overall aesthetics.



Safety

To ensure the occupant on the quad would be safe, an anti-roll bar was fabricated to prevent the quad from tipping over in areas of uneven road surfaces. The anti-roll bar is retractable to allow the occupant to use the quad as normal when travelling on even surfaces and can be retracted easily when going on uneven surfaces. Quad bike accidents have claimed 45 lives and caused 17,000 injuries in the last decade mostly in the farming community. This simple device will help save lives.



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Automated Oyster Frill Breaking Machine

Process Improvement in Oyster Farming

Project Group 6:

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Supervised by Robert Craig, Donal Lyons, Michael Moffatt, Mary Nolan, and Eamonn Price

IT Sligo
An Institiúid Teicneolaíochta, Sligeach

Introduction

Frill is a thin layer of shell which grows on oysters before hardening and thickening. The quality and size of farmed oysters is increased when this layer of frill is regularly broken off throughout its growth, as such a large amount of time spent farming oysters is dedicated to shaking them in their bags to break off this layer of frill.

Image @Jerk Cliparts

The need for this project arose when local oyster farm, Coney Island Shellfish, expressed the need for a product that would automate the process of shaking oyster bags.

The established method of hand-shaking the bags is a time consuming and inefficient process. This machine would speed up this process while relying on as little manpower as possible.

Research

The objectives of the product were laid out in a product design specification from which a list of aspects of the machine was created. Solutions to these aspects were then individually researched and evaluated against each other using a predetermined set of factors to find objective solutions to each aspect. Investigated aspects included:

- Methods of shaking,
- Deployment mechanism,
- Positioning relative to the tractor, and
- Drive type.

Design

Concept sketches were created to visualise how the different components would function. These were then expanded into a computer model of the machine using *Solidworks*.

Some aspects such as the truss structure of the machine were analysed to find the lowest stress setup of reinforcement.

However, as it would not be feasible to analyse every component of the project due to time constraints, many of the solutions were designed as needed for potential improvement in the future.

Fabrication

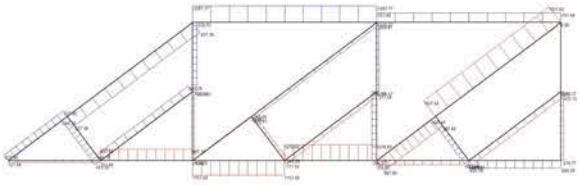
The majority of the fabrication process took part in the college, where a variety of fabrication machines were available for use. As can be seen in the images on the right, box section and sheet steel were used to construct the frame and attachment components. Sheet aluminium was used for the chain guard.

External assistance was acquired for the conveyors and drive mechanisms as the means of manufacturing them was neither available nor within the scope of the project.

Technical Analysis

As well as calculating the specifications of the belts and hydraulic motor, and analysing the hydraulic system; a modal analysis of the truss structure of the machine was carried out to determine the optimum placement of reinforcements.

Various structures were designed and recreated in *Linpro*, to which estimated loads were applied and the maximum stress locations were identified. The lowest load solution was then further subdivided into designs with different cross sections and the lowest load solution was then chosen again.



Compressive (red) and tensile (blue) stresses on the truss structure from *Linpro*

The forces surrounding the members experiencing maximum stress were used to verify the structure would not fail by using simple beam calculations and applying the results to *von Mises* failure theory.

Mechanism

The machine operates while being suspended from the side of a tractor. A human places an oyster bag onto the leading conveyor, which is then carried up to a height and dropped onto the second conveyor. This process is repeated twice before the bag falls back onto the trestles below.

When the machine is no longer needed for use and must be transported back to storage, it can be swung around to the rear of the tractor and driven back to the storage facility.

Conclusion

The objectives of the project were completed to the criteria as set out in the product design specification. As such, the project produced a satisfactory solution to the problem of automating the hand-shaking of oyster bags

The project ran as scheduled with only a few minor delays. Various technical analyses were completed to showcase the expertise of the members of the project group. Proper design process from idea to research, and from concept to completion, was carried out in line with standard procedures.

From this, it can be concluded that the product was created which both satisfied the needs of the consumer, and showcases the abilities of the project group.

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A link to the report will be available at the Expo

KRUNCH KART

Introduction

The Idea of the Krunch Kart came around when brainstorming possible quad attachments for use on the farm.

Our main objective was to produce a prototype which gives the operator an easier time when feeding livestock inside or outside.

The nature of the design was to keep it simple and robust while keeping the build as cost effective as possible.

Aim of Study

To showcase and demonstrate the skills and knowledge gained over the course of our study in a practical, real world applications.

Methodology

Research:

Research began by observing products on the market, then selecting how to improve them with the aim of making the process as simple and efficient as possible. The improvements had three primary sections.

1. Conveyor operation
2. Automated sliding door
3. Build strength

Design/Planning:

The design process involved:
•Selecting base frame style, Hopper size and capacity, Conveyor style and size.
•Develop project schedule
•Develop initial concepts
•Reviewing available resources
•Assign tasks among project members
•Develop detailed plans for three main sections outlined above
•Model design in Solid works

Fabrication:

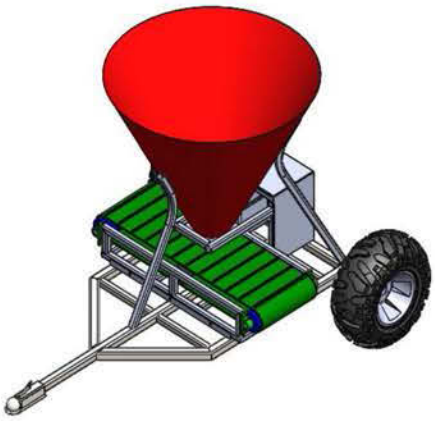
•The vast majority of the parts were fabricated in the GEW.
•The entire main frame was fabricated using steel box section that was then galvanized.
•The hopper, stub axles, flotation tires, hitch, motors and box section were sourced locally.
•The conveyor and other small parts were sourced from GEW.
•Fabricated parts include the frame, Sliding door, Motor mountings etc.

Results

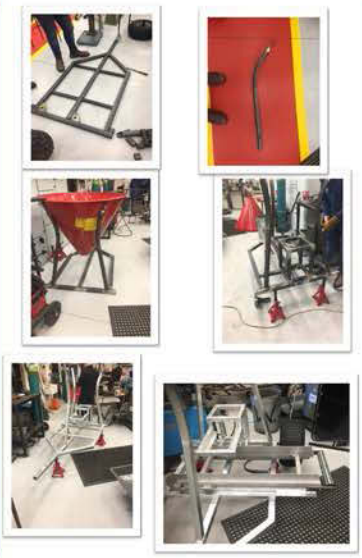
Design/Planning:

After reviewing existing solutions, a concept was developed for the Krunch Kart automated livestock feeder.

- Frame work - 50 mm & 40 mm box section.
- Hopper - 500kg fertiliser spreader.
- Drop door and conveyor powered by two car window wiper motors.
- Both motors powered and controlled by quads 12v power supply.
- Conveyors ability to distribute the feed from left or right depending on the operators needs.
- Krunch Karts ability to be operated in sheds or in the field.



Fabrication Stages



Assembly:

•Framework and mechanism's were fabricated in the GEW
•Bought in parts consisted of the hopper, hitch, wheels, stub axles and conveyor components.
•Framework galvanized with Rathedmond engineering Sligo.
•Wiring of conveyor and drop door to control panel on quad.
•Emergency stop added to maximise safety when operating the Krunch Kart.

Conclusions

•This project provided an opportunity to display skills and knowledge gained from the course in a practical way. Overall the project was a success and was an excellent learning experience.
•The objective to increase the efficiency of the manual process was achieved
•The project schedule ran according to plan

The main limiting factors of the project Included:
•Limited time considering the amount of fabrication required.

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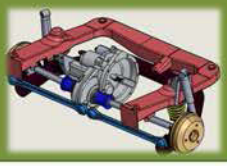
EV Smart Roadster Conversion ft Disability Seat Installation



Mechanical/ Precision Engineering
Year 3 Project

EV Conversion

Introduction

The aim of this part of this integrated project is to convert an Smart Roadster to an Electric running vehicle. When tackling this side of the project many dealerships and car breakers were contacted for help on sourcing vital components we needed, for example we managed to obtain the 2015 Nissan Leaf Motor, inverter, 8 lead acid batteries in which we wired in series, a recharger, controller, gear train, ECU which was obtained from PnS ECU in America and main relay. Our main sponsors were Phil Fitzgerald from Electric Autos in Naas Kildare, and Kevin Egan from Kevin Egan Cars Sligo.

Background/ Objective

Due to the increase in Carbon monoxide from burning fossil fuels, this has resulted in great changes in weather and environment we live in and not for the best, the main source of the downfall of the environment is petrol and diesel cars. Due to climate change and multiple other factors that effect global warming this has resulted to an increase need for natural substances to try and save the world we live in. To solve this global crisis many countries are putting in bans to stop the selling of petrol and diesel cars. With this change in society effecting many areas of our lives it was decided then to dive in and take the challenge on of doing an EV Conversion.

Results

When dismounting the engine and sub frame the team had to be quite technical when going about this. With the sub frame, some additions were made to cater to the new engine being placed into the Roadster. The new size of the engine left big room for changes to the sub frame being made. Alterations were then done to give support to the to the size of the Nissan Leaf engine. Once the alterations were made the new engine was then mounted back into the sub frame and assembled back into the car .

The connections for the ECU were not as straightforward, the top part of the inverter had to be removed to access the ECU. Care had to be taken when changing the old ECU and the new ECU, especially when connecting everything up, due to the voltage being supplied to the motor from the batteries. The biggest risk was the batteries could possibly blow out if wrong connections were made when testing the contractor relay.

Disability Seat Installation

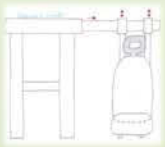
Introduction

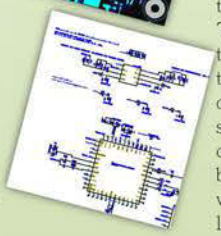
When beginning the Disability accessible seat a lot of things had to be considered but our main aim was to appeal to a broad audience so that everyone could have the experience of being able to imagine themselves not only in an electric car but also in a sports car. With the car being quite small in height a lot of considerations had to be made like how the seat would exit the car to pick up the driver and if there was space for it to come out of the car.

Concept Design

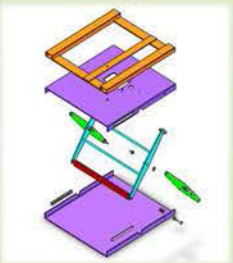
The first is a hoist system that has the chair of the car on a frame that will lift the chair out of the car and place it outside the car by a pneumatic cylinder. The seat can be adjusted back and forward as well as up and down by a controller run of two motors to make it fit in and out of the car.

The second concept was to have a rail system leaving the exterior of the car and having the seat come out. The rails would reside in the car once doors were closed and come out and fold down when the door was open.





The final concept was to reduce waste and overall simply the concept to help machine and construct. The design has two motions. The upward and downward motion of the chair which bring the chair the right height to exit the cars exterior. The swinging motion which brings swings the chair out of the car and leaves it ready to get the person into the chair. The first one is powered by an electric ram and the second is powered by a motor both connected to a controller. The seat would be set at resting position (lowest point) and when the occupant wanted to enter or leave the car the chair would rise up by the ram and then swing around by the electric motor.



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Disability Hoist for Quad

Introduction:

The idea for this project arose when one of the group members suggested we should try and help and assist his relative, who is suffering from multiple sclerosis, going about his daily life on the farm. The main aim of the project was to design and build a disability hoist which would transfer him from his wheelchair to the seat of the quad without any assistance required.

Aims of Study:

To demonstrate and put into work, the knowledge and skills we have gained over the past three years, into the project.

Methodology:

Research:
Research began by observing and analysing other disability hoists which are on the market. There are currently no hoists for quads available so brainstorming took place to decide what would be the most effective and efficient way to carry out this operation.

Design/Planning:
The design process involved:
- Multiple sketches by each group member.
- Develop project schedule.
- Develop one final concept.
- Model design in Solidworks.
- Assign tasks among each project member.
- Acquire any resources available.
- Lay out milestones and essential jobs that are critical.

Fabrication:
- All of the parts were fabricated in the GEW
- The project was made mostly from steel with the exception of some other small components.
- Materials were sourced from GEW, however, a lot of parts and components were donated to us such as wheelchairs, hoists, etc.
- Fabricated parts include the frame, hoist arm and back door.

Hoist:
- Design hoist mechanism which would be able to lift and transfer operator from wheelchair to quad
- Select all what bearings should be used.
- Create Solidworks drawing.
- Manufacture and fabricate in workshop.
- Test mechanism/Trouble Shoot.

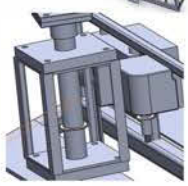
Methodology (Continued):

Testing /Troubleshooting: (Hoist)
- Ensuring hoist was able to withstand weight of person (120-130kg)
- Test carried out on one of the group members.

Testing /Troubleshooting: (Back door)
- Manufactured door ensuring the angle was suitable for wheelchair user.
- Acquired wheelchair and ensured it was possible for user to wheel themselves up.

Safety:
Safety was paramount in the design of the project. The project is fitted with safety harness and safety guard around hoist mechanism.

Results:



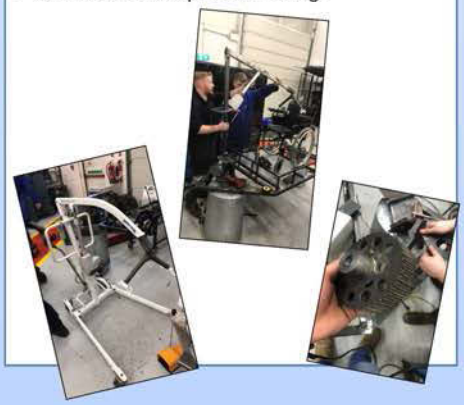
Design/Planning:
After reviewing existing disability hoists, a final design concept was developed. It compromised of the following steps and procedures:
- Final idea sketched and approved by each member
- Acquire used wheelchairs and hoists.
- Tested motors and actuators to ensure they worked efficiently.
- Designed on Solidworks based on resources we acquired.
- Commenced manufacturing in workshop.

Results (Continued):

Hoist Mechanism:
- Two flange bearing units and a trust bearing were required along with two sprockets and a belt which would turn the hoist.
- A 40mm shaft of length 600mm was machined
- A casing unit, consisting of two plates and four support uprights was fabricated for reinforcement.
- Shaft was placed down through casing and sprocket and belt were connected to it. The second sprocket was joined to motor and the second belt was attached to this sprocket.
- Testing was carried out and proved successful, lifting one of the group members and rotating them using remote control.

Wiring:
- 12v dc power supply used from car battery.
- Single control panel being used.
- All wiring secured and coated to prevent short circuit.

- **Fabrication:**
- 100% of fabrication was completed in GEW
- 20% bought-in parts/ donated parts.
- Industrial standard components and materials were used throughout
- Perspex screens were used for Safety
- Assistance was required on wiring.



Conclusions:

- This project provided an opportunity to display skills and knowledge gained from the course in a practical way. Overall the project was a success and was an excellent learning experience.
- The objective to transfer the operator from wheelchair to quad was a success.
- The project schedule ran according to plan

The main limiting factor of the project Included:
- Time and the amount of fabrication required
- The addition of reinforcement struts around hoist mechanism cost us time.
- Alternative solution to back door mechanism if time permitted.

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Automated Bottle Capping Machine

Introduction

The aim of the project was to design, build and test a working prototype for an automated assembly line using the knowledge acquired from the course in IT Sligo over the past three years.

Some stated that the projects complexity would be too difficult ,too risky and take too much time. But being the hungry and motivated individuals we are, we accepted the challenge

Methodology

Research

We started off by brainstorming different concepts and ideas . It was Important that we came up with the sort of process we were going to use, in other words how were we going to put the caps onto the bottle. After many concept sketches and thought out processes we had come to a final design. A process involving a conveyor with clamp and screw actuators.

Project Management

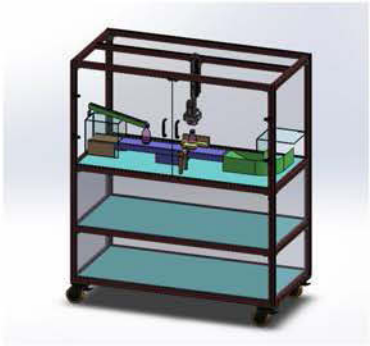
Without the correct use of project management it would of been very difficult to plan. Having this as a module proved very Beneficial to our project. It ensured tasks and milestones were completed each week. This meant that there was no complications or delay in progress through out the year.

Design

In order to start any manufacturing a blue print was needed. Estimated measurements were taken for each part of the project. From there each part was made and drawings were drafted using solid works.

Methodology Continued

A solid works assembly was created. This gave us our first realistic glimpse of what our project might look like.

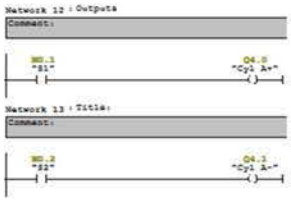


Manufacturing

Using the part drawings drafted from solid works we started the manufacturing process. Dimensions highlighted clearly helped us with the machining. A considerable amount of machining was done producing parts such as the clamp, supports, slides and conveyor. Machining was all done in the GEW using the milling machine, lathe, ban saw etc.

Programming (PLC)

The PLC used in this project was a Siemens " S7 300". The software used was Simatic Manager. Using the knowledge from our CIM module we were able to build a working programme . We spent many months practicing and testing with a mock test-rig doing little pieces at a time. This is where we learned how to programme and developed very valuable skills. The programme was built with Initial Conditions, Transitions, States, outputs and timers.



Methodology Continued

Safety

We understand that safety is extremely important, especially in industry. This is why we ensured the correct measures were taken . The project is protected from a closed Perspex wall. We introduced an Emergency stop with a dump valve. We added sensors to the doors ensuring that the programme would not run until the doors are closed and there is no risk of injury.

Results

When built, the machine was successfully able to:

- Run bottles along the conveyor
- Sensor detection of bottle
- Timers set
- Bottle clamped into position
- Cap screwed on

Conclusion

We achieved an extraordinary amount of experience as well as valuable skills to prepare us for industry . Through team work, hard work and dedication we got the job done and really enjoyed it in the process.

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Orbital Bale Handler




Introduction:

The purpose of this project was to create an innovated design that would transport round bales more effectively than other products on the market.

The main aim for the design was to keep the weight to a minimum while retaining strength in a simplistic manner.

Aims Of Study:

To demonstrate the theoretical knowledge gained over our study in a practical and real world application.

Methodology:

Research

Research began by looking at the Irish and UK market and seeing what type of bale handlers where out there. Result's showed that all bale lifters where basically the same with just one function.

Design/Planning:

The design process involved:

- Selecting technology
- Analysis possible health and safety issues
- Develop project schedule
- Develop initial concepts
- Assign tasks among project team.
- Develop detailed plans for three main sections outlined above
- Model design in Solid Works.

Fabrication:

- Most of the fabrication took place in Monaghan as this is where the material was delivered. Due to the project size it was also easier to manufacture in Monaghan.
- Fabrication parts include the tree point linkage, mast and soft hands
- The majority of the steel was plasma cut from an external source at C.Mar engineering.
- Two six port solenoid valves were added to the project to accommodate the five hydraulic rams.
- Smaller parts for the Orbital bale handler were made in the college workshop.



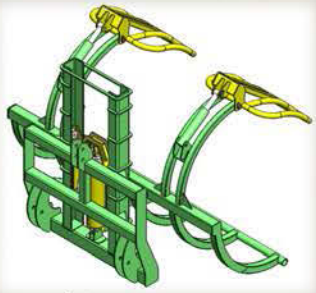
Methodology (Continued):

Quality Check

Safety was paramount in the design of the project. The project includes non-return valves which are used to prevent backflow and maintain pressure. They are commonly used as a backup in case a pump fails or creep on the rams.

The Power source is hydraulically driven off the tractor. Further safety was achieved by not having live hydraulics mounted in the cab as electric operated controls where been used.

Results:



Design/planning outcome:

After extensive research and reviewing possible solutions we selected an appropriate design. The chosen design fulfilled the brief to the highest degree.

- The machine is capable of transporting round bales of silage from the field to the desired location unharmed.
- The implement can rotate the round bales 90 degrees in position for stacking.
- Ease of use was achieved. The machine can also be universally fitted to any tractor capable of carrying two round bales.
- An electric circuit was used to operate the project, which resulted in an efficient outcome. Two six port solenoids were integrated into the project where successful in operation. The outcome gave extra hydraulic functions to the tractor.

Conclusion:

- This project provided an opportunity to display skills and knowledge gained from the course in a practical way which will be very helpful in industry.
- Team management was a massive skill that was used in the manufacturing of this project.
- The project schedule ran according to plan.

The main limiting factor of the project Included:

- Time and the amount of fabrication required
- Budget and resources available, e.g. Plasma cutting, sheet metal folding at a range of 12 to 15 mm thick.
- The Scale of the build meant main fabrication took place outside IT Sligo Campus, which resulted in traveling Co.Monaghan for manufacture.

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IT Sligo
An Institiúid Teicneolaíochta, Shligeach
Engineering & Design

Interactive Wave Generator

Introduction:

The need for this project arose when we were approached by Ronan Gilroy, a member of the Grange Spanish Armada committee, to build a prototype interactive wave generator for their upcoming museum. Our aim was to imitate conditions at sea experienced by the ships many years ago, also to minimise any potential hazards while being operated by the public.

Aims of Study:

We aim to show the skills and talents we have acquired through our studies in college, we also aim to build on these skills and showcase our ability in the engineering field.

Methodology:

Research
Research began by investigating the different types of wave generation and wave control, and the most popular methods of achieving this. This research included getting in contact with water world, Bundoran, researching online and gained information through lecturers.

Design/Planning
The design process included:
- Develop project schedule
- Develop initial concepts
- Investigating available resources
- Select final concept
- Assign jobs to group members
- Develop detailed plans for chosen design concept

Fabrication
- All parts used in our project were manufactured in the GEW.
- Materials used were sourced from the GEW.
- The parts we fabricated for our project included steel table, steel frame around tank, glued polycarbonate for tank and all linkages required for pneumatic movement.

Control
- The tank is solely ran and controlled with the use of pneumatics.
- The components used in the running and controlling of the tank included three 5/2 Directional control valves, four 3 Port mechanical valves, two pneumatic cylinders, start/stop button and flow control valves.
- The pneumatics will be run at 6 bar and 6mm piping.

Methodology (Continued):

Safety
Safety was key throughout the design of our wave generator. We took safety very seriously throughout as members of the general public including children will potentially be using this wave generator in the future. With such emphasis on safety and operator safety while using this wave generator, we cam to the conclusion through our concept ideas that pneumatics would be a much safer approach compared to electrics, especially around water. In the case of a fault while in use it would only result in an air leakage rather than a more serious issue with as a result of the electricity, water and steel frame.

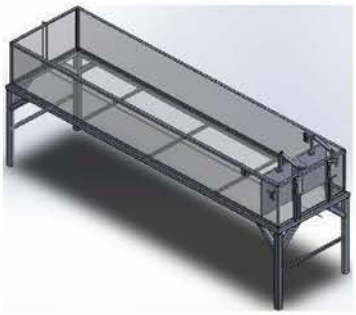
Results:

Design/Planning
After putting together our concept design ideas and discussing what parts of each idea would work best for us, we sourced a small acrylic tank, with this tank we were able to create a smaller scale model of what we hoped to include in our project. This was a great advantage to us as we had a better understanding of what would work and what would not work. It also showed what mechanism and motion would produce the type of wave we desired. we narrowed it down to either using a flat flap or a fin shaped blade. We made up a linkage and cam and wired up a wiper motor out of an old car to give us the motion we were after with the flap. After carrying out this test we concluded that the flat flap gave us the wave we desired. From this we split the flap in two to give us more control over the wave and enable us to create different kinds of waves. A scaled model of the linkages was also made up to investigate measurements of the linkage and to find the exact pivot point that gave us the correct amount of movement.

Results (Continued):

Control
The running and control of our wave generator is done through pneumatics. The main control of our tank include:
- Frequency of wave
- Size of wave
- Direction of wave
- Start/Stop of machine
- Wind speed

These factors will be controlled with the use of start/stop button, flow control valves and 3 port mechanical valves.



Fabrication
- 80% of fabrication was completed in GEW
- 20% bought-in parts
- Mainly SMC Pneumatic components used
- Poly Carbonate was used in the manufacture of the tank due to its high strength properties
- Emergency stop will dump all air from system through a dump valve.

Conclusions:

- By completing this project it gave us a great opportunity to showcase our skills that we have developed through our time in college. It also gave us the chance to build on these skills and put them in to practice in a practical environment.
- The project schedule ran according to plan

The main problems we ran in to throughout included:
- Parts not arriving on time.
- Budget – pneumatic components are very expensive.
- Schedule – Tight on time, parts not arriving.

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AUTOMATION EDUCATION UNIT

Introduction:

Automation is playing an increasing role in industry and though traditionally an electrical branch of engineering, it is becoming more relevant in the mechanical disciplines of engineering. Factories are becoming more productive and efficient, and the use of automation is driving this change.

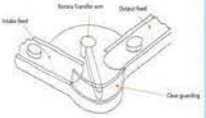
Although the team did not initially plan on undertaking a project of this type, on consultation with the lecturers, it was decided to explore this area. The lecturers explained that it would be beneficial to them to have a project to use for demonstration at Open days and visits to the college. It was then decided that the group would endeavor to build a machine to fulfil this role.

Methods/Design

The first of many different designs was researched and sketched out for the Automation Education project. The final design was split into four sections and the team began identifying concepts and ideas for the design.

The final four designs were:

- Geneva Wheel
- Conveyor
- Walking Beam
- Pick & Place Gantry



Design:

The design process included:

- Sketch out designs
- Course design
- Selecting material
- Develop project schedule
- Research available resources
- Assign tasks to project members
- Model design in Solidworks
- Develop detailed drawings for four main components

Fabrication:

- Most of the parts were fabricated in the GEW
- Materials sourced from GEW or ordered in
- Fabricated parts include the frame, Geneva wheel, Walking beam & conveyor

Machinery used:

- CNC Milling Machining
- 3D Printer
- Lathe
- Milling machine
- Band saw
- Laser cutter
- Plasma cutter

PLC:

- Research PLC's and software
- Write PLC code in FPWIN GR
- Test program

Software Used:

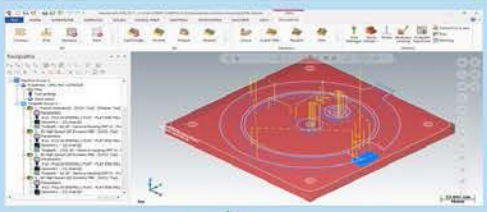
- Solidworks
- Master Cam
- FPWIN

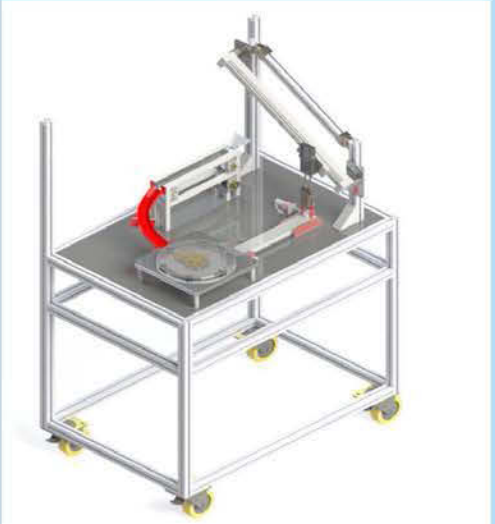
Safety:

Safety was very important in the design as this will be an operational machine in public. The project includes an emergency stop, warning lights, door sensors and also has a complete enclosure with perspex sheeting for the safety of the user and onlooker.

Aims of study:

The design brief for this project stated that the team must "design, build and test a working prototype of an automated conveyor system operating across different levels which will be used by I.T. Sligo as a teaching aid and as a demonstration of student project work for open days and visitors".



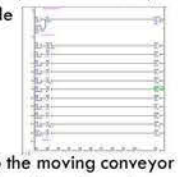


Results:

The final concept was designed and assembled as seen in the assembly drawing below. The four cells work in a continuous system together.

PLC

- The PLC could operate 32 inputs and 28 outputs
- These inputs/outputs include
  - Solenoid valves
  - Motors
  - Sensors



How Does it work?

- The product is placed onto the moving conveyor
- The through beam sensor breaks and sends a signal to the PLC
- The product moves into position for the gripper
- The double acting cylinder extends down and the gripper closes
- The Rodless cylinder then travels into position above the walking beam to drop the product
- The walking beam transfers the product to the slide
- The product is transferred into the Geneva Wheel from the slide and is indexed around to drop onto the conveyor
- This process is then repeated

Conclusion:

The overall project was a great experience for each member of the team as it demonstrated the skills learned in the course during the previous years in IT Sligo. The project was successful as the team worked together to produce a suitable machine which meets the requirements of the brief. The project schedule ran according to plan.

The main limiting factor of the project included:

- Time and the amount of fabrication required
- Budget and resources available

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Vertical axis wind turbine



Introduction

This project was attempted twice before and it really excited the project team to try and maximise the efficiency and the aesthetic. The team had no prior experience in wind energy so the thrill of the unknown grasped the teams attention. The focus of the design was not only improve the existing design but it was to also make something unique and artistic to show off on expo day.

Brief

The team wants to take on the "Vertical Axis Wind Turbine" and improve its design and output ability. Design of components to match the existing design and to improve the project in all aspects.

Methodology

Research:

The tem began the research by studying every aspect of the previous years project. Research also included generator, wind turbine blade and actuators.

Design:

The design stage included for the team. Refurbishment and ng, the challenge for the team design wise was to improve all the current feature while also giving the project a nice overhaul. The design phase also included completing several freehand sketches and then modelling a complete design on Solidworks.

Fabrication:

This stage took place in segments, the team concentrated on harder aspects of the project first. This method ensured that the team would not scramble to the finish line.





Methodology continued

Safety:

This aspect of the project was in the back of the members minds at all time. During workshop hours proper safety measures had to be taken into account.

Results

From testing the prototype, the results meant that a helical blade was on the agenda. Trial and error was tried with the blades until the right concept was eventually achieved.

The **design** was not often Changed but little adjustments were made along the way. Any encountered issues were brought to the attention of the supervisors and appropriate measures were taken.

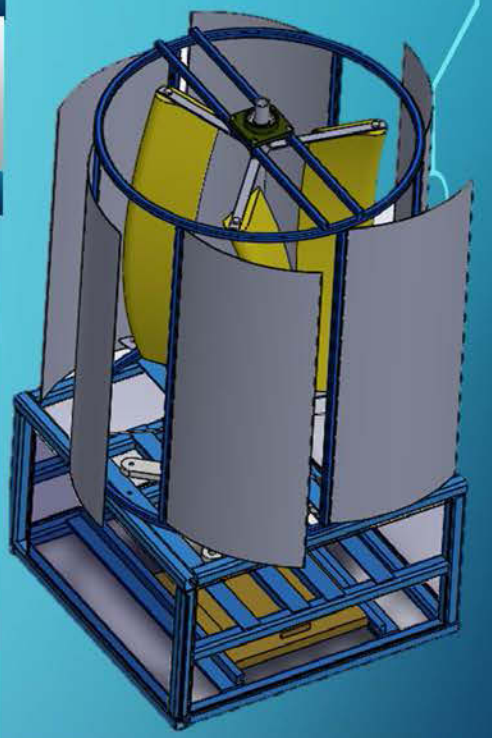
The main aspects of the Design changes were

- Blade type
- Door opening mechanism
- Generator
- Hinges
- Frame cover
- anemometer

The **fabrication** took place mainly in the workshop except for when the casting of the resin had to be done. That part took place in a members shed.

The disappointing feature from the this whole experience is that the linear actuator did not arrive on time, this set back the team both morally and physically.

The result gotten from The overhaul was quite Satisfactory, there Were some obstacles Along the way however The team dealt with it quite professionally. Different parts of the project were done by different members who had the skill set to tackle that task. Manufacturing concluded with painting and cleaning the project. The parts were assembled and made ready for expo day which is a huge opportunity for project members to show off the skills that they have acquired throughout the integrated project year



conclusion

The takeaway from this processes differs for each members, for three members it gave them an idea of what it is like to work under foreign environment, for the fourth member it reinforced the belief that a great personality is needed to thrive in a working environment.

The following is a list of the main learning points that the individual took away from the integrated project.

- Working in industry type conditions
- Working in a team to achieve a common goal
- Working on a timetable while ordering material and handling issues that arise.

The project ran on course for the majority of it however towards the end a few issues were brought to the teams attention.

Issues/ limitations

- Time
- Budget
- Ordered material not coming in on time
- Workshop hours

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Bucket shredder

Paddy Creegan, Mark Kennedy, Faustino Osawaru, Killian Murray

Introduction

For this project we were tasked to design and build a machine that could shred buckets made of PE/HD plastic for the company ALW, The buckets have a max tensile strength of 32MPa. The reason that they had to be shredded was due to the fact that ALW buys in buckets of UV Ink, these same buckets then have to be sent in a barrel provided for back to the company it was bought from. Due to the bucket's size it means that only 75 amount of buckets can be sent back at any time, sending the buckets in the barrels back costs roughly 4,500 euro each time. If we were able to even double the amount of buckets sent back at each time then the company would very quickly see a profit from this investment. With the buckets being shredded then a much greater amount could be sent back at any given time and thus save money for ALW. The company that the UV ink comes from incinerates the buckets so it doesn't matter how they are sent back.

Final design

The final design we settled on was a strong, durable and a safe one. The main frame of the design would be constructed using 40x40 box steel, with just enough room to comfortably slide the barrel in and out from below. The shafts that the cutters are located on two pillow blocks on each ends of the headframe, this is in order to ensure the shafts freely spin and reduce friction loss. These shafts would then be attached to gears and the gears would be spun using a motor. The motor needed for the design would have to be high torque due to the strength of the bucket, with the calculations we got for the torque being 75N/M. We also finalised the design for the lid of the mainframe. This lid was designed in such a way that the bucket was easy to throw into the shredders and it also prevented the bucket from skipping off the cutters, this will ensure that the bucket will be fed into the shredders. There was also a small frame added around the gears for safety reasons. All the frames will also be covered in sheet metal to ensure that no pieces of the shredded bucket fly out of the sides.

Aims of the study

The aim of this study in our mechanical engineering project is to apply and demonstrate the theory and practices we've learned over the past 2 years of study. To help us put these things we've learned into use and construct some thing from it.

Methodology

Engineering specifications:
The size of the barrel is 96cm long and 60cm wide, this meant that the mainframe that the shredder would sit upon would have to at least be these dimensions plus a little leave-way. There would also have to be enough support in the mainframe to support the shredders and also the motor to power them. We as a group decided that the best material to have it made in would be box steel due to it being cheap and also very strong and durable. There must also be a number of safety procedures, such as an emergency stop, a reverse and safety latches on the machine so it can't be operated until it is full closed.

Fabrication

- A number of processes in the construction of this project.
- The 40x40 bars where cut by band saw as the band saw ensures an accurate and straight cut, which is needed for this project.
- The pieces cut then were welded together using a MIG welder due to being easy to us.
- Next the sheet metal for around the frames were done using a plasma cutter and spot welded them to double up the thickness.
- For the shredders and spacers a laser cutting was used in order to make them all accurate.
- The shafts were keyed using a milling machine, as were the holes in the end spacers.
- The lathe was used to construct the end spacers and take the shafts down a mill.

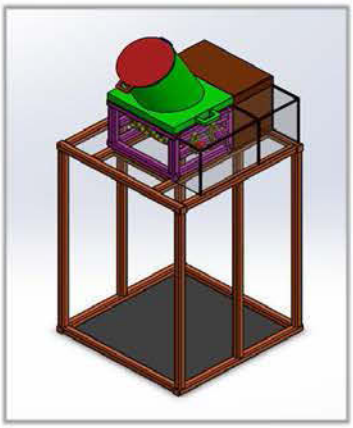
Results

The main aim of this project was to design and complete the build for a bucket shredder. This consisted of a motor, a control panel with stop/start/reverse, laser cut shredder blades, safety switches, gears, shafts and mainframes.

- The lid of the roof is connected with a safety switch that only allows the machine to be in use when closed
- From the rest position as the bucket lies on top of the shredders you must manually press start on the control panel to spin the blades
- The bucket then gets shredded between the blades, passing through and falling into the barrel below, designed to hold the buckets
- The frame below is designed to fit over each barrel till it is full

The shredder contains many safety features, such as:

- Switches
- Safety stop
- Covered in metal sheeting
- Reverse/stop button
- No exposed wires



Problems we faced

- Very tight space between shredders
- Very large motor
- Difficult to source components
- Expensive parts
- Unrealistic views within Solid Works
- Unspecified components made it hard to get an accurate weight in the design phase

CONCLUSION

From this project we learned the process that goes into the design and construction phase of a product. This also was a good exercise in time and budget management and showed us how to run a project on schedule. We gained valuable knowledge about teaming up with an outside company and learned how the other company operates and works. We also achieved our goal of constructing a bucket shredder
The main limiting factors of the product:

- We had to work off a budget, this limited out spending and make us conscious of cheaper alternatives
- We found it hard to find a strong enough motor for a reasonable price
- The weight factor was a challenge because of unknown components

Automated Capping Machine

Introduction:

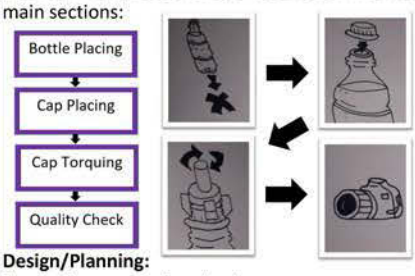
This project originated when I was searching for ideas and decided I could try some form of automation with the capping process of a water bottle.
I then researched different ways of automating the capping process of a water bottle and concluded that automating the capping process was the most challenging aspect in relation to any water bottle process.
I started by selecting parts for the project such as a PLC/ LabView for the programming side and used Solidworks to design the project and pick the parts necessary for it to work.
The goal for the project was to have it work efficiently and work with little user input while completing the process.

Aims of Study:

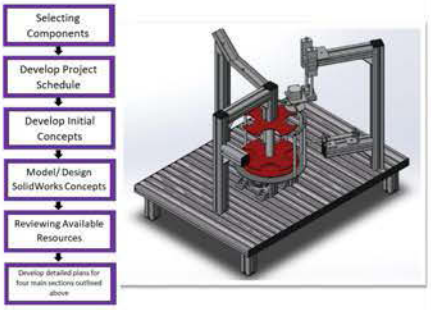
To showcase the skills within programming, design and automation I have acquired throughout the course so far and apply them to a process commonly used in industry.

Methodology:

Research:
My research began by studying the current processes, then selecting the steps required and automating these steps in the most efficient way possible. The process I chose was broken into four main sections:



Design/Planning:
The design process involved:

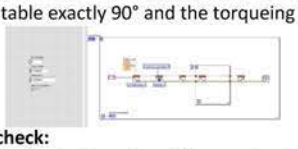


Fabrication:
- Most of the parts were fabricated in the GEW. This includes the index table base, index table shaft, spacers, brackets, etc
- Additional materials sourced from a local company as I didn't have time to complete them myself

PLC/Control:
- I/O count of process for Siemens S7-300
- Select all DCVs, Solenoids and sensors
- Create master document including state transition diagram and symbolic table
- Write PLC code in Simatic Manager
- Build simulation model in FluidSim
- Test program/Trouble Shoot

Methodology (Continued):

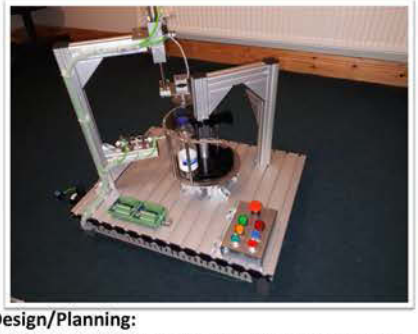
LabView/HMI:
- The purpose of LabView within this project was to control the stepper motors
- Using an NI DAQ connected to my laptop I created a LabView program to send out a clock pulse to the motors
- Using a For-Loop I controlled the amount of steps the motor would turn to accurately rotate the index table exactly 90° and the torqueing motor 360°



Quality check:
- Quality check determines if the cap has been correctly fastened on to the bottle.
- A Cognex checker vision system will process and compare a captured image once a break-beam sensor is broken and the camera is triggered.
- The camera will then send back either a positive or negative signal and activate a green (pass) light or a red (fail) light depending on the quality of the capping process.

Safety:
Safety was very important in the design of the project. The project includes an emergency stop button to stop all operation of the system before any further damage can be done.

Results:



Design/Planning:
After reviewing existing solutions, a concept was developed for the automated solution. It comprised of the following steps using an electro pneumatic PLC & LabView system:
- Place bottle in position one.
- Table indexes 90° and a cap is placed on the bottle in position two
- Table indexes 90° and a sensor will activate once in position
- Pneumatic guided cylinder lowers
- Bottle is pneumatically pressed
- Cap is screwed on
- Pneumatic cylinders retract
- Table indexes 90° and a sensor will activate once in position
- Vision system determines if the cap is fastened properly

Results (Continued):

PLC/Control:
- Siemens S7-300 had 16 DI and 16 DO connections
- The PLC code comprised of ladder logic in a state transition style of coding
- The connected equipment consisted of two 5/3 DCVs with four solenoids, two break beam sensors, three push buttons and three L.E.D.s
- Reset button was implemented to reset the cylinders and retract them in the event of the emergency stop being pushed

LabView/HMI:
- Using a LabView VI I was able to control the direction and rotation amounts for both stepper motors
- As the NI DAQ I was using could only output 5V per port I used a BUZ11 chip to switch it to 24V and increase the signal of the clock pulse

Fabrication:
- 40% of fabrication was completed in GEW
- 60% bought-in parts
- Industrial standard components and materials were used throughout
- Mainly Festo Pneumatic components used
- Emergency stop disables all outputs
- Majority of wiring placed underneath the base to save space and make above the board more aesthetically pleasing




Conclusions:

- My conclusions for this project is that it provided a very challenging opportunity to showcase my learnings over the past 3 years but also to apply it to a common automation project in industry.
- The objective to automate the process of capping a water bottle and returning a pass or fail through the vision system was successful

What I would do different:
- If more time was allocated I would add a self loading conveyer with an automatic rejecting system if a fail was to occur and an exit conveyer to send off quality water bottles to a packing area

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AUTOMATED SORTING STATION

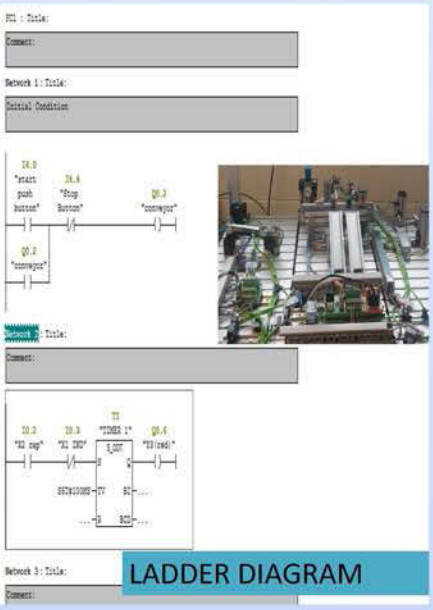
Introduction

- As a third year student in Mechatronics, at IT SLIGO, it is required to design and build a project that will enable student to put in practice all the theoretical knowledge gained throughout three years of study.
- Automation technology is one of the sectors of most interest to industry today and it is also a big interest of mine.
- My project is based in an automated sorting station that will sort a work piece along a conveyor belt according to their colour.
- The system will incorporate three sensors to detect the colour and activated a double acting cylinder to eject the work piece in the appropriate box for storage.

Siemens S7-300

SOFTWARE

Siemens S7 SIMATIC manager has been used for the implementation of the ladder diagram and download into the PLC.



LADDER DIAGRAM

Aims of Study:

- The main objective of the project is to design an automated system that will be select and arrange a variety of pieces according to colour.
- Through this project, I will demonstrate skills learned by implementation of the programming code to enable the system to function in a real time.

Results:

The operation of the system is as follow

- A user interface will press start button
- The distribution station will pick work piece into the stacking magazine and placed it along the conveyor belt
- Sensors mounted along the system will detect work piece colour
- Double acting cylinder will deflect object in appropriate box

Methodology:

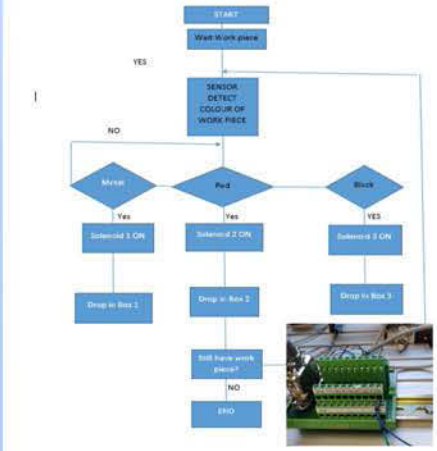
Research:
Research of my project began by analysing different projects ideas and programming code.
Upon reflexion, I decided to choose an automated conveyor sorting station as final year project.
The project is broke down into two main parts:

- HARDWARE
- SOFTWARE

Hardware components:

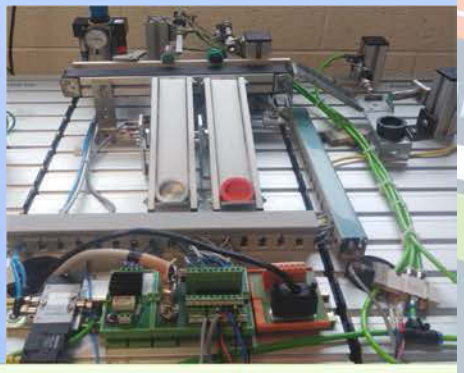
- Double acting cylinder
- 5/2 solenoid valve
- limit switch
- Stroke valve
- Pressure gauge
- Conveyor module with DC motor
- Diffuse sensor
- Capacitive sensor
- Inductive sensor
- Slide module
- Changer module
- Stacking magazine

FLOW CHART DIAGRIAM



Conclusions:

This project provided an opportunity to understand how to program an automated system through a PLC programming code.
I upgraded my skill through the implementation of the PLC wiring diagram and pneumatic compartments involves in the operation of the system.



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Automated Palletizing Cell

Introduction:

I decided to build a robotic palletising cell as I have been working in a robotics company called robotics and drives for the last three years. We build a large amount of palletising cells each year and I have always found the operation and efficiency of them to be intriguing so I decided to build one myself but on a smaller scale. This would still show the research, design, fabrication and programming involved in building a palletizing cell.

Aims of Study:

The aim of this project is to combine the skills that I have acquired in both college and in my work place to build a palletising cell which will take parts off a conveyor and stack them on a pallet.

Methodology:

Research:
My research began with sketching different concepts and designs, these designs constantly changed throughout the build as some part I wasn't able to get and part I thought I couldn't get I got.

Design/Planning:
The design process involved:
- Selecting technology
- Develop project schedule
- Develop initial concepts
- Reviewing available resources
- Assign tasks among project members
- Develop detailed plans for three main sections outlined above
- Model design in Solidworks

Fabrication:
- Have the ability to use the milling machine ,lead and other machinery I split the build between work and the GEW in the college

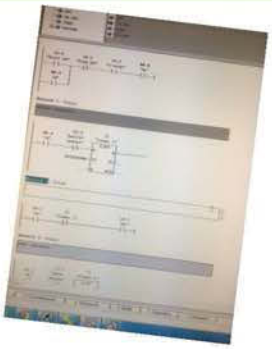
- The college supplied me with the profile to build the main frame of the cell which was cut to size in the GEW and assembled in my work.

- I was able to source the aluminium sheets off a friend and cut them in work.

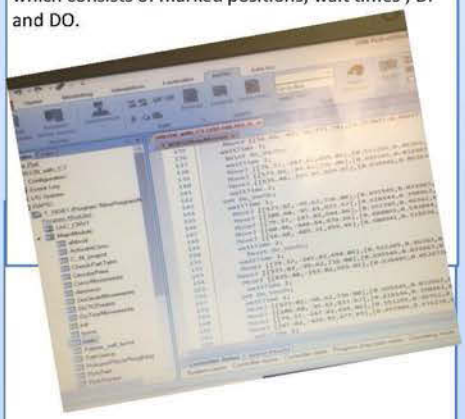
- The robot plate and other machining was done in my work place as time was an issue in the GEW.

PLC/Control:
- I/O count of process for Siemens S7-300
- Select all switches and sensors
- Write PLC code in Simatic Manager
- Test program/Trouble Shoot
- Control of all sensors and conveyors

Methodology (Continued):



Robotic control
To program the robot I used ABB's Robotic studio. I acquired the skills to use this through work and in our CIM class. The program used is called rapid, which consists of marked positions, wait times , DI and DO.



The robot pennant was used to minovery the robot arm to the required position and then these positions transferred to robot studio where it was easier to program.

Results:

When completed the cell worked as planned. When the start button is activated the two conveyor start and the robot lifts two boxes at a time and fills the wooden pallet.

Personal information

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Results (Continued):

PLC/Control:
- Siemens S7-300 had 8 DI and6 DO connections
- These inputs consisted of pushbuttons, E-stops sensors and control.
- The outputs were used to start both conveyors, control the light stack and to send a signal to the robot controller to tell it to start its cycle

Robot control
- The robot program allowed it to go to the set positions.
- The robot controller also used DO to turn on a solenoid valve to activate the vacuum to lift the parts.

Fabrication:
- 60% of fabrication was completed in GEW
- 40% bought-in parts
- Industrial standard components and materials were used throughout
- Mainly Festo Pneumatic components used
- Perspex screens and doors were used for Safety
- Emergency stop disables all outputs

Conclusions:

- This project provided an opportunity to display skills and knowledge gained from the course in a practical way. Overall the project was a success and was an excellent learning experience.
- The objective was to pack a full pallet using vacuum on the robot.
- The project schedule ran according to plan

The main limiting factor of the project Included:

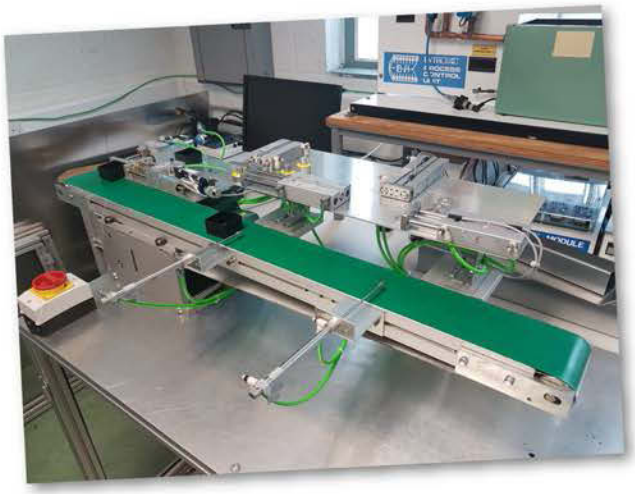
- Time and the amount of fabrication required
- Building the cell on my own was quite challenging as it had a lot of fabrication and programming.

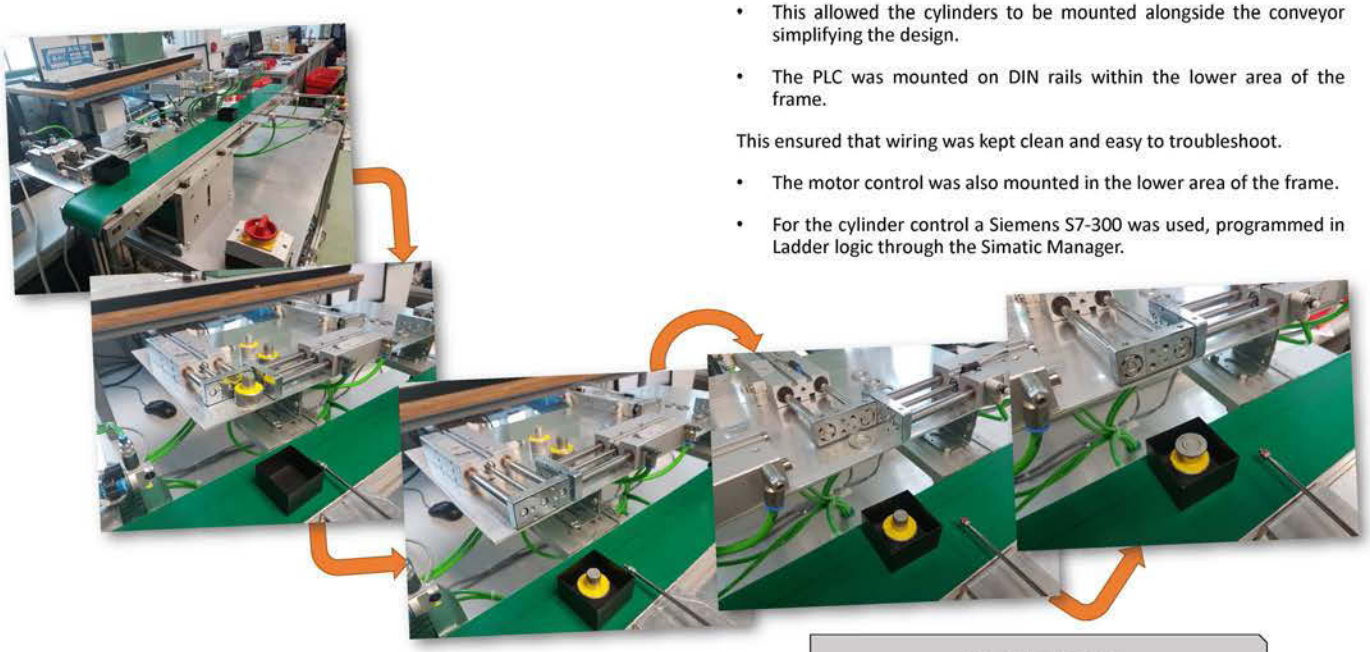
PLC Controlled Assembly Line

Third Year Mechatronics Project

Introduction

During my time in college we learned a lot about various solutions for different styles of assembly lines. I hence decided to attempt to make a easy to use and efficient assembly line that would be able keep running as long as it had raw material available to it, and then alert the user and shut down when it ran out of material.





Methodology

The first part following the selection of this project was research.

- Investigation of various approaches to cylinder control.
- Research of three phase motor control.
- Comparison of linear and rotary assembly lines.
- Approaches to assembly of the selected layout.

Next the fabrication of the project was planned.

- The frame of the project was taken from a pervious project, and altered to suit the new requirements.
- This included an expansion to the PLC cards, and mounting options for the additional cylinders.

Then the software to be used was considered.

- The Simatic Manager was used to write a PLC code in ladder logic for an S7-300 PLC.
- This fully annotated state transition diagram was tested in Fluidsim for troubleshooting before integration to the project.

Safety was paramount in the development of this project and as such there are various emplacements to prevent injury or accident.

Results

It was decided what approach would be used.

- A linear design was decided upon.
- This allowed the cylinders to be mounted alongside the conveyor simplifying the design.
- The PLC was mounted on DIN rails within the lower area of the frame.

This ensured that wiring was kept clean and easy to troubleshoot.

- The motor control was also mounted in the lower area of the frame.
- For the cylinder control a Siemens S7-300 was used, programmed in Ladder logic through the Simatic Manager.

Conclusions:

This project is a showcase of the Mechatronics course, displaying elements of physical building, programming and electric wiring. I personally feel it was a great learning experience and provided an opportunity to plan and then follow through with a project from conceptualisation to finalisation.

I feel it would have been possible to greatly expand upon this project with a pass/rejection system, but due to time constraints it was not possible to include this.

Contact:

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Railway Barrier System

Introduction:

Level crossings are controlled by either large relay based or PLC based control systems which require expensive control rooms and only allow limited interaction with the user via a wired control panel.
The aim of this project is to design a railway barrier system that is less complex and allows the user interact with the crossing via an Android application.
This will give the application user vital feedback as to the position of approaching trains and the status of the barriers at the crossing.
Designing a more compact system would reduce the cost of new installations and also make it easier to upgrade older level crossing.

Aims of Study:

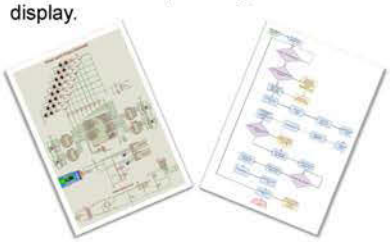
To design and build a more compact railway barrier control system while demonstrating that the knowledge I have gained during the course of my studies can be applied to practical uses.

Methodology:

Research:
My research for this project began with analysing the barrier systems that are currently in use within Irish Rail. My research then concentrated on how an Android application could be used to interact with control systems. Once I had a clear understanding of how these worked the design process could begin.

Design/Planning:
The design process for my project was broken down into three different stages:

1. Hardware: Selecting the electronic components to be used.
2. Software: Deciding on which programming language to use and drafting a software sequence flowchart.
3. Structure: Develop a design for the final display.



Build/Fabrication:

- Hardware components were obtained online from various sources and included PIC 18F4520 microcontroller, stepper motors, LEDs, audible alarm, IR reflective sensors, Bluetooth module and power supply.
- Most of the display was fabricated from plywood and painted to resemble a real railway barrier crossing. These materials were sourced from local suppliers.

Methodology (Continued):

Microcontroller/Programming:

- I wrote the PIC microcontroller code in MPLAB-X using the C programming language. The entire program was generated over a twelve week period.
- The electronic components were connected as inputs and outputs to the PIC microcontroller.
- The Android application was developed using MIT App Inventor 2.

Testing:
The project has three test phases:

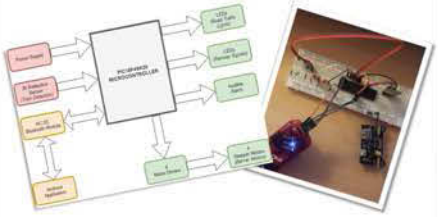
1. Verification testing: Physical check to verify hardware is configured as designed and wire count.
2. Functional testing: Confirms the entire project functions as designed. Software code testing is also carried out in this phase.
3. Principles testing: Ensures the project achieved what it set out to achieve.

Safety:
Safety was a priority throughout the project and all electronic components are encased to ensure safety. The safety-critical nature of railway barrier systems meant that all relevant safety standards had to be adhered to.

Results:

Design/Planning:
The design/planning phase enabled me to generate a blueprint for the sequence of events that would be co-ordinated by the PIC microcontroller to operate the barrier system:

- The Android application is connected to the crossing via Bluetooth.
- Train approaches crossing activating sensor.
- App user requests the barriers to lower.
- Amber Road Traffic Lights (RTLs) illuminate (5s).
- Red RTLs Flash (7.5s).
- Barriers lower.
- App user requests the signals to show proceed.
- Railway signals change from red to green.
- Train passes through the crossing activating another sensor.
- App user requests the barriers to raise.
- Barriers raise.
- System awaits arrival of next train.



Results (Continued):

Microcontroller/Programming:

- Input: IR reflective sensors.
- Outputs: LEDs, Stepper Motors, Buzzer.
- RX/TX data transfer: Bluetooth module.
- Simulation was carried out using Proteus Design Suite to allow for troubleshooting.
- The components were all connected to the 40-pin PIC 18F4520 microcontroller.
- The program was uploaded to the microcontroller for testing.

Testing:

- The full test plan was carried out which included voltage checks, operation checks and safety checks.
- The safety of the public is paramount in the rail industry so tests were carried out to ensure the railway signals could not show green aspects until the barriers were fully lowered at the crossing.

Conclusions:

- My aim of creating a more compact barrier control system was met while I also gained practical knowledge of microcontrollers and other electronic components which can be utilised in my future career as an electronic engineer.
- Overall the project was a success and the display can be scaled up to allow the project to be a commercially viable concept for use on any railway network.

Recommendations:

The Android application has two modes of operation, manual or automatic. The potential is there to develop the application to give step by step instructions to the user with regard to the safety protocols involved in operating a railway barrier system correctly.

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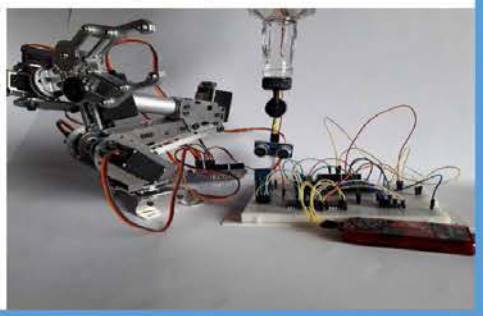
Robotic Barman
By Fran Finan

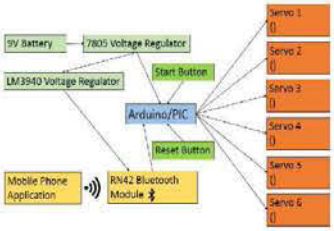
Introduction:

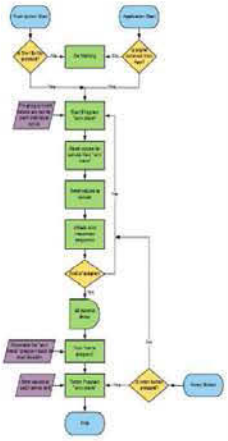
- The robotic barman is an electronically controlled robotic arm which is programmed to carry out the task of making a drink at the push of a button. In addition, it can be also controlled from your phone through Bluetooth.
- The robotic arm will pick up a glass and place it under the desired dispenser. The dispenser will have a proximity sensor on it that will sense the glass and release the liquid into the glass.
- The robotic barman would be an ideal addition to any man-cave.



Aims of the project:

To demonstrate the knowledge and skills I have developed by designing and building a fully functioning robotic arm which will preform the task of making a drink. The arm can be both remotely and directly controlled with Bluetooth incorporated into the project.





Methodology/Approach

Concept selection:

- From researching on the internet there are many different types of these online, some include using a rail type system to slide the glass under the desired dispensers. Others have a stationary glass with an array of tubes going into the different bottles and a pump attached to dispense the liquid.
- After weighing up the different options the desired option was to go for a different approach, instead of the rail system a robotic arm will pick up a glass and place it under the desired dispenser.

Research:

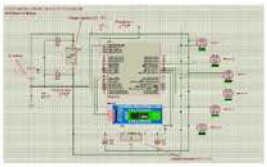
- **Cost:** The biggest problem encountered was finding a robotic arm that was not only sturdy enough to carry out the tasks needed but also the one which wasn't extremely expensive, as the sky is the limit when it comes to robotics. After much researching the 6DOF robotic arm came up.
- **Practicality:** This arm has uprated MG996R servos which have a good load capacity, can be controlled by a PIC microcontroller and is reasonably priced.

Design concept:

- The main body of the project is the robotic arm.
- Powered by a total of 6 servos connected to the arm allowing a full range of motion.
- A PIC microcontroller is used that will be programmed to carry out the different tasks that are required.

Methodology/Approach (cont.)

- Illuminated button controls are attached to select and control the beverage amount.
- in addition, an app which will control the arm through Bluetooth, so it is possible to remotely make your desired beverage.



The build:

Hardware: Once the project was simulated on proteus and the schematics were finalised the build started. The build consisted of :

- Assembling the arm together using all the various aluminium parts, screws and bearings.
- Mounting the 7 servos.
- Attaching the claw grip.
- Attaching the solenoid valve to the dispenser.
- Connecting the proximity sensor to the Arduino and the solenoid valve.

Software: The software used in this project Included:

- Proteus 8: used to simulate the project and also to design the schematic and PCB design.
- Mplab X: used to program the 18f4520 PIC microcontroller through the Pickit3.

Results/Conclusion

Results:

The results of the tests for the project were very pleasing, each servo moves as it should in each direction from the pulse widths. Being sent from the PIC. All the voltage tests throughout the circuit passed. In addition the water dispenser circuit, sonic sensor and solenoid valve all passed the various tests that were carried out.

Conclusion:

Overall I am happy with how the project turned out. The project does what I intended it to do, carrying out the task of remotely making a drink at the push of a button. If I had more time to do the project I would have added an LCD screen to display when the drink was ready. And also maybe a beeper. If I could change one thing I would have started with a different arm as this arm is heavy and not user friendly.

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Smartphone Controlled RC Car

Introduction

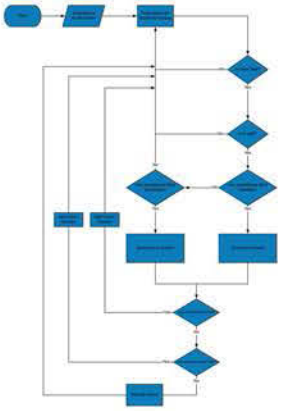
The aim of this project is to connect two Bluetooth devices, a PIC controlled RC Car and a Android smartphone. The smartphone will act as the steering wheel for the car as the accelerometer input will be the key to how it is controlled. If the smartphone is tilted left, right , forwards or backwards the RC car will move in the corresponding direction all the while doing this wirelessly.

Smartphone Control Robotics using Arduino and Android—Udemy.com

Methodology

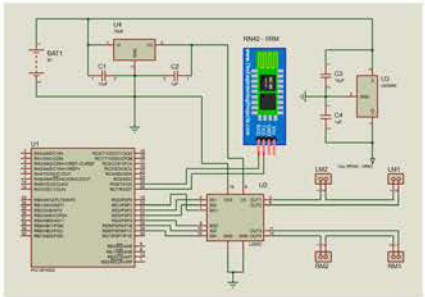
Software

For the software development of the project, The PIC18 series microcontroller is programmed using the MPLAB X IDE V2.15. The purpose behind the for the PIC is to control the DC Motors in accordingly to the input from the Bluetooth Module. As for the smartphone, the Android Application is being developed on Android Studio. The application allows for the connection of the smartphone and the RC car and determining the phones acceleration per axis using its built in accelerometer. This will allow the phone to act like similarly to a steering wheel (e.g. if the phone is tilted left, the RC car turns left). To get a better understanding of how the program should run, the following software flowchart explains how each function works.



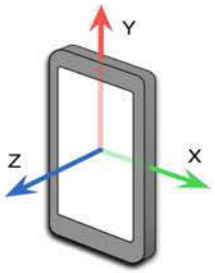
Hardware

Research was carried out on which components are needed for this project. The chosen PIC is the PIC18F4520. as this PIC runs on 5V, this makes it easier to interface with the 5V DC Motors. The Bluetooth Module is the RN42— I/RM, this will be transmitting the accelerometer data to the PIC while also receiving accelerometer data from the Android smartphone. Since this is a 3.3V module, a voltage regulator is needed for the RN42 voltage supply, this is where a LM3940 is used to deliver the required 3.3V. The wheels of the RC car will be driven by 4 5V DC Motors, and in order to control multiple motors at once, the L293D Motor IC will be able to control which motors are active. Since this is a Dual H- Bridge IC, 2 motors will be controlled in parallel (left side and right side). Depending on which way the RC car is moving, each side can be controlled to make the RC car go forwards, backwards, turn left and turn right. All of these components were placed in a schematic, connected and created a PCB layout in Proteus 8 Professional.



Results

Since the accelerometer detects changes in speed per axis. The application can will determine the threshold for how much acceleration in a particular axis will change the direction of the motors. The screenshot below shows an app that shows the accelerometer sensor, this displays the acceleration ranging from a scale ranging from –1.0 to 1.0.



Android Accelerometer Reorientation—Medium.com

Using this information, this can determine which direction the smartphone was tilted. For example, when the phone is tilted to the right this should cause an increase in acceleration in the x—axis. And when it reaches a set threshold it will send a signal to the RN42 and then to the PIC microcontroller, the PIC will then enable the two left motors to move forward and the two right motors in the reverse direction, and if the smartphone is moved back in the opposite direction the car will stop turning.

Conclusion

This Project provides an opportunity to demonstrate my technical skills and abilities that I have learned from studying at IT Sligo as it incorporates what I have learned from multiple modules that focus on hardware and software which were crucial for this project. The objective is to use a smartphone to control a RC car using Bluetooth using tilt gestures. One of the main issues with the project so far is keeping up with time constraints as there is a lot of work involved to have this project ready and demo - able for the IT Sligo Engineering Expo on May 2 2019.

Project Report

Ball Balancing Table

Introduction:

Ball Balancing Table has two rotational degrees of freedom. Each degree of freedom is controlled by an RC servo motor which is attached to the table. Position data is read from 15inch touch screen and sent to Arduino over USB connection cable. Arduino controls RC servo motor angles by sending a PWM signal. Through an implemented PID algorithm, Arduino controls the position of the ball by getting the position feedback data over USB connection and actuating the servo motors over PWM signals.

Aims of Study:

To demonstrate the abstract knowledge acquired over the course of our study in a practical, real life application.

Research

Before the project has been started it had to be planned, Therefore quite a few things had to be researched. Below is a list of the main factors that had to be researched:

- NI LabVIEW Programming
- Arduino programming
- PID controller
- Software interfacing
- Sensing elements
- electric motors

Methodology:

Design/Planning:

The design & planning processes involved:

- Selecting technology
- Develop project schedule
- Develop initial concepts
- Reviewing available resources
- Assign deadlines for tasks
- Develop detailed concept for the rig.
- Sketching initial concepts.

Fabrication:

- Some of the parts were fabricated in the GEW.
- Materials sourced from GEW and local suppliers.
- Rod ends and universal joint were used for more flexibility.
- Fabricated parts include the rig base, brackets, angles, etc.

Arduino/ PID Control:

- Connecting all inputs and outputs of the rig to either I/O and Analogue input ports in Arduino.
- Configuration of the Arduino hardware in LabVIEW.
- Reading the position data of the metal ball from the resistive touch screen.
- Writing a program to determine X and Y coordinates of the metal ball position.
- Applying PID control algorithms to calculate the PWM to drive the servo motors .
- Design a closed loop control; the previously specified performance measures can be achieved.
- Test program/Troubleshoot.

Methodology (Continued):

Safety:

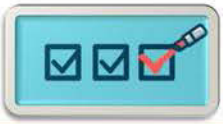
Safety was vital in the design of the project. The project includes a stop button that are used to disable the system.

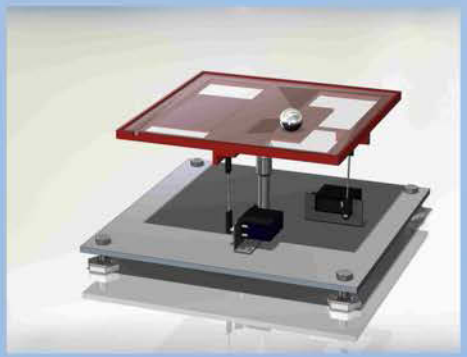
Results:

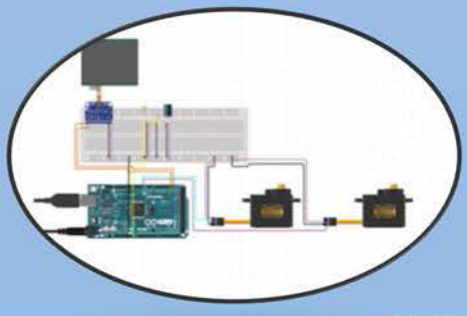
Design/Planning:

After reviewing what is available in the store, it was decided to avail the existing resistive touch screen sensor and motors to start building the rig. Also, the concept design of the rig was created and used to build the physical model of the Ball Balancing Table. It comprised of the following steps using LabVIEW PID controller and Arduino:

- Use analogue IN/OUT serial to calibrate the touch screen sensor.
- The NI VISA driver makes a software interface to transfer data between LabVIEW and the touch screen sensor.
- Display X and Y coordinates of the ball position in the program VI in the front panel in the form of a waveform graph.
- The touch screen worked extremely well. The response time of 10ms made it ideal for tracking the position of the ball while travelling across the plate.
- LINX software interface enables communications between the Arduino and LabVIEW via USB with a maximum baud rate of 9600 Bd.







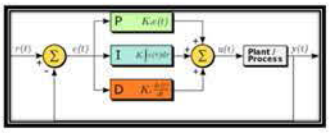
Results (Continued):

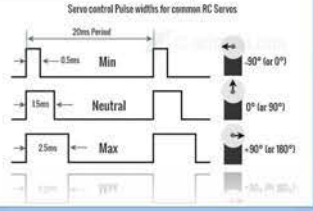
PLC/Control:

- The controller receives a setpoint for both the X and Y planes from the user.
- The controller was configured and appropriate
- The controller generates a motor control signal.
- The signal is then converted to a PWM signal that drives the servo motor to the required position.
- The project ran the motors in a closed loop configuration.
- The servos will rotate to the indicated position , until the next PWM signal received.
- The process is repeated until the ball reaches the setpoint as defined by the user.
- Adjust PID parameters to minimize the feedback error from the touch sensor.

Fabrication:

- Some parts were fabricated in the GEW
- Some parts were taken from the store
- Stop button disable the system.





Conclusions:

- This project provided a chance to show skills and knowledge gained from the course in a practical way. Overall the project was a success and was a great learning experience.
- The objective to automate the balancing process was achieved
- The project schedule had to be modified at some stages in order to fully utilize time

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Awareness and Time Reaction Test

Introduction:

Concept:
When playing any team sport, taking continuously pictures of what is happening in around us is a key factor impacting our performance. From visual point of view sports like tennis or golf are considered more centrally focused, on the other hand team sports are considered more peripherally focused.

Research:
Research began by observing the youth teams playing football in competitive leagues. Young players have a tendency to a ball watching and it is happening even when they don't have a ball in possession. Player decisions, with a football or without it are based on information collected during the game. If she or he are not tracking changes regarding the area of play, then decision making process is very limited.

The aim of study
The aim of study was to create a tool that is practicing player habit of checking shoulders using peripheral vision.

CONCEPT
COMBINE
CREATE

Process of collecting information in action...so now... what is my Next move?

Results :

Simulation and testing

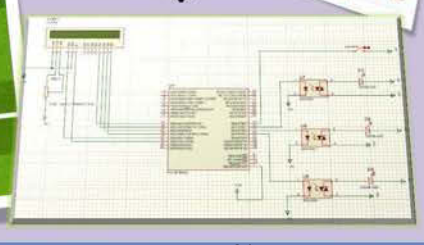
- Code simulations run in MPLAB using XC8 compiler. Both provided good platform to initially debug a software.
- Proteus program allowed to download all work from MPLAB and test it to see first outputs on the simulated hardware.
- All testes on hardware where run in steps going from one circuit to next.
- Run tests on the hardware firstly without controller to make sure all components where working correctly in regards to voltage and current.
- First tests performed on PIC where done on breadboard and small voltage components before going into larger circuits

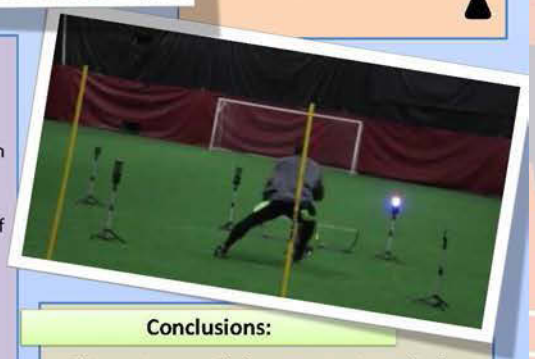
Science Technology Engineering Math

Methodology:

Operation:
User positioned in between two stands, each equipped with LED light. Additionally there is third stand set in front of a player, containing a push button and light indicating machine mode.
User need to use his peripheral perception to detect which of two lights on the sides will turn ON but at same time he have to keep on eye on the front LED to control the machine mode. The moment when one of LEDs on the side will turn ON the timer will start measuring time reaction and will stop if user will press the push button set in front of him. However the timer have a limit of 8seconds and when it overflows, the front light will switch off to indicate user attempt as a fail. LCD screen will output results and information regarding stage of exercise: run, fail, end.

Design:
Concept was developed to consist three LEDs, one push button, microcontroller and LCD screen. All indication lights are connected to same port at the controller. LED power supply is at 12V and it is separated from signal circuit by relay/optocoupler shield. Push button is connected directly to microcontroller. PIC will send signals to LED and receive signal from button. Time reaction will be measured using microcontroller internal timer. Value of time reaction will be converted into string so the data can be send to LCD to be outputted on a screen for user information. Software will also output information to a player regarding exercise stages.





Conclusions:

- This project provided an opportunity to display skills and knowledge gained from the course in a practical way.
- The project schedule run with no major delays
- Troubleshooting and problem solving skills where tested at every stage of a project build process
- Budget and resources managed to keep below the cap
- Interfacing LCD witch PIC was the biggest challenge

CONCEPT + COMBINE + CREATE

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Automated Meal Dispenser

BEng in Mechatronic Engineering Level 7

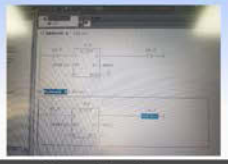
Introduction

The aim of the project was to research, design, build and test a pneumatically operated meal dispenser.

- Farming is a fulltime job with very little rest and any way in which this job can be made easier must be seized.
- I aim to create a small prototype animal feed system with a bowl acting as a meal bin attached to a tractor.
- I wish to create a program for a Siemens S7 Programmable Logic Controller to operate the feed routine of the system.

Results

- The timing of the cylinders retracting and extending was resolved by trial and error, setting the timing in the PLC program as well as the air pressure regulator.
- I resulted to using Rice Krispies cereal as means of demonstration because of it's texture and density.



Design

- My idea was to have two containers to act as silo's. Each container consisting of different food substances.
- Right of centre is my prototype funnel for my containers, made of cardboard from a cereal box, and beneath it, the completed design created with the use of a spot welder.
- I wished for the process to be seen, however, not the cylinders themselves. To achieve this I mounted a steel backplate with slots accurately cut to allow smooth transition of the slides.
- Through this mounting of the containers at the front with the pneumatics hidden at the back, the danger of hands being caught is reduced to zero

Method

- To initiate the process I used two sets of break-beam sensors.
- Whichever meal is required, the bowl will be placed beneath the silo, in turn activating the break-beam sensor.
- This will begin the program from the PLC which incorporates timers.
- The top shoot retracts for 2 seconds, closes, and the bottom cylinder retracts allowing the feed into the bowl.
- The process will repeat after a short delay of 8 seconds until the bowl is removed.

Conclusion

- The objective of my project was to build a functional automated feeding system through the use of pneumatics and a Siemens S7 PLC. I am delighted to have successfully achieved my goal.
- My design successfully incorporates safety as I have the cylinders operating behind the silo's, preventing any risk of injury to the operator.

Additional Information

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Automated Game: X's and O's

BEng in Mechatronics Level 7
By Tobias Brockmann

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Introduction

The aim of this project was to develop and automate a game which could be played against a computer. The game is played on a physical board, with LabVIEW controlling the physical board and Python deciding on the computers next move. All the communication between the programs is done using a TCP/IP Network.

X's and O's was chosen as it is:
- Easy to understand
- Has a limited number of moves
- Requires the program to think ahead.
- Small Scale
- Doesn't take away from the rest of the project.

How It Works

Methodology

SETUP
- Retrieve an old 3 axis robot.
- Collect the old report associated with the rig.

REPAIR
- Disassemble the Rig.
- Clean or permanently remove unnecessary parts and circuits.
- Reassemble parts and circuits e.g. Stepper Driver Boards, Pneumatic system etc.

SOFTWARE
- Develop the X's and O's game using **Python**.
- Develop the Rig control and HMI (Human-Machine Interface) using **LabVIEW.**
- Use **TCP/IP** for communication

3D Printing
- Design parts on SolidWorks.
- Print parts using the Ultimaker 2
- Draw the Board

Vision System
- Using a Basic Camera and LabVIEW, the vision system can check if the correct pieces are being used.

Future Improvements

- **Add more safety!** Safety is a huge concern with this project as there is no emergency stop or casing around rig.
- Allow the User to move their own piece while the Rig only moves the computers move.
- Hide wires to improve the overall aesthetics and safety.
- Search programs for better programming efficiency.
- Feeding System supplies the Rig with the game Pieces.
- Upscale to more complicated and sophisticated games (X's-and-O's -> 4-in-a-row -> Checkers -> Chess).
- Improve the Visions Systems function.

Results

The game is playable without any constraints. The motors and pneumatics all work together the way they were expected too. The ultimate goal was accomplished.
- 4N25 Phototransistors were leaking so they were replaced by Buz11 Transistor.
- Broken end sensor was removed and the code was reprogrammed to accommodate this change. (Sensor was found to be unnecessary)
- Program slow to react to inputs. Stepper motors not immediately stopping when reaching the end sensors.

Major errors occurred during testing but were immediately addressed and fixed. A few minor errors were either temporarily fixed or ignored due to time restrictions.

Conclusion

- The original objective of automating a game was achieved.
- The project allowed me to learn and develop skills that were not covered as part of the course such as:
  - Python programming
  - Working with advanced driver boards and stepper motors
  - Putting together a pneumatic system
  - Communicating between two different programming languages
  - 3D printing
  - Vision systems
  - Advanced problem solving
  - Planning projects of a larger scope

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Biometric Security System

Introduction

Inspired By An Assignment That Was Previously Completed For Creativity, Innovation & Entrepreneurship, Titled 'Security Alarm Systems'

Biometric Security Systems Can Be Configured In Several Different Ways — Either As A Physical Device Or As A Protocol (Specific Area Of A Building, Etc...)

Biometric Security Systems Can Be Implemented In Several Different Ways — Requirement Of A Fingerprint, Iris Scanning, Facial Features, Etc...

Aim Of The Project

The Aim Of The Project Is To Construct An Operational Biometric Security System Based Off The Information Mentioned Above (Physical Circuitry With The Use Of Fingerprint Recognition)

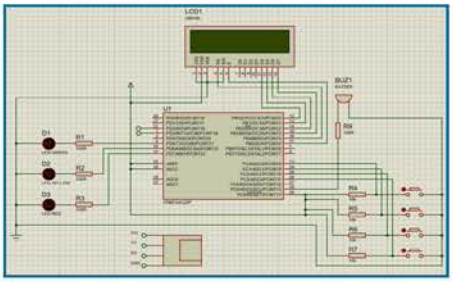
Methodology

Research:

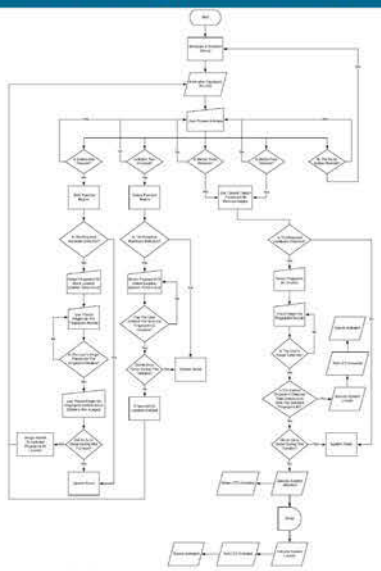
Extensive Research Was Carried Out Before Commencing On The Project To Ensure What Had To Be Worked On Step By Step And The Amount Of Time Required To Compete The Project. Any Other Information That Was Relevant To The Project Was Noted

Planning & Design:

Use Of Simulation Software And Flowcharts Provided The Foundation Of Planning & Designing The Project, Ensuring How Multiple Components Were Connected To Each Other And The Manner In Which They Operated



Methodology (Continued)



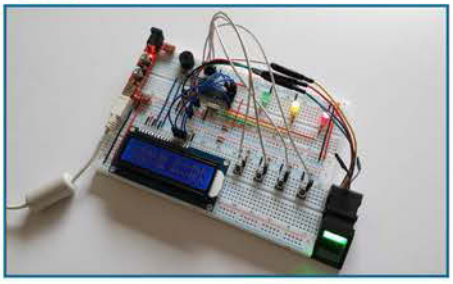
Hardware & Software:

Use Of A 12V / 5V Breadboard Power Supply Unit To Power The Circuit

Multiple Components Interlinked To A Single Microcontroller Unit — ATmega328 MCU

Arduino Uno Board (w/ MCU Removed) And Arduino IDE Required To Write, Verify And Upload The Code To ATmega328 MCU

Main Components Connected To The MCU:
- R307 Fingerprint Module
- Liquid Crystal Display
- Push Buttons
- Light Emitted Diodes
- Buzzer



Results

Once The Circuitry And Coding For The Project Was Completed, The Biometric Security System Was Tested To Ensure That The User's Fingerprint Could Be Detected And Stored Without Any Issues

It Was Noticed That The Up / Match Or Down / Match Push Buttons Had To Be Held Down For Optimal Functionality To Detect The User's Fingerprint

One Component Was Not Operational Due To Several Factors — Solenoid Lock

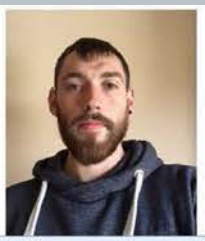
Conclusions

The Project Provided The Opportunity To Showcase The Skills And Knowledge Obtained Through The Electronic & Computer Engineering Course

The Main Objective Of The Project Was A Success — To Showcase The Working Circuitry Of A Biometric Security System

Limiting Factors Of The Project:
- Breadboard Power Supply Limited To Specific Voltage And Current Rating — The More Voltage Applied, The Less Current Provided
- Solenoid Lock Was Not Operational Due To Current Limitations

Automatic Solar Tracker



Introduction

The burning of fossil fuels is an expensive and environmentally dangerous process. There is no surprise in the rapidly increasing popularity of renewable energy and solar panels.
Renewable energy is a form energy that can never run out. Most forms of renewable

Aims

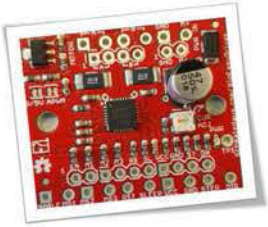
The aim of this project is to use a microcontroller to tilt a solar panel in the exact direction of the sun, to harvest as much energy as possible.

Methodology:

Single Axis vs Dual Axis
There are two different types of solar trackers that could have been chosen for the project, single axis or dual axis.
Single axis has only one direction of movement, along a north-south axis or east-west axis. They can produce up to 30% more electricity than a stationary solar panel.
Dual axis solar panels can move to any point within a 360° rotation and can produce up to 50% more electricity than stationary solar panels. Dual axis stands can also act as a mirror to direct sunlight to a stationary receiver.
A single axis was chosen for the project as it is:

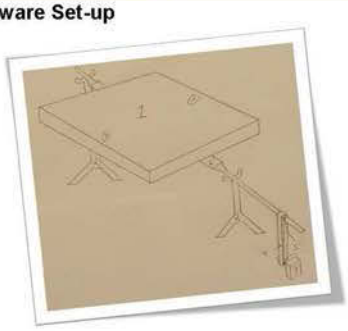
- Less time consuming.
- Less expensive.
- The same required engineering skills.
- Single axis can achieve the aims of the project just as well as a dual axis.

The Big Easy Driver
The big easy driver is a motor driver for bi-polar stepper motors. It is based on the Allegro A4983 stepper driver chip. Big Easy Driver can drive up to 2A per phase and it can take a max motor drive voltage of 35V. It also includes on-board 5V/3.3V regulation, so only one supply is necessary. It is recommended to use a heatsink for loads nearing 2A per phase as this project will operate with roughly 1.5A per phase.

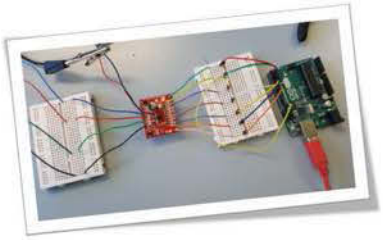


Methodology (Continued):

Hardware Set-up



1. This projects aim is to track the sun as it moves, there is no actual work or connections being doing with a solar panel. Therefore a replica seemed more practical in terms of cost.
2. The stand holds the replica upright and consists of a bearing on each one to allow the bar to twist easily.
3. The stepper motor will be connected to the microcontroller.
4. The motor is connected to a bar, by a belt with grooves that interlock with two pulleys.
5. A pulley on the end of the twisting bar is connected to another pulley on the shaft of the motor to allow the replica to twist in either direction.
6. The replica is stuck to a flat bar with rounded ends so that the pulley can be easily placed on.
7. An LDR on either side of the replica is connected to the Arduino board to determine which side has more light shining on it.



Quality Check

- Quality check is based on the movement of replica with respect to the position of the sun.
- The LDR with the least resistance means it is the LDR receiving the most sun light.
- Code wrote in Arduino handles the reading of LDR's and then controls movement of motors.
- The Arduino reads the LDR's resistance and decides on whether to move the motor or not.

Results:

Conclusions:

- The project provided an opportunity to display skills and knowledge gained from the course in a practical way. Overall the project was a success and was an excellent learning experience.
- The objective to making the solar panel rotate in the direction of the sun was achieved.

The main limiting factor of the project Included:

- The timescale giving to do this project was underestimated.
- Extra research on stepper motors would have improved the final outcome.
- The addition and use of a solar panel could have been added if time permitted.

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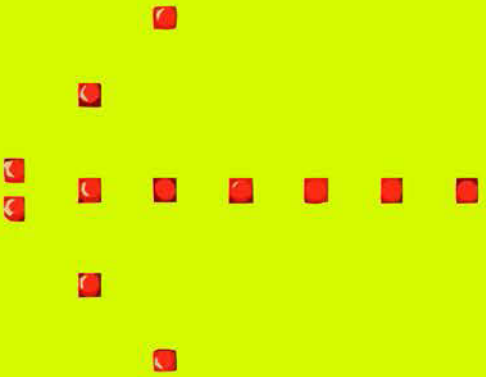
LED turn signal indicator vest



Introduction:

The purpose of this project is to improve the cyclists' safety on Irish roads. While hand signals are mandatory, quite often they are sparsely used by younger generation of cyclists. The red LED arrow(s) would be visible during day or night and controlled remotely by mobile application.

Aims of Study:

To design and build electronic project using the knowledge gained throughout the two-year engineering course.

Eliza Bielewicz / eliza@bielewicz.com / 0870640900 / LinkedIn QR

Methodology:

Research:
- Calculating the power supply needed
- Learning about resistors
- Programing the PIC microcontroller
- Interfacing Bluetooth module with PIC microcontroller

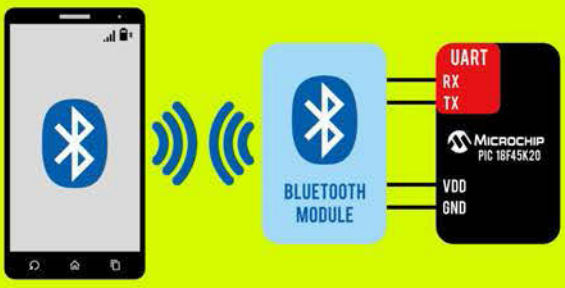
Design/Planning:
- Schematic capture and PCB layout in Proteus
- Software flowchart
- Test plan
- Review available resources
- Decide on components

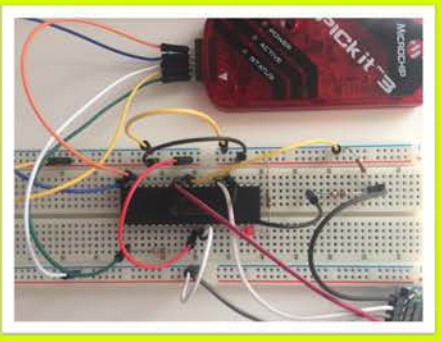
Results:

Design/Planning:
- After reviewing available LEDs solutions, decision was made to go with the LMMR1, a LED waterproof strip. It is very easy to use and has low power consumption (<0.25W per module). The individual modules can be snipped from string and strings can be joined to form long runs.
- Went with HC-05 Bluetooth module over HC-06, due to that version of the model can be either a master or a slave. Therefore, it can initiate a connection to another device, rather than just accept a connection.

Conclusions:

- Great learning experience and opportunity to put into practice everything which was learnt during the engineering course.
- The objective to build LED turn signals remotely controlled by a mobile app was achieved, although not implemented on a vest.
- The issue was with waterproofing the electronic components, so they can be used in any weather conditions by a cyclist.
- Limiting factor was time, budget and resources available.





Introduction

The aim is to use Festo MPS systems for the project. The MPS rig incorporates many elements which were taught throughout the year. An engineer needs to be competent with implementing such a system into an already existing network of tasks. The stations may require specialist knowledge such as plc programming, HMI (Human Machine Interface) configuration, wiring etc.

Methodology

Choosing the stations:

Deciding what stations of the Festo MPS to use was an important factor in the project. The choice of what stations chosen relied on what was needed, what was available for use, and how these stations worked together.

Process:

The process of these two systems is to have them working autonomously with one another with added safety and functionality built in.

Safety:

As within all autonomous systems, safety should be a priority. The safety features within this project were carefully adhered to, to insure that the system met required safety standards and that it would not be harmful to the operator. There are multiple emergency stop buttons integrated into the system always within easy reach for the operator.

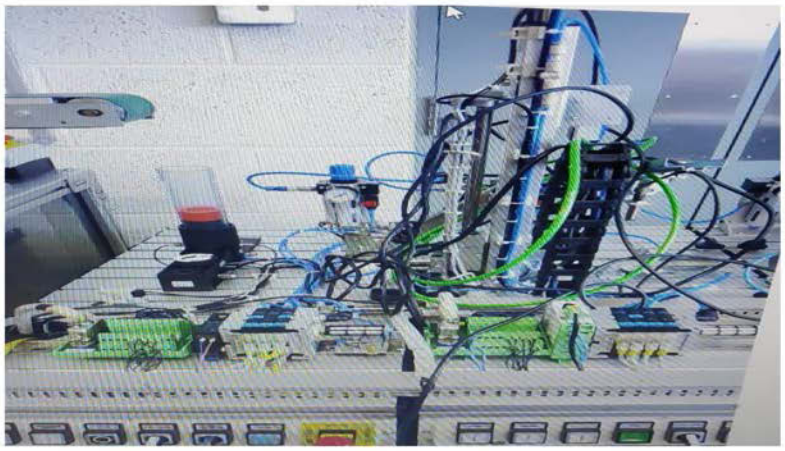
Results

How the stations work:

The distribution station uses multiple components to function autonomously. A PLC (programmable logic controller) is used to control different functions of the task. Pneumatics are used as a means of actuation for the arm and as a vacuum end effector for picking p the product and moving it to the next area.

Conclusion

This Festo MPS systems used for this project were a comprehensive solution to meeting the project brief. Interface lights on the operator panel illuminate showing what needs attention in the system. The programming of this is at the programmer's discretion. Having the information in a clear manner is important for safety as well as diagnosing problems.
Electronic engineering was used in the wiring of many components. These components needed to be correctly wired into the system using certain standards for safety. On the mechanical side, the integration of the moving components was beneficial and the understanding of mounting systems. Pneumatically, the system needed to be securely piped, ensuring no leaks or weak points were in the system.



Motion Detection and Tracking Turret System

Introduction:

My decision to make this project was based on my interest in how tracking and motion systems are designed and how they operate.. The aim of this project was to design and manufacture a turret that can detect and move in the direction of the object that was detected. I tried to keep the design as simple and compact as I possibly could, while also looking clean and aesthetically pleasing.

Aims of Study:

To demonstrate the information learned over the course of my studies in a practical, real world application that can be used in an array of fields.

Methodology:

Research:
My research began by analysing the way in which detection and tracking systems operate and which physical aspects that they use to detect objects. . I broke the process down into two main sections:

1. Object Pattern Matching
2. Colour Pattern Matching

Design/Planning:
My design process involved:
- Selecting required hardware
- Developing a realistic schedule
- Develop project concepts
- Checking availability of resources
- Develop research schedule and plan to execute two sections listed above
- Model my designs in Solidworks

Fabrication of Project:
- All of my parts were fabricated in the General Workshop (GW) in the college
- All of my manufactured parts were made from sheet acrylic plastic (5mm and 3mm) and sheet steel
- Materials were sourced from GW only
- Fabricated parts include my swivel plate, webcam mount, and motor mount

LabVIEW/Control:
- Object pattern matching inputted by user in LabVIEW
- Create template of object the user wishes to detect/track
- Create colour pattern matching template using a screengrab of the object that the user wishes to track
- Write program within LabVIEW to control DC motor
- Test program and trouble shoot if necessary

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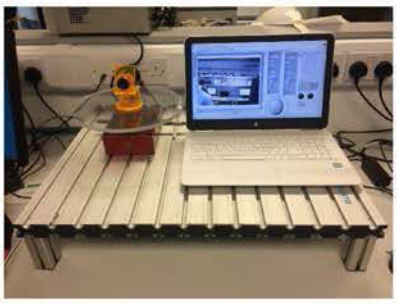
Methodology (Continued):

Quality Checking:
- Check that webcam is operating correctly
- Analyse program to ensure object tracking is as the user specified.
- Ensure surrounding lighting isn't hindering tracking results
- Ensure NI myDAQ is powering the DC Motor efficiently

Safety:
There was not much need for strict safety precautions in relation to the hardware operation of this project as it operates at a low voltage, but there is a stop button within the LabVIEW program which will stop the entire program if necessary

Results:



Design/Planning:
After analysing all of my designs, I decided to go with the above design. It comprised of the following the following program functions:
- Set object template as shown on image from camera
- Set colour matching template from image from camera
- Reset the Boolean switches and LED's on the front panel
- Run the program
- Control the direction of the motor controlling the plate which will determine direction of camera for tracking
- Stop the program once the object is tracked as the user desired

Results (Continued):

Fabrication:
- 100% of fabrication was completed in GW
- Industrial standard components and materials were used throughout
- Standard 24V DC Motor was used to control plate for camera
- Camera mount was made using laser cutting from a Solidworks drawing in the GW and bent using a strip heater to required angles.

Conclusions:

- This project provided an opportunity to display skills and knowledge gained from the course in a practical way. Overall the project was a success and was an excellent learning experience.
- The objective to automate a motion detection turret was achieved
- The project schedule ran according to plan

Pick and Place Robot with Machine Vision

Introduction

Pick and Place robots are widely used in various industries thought the globe. Many industrial and pharmaceutical companies are investing in robotic labour over manual labour for the reason of profit and production.

Pick and Place robots mostly rely on pre-set coordination points for objects when used adjacent to production lines, when used along a vision system such robot would be able to detect objects thought the line.

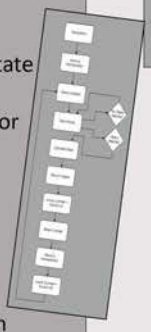
Aim

The aim of the project was to design and build a prototype machine which uses both robotics and machine vision in order to create a Pick and Place robot which can be fitted aside a conveyor belt to pick pieces form it and place in a designated area.

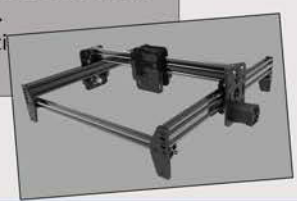
Methodology

Research:
The research began with learning about various types of robots used for pick and place work. The next step was to learn about Machine Vision and how it can aid a robot locating an object.

Design/Planning:
- Selecting a robot type
- Developing initial concepts
- Producing a flowchart for a state machine
- Developing wiring diagrams for electronic components
- Developing a pneumatic
- diagram

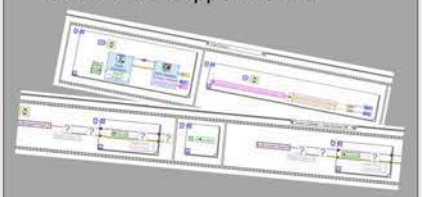


Build:
- Assembly of the ACRO system
- Wiring of limit switches in order to mark home position
- Wiring of stepper motors to drivers and the DAQ board.
- Setting up pneumati
  the ARCO system



Methodology(Continued)

Software:
- LabVIEW machine vision system for detecting object
- Calculating steps using the coordinates of the object
- Outputs going out of the DAQ board to move the stepper motors.



HMI/Control:
- Pressure gauge for airflow control
- NI-IMAQ image acquisition displaying the Region of Interest(ROI) in the HMI
- HMI displaying if it detected an object

Safety:
- The machine will only operate if the operator pressed the power switch and move if it only detects an object
- An emergency switch that will stop the machine

Results

Upon a successful build with every I/O connected to the DAQ board the machine proved to work just as it was designed.

The HMI displayed the object as well as the initial coordinates of the object on the ROI. The ARCO system was reaching the object without any major problems and the pneumatics system was able to pick up the object

Conclusion

The work on this project provided an opportunity to display the skills and knowledge gained in a practical way. The prototype machine has accomplished the aim of the project.

If more time was given the ROI could been made into a convertor belt which moved and stopped if an object was detected.

Contact

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REAL TIME CLOCK

Nikodem Kazmierczak
Student of the School of Engineering and Design department on IT Sligo
L7 BEng Electronic & Computer Engineering

INTRODUCTION

The clock is a widely available device, designed to inform us about the exact time and date. For displaying time, most digital clocks use seven-segment displays or LCD.
The main goal of this project was to create an electronic clock from scratch, which will be displayed current time and date.

AIM OF THE STUDY

Studying at level 7 of the BEng Engineering and Design I have the knowledge of the Microcontroller Architecture, Embedded system, and System Design. This basic information about the structure of the electronic devices, principles of their connection or construction of the C code is sufficient to create the first project.

METHODS

Research:
At this stage, I can consider what project would be suitable for me, that I can build using acquired knowledge. The idea of creating an RTC was come up during a joint discussion together with my lecturer.

Literature Review:
The source for inspiration when choosing first project was the Internet, thematic books and the advice of an experienced person. As the example is Dogan Ibrahim's book "PIC Microcontroller Projects in C - Basic to Advanced", which was my main basic source.
This book contains many valuable tips for many projects.

Ethical Considerations
Working on a project, I was following all rules - both ethical and health and safety. It is important that the project will not be used for the wrong purpose, for example against another person. The project was made to facilitate life, meet the needs of the recipient, meet all standards and be safe in use.

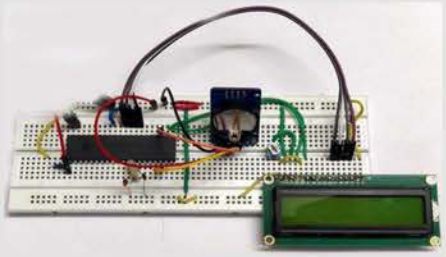
Design;
To create the project a carefully designed plan has been developed. It contained technical drawings, diagrams, and list of components. The initial cost of the project was estimated and then the necessary components were purchased. Afterwards, all components have been tested for correct operation.

METHODS (continued)

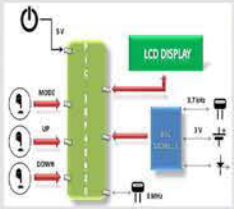
List Of The Components:

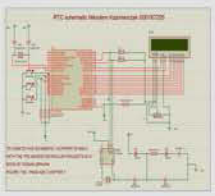
- LCD display
- PIC18F45k22
- Crystal Oscillators: 8Mhz and 32.7 kHz (attached to RTC module)
- 4 Capacitors: 22pF and 100nF
- 4 10k Resistors
- 3 1k Resistors
- 3 Push Buttons
- DS1302 RTC Module
- 2 LED Diodes
- Power supply: 3V battery (included to RTC) and 5V AC/DC

Tests:
The diagram is necessary to create the target design circuit. This allowed me to accurately plan the diagram, the correct connection of the circuit and its correct operation. For this purpose, the Proteus Professional program was used. Virtual components have been connected according to the scheme. Then the program was implemented into a virtual project.

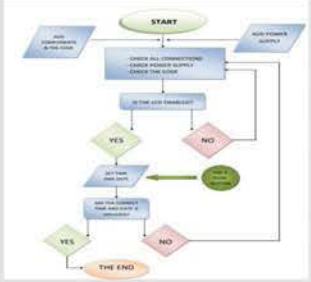


Block Diagram & Flowchart:
The diagram illustrates the basic layout of the project - its construction and how components are connected to each other.





The block diagram allows to view the basic stages of the steps, and the logical relationship between them. This diagram presents the procedure, system and program that are represented by the geometrical figures described related to vectors according to the order in which actions are carried out resulting from the adopted task solution algorithm.



RESULTS

Connection of Components:
All necessary components have been connected with short wires on the "white board", according to the technical drawing. The power source is 3 x AA batteries, which gives a total of 4.5V.

The program was created in the **MPLAB-X8** compiler and then uploaded via **PICkit 3** to the microcontroller. The program contains:
- interrupts mode, to activate switch buttons
- RTC and I2C activation code
- main body, contains code lines that control the entire program

RTC module based on the 8 MHz oscillator, generates precise time and date, which are displayed on the LCD.
With three buttons can be set or modify the exact time (Set, Up, Down).
RTC module has its own 3V battery power source, which has a very long life. In the moment of cutting the main power source, our module continues to operate.

CONCLUSIONS

The main goal of the project was to test theoretical and practical knowledge in the field of Automation, Electronics, and Computerisation. During the creation and implementation of the project I had the opportunity to deepen my knowledge in this field. The final result is a fully operational RTC clock. Each implementation was closely monitored, so as not to cause an error.
All preparation, research and problem solving at every stage of work allowed me to deepen my technical skills; I learned to use different resources and materials gathered during my studies. While writing the program, I have expanded my knowledge of C ++ language.

NOTE: This project should be safe to use and should to be used for training purposes only - under no circumstances should not be used against ethical principles.

Scan me

Home Automation System

Introduction:

Home Automation is now becoming increasingly popular around the world with the integration of smart devices into the home. Devices such as heating, security systems, lighting and household appliances like the fridge or kettle can now all be monitored and controlled over a home network or from the cloud.

Aim:

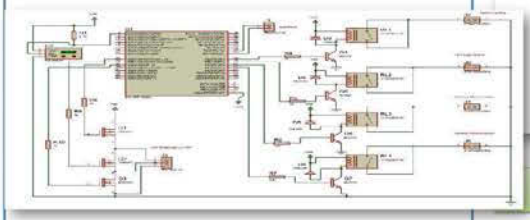
The aim of the project is to showcase some of this control using the ***PIC18F microcontroller*** and the ***ESP8266 Wifi module***.

The PIC controls each of the devices and the ESP8266 Wi-Fi module is used to connect the PIC to the home network.

The devices can be activated using voice commands through the Amazon Alexa Smart Speaker and also through a custom web app.

Methodology:

Research
Research comprised of deciding on what components were needed to complete the project and how the PIC was going to be connected to the Internet and controlled via an app and by the smart Speaker. Once this was established the design and planning phase commenced.



Design and Planning

Design and planning consisted of 5 phases:

1. Block Diagram
Block diagram was drawn up to kick off the project. With the PIC as the central point of the project all inputs and outputs were added to the diagram around it. It gave a clear starting platform to work from.

2. Gantt Chart
Gantt Chart was drawn up to keep track of the project timeline.
The project was given 32 weeks for completion

3. Schematic and PCB design
Using Proteus PCB design software the Schematic and PCB design were drawn up with components decided upon during the research and design stages.

Methodology (Continued):

4. Software Flowchart
The software flowchart consisted of setting out the flow of software from initialisation to every possible command execution. This ensured there was a clear path to follow in the writing of the code.

5. Test Plan
Final part of the design and planning phase was to draw up the test plan for the system for when the build was complete. This consisted of various tests on the system to ensure it meets its design specification.

Results:

ESP Wifi Module Control:

- The ESP was programmed using ***Arduino IDE***.
- It was programmed to connect the system to the home network using ***Async TCP protocol.***

- *The device is then paired with the **Amazon Alexa** and waits for any voice commands*
- When voice commands are received it send it to the PIC through serial communication. The PIC then carries out the commands

Results (Continued):

The ESP module can also act as a small webserver so a web app was created to control the various devices which can also be controlled remotely. The app UI was designed using basic html and uses http requests to send commands back to the esp module.

- The PIC was programmed using ***MPLAB IDE.***
- Three outputs Pins were programmed to control the colours of the LED.
- Different colour schemes can be created by altering the voltage to the Pins through Pulse Width Modulation on the pins
- Two output Pins were programmed for the window blinds up/down motion. The motor is connected to a two-way relay. One relay is used for the up motion and the other for down.

- One output Pin was programmed for heating control. This is controlled using a relay with on/off functions.
- One input Pin was programmed for the ***DS18B20 temperature sensor***. This is used to monitor the room temperature and turn on/off the heating relay if not within specified limits

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Automated staircase lighting using piezoelectric sensors

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Introduction:

The goal of this project is to design and build a device that automates switching of the LED lights attached alongside the staircase. Most of the existing solutions use infrared sensors located on either end of the stairs to detect a person. There are some downsides to this method:

- You can lift your feet above the sensor preventing it from triggering.
- Harsh sunlight or sources of heat, like radiators can affect sensing

The commonly used LED strips allow only for a single colour to be selected for the entire length.
My solution uses multiple piezoelectric sensors to detect small vibrations of the staircase when in use. LED strip selected for this project utilises individually addressable LEDs which can be animated. With these two components it should be possible to estimate persons location after each step was taken and create effects like a short section of light following a person or LEDs pulsing with every step.

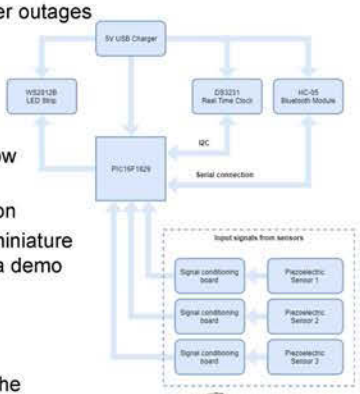
Methodology:

Planning:
During the planning stage, the base requirements for the system were determined:

- Powered from a regular micro USB socket commonly used in mobile phone chargers.
- Modes of operation selected wirelessly using a mobile phone
- Option to schedule different modes depending on the time of the day or date
- Accurate time tracking not affected by power outages

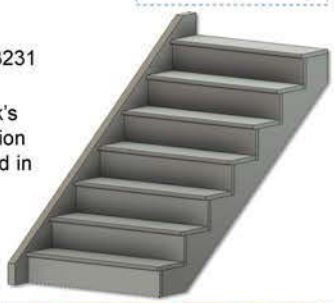
The design process was divided into stages:

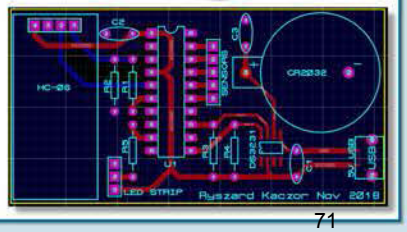
- Development of the project schedule (Gantt Chart)
- Component selection and ordering
- Drafting of a block diagram representing how modules are connected
- Electrical schematic and PCB layout creation
- Design and Build of a wooden model of a miniature staircase to be used during testing and as a demo
- Android application development
- Microcontroller firmware development



Design:

- HC-06 Bluetooth module was selected for the wireless communication
- Time tracking was achieved by the use of DS3231 RTC which provides a build in battery support
- Staircase 3D model was designed in Autodesk's Fusion 360. This allowed for a quick visualisation to avoid any mistakes before attempting a build in real life.
- Wooden model was built out of good quality plywood
- To allow for easier soldering by hand, surface mount components were avoided with the exception of the Real Time Clock and the USB socket which weren't available in other packages
- Because of the amount of LEDs used, the current draw can be quite high, so the PCBs were fabricated with 2oz copper layer thickness.





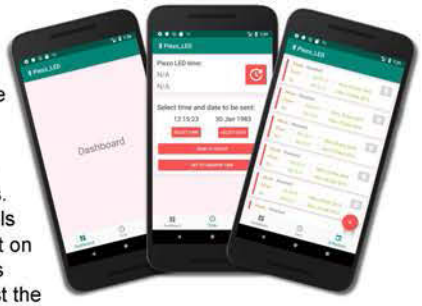
Results:

Device:

- PCB design was submitted to a professional manufacturer in China
- Staircase miniature model was built first as it was later used during programming stage for testing which speed up the process
- Code written for the LED had to be fast and efficient. Control signal has very strict timing requirements.
- It is controlled by bit banging 3 Bytes of data representing RGB values into the first LED. When another set of 3 Bytes is sent, the data stored in the first LED is shifted to the next.
- The biggest constraint was the maximum time of 500ns for the 0-bit pulse which on a 16MHz microcontroller is only 8 cycles.
- To remove any unnecessary conditional logic that could affect the timings an array of RGB values for all LEDs is created in RAM prior to sending it to the strip.
- During bit banging process all interrupts are being disabled

- DS3231 RTC uses I2C serial communication for setting and reading the time
- Bluetooth module communicates with the microcontroller over USART port
- Basic transmission protocol was designed to allow sending commands to the device from a mobile phone application

Android Application:



Consists of 3 screens. First is the dashboard which allows for manual control of the LED colours and modes. Second one controls the current time set on the device and was implemented to test the scheduler. By manually setting the time, you can trigger the previously created events. Last screen is used to add new events to the schedule. It allows to select 'From' and 'To' time and a mode of operation. Bluetooth connection status is displayed in the top bar and the application connects to the device automatically once paired.

Conclusions:

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TBD

Autonomous Crash and Alerting System

Introduction

The aim of this project was to build a prototype Autonomous car theft and crash reporting system which can be integrated in a vehicle. In the event of a crash or road traffic accident, the speed of the response of aid is a critical factor, hugely impacting the outcome.

Aims

- Develop an operational prototype
- Integrate multiple components
- Write C programme to control all peripheral devices

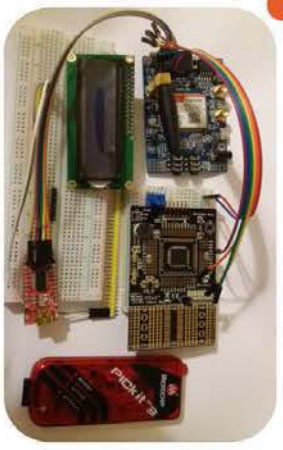
Operation

The Accelerometer was programmed to detect an impact by specifying certain parameters. Once detected, a 30 second interval allows for the driver to disable the alert in the event there is no need to send notification. If the alert is not answered then a notification is sent to pre-programmed numbers, along with GPS co-ordinates.

Location

The Global Positioning System (GPS) has global coverage and data is accurate to 10 metres. Information may be obtained about an objects location, direction of travel, GMT etc. In the event of an incident or in the event of a theft, reliable GPS co-ordinates are crucial.

Prototype



Safety

In Ireland, within the first six months of 2018, 65% of fatal accidents occurred on rural roads. Of the 78 fatalities on Irish roads over those 6 months, 29 of those occurred between the hours of midnight and 10am. This design would be specifically beneficial to those incidents occurring on rural roads during that period of time.

Project Build

The prototype itself is based around a PIC microcontroller (18f45k20), integrated with an ADXL 345 accelerometer for impact detection, a SIM808 GSM/GPS unit for communications, and an LCD display for viewing system status

Security

A secondary function of the system is as a location tracker in the event of vehicle theft. An SMS command sent to the unit returns its current GPS location

Data Analysis

With the consent of the user, data gathered by multiple systems could be analysed to determine patterns or trends of incidents: locations, time of day, driver information ,vehicle types, weather etc.

Trends in location could be used to increase safety measures on roads, and influence road and car design

Project Designer

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Automated Fertiliser Spreader

IT Sligo
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Engineering

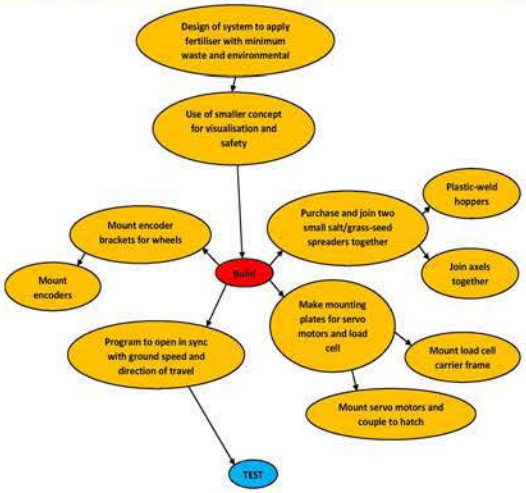
INTRODUCTION

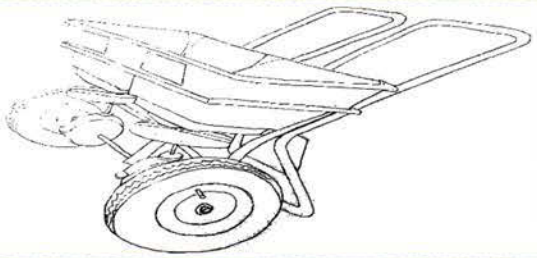
- Accurate delivery of the correct amount of fertiliser as the machine is turning.
- Environmentally safe application of fertiliser.
- Cost efficient method of spreading fertiliser.
- Constant weight monitoring of hopper contents in Kg's.

AIM

To demonstrate/implement controlled application off fertiliser on a small scale.

METHODOLOGY





METHODOLOGY (CONTINUED)

Design/Planning/solid-works:

The design was influenced on what is mostly used in the farming industry, double hopper with twin spinners.

Fabrication:

The fabrication mainly took place in the Engineering Workshop. Fabrication mostly consisted of cutting and joining two small salt/ grass-seed hoppers together, making brackets and a frame for the load cell, servo motors and encoders.

Control:

- MyRio gives an interface between the encoders, load cell and servo drives.

- Servo motors are controlled by PWM to operate simultaneously.

METHODOLOGY (CONTINUED)

LabVIEW computer programme to control the servo motors.

- Encoders relay a signal back to the programme as to the position of the wheels.

HMI:

- NI MYDAQ transmits reading from Encoders to LabVIEW VI which decides the position of the wheels and its speed.
- The Load cell also transmits the volume of fertiliser within the hoppers.
- The HMI displays both of the hoppers fertiliser load and the rate at which it is emptying at.
- The HMI also displays the path to travel on with the next run.

RESULTS

Safety:

In all aspects of engineering safety is Paramount, so our system is designed with:

- Operation through HMI
- E-stop incorporated on machine to stop operation of motors.
- Lightweight to avoid injuries.

With the operation of a full scale machine, safety involved would be:

- Overall machine operator knowledge and competency
- PTO shaft safety
- Staying away from suspended bags when loading hopper

CONCLUSION

- To build a working design that carries the basic concept.
- Capable of been further developed to full scale operation.
- Further develop GPS directional control.
- Ensuring that all environmental and safety factors are maintained to a high standard.

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An Institiúid Teicneolaíochta, Sligeach
BEng in Mechatronics

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Exoplanet detection using Convolutional Neural Network analysis of Kepler telescope data.

Leonard Kiersey
BEng Electronic Engineering - Year 4 Project

Introduction

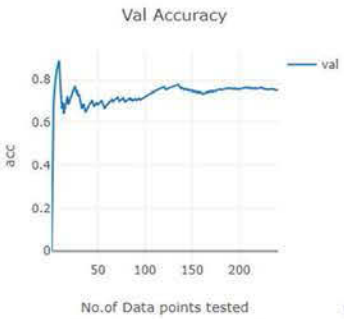
Over the last 9 years, the Kepler space telescope has monitored thousands of stars for the presence of exoplanets. The light flux from the stars is analysed for periodic dips in intensity that last for a fixed length of time, which may indicate a planet orbiting in front of the star. The analysis of this data is quite labour intensive and open to misinterpretation and human error.

The aim of the project was to design and train a convolutional neural network that can analyse data from the Kepler space telescope and predict whether an orbiting Exoplanet exists around a star, thereby eliminating a bulk of the human workload. In order to create this project it was necessary to research the current methods of exoplanet detection, as well as researching the fundamentals of convolutional neural networks, and how they are trained.

Method

A training data set was created using light curves that contain known exoplanets and light curves with known false positives. The training data was split into three groups. A training group, a validation group and a test group. This training group was then used to train a convolutional neural network or CNN. The CNN learns the features that describe the presence of a an orbiting exoplanet from the light curve. The validation group was used to ensure the network was training properly, and finally the test group was used to determine the accuracy of the network to unseen data. The trained network can then be fed data from the Kepler data repository that it hasn't seen before and predict whether there is a planet present or not..

If a planet is detected it will then try and predict the orbital period of the planet and plot the associated light curve for this transit.
The CNN was trained over 32 Epochs and achieved a 77% accuracy.



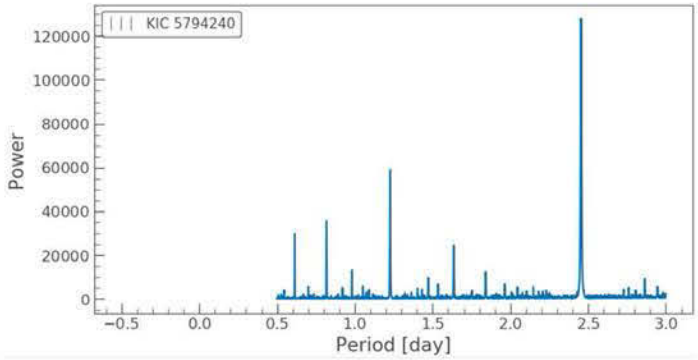
CNN Accuracy result

Results

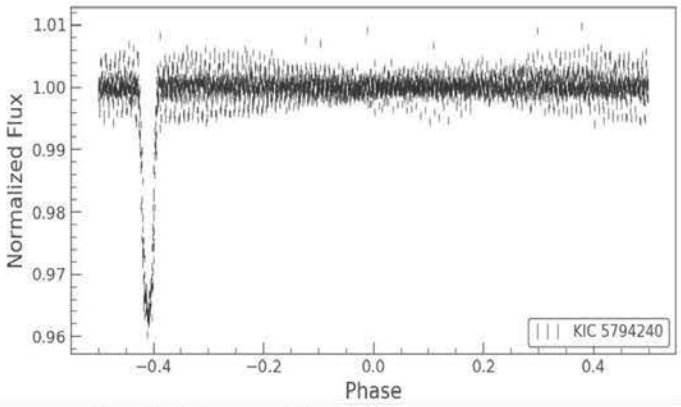
During testing 10 Kepler objects of interested where tested 5 known planet candidates and 5 known false positives. The CNN was 80% accurate in predicting whether a planet was present but only 20% accurate n predicting the correct orbital period. This was most likely caused by incorrectly determining the initial parameters for the algorithm during testing. CNN correctly predicted the presence of an exoplanet with an orbital period of 2.45 days on Kepler-45

```
Data downloaded
Cleaning and normalising data
Data Normalised
Prediction in progress
Potential Exoplanet found within object:Kepler-45
Best Fit Period: 2.4550 days
```

CNN prediction



Orbital period prediction of Kepler-45



Transit light curve of Kepler-45

Conclusions

The project was designed to predict the presence of exoplanets from the Kepler space telescope data. It was successful in doing this with an accuracy of 77%. I would like to improve on this accuracy by re-training the network and tweaking the hyper-parameters until a satisfactory accuracy could be achieved. I would also like to improve on the orbital period prediction algorithm so that I can get a more robust result that has a much better accuracy than established in testing.

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FIRE FIGHTING ROBOT USING LABVIEW

B.Eng. Mechatronics Engineering L7,Year 3

1 Introduction

The purpose of this project is to integrate a fire fighting system to tackle the dangers involved with humans going into burning buildings to extinguish fires and save lives. The objectives of this project are that by examining different technology already in place and using the knowledge gained to design a practical project. A rover 5 chassis with different hardware elements such as an extinguishing system and a USB camera along with software elements being controlled using NI SCB-68 and LabVIEW the popular graphic programming environment to implement this project, in order to test, measure and control the system.

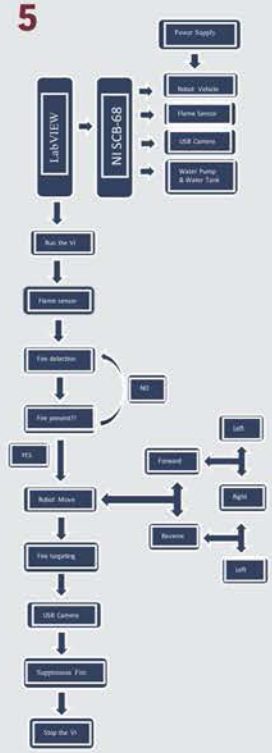
2 PROJECT AIMS

- To elimination of fire before it spread away will avoid catastrophic effects. (If each building has the Fire Fighting Robot)
- To take the firefighters out of the situation of having to put themselves into dangers in order to extinguish fires and save lives. This saves the firefighters from death, injury and physiological issues.

3 Design Process

- Run the LabVIEW VI.
- The flame sensor starts to detect the fire.
- The fire fighter robot starts to move.
- The USB camera views the current location.
- The robot rotates in clockwise or counter clockwise until the fire is located.
- Extinguish the fire after its detected using the water tank and water pump that loaded onto the vehicle.
- The robot stops (The VI stop running), after the required mission is completed.

5

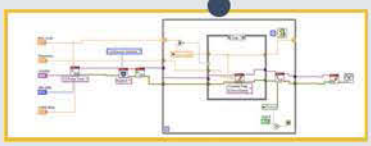


Digital Output Signals

As regards to the robotic vehicle, there are four DC motors, two sides where each side is controlled by one digital output. In that, created a VI to control the motors direction to run in forward or reverse, clockwise or counter clockwise dependent on the power supply pass through each motor (0V or 9V) in another word, if the switch ON/OFF

PWM

Pulse Width Modulation (PWM) is a technique in which a series of digital pulses is used to control an analog circuit. The length and frequency of these pulses determines the total power delivered to the circuit. PWM signals are most commonly used to control DC motors, but have many other applications ranging from controlling valves or pumps to adjusting the brightness of an LED. In this project used PWM signals to generated a digital signal, using counters or digital output lines. In that, used DAQmx functions in order to program PWM (Pulse Width Modulation) in LabVIEW. The LabVIEW graphical development environment, combined with NI-DAQmx, to get the tools needed to easily construct applications using counters to generate PWM signals.



LabVIEW

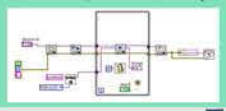
LabVIEW is a software development environment created by National Instruments. Originally it was focused on taking measurements from various lab instruments, but it's expanded drastically from its inception. Strictly speaking, LabVIEW is not a coding language, it's a development environment. LabVIEW is a graphical programming. Program is created using graphical notations other than text-based programming as in C, C++, or Java. Graphical programming eliminates a lot of the syntactical details associated with text-based languages. It allows the programmer to concentrate on the flow of data within the application since its simple syntax does not obscure what the program is doing.

Flame Sensor

The flame sensor is used for this project has 5-channels (5-sensors), in that created a VI to control one channel for all lines by used DAQmx functions. After that connected the data output to case structure in order to control the different angles for each sensor where this flame sensor detect the fire in the range > 120°.

USB Camera

NI-IMAQ for USB Cameras driver software allows users to configure any DirectShow imaging device and acquire images into LabVIEW. Devices that support this feature include USB cameras, webcams, microscopes, scanners, and many consumer-grade imaging products. IMAQ Vision for LabVIEW is an image processing and analysis library consisting of more than 400 VIs. IMAQ Vision for LabVIEW is required to use the NI-IMAQ for USB Cameras VI library.



6 Testing

Hardware

Rover 5 chassis
The Rover 5 Chassis was a good model rover to pick as the tracks had come with it, tracks were essential to the project as the robot built had to be able to turn on the spot, which would have been a lot more difficult without the tracks.

Flame sensor
Used 5-channel flame sensor was helpful where the detection range is greater than 120 ° which allowed to detect the fire faster.

USB camera
Used of the camera to detect the flame was a massive success as it could not only be used to detect fires but also be used to find the direction in which the extinguisher is to be pointed.

Driver PCB
Because of was Designed originally for the Rover 5 chassis, in that was easy to deal with.

Water Tank and Water Pump
The pump works properly as was required.

Software

LabVIEW
The VI works well, the Flat Sequence was used in the block diagram, make the program easy to follow and understand. The vision system works properly, where from the image in the front panel, the user can follow the location of the robot vehicle when its moving and looking for the fire to detect it through the flame sensor.

4 Programming

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7 Conclusion

Upon completion of the Fire & Suppression Unit is that it completed all of its objectives, therefore it can be considered a success. The design and build of the project were executed well, although some difficulties were met, with problem solving and trial and error testing these difficulties were overcome.

Smart Mirror

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Introduction:

The aim of this project was to design and build a smart mirror to manage information flow and also to provide information accessibility to those with disabilities .

In modern society information overload is a real problem, from we wake until we go to sleep we are bombarded with information from a plither of devices and sources across the web and TV's.

On the flip side the advances in technology have left large portions of society behind. This mirror presents the user with relevant information on a screen disguised as a mirror in a sleek manner and provides the ability to interact with it using gesture and voice commands.

Methodology:

Research:

After investigation it was decided the best method to create a information management system that could be displayed on a screen was to use a Raspberry Pi mini computer to drive the screen via HDMI.

A Raspberry Pi 3 B+ was chosen as it is the most powerful of these devices.

It boosts a 1.4 GHz 64-bit Quad-Core Processor, 1 GB RAM, Dual Band 2.4GHz and 5GHz IEEE 802.11.b/g/n/ac Wireless LAN and Enhanced Ethernet Performance via the ethernet port.

With a built in HDMI port the Pi is ideal for this project.

Next the software development application suit was chosen, using the following software, libraries and API's to develop the project:

1. Raspbian 4.14 OS.
2. Python programming language.
3. Flask microframework.
4. HTML to develop the GUI.
5. Darksky API for the weather.
6. Google API's for real time traffic, Calendar, Geocoding and Speech-to-text.

Design/Planning:

The design process involved:

1. Design the GUI layout as shown below
2. Deciding an approach to achieve each goal.
3. Setting out the software in a modular approach so each element can be programmed and tested individually.
4. Generate a Flow Chart to help with the programming.
5. Designing a frame for the mirror to hang it on the wall.

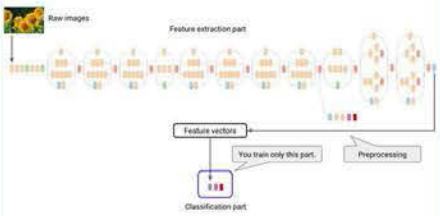
The GUI was designed to show the useful information on the left and right hand side of the screen and the news headlines appear in a bottom of the screen. The center block is generally clear and used for custom calls such as 7 day weather forecast etc.

Methodology(continued):

Programming:

The Programming of the project was done using the Pycharm IDE Software, Pycharm is an IDE specifically for Python. The following steps were taken.

1. Develope the main application (app.py) this creates the view functions for the index and settings page.
2. Develop the template HTML pages to display the information.
3. Develop the Helpers to collect the data from the various API calls and deal with Calendar calls and the configuration page.
4. Develop the JavaScript files which handle the asynchronous updates page changes, time, weather etc..
5. Develop the static files CSS Styling, Images, Weather icons etc.
6. Using the speech to text API from Google the speech.py module was developed so the mirror can respond to custom voice commands.
7. Modern image recognition models have millions of parameters. Training them from scratch requires a lot of labeled training data and a lot of computing power (hundreds of GPU-hours or more). Transfer Learning is a technique that shortcuts much of this by taking a piece of a model that has already been trained on a related task and reusing it in a new model. This was done using datasets available online to recognise sign language hand spelling. This made it possible to add hand gesture custom commands.



Design and development:

The original design intent used the python GUI library Tkinter as the main approach to building the project, Tkinter had limitations around the size of the display due to the way it packs (pack()) the different containers/frames this made it hard to keep a consistent size for the GUI.

Tkinter also doesn't support the display of web pages this would have seriously reduced the flexibility of the Mirror so it was decided to move towards a more web based application and use Flask.

The Raspbian image was written to the micro SD card using etcher and the Raspberry Pi was setup. The Pi has the Google open source web browser Chromium running on it which is used as the web server.

The mirror has a frame around it so it blends into its surroundings and looks more like furniture.

Design/Dev & Results:

The Mirror can be configure for any location for News by inputting the country code (ie FR for France, UK for the United Kingdom, IE for Ireland, US for the United States of America etc)

The Weather location can also be input in the settings menu by simply inputting a location such as Portland Oregon, USA or Queenstown, New Zealand etc. as seen below and selecting the preferred units SI or US for metric or imperial.

The Settings page also allows for 2 custom routes for live traffic which can be configured as needed.

The settings page also has the containers for the API keys.

Results:

The result is a sleek application that runs on the raspberry with little memory.

The application itself (the entire folder) takes up a minimal amount of memory (in the region of 1KB)

As can be seen from the screen below the display is sharp and clear.

The speech and gesture commands work well.

Conclusion:

- This project provided an opportunity to work on software development skills and give great insight into the flexibility of Python.
- Overall the project was a success and the objectives were achieved albeit with limitations.

Further work:

The project could be greatly improved with the development of sign language translation and/or a better trained model.

Unfortunately time did not permit more development in this area, also it wasn't feasible to add a braille interface in the time available.

The Raspberry Pi 3 B+ starter kit which include the Pi, the case, a power supply, a HDMI lead and the 32GB SD card shown below

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