An-Najah National University

Faculty of Engineering & Information Technology

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Bachelor degree in Computer Engineering

Graduation Project 2

Sheep MilkPro

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Acknowledgment

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Disclaimer Statement

This report was written by the two students in the Department of Computer Engineering at the College of Engineering, Alaa Yamak and Tasneem Abu Al-Rob. It may contain linguistic errors or errors in the content because it has not been modified. All opinions, suggestions, and results in it are from the students themselves, and the university is not responsible for any use of this report other than the purpose for which it was presented.

Abstract

Sheep MilkPro is a design and implementation of a feeding machine for sheep and cows. It consists of four units: a Heating Unit, an Input/Output Unit, making milk and a Control Unit. To keep the water boiling, the heating appliance uses a heating element. Users of the input/output unit can prepare milk using an LCD and a keypad. Using an Arduino Mega and an ESP8266, the Control Unit establishes communication between the components and links the machine to the mobile application.

It's mainly for water and milk stocks. The water is heated to 40 degrees to protect these animals from any health problems. Milk production takes place through a mixing process between them, after which special valves are opened so that animals obtain milk through the process of suction. The milk is passed through flow sensors so that the owner of the barn can obtain accurate information about the quantities that are consumed in each feeding, which is what matters to him from an economic point of view. The machine also has a cleaning feature, which is a process of pumping water without milk to remove residues and plankton from food.

It also contains additional features such as Ultrasonic sensors that are used to get an alert of low water and milk supply, RFID for each sheep to check main information about it, and the RTC for the scheduling process, to carry out the feeding operation or cleaning operation at specific times.

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Chapter 1

Introduction

1.1 Statement of the problem

Large barns that contain many numbers of sheep or cows constitute a large source of income for their owner, which must be taken care of in a technological manner, with great accuracy and care in terms of quantities, temperature, and milk concentrations according to the age of the animal, feeding dates all of which are difficult to deal with in the traditional ways that Its error rate will be much greater.

1.2 Objectives of the work

Designing and developing a modern feeding machine to make it easier for the owner of large barns to deal with livestock, which leads to an increase in production. A machine that takes care of the water temperature and milk concentration according to the age of the animal. Traditional methods can be more difficult in terms of scheduling, cleaning, and knowing what was consumed per day.

1.3 Scope of the work

The scope of this project includes the design, development and implementation of a sucking machine for sheep and cows, in which milk is mainly produced by mixing certain amounts of water at certain temperatures with specific concentrations of milk according to the age of the animal, to produce a milk solution.

In addition to the cleaning system to get rid of any impurities or plankton. The machine consists of two modes, feeding and cleaning. The quantities of water and the age of the animal are entered through a keypad, and then the machine performs the mixing process according to what has been entered. It also contains sensors to monitor the supply of water and milk and

ensure that it is replenished as needed. An app has been developed to allow the barn owner to get notifications about stock issues. And a schedule was made for the compatibility between the two modes that we have.

1.4 Significance of our work

The development of a modern feeding machine for sheep is an important initiative that can provide many benefits to society. It will enable the owner of these sheep to deal with his animals in a planned manner in terms of quantities, time and concentrations. In addition, the machine will be kept clean of any plankton in it, and it will also be monitored. Store water and milk and send notifications to the application so that it can fill it. This will facilitate dealing with large numbers of sheep in a way that increases their productivity, especially since traditional methods may cause some problems such as not adjusting the water to the appropriate temperature, or even not cleaning the machine!

1.5 Organization of the report

The arrangement of this report comprises multiple segments. The introductory part offers an outline of the project and its goals. The subsequent section delineates the extent and limitations of the undertaking. Following that, the third part highlights the approach and steps undertaken to finalize the project. In the fourth division, outcomes and discoveries are showcased, encompassing any difficulties confronted and their subsequent solutions. The fifth section delves into the importance and potential influence of the project. Ultimately, the concluding remarks encapsulate the essential elements of the report and offer suggestions for future endeavors. Supplementary materials, containing pertinent data and information concerning the project, are enclosed in the appendices.

Chapter 2

Constraints, Standards/ Codes and Earlier course work

2.1 Constraints and limitation

1. Time limitation: We encountered great difficulties during the completion of this project during the summer semester, because it is the first time that we have been able to build an integrated and large system that contains many mechanical and electronic parts that we have not dealt with before and that require lot of power and different levels of voltage (3.3 V, 5 V, 12V, 220V). It was our responsibility to define the overall structure of the system, the components to be used and how to deal with them, as get to know the Arduino and write codes for the hardware, and then build a complete system.

2. Project Size and Weight: Due to the relatively large scale of the design, we encountered an issue of not being able to transport it and carry out the work elsewhere apart from the university. After installing most of the mechanical components in their respective positions, our main work was scheduled during specific hours, including university working hours, which caused some delays in our progress to some extent.

3. Safety and Security: Due to the project's concept, we were compelled to utilize water as a fundamental element in representing the project. Additionally, mechanical and electrical components were employed that only operate at a voltage of 220. Therefore, testing the project, given its inclusion of potent liquids and electricity, was a delicate matter that required precision and attention.

4. Precision and Attention: Our project encompasses various operations such as heating water to a specific temperature, measuring water quantities, and precisely calibrating the operation of numerous mechanical components. This precision is essential for their proper functioning due to the extensive diversity of components employed. Additionally, we manually crafted the project's design using plastic or metal pieces that were opened to accommodate the majority of components. The design was meticulously and securely crafted with precision and skill.

5. Power Distribution: As previously mentioned, for the first time, we have undertaken a comprehensive and large-scale project. Consequently, we encountered a challenge in distributing power to the components used in its construction. These components require different current values and voltage levels. For instance, regarding the issue of current usage, we employed four valves that operate at 12 volts and two pumps that also operate at the same voltage. However, the amount of current drawn was substantial and insufficiently supplied by the power source. It's worth noting that we also incorporated components with varying voltage levels. For example, a water heater operating at 220 volts and sensors operating at 5 volts or 12 volts, so to solve the problem we used a switching control power supply and power converter.

6. Limited Resources: The subject of the project involves the category of farmers and livestock breeders in the community, which is currently a relatively small group. Additionally, most of this category relies on traditional methods for feeding livestock on larger farms, avoiding the use of such machinery. Consequently, we faced challenges in finding sources that have implemented modern approaches in the feeding process similar to what we are attempting. The scarcity of resources also extends to difficulties in locating a supplier for a specific type of feeders we require at an appropriate price.

2.2 Standards and Codes

The system's software elements encompass an Arduino program coded in C++. This program integrates a variety of libraries and functions, notably Keypad.h, LiquidCrystalI2C.h, wire.h, OneWire.h, DallasTemperature.h, RTClib.h, and SPI.h. Additionally, the user interface was crafted using the Blynk platform. The system's software components were designed and implemented in accordance with pertinent industry standards and guidelines.

2.3 Earlier coursework

It was really helpful to take the Microcontroller Using PIC Controller course,it improved our knowledge of microcontroller programming, which was necessary for creating our device utilizing an Arduino Mega.
We also learned how to use tools like I2C and PWM and interact with different components. With the information we obtained from this course, we were able to efficiently construct the code for the machine—the project's main component—which contained the necessary algorithm.
In order to build the machine, it was also vital for us to take an Arduino course because it gave us the abilities and knowledge to operate with the Arduino Mega board. The course provided us with practical training in programming and debugging the Arduino board, which was essential for creating the control system.

The ability to approach the project methodically and make wise conclusions was provided by the Critical Thinking course, which was crucial to the project's success. The course helped us develop critical thinking abilities that enabled us to recognize potential problems, examine them, and come up with workable solutions. This was crucial, especially as the project progressed and we encountered design and power-related problems. And many important courses, such as digital design, electronic circuits and electrical circuits that supported us in understanding the basics and key concepts during work to form an integrated working system.

Chapter 3

Literature Review

The "Sheep MilkPro" Machine aims to provide users with the ability to control a quick feeding process, with less effort and cost for their sheep, especially in large farms, in addition to a monitoring system to read sensors and ingredient levels. This section will examine relevant material on the creation of creative feeding milk machines.

- "Using automatic feeders for calves and lambs"
  Automatic feeders are used to manage the feeding of young mammals, with lambs and calves as primary recipients. These feeders provide monitored milk replacers based on individual needs and record data on intake. Proper ventilation, space allocation, and cleaning are essential for calf health. Lambs have free access to milk replacers, and their feeding process requires attention to ventilation, space, and cleanliness. Halavit offers high-quality milk replacers for optimal growth, emphasizing the importance of nutrition and monitoring. [1] [2]

- "Automatic Eco Lamb Feeder"
  The Förster-Technic Automatic Eco Lamb Feeder is made to feed 40 to 240 lambs and provides simple operation and low-labor feeding for healthy lamb rearing. Warm water and milk substitute prepared in small volumes are available for the lambs to drink as needed. With up to 16 teats supported by the feeder's eight outputs, it can feed 240 lambs at a rate of 15 lambs per teat. The control unit's easy interface lets you customize different portion sizes. The feeder guarantees dependable temperature control and is simple to clean. It has fly protection and needs a mains water connection and 16 amp power supply. Contact Förster-Technic for additional information. [3]

- "Agromasters' Ambrosia Milk Feeding System"
  is an advanced automated method for raising lambs and young goats. This sturdy milk

feeder, which can hold up to 800 animals, provides controlled nutrition as well as advantages such resembling natural feeding patterns, lowering disease risks, and effective feeding. The system's numerous feeding stations, pinch valve control, constant water temperature, and exact dosing ensure that young animals are cared for and grown for optimally.[4]

- "Lamp-Bar"

  This section discusses the artificial rearing of lambs, covering situations such as orphans, mis-mothered lambs, and weak lambs. Lambs are removed for artificial rearing on the first day, fed colostrum from a bottle if needed, and trained to nurse from a nipple bar. Two types of systems are described: one with individual pens, and the other with group pens where milk is distributed through a pipeline or plastic containers with nipples.[5]

  This system utilizes rubber nipples connected to plastic tubing with a non-return valve to control milk flow. Milk replacer is prepared with warm water, and pens hold 10-15 lambs each, with lamb bars and nipples for feeding. Quality milk replacer with specific nutritional content is crucial. Lambs are fed about 8-10 kg of milk replacer until weaning at 42 days, with adjusted intake in the last two weeks to promote solid feed consumption. The decision to use milk replacer depends on various factors. After weaning, lambs spend a week in the same barn before being moved, and the rearing units are cleaned and disinfected after each batch. In summary, this section details the practices and considerations for artificial rearing of lambs, including feeding systems, milk replacer preparation, and the transition to solid feed.[6]

Previous literature reviews indicated that the production of such machines will improve the livestock feeding process in the farms, in terms of ensuring hygiene, reducing the time and effort of the farmer and helping him to feed lambs resulting from multiple births, lambs suffering from malnutrition, orphans or weak lambs in the first week of pregnancy her life.
Our project shares a common sub-process with previous works in the field, including techniques for heating the water, The mechanism for distributing milk and using nipples for feeding contains a reciprocating valve , Our machine stands apart from earlier models thanks to a number of distinctive new features.
Firstly, it includes a subsystem beyond milk supply, which is the provision of vitamins to the sheep. Additionally, the system is connected to a mobile application for monitoring water and milk levels to give farmers an alert when quantities are low. It also incorporates RFID to identify ID each sheep upon entry into the farm system. This ensures that the milk concentration each sheep drinks is based on its age category, guaranteeing that all sheep have consumed milk. The

key data associated with each sheep's tag number is displayed correspondingly. In addition to the aforementioned unique features, our machine also boasts the capability to automatically supply water to the device when water levels drop. This feature eliminates the need for manual water tank refilling, ensuring a seamless and continuous experience. It further enhances the convenience factor of our device, setting it apart from other devices in the market.

Chapter 4

Methodology

The hardware components utilized to construct the system, their connections, and the overall system design will all be covered in this chapter. We will also go through how the system functions, as well as how the software and mobile app.

4.1 Hardware Components

4.1.1 Microcontrollers

- Arduino Mega 2560

The Arduino Mega stands as a microcontroller platform established upon the ATmega2560. It encompasses 54 pins designed for both receiving and transmitting digital signals (with 14 of these capable of serving as outputs for pulse-width modulation). Moreover, it integrates 16 analog inputs, boasts 256k of Flash Memory, accommodates 4 UARTs for hardware-based serial communication, houses a 16 MHz crystal oscillator, features a USB link, incorporates a power jack, incorporates an ICSP header, and incorporates a reset button. The Mega 2560 R3 version introduces further enhancements such as the inclusion of SDA and SCL pins positioned adjacent to the AREF pin. Furthermore, two novel pins have been introduced near the RESET pin. One of these is labeled IOREF and serves to enable shields to adjust their voltage requirements in accordance with the board. The second pin remains unconnected and has been reserved for prospective applications. The Mega 2560 R3 is fully compatible with all existing shields while also being adaptable to upcoming shields designed to make use of these supplementary pins.

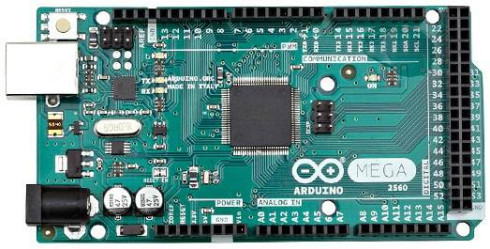

Figure 4.1: arduino Mega 2560

- **ESP8266EX**

Our project includes creating a communication channel between microcontrollers ESP and Arduino Mega. In addition, we have developed a mobile application to facilitate the admin's access to the machine, through which he can monitor the stock of water and milk.

1- Single-core 32-bit LX106 microprocessor with a clock frequency of up to 160 MHz. 2- 80 KB of SRAM, 1 MB of flash memory.

3- Supports 802.11 b/g/n Wi-Fi connectivity with speeds up to 72.2 Mbps.

4- Supports Classic Bluetooth v2.1 and BLE specifications.

5- 17 programmable GPIOs.

6- Up to 10 channels of 12-bit SAR ADC.

7- Serial connectivity includes 2 x UART.

8- No built-in Ethernet MAC; Wi-Fi connectivity only.

9- No dedicated SD/SDIO/MMC controller.

10- Supports PWM output on some GPIO pins.

11- No native secure boot or flash encryption.

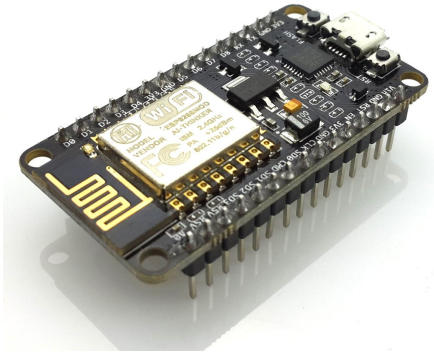

Figure 4.2: ESP 8266

4.1.2 Motors and drivers

- DC motor

It was used in the milk stock box, to move the spiral coil responsible for lowering the milk into the mixer in the correct way, which prevents any agglomeration of milk powder.

Figure 4.3: DC motor

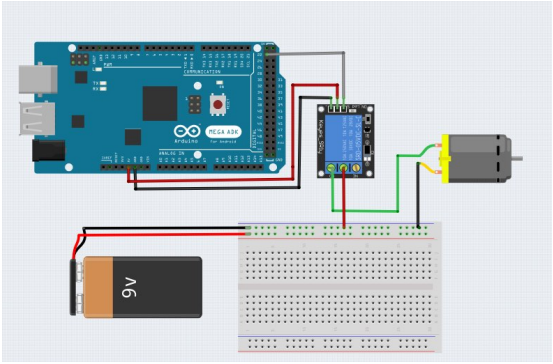

Figure 4.4: DC motor connection

4.1.3 Sensors

- Ultrasonic sensors

We used two of them to check and monitor the water and milk stock levels.

Figure 4.5: Ultrasonic sensor

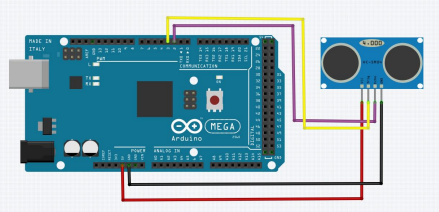

Figure 4.6: Ultrasonic sensor connection

- Water flow sensor

We used three of them, in order to calculate the amount of milk in liters that is fed from each tube.

Figure 4.7: Water flow sensor

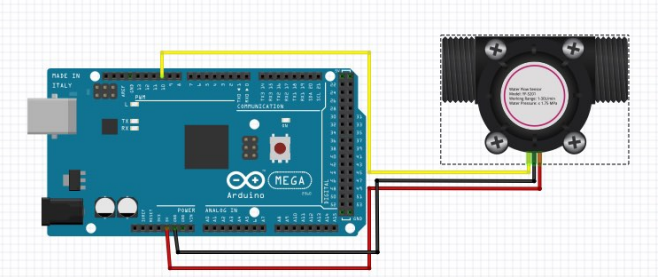

Figure 4.8: Water flow sensor connection

- Waterproof 1-Wire DS18B20 Digital temperature sensor

Responsible for checking the temperature during heating so that the heater is stopped at the appropriate time (the time the water reaches 40 degrees).

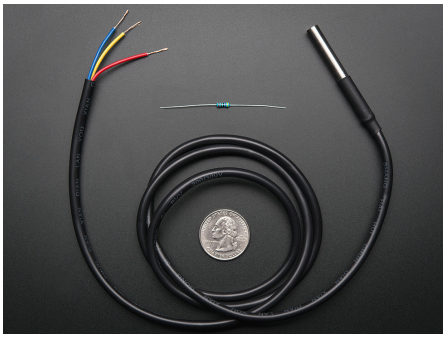

Figure 4.9: Digital temperature sensor

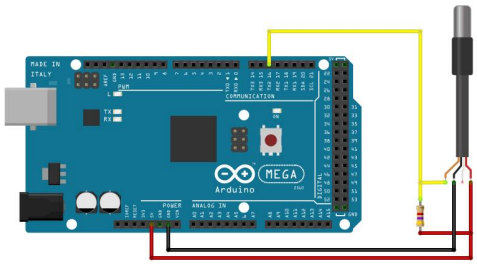

Figure 4.10: Digital temperature sensor connection

4.1.4 Input/Output Devices

- LCD 20*4 and I2C

To display some of the necessary inputs and outputs, such as displaying the things that we have selected from the keypad, displaying the state that the machine has reached at this time.

Figure 4.11: LCD and I2C

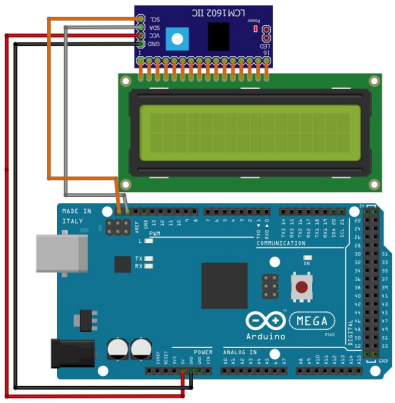

Figure 4.12: LCD and I2C connection

- RFID

It was used in our project as an ID card for each sheep, displaying essential information about the sheep, including its number, weight, age category, and milk consumption quantity.

Figure 4.13: RFID

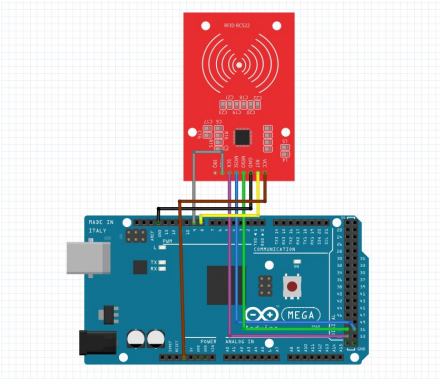

Figure 4.14: RFID Connection

- Keypad

The user interface through which he enters the mode (feeding, cleaning and data), the age of the animal, The amount of water, and other details needed to start the milk production process.

Figure 4.15: Keypad

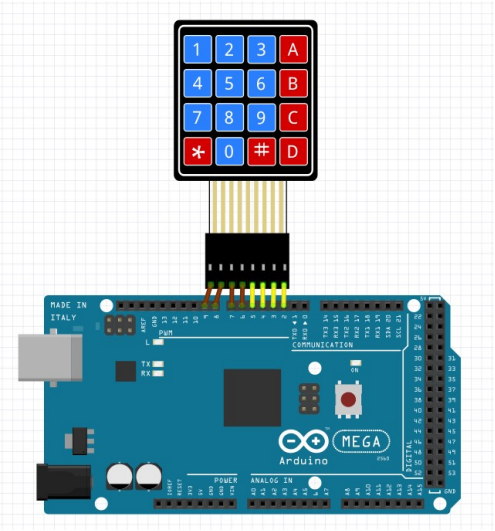

Figure 4.16: Keypad Connection

- Serial MP3 player

It was used in the project to provide the project with music and a specific song that can be controlled, in addition to using its memory for song storage and a speaker for song output.

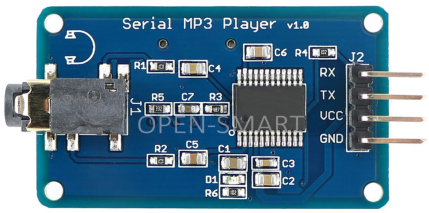

Figure 4.17: Serial MP3 player

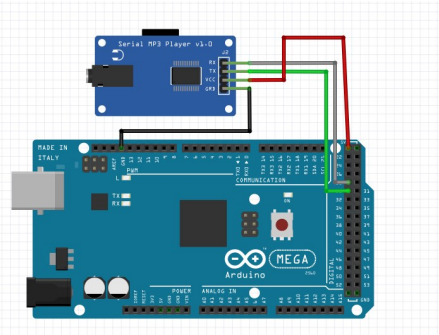

Figure 4.18: Serial MP3 player connection

- RGB Strip

Generate light based on the control signals they receive.

Figure 4.19: RGB Strip

4.1.5 Power Devices

- Power Supply

We decided to use a computer power supply since it can offer the required 5 volts for numerous devices and 12 volts for pumps and DC motors in order to meet the voltage specifications for our project. The power supply also provides a sufficient current output to suit the requirements

of our project.

Figure 4.20: Power Supply

- Heater

It was used to heat water to a specific temperature, with the note that it operates at 220 volts.

Figure 4.21: Heater

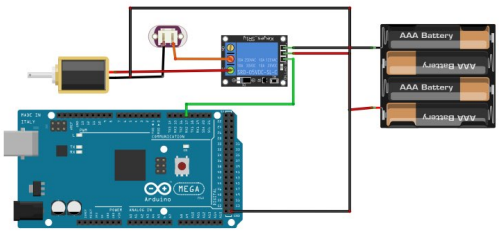

Figure 4.22: Heater Connection

4.1.6 Other Devices

- Water Pump

Three water pumps, each operating at 12 volts, were used. The first pump is for pumping water from the water tank, the second is for distributing milk in the blender after mixing, and the last one is on the water drainage side after the cleaning process. **- 12V DC Fish Tank Pump**

Figure 4.23: Water pump

This pump was used in the project with the aim of mixing powdered milk with hot water in the mixing unit, as this pump operates to circulate water and agitate it within the tank.

Figure 4.24: DC Fish Tank Pump

- Valves

Five water valves were used in different units in the project, one of them operates at 220 volts, and the others at 12 volts, to control the flow of liquids. We also used valve accessories to ensure that both sides of the valve were compatible with both tube and another side in different units.

Figure 4.25: Valve

Figure 4.26: Valve Accessories

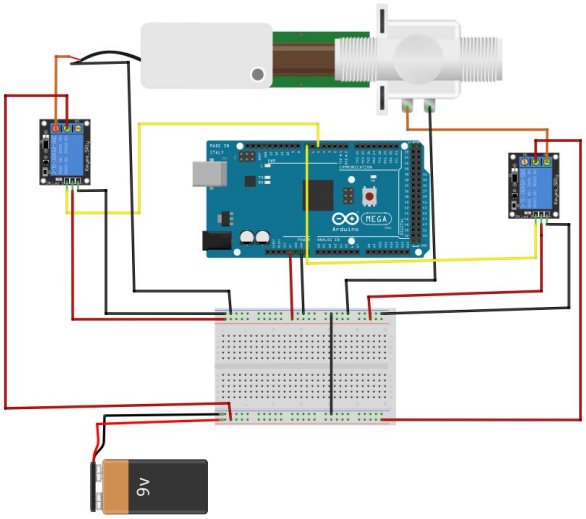

Figure 4.27: Valve and pump connection

- RTC -Real-Time Clock

It was used to track the current time accurately in real-time and was set to initiate the feeding process at a specific hour and start the cleaning process at a specific hour.

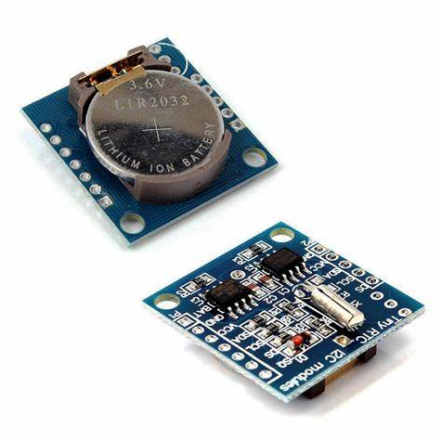

Figure 4.28: RTC

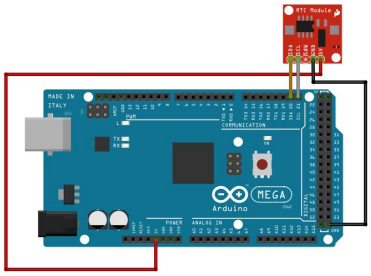

Figure 4.29: RTC Connection

- Relay

5-volt relay module is a type of relay that can be controlled by a 5-volt signal, which is compatible with the Arduino microcontroller, It was used in the project to control the opening and closing of most of the mechanical and electrical components.

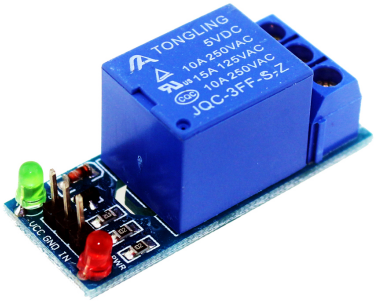

Figure 4.30: Relay

- Water tubes

Various types of it were used, with different sizes and fasteners for their installation.

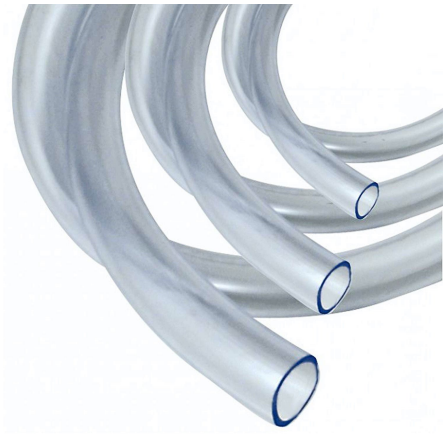

Figure 4.31: Tube

- Milk bar feeders

Through it, milk will be supplied to the livestock.

Figure 4.32: Milk bar feeders

- Push button

It is used to control the pause and playback of the song supplied by the MP3 player.

Figure 4.33: Push button

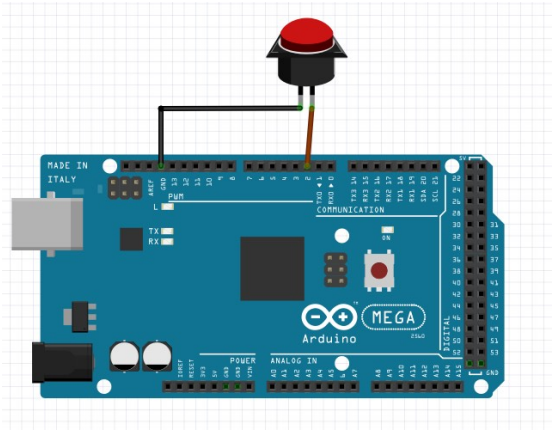

Figure 4.34: Push button connection

- On/Off switch

It is used to control the 220 volt, for emergency.

Figure 4.35: On/Off switch

- Wires

For various connections, we used male-to-male, female-to-female, and male-to-female wires.

Figure 4.36: Wires

4.2 Hardware Implementation

4.2.1 Heating Unit

We used a heater to heat the water at 40 degrees (the degree at which goats drink milk), this degree can be controlled in terms of reducing or increasing it through the Keybad, in addition to a temperature sensor that makes sure that the water reaches the required degree, a pump was used to pump water After that to the bowl responsible for making the milk.

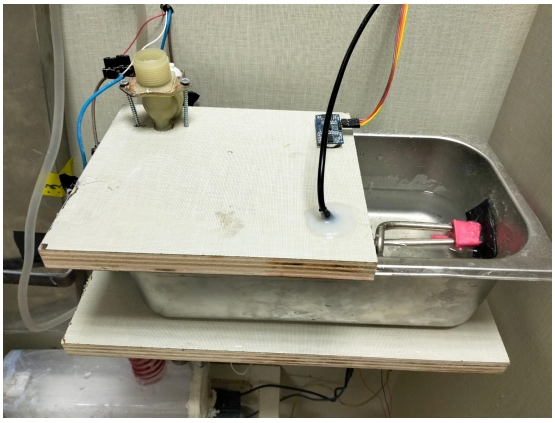

Figure 4.37: Heating Unit

4.2.2 Input-Output Unit

We have the LCD and Keypad to take orders from farmers, and the RFID to identify sheep IDs,And using it to display the sheep's data and confirm its milk consumption according to its age group. A mechanism for distributing and pumping milk, after processing it, to a group of nipples that contain retractors, and are connected to valves. A sheep simulating sound is played when the milk is ready.

Figure 4.38: Input/Output Unit

Figure 4.39: Output Unit

4.2.3 Making Milk

In the beginning, the water is heated as mentioned above and is pumped into the container designated for the preparation of milk, after that the DC motor, which is attached to the helical coil, drops specific quantities of milk powder into the same container. The bowl contains three pumps, one for the process of mixing the ingredients, and the second for pumping it on three valves connected to the bottles that the sheep will drink from. As for the third pump, it is for the drainage or cleaning process, in which we pump a certain amount of hot water into the container with a pumping process to remove impurities and plankton, and then drain it by means of the third pump.

Figure 4.40: Milk Unit

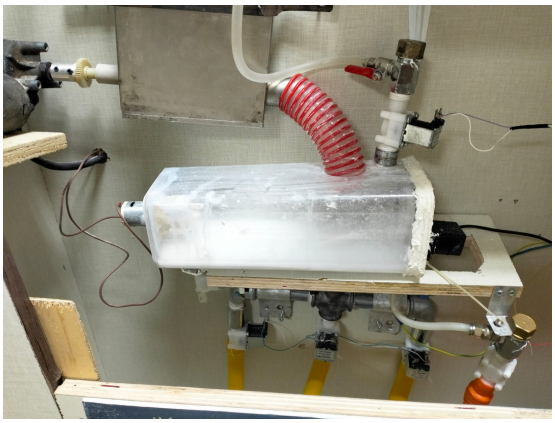

Figure 4.41: Making Milk Unit

4.2.4 Control Unit

Within the control segment, the entirety of the machine's operations is overseen by the Arduino. The Arduino is linked to the ESP8266, which is subsequently connected to a mobile application, enabling farmers to oversee quantity levels. Moreover, the machine's components are powered by a PC power supply.

4.3 Mobile Interface

The application was designed using the Blink platform, it includes 2 LED indicators. with the aim of monitoring the levels of water and milk inside their respective inventories. It provides an alert to the administrator in case of a shortage in the water inventory to automatically open the water valve and fill it, and in case of a shortage in the milk inventory, it is also filled automatically.

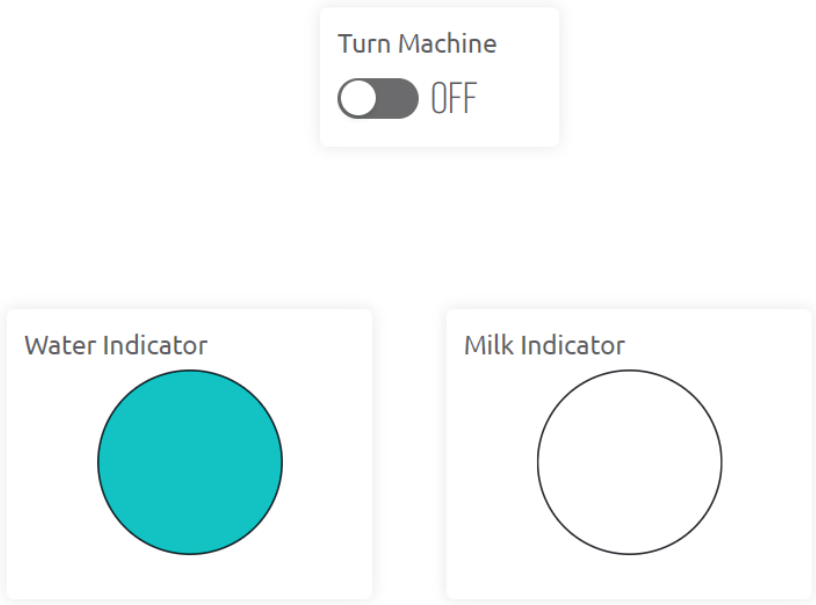

Figure 4.42: Mobile Interface

Chapter 5

Results and Discussion

5.1 Conclusion

At the end of this project, we have successfully created a milk-making machine for livestock feeding, which includes many features, with the most important being ease of use. It can be controlled through a LCD and keypad, and it also has a monitoring system accessible via a mobile phone. Additionally, it provides the RFID feature for each sheep, ensuring that each one has its own unique ID associated with a dedicated storage and essential information.

Through the implementation of the Sheep Milk Pro project, our aim is to serve farmers in the process of feeding livestock, especially during special circumstances when they cannot obtain milk from their mothers. This is achieved through an easy, fast, and automatic method to ensure cleanliness and health for the livestock while saving time and effort for the farmers.

Despite the overall success of the project, we encountered some challenges and limitations during the implementation process. The most significant ones included time constraints, as the project was completed during a summer term rather than a regular academic term, which coincided with other coursework commitments. Precision in work was also a challenge, particularly when measuring milk concentrations and water quantities. Furthermore, ensuring safety and security during usage was a concern due to the use of liquids and some electrical components operating at 220 volts.

The varied components' various voltage requirements made power distribution an issue as well. We used a switching control power supply to deliver the appropriate power and voltage levels for the system to function properly in order to resolve this.

In addition to the problems we faced during the design of the milk tank, it was modified several

times to achieve a smooth design that allows the powdered milk to flow without solidifying or hardening. We eventually arrived at the correct design, which includes a metal spiral coil connected to a DC motor to vigorously agitate and push the milk to prevent it from solidifying and hardening.

Chapter 6

Conclusions and Recommendation

6.1 Summary

We have succeeded as a team in designing and developing a milk-making machine for livestock feeding in large, modern barns to make it easier and healthier for the animals. The machine incorporates a set of technologies that facilitate control and operation for the farmers or administrators. It includes an LCD screen and a keypad for input and output control. Additionally, it features a simple monitoring system using a mobile application, which is the standout feature of the machine. This will greatly simplify the feeding process for livestock instead of manual handling, while taking into consideration many details during this process to ensure the animals' health, such as heating the water to a specific temperature and controlling milk concentrations based on the age category of the livestock.

Powering the various parts of the machine was one of the difficulties we encountered. While some parts needed 220 volts, others just needed 12 volts. We used a power supply from an old computer to generate both 5 and 12 volts, and we used regular electricity from houses and labs for the 220-volt components to overcome this issue.

In summary, the Sheep Milk Pro machine offers a convenient and seamless service to farmers by facilitating the process of feeding and milking sheep. This machine is particularly useful in cases where there is a large number of livestock in early weaning, orphaned animals, or even those with weak physical conditions. It provides these services automatically, allowing farmers at all levels to easily utilize it.

6.2 Recommendations

1. Arduino Board Usage Caution
Exercise caution while working with Arduino boards, particularly the Chinese variants, due to their output voltage being 3.1 volts, instead of the standard 5 volts,which may affect the proper functioning of certain components.

2. Independent Power Supply for Sensors and Devices
To ensure optimal performance and prevent potential issues, refrain from directly powering sensors and devices via the Arduino board. Instead, make use of a dedicated power supply to provide appropriate voltage levels.

3. Importance of Soldering
Prioritize the soldering of wires over mere connections, as wires that are solely connected are prone to easy breakage. Soldering contributes to enhanced durability and reliability.

4. Handle high voltages such as 220 volts with caution, especially in the presence of water.

6.3 What we have learned

- Dealing with different mechanical and electrical parts and sensors and programming them to form a complete system.

- Dealing with different levels of voltage and varying values of currents, as appropriate for each piece.

- Connecting Arduino to ESP8266 and Utilizing Its Wi-Fi Capabilities.

- Learn the skills of building and designing a model for an integrated system, including practical skills such as assembling pieces, fixing iron and wood, and using some industrial tools.

6.4 Future Work

- Using a load sensor to measure the weights of milk coming from the store, to increase accuracy in milk concentrations.

- Improving the mobile application to be done by controlling the entire process, in addition to creating a login page, and displaying some statistics and data related to sheep and drinking quantities.

- Developing cleaning mode, not only using water, but also adding sterilizers and acids in an automatic way during the cleaning process.

References

[1] Gustavo Mazon, Donna M. Amaral-Phillips, and Joao H. C. Costa. "Getting the Most from Automatic Dairy Calf Feeders". In: *Journal Name* (2023). URL: https://afs.ca.uky.edu/content/dairy-getting-the-most-from-automatic-dairy-calf-fee.

[2] Susan Schoenian. "Sheep 201: Feeding and watering equipment". In: *beginners guide to raising sheep* (19-Apr-2021). URL: http://www.sheep101.info/201/feedwaterequip.html.

[3] Volac Company. "Automatic Eco Lamb Feeder". In: *Volac* (). URL: volac_automatic_eco_lamb_feeder.pdf%20(lamlac.co.uk).

[4] agromaster$_a dmin$. "Agromasters Milk Feeding System for lambs baby goats". In: *Agromasters* (31 May 2023). URL: https://www.agromasters.gr/en/agromasters-milk-feeding-system-for-lambs-baby-goats/.

[5] FAO Consultant Soterios Economides. "Artificial rearing of lambs". In: (Rome, 1983). URL: https://www.fao.org/3/x6542e/X6542E00.htm.

[6] R. V. Large. "The artificial rearing of lambs". In: *The Journal of Agricultural Science* 65.1 (1965), pp. 101–108. DOI: 10.1017/S0021859600085403.