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FINAL YEAR PROJECT:
DESIGN AND IMPLEMENTATION OF A SMART AUTOMATIC FOOD DISPENSER

Final year project submitted in partial fulfilment of the requirement for the award of advanced diploma in Electronics and Telecommunication Technology.

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October 2024

DECLARATION A

I, MUGISHO MWIMUKA Romuald Declare that This research study is my original work and has not been presented for a Degree or any other academic award in any University or Institution of Learning. No part of this research should be reproduced without the authors' consent or that of ULK Polytechnic Institute.

Student name: MUGISHO MWIMUKA Romuald

Signature: ____________________________ Date: _________________

DECLARATION B

I certify that the work reported in this research project was carried out by the candidate under my supervision and it has been submitted with my approval as the UPI supervisor.

Supervisor name:

Signature: Date:

DEDICATION

I dedicate this project:

To the Almighty God who is always there to protect me.

To my father, mother, and family who did their best to keep me here.

To my supervisor, lectures and friends, who supported me in all my research.

ACKNOWLEDGEMENT

First and foremost, I heatedly thank Almighty Lord for the gift of life and the spirit of hard working that he gave me.

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My great appreciation goes to several colleagues who broadened my knowledge and technical skills to fulfill the requirements to this report.

Finally, I wish to express my heartfelt thanks to my parents for their moral and financial support during my studies.

ABSTRACT

This project presents the design and implementation of a smart automatic food dispenser in a farm, tailored for agricultural environments, aimed at improving livestock feeding processes. The proposed methodology consists of an IoT system and automation technologies to deliver precise and timely portions of food to animals, based on their specific dietary needs and feeding schedules. The distributor is designed to monitor and analyze animal behavior and consumption patterns, thus adjusting food distribution to promote optimal health and growth. The Blynk IoT application allows farmers to remotely manage and customize feeding protocols, ensuring flexibility and control. The part of coding use Arduino IDE that make IoT system operational. This smart system minimizes human labor, reduces food waste, and ensures consistent and balanced nutrition for livestock. Field tests have demonstrated its effectiveness in improving animal well-being and farm productivity. The implementation of this innovative solution promises significant advancements in efficiency, sustainability, and the overall management of farm feeding practices.

Keywords: Blynk, ESP32, IoT, Arduino.

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LIST OF ACCRONYMS AND ABBREVIATION

GPIO: General Purpose Input/ Output

IoT: Internet of things

I2C: Inter-Integrated Circuit

LCD: Liquid Crystal Display

NTP: Network Time Protocol

PWM: Pulse Width modulation

CHAPTER 1: GENERAL INTRODUCTION

1.0 Introduction

Nowadays, without a smart automatic food dispenser, farm animals may face inconsistent feeding schedules, leading to stress and irregular eating patterns. Farmers must manually feed the animals, which is time-consuming and labor-intensive, especially on larger farms. This manual process can result in unequal food distribution, with some animals receiving more or less than they need, potentially causing malnutrition or obesity. Human error can lead to overfeeding or underfeeding, impacting the animals' health and productivity. Overall, the lack of automation in feeding systems can lead to inefficiencies and potential welfare issues for the animals.

To solve that problem Smart Automatic Food Dispenser for Farm Animals is a solution .it is an innovative initiative aimed at transforming the traditional feeding practices on farms through the integration of advanced technology. This project aims to develop and implement an automated feeding system designed to enhance the efficiency, accuracy, and effectiveness of livestock feeding processes. By leveraging smart technology, the project aims to address common challenges faced by farmers, such as labor-intensive feeding routines, inconsistent feed distribution, and high feed wastage.

1.1 Background of the study

The development of automatic food dispensers is driven by the need for efficient and reliable systems to manage the feeding of animals, particularly in situations where manual feeding can be inconsistent or inconvenient. In the agricultural sector, for instance, automated feeding systems have been implemented to improve productivity, reduce labor, and ensure timely feeding of livestock. Studies have shown that automated systems can enhance animal health and growth by providing controlled, consistent portions of food at regular intervals, reducing the risk of overfeeding or underfeeding (Smith & Johnson, 2018), [1].
Research in this field has also extended into domestic applications, such as pet feeders, where similar technologies are applied to manage the feeding of household pets when owners are away. These systems typically involve components like sensors, timers, and

wireless communication, allowing for remote control and monitoring through smartphone applications (Brown, et al., 2019), [2]. The integration of smart technologies such as IoT (Internet of Things) has further expanded the functionality of these feeders, enabling real-time data collection on feeding patterns and food levels (Singh & Kumar, 2020),[3].

Moreover, the use of automatic food dispensers has been linked to improved convenience and efficiency in feeding, as demonstrated by studies exploring their application in aquaculture and poultry farming, where feeding times and quantities can significantly impact growth rates (Garcia & Lopez, 2021), [4].

1.2 Statement of the problem

The study of a smart automatic food dispenser aims to enhance the convenience and efficiency of feeding processes, whether for humans or animals. It seeks to automate meal distribution, ensuring consistent portion control and timely feeding, which can improve health outcomes and reduce waste. By integrating smart technology, such dispensers can be programmed and controlled remotely, allowing users to customize feeding schedules and monitor consumption patterns. This study also explores how IoT and machine learning can optimize the functionality of the dispenser, adapting to user preferences and dietary needs over time. It examines the potential for reducing manual labor and errors associated with traditional feeding methods. The study assesses the environmental impact and cost-effectiveness of such devices, aiming to provide sustainable solutions for busy households or facilities.

1.3 Research objectives

Based on an analysis of existing studies of a smart automatic food dispenser, we have two types of objectives:

1.3.1 Main objective

To automate the feeding process for livestock, ensuring that food is dispensed accurately, on time, and in the correct portions.

1.3.2 Specific objective

i. To ensure consistent feeding intervals and amounts, reducing the risk of overfeeding or underfeeding, which can affect livestock health and productivity.

ii. To analyze how the use of a smart dispenser can reduce feed waste and improve resource management on the farm by precisely controlling portions and minimizing wastage and spoilage.

iii. To assess the economic impact of implementing smart automatic food dispensers on the farm, including cost savings from reduced labor and feed waste, and the potential increase in profitability due to improved livestock performance and health.

1.4 Research questions

Direct this research and ensure it achieves its goals, the following research questions have been developed:

i. What is the impact of consistent feeding intervals and controlled food portions, delivered by an automatic food dispenser, on the health and productivity of livestock?

ii. In what ways does the use of a smart automatic food dispenser contribute to reducing feed waste and optimizing resource management on the farm?

iii. What are the economic impacts of implementing smart automatic food dispensers on farms, particularly in terms of cost savings from reduced labor and feed waste, and how do these systems influence profitability through improved livestock performance and health?

1.5 Scope

The scope of this study is as follows: The research is grounded in principles of precision agriculture, IoT technology, and sustainable farming practices, exploring how these frameworks can be applied to enhance feeding efficiency and resource management in animal farming. In terms of content, the report examines the design and functionality of the smart dispensers, their impact on feeding accuracy and nutritional outcomes for livestock, and their potential to optimize resource use by reducing feed waste and labor costs.

1.6 Significance of study

The significance of this study lies in its potential to revolutionize livestock farming by automating and optimizing the feeding process. By ensuring precise and consistent feeding, the system improves animal health and boosts productivity, contributing to better farm outcomes. It reduces manual labor, allowing farm workers to focus on other essential tasks, thereby enhancing operational efficiency. Additionally, the technology minimizes feed waste, promoting more sustainable resource management. The system's remote monitoring capabilities provide farmers with greater control and flexibility, enabling more efficient and informed decision-making in livestock management.

1.7 Organization the study

This study is organized into five chapters, with each chapter focusing on specific aspects of the research:

Chapter 1. General Introduction: offers an overview of the research topic, highlighting its importance and relevance. It contains the background information, the problem statement, the research objectives, and the research questions.

Chapter 2. Literature Review: this chapter reviews existing literature on food dispenser.

Chapter3. Research methodology: Outlines the methodology for data collection, including how research participants were selected and the data analysis techniques that were applied.

Chapter 4. System design, analysis and implementation: presents the system design of the automatic food dispenser, it presents also the result of the implementation system.

Chapter 5. Conclusion and recommendation: present the summary of the study and provide the recommendation for future research. References and indices are provided.

CHAPTER 2: LITERATURE REVIEW

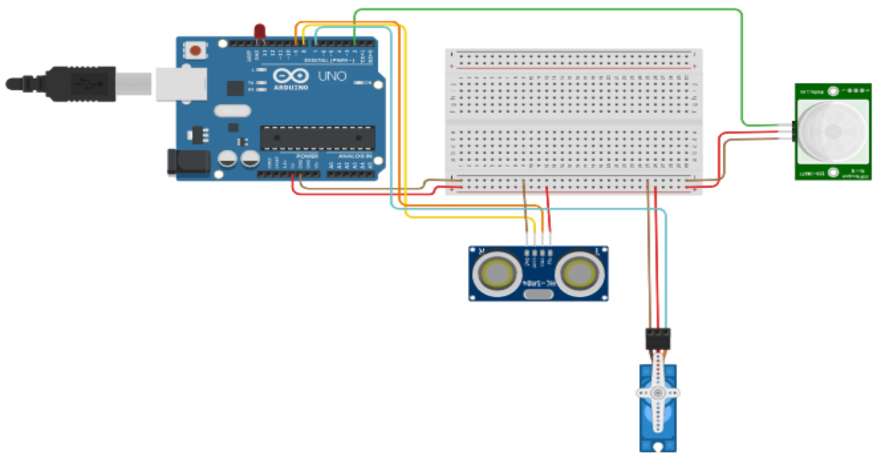
2.0 Introduction

In the modern agricultural landscape. people are always looking for better ways to be efficient and sustainable. One of the new improvements is the use of smart automatic food dispensers for farm animals. This chapter aims to provide a comprehensive understanding of these systems by exploring key areas that influence their effectiveness and application.

2.1 Smart Automatic Food Dispenser system

Analyzing the development of smart automatic food dispensers shows a major transition from conventional approaches to advanced, technology-based solutions. Same researchers such Peter Corke [5] believed that automation can significantly reduce food waste and improve portion control, Michael Wolf [6], he provided a range of insights on the implementation of smart automatic food dispensers, highlighting their benefits in various settings, from home kitchens to agriculture.

Block diagram of a previous automatic food dispenser



C

Figure 1: Circuit diagram of a previous study [13]

An automatic food dispenser automates the process of dispensing food at scheduled times, ensuring precise portions and efficient feeding

2.1.1 COMPONENTS USED

- ESP32
- LCD I2C Display
- Servomotor

- Ultrasonic sensor
- Push button
- Arduino Uno

2.1.1.1 Microcontroller

A microcontroller is a small integrated circuit that controls specific tasks in devices. It includes a processor, memory, and input/output interfaces, allowing it to manage sensors, motors, and other components. Commonly used in embedded systems like home appliances and IoT devices.

A. ESP32: It’s a low-cost, low-power microcontroller with built-in Wi-Fi and Bluetooth capabilities, developed by Espressif Systems. It features a dual-core processor, multiple GPIO pins, and supports a wide range of peripherals like SPI, I2C, and PWM.

Figure 2: ESP32 WROOM-32 [14]

It’s used in a wide range of applications, including Internet of Things (IoT) devices for remote monitoring and control, smart home systems for managing appliances and security, wearable technology like fitness trackers, and industrial automation for controlling machinery. We used its because it’s built-in Wi-Fi and Bluetooth capabilities make it ideal for wireless communication, while its low power consumption.

B. Arduino Board: It’s a microcontroller-based platform with input/output pins, used for building electronic projects. It can control sensors, motors, and other components, and is programmed using the Arduino IDE.

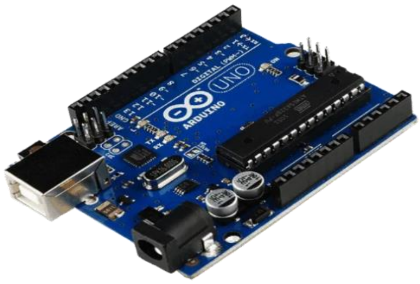


Figure 3: Arduino board [15]

Arduino boards are used in various applications, such as home automation to control appliances, robotics for building and programming robots, and environmental monitoring through sensors. We used it just to supply LCD and servo motor with 5V.

C. **ESP8266 (NodemCU)**: It's a low-cost microcontroller with Wi-Fi capability and a full TCP/IP stack, developed by Espressif Systems. It allows devices to connect to a Wi-Fi network and can be programmed to perform tasks like data processing and communication.

Figure 4: ESP8266 (NodemCU) [16]

2.1.1.2 sensors

Sensors are devices that detects and measures physical properties from the environment, such as temperature, humidity, pressure, light, motion, or sound, and converts this information into data or signals that can be read and processed by electronic systems, like microcontrollers.

A. **Ultrasonic sensor**: An ultrasonic sensor is a device that measures distance by emitting ultrasonic sound waves and detecting the time it takes for the sound waves to bounce back after hitting an object. It uses the speed of sound to calculate the distance between the sensor and the object.

Figure 5: Ultrasonic sensor [17]

Ultrasonic sensor is used for obstacle detection in robotics, parking assistance, automatic door control, and level measurement in tanks. Their ability to provide accurate distance measurements without physical contact makes them ideal for a range of automation and safety systems. We used it to detect the level of food in the container.

B. Infrared sensor: An infrared (IR) sensor is a device that detects infrared radiation, which is emitted by objects in the form of heat. It senses the presence or changes in IR light and converts this into an electrical signal.

Figure 6: Infrared sensor [18]

IR sensors are often used to detect objects, measure heat levels, or sense motion. They come in two types: active (which emit and detect IR light, like in remote controls) and passive (which only detect IR light from external sources, like in motion detectors).

2.1.1.3 Displays

A display refers to a component or module that visually shows information, often used for debugging, displaying sensor data, or providing user feedback in a project.

A. Liquid Crystal Display: is a type of display that uses liquid crystals to produce a visible image. In Arduino projects, the most commonly used LCD is a 16x2 character LCD**,** meaning it can display 16 characters per line on 2 lines.

Figure 7: Liquid Crystal Display I2C [19]

An LCD with I2C allows for displaying real-time data using only two pins (SDA, SCL), simplifying wiring and saving space for other components. We found it ideal for project like an automatic food dispenser, where the LCD can show information such as feeding schedules or sensor data, providing clear feedback while keeping the system efficient and scalable.

B. OLED DISPLAY: is a type of display technology that use organic materials to emit light, each pixel emits its own light, eliminating the need for a backlight.

Figure 8: OLED Display [20]

An OLED display is widely used in Arduino projects for showing crisp text, graphics, or sensor data due to its high contrast and energy efficiency.

C. TFT LCD Display: A TFT (Thin Film Transistor) display is a type of LCD that offers vibrant colors, high resolution, and fast refresh rates, making it suitable for displaying detailed images, animations, and complex graphical interfaces.

Figure 9: TFT LCD Display [21]

A TFT display is used in Arduino projects where detailed, colourful visuals are needed, such as in touch-controlled interfaces or graphical user displays.

2.1.1.4 Motor

A motor is a mechanical device that converts electrical energy into rotational or linear mechanical motion. It achieves this by using electromagnetic principles to create forces that move a rotor or armature.

A. **Servo motor:** A servo motor is a type of motor that includes a feedback mechanism to provide precise control of its angular position, speed, and torque. It typically consists of a DC motor, a gear system, a position sensor (like a potentiometer), and a control circuit.

Figure 10: Servo motor [22]

Unlike regular DC motors, which rotate continuously, servomotors are designed to move to a specific position and hold that position until instructed to move again. We used it to control the opening and closing of the container.

B. **Stepper motor:** is a type of motor that moves in precise, discrete steps, allowing for accurate control of position and speed.

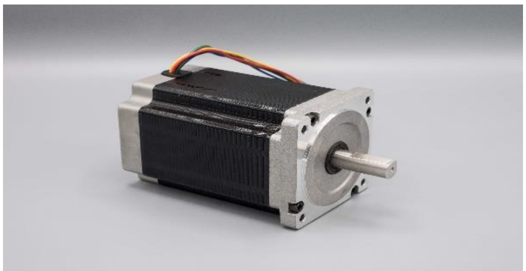


Figure 11: Stepper motor [23]

A stepper motor is widely used in applications where precise control of movement is essential, such as in 3D printers and CNC machines. Its ability to move in discrete steps allows for accurate positioning of components.

2.1.1.5 push button

A push button is a simple mechanical switch that controls an electrical circuit when pressed. When the button is pressed, it either completes or interrupts the flow of current, depending on its configuration.

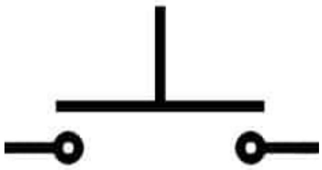


Figure 12: push button symbol [24]

A. **Momentary push button:** Are the most common type, designed to only stay activated while being pressed. They come in two variations: Normally Open (NO), where the circuit is open and remains off until the button is pressed and closed; and Normally Closed (NC), where the circuit is closed and remains on until the button is pressed and opened.

Figure 13: Servo motor [25]

This push button is commonly used in a wide variety of applications for user control and input. For example, in an Arduino-based project, a push button can be used to trigger specific actions such as starting or stopping a motor, changing modes in a system, or resetting a device. We use it to control servo motor when there not internet connection.

B. **Illuminated Push Buttons:** incorporate built-in lighting to provide visual feedback about the button's status. The illumination helps users easily identify whether the button is active or not, making them ideal for control panels and devices where visual confirmation is important.

Figure 14: Illuminated push button [26]

C. **Latching Push Buttons:** Are designed to toggle between two states with each press. When pressed, they switch to one state (on or off) and stay in that state until pressed again. This type is often used in applications where a persistent on/off switch is needed, such as in power switches or mode selectors.

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Figure 15:Latching push button [27]

2.2 Specifications

Table 1 Specifications table

Components	Specifications
Microcontroller	Model: ESP32 Memory:520KB SRAM Processor:32-bit dual core Connectivity: Wi-Fi, Bluetooth GPIO Pins: 30 Operating voltage: 3,3V
Servomotor	Rotation:0-180° Model:SG90 Torque:2.5kg/cm Operating voltage: 5V Speed: 0.12 seconds per 60°
LCD	Model: LCD1602A Default address 0*27, 0*3F Protocol: I2C Flash Memory**:** 4 MB Operating voltage: 3.3V-5V
Sensor (ultrasonic)	Model: HC-SR04 Working frequency:40Hz Ranging Distance:2cm-400cm Trigger input pulse width: 10Us Operating Current: 15 mA Range voltage: 3.3V-5V
Push button	Power rating: MAX 50mA 24 DC Operating temperature range: -20 to 70℃
Jumper wires	Operating voltage:3.3V-12V Frequency:5KHz Temperature:80 to 105℃ Current max: 1-2A

Arduino Uno	Microcontroller: ATmega328P Clock Speed: 16 MHz Flash Memory: 32 KB SRAM: 2 KB EEPROM: 1 KB Voltage operating: 5V

2.3 Related Studies

Gaining insight into the advancements and obstacles in smart automatic food dispenser necessitates a thorough examination of past research. This section reviews important studies, their methodologies, and key outcomes, providing a foundation for our research.

Peter Corke (2011), [1] in his research untitled as" Robotics, Vision and Control: Fundamental Algorithms in MATLAB®." provided a foundational understanding of the technologies that can be applied to smart food dispensers, such as the use of sensors for precise portion control and the integration of automation for seamless operation. While this work doesn't directly address food dispensers, the principles outlined are crucial for their development.

Chee Kai Ong et al (2015),[8] in their research entitled "Design and Implementation of Automatic Food Dispenser" presented the design and implementation of an automatic food dispenser system. The system uses microcontrollers, sensors, and actuators to automate the feeding process, ensuring precise portion control and scheduling, similar to what is needed in smart food dispensers for humans.

M. Gayathri et al (2019), [9] "Smart Automatic Food Dispenser Using IoT."

Published by Anusha M., Gayathri C., and their team, this study focuses on the development of an IoT-based smart food dispenser that can be controlled remotely via a mobile application. The system includes features like real-time monitoring, scheduling, and portion control, which are directly applicable to the development of smart automatic food dispensers.

S. Mahmud et al (2020), [10] "Automated Livestock Feeder Using IoT-Based Monitoring System."

This research highlights the integration of Internet of Things (IoT) technology into an automated livestock feeder. It discusses how sensors monitor the feed levels, and the system automatically dispenses food based on pre-programmed schedules and real-time data from the environment.

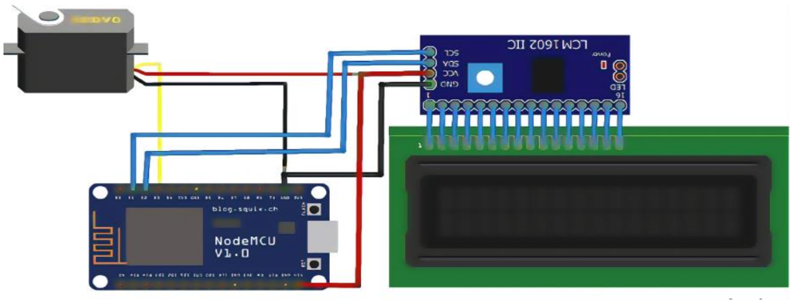


Figure 16: circuit diagram of an automatic food dispenser using IoT [28]

W.M. Simbi et al (2018), [11] "Development of an Automatic Feeding System for Livestock.**"**

This study focused on the design and development of a microcontroller-based automatic feeding system for livestock. It explored the use of sensors and actuators to dispense feed at specified intervals, helping improve feeding efficiency and reduce labor costs.

CHAPTER 3: RESEARCH METHODOLOGY

3.0 Introduction

Accurate and relevant data is essential for any meaningful research. In this section, we outline the methods and strategies used to gather and analyze the data required for our study. It offers an in-depth look at the tools and techniques employed to ensure the reliability and validity of the data, which in turn shapes the findings and conclusions of our research. By carefully selecting and applying various data collection and analysis approaches, we strive to provide a thorough and clear understanding of the current status and future potential of smart automatic food dispenser in a farm.

3.1 Research design

The research adopts a quasi-experimental design with a quantitative approach to evaluate the performance of an automated food dispenser in a farm setting. This design is appropriate because it allows for testing the system under real-world farm conditions without random assignment, ensuring practical relevance while maintaining control over key variables. The study will collect and analyze data on the system's accuracy, reliability, and operational efficiency using objective performance metrics. A quasi-experimental approach is justified as it facilitates cause-and-effect analysis of the dispenser's effectiveness in dispensing food to livestock. The absence of a survey ensures all data is collected through system logs and manual measurements, allowing for precise quantitative evaluation.

3.2 Research population

The research population for this study on the implementation of smart automatic food dispensers in a farm setting includes the entire group of livestock (such as cattle, pigs, or poultry) that are managed using automated feeding systems. The **target population** for this research is the livestock on medium to large-scale farms that utilize or are interested in adopting smart feeding technology. This population is particularly relevant as it provides a comprehensive view of how these systems perform in real-world, agricultural environments.

Inclusion criteria for selecting respondents include those with direct experience in managing farm operations with smart feeding systems, those who have been using the system for at least six months, and farms that have integrated these systems with other smart technologies. **Exclusion criteria** will exclude respondents from small-scale farms that do not use automated systems or those who have recently implemented the system and do not yet have sufficient experience with its operation.

3.3 Sample Size

To determine an appropriate sample size for studying the use of automatic food dispensers in farm animals, a systematic approach is necessary. This ensures that the sample is representative of the accessible population, allowing the results to be generalized to similar farm settings.

- **Population**: The first step is to define the population of interest. For our study, the population could be farm animals that would potentially use the automatic food dispenser.

3.3.1 Sampling Procedure

For the sampling procedure of the automatic food dispenser in a farm, purposive sampling will be adopted to ensure a representative sample of farms. Farms will be selected based on key characteristics such as the type of livestock (e.g., cattle, poultry), size (small, medium, large), and feeding methods currently in use (manual or semi-automated). This approach ensures that the selected farms reflect the diversity of the farming population that the food dispenser aims to serve.

During testing, the food dispenser will be deployed in various farm settings, ensuring that it is evaluated under different operational conditions, such as feeding times, portion sizes, and animal behavior. The farms will be selected to reflect variations in feed types (e.g., grains, pellets) to assess the dispenser's versatility.

3.4 Research Instrument

3.4.1 Choice of the research instrument

For our research, smart automatic food dispensers for farm animals, a combination of three key research instruments can be employed: a structured questionnaire, an interview guide, and an observational checklist. For me a chooses the observation checklist.

- Efficiency of distribution: Observe whether the automated dispensers deliver the exact amount of food needed for each animal or group of animals, and assess if this reduces waste or improves animal growth.
- Animal behavior: Study how animals react to the use of automated dispensers, including signs of stress, quick adaptation, or changes in feeding behavior.
- System reliability: Analyze the frequency of malfunctions or breakdowns of the automated dispensers and the impact of these interruptions on the animals' health and well-being.
- Cost-Benefit Analysis: Analyze the cost-benefit ratio of installing and maintaining automated food dispensers compared to traditional food distribution methods.
- Maintenance and Durability: Evaluate the frequency and ease of maintenance operations on the automated dispensers, as well as their durability.

3.4.2 Validity and Reliability of the Instrument

To ensure the **validity** of the instruments in evaluating the automatic food dispenser, the researcher will first verify that the sensors and dispensing mechanism are appropriate for measuring food portions accurately. This will be done by calibrating the ultrasonic sensors against known quantities of food and comparing the system's readings with manual measurements. **Content validity** will be further established by consulting experts in agricultural automation and livestock management to confirm the instruments' relevance to real-world farm conditions.

For **reliability**, the system will undergo repeated trials under consistent conditions to measure the consistency of the food dispensed. Multiple trials will be conducted at different times and on different days to ensure the system produces stable results across all trials. To enhance **triangulation**, more than one instrument will be used, including automatic sensor logs and manual weighing of dispensed food. This combination will cross-verify data, ensuring both the precision and reliability of the food dispenser's performance in diverse farm settings.

3.5 Data Gathering Procedures

This section outlines the step-by-step procedures that will be followed before, during, and after the administration of the research instruments.

1. Pre-Data Collection Phase

- Getting ideas: I am doing some research regarding animal feeding on farms. I took the most important ideas to help me understand how to manage the feeding of farm animals.

2. Data Collection Phase

- Look at the manual distribution: I watch videos to see how the food distribution is done manually to try to see where are problems that I need to solve for a good distribution.

3. Post-Data Collection Phase

- Making a plan: After receiving the ideas and watching videos we developed a plan to improve food dispenser and how to apply it on farms.

3.6 Ethical considerations

In conducting the study on automatic food dispensers for farm animals, ethical considerations are paramount to ensure the safety, social, and psychological well-being of both the animals and the farming community involved. The research adheres to strict ethical guidelines, including obtaining approval from an appropriate ethics committee and securing informed consent from participating farmers. The welfare of the animals is prioritized through humane treatment and continuous monitoring to prevent stress or harm. Additionally, the study is conducted transparently, with clear communication to the farmers about the research objectives and procedures, ensuring that their participation is voluntary and informed.

3.7 Limitations of the study

One limitation of the smart automatic food dispenser is its dependency on stable internet connectivity for real-time data transmission and monitoring, which can be challenging in remote or rural farming areas. Additionally, initial setup costs and maintenance requirements, particularly for complex IoT sensors and automated systems, could be prohibitive for small-scale farmers. To overcome these limitations, innovations such as offline functionality with local data storage and processing could be implemented, ensuring the system remains operational without constant internet access. Low-cost, energy-efficient sensors and the integration of solar-powered systems can further enhance accessibility and sustainability, making the technology more viable for diverse farming operations.

CHAPTER 4: SYSTEM DESIGN, ANALYSIS AND IMPLEMENTATION

4.0 Introduction

This chapter offers a detailed overview of the process involved in designing, analyzing, and implementing an automatic food dispenser system. It begins with an in-depth discussion of the calculations required to ensure the system meets its performance and functionality requirements. Detailed drawings are presented to visualize the system architecture and component layout. The chapter also outlines the specifications and cost estimation to give a clear understanding of the project's scope and budget. Finally, implementation strategies are discussed, offering insight into how the system is assembled, tested, and refined to achieve optimal performance.

4.1 Calculations

- **ESP32**

U=3.3V

Imax= 500mA

Power= voltage × current

P=U×V=3.3 × 500= 1650mW

- **Servomotor**

U=5V

Imax=500mA

Power= Voltage × current

P=U×V=5 × 500= 2500mW

- **LCD with I2C**

U=5V

Power= voltage × current

Imax= 50mA

Power= voltage × current

P=U×V= 5 × 50= 250mW

- **Arduino Uno**

U=5V

Imax=330mA

P= U ×V=5 × 330=1650mW

- **Ultrasonic sensor**

Imax =15mA

U=3.3V

P= V × I= 3.3 × 15= 49,5mW

- **Total power of the circuit**

The total power is the summation of all power of each component

Pt = 2500+250+49.5+1650+1650 =4449.51mW

- **Total current**

$I=\frac{4400}{5}$=0.88A $I=\frac{1699.5}{3}$=0.51A

Imax= 0.88+0.51=1.39A

4.2 Drawings

4.2.1 Block diagram

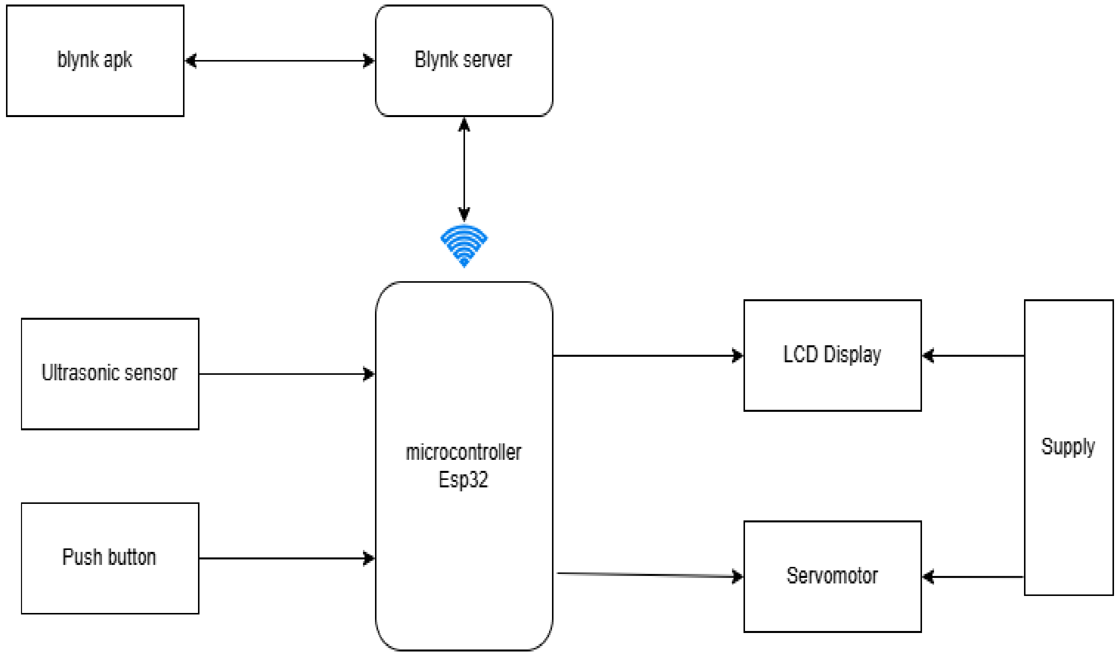


Figure 17: Block diagram

4.2.2 Flowchart

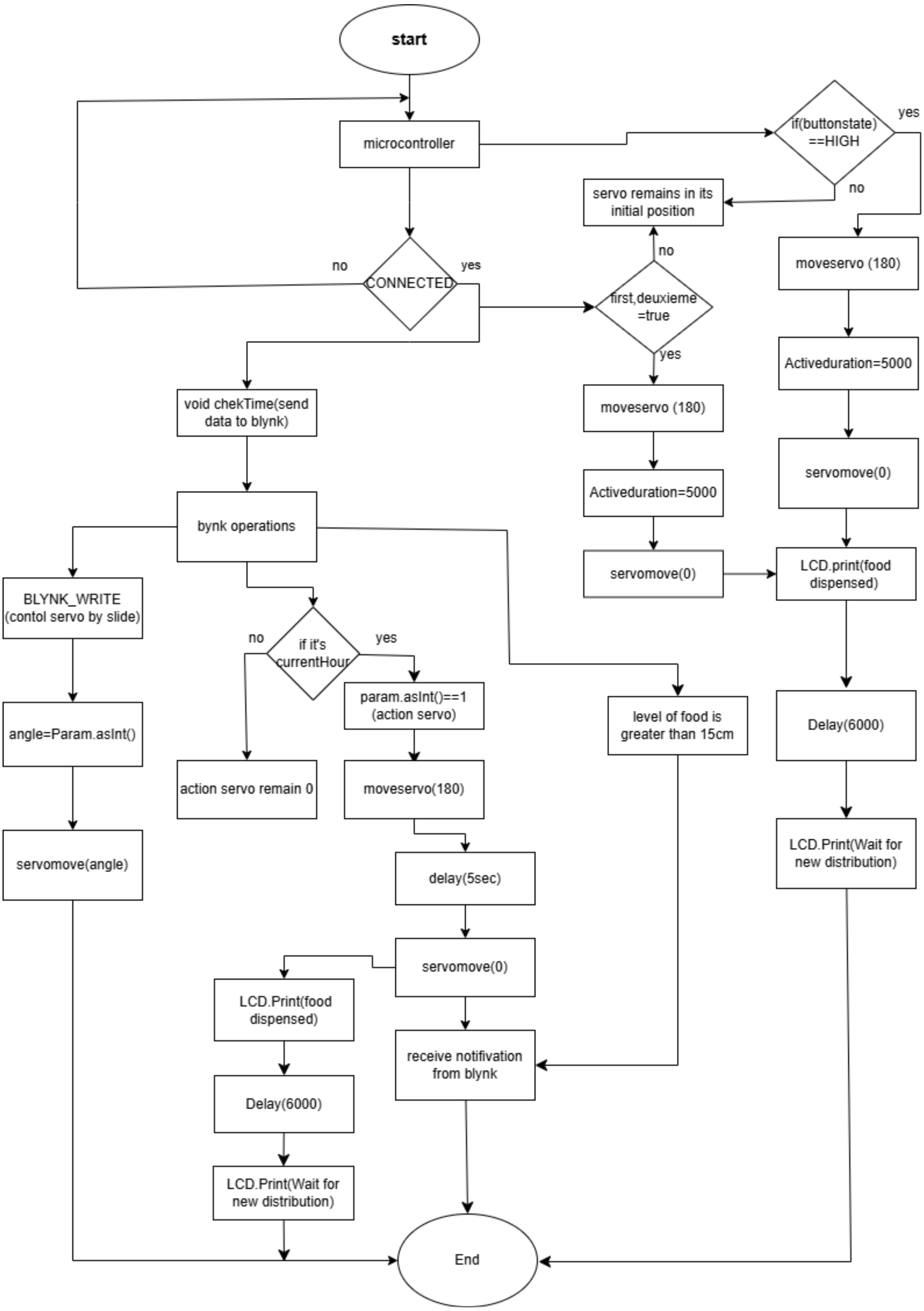


Figure 18: Flowchart

4.2.3 Circuit diagram

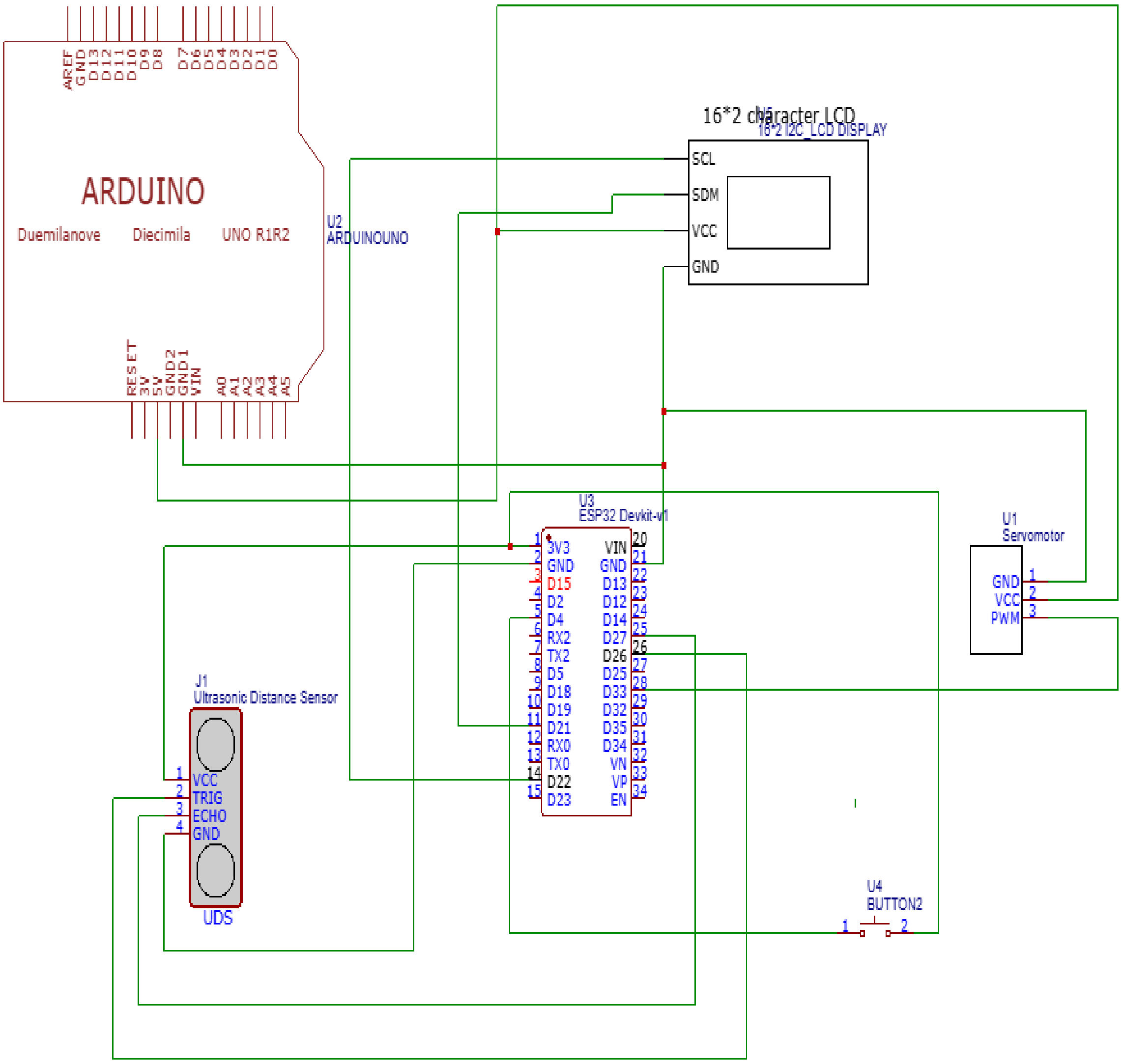
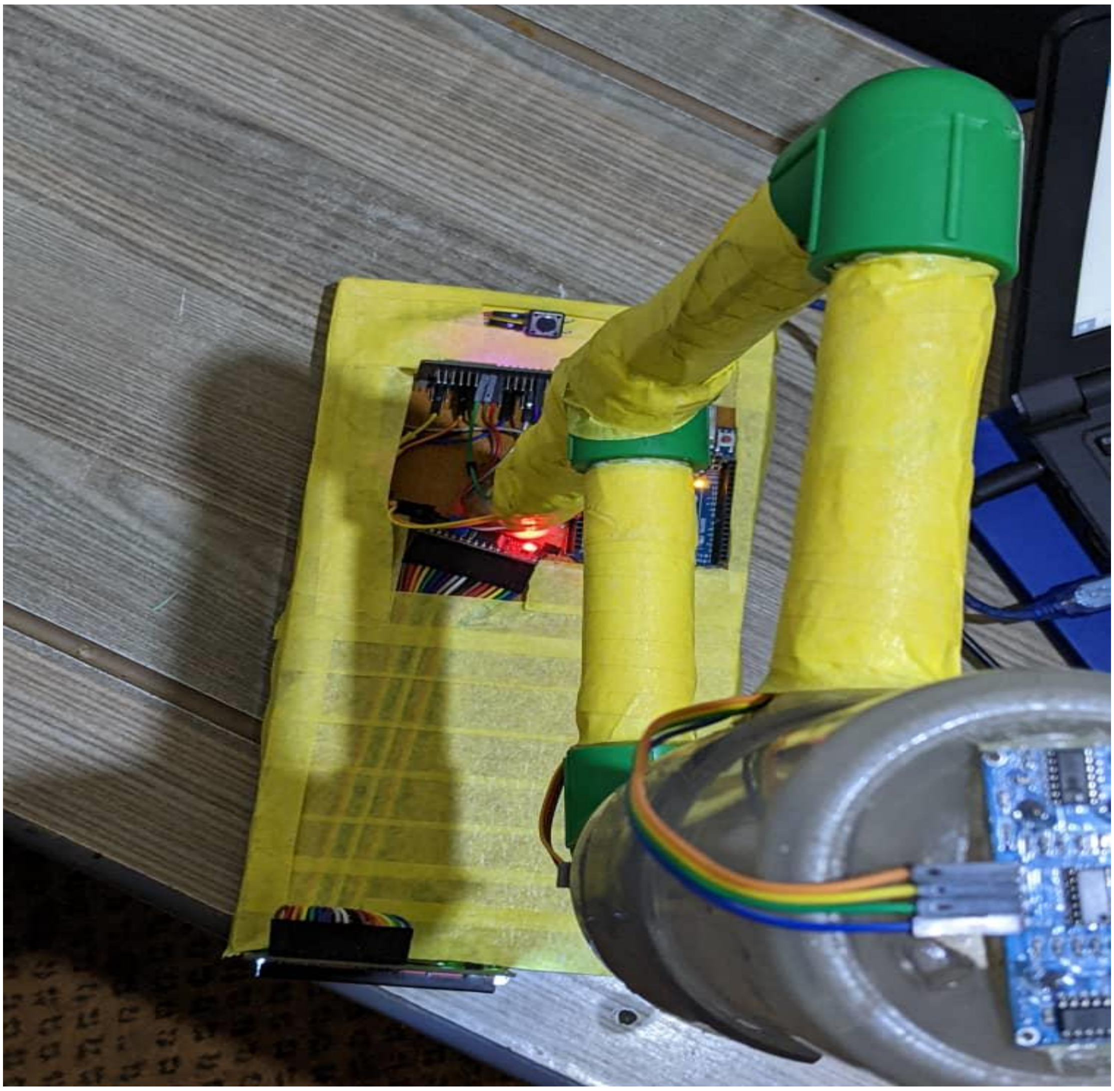


Figure 19: Circuit diagram

4.3 Implementation



4.3.1 Working principal

The system initializes by connecting to Wi-Fi and setting up the servo, LCD, and Blynk.
Every second, the current time is checked against the predefined times for food dispensing. If a match is found, the servo activates and dispenses food.
The button can be pressed at any time to manually dispense food.
The Blynk app can be used remotely to either activate the food dispenser by using automations when the current time is egal to the time define in automation part.
After the servo dispenses food, it automatically returns to the initial position after the predefined duration.

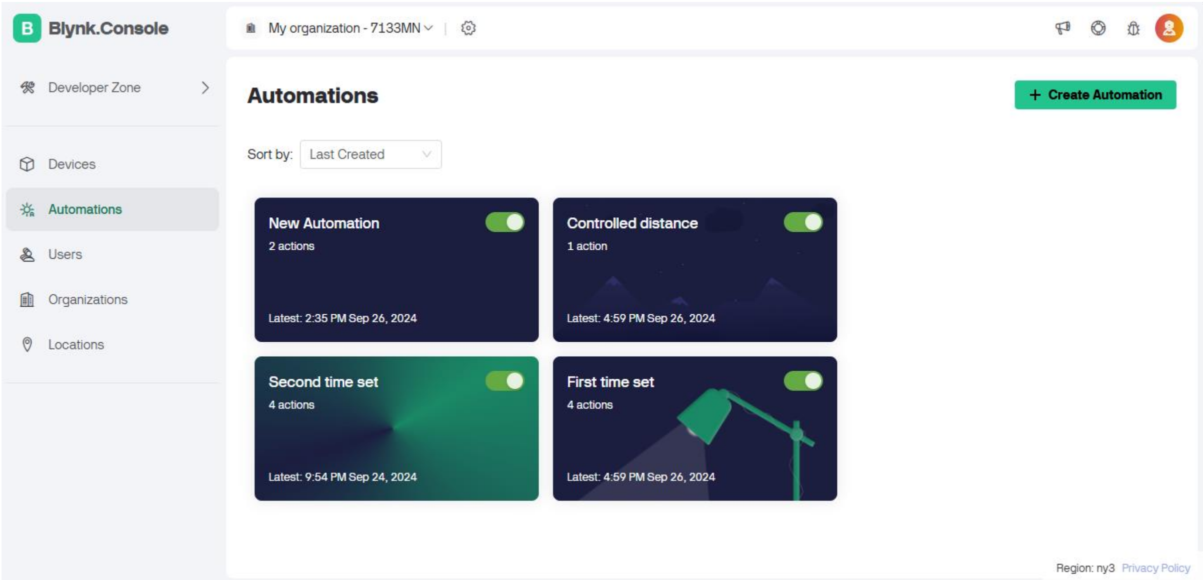


Figure 20 Automation part

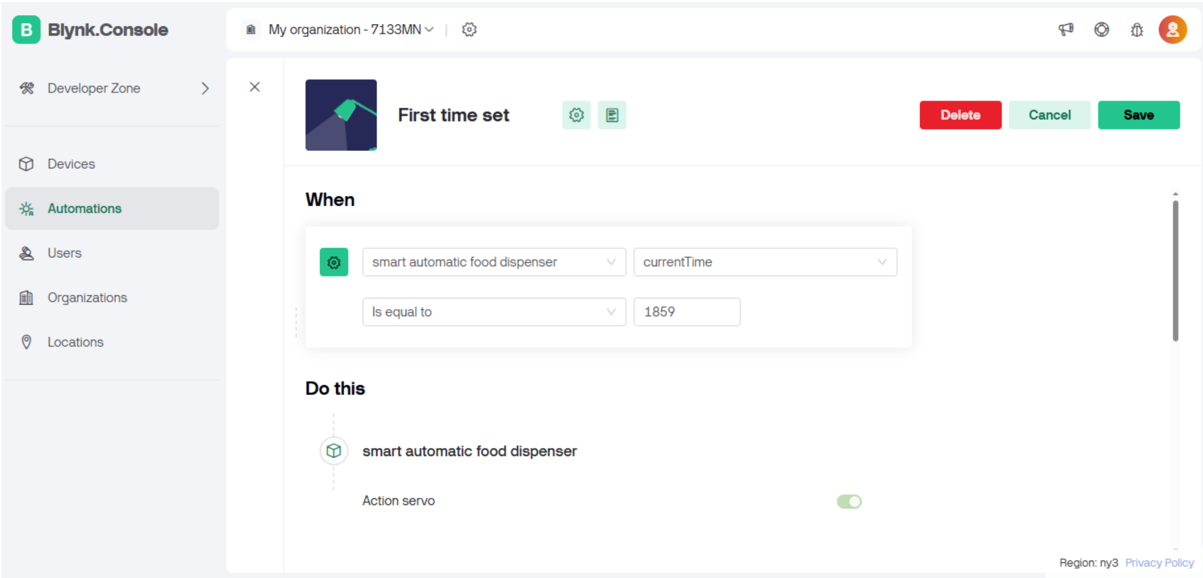


Figure 21 Automation part first time set

Another function of Blynk is to activate the servo motor using a slider when you are not at home but you want to activate the servo motor without waiting the delivery time.

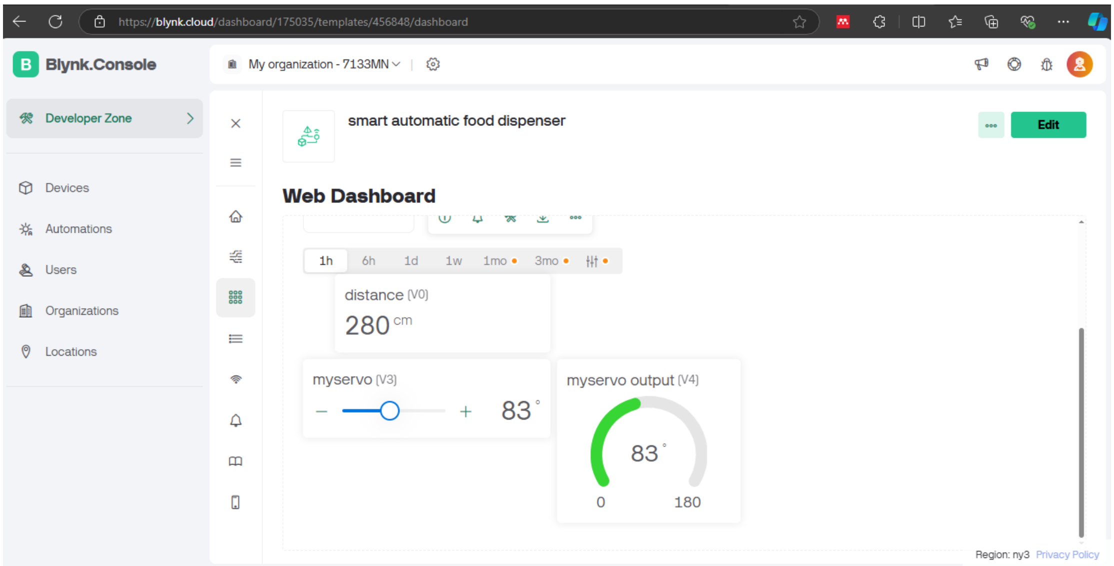


Figure 22 control with slider on blynk platform

the distance measured by the ultrasonic sensor is written to virtual pin **V0** in the Blynk app. This allows to monitor the food level on the application and thanks to automation on blynk we receive a notification if the level of food is low.

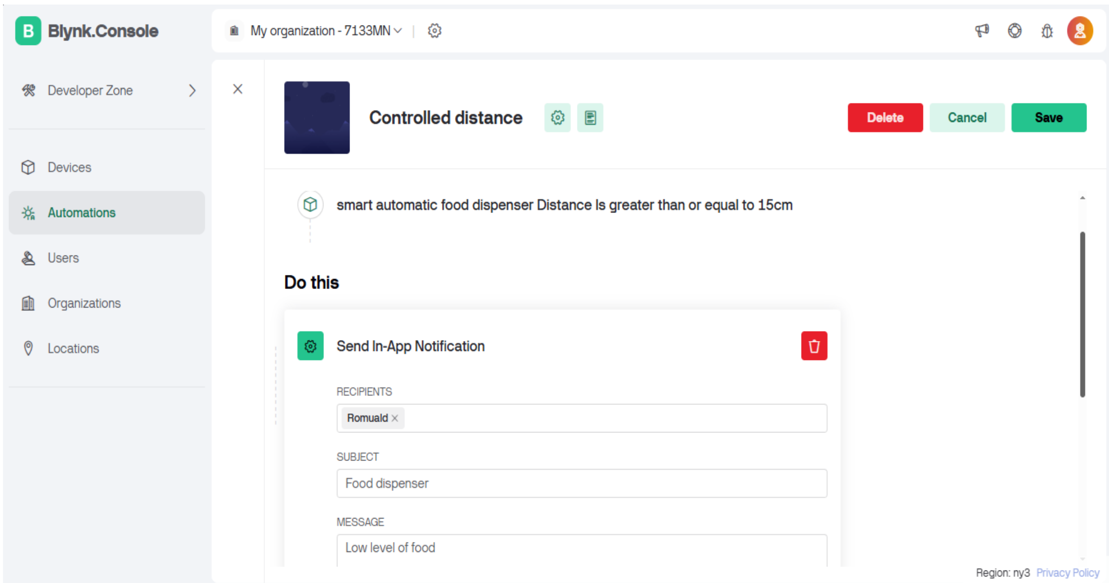


Figure 23 automation part for ultrasonic sensor

The LCD provides feedback on the system's status (whether food was dispensed, waiting for the next activation, etc.).

CHAPTER 5: CONCLUSION AND RECOMMENDATION

5.0 Introduction

This chapter provides an overview of the research findings on the smart automatic food dispenser, outlining the main conclusions derived from the study. It provides targeted recommendations to enhance the design, functionality, and usability of the dispenser, ensuring greater efficiency and user satisfaction. Furthermore, this chapter identifies opportunities for further research, suggesting areas where additional exploration could drive advancements in smart food dispensing technologies.

5.1 Conclusions

The smart automatic food dispenser has significantly improved feeding efficiency and livestock nutrition compared to traditional methods. By accurately regulating portion sizes and feeding schedules, it ensures consistent, balanced nutrition tailored to the animals' needs. This precision reduces feed waste and minimizes the risks of overfeeding or underfeeding, resulting in more efficient resource use.

Smart automatic food dispensers on farms offer significant economic benefits by cutting labor costs and reducing feed waste. Automating the feeding process minimizes manual labor, leading to savings, while precise portioning prevents overfeeding and underfeeding, lowering feed costs. Additionally, these systems boost profitability by enhancing livestock performance and health through consistent, tailored nutrition, optimizing growth rates and reducing health issues for improved productivity

5.2 Recommendations

Based on our findings and the challenges encountered throughout our research, we would like to propose several recommendations for the future.

- Farmers to adopt automatic food dispensers to optimize their operations, improve feed management, and reduce labor dependency.
- Governments should support this shift through subsidies, grants, and policies that encourage the use of smart agriculture technologies, contributing to national sustainability goals.

- Researchers should focus on enhancing system affordability, scalability, and energy efficiency to benefit farms of all sizes. These collaborative efforts will lead to more competitive and sustainable agricultural practices.

5.3 Suggestions for further study

A suggestion for future research would be to explore the integration of advanced technologies such as machine learning and IoT sensors to optimize feeding schedules based on real-time animal behavior, health metrics, and environmental conditions. This could involve developing adaptive systems that adjust feed portions dynamically, improving not only efficiency but also animal welfare. Additionally, future studies should focus on making these systems more energy-efficient, cost-effective, and scalable for both small and large farms, ensuring wider adoption across different farming environments.

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APPENDICES

Appendix A: Code

```
#define BLYNK_TEMPLATE_ID "TMPL2Vy8FXnEZ"
#define BLYNK_TEMPLATE_NAME "smart automatic food dispenser"
#define BLYNK_AUTH_TOKEN "HHZ31GUZFMVbooKB4ayFCFC0qB27tYDP"

#include <ESP32Servo.h>
#include <WiFi.h>
#include <TimeLib.h>
#include <NTPClient.h>
#include <WiFiUdp.h>
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
#include <BlynkSimpleEsp32.h>

#define TRIGGERPIN 26
#define ECHOPIN 25

const char* ssid = "CANALBOX-8AC3-2G";
const char* password = "DanPatRom@621";
char auth[] = BLYNK_AUTH_TOKEN;
// Define NTP client to get time

int currentHour;
WiFiUDP ntpUDP;
const long utcOffsetInSeconds = 2 * 3600;  // Adjust according to your
timezone (UTC+2)
const unsigned long updateInterval = 60000;  // Update interval in
milliseconds (60 seconds)

NTPClient timeClient(ntpUDP, "pool.ntp.org", utcOffsetInSeconds,
updateInterval);

LiquidCrystal_I2C lcd(0x27, 16, 2);
Servo myservo;
BlynkTimer timer;

const int buttonPin = 4;
int buttonState = 0;         // Variable for reading the button status
const int servoPin = 33;     // Pin connected to the servo
long duration, distance;
int angle;
// Times in 24-hour format (e.g., 8 AM and 16 PM)
const int activationHour1 = 15;
const int activationMinute1 = 27;
```

```
const int activationHour2 = 15;
const int activationMinute2 = 28;
const int activationSecond1=30;
const int activationSecond2=30;
String temps;
int sentTime;
// Duration to keep the servo in active position in milliseconds
const unsigned long activeDuration = 5000;  // 5 seconds

bool isServoActive = false;
unsigned long servoStartTime = 0; // Variable to store the servo
activation time


bool bouton , first ;
bool deuxieme;


void moveServo(int angle) {
  myservo.write(angle);
}
void checkTime() {
   Blynk.virtualWrite(V0,distance);
   Blynk.virtualWrite(V1,temps);
   Blynk.virtualWrite(V4,angle);
}
BLYNK_WRITE(V2) //
{
  if(param.asInt() == 1)
  {
   moveServo(180);
  lcd.clear();
    lcd.setCursor(6, 0);
    lcd.print("Food");
    lcd.setCursor(3,1);
    lcd.print("Dispensed");
    delay(10000);
    lcd.clear();
    lcd.setCursor(0, 0);
    lcd.print("Waiting for new");
    lcd.setCursor(2,1);
    lcd.print("distribution");
  }
  else
  {
   moveServo(0);

  }
```

```
}
  BLYNK_WRITE(V3) // Slider Widget for Servo on V3
{
   angle = param.asInt(); // Get value from slider

   moveServo(angle); // Set servo 1 position

 }

void setup() {
  Serial.begin(115200);
  pinMode(buttonPin, INPUT);
  // Connect to WiFi
  WiFi.begin(ssid, password);
  while (WiFi.status() != WL_CONNECTED) {
    delay(1000);
    Serial.println("Connecting to WiFi...");
  }
  Serial.println("Connected to WiFi");

  // Initialize time client
  timeClient.begin();
  timeClient.update();

  // Attach the servo
  myservo.attach(servoPin);
  myservo.write(0);  // Start with servo in the initial position
  pinMode(TRIGGERPIN, OUTPUT);
  pinMode(ECHOPIN, INPUT);
  // Initialize LCD
  lcd.init();                         // initialize the lcd
  lcd.init();
  lcd.backlight();
  lcd.setCursor(0, 0);
  lcd.print("Initializing...");
  delay(3000);
  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print("Distribution is");
  lcd.setCursor(6, 1);
  lcd.print("ready");
   // Connect to Blynk
  Blynk.begin(auth, ssid, password);

  // Synchronize time
  setSyncInterval(10 * 60); // Sync interval in seconds
```

```
  // Setup timer to check time every second
  timer.setInterval(1000L, checkTime);
}
void loop() {
  digitalWrite(TRIGGERPIN, LOW);
  delayMicroseconds(3);
  digitalWrite(TRIGGERPIN, HIGH);
  delayMicroseconds(10);
  digitalWrite(TRIGGERPIN, LOW);
  duration = pulseIn(ECHOPIN, HIGH);
  distance = (duration/2) / 29.1;
  Serial.print(distance);
  Serial.println("Cm");

  Serial.print(angle);
  Serial.println("degrees");
  Serial.println("");


  timeClient.update();

  int currentHour = timeClient.getHours();
  int currentMinute = timeClient.getMinutes();
  int currentSecond= timeClient.getSeconds();

  String hour=String(currentHour);
  String minute=String(currentMinute);
  String seconde=String(currentSecond);

  //temps= hour+minute+seconde;
  temps= hour+minute;
  Serial.println(temps);


  Serial.print("Current time: ");
  Serial.print(currentHour);
  Serial.print("h:");
  Serial.print(currentMinute);
  Serial.print("min:");
  Serial.println(currentSecond);
  Serial.println("  ");
  //delay(1000);

  //+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
+++++++++++++++++++++++++++++++++++++++++++

  // Check if it's time to activate the servo
```

```
  if (currentHour == activationHour1 && currentMinute ==
activationMinute1 && currentSecond == activationSecond1){
    first= true;
    //deuxieme=false;
    //bouton=false;
    if (!isServoActive) {  // Activate only if not already active
      moveServo(180);  // Move the servo to 180 degrees
      isServoActive = true;
      servoStartTime = millis();  // Record the start time
    }
  }
 // Check if the active duration has passed
  if (isServoActive) {
    unsigned long currentTime = millis();
    if (currentTime - servoStartTime >= activeDuration) {
      moveServo(0);  // Return the servo to 0 degrees
      isServoActive = false;

    }
  }
  //++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++++++++++++++++++++++++++++++++++++++++++++++++++
    else if  (currentHour == activationHour2 && currentMinute ==
activationMinute2  && currentSecond == activationSecond2) {
      deuxieme=true;
      //first=false;
      //bouton=false;
    if (!isServoActive) {  // Activate only if not already active
      moveServo(180);  // Move the servo to 90 degrees
      isServoActive = true;
      servoStartTime = millis();  // Record the start time
    }
  }

  if (isServoActive) {
    unsigned long currentTime = millis();
    if (currentTime - servoStartTime >= activeDuration) {
      moveServo(0);  // Return the servo to 0 degrees
      isServoActive = false;

    }
  }
  //++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++++++++++++++++++++++++++++++++++++++++++++

       //lastButtonState = buttonState;
     buttonState = digitalRead(buttonPin);
```

```
  if (buttonState == HIGH )
    {
    moveServo(180);
    isServoActive = true;
    bouton= true;
    //first=false;
    //deuxieme=false;
    servoStartTime = millis();    // Record the time when the servo was
activated

  }


 if (isServoActive && millis() - servoStartTime >= activeDuration ) {
    moveServo(0);
    isServoActive = false;        // Reset the active flag


  }
  //++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
+++

      if (deuxieme){
        lcd.clear();
        lcd.setCursor(2, 0);
        lcd.print("Done seconde");
        lcd.setCursor(2, 1);
        lcd.print("Distribution");
        delay(6000);
       deuxieme=false;
      }
   //+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
   if (first){
        lcd.clear();
        lcd.setCursor(2, 0);
        lcd.print("Done First");
        lcd.setCursor(2, 1);
        lcd.print("Distribution");
        delay(6000);
        first=false;
      }
    //++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
    if (bouton){
    lcd.clear();
```

```
    lcd.setCursor(6, 0);
    lcd.print("Food");
    lcd.setCursor(3,1);
    lcd.print("Dispensed");
    delay(6000);
    bouton=false;

    }
    //+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
+++
    lcd.clear();
    lcd.setCursor(0, 0);
    lcd.print("Waiting for new");
    lcd.setCursor(2,1);
    lcd.print("distribution");
    delay(300);

  Blynk.run();
  timer.run();
}
```

Appendix B: Cost estimation

Table 2: cost estimation

Component	**Quantity**	**Unit Cost**	**Total Cost**
Esp32	1	15500Fr	15500Fr
LCD 16*2_i2c	1	1000Fr	1000Fr
Ultrasonic sensor	1	4500Fr	4500Fr
Servo motor	1	4000Fr	4000Fr
Arduino	1	15000Fr	15000Fr
Push button	1	500Fr	500Fr
PVC pipe elbow	2	700Fr	1400Fr
T PVC pipe	1	1000Fr	1000Fr
pipe	1	2000Fr	2000Fr

PCB	1	1500Fr	1500Fr
Gourd	1	3000Fr	3000Fr
Jumper wires	30	50Fr	1500Fr
Hot glue	6	300Fr	1800Fr
Total			53000Fr