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Management and Supervision of Smart Sheep Farms

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Summary

This thesis focuses on the study of smart and protected sheep farming in the context of modern agriculture. It explores various aspects, emphasizing system design, monitoring, and reading environmental parameters. Through the use of sensors, electronic control units, micro software, and mobile applications, smart sheep farms contribute to improving production by ensuring ideal growth conditions for sheep. Automated management of smart sheep farming offers farmers an efficient means of controlling and managing climatic factors, thereby promoting healthy growth and more efficient resource utilization. By combining modern knowledge with traditional agriculture and leveraging the benefits of technology, smart sheep farming represents a promising advancement towards a more productive, sustainable, and resilient agriculture in the face of global challenges.

Keywords: Smart sheep farms, automation, sensors, control, agriculture

Résumé

Cette thèse se concentre sur l'étude de l'élevage ovin intelligent et protégé dans le contexte de l'agriculture moderne. Elle explore divers aspects, en mettant l'accent sur la conception des systèmes, la surveillance et la lecture des paramètres environnementaux. Grâce à l'utilisation de capteurs, d'unités de contrôle électroniques, de logiciels micro et d'applications mobiles, les fermes ovines intelligentes contribuent à améliorer la production en garantissant des conditions de croissance idéales pour les moutons. La gestion automatisée de l'élevage ovin intelligent offre aux agriculteurs un moyen efficace de contrôler et de gérer les facteurs climatiques, favorisant ainsi une croissance saine et une utilisation plus efficace des ressources. En combinant les connaissances modernes avec l'agriculture traditionnelle et en tirant parti des avantages de la technologie, l'élevage ovin intelligent représente une avancée prometteuse vers une agriculture plus productive, durable et résiliente face aux défis mondiaux.

Mots-clés : Fermes ovines intelligentes, automatisation, capteurs, contrôle, agriculture

الملخص:

تركز هذه الرسالة على دراسة تربية الذكية للأغنام والمحمية في سياق الزراعة الحديثة. وتستكشف مختلف الجوانب، مع التركيز على تصميم النظام والمراقبة وقراءة البارامترات البيئية. من خلال استخدام المستشعرات ووحدات التحكم الإلكترونية والبرامج الدقيقة والتطبيقات الجوالة، تساهم المزارع الذكية للأغنام في تحسين الإنتاج من خلال ضمان

ظروف النمو المثالية للأغنام. يوفر الإدارة الآلية لتربية الذكية للأغنام للمزارعين وسيلة فعالة للتحكم في العوامل المناخية وإدارتها، مما يعزز النمو الصحي واستخدام الموارد بكفاءة أكبر. من خلال الجمع بين المعرفة الحديثة والزراعة التقليدية واستغلال مزايا التكنولوجيا، تمثل تربية الذكية للأغنام تقدماً واعدًا نحو زراعة أكثر إنتاجية .واستدامة ومرونة في مواجهة التحديات العالمية

.الكلمات الرئيسية: المزارع الذكية للأغنام ، الأتمتة، المستشعرات، التحكم، الزراعة

Table des matières

Acknowledgments i

Summary ii

Table des matières iv

List of figures viii

General Introduction 11

Chapter1: Overview of Farms 12

1.1 Introduction 12

1.2 Definition of Farmer 12

1.3 History of Sheep Farming 12

1.4 History of Sheep farms 13

1.4.1 Ancient Times 13

1.4.2 Medieval Era 13

1.4.3 Modern and Contemporary Times 14

1.4.4 Future 14

1.5 Types of Farms 14

1.5.1 Closed Farm 15

1.5.2 Open Farm 15

1.6 Advantages and Disadvantages of Sheep Farms 16

1.6.1 Benefits 16

1.6.2 Defects 17

1.7 Selection Conditions of Materials and Tools 18

1.8 Conclusion 19

Chapter2: Description of smart farms 21

2.1 Introduction 21

2.2 Definition of Automated Farm 21
2.3 Distinction between Automated Farm and Automatic Farm 21
2.4 Smart Farms 22
2.5 Characteristics of Smart Farms 23
2.6 Shortcomings of Smart Farms 24
2.7 Appropriate Conditions in Breeding and Control Methods 24
2.7.1 Conditions to Be Met by Farms 24
2.7.2 Ventilation 24
2.7.3 Mechanical Ventilation 25
2.7.4 Heat 25
2.7.5 Feed 26
2.7.6 Dampness 28
2.7.7 Lighting 28
2.8 Intensive sheep farming 30
2.8.1 Microfiltration method 30
2.8.2 Objectives 30
2.8.3 The most modern tools in the field of livestock 30
2.9 Portable devices 32
Chapter 3: Hardware and Software 35
3.1 Introduction 35
3.2 Sensors for farm parameters 35
3.2.1 Sensor 35
3.2.2 types of sensors 35
3.2.3 Sensor internal components 36
3.3 Basic Application Equipment 36
3.3.1 Arduino Ono 36

3.3.2 temperature and humidity sensor DHT11 37
3.3.3 Soil Moisture Sensor FC-28 38
Low-cost water level sensor 40
3.4 Integration with Arduino 41
3.4.1 Programming the Water level sensor 41
3.4.2 Bluetooth HC-05 Module 42
3.4.3 Bluetooth module HC-05 connected to Arduino 42
3.4.4 Programming the Bluetooth module HC-05 43
3.4.5 Servo Motors 43
3.4.6 Servomotors connected to Arduino 44
3.4.7 Programming the servo motor 45
3.4.8 LCD screens (LCD screens) 45
3.4.9 LCD Display connected to Arduino 47
3.4.10 Programming the control of the LCD screen. 47
3.5 Small Motor Water Pump 48
3.5.1 Water pump connected to Arduino 48
3.5.2 Fan 51
3.6 Required software 52
3.6.1 Arduino IDE Development Environment 53
3.6.2 MIT App Inventor 53
3.7 Conclusion 54
Chapter 4: production and development 56
4.1 Introduction 56
4.2 Principle of operation 56
4.2.1 Specifications 56
4.3 Development of electronic panels 57

4.3.1 Development of Android applications 61

4.4 Conclusion 69

General conclusion 70

Bibliographies 72

List of figures

Figure 1-1 : An ancient sheep farm 13

Figure 1-2 : A 3D image of a modern sheep farm design 14

Figure 1-3 : A 3D image of a modern sheep farm design 15

Figure 1-4 : Open (shaded, semi-shaded) farm 16

Figure 1-5 : : An image representing food waste 17

Figure 1-6 : : Structural components of a livestock farm 18

Figure 2-1 : Smart sheep management and control technology 22

Figure 2-2 : Illustration of motion analysis 23

Figure 2-3: Natural air cannons flowing inside the farm.......... 25

Figure 2-4 : :Mechanical ventilation 25

Figure 2-5 : Mist cooling 26

Figure 2-6 : Automatic feed distribution system by belt 27

Figure 2-7 : Automatic feed distribution system by cart 27

Figure 2-8 : Economic zones in sheep farming 28

Figure 2-9 Multiple openings for natural 29

Figure 2-10 : Some different effects of melatonin on sheep 29

Figure 2-11 : Automated and traditional milking systems on dairy farms 31

Figure 2-12 : Automated workstation for livestock monitoring 31

Figure 2-13 : Traditional livestock care 32

Figure 2-14 : Livestock control 32

Figure 2-15 : ;Portable tracking device 33

Figure 3-1 : Internal structure of a sensor 36

Figure 3-1 : Arduino Uno 37

Figure 3-2 : The hardware structure of Arduino Uno 37

Figure 3-3:DHT11 sensor 37
Figure 3-4 : Wiring of a DHT11 sensor on the Arduino Uno 38
Figure 3-5 Demonstration code of a DHT11 sensor 38
Figure 3-6 : FC-28 sensor 39
Figure 3-7 : Wiring of an FC-28 sensor on the Arduino Uno 40
Figure 3-8 : Demonstration code of an FC-28 sensor 40
Figure 3-9 : Water level sensor 40
Figure 3-1 : Water level sensor 41
Figure 3-2 : programming the Water level sensor 41
Figure 3-3 : Bluetooth module HC-05 42
Figure 3-4 : Wiring of a Bluetooth Module HC-05 on the Arduino Uno 43
Figure 3-5: A servo motor 44
Figure 3-6: Wiring of a servo motor on the Arduino Uno 45
Figure 3-7 : An LCD (Liquid Crystal Display) 46
Figure 3-8 : Wiring of an LCD display on the Arduino Uno 47
Figure 3-1 : Mini water pump motor 48
Figure 3-2 : Relay 49
Figure 3-3 : Push button 49
Figure 3-4 : Wiring of a water pump using a relay on the Arduino Uno 50
Figure 3-5 : Dispositive de suave portable 50
Figure 3-6: 12V DC fan 51
Figure 3-7 Connecting the fan to Arduino 52
Figure 3-1 : Arduino IDE 53
Figure 3-2: MIT App Inventor 54
Figure 4-1 : System block diagram 57
Figure 4-2 : System diagram 58

Figure 4-3 : Placement of components on the printed circuit board 59
Figure 4-4 : Soldering of components with Arduino Uno on the printed circuit board 59
Figure 4-5 : Placement of the circuit in the electrical box... 60
Figure 4-6 : Final electrical box 60
Figure 4-7 : Prototype of a realized agricultural greenhouse 60
Figure 4-10 : Blocks for receiving data 61
Figure 4-11 Bluetooth connection blocks.. 62
Figure 4-12 : Programming blocks for sending data to Arduino... 62
Figure 4-13 : Programming blocks for displaying data 63
Figure 4-14 : Programming blocks for switch control 64
Figure 4-15 : Programming blocks for control varieties 65
Figure 4-16 : The front-facing view of the application. 66
Figure 4-17 : The third page of the application. 67
Figure 4-18 The fourth page of the application. 68

General Introduction

Sheep farming has evolved over history from traditional methods to the use of modern technology in smart sheep farms. According to a study by Smith et al. (2018), the shift towards smart farming practices in the livestock industry has been driven by the need to increase productivity, optimize resource utilization, and enhance animal welfare in the face of growing global demand for food and environmental challenges.

Smart sheep farms use monitoring and automated control techniques to improve farm productivity and animal health. Researchers like Jones and Lee (2020) have highlighted how the integration of sensors, data analytics, and intelligent control systems can enable real-time monitoring of environmental parameters, early detection of health issues, and automated adjustments to feeding, ventilation, and other management practices.

This thesis will provide a comprehensive review of the concepts and techniques related to smart sheep farms, analyze the potential benefits of applying technology in this context, and the challenges that may face the transition to smart farms. As noted by a review by Green and Wilkins (2021), the successful implementation of smart farming solutions in the sheep industry requires addressing technical, economic, and social barriers, such as the affordability of technologies, farmers' digital literacy, and the integration with traditional farming practices.

The objective is to shed light on the tremendous opportunities offered by smart agricultural technology to improve the efficiency of animal production and enhance the sustainability of the agricultural industry in the future. Researchers like Shen and Cao (2019) have emphasized the potential of smart farming to reduce greenhouse gas emissions, optimize resource use, and enhance the resilience of livestock production systems to climate change and other environmental stresses [17].

Chapter1: Overview of Farms

1.1 Introduction

This part of the research addresses the history and evolution of sheep farms over the centuries. Sheep farms started with simple structures, and then evolved over the ages. In the modern era, sheep farms have developed using advanced techniques to improve animal care, such as water consumption monitoring systems and remote technologies to monitor animal health. This evolution is expected to accelerate in the future with the use of artificial intelligence technologies. Farms have also been classified into different types, such as closed and open farms, with an explanation of their advantages and disadvantages.

1.2 Definition of Farmer

It is known throughout the ages that the farm is a peasant builder used to raise livestock and animals of all kinds and factions, such as mammals like sheep and goats, birds such as pigeons, birds, chickens, and quails, and fish such as sardines and tilapia. The sheep herd is also one of the most important ingredients for establishing a sheep farming project, benefiting from great importance and specific characteristics. Sheep farms have many varieties and facilities that vary depending on the area where the farm is located. When constructing a sheep farming stable, all necessary care facilities must be available and must contain sufficient spaces toavoid overcrowding and the spread of diseases that can affect sheep [1].

1.3 History of Sheep Farming

It is said in biographical books that the first to graze livestock is our Master Adam, peace and blessings be upon him, followed by a clique of prophets. The farm was only a place of shade to prevent the sun's rays, and it was only surrounded by wood and others that they used trained dogs as they relied on mobility to feed on livestock

1.4 History of Sheep farms

The sheep farm has evolved considerably throughout history, seeing changes and improvements in designs and techniques used. Here is an overview of the evolution of sheep farms throughout history.

1.4.1 Ancient Times

In ancient times, the sheep farm (Figure I-1) was made up of simple structures of wood, mud, or stones. These structures protected the animals from weather agents and predators. [2]

Figure 1-1 : An ancient sheep farm

1.4.2 Medieval Era

During the Middle Ages, the design of sheep farms evolved (Figure I-2) to include more facilities such as toilets, food storage areas, and agricultural tools. The use of farms also increased for other activities such as poultry farming [3].

Figure 1-2 : A 3D image of a modern sheep farm design

1.4.3 Modern and Contemporary Times

With the advancement of technology and the development of industrial agriculture, sheep farms have evolved to use sophisticated techniques to improve animal care. These techniques include the use of timing and drinking water consumption systems, remote monitoring technology to monitor animal health, and the use of robots in care and nutrition. [4]

1.4.4 Future

The evolution of sheep farms is expected to accelerate in the future as cutting-edge technologies such as artificial intelligence and analytical data are used to improve efficient grazing management and animal production. Environmental concerns and sustainability may also play a role in the future construction and operation of sheep farms.

In summary, sheep farms have evolved over the ages to become more efficient and effective as cutting-edge tools continue to improve grazing management and animal welfare. [5]

1.5 Types of Farms

Modern farms have become semi-factories, so farms mainly diversify based on economic, physical, environmental, administrative integration, herd size, and nutrition.

1.5.1 Closed Farm

It is a farm that has the shape of a fully closed room (Figure I-3), except for fans, often not based on sheep grazing, and it is the most sophisticated farm because it has all the equipment to make the sheep believe they are in their natural environment.

The farm dedicated to the care and fattening of sheep is characterized as a fixed farm containing certain conditions that must be available when established. The farm should be in a relatively quiet place and away from residential gatherings, transportation, and other farms. It is also preferable to be oriented towards the south and to have enough space for rams and ewes with their products and for animals of a certain age. The ceiling height in this type of farm varies from 3.5 to 4.0 meters, depending on weather conditions and the number of herd members [6].

Figure 0-3 : A 3D image of a modern sheep farm design

1.5.2 Open Farm

It is a farm that is half closed and half misleading (Figure I-4), (partially shaded) and known since ages, used in most countries around the world when the farm relies on concentrated feeds and natural herbs infused with greenery, and suitable for all environmental conditions of heat and cold, and is capable of achieving significant success as well as ease of construction. They are usually closed on only three sides and fenced on the grazing side, and the shaded part can be in the middle or in the built-up part. It is less sophisticated while we can add water sprayers and air motors to cool the air in high heat, but it does not have cold heating systems [6].

Figure 0-4 : Open (shaded, semi-shaded) farm

1.6 Advantages and Disadvantages of Sheep Farms

Mechanized farming is a significant step towards improving breeding conditions and increasing production in the agricultural sector. Farms provide a confined and controlled environment for animals, and despite their benefits, they have shortcomings that breeders seek to overcome.

1.6.1 Benefits

Environmental Factors Control

Protected enclosures for sheep offer a sort of almost complete control of environmental conditions such as heat, lighting, and humidity.

- Protection

The farm is an environment independent of the outside world that provides the right environment for livestock growth regardless of external factors and provides protection against damages from wind and external disease predators [2].

- Production

Many animal farms are referred to as factories to allow them to significantly and noticeably increase production, whether for meat, wool, or milk [2].

- Reducing Food Waste

As it is an unconventional environment, the amount of food provided can be monitored, and the leftovers can be retrieved, unlike outdoor grazing where excess food is often damaged and wasted by rain and wind [3].

Figure 0-5 : : An image representing food waste

1.6.2 Defects

Unfortunately, we cannot find an absolute entity. Farms are inundated with defects, although minor ones

- Material Value

While they may be large compared to their open or traditional counterparts, they require many ingredients that are probably not present in the environment normally [2].

- Energy Requirements

Where you need energy to move agricultural tools, which we do not characterize with simplicity, even with high production [2].

- Luxury Problem

Even with evolution, there may be issues in controlling the practical comfortable environment of the sheep, especially if all requirements do not align with all technical tool standards [2].

1.7 Selection Conditions of Materials and Tools

The selection of tools and materials plays a key role in providing perfect care to achieve desired results (Figure I-6), so the following conditions must be followed [9]

- Price

  Before construction, prices must be studied to preserve capital by using available materials such as palm wood, band, or plastic and cardboard [9].

- Durability and Toughness

Livestock are known to be animals that love vitality and are strong in structure, so durable and powerful materials such as aluminum iron must be used [9].

- Installation

Choosing materials that are easy to install and disintegrate in case the farmer wishes to restructure, maintain, add, or remove a piece, so it is recommended to use separate and separate parts and pieces [9].

- Veterinary

Construction pieces must be non-toxic and harmless to livestock and not aid in containing insects, diseases, and harmful types such as old wood used in ancient construction [9].

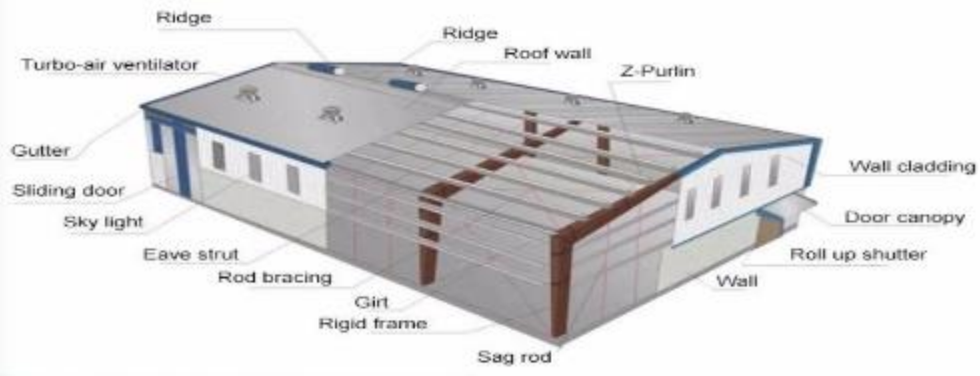

Figure 1-6 : : Structural components of a livestock farm

1.8 Conclusion

In this chapter, we were able to identify different types of farms, mention their advantages and disadvantages, and some conditions suitable for farming such as heat, healthcare, and nutrition. It also provides us with the concept that intensive farms are beginning to be classified as factories for their frequent production of meat, wool, and milk.

The presented information in this chapter represents a solid foundation for knowledge, understanding, and study of farms, and serves as motivation for farmers to take a step towards implementing intensive production methods.

Chapter2: Description of smart farms

2.1 Introduction

This chapter provides an overview of the concept of smart farms in the sheep farming industry. Starting with the definition of automated farms and the distinction between them and automatic farms, the chapter proceeds to explain the characteristics of smart farms and the modern technologies they rely on.

The chapter highlights how smart farms use monitoring and automation technologies to improve farm productivity and animal health, such as early disease detection systems and advanced veterinary diagnostics.

Despite the benefits offered by smart farms, the chapter discusses some of their shortcomings, such as the high cost of the technology used and the farmers' need for specialized training.

Finally, the chapter reviews the appropriate conditions and practices in sheep farming and control, including ventilation, lighting, feeding, and veterinary care. It also touches on advanced applications such as remote monitoring and tracking systems.

2.2 Definition of Automated Farm

Mechanized farms represent a qualitative breakthrough in livestock farming, where machinery and modern technology are utilized to save labor and human effort. These farms rely heavily on machines, with minimal human intervention, particularly in tasks related to feeding, watering, and cleaning [2].

2.3 Distinction between Automated Farm and Automatic Farm

Both utilize technology to enhance animal welfare, yet there are distinctions between them. An automated farm relies on equipment and mechanical tools to facilitate processes such as water supply, feeding, and cleaning, often requiring some level of human intervention to operate.

On the other hand, an automatic farm relies more heavily on technology to operate autonomously without direct human interference. It can automatically identify and provide appropriate quantities of water and food. Generally, the automatic farm relies more on technology and artificial intelligence techniques to automate operations without direct human involvement, whereas the automated farm may require human intervention for certain processes [2].

2.4 Smart Farms

Smart farms heavily rely on modern animal welfare technology, utilizing sensor systems and communication techniques to continuously monitor the condition of animals and their environment. Through intelligent detection and analysis, a smart farm can automatically identify and address the animals' needs for water, food, and healthcare. Additionally, a smart farm can provide precise data on animal performance and health, assisting farmers in making informed decisions. Overall, the smart farm represents a living example of technological advancement in animal welfare, aiming to enhance production efficiency, animal well-being, and reduce labor costs [2].

Figure 0-1 : Smart sheep management and control technology

2.5 Characteristics of Smart Farms

Efficient and Abundant Production: Smart farms enable large-scale production and abundance of final output through the use of advanced technologies.

Reduced Errors: By using precision machinery and programmed techniques, the rate of accuracy and efficiency increases, which reduces human errors.

Convenience: Thanks to modern agricultural technologies, operators can rely on programmed automated control, which reduces the need for constant on-site supervision.

Improved Animal Welfare: Smart farms offer a better, more stable, and more favorable environment for animals, contributing to their overall well-being.

Veterinary Health: Diagnostic techniques in sheep farming have significantly evolved thanks to the use of advanced diagnostic tools, such as artificial intelligence and machine learning algorithms, allowing for more accurate and efficient detection of potential health issues.

Automated Monitoring Systems: Smart farms utilize automated monitoring systems to detect diseases earlier and more accurately. These systems include real-time sound analysis compared to pre-established sound models, as well as movement analysis based on comparisons with recorded images.

Figure 0-2 : Illustration of motion analysis

2.6 Shortcomings of Smart Farms

- Cost: Agricultural automation relies on modern technologies and efficient machinery, the cost of which depends on the desired precision of the device or sensor. However, they remain expensive for new investors.
- Technology: Increased reliance on artificial well-being can lead to a lack of expertise in human labor, as there is a near-total dependence on machines to perform most tasks [4].
- Training Requirement: Transitioning from manual human labor to machine programming requires specialized training courses to adapt to new technologies.

Despite these challenges, the mechanized (smart) farm remains a qualitative boon for most farmers.

2.7 Appropriate Conditions in Breeding and Control Methods

2.7.1 Conditions to Be Met by Farms

When constructing sheep farms, special attention must be paid to simplicity and cost reduction, especially if the sheep primarily depend on pastures where they spend most of their time.

It is preferable for farms to be spacious and well-equipped for ventilation and lighting. Severe air currents should be avoided, and measures should be taken to prevent dramatic warming in summer.

Modern farmers are interested in providing comprehensive conditions and standards within their facilities in all important respects [2].

2.7.2 Ventilation

Ventilation is an essential factor in the farm, and its imbalance can reduce milk production by 10% of the normal level, a major cause of tuberculosis and other diseases.

An adult animal requires 100 to 70 kg of air, so approximately 7% of the building should be left for ventilation to maintain excellent biological health.

The farm may have one of the following ventilation systems:

Natural Ventilation: This system relies on providing air outlets that automatically open and close as needed to facilitate natural air flows within the farm [2].

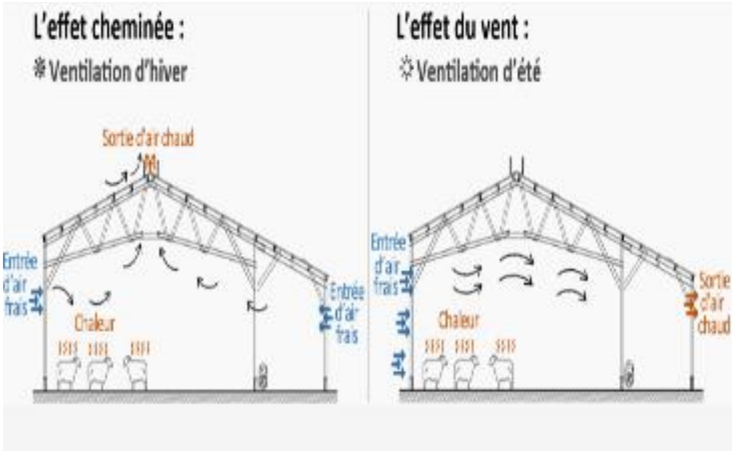

Figure 0-3: Natural air cannons flowing inside the farm

2.7.3 Mechanical Ventilation

This relies on fans mounted at high or low altitudes to draw air from the outside into the farm and from the inside out.

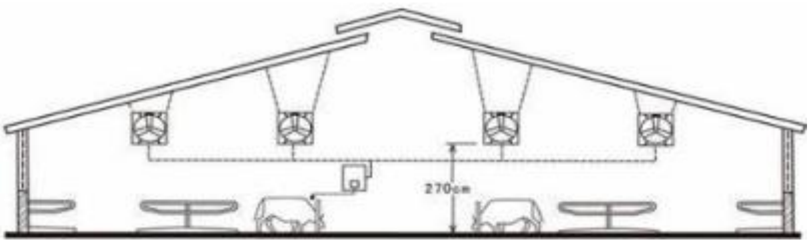

Figure 0-4 : :Mechanical ventilation

2.7.4 Heat

Sheep from acclimatized animals are to an excellent extent, but they are affected by the high heat, theoretically the milk stops well at 50 degrees and this helps solve the problems of nutrient conversion to achieve the desired results, so cooling fans are installed to be hypothermic, and they are measured using a simple conventional measurement and cooling maturity.

He has fans in front of him on the other side as much water moisturizer as needed, The same air outlets where hot air is expelled and cold air is received, In that heat has been affected by sheep’s milk, and their increased need for water, And I said it to eat, and causes problems of conversion and health, farms are indispensable [5].

Heat can also be controlled by providing cold water or atoms in the farm (Figure II-5).

Figure 2-5 : Mist cooling

2.7.5 Feed

Nutritional maturity consists of two parts

Eating

The system includes a tractor trolley (Figure II-6), which lowers concentrated food above the tunnel, placed at an appropriate height (for 50cm), and is automated at a time determined by the farmer by two or three times a day.

A manufacturer shall provide the following definition of the conveyor belt (Figure II-7) that it manufactures

The vertical conveyor for sheep and goats offers an easy, efficient and clean feeding method, which helps to ensure healthy feeding of animals. It also contributes to a better use of the sheepfold space and saves time thanks to the automatic return of the belt. The belt can be easily installed in each shed and requires only a level floor. The belt speed can be adjusted from 6 to 20 meters per minute and is available in several different models ranging from 5 to 100 meters in length. The belt features durable plastic parts. It operates an electronic control system with a voltage of 220V or 380V depending on the length of the belt [7].

Automated feeding options include a straw vehicle, an automatic feeding container, a closing system, an electronic remote control, feeding basins and an electronic sensor to advance the belt during loading [7].

Figure 0-6 : Automatic feed distribution system by belt

Figure 0-7 : Automatic feed distribution system by cart

Drink

Available in a fluid placement system, this system offers a reduction of water waste, designed for a capacity of 2 to 5 liters per adult sheep per day.

On the other hand, it is better to use a plastic bathtub with a valve (Figure II-8), since it has several features:

Unique design that makes it suitable for supplying sheep with water, provides worker tension, provides clean water and protects sheep from disease transmission: Where water is discharged from the sink and directed once the valve is moved. This tub is almost enough (8-10)sheep [8].

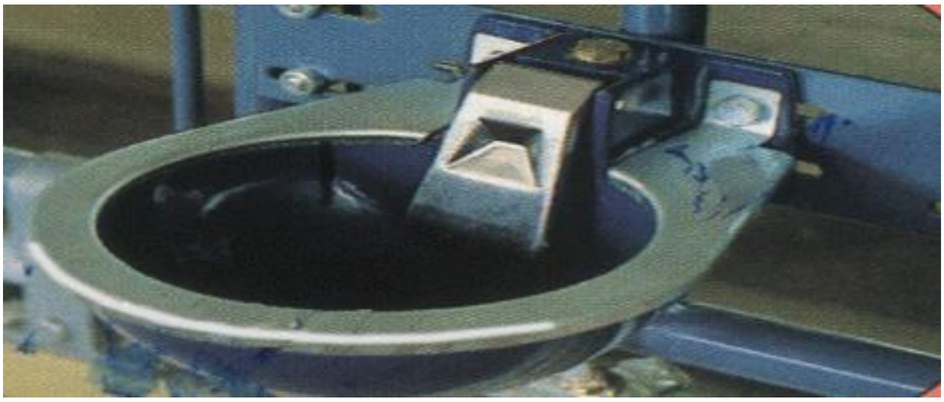

Figure 2-8 : Economic zones in sheep farming

2.7.6 Dampness

High humidity is a problem for sheep in all phases, as it is a cause of epidemics of skin diseases and increase of insect pests because it is a cause of diarrhea and serious lung diseases, so the farm has a moisture reduction ripple with a ventilation system and moisture sensitivity, and is either ventilated with top or side ceiling vents.

2.7.7 Lighting

The quality of lighting in livestock buildings can affect the quality and productivity of livestock, especially on farms where animals are raised. Improving the lighting of buildings in winter benefits animals and breeders. Improved lighting helps stimulate the production of vitamin D and calcium, calcium deficiency can lead to stunting or abnormalities. True-Light fluorescent tubes (neon lighting) can be installed to achieve rapid agricultural profitability and permanently improve lighting.

Lighting is an essential factor in life in general. A special system of lights of both types must be established.

- Natural: Contains openings with several areas of natural light on the sides or ceiling (Figure II-9).

Natural lighting can be used with large openings to infiltrate sunlight which in turn contains sanitary benefits [9].

Figure 0-9 Multiple openings for natural

- Artificial: It has a sensitivity to the light ratio and increases the light rate using Lad lamps, which are characterized by their low energy requirement.

What is melatonin?

Melatonin is excreted by the body in the dark and is an essential part of the normal sleep and wake-up cycle of humans and animals. Melatonin secretion is strongly influenced by lighting, increasing its secretion in the dark and decreasing during the day. Bright lighting at night and prolonged exposure to industrial lighting at night are key effects that can reduce melatonin secretion [10].

The following figure shows different effects of melatonin on sheep:

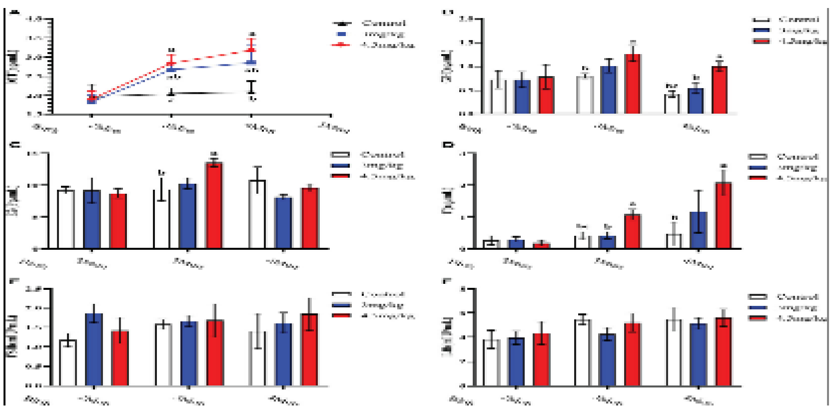

Figure 0-10 : Some different effects of melatonin on sheep

2.8 Intensive sheep farming

It is a modern style that is spreading in western countries, where it aims to increase productivity and achieve self-sufficiency in meat.

the features of this style are:

- Increase in birth rate compared to traditional sheep farming
- the ease of monitoring diseases and isolating patients quickly
- the ease of applying treatments quickly
- Identify the sheep did not get pregnant
- The transition from traditional and random training to vocational training
- Plus a higher return on investment compared to traditional sheep farming.

2.8.1 Microfiltration method

Remote sensing technology is improving livestock farming on smart farms. According to a study published in the journal 'computers and electronics in agriculture', micro-livestock farming depends on the use of scientific and technological platforms and information to manage agriculture in a modern and reasonable way.

2.8.2 Objectives

These methods aim to use individual differences between animals to adjust quantitative nutrition and expand the entire production process.

The research aims to achieve high efficiency and lower cost while ensuring the quality and safety of animal products, and to make the livestock industry sustainable

2.8.3 The most modern tools in the field of livestock

Automated milking systems on dairy farms are a good example of how to integrate non-mobile technologies with automation (robotic arms) to assist dairy farmers' staff. Milk training technology can provide information about nutrition, nutritional composition status and health through analysis of dairy ingredients and changes [11].

Figure 2-11 : Automated and traditional milking systems on dairy farms

Milk sampling is non-invasive and automatic, data can be collected periodically and infra-red technology can be used to analyze its composition accurately. This technology can also be used to detect bio-markers such as acids and fatty compounds.

Other technologies developed in EU countries include the use of automated electronic measurements to record body weight and diet, as well as the use of technologies such as infra-red thermal imaging to monitor lameness and the use of drones (Figure II-12) improving safety on farms where traditional livestock protection systems do not reach them cannot be forgotten (Figure II-13).

This development is a useful tool for large areas looking for pasture and water for livestock [10].

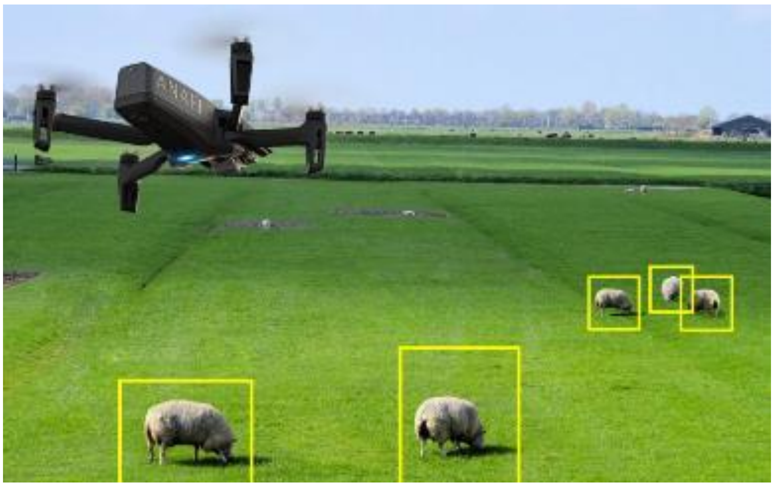

Figure 0-12 : Automated workstation for livestock monitoring

Figure 2-13 : Traditional livestock care

2.9 Portable devices

For wear Ables (Figure II-14), activity sensors that can be placed on animals are wide-spread in cow herds and much less in sheep. These devices are based on accelerometers.

These are systems that can be linked to different parts of animals and are used to collect health data, such as body temperature, heart rate, respiration and other indicators, making it easier for farmers to monitor the health of their herds and react immediately if they occur Heath problems.

Figure 2-14 : Livestock control

The tracker is a device that mounts on the necks of sheep, in the case of open grazing, the device is used to find stray sheep from the herd (Figure II-15) [11].

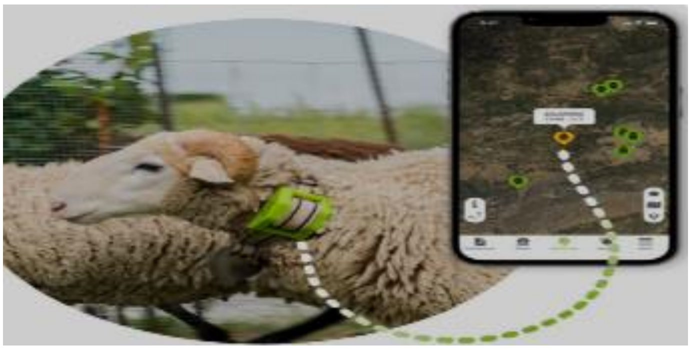

Figure 0-15 : ;Portable tracking device

Chapter 3: Hardware and Software

3.1 Introduction

This chapter discusses the use of sensors and basic equipment in smart sheep farms. The covered devices include sensors for measuring temperature, humidity, and feed content. The Arduino Uno platform was introduced as a key component for integrating sensors and automating farm operations. Specific sensors such as DHT11 and FC-28 were covered, with details on how to connect them to the Arduino platform. Other components like Bluetooth modules, water pumps, and ventilation fans were also addressed. The programming and control of these components using software environments like Arduino IDE and MIT App Inventor were explained. The chapter summarizes how sensor-based smart control can be used to improve and automate sheep farming operations.

3.2 Sensors for farm parameters

Sensors are tools that help us measure environmental parameters such as temperature, humidity and food quantity inside a sheep shed. These measures ensure the best growing conditions for the animals. There are ways to control elements such as temperature and humidity using advanced techniques such as PID and LQG [7].

3.2.1 Sensor

The sensor is an electronic device that converts physical quantities into measurable numerical values, such as the conversion of temperature into an electrical signal that can be displayed on a screen. The accuracy of the sensor is affected by environmental factors such as temperature, so it must be taken into account.

3.2.2 types of sensors

There are three main types:

1. Analog sensor: measures physical quantities such as temperature, pressure and lighting, and gives a variable signal depending on the measurement.

2. Logical sensor: indicates the presence or absence of a measured phenomenon and gives a yes or no answer [8].
3. Digital sensor: measures physical quantities and produces a numerical value that a computer can understand [9].

3.2.3 Sensor internal components

The sensor consists of two main components: the test part that gives the right amount for the measurement, and the conversion element that transforms the body's response into an electrical signal. The sensor may need an external power source to operate and form the output signal [10].

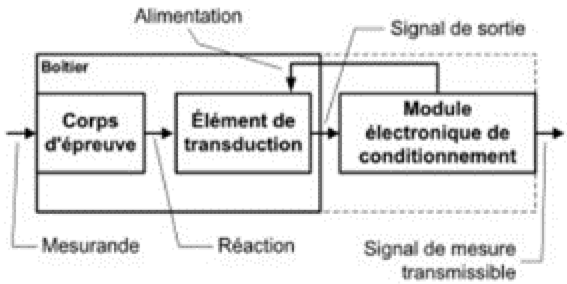

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Figure 3-1 : Internal structure of a sensor

3.3 Basic Application Equipment

Smart Farm is designed to automate and improve sheep care in

Controlled environment. The materials we use include:

3.3.1 Arduino Ono

Micro-control panel based on an open source and programmable ATmega328P processor. It has built-in components to support the precise observer, and can be connected to the computer using a USB cable c [11].

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Figure 3-2 : Arduino Uno

Arduino Board Components

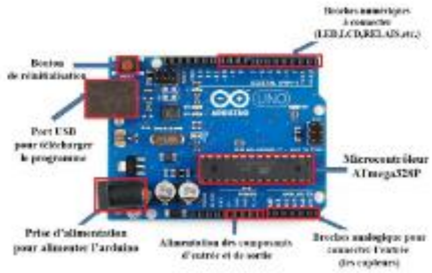

Figure 3-3 : The hardware structure of Arduino Uno

3.3.2 temperature and humidity sensor DHT11

Low cost sensor for temperature and humidity measurement, uses humidity sensor, thermostat and emits digital signal on the pin [12].

Figure 3-4 :DHT11 sensor

Integration with Arduino

To start our assembly, just wire the 5 V of the Arduino Uno with pin 5 V, the Arduino Uno ground on the GND pin and the sensor DATA pin on the pin Arduino Uno «2» digital by example [12].

Figure 3-5 : Wiring of a DHT11 sensor on the Arduino Uno

The demonstration code

```
#include "DHT.h"
DHT dht(2, DHT11);

void setup() {
   dht.begin();
   Serial.begin(9600);
}

void loop() {
   float h = dht.readHumidity();
   float t = dht.readTemperature();

   Serial.print("Humidity: ");
   Serial.println(h);
   Serial.print("Temperature: ");
   Serial.println(t);

   delay(1000);
}
```

Figure 3-6 : Demonstration code of a DHT11 sensor **خطأ! استخدم علامة التبويب "الصفحة الرئيسية" لتطبيق chapitre على النص الذي ترغب في أن يظهر هنا.**

3.3.3 Soil Moisture Sensor FC-28

The FC-28 soil moisture sensor is a simple and inexpensive device used in automated crop irrigation systems. The main objective of this sensor is to determine the soil moisture content [12].

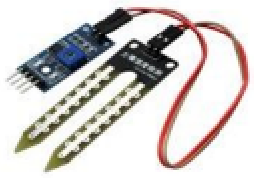

Figure 3-7 : FC-28 sensor

The sensor consists of two main parts:

1. Open two-core probe: This part is immersed in the ground to measure the moisture level.
2. Electronic comparison module LM393: this unit converts moisture measurements into digital and analog signals.

When the FC-28 sensor is connected to the Arduino plate, the system will be able to obtain accurate data on the soil moisture content. This makes it possible to manage the irrigation system more efficiently and ensure the provision of water for crops.

Integration with Arduino

To connect the FC-28 soil moisture sensor to the Arduino plate, we will use the analog output of the sensor. The sensor produces an analog value ranging from 0 to 1023 [12].

For the measurement of the humidity percentage, we will convert this analog value into a range from 0 to 100%.

Next, we will display the calculated humidity value on the serial display connected to the Arduino panel. This will allow us to easily monitor and monitor the moisture level in the soil.

Turning the analog measurement into a percentage of humidity and displaying it on the screen will allow us to understand and manage the irrigation system more accurately and efficiently.

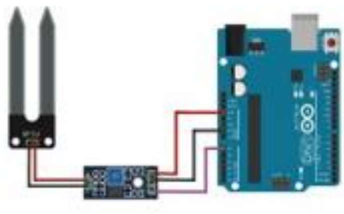

Figure 3-8 : Wiring of an FC-28 sensor on the Arduino Uno

The demonstration code

```
#define solPin A1 // port de connexion du capteur
#define ledPin 13 // port de connexion du led

int minsol = 300; // minimal d'humidité du sol
int sol;

void setup(){
   Serial.begin(9600);

   pinMode(solPin, INPUT);
   pinMode(ledPin, OUTPUT);
}

void loop(){
   sol = analogRead(solPin);
   Serial.print("sol = ");
   Serial.println(sol); // afficher variable

   if (sol > minsol) { digitalWrite(ledPin, LOW); }
   if (sol < minsol) { digitalWrite(ledPin, HIGH); }

   delay(1000);
}
```

Figure 3-9 : Demonstration code of an FC-28 sensor

Low-cost water level sensor

This sensor is used to measure the level of water or other liquids. The sensor operates by emitting a digital signal on one of the terminals when a certain liquid level is reached.

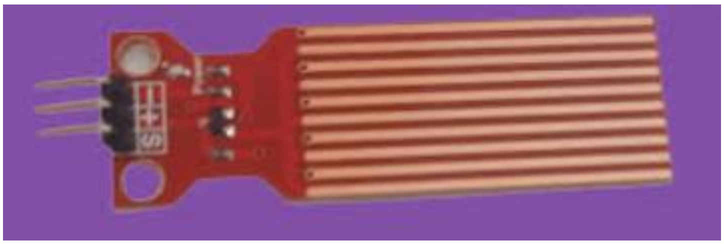

Figure 3-10 : Water level sensor

3.4 Integration with Arduino

To connect this sensor to the Arduino Uno board, you simply need to connect the power terminal (+) of the sensor to the 5V from the Arduino Uno, and connect the ground terminal

(-) of the sensor to the GND terminal of the Arduino Uno. The signal terminal of the sensor is then connected to one of the digital pins on the Arduino Uno, for example, pin 8.

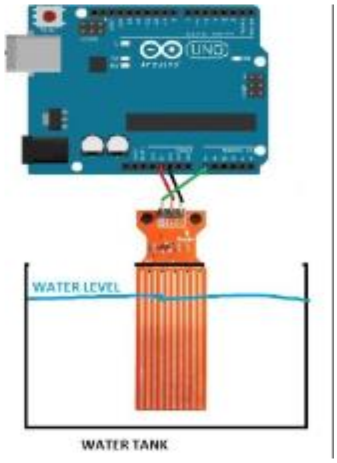

Figure 3-11 : Water level sensor

3.4.1 Programming the Water level sensor

```
sketch_jun05a §

// قراءة مستوى الماء
int waterLevel = analogRead(WATER_LEVEL_PIN);

lcd.setCursor(0, 3);
lcd.print("Water Level: ");
lcd.print(waterLevel);

if (waterLevel < WATER_LEVEL_THRESHOLD) {
  digitalWrite(PUMP1_PIN, HIGH);
  digitalWrite(PUMP2_PIN, HIGH);
} else {
  digitalWrite(PUMP1_PIN, LOW);
  digitalWrite(PUMP2_PIN, LOW);
}
```

Figure 3-12 : programming the Water level sensor

3.4.2 Bluetooth HC-05 Module

The HC-05 Bluetooth module is a commonly used wireless radio module. This module allows devices to communicate and communicate wirelessly with each other.

The HC-05 are generally used for wireless communication between various mobile devices such as smartphones, laptops, tablets and even micro control panels such as Arduino.

This wireless connection capability allows data exchange and remote control of devices without the need for wired connections. This makes the HC-05 Bluetooth module a popular and useful option in a wide range of applications [12].

Figure 3-13 : Bluetooth module HC-05

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3.4.3 Bluetooth module HC-05 connected to Arduino

When connecting the HC-05 unit to the Arduino board, there are two delivery options

. Use the preset RX and TX pins on the Arduino plate (pins 0 and 1)

2 Use all other pins as RX and TX pins using the Software Serial library [12].

In this example, we will use pins 10 and 11 on Arduino as RX and TX pins respectively. We will connect the RX pin on Arduino to the TX pin on the HC-05 module, and vice versa.

In addition to connecting RX and TX pins, we will also connect power pins: VCC on the 5V pin HC-05 module on Arduino, GND on the HC-05 pin GND module on Arduino.

This connection will allow wireless connectivity between the Bluetooth HC-05 module and the Arduino board, providing useful wireless connectivity capabilities for Arduino applications

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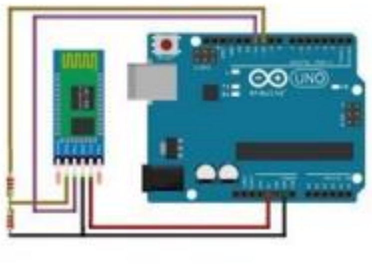

Figure 3-14 : Wiring of a Bluetooth Module HC-05 on the Arduino Uno

3.4.4 Programming the Bluetooth module HC-05

To manage the HC-05 module and use its communication functions, we will use the Software Serial. This library allows us to create a different serial port than the standard USB port on the Arduino panel [12].

Using this code, we will be able to manage all aspects of communication with the HC-05 module - such as changing the module name, PIN code, connection speed and getting information about the installed firmware.

To ensure a good connection, we will need to ensure that the correct pod rate (baudrate) is selected in the serial screen. In addition, we will select new line settings (NL) in the connection settings.

These settings and software steps will ensure efficient and reliable communication between the Arduino panel and the HC-05 Bluetooth module for data exchange and remote control.

3.4.5 Servo Motors

Servo motors are essential components in the design of robotics and various mechanisms used with Arduino plates.

These motors are very precise modules that are precisely controlled by feedback.

This precise control of servo motors allows precise control of the different movements and modes of machines and robots designed using Arduino plates.

These motors are essential in a wide range of robotic and mechanical applications that use Arduino electronic tiles [12].

Figure 3-15 A servo motor

3.4.6 Servomotors connected to Arduino

Servomotors are usually delivered with three wires: two powers (VCC and GND) and a signal.

Arduino plate can provide enough power to operate a small servo like SG90. However, if it is necessary to use a larger servo or a set of small servos, it would be better to use an external power source.

To control the servo motor via Arduino, the signal cable (yellow) of the servo must be connected to one of the digital pins on the Arduino panel. In this example, we will use pin number 2.

This connection between the servo and the Arduino panel will allow us to carefully control the servo motor position and locations through programming.

Figure 3-16 Wiring of a servo motor on the Arduino Uno

3.4.7 Programming the servo motor

To control the servo motors connected to the Arduino board, we will use the Servo. This library is pre-installed in the Arduino IDE development environment.

Thanks to this library, we will be able to send appropriate control signals to the connected servo motors. This will allow us to precisely control the angles and positions of these motors according to the requirements of the application.

Servo provides a range of functions and functions that we can use to adjust the servo motor angle, control the travel speed and get information about the current motor position.

Thanks to these software tools, we will be able to efficiently integrate servo motors in the design of mechanisms and robotics based on the Arduino board.

3.4.8 LCD screens (LCD screens)

LCD displays are a type of display that uses liquid crystal (LCD) technology to display text and symbols. This type of screen is commonly used in Arduino projects to display information and data directly and clearly [12].

Arduino-compatible LCDs are available in different sizes and configurations. Most of these displays depend on the HD44780 controller as the main component. This unit supports screens consisting of two lines, so up to 16 characters can be displayed in each line.

The main advantage of LCD displays is that they allow the Arduino panel to view information and data in a direct and easy to understand way. They can be used to demonstrate environmental measurements, operational conditions, alerts and other vital information for Arduino applications.

Figure 3-17 : An LCD (Liquid Crystal Display)

3.4.9 LCD Display connected to Arduino

LCD screens compatible with Arduino use between 6 and 10 data pins (D0 to D7) or (D4 to D7 plus RS and E pins). Additionally, the screen requires two power sources (+5V and GND).

Some LCD screens may also have analog inputs to adjust the display contrast. These inputs are connected via a 10kΩ variable resistor.

When connecting the LCD screen to the Arduino board, we can connect the data pins to one of the board's digital input/output pins. However, we will then need to reference the Liquid Crystal library in the programming to determine how to connect these pins.

This connectivity and integration with the Liquid Crystal Library will allow us to control the LCD screen and effectively display information and data in Arduino applications.

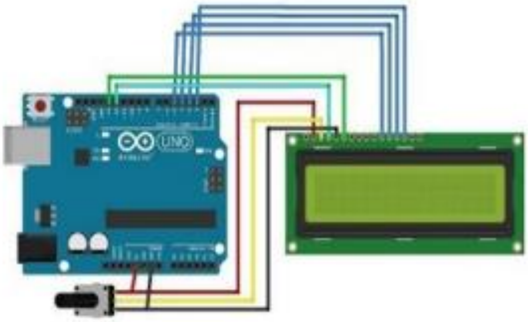

Figure 3-18 : Wiring of an LCD display on the Arduino Uno

3.4.10 Programming the control of the LCD screen.

To enable control of the LCD screen connected to the Arduino board, we will use the "Liquid Crystal" library.

Integrating this library into our Arduino project is a very simple process. Simply click on the "Import Library" menu in the Arduino IDE development environment, then search for and choose the "Liquid Crystal" library.

Once integrated, we will be able to use its software functions and methods to fully control the connected LCD screen. This library will give us the ability to send texts, symbols, control display variations, and other functions.

This simple integration with the Liquid Crystal Library will facilitate the integration of LCD screens into Arduino software and the clear and direct visualization of information for the user.

3.5 Small Motor Water Pump

A water pump is a device used to pump liquids through pipes, where it is used using an electric or fuel motor (gasoline [13].

These pumps have wide applications in various fields such as irrigation, water distribution, cooling and global fluid transport.

Electric water pumps are generally energy efficient and less noisy, but require an electrical power source. On the other hand, fuel water pumps (gasoline) are more independent, but they may be noisier and need fuel.

Water pumps are used in various fields such as agriculture, construction, industry and domestic use. They are often used to pump large amounts of fluid over long distances or under high pressures.

Figure 3-19: Mini water pump motor

3.5.1 Water pump connected to Arduino

To connect the water pump to the Arduino board, we will use a device called Relay.

The relay is an electrical switch used to control high power circuits using low power control signals such as those emitted by Arduino.

Relays are widely used in various fields such as industrial monitoring systems. They control the operation and shutdown of motors, lights and other electrical consumables.

Some relays are designed for fast circuit activation and cancellation, while there are other types designed for the most precise control that can be used to change the voltage passing through the circuit [13].

Figure 3-20 : Relay

Using the relay, we will be able to control the operation and shutdown of the water pump through the Arduino digital signals. This will allow us to effectively control the operation of the water pump in Arduino applications [7].

Push button

When the push button is pressed, it creates an electronic signal that the Arduino board or other electronic system can detect and interpret. This allows the user to interact with and control various systems and devices.

The ease of integration and simplicity of use of push buttons have made them essential components in the field of electronic control and system automation, including various Arduino applications [13].

Figure 3-21 : Push button

9V Battery

The 9V battery is an electrical power source that provides a 9V electrical voltage. This type of battery is commonly used in many portable electronic devices such as wireless transmitters, toys, and various other electronic tools.

In addition to mobile uses, 9V batteries are also common in manual and recreational applications such as electronic circuits and certain robotics projects [13].

The availability of this specific and suitable electrical voltage has made 9V batteries a popular and preferred option in many electronic and electrical applications that require a portable and replaceable power source.

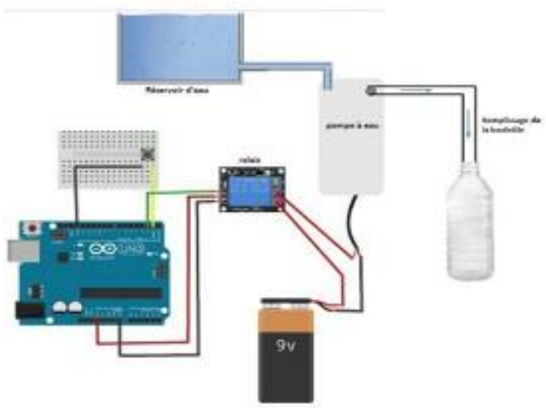

Figure 3-22 : Wiring of a water pump using a relay on the Arduino Uno

Demonstration code

```
void setup() {
  pinMode(2,OUTPUT);
}

void loop() {
  digitalWrite(2, HIGH);
  delay(2000);
  digitalWrite(2, LOW);
  delay(3000);
}
```

Figure 3-23 : Dispositive de suave portable

3.5.2 Fan

The fan is an electrical device composed of rotating blades or enclosed blades in a structure. The main purpose of the fan is to create an air flow by generating a directed and controlled movement [14].

Fans are generally used to distribute and exchange air in enclosed and confined spaces, such as greenhouses. They help regulate temperature, humidity, and air quality in these environments.

In an intelligent glass greenhouse project, fans can be used in conjunction with the Arduino board for precise control of the ventilation system and environmental control. Arduino allows the automation and management of fan operation based on environmental measurements and operational requirements [19].

This integration of the blades and Arduino will provide effective control and regulation of environmental conditions in the Smart sheep farm.

Figure 3-24 : 12V DC fan

Connecting the fan to Arduino

To integrate the fan with the Arduino board using the relay, here are some basic steps to follow:

First, you must choose a fan suitable for your needs and ensure it is compatible with the relay to be used.

Then, the relay control cord will be connected to one of the digital inputs/outputs on the Arduino board. The relay must be driven by an independent external power source or using the internal power source available on the Arduino board.

The power wires of the blades are then connected to the external terminals of the relay.

By programming the Arduino, we can control the operation and shutdown of the fan by controlling the state of the relay using the digital Write () function.

Precautions must be taken when handling electricity and by following the safety instructions and specific specifications of the relay and fan used.

This integration between the fan, relay, and Arduino will allow us to effectively control the air distribution and purification in smart enclosure applications [14].

```
void setup() {
  pinMode(2,OUTPUT);
}

void loop() {
  digitalWrite(2, HIGH);
  delay(2000);
  digitalWrite(2, LOW);
  delay(3000);
}
```

Figure 3-25 Connecting the fan to Arduino

3.6 Required software

To achieve comprehensive control and management of the Smart sheep farm's intelligent components, programming the Arduino board and developing appropriate software applications are essential.

This software will allow us to optimally automate the system and effectively monitor the plant growing environment. Therefore, the use of appropriate software is vital for this project [18].

3.6.1 Arduino IDE Development Environment

Arduino IDE (Integrated Development Environment) is an open-source software platform used for programming Arduino boards. This environment provides a set of tools that allow users to write, assemble, and upload software onto Arduino boards.

Arduino IDE offers an easy-to-use interface with useful features such as code auto-completion, automatic correction, and code validation. This facilitates the process of software preparation for users.

This integrated development environment will be a key tool in programming the Arduino board and developing the appropriate application to control the Smart sheep farm. [15].

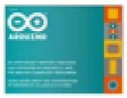

Figure 3-26: Arduino IDE

3.6.2 MIT App Inventor

MIT App Inventor is a visual application development environment that allows users to create mobile apps for Android with great ease. This tool simplifies the development process and even allows non-programming users to create their own applications.

Using the drag-and-drop interface, users can design graphical user interfaces, define component behaviors, and create various interactive functionalities for their applications. This allows a wide range of people to quickly create applications without the need for complex programming skills.

MIT App Inventor significantly streamlines the mobile application development process, making it a valuable tool for a variety of users, from beginners to professionals. This will facilitate the creation of custom applications for the Smart sheep farm. project without the need for advanced programming skills [16].

Figure 3-27 : MIT App Inventor

3.7 Conclusion

In this chapter, we have addressed the materials and software used in smart farms. We analyzed the materials used to build these smart farms and their importance, and examined the programs used to monitor and control the environment in these farms.

In terms of software, intelligent sensors and automated control systems have been used to monitor and regulate various variables within the farm. Specific programs have been developed to measure and monitor temperature levels, humidity, water, and other environmental factors affecting the growth and health of the sheep. This software collects and analyzes data to make intelligent decisions about conditions in the farms, ensuring optimal conditions for sheep growth.

In conclusion, after a thorough analysis of the materials and software used in smart farms, it has become clear that they played an essential role. The materials ensure optimal thermal insulation and facilitate light transmission, while the software helps collect and analyze data to make informed decisions. The use of these materials and programs in smart farms contributes to more efficient environmental management and improved agricultural production.

Chapter 4: production and development

4.1 Introduction

In this chapter, we will provide the setup of our working environment, then examine the resalts obtained during the programming and testing of various sensors on our farm prototype. Finally, we will start by proposing the features of the application and the different facades.

4.2 Principle of operation

Our project aims to make the farm intelligent using an electronic panel. This panel will continuously monitor the temperature, humidity, irrigation and drinking water needs of the farm. It will automatically adjust the opening of the windows, ventilation, irrigation and consumption activities based on the detected conditions.

The main objective of this project is to automate the environmental control processes in the farm, in order to create ideal growth conditions for the sheep. Thanks to this technology, we will save time and effort, while maximizing the conversion and growth rate and improving the quality of the meat.

4.2.1 Specifications

Sensors: the electronic panel will be equipped with temperature, humidity and water sensors to monitor the environmental conditions.

Programming: The electronic panel will be programmed to continuously analyze the sensor data and make decisions based on predetermined thresholds.

Ventilation system: If the temperature exceeds 35°C, the ventilation system will be activated to reduce heat and humidity.

Irrigation and watering system: if the water ratio is less than 7 cm, the irrigation system will be used to provide the necessary irrigation and drinking water in the morning and evening.

Integration: the electronic panel will be integrated into the farm control system to ensure communication and coordination between the different tasks.

Testing and modifications: a series of tests will be carried out to verify the performance of the electronic panel and make modifications if necessary.

Documentation: all aspects of the project will be documented, including wiring diagrams, programming sheets and operating procedures.

Thanks to our project, our farm will become an intelligent system capable of automatically controlling temperature, humidity, irrigation and consumption. This is a significant

advancement in smart agriculture, with benefits in terms of efficiency, effective resource management and improved production quality.

4.3 Development of electronic panels

The automated farm control system uses DHT11 and FC-28 sensors to measure temperature, humidity and water humidity and consumption time. This is done.

Processing this data by the electronic panel that regulates the windows and the fan to maintain optimal conditions. The water pump is also activated for irrigation and drinking.

In this system, the mobile application uses the HC-05 Bluetooth module to send and receive real-time data from the farm. The electronic panel collects measurements from the DHT11 and FC-28 sensors to regulate the ventilation using servomotors and fans. Consumption is ensured by an active pump when the water ratio is low.

The entire system operates in a loop, ensuring comprehensive monitoring.

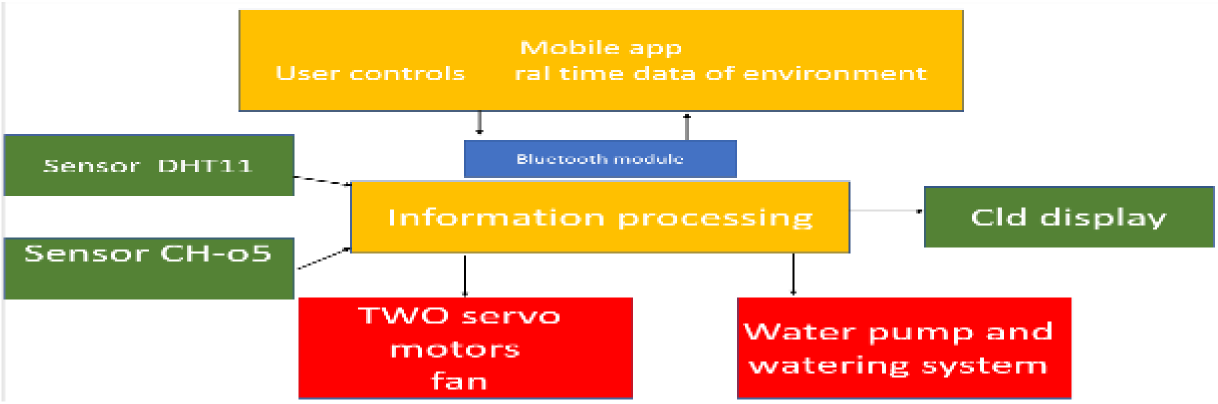

Figure 4-1 : System block diagram

System flowchart

The flowchart illustrated in Figure (IV-5) represents the overall operation of the control panel, which is in line with the specifications mentioned in paragraph (IV.2.1).

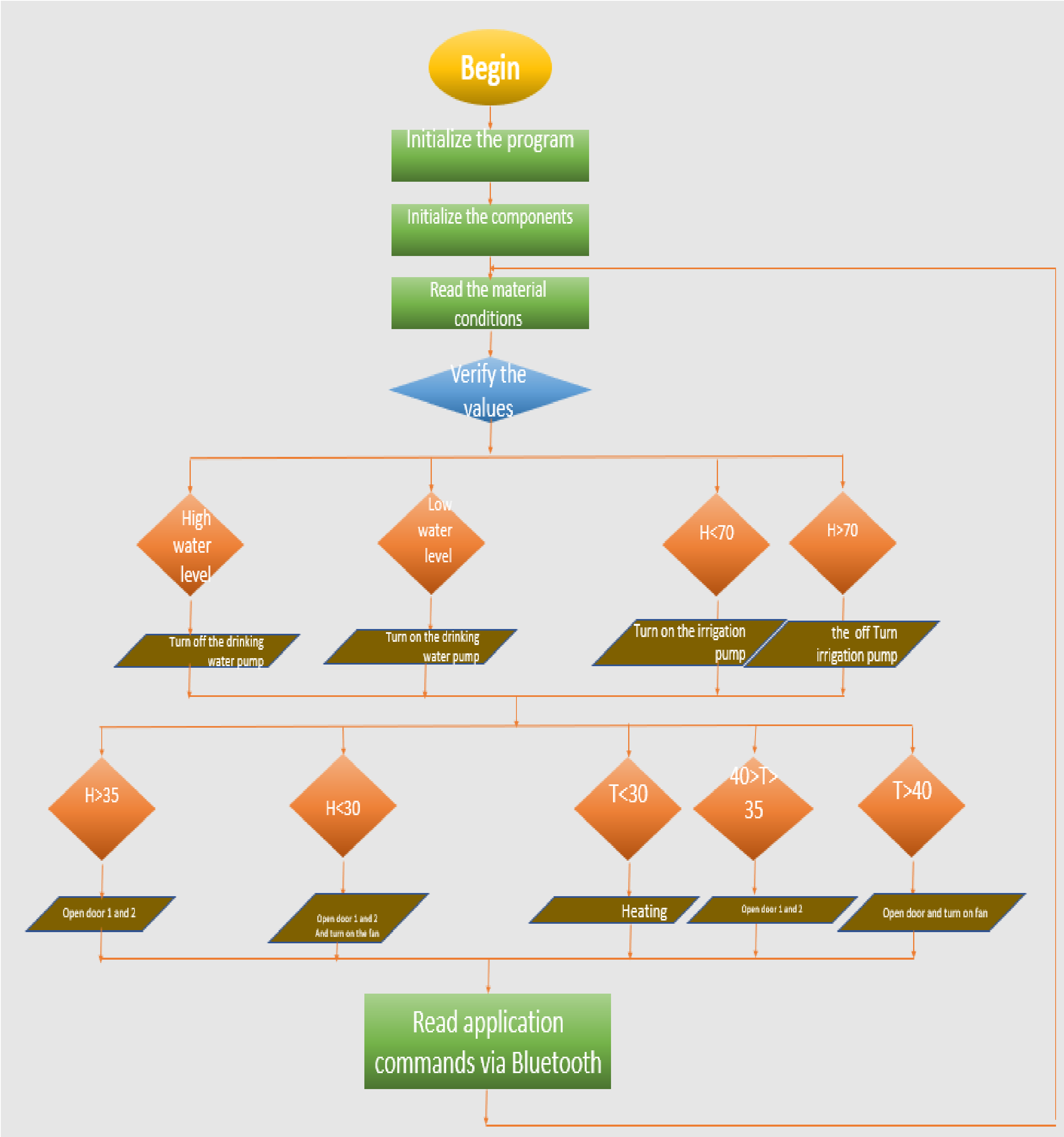

Figure 4-2 : System diagram

Integration of sensors, actuators and installation in the greenhouse

The photos below represent the integration of sensors and actuators into the electronic card, as well as the installation of the system in the greenhouse.

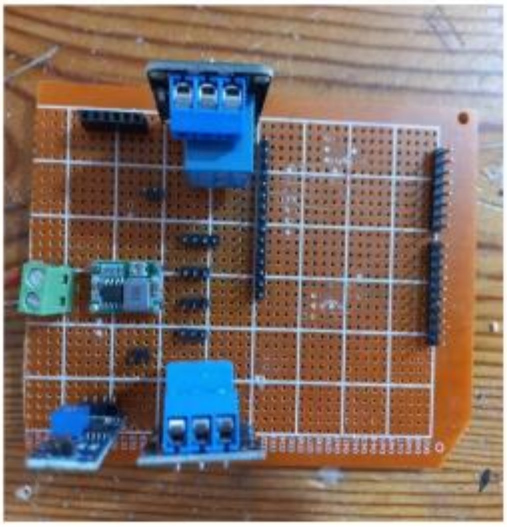

Figure 4-1 : Placement of components on the printed circuit board

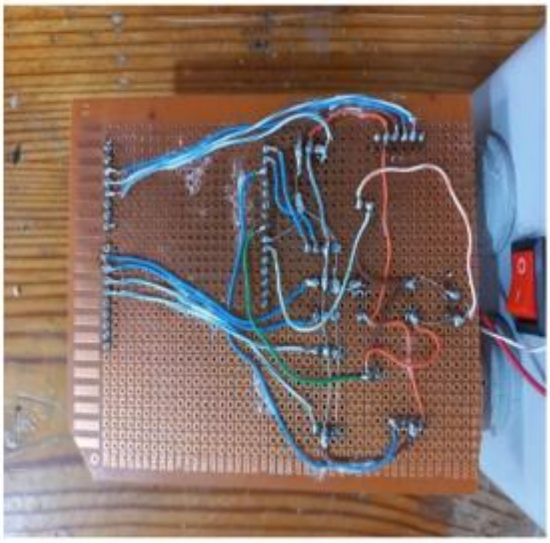

Figure 4-4 : Soldering of components with Arduino Uno on the printed circuit board

Figure 4-5 : Placement of the circuit in the electrical box

Figure 4-6 : Final electrical box

Figure 4-7 : Prototype of a realized agricultural greenhouse

4.3.1 Development of Android applications

As part of the development of the Android application, we used the MIT App Inventor application to design and create an easy-to-use user interface. This application provides functions to monitor and supervise the farm system, allowing the user to adapt and process data in real time. The simplified and easy-to-use approach of MIT App Inventor facilitates the develop-ment of applications quickly and efficiently, offering a smooth and intuitive user experience.

The images below show application blocks created using MIT App Inventor. These blocks

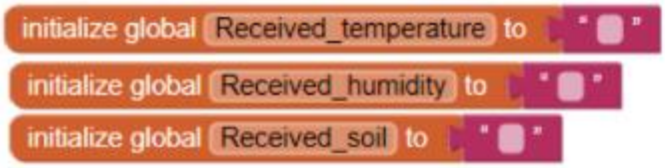

Figure 4-2 : Blocks for receiving data

allow you to determine the logic and behavior of the Android application to monitor and track the farm system. Thanks to an easy-to-use visual interface, MIT App Inventor facilitates the creation of customized application blocks without the need for advanced software knowledge.

Thanks to the mobile application, we can manage the control functions on our mobile phone as follows:

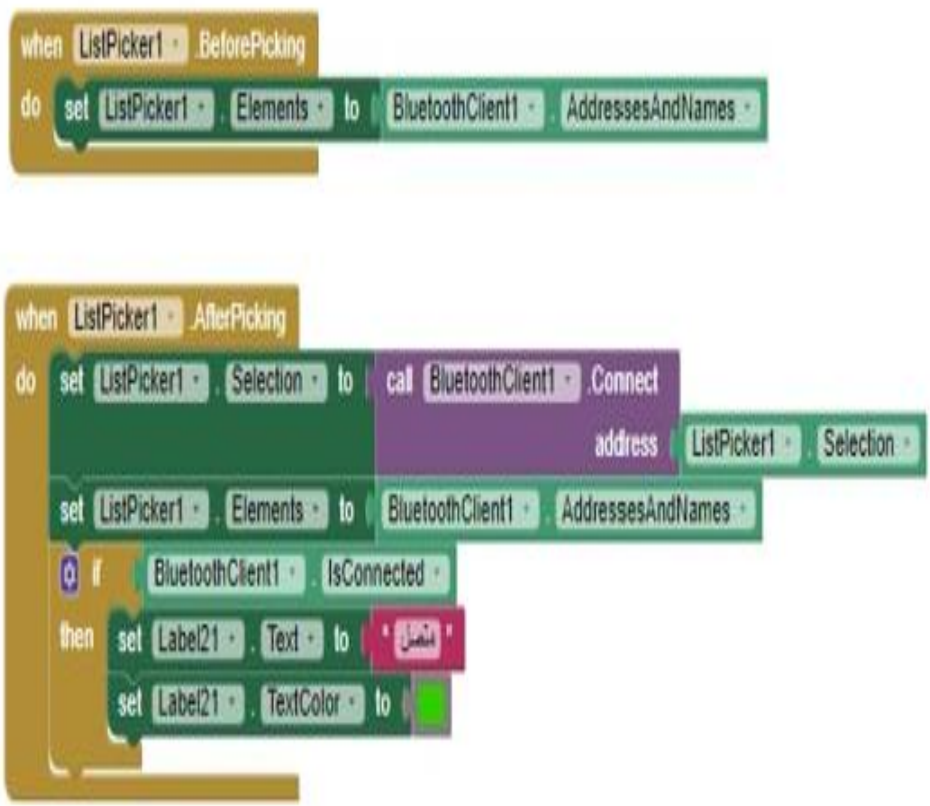

Figure 4-9 : Bluetooth connection blocks

Control part: this part is used to monitor climatic factors

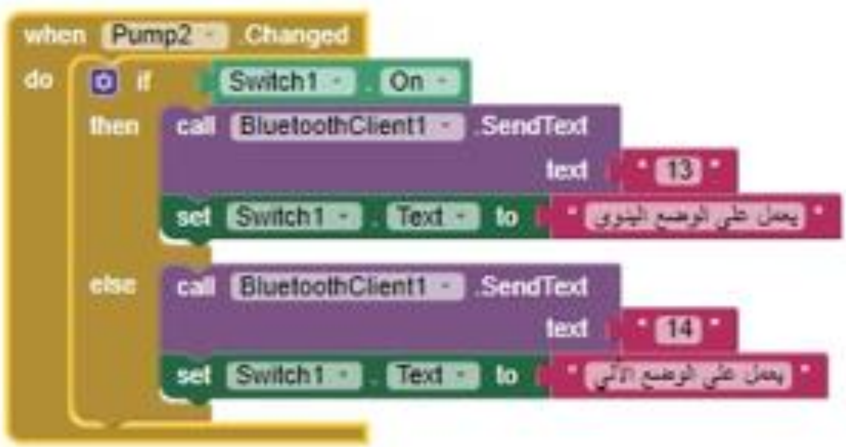

Figure 4-3 : Programming blocks for sending data to Arduino

Temperature, humidity and feeding conditions

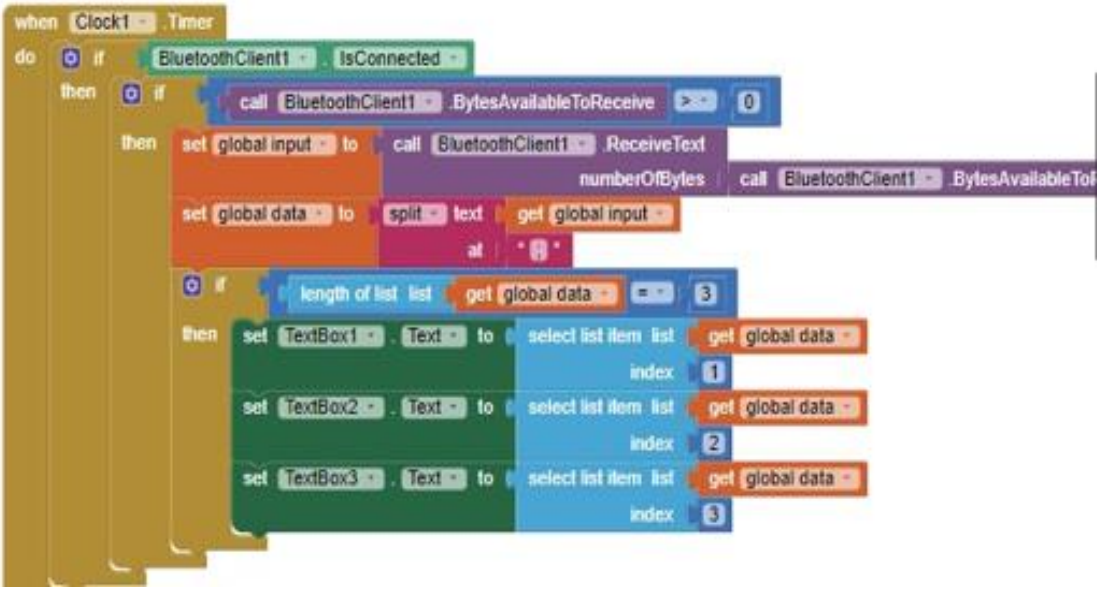

Figure 4-4 : Programming blocks for displaying data

For operators: fan, pump, window, controlled by the user by pressing the buttons after activating the manual mode

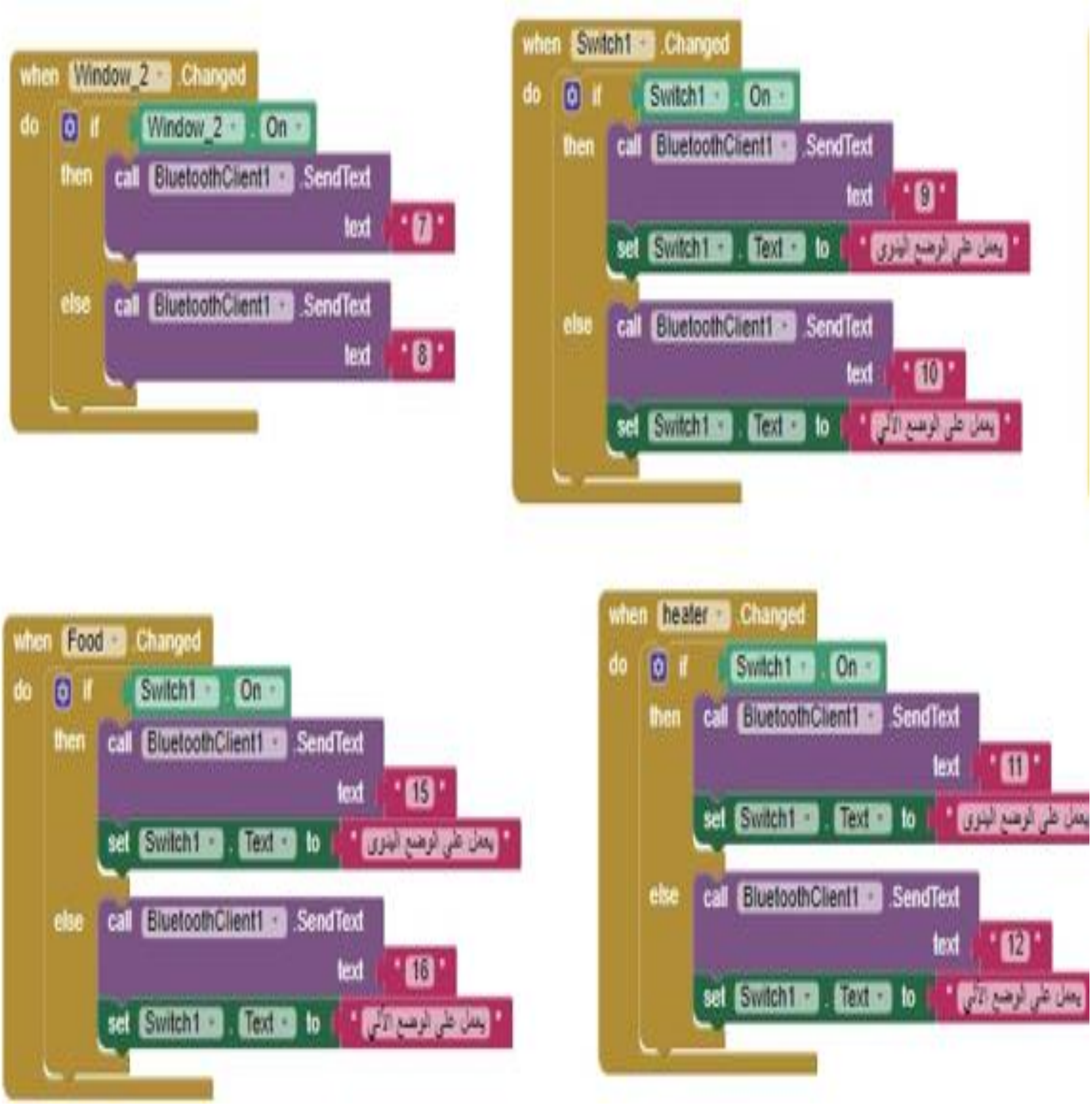

Figure 4-5 : Programming blocks for switch control

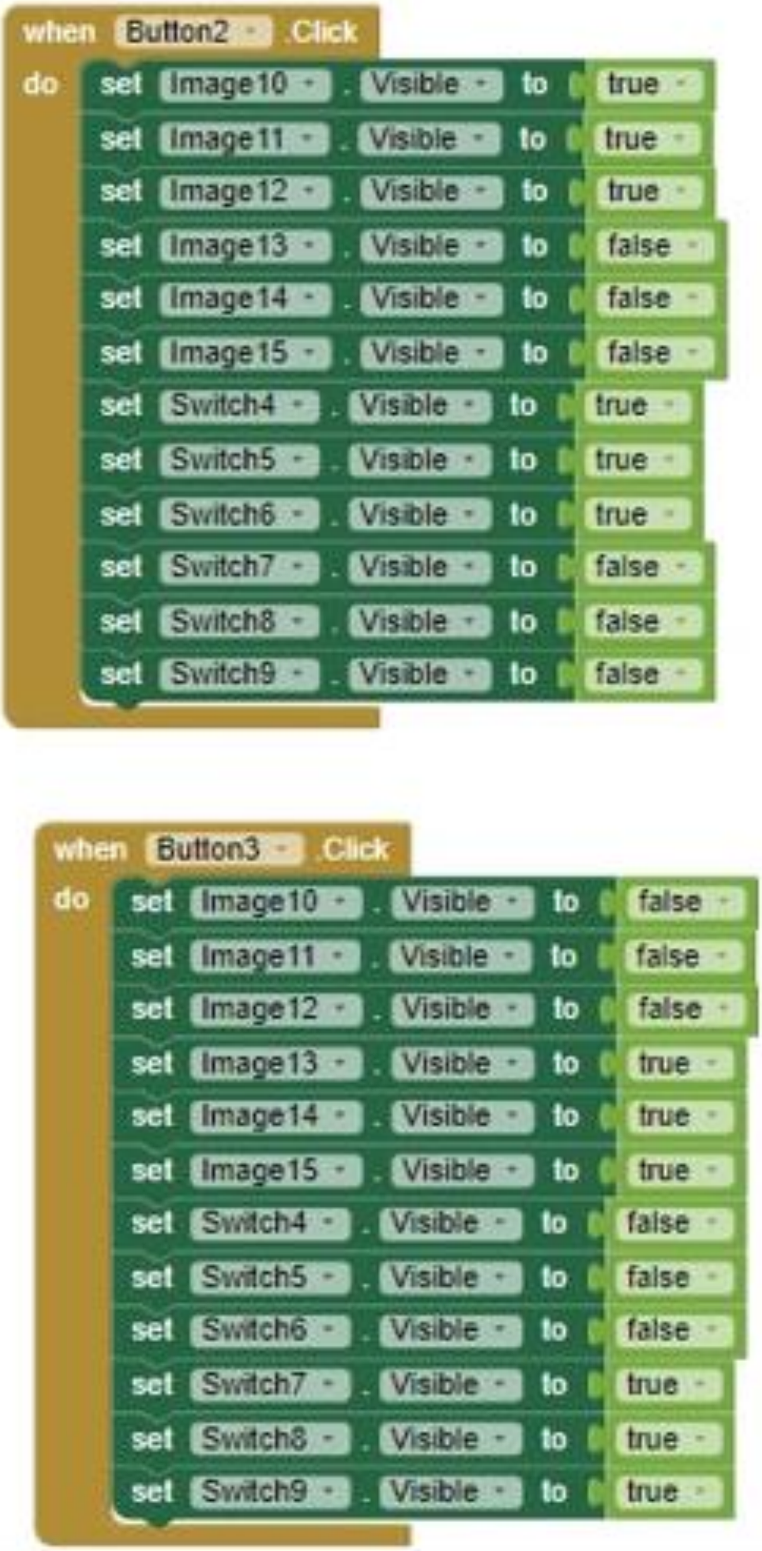

Figure 4-6 : Programming blocks for control varieties

The image below represents the application interface:

Figure 4-7 : The front-facing view of the application.

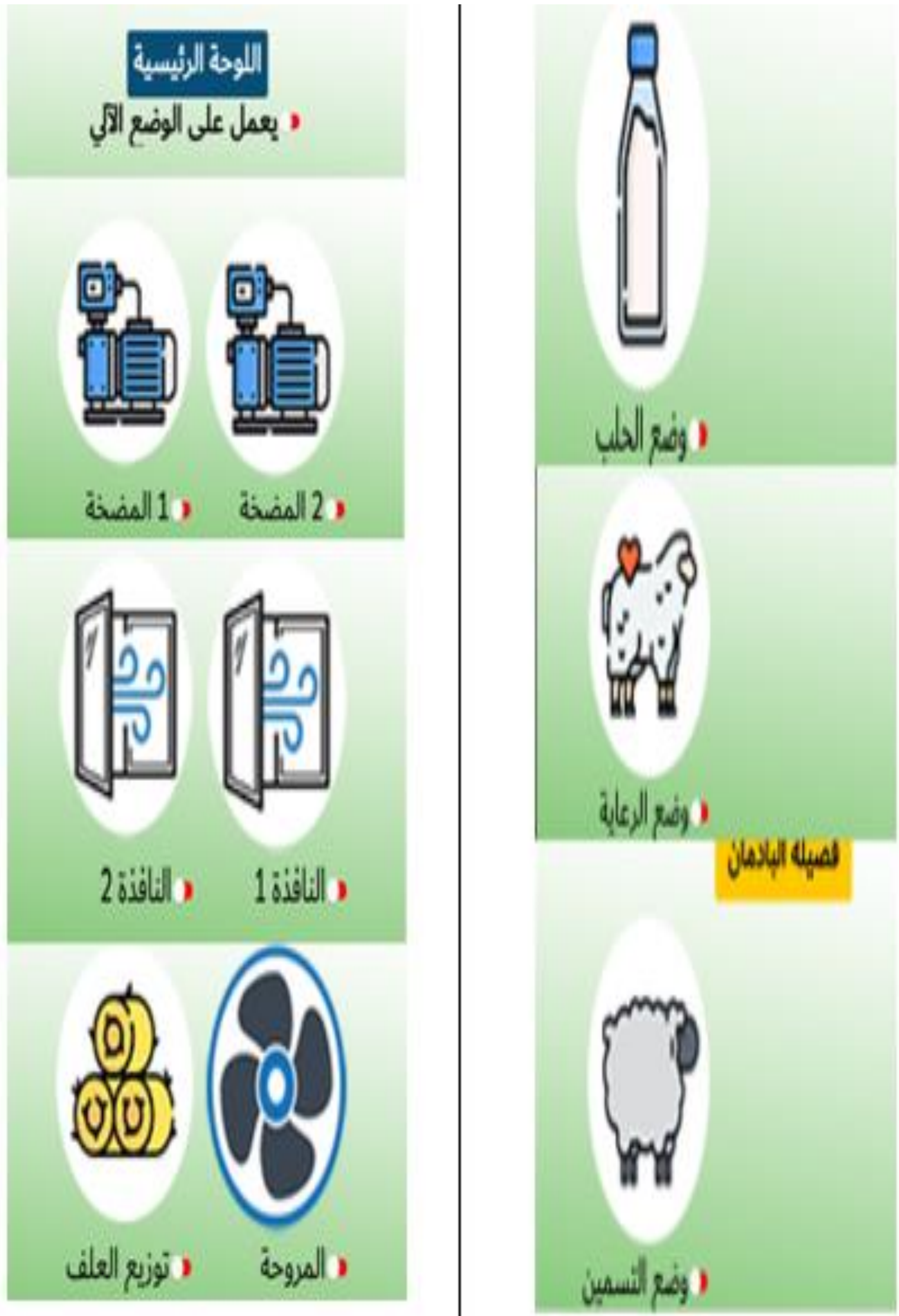

Figure 4-8 : The third page of the application.

The second page of the application

Figure 4-9 The fourth page of the application.

4.4 Conclusion

this chapter has shown that automated farm management can be achieved through the use of smart sensors, microprocessors and Android applications. This system al-

lows farmers to effectively control the climatic factors of their sheep or cattle farms, thus help-

Ing to maximize production and ensure optimal herd health and growth.

The Android application provides an easy-to-use interface and offers advanced remote monitoring features, which facilitates farm management, even outside the production site. By combining technological advances with agricultural knowledge, automated farm management opens up new opportunities for modern agriculture by improving the efficiency, productivity and sustainability of food production.

Here is the summary of the general conclusion of the end-of-studies note entitled "Man-argument and supervision of intelligent sheep farms" after reformulation:

General conclusion

This research has provided a comprehensive overview of the concept of smart sheep farming and its evolution over time. The study has highlighted the tremendous potential of leveraging modern technologies to enhance productivity, animal welfare, and sustainability in the agricultural sector.

The historical analysis revealed how sheep farms have progressed from simple, traditional structures to more sophisticated, technologically-driven facilities. This evolution has been driven by the need to improve production efficiency and meet the growing global demand for food.

The examination of smart farm characteristics underscored the numerous benefits these systems offer, including enhanced productivity, reduced errors, improved animal welfare, and advanced veterinary health monitoring. Smart farms harness the power of sensors, automation, and data analytics to optimize every aspect of the farming process.

While smart farms present promising solutions, the research also identified certain shortcomings, such as the high initial investment costs and the need for specialized training. Nonetheless, the advantages of smart farming technologies outweigh the challenges, making them a viable and valuable option for the future of agriculture.

The detailed exploration of the appropriate conditions for breeding and control methods, such as ventilation, heat management, feeding, and lighting, demonstrated the critical role that environmental factors play in ensuring the well-being and productivity of sheep. The integration of these essential elements with advanced technologies is a key hallmark of smart sheep farming.

Overall, this research has highlighted the tremendous opportunities offered by smart agricultural technologies to improve animal production efficiency and strengthen the sustainability of the agricultural industry. By combining modern knowledge with traditional practices and leveraging the benefits of technology, smart sheep farming represents a promising advancement towards a more productive, sustainable, and resilient agricultural future. [17].

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كلية العلوم والتكنولوجيا
قسم الآلية والكهروميكانيك

Université de Ghardaïa

غرداية في: 2024/09/24

إذن بالطباعة (مذكرة ماستر)

بعد الاطلاع على التصحيحات المطلوبة على محتوى المذكرة المنجزة من طرف الطلبة التالية أسماؤهم:

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2. الطالب (ة): بندارة محمد الصادق

تخصص: آلية وأنظمة

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الإذن بطباعة النسخة النهائية لمذكرة ماستر الموسومة بعنوان

Management and supervision of smart sheep farms

إمضاء رئيس القسم

العلمي عبد اللطيف
رئيس قسم الآلية
و الكهروميكانيك

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كلية العلوم و التكنولوجيا