

**Final Year Project Live Document**

**Faculty of Computing**

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1. **Problem Context & Elucidation**

Within the farming sector of Northern Ireland, over half of this sector are livestock farmers. Livestock farmers raise domesticated animals in an agriculture setting for commodities such as meat, eggs, wool, leather etc. During the raising of these animals there are numerous amounts of jobs needing done everyday from feeding and cleaning to animal birth to health injections. Sometimes there isn’t enough hours in the day.

Whatever herd a livestock farmer is running, weaning will eventually play a part.

Weaning is the process of gradually introducing an infant mammal to what will be its adult diet and withdrawing the supply of its mother milk (En.wikipedia.org, 2018).

The diary cow herd is known for using weaning a lot. When the dairy cow has a calve, it is normally removed from its mother within the first 24/36-hour period of being born. This method can cause various different opinions between people on whether it should be used or not. There is a lot of various reasons why it is removed. To name a few:

* Calf Safety: Sometimes the cow can accidently lie on the calve causing the cow to crush the calve resulting in serious injury or death for the calve.
* Reduced Milk Output: With a cow having a calve at the foot it can mean a reduced output of milk from the cow as the calve is drinking 75% of this milk, therefore loss in profit for farmer.
* Save Water: A cow will drink less water with a calve not at its foot compared to a cow with a calve at the foot.

Above is only some of the numerous reasons why calves are weaned. But what are these calves fed if they don’t get the milk from the mother cow?

These calves, once removed from their mother cow are placed into smaller, individual pens. They are kept in these pens until they have developed an immune system strong enough for themselves to survive for themselves. While in these pens, the calve is taught to drink milk and eat solid foods such as nuts/meal which will bring the calve to their desired body weight. The milk for these calves is made from a powdered formula which is mixed with warm water ( Usually between 20 - 50°C). This milk is then dispensed into each bucket for each calve to drink.

Depending on which feeding plan the farmer decides to use when rearing these calves, each calve must get fed this milk twice a day, everyday for the first week or so then it is reduced accordingly. This means the farmer is spending at least a quarter of their day feeding calves. I think this process can be automated with the use of software.

1. **Project Aim:**

This project will aim to develop a system which will be controlled by a raspberry pie to automatically mix and dispense milk into buckets for individual calves. To allow the user to interface with the system, there will be a touch screen module with features allowing the user to select different modes and input data about each calve. I will be using LabVIEW to simulate the mixing and dispensing of milk.

1. **Project Objectives:**

At the end of my project, I hope the following the following objectives will have been met either through this report or the system requirements listed further down the report. ( No particular order ).

|  |  |  |
| --- | --- | --- |
| Objective Number | Objective Description | Has this been achieved? Yes/No |
| OJB1 | Review and analysis literature on similar products in the market. |  |
| OJB2 | Discussion and review with identified stakeholder’s. |  |
| OJB3 | Develop list of functional and non – functional requirements. |  |
| OJB4 | Evaluate requirements (OJB3) with suitable a methodology used to prioritise and create comprehensive Requirement Specification. |  |
| OJB5 | Design and Develop User Interface for user to select desired functions of the system. |  |
| OJB6 | Design and Develop simulation on system. |  |
| OJB7 | Consider what database will hold Calve data and consider Data Protection Rules. |  |
| OBJ8 | Development of User Interface to produce reports about data in the form of charts, graphs etc. |  |
| OBJ9 | A comprehensive list of tests ensuring system fully works. |  |
| OBJ10 | Consider a User Manual for technical support for the user. |  |

1. **Literature Review: Initial Investigation of the Project Area.**

This section is designed to give the author a more detailed insight into certain areas which may not be as familiar as others. These areas include: Raspberry Pie, LabVIEW Software. With a more detailed understanding in these areas, development of the system should be easier. Below paragraphs will document the areas highlighted above.  
Hardware:  
In this project I wasn’t sure which small PC to use to power and use in my project. With a little more research I had narrowed it down to a decision between a Raspberry Pie or an Arduino. I decided to make a table of pro’s and con’s to make my decision.

|  |  |  |
| --- | --- | --- |
| Raspberry Pie 3: | Positives | Negatives |
|  | Very powerful with large memory and processing capabilities. Memory may be expanded. | Basic knowledge of Linux required to start using Pi. |
|  | Linux OS and Windows 10 can be used to make more user friendly interface. | Uses a lot of power. |
|  | Variety of different programming languages can be used ( Python, C, C++). |  |
|  | A lot of GPIO’s available. |  |
| Arduino: | Easy to get started with. Good online product support. | Memory Limitations. |
|  | Can send data wirelessly using Bluetooth. | No internet capabilities. |
|  | Open Source. | Less powerful than a PI. Couldn’t run additional accessories like touchscreen etc. |

After reading the positives and negatives I have decided to use the Raspberry Pi. The raspberry pie should be able to allow me to integrate a touch screen module which will give the user an interface to which they will be able to select key functions on the system. So I will use the Raspberry Pi 3 with touchscreen module.

Draft Requirements with Stakeholders (Farmers).

|  |  |  |  |
| --- | --- | --- | --- |
| Requirement ID | Functional/Non-Functional | Requirement | Achievable |
| REQ1 | Functional | The user should be able to login into system. | Yes |
| REQ2 | Functional | The user should be able to amend data when logged into system about calves. | Yes |
| REQ3 | Functional | The user should be able to select a wash mode to clean all buckets and pipes. | Yes |
| REQ4 | Functional | The user should be able to view data in a graphical representation about calves using data already stored. | - |
| REQ5 | Functional | The simulation should automatically mix the milk. |  |
| REQ6 | Functional | The simulation should automatically refill water tanks when connected to water pipe. |  |
| REQ7 | Functional | The system should display current levels of milk powder, water etc. to allow for refills. |  |
| REQ8 | Functional | The system should text alert user when feeding has been completed. |  |
| REQ9 | Functional | The output of the system should be represented on a breadboard using LED’s. |  |
| REQ10 | Non – Functional | The systems GUI should be written with Python 3. |  |
| REQ11 | Non – Functional | The Raspberry Pi should have text messaging software installed and be connected to the internet. |  |
| REQ12 | Non – Functional | The data stored about calves should be stored on a database. |  |
| REQ13 | Non – Functional | The data should not be kept for longer than needed. |  |
| REQ14 | Non – Functional | The system should be fully tested with a test suite. |  |

**6.5 Justification of Software Lifecycle Methodology:**

In the software industry today, many companies use a different approach to each project when it comes to which lifecycle they choose to use. There are several different methodologies that can be used. Some methods many be more applicable to a project than others. Below I have summarised the benefits and cons of each method to help me decide which method I think will be appropriate to use and implement in a project.

|  |  |  |
| --- | --- | --- |
| LifeCycle Model | Advantages | Disadvantages |
| Agile | Changes to Requirements can be adapted at any stage of the development process. | Can be difficult with large projects to access effort required. |
|  | Feedback is display throughout whole process meaning a better product is delivered, meeting all customers’ needs. | Project may be taken of course if customer doesn’t know a final clear outcome. |
|  | Testing conducted throughout development so problems can be identified early. |  |
|  | More customers’ interaction during development. |  |
|  |  |  |
| Waterfall | Simple and Easy to understand and implement. | Can be very hard to go back and implement a change if not identified at the concept stage. |
|  | Management of project is easier as each phase has a specific deliverable. | Can be hard to work with complex projects or object-oriented projects. |
|  | Phases do not overlap. | Poor model to use for long or on-going projects. |
|  | Ideal for smaller projects. | Not suitable for projects in which requirements have a high risk of changing. |
|  |  |  |
| Incremental | Customer can respond to each build. | Needs good planning and design. |
|  | Lowers initial delivery cost. |  |
|  | Easier to debug and test during a smaller iteration. |  |

After looking at the table above and considering all the points, for this project I think I will use an agile methodology. I have chosen this methodology as this model will allow for changes in requirements at any stage of the development. For me, this is the main reason why I choose Agile. It means if I have missed anything or the stakeholders would like anything added it can be implemented with limited impact on the whole project. Another key feature this model offers is more interaction with the customer through feedback and development. This will hopefully lead to a better designed product which will meet all of their desired requirements and exceed expectations. One final point which influenced my decision to an agile method was the fact that testing occurs throughout the development process meaning problems may be identified earlier, thus ensuring when delivering the final product it will not be delayed.

Initial Report

Project Context + Aims

Design

Automatic Calve Feeder/Dispenser

Implementation

Testing

Integration Testing

*6.7.1 Work Breakdown Structure*

Final Report

Introduction

Configure Raspberry Pi with Touch Screen Module.

System Validation

Conclusion + Reflection

System Verification

System Design

System Implementation

Requirement Control Documentation.

Acknowledgements

User Testing

Unit Testing

System Testing

Link Simulation to Raspberry Pi.

Create Simulation on LabVIEW.

Link Graphical User Interface to Database.

Create Database for Graphical User Interface.

Create Graphical User Interface.

Requirement Gathering

Requirement Justification + Analysis

Product Design

Risk Assessment

Initial Plan

Literature Review + Analysis

Project Objectives

|  |  |
| --- | --- |
|  | Initial Report |
|  | Design |
|  | Implementation |
|  | Testing |
|  | Final Report |

*6.7.2 Gantt Chart:*

***6.7.3 Resources Identification:***Below I will highlight what resources will be needed for this project:   
 1. Laptop / PC *(Hardware)*  
 2. PyCharm IDE (Integrated Development Environment) *(Software)*  
 3. Raspberry Pi 3 *(Hardware)*  
 4. Touch-Screen Module for Raspberry Pi *(Hardware)*  
 5. LabVIEW *(Software)*  
 6. Github Repositories *(Software)*

1. Laptop / PC: These both will be used for the day to day development of project.

2. PyCharm: This IDE will be used for the development of the Graphical User Interface and Python code needed for the project. It will help ensure the code is clean and easily readable. PyCharm can connect to Github allowing for Version Control of code.

3. Raspberry Pi 3: This will power the system and the GUI will also be powered of this.

4. Touch – Screen Module for Raspberry Pi 3: This is used to allow the User to interact with the system and select available functions.

5. LabVIEW: This is used to create the simulation part of my project. It allows me to use logic to create simulation.

6. Github Repositories’: This is free online software in which I will save my project to. This will allow the use of version control to be used in the project.

Refernces used

<https://en.wikipedia.org/wiki/Weaning>

(En.wikipedia.org, 2018)