

# Proposal

*by* Nathan Evans

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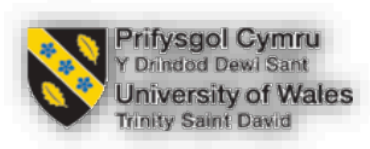
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***Evidence Provided***  
***Development of a smart irrigation system***



***Nathan Evans***  
**Electrical and Electronic Engineering / Final year Project Proposal**  
***Submitted to: Seena Joseph / Gaynor Thomas***  
***UWTSD – Waterfront Campus***  
***27/10/24***

## ***Development of a smart irrigation system***

### ***Contents Page:***

The following report will demonstrate competence in the following areas.

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*The work of this report completed under the supervision of (Seena Joseph). I declare that this report is the product of my own work and is not being submitted for any other degree.*

*N. Evans*

## ***Final Year Project Proposal***

### ***Introduction to Project***

As the world advances into a digital era, the need grows for up-to-date modern agricultural devices which assist farmers and those in the industry. Building a device that allows farmers to manage their field irrigation levels allows for a sustainable practise. The primary aim of this project is to design, build and implement a comprehensive automated smart agricultural system which primarily targets the farming industry, but will also cater to gardening enthusiasts and domestic users. The system will be comprised of various sensors to monitor soil irrigation levels, pest control and crop level all leading into a Pic microcontroller which will perform a variety of commands, all which will be dependent on the information it is receiving from the sensors. Alongside this, the device will also be WI-FI compatible, receiving data such as the weather forecast and air temperature from online sources and the displaying it to the user. It aims to reduce the overall costs that come with manual irrigation, and pest control such as labour costs, enhancing crop growth by making sure the plants get the right amount of water when they need it. The project also aims to tackle the ever-growing issue of water usage in agriculture thus being how much is used as a whole and how much is wasted within the sector.

## ***Background to the project / Research problem statement***

Having an understanding to any problem means that the problem is 50% solved. The main issues that are to be addressed are, water conservation, pest control and optimised crop growth. Water is a vital resource used in all areas of the world. In the agricultural sector, water supplies have come under threat in recent years for a number reasons, those primarily being, increased world population meaning more demand on water supplies and climate change which creates water scarcity. A direct outcome of climate change equates to rising temperatures, which disrupt precipitation pattern, including the water cycle [1].

Alongside water usage, food production rates have increased up over the past 25 years. The abstract of this reference states "food production has grown at 2.8% per year due to the application of better crop production techniques.",[2] meaning that water usage has seen a corresponding level of increase and will continue to do so in the coming years.

The FAO have estimated that the global food industry will have to increase their production by 60% by 2050 as of their 2012 reports. [3] States these figures and discusses them further.

These issues are closely linked to each other as a rapidly increasing rate of food production directly correlates to an increased level of water usage as there are no alternatives that farmers can use for their crops to grow. In many cases, irrigation has been subjected to manual and scheduled times, this isn't optimal for crop grow as weather can also affect the moisture levels of the soil. Both methods entail both over and under irrigation which leads to water wastage. [4] Discusses the importance of water in agriculture.

Alongside water wastage deterioration of soil quality. Another negative effect these methods can have, is fertilisers leaching to the water. All these side effect ultimately led to a reduction of crop yield which highlights a flaw in the irrigation system as poor crop yield is a worldwide issue. [5] stated in 2009 " yields appear to be at or near 80% of yield potential, with no evidence for yields having exceeded this threshold to date." [6] Also provides information on environmental factors affecting crop yields.

A promising approach that combines technology and data analytics to better control water delivery is automated irrigation systems. According to earlier studies, irrigation efficiency may be greatly increased by combining automated control systems with sensors to measure soil moisture levels[7] Provides an in-depth analysis of this stating some methods can reduce water and energy consumption. This research was conducting in China. Research indicates that these systems can preserve or increase crop yields while consuming less water than traditional techniques.[8] Provides statistics on the matter This research leads the project into its development stage.

The 'brains' of the project will undoubtedly be A Microcontroller. A PIC will be flexible option for irrigation process automation is offered by the integration of microcontrollers.

These can interface with a variety of sensors and are inexpensive and are simple to program. The automated irrigation system will use a PIC microcontroller to precisely control watering schedules based on real-time data, allowing it to adjust to shifting weather patterns and soil conditions.

In conclusion, by developing a comprehensive solution that integrates real-time monitoring, microcontroller technology, and user-friendly interfaces, the proposed research seeks to expand on the body of information already available on automated irrigation systems.

In addition to this, the project aims to create a more sustainable farming practise creating an ecofriendly solution.

## ***Research problem statement***

By creating a smart irrigation system, the project aims to solve the urgent demand for an affordable, effective, and easily accessible irrigation solution. Based on crop needs and soil condition, while also combating other imperfections that other competitors have such as pest counter measures and the addition of real time weather forecast monitoring.

This system will optimise water utilisation using automated water distribution, real-time soil moisture monitoring, and data logging from external sources such as predicted weather forecast from the internet. This smart irrigation system will help cut down on water wastage, save operating costs, and enhance sustainability in farming practices by putting into practice a responsive, data-driven strategy.

To conclude, the project statement is: ***How can the development of a smart irrigation system incorporate a variety of features to combat ever growing issues around the globe?***

## ***Research aim and objectives***

- Design a comprehensive and reliable soil moisture monitoring system
  - Research different moisture level sensors and incorporate the most suitable option
  - Connect the sensor to a suitable microcontroller to record and output data to perform specific tasks
  - Perform multiple tests on with different moisture levels to ensure to the sensor is calibrated for the task
- Develop a pest control measures
  - Research eco friendly pest control measures and ones that are best suited for the kinds of crops that will be tested
  - Develop a schedule for the pest control to be disbursed using a microcontroller to communicate with the dispenser, using inputted data to perform functions, such as dispensing and when to dispense
- Incorporate external data reading methods to enhance system effectiveness
  - Incorporate a Wi-Fi module which will read data such as weather forecasts to make a informed decision on when to irrigate the soil
- Analyse the Impact of the smart irrigation system and how effective it is in water conservation and crop productivity and costs
  - Compare the water conservation of my system and similar competitors, specifically systems that run off a scheduled basis
  - Analyse the physical costs of the water consumption of both systems and summarise the findings
  - Analyse all findings and research recommendations of how further developments could benefit the system.

## ***Data collection methods***

Data collection is essential in producing a good quality product, through the duration of the project development phase, the student aims to collect data via various methods and then use the data to improve to overall effectiveness of the system.

### ***Sensor data collection (Quantitative)***

Collecting data from the various sensors primarily the soil moisture sensor will be crucial for finetuning the system for specific kinds of crops. Different crops will have different water consumption rates. To understand what crops, need more water, the project will incorporate moisture sensors at different levels to test for variability in soil condition and how different plants will consume water.

### ***Scheduled system vs smart system water irrigation effectiveness (Quantitative)***

Measuring how well the smart system keeps the soil moisture at an optimal level, while comparing the same measurements from a scheduled based system. This will be achieved by conducting soil moisture samples at intervals such as before, during and after irrigation. Furthermore, analysing when the soil stays at an optimal level will play a key part in the data analysis.

### ***Crop Management (Quantitative)***

Evaluating the impact of crop growth and general health can comparing the findings from both systems. This will be achieved through measuring key indications in what healthy versions of the plant looks like, for example, plant size/height, leaf size, healthy colours, all analysed at regular intervals. Relevant tools can be used to take these measurements such as, a chlorophyll meter.

Collection of this data will help prove the effectiveness of the system.

### ***Data collection of weather and environmental conditions (Quantitative)***

Collection of this data will allow the user to understand the external factors that could impact the systems effectiveness such as crop water need and soil moisture. Simply collecting local weather station data will suffice, recording this data weekly over a period of weeks and taking into account, will allow the student to assess how variations in weather conditions such as rain, temperature etc influence the overall performance of the system.

Understanding the importance of external factors and how they can alter the systems performance is vital in tackling some of the main concerns that the project aims to address, water consumption rates is a key example of this.

### ***User questionnaire and feedback (Qualitative)***

Collecting feedback from avid gardeners and farmers if possible, through the form of a questionnaire will give the student access to the overall usability and reliability of the project. This data will be valuable for further development of the system.

Developing a questionnaire with tailored questions will allow for optimal data collection that is specific to the project.

Obtaining this qualitative data will allow for in depth analysis of how well the system performs when put into a practical setting, meaning it is crucial for fault finding and future improvements, if necessary.

### ***Resources and planning***

Throughout the development process, the use of online resources will be crucial to achieve the aims. A list of resources includes

- Proteus
- MPLAB
- C programming language
- Various online journals

| <b><i>Phase</i></b>                     | <b><i>Milestone</i></b>                                                                            | <b><i>Timeline – Start to completion</i></b> |
|-----------------------------------------|----------------------------------------------------------------------------------------------------|----------------------------------------------|
| Phase 1: Project Planning               | Proposal start to approval                                                                         | 01/10/24 – 28/10/24                          |
| Phase 2: System Design                  | Completion of Design                                                                               | 01/11/24 – 01/12/2024                        |
| Phase 3: Hardware Design                | Implement all components in working order                                                          | 01/12/2024 – 01/01/2025                      |
| Phase 4: Software Development           | Design comprehensive organised code for the microcontroller                                        | 01/12/2024 - 01/01/2025                      |
| Phase 5: System Integration and Testing | Conduct a variety of tests testing the functionality                                               | 01/01/25 – 01/02/2025                        |
| Phase 6: Data Analysis and Evaluation   | Analyse all data collected from personal and public tests                                          | 01/02/2025-01/03/2025                        |
| Phase 7: Documentation and Reporting    | Final Submissions for<br>-Proposal<br>- Interim Viva<br>- Final Report<br>- Final Viva<br>- Poster | 01/10/2024/ - 09/05/2025                     |

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[5]

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[7]

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# Proposal

## GRADEMARK REPORT

FINAL GRADE

GENERAL COMMENTS

58/100

| Intro / A&O (400 words)                                                                                                                                                                                                                                   |    |    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|
| A good<br>general introduction to the<br>problem.                                                                                                                                                                                                         | 20 | 65 |
| Background to the Project / Literature<br>Review (400 words)                                                                                                                                                                                              |    |    |
| General comment<br>overall: well presented report, with<br>a good overall idea.                                                                                                                                                                           | 20 | 58 |
| The proposal<br>is also meant to be a feasibility<br>study document, and little<br>investigation<br>seems to have been done at all into<br>HOW some of the proposed things<br>are going<br>to be achieved – e.g. gathering the<br>data from the internet. |    |    |
| Project Design (500 words)                                                                                                                                                                                                                                |    |    |
| Clear statement of which<br>development methods are to be<br>used and why<br>they are appropriate; Clear<br>statement of<br>which tools are to be used and why                                                                                            | 30 | 50 |

|                                                                                                                                                                                                                 |    |    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|
| they are appropriate; Clear description of how data collected will be analysed                                                                                                                                  |    |    |
| <b>Resources / Planning (200 words)</b>                                                                                                                                                                         |    |    |
| <p>List of any deliverables; Clear diagram showing both timing and resource use; Completed ethics form; Limited and relevant appendices</p> <p>Good Gantt chart, but weak detail on the other requirements.</p> | 15 | 58 |
| <b>Document Presentation</b>                                                                                                                                                                                    |    |    |
| <p>Correct spelling, grammar and punctuation;</p> <p>Flow of narrative/fluency;</p> <p>Coherence; Word processed ;</p>                                                                                          | 15 | 65 |

|                                                                          |            |     |
|--------------------------------------------------------------------------|------------|-----|
| Correct<br>use of referencing with<br>bibliography; Strict<br>word limit |            |     |
| <b>TOTAL</b>                                                             | <b>100</b> | 58% |

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