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We look forward to the future with optimism and know that we have the ability to achieve more thanks to you. Thank you again for everything.

Thank you all

Abstract

Broiler chicken farming has developed in recent years and has become dependent on science and technology to obtain the greatest economic return in the shortest time and at the lowest possible cost. To realize the potential and increase broiler production, it is essential to provide them with everything they need, including proper temperature, humidity, and ventilation, along with a good lighting management programme.

So if it is given proper temperature, ventilation and lighting program for each stage, we will get satisfactory results on time.

For this, and by using IoT technology, we can provide everything the chicken needs for its good growth and overcome most of the problems facing breeders, which is how to maintain a constant temperature at each stage, proper ventilation and cooling, especially in the summer, a lighting program, and control of the coop in real time.

الملخص

تطورت تربية الدجاج اللاحم في السنوات الأخيرة وأصبحت تعتمد على العلم والتكنولوجيا للحصول على أكبر عائد اقتصادي في أقصر وقت وبأقل تكلفة ممكنة. لتحقيق إمكانات وزيادة إنتاج دجاج التسمين ، من الضروري تزويدهم بكل ما يحتاجون إليه ، بما في ذلك درجة الحرارة المناسبة والرطوبة والتهوية ، إلى جانب برنامج جيد لإدارة الإضاءة.

لذلك إذا تم توفير برنامج درجة الحرارة والتهوية والإضاءة المناسبين لكل مرحلة ، فسوف نحصل على نتائج مرضية في الوقت المحدد.

لهذا ، وباستخدام تقنية إنترنت الأشياء ، يمكننا توفير كل ما يحتاجه الدجاج لنموه الجيد والتغلب على معظم المشاكل التي تواجه المربين ، وهي كيفية الحفاظ على درجة حرارة ثابتة في كل مرحلة ، والتهوية والتبريد المناسبين ، خاصة في فصل الصيف ، وبرنامج إضاءة ، والتحكم في الحظيرة في الوقت الفعلي

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General Introduction

The Internet of Things has technical, social and economic importance. Where this technology has entered almost all fields, products, durable goods, cars, trucks, industrial components, utilities, sensors, etc., where objects are integrated with Internet connectivity and data analysis capabilities.

In this sense, we see it as a completely new branch of the Internet that aims to connect people, data and all kinds of objects in order to create a seamless transition between the physical and virtual worlds. As a result, physical objects will be integrated into the virtual world of the Internet.

The Internet of Things (IoT) experienced explosive growth. In 2008-2009, the number of objects connected to the Internet exceeded the world's population for the first time. Today there are about 27 billion connected devices, whether they are sensors, home appliances, machines, wind turbines, medical devices or cars.

The cloud is a huge interconnected network of powerful servers that provide services to businesses and individuals. The Internet of Things (IoT) is a system of mechanical and digital computing devices and machines with unique identifiers and capable of transmitting data over a network without the need for interaction.

The Internet of Things generates a lot of data and cloud services pave the way for the circulation of this data. In addition, cloud hosting as a service adds value to companies using the Internet of Things by allowing them to achieve economies of scale to reduce their overall cost structure.

Broiler farming is the process of raising poultry to obtain high quality meat and healthy, tasty chicken products. Broiler breeding is an important industry in the agricultural sector, as chickens are raised to obtain fresh meat that can be consumed as food.

Poultry is an easy animal to raise and manage, and can be raised successfully on both large and small farms.

The most common species in broiler farming is the commercial broiler, which is specially selected and raised for the purposes of broiler production.
The process of raising broiler chickens includes many important factors such as choosing a suitable chicken breed, providing a suitable environment for growth and development, healthy and balanced nutrition, good health care and disease prevention, and effective chicken breeding management.
Broiler farming can face some problems and challenges, and One of the most common problems in raising broiler chickens is environmental control, where a suitable environment must be provided for broiler chickens in terms of temperature, humidity and ventilation. Poor environmental conditions can affect the health and growth of chickens and lead to problems such as stress and diseases caused by excessive heat or humidity, carbon dioxide and ammonia from chickens.
Introducing the Internet of Things in broiler farming can have a positive impact on the efficiency and management of the breeding process. Here are some potential uses of the Internet of Things in this context:
Environment monitoring where internet-connected sensors can be used to monitor the temperature, humidity, and air quality of the chicken farming space. This information can help to better adjust the environment to meet the chickens' needs and improve their comfort and health.
Tracking, monitoring and smart feeding where internet-connected devices can be used to improve the feeding process.
Lighting management: Internet-connected lighting systems can be used to improve lighting management in a chicken farming space. Lighting times can be set elaborately to achieve healthy and stimulating chicken growth. Productivity and analysis: Data can be collected from all aspects of chicken farming and analyzed.
This work, which aims to prepare a prototype of a smart chicken shed, is organized into three chapters:

1. Chapter 1 presents the generalities of the Internet of Things, incl Properties and their relationship to cloud.

2. The second chapter studies the concept of broilers, its objectives, and all the

information the farmer needs in terms of how to raise chickens. An example of an Algerian company working in the field The problems facing the farmer and finally the proposed solutions.

3. The third chapter is divided into two parts:

- Perceptions section containing a general and detailed plan and details of proposed solutions and schemes

- An applied section that includes everything related to the applied side, i.e. programming languages...etc

The proposed model is based on certain types of sensors, Aduino, web and mobile applications, and cloud computations.

Chapter 1

Basic concepts

1.1 Introduction

Internet of Things (IoT) is a term that refers to a network of devices and things connected to each other and to the Internet, which exchange data and interact with their environment in an intelligent and connected way. These things are enabled by being equipped with sensors and sensors, provided with the ability to connect to the Internet and interact with software and cloud servers.

IoT represents a revolution in the world of technology, where connected devices and objects can exchange data and interact with each other to improve efficiency and achieve specific goals. These things can be various and varied, including smart home devices such as refrigerators, televisions, and lighting devices, wearable devices such as smart watches and health monitoring sensors, and environmental sensors such as weather stations and sensors in smart cities.

IoT works by equipping things with sensors that capture data and information around them, and then transmit it over the internet to the cloud or centralized servers.

The Internet of Things (IoT) and the Cloud have a close relationship and collaborate to provide smart and advanced technological solutions. Their relationship is essential in developing and operating IoT systems.

This data is processed, analyzed and used to extract knowledge and make smart decisions. Signals and instructions from the cloud are also sent to objects to perform specific actions, which leads to interaction and intelligent control of various devices and objects.

1.2 Internet of things

1.2.1 Definition

There is no specific definition of the Internet of Things However, we will highlight some of the most common definitions :

Definition 1 :

The Internet of Things (IoT) is a network of physical things, gadgets, cars, buildings, and other items that have sensors, software, and connection to gather and share data via the internet. These things, known as ”smart” or ”connected” gadgets, may communicate with one another and with humans to deliver new services, increase efficiency, and boost productivity [1].

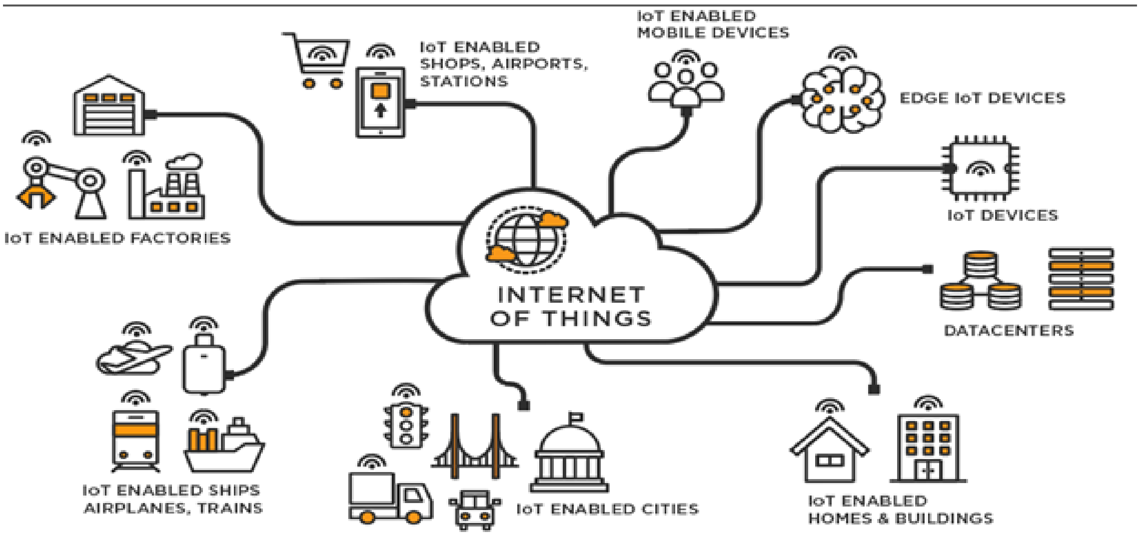

Figure 1.1: Description image for IoT [2]

Definition 2 :

“The Internet of Things represents an evolution in which objects are able to interact with other objects.” (IBM)

Definition 3 :

"Internet of Things (IoT) is the Internet and networks that extend to places such as manufacturing plants, energy grids, healthcare facilities, and transportation" (Cisco Systems).

1.2.2 Architecture of IoT

The most interesting aspect of the Internet of Things is the lack of a defined structure. Researchers have proposed different designs for the Internet of Things. However, it is the three-Layer and five-Layer structures that have been advocated most often [3].

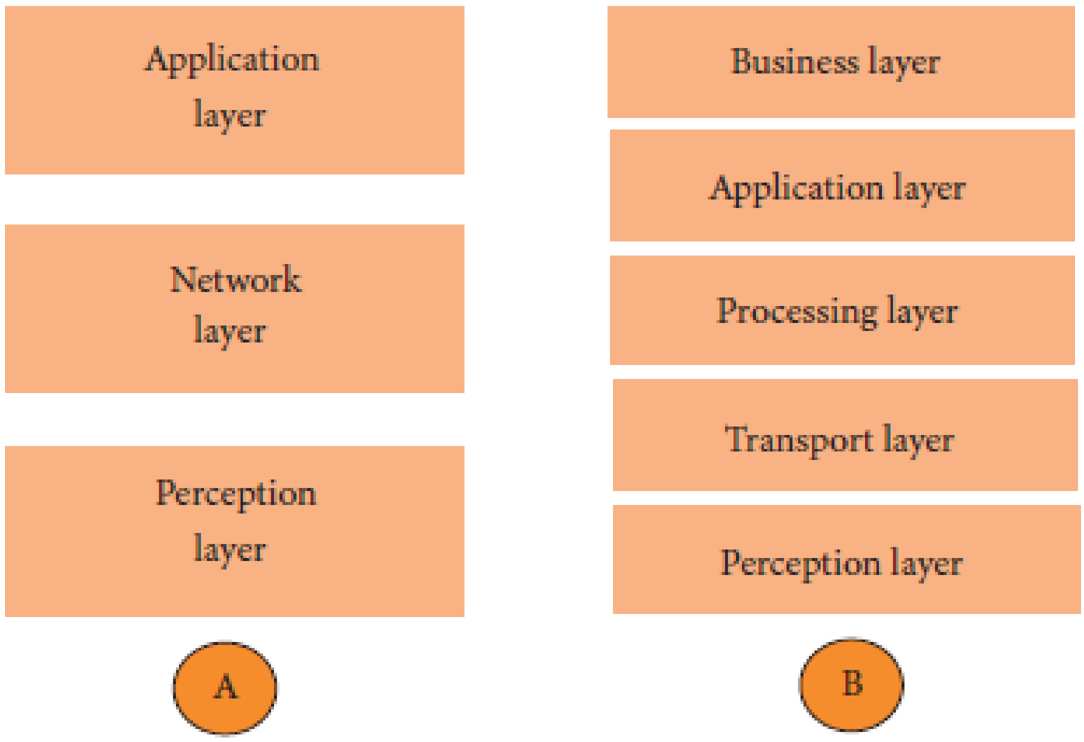

Figure 1.2: Architecture of IoT (A: three layers) (B: five layers). [3]

Three-Layer Architecture

In Figure 1 shown is the three-layer structure which is the basic one. It was first used in the early stages of this field of study. Visualization, network and application layers are its three layers.

Perception layer : Represents the physical sensors of the Internet of Things that gather and analyze data. This layer contains sensors and actuators that perform various functions such as querying location, temperature, weight, motion, vibration, acceleration, humidity, and so on. The perception layer must employ standardized plug-and-play procedures to configure heterogeneous objects. Through secure connections, the perception layer digitizes and sends data to the Object Abstraction layer. Big data generated by IoT is begun at this layer[4].

Network layer : It sits between the perception and application layers. It may be considered as an amalgamation of disparate legacy networks, technologies, and protocols. Its function is to provide data collected by perception nodes to the information processing unit (or high-level decision-making units) through wired or wireless communication channels for analysis, data mining, data aggregation, and data encoding. It is also in charge of delivering network management features[3].

Application layer : Customers' services are provided via the application layer. For example, the application layer can offer temperature and humidity metrics to a client who requests them. The value of this layer for the IoT is that it can supply high-quality smart services to fulfill the expectations of customers. The application layer encompasses a wide range of vertical sectors, including smart homes, smart buildings, transportation, industrial automation, and smart healthcare[4].

The three-layer design encapsulates the core concept of the Internet of Things, however research on IoT frequently focuses on its more intricate details, therefore it is insufficient. Because of this, the literature has suggested a lot more layered structures. The first is a five-layer design that also comprises business and processing levels [3-6]. Perception, transport, processing, application, and business layers make up the five levels (see Figure 1). The perception and application layers have the same role as in a three-layer design. We describe the purpose of the final three tiers[3].

Five-Layer Architecture

The transport layer : The transport layer is an important part of IoT architecture. It enables data collection and transfer across networks such as 3G, radio-frequency identification (RFID), and Zigbee. The network layer is in charge of transferring data between networks. It guarantees that data is received in an orderly and secure way. The transport layer connects networks and allows them to interact with one another. At this layer, security is equally vital since it provides data integrity, secrecy, and authentication. It also includes network access mechanisms such as IP addresses and port numbers. The transport layer protects the security and stability of the networks that comprise an IoT system by delivering these services[3].

The processing layer : The processing layer is in charge of storing, analyzing, and transforming data from the transport layer. This layer is made up of cloud computing platforms that can analyse and interpret data from the physical world. It accepts raw data from sensors and converts it into meaningful information using cloud services and big data modules.In addition, the processing layer enables the system to act on inputs and reply in real time. It is in charge of making judgments and acting on the data it receives. Based on the data obtained in the perception stage, this layer is also utilized to create predictions and give insights. Because it is the third of five levels in IoT architecture, it is also known as the middleware layer[3].

The business layer : It is also called the ”management layer” that oversees the overall operations and services of the IoT system. The tasks of this layer include creating a business model, graphs, flowcharts, etc. based on the data received from the application layer. It is also expected to design, analyze, implement, evaluate, monitor, and develop aspects of the IoT system. The business layer enables support for decision-making processes based on big data. This layer also monitors and manages the four base levels. Furthermore, this layer compares the output of each layer to the expected output in order to improve services while protecting customer privacy[4].

1.2.3 Protocols of IoT

The present IoT application layer protocols for connecting devices and end-user applications to the Internet are IETF's CoAP, IBM's MQTT, XMPP, and AMQP. UDP and TCP are transport layer protocols, while IPv6, ROLL RPL, and 6LoWPAN offer network routing and encapsulation. BLE, Z-Wave, ZigBee, HomePlug GP, and Dash7 are five short-range wireless communication technologies with low power consumption. In terms of energy efficiency, we discovered that the present IEEE 802.15.4-2006 PHY layer(s) and its upgrade are enough[5].

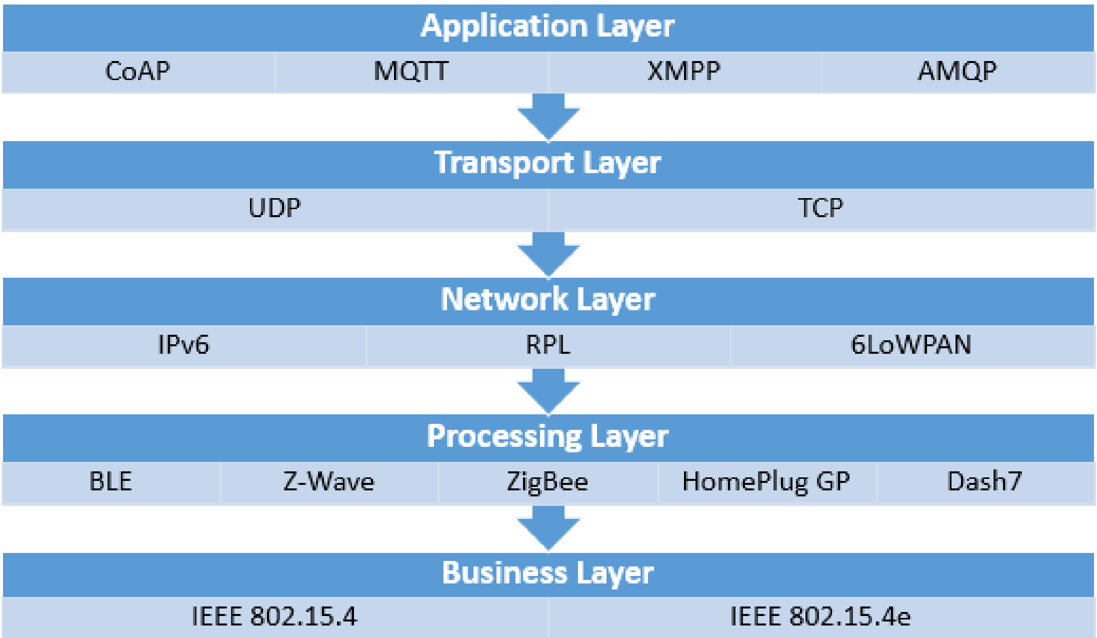

Figure 1.3: IoT Protocol Stack [5]

CoAP

Like HTTP, is a document transport protocol. However, this is utilized for constrained devices (devices with limited resources in terms of energy, memory, and compute), such as sensor nodes in WSNs, to receive the data read by the sensors, similar to the values retrieved through Web APIs. CoAP employs UDP at the Transport layer. CoAP may even be employed in microcontrollers with limited resources, such as 10 KB of RAM. CoAP also allows multicasting, which is critical for many IoT applications. There is also an option to translate CoAP to HTTP utilizing application-independent cross-protocol proxies [6].

MQTT

MQTT is a lightweight M2M communication protocol that is built on the pub/sub paradigm. MQTT uses a client/server approach to gather data from objects (sensors) and communicate it via TCP to the server (broker). MQTT supports one-to-one, one-to-many, and many-to-many communication. MQTT supports a variety of application domains where bandwidth restrictions and gaps in communication previously occurred. Although MQTT supports lightweight communications, it has several restrictions. For starters, it only supports TCP, which is a disadvantage for networks where packet loss is common. Second, the name conventions employed in MQTT are rather lengthy, making IEEE802.15.4 impracticable [6].

XMPP

Extensible Messaging and Presence Protocol (XMPP) is a communications protocol initially created for chatting and message sharing applications. The IETF standardized it more than a decade ago. As a result, it is well recognized and has shown to be quite effective over the internet. This reuse of the same standard is owing to its usage of XML, which allows for easy extensibility. XMPP supports both publish/subscribe and request/response architectures, and the application developer may select which to utilize. It is intended for near-real-time applications and so handles low-latency short messages efficiently. It does not ensure quality of service and so is unsuitable for M2M communications. Furthermore, because of the numerous headers and tag formats, XML messages generate additional overhead, increasing power consumption, which is crucial for IoT applications. As a result, while XMPP is rarely utilized in IoT, there is considerable interest in improving its design to accommodate IoT applications [7].

AQMP

Is an application layer protocol used to convey data between apps or organizations. AQMP is a wire-oriented protocol that uses TCP as the underlying protocol and includes dependability, flow management, authentication, and other features [6].

TCP

Short for Transmission Control Protocol is the dominant protocol for the majority of Internet connectivity. It provides host-to-host communication, splitting large blocks of data into individual packets and retransmitting and reassembling the packets as needed [8].

UDP

Short for User Datagram Protocol is a communications protocol that enables process-to-process communication and runs on top of IP. UDP improves data transfer rates over TCP and best suits applications that require lossless data transmissions [8].

IPv6

Is a relatively new IP protocol designed for packet-switched interconnection. Existing IP addresses may not be sufficient to offer unique identifiers for each object in an IoT network. Because IPv6 has a 128-bit address space, it will supply 4.3 billion addresses. Aside from address space, IPv6 has hierarchical address allocation methods, overcoming the issue of routing table growth [6].

RPL

Is a routing protocol designed for low-power, lossy networks. RPL allows multipoint-to-point traffic in IoT networks. RPL produces a Destination Oriented Directed Acyclic Graph (DODAG) for multipoint-to-point traffic. RPL also has optional security capabilities to provide message authentication utilizing advanced encryption standard (AES) and RSA signatures for data integrity [6].

6LoWPAN

Is an IPv6 form of low power wireless PAN that allows IPv6 packets to be sent and received over IEEE 802.15.4 networks. To incorporate IPv6 into IoT, the 6LoWPAN protocol is suggested for backward compatibility with IP networks. 6LoWPAN facilitates the usage of IPv6 for IoT, allowing the present network to be readily implemented in IoT. 6LoWPAN is mostly utilized in application situations like as home automation, smart meters, and so on [6].

BLE

Bluetooth low energy is a short-range communication protocol having a PHY and MAC layer that is commonly used for in-vehicle networking. Its low energy can be ten times that of traditional Bluetooth, while its latency can be 15 times that of traditional Bluetooth. It employs a contentionless MAC with low latency and rapid transmission for access control. It has a master/slave architecture and provides two sorts of frames: advertising frames and data frames. The Advertising frame is used for discovery and is transmitted by slaves over one or more specialized advertisement channels. Master nodes detect advertisement channels in order to locate and link slaves. Following the connection, the master informs the slave about its waking cycle and scheduling sequence. Nodes are typically awake only while communicating, and they sleep otherwise to conserve power [7].

Z-Wave

Is a low-power MAC protocol that was developed for home automation and has been utilized for IoT communication, particularly in smart homes and small business domains. It has a range of around 30 meters and is suited for tiny messages in IoT applications such as light control, energy management, wearable healthcare control, and others. For collision detection and reliable transmission, it employs CSMA/CA and ACK messages. It has a master/slave design in which the master controls the slaves, sends orders to them, and handles network scheduling [7].

ZigBee

Is a wireless technology that was created to establish Personal Area Networks (PAN) with low-power, low-cost, and low-bandwidth devices that may be utilized to develop IoT applications. ZigBee may be used to create mesh networks, which include many pathways between nodes in the network. This design enables nodes to confgure dynamically and give ad hoc routing capacity to network nodes [6].

HomePlugGP

HomePlug GreenPHY is another MAC protocol created by the HomePlug Powerline Alliance and utilized in home automation applications. The HomePlug suite has three versions that cover both the PHY and MAC layers: HomePlug-AV, HomePlug-AV2, and HomePlugGP. HomePlug-AV is a simple power line communication protocol that employs TDMA and CSMA/CA as MAC layer protocols, adaptive bit loading (which allows it to adjust its rate depending on the noise level), and four modulation schemes [7].

DASH7

Is an active RFID wireless communication protocol that runs in the globally accessible Industrial Scientific Medical (ISM) band and is appropriate for IoT applications. It is primarily intended for scalable, long-range outdoor coverage with a greater data rate than standard ZigBee. It is a low-cost solution with encryption and IPv6 addressing. It is designed for burst, lightweight, asynchronous, and transitive traffic and offers a master/slave architecture [7].

IEEE 802.15.4

Is the most widely utilized IoT MAC standard. It specifies a frame structure, headers that provide source and destination addresses, and how nodes communicate with one another. Due to their overhead, existing network frame formats are unsuitable for low power multi-hop networking in IoT. IEEE802.15.4e was developed in 2008 to expand IEEE802.15.4 and provide low power communication. It employs time synchronization and channel hopping to provide high reliability, low cost, and to suit the needs of IoT communications [7].

1.2.4 Characteristics of IoT

The Internet of Things (IoT) is characterized by several key features that distinguish it from traditional computing systems. Here are the characteristics of IoT [9]:

Interconnectivity

In terms of the Internet of Things, anything may be linked to the global information and communication infrastructure.

Things-related services

Within the restrictions of things, the IoT can provide thing-related services such as privacy protection and semantic consistency between physical things and their corresponding virtual things. Both physical and information technology will alter in order to deliver thing-related services within the restrictions of things.

Heterogeneity

IoT devices are heterogeneous in that they are based on several hardware platforms and networks. They can communicate with other devices on various networks.

Dynamic changes

Device states fluctuate dynamically, such as sleeping and waking up, being connected and/or disconnected, and the context of devices, such as location and speed. Furthermore, the number of devices might fluctuate dynamically.

Enormous scale

The number of devices that must be controlled and interact with one another will be at least an order of magnitude greater than the number of devices currently linked to the Internet. More crucial will be created, as will their interpretation. This is related to handling semantics.

Safety

We must not lose sight of safety while we reap the benefits of the Internet of Things. We must design for safety as both makers and recipients of IoT. This includes data and the safety of our physical well endpoints, networks, and the data travelling across all of it, which necessitates the development of a scalable security paradigm.

Connectivity

Connectivity is required for network access compatibility. Access is the ability to connect to a network, whereas compatibility is the shared capacity to consume and generate data.

1.2.5 Applications of IoT

Figure 6 depicts the breadth of IoT application domains. These applications might be viewed as the fulfillment of industrial demands. These include consumer-oriented applications such as wearable devices, smart homes, and smart healthcare; commercial applications such as logistics and retail; industrial applications such as resource and energy management, intelligent transportation, and manufacturing; and public-sector applications such as smart cities, safety and surveillance, and so on, all of which aim to improve the quality of people's lives. Users may access IoT apps and services directly through portable devices such as mobile phones, PCs, Personal Digital Assistants (PDAs), and so on [10].

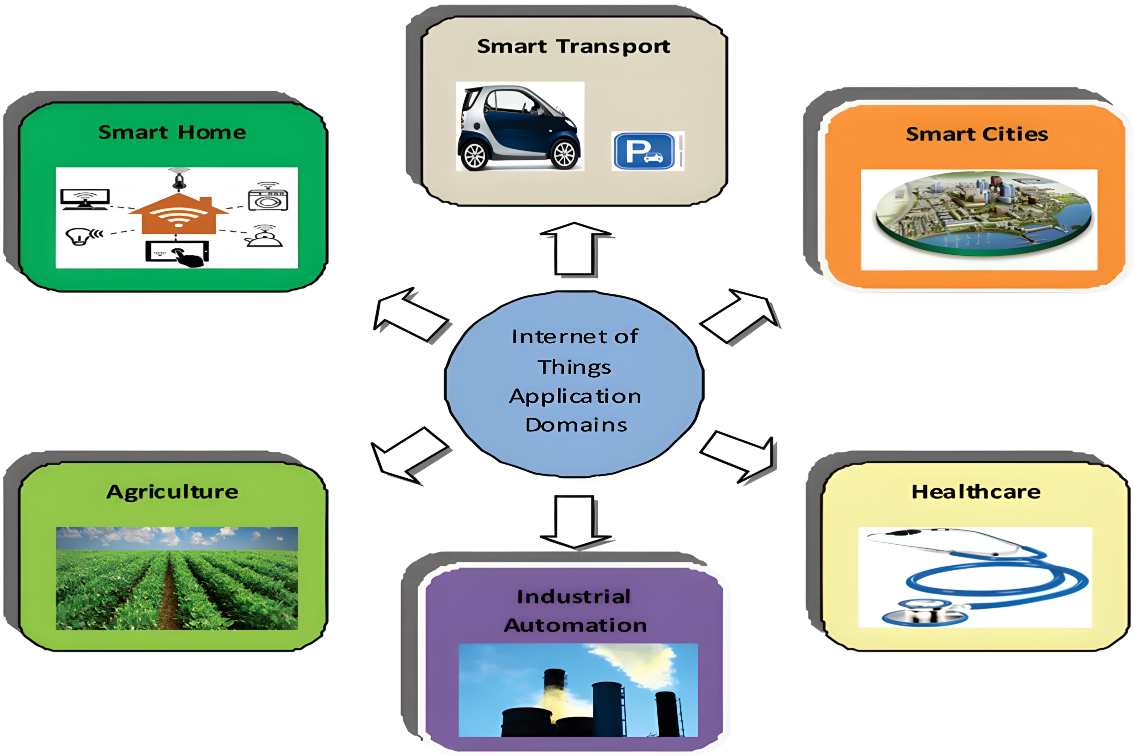

Figure 1.4: IoT application domains [10]

1.2.6 Future challenges for IoT

The Internet of Things (IoT) continues to expand and evolve with the passage of time, bringing with it new opportunities and challenges. Here are some potential challenges that the Internet of Things may face [11] :

Privacy and Security

As the Internet of Things becomes a crucial component of the Future Internet, and the use of the Internet of Things for large-scale, largely mission-critical systems, there is an increased need to address trust and security functions. New challenges identified in privacy, trust, and reliability are:

- providing trust and quality of information in shared information models to enable re-use across many applications.
- providing secure data exchange between IoT devices and consumers of their information.

Cost versus Usability

IoT connects physical items to the Internet through the use of technology. For IoT adoption to rise in the next years, the cost of components required to enable features such as sensing, tracking, and control mechanisms must be relatively low.

Interoperability

Interoperability is the most fundamental core property of the conventional Internet; the first condition of Internet connectivity is that ”connected” devices ”talk the same language” of protocols and encodings. Today, several sectors employ various standards to support their applications. With multiple data sources and heterogeneous devices, consistent interfaces between these disparate entities become critical. This is particularly true for applications that allow cross-organizational and system borders. As a result, IoT systems must provide a high level of interoperability.

Data Management

Data management is an essential aspect of the Internet of Things. When contemplating a world of networked items continually sharing various sorts of information, the volume of created data and the procedures involved in its treatment become essential.

Power issues at the device level

The challenge of figuring out how to connect ”things” in an interoperable manner while considering power constraints is a fundamental challenge in IoT, since connectivity is the most power-intensive process on devices.

1.3 Cloud computing

Today is the era of cloud computing technology in information technology fields. Cloud computing based on the Internet has the most powerful computing architecture. Comprises a collection of embedded and connected Internet hardware, software, and infrastructure. It has various benefits beyond network processing and other computations. we submitted the fundamentals about Cloud Computing such as definition, characteristics and Types and Services models.

1.3.1 Definition

Cloud computing refers to the process of storing and accessing data and software through the Internet as opposed to our computer's hard drive. The Internet may be compared to a cloud. In a computer network, the internet is commonly represented as a cloud, as in the illustration. Utilizing hardware and software to deliver a service over a network, most frequently the Internet, is known as cloud computing. Users of cloud computing may access data and utilize apps from any computer or device that has Internet connectivity. Google's Gmail is an illustration of a cloud computing service [12].

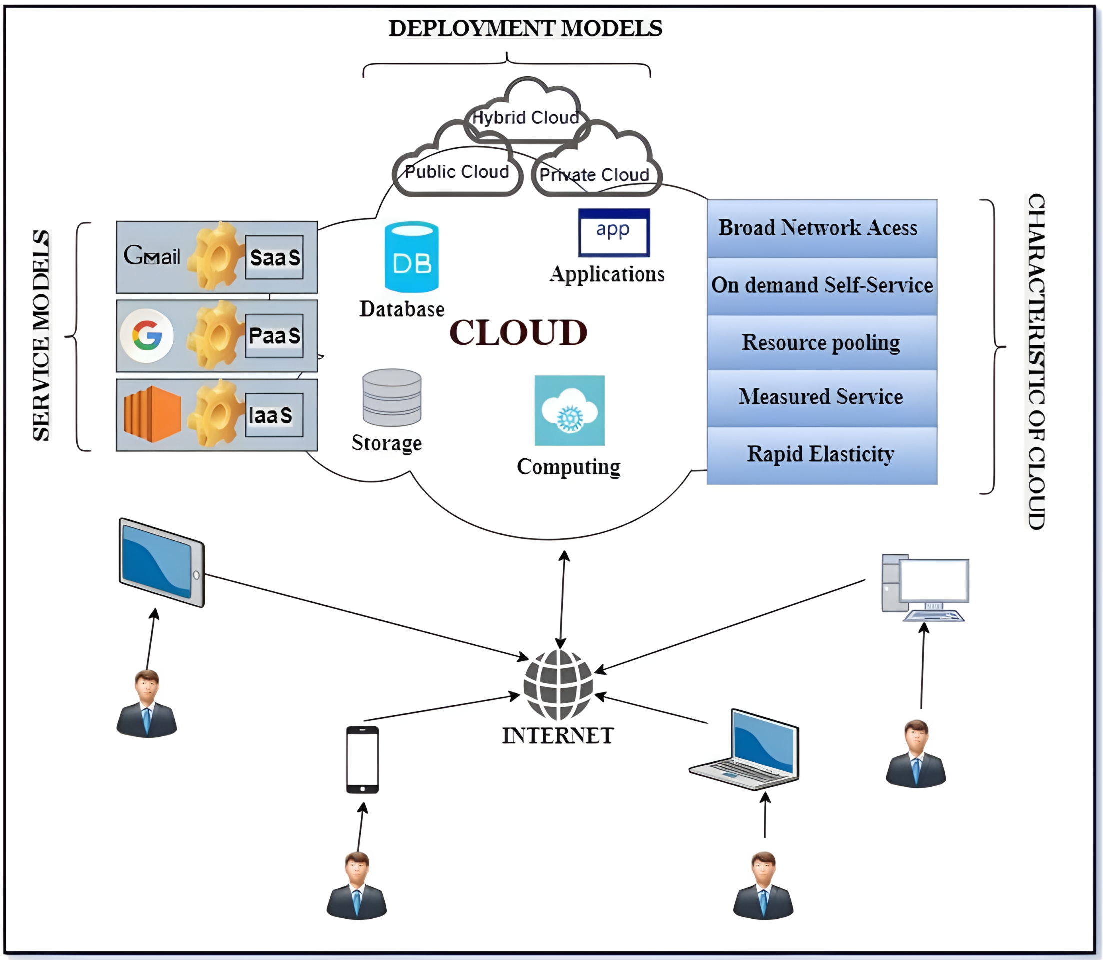

Figure 1.5: Overview of Cloud Computing [12]

The National Institute of Standards and Technology (NIST) provides a widely accepted definition of cloud computing:

”Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model promotes availability and is composed of five essential characteristics, three service models, and four deployment models.”

1.3.2 Characteristics of Cloud Computing

Cloud computing has several characteristics that make it a popular and effective technology for businesses and organizations. These characteristics include [13]:

Broad network access (mobility)

Cloud computing services are available over the internet or other wide-area networks from any device with an internet connection (such as smartphones, computers), from any location (i.e., ubiquitously).

High scalability

Cloud computing infrastructure is highly scalable. Cloud service providers can add new nodes and servers to the cloud with minor changes to cloud infrastructure and software.

High availability and reliability

Because there are more reliable and high-availability servers, there are fewer opportunities for infrastructure failure.

Maintenance

Applications for cloud computing may be accessible from different locations and do not need to be installed on every machine, making maintenance simpler and ultimately less expensive.

Measured services

Cloud computing resources are typically provided on a pay-per-use basis, allowing organizations to only pay for the resources they consume.

Rapid elasticity

Cloud computing resources can be quickly scaled up or down in response to changing demand, providing businesses with the flexibility to meet their needs without needing to invest in and maintain their own hardware.

Cost effectiveness

The services offered by cloud service providers are extremely affordable, if not free. Pay as you go billing eliminates the need to acquire infrastructure, which minimizes maintenance costs.

On-Demand self service

Cloud computing allows users to quickly and easily provision computing resources as needed without the need for human interaction with the service provider.

Resource pooling

Cloud computing resources, such as computing power, storage, and bandwidth, are shared among multiple users to optimize resource utilization and efficiency.

Multi-sharing

A cloud offers services to several users simultaneously. Each of those users is segregated within a unique virtual application instance while sharing network, host, and application resources in the cloud.

Virtualization

Cloud computing enables users to access services from any type of terminal, anywhere. It needed resources from the cloud rather than a visible entity. Using a laptop or a mobile phone with internet service, you can accomplish anything you want. Users may access or share it securely at any time or anywhere using a simple method. A task that cannot be accomplished by a single computer can be completed by users.

1.3.3 Types of Cloud Computing

Public cloud

Through the internet, all external clients have access to this cloud. These clients can register with the cloud and use its resources on a pay-per-use basis. Unlike a private cloud, this cloud is not secure. As a result of its openness, it is accessible to all internet users. It may be customized far less than a private cloud. A sizable Cloud Service Provider (CSP) owns and oversees the cloud infrastructure.The universal public cloud and its IT resources are created and continuously supported by the cloud provider. The external cloud, often known as the open cloud, is when resources are effectively provided on a self-benefits basis through the internet [14].

Private cloud

This cloud is configured specifically for a company within its own data center. All of the cloud resources that belong to the organizations are managed by them. When compared to an open or hybrid cloud, the private cloud provides greater security.Public cloud resources are more cost-effective than private cloud resources, but private cloud resources are more productive than open cloud. The cloud can be found inside or beyond the organization's boundaries; it is controlled by an association and alone serves it. The private cloud, often known as the internal or corporate cloud, provides enabled devices to a set number of users behind a firewall [14].

Hybrid cloud

It is a collection of communal, private, and public clouds. However, the non-critical activity is completed using the public cloud while the critical activity is completed using the private cloud. Because private cloud is more expensive than public cloud, hybrid clouds can save money in this way. It's crucial to ensure surplus across data centers since hybrid cloud models depend on internal IT infrastructure. One cloud client may, for instance, direct some cloud services dealing with sensitive data to a private cloud and others, dealing with less sensitive data, to a public cloud [14].

Community cloud

A few businesses work together to develop and provide a common cloud infrastructure, as well as policies, demands, ideals, and issues. A level of economic scalability and democratic balance emerges from the community cloud. A third-party vendor or one of the community's groups may provide the cloud infrastructure. The cloud is managed by a few companies and supports a certain group of people who are interested in the same things. Compared to public clouds, community clouds are even more secure [14].

1.3.4 Cloud computing service models

Services enable the cloud to interact with a client (user or application) in several ways. There are three main types or models of services :

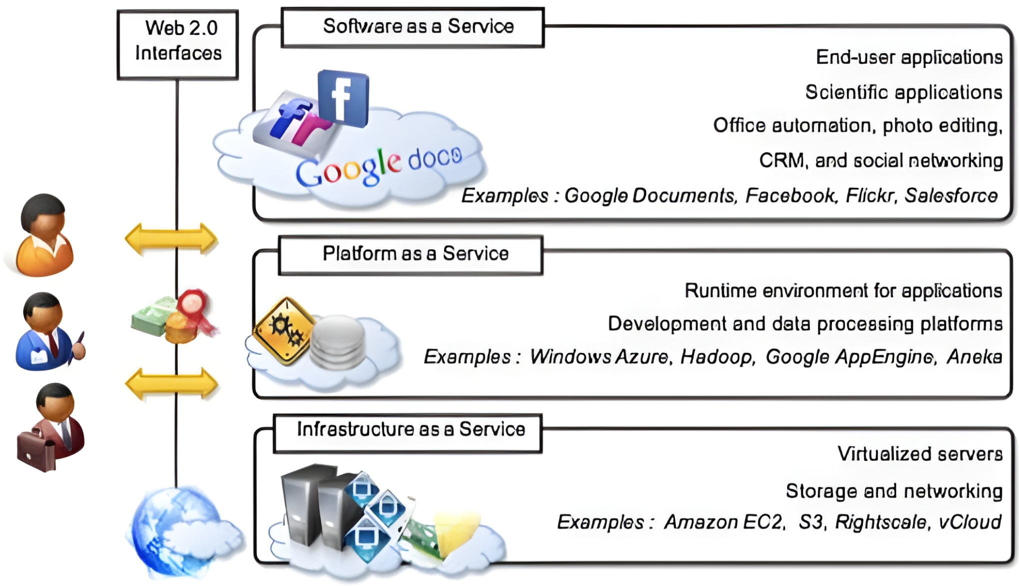

Figure 1.6: Cloud Computing Reference Model [15]

Software as a Service (SaaS)

In this model, operating systems, application software, and other resources are managed and updated by cloud service providers. When a consumer uses a web browser to access services delivered through the internet, they see the SaaS model as a web-based application interface. Mobile phones, laptops, and other devices can all be used to access hosted applications like Gmail and Google Docs. SaaS has the benefit of not requiring the customer to purchase licenses, install, upgrade, maintain, or use software on his own computer, in contrast to traditional software. Other benefits include multitenant effectiveness, configurability, and scalability [16].

SaaS Advantages

- Low upfront cost.
- The maintenance of the software being managed by the service provider.
- New features and updates.

SaaS Disavantages

- Risk of interruption of services.
- Connectivity needed (Requiert une connexion Internet constante et rapide).
- No use of software in case of system failure.

Platform as a Service (PaaS)

System software and other computer resources are offered, run, and maintained via PaaS, a more advanced form of cloud computing service. Services offered include online service integration, collaboration, database integration, design, development, and hosting of applications. The necessity for users to have their own hardware and software resources or to pay professionals for management is not a concern. Interoperability and portability between providers are, however, lacking. PaaS examples include Microsoft Azure, Google App Engine, and Rackspace Cloud Sites from Salesforce.com [16].

PaaS Advantages

- Increase development process flexibility while decreasing server storage overhead.
- Security is given, which includes data security, recovery, and backup.
- Lower costs by renting physical space and eliminating the need for specialist infrastructure management.

PaaS Disavantages

- The client has no control over the virtual machine that handles data.

- Only appropriate for web apps.

- To effectively implement the PaaS cloud model into the system, basic coding skills and programming experience are required.

Infrastructure as a Service (IaaS)

In Infrastructure as a Service (IaaS), the cloud service provider offers a collection of virtualized computing resources like CPU, Memory, OS, and Application Software etc. Virtualization technology is used by IaaS to transform physical resources into logical resources that customers may dynamically supply and release as required. Rackspace Cloud Servers, Google, Amazon EC2, IBM, and Verizon are some of the well-known businesses that provide infrastructure as a service [16].

IaaS Advantages

- Because virtualization as a service is provided, the client can operate a virtual machine.

- Network as a service is offered, including load balancing and router and firewall hardware.

- Saving money on human resources and hardware.

IaaS Disavantages

- Network Dependency and Latency.

- Technical complexity as IaaS requires technical expertise to set up, configure and manage the infrastructure.

- Downtime or service disruptions on the provider's end can impact the organization's operations and access to resources.

1.3.5 Challenges Integration of Cloud Computing and IoT

The integration of cloud and IoT offers many advantages and drives the birth or improvement of some interesting applications. At the same time, the complex scenario of CloudIoT poses many challenges for every application that is currently attracting the attention of the research community. In this section, we address these challenges [17].

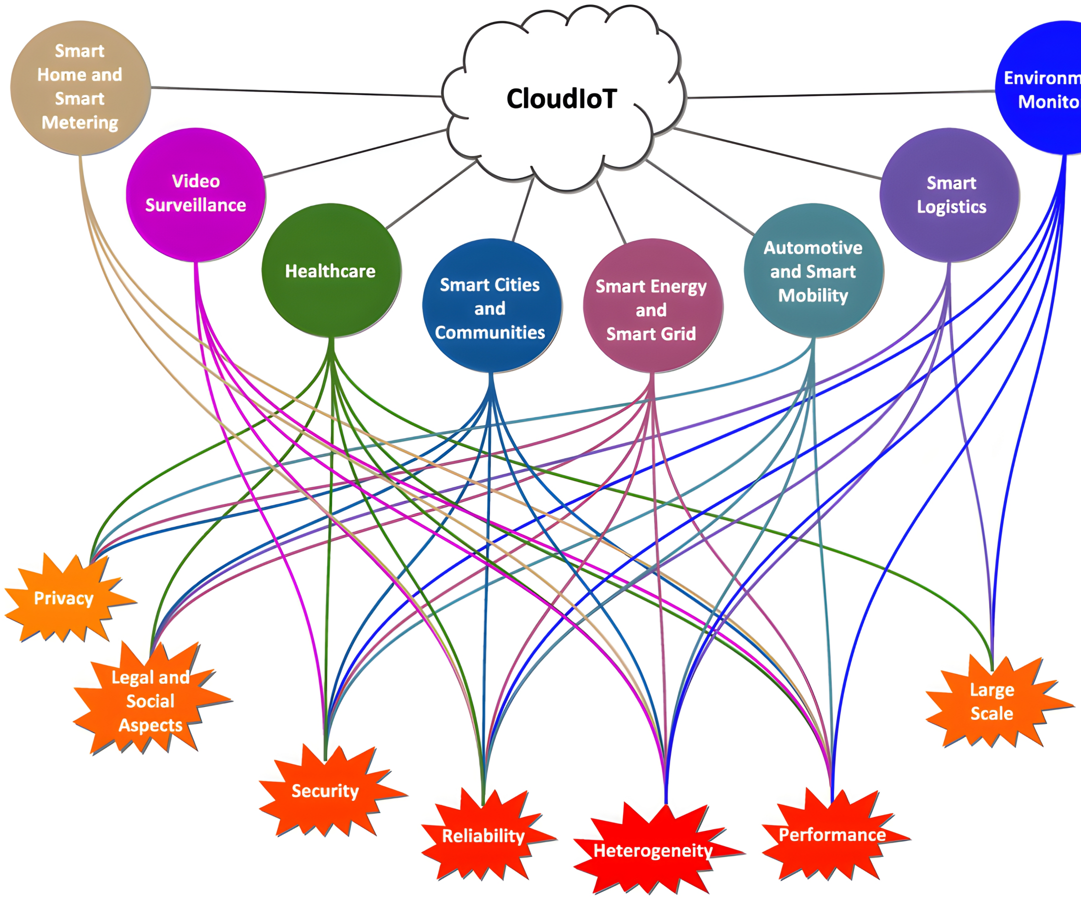

Figure 1.7: Application scenarios driven by the CloudIoT paradigm and related challenges.[17]

Security and Privacy

Concerns occur when essential IoT applications are moved to the Cloud owing to a lack of, for example, confidence in the service provider, understanding of service level agreements (SLAs), and awareness of the actual location of data. As a result, new difficulties require special attention. A distributed system like this is vulnerable to a variety of attacks (such as session riding, SQL injection, cross-site scripting, and sidechanneling) and critical vulnerabilities (such as session hijacking and virtual machine escape). Multi-tenancy can potentially jeopardize security and expose critical information. Furthermore, because to the processing power restrictions imposed by the objects, public key cryptography cannot be used at all tiers. These are some of the themes that are presently being researched in order to address the major difficulty of security and privacy in CloudIoT.

Heterogeneity

A significant issue in Cloud Computing and IoT integration is the broad variety of devices, operating systems, platforms, and services accessible for new or better applications.

Performance

Often, Cloud Computing and IoT integration applications bring unique performance and QoS needs at several levels (i.e. for communication, compute, and storage elements), and achieving such requirements may be difficult in some cases.

Reliability

When Cloud Computing and IoT integration are used for mission-critical applications, reliability problems usually arise. For example, in the context of smart mobility, cars are frequently on the go, and vehicular networking and communication is frequently sporadic or unreliable. It is frequently intermittent or unreliable. When applications are deployed in resource restricted environments, they face a number of issues such as device failure or devices that are not always available.

Big Data

With an expected 50 billion networked devices by 2020, special attention must be devoted to the transit, storage, access, and processing of the massive quantity of data they will generate. The pervasiveness of sensors and the pervasiveness of mobile devices necessitate scalable computing systems.

Monitoring

Monitoring, as well documented in the literature, is a vital activity in Cloud settings for capacity planning, resource management, SLAs, performance and security, and troubleshooting.

Large Scale

CloudIoT enables the development of innovative applications for integrating and analyzing data from real-world (embedded) devices. Some of the described situations implicitly demand contact with a large number of these devices, which are often scattered across huge areas. Because of the vast scale of the resulting systems, normal difficulties become more difficult to address. Furthermore, the deployment of IoT devices makes monitoring jobs more difficult since they must contend with delay dynamics and connection concerns.

Chapter 2

Poultry shed study

2.1 Introduction

The production of eggs and chickens is one of the profitable projects to a good degree, and investing in them is one of the best decisions taken by the productive individual in the community in light of these circumstances, which witnessed the high prices of these two materials in the market. The idea of a factory or poultry farm is one of the best product ideas.

Before starting a poultry farming project or factory, a study should be made of the characteristics of the project, such as the needs, how to choose the appropriate place, the features of the building in which the project will work, as well as a study of environmental factors such as climate, temperatures, and humidity in the factory, as well as a study of the factors affecting productivity, the productivity of the factory or farm from ventilation. Heating and lighting it, as well as the proper selection of the strain that works on it.

The chicken industry has been formed during the past 20 years excellently by controlling breeding, care, and prevention of diseases that affect chickens, especially by using artificial incubation methods for eggs, which led to an increase in the efficiency and productivity of each chicken with a very large number of chicks in one batch by using hatcheries And programmed electronic hatcheries in the intensive poultry industry, where the hatching process provided the appropriate conditions for growth and hatching.

Hence the idea of including technology in the field of poultry farming, where detection and control of the factors affecting productivity is the best way to produce these foods with high quality, as this can only be done through automatic smart systems that work on the principle of the Internet of things, where the defect is detected, an alert is sent, and then operations are performed for better productivity.

2.2 Broiler chicken

It is the breed that has the ability to convert the feed into meat, as the consumption of chicken 2 kg of feed results in 1 kg of meat, and this percentage can be decreased or increased, depending on the quality and baskets of chicken or the good specifications of the feed [18].

”Broilers are young chickens (6-7 weeks old) of both sexes (different males and females) and weigh between (1.5-2.5) kg. They have soft meat, thin, smooth and flexible skin, and flexible and cartilaginous breastbone. Where this type of chicken is characterized by rapid growth, rapid feathering and high efficiency in cleaning meat at the slaughter and wide chest” [19].

An agriculture production is presented as follows:

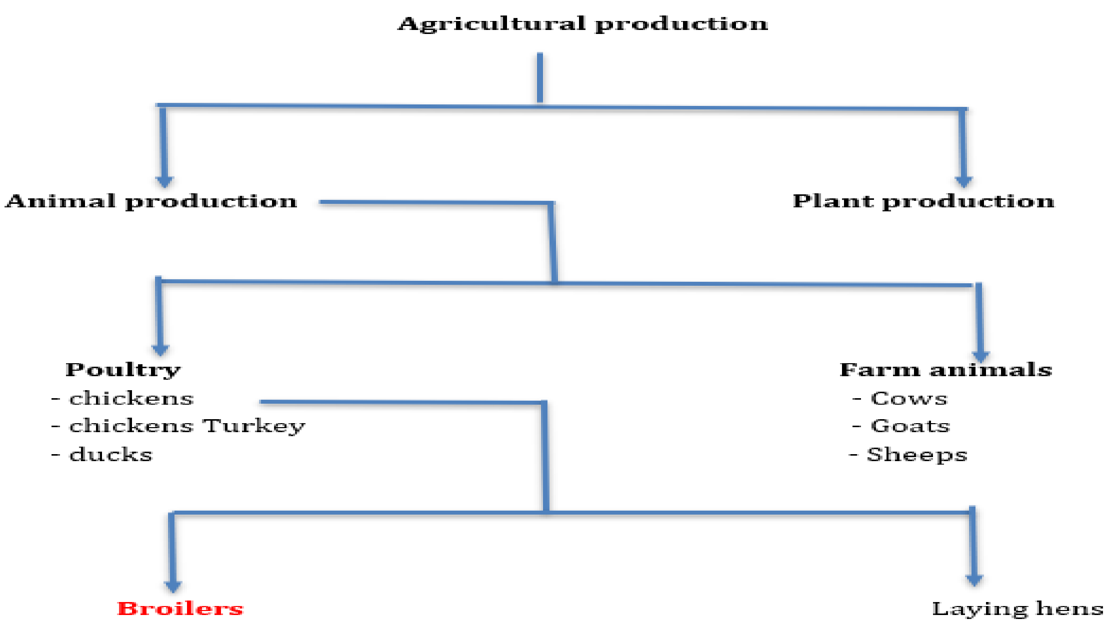

Figure 2.1: Poultry production within the agricultural system. [19]

2.3 Benefits of raising broiler chickens

Raising chickens has many benefits, including:

- Convert concentrated plant feed into animal protein (meat).

- The breeding period is short, as it can be marketed after 30 days, which leads to profits compared to other projects.

- In one year, 6 to 7 cycles can be done (between one cycle and the last 10 days for cleaning).

- A poultry farm does not require a lot of capital compared to other projects.

- The remains are considered complete fertilizer as they provide the soil with basic elements such as nitrogen, phosphorus, and potassium and are considered one of the best organic fertilizers as it is characterized by rapid decomposition and absorption from the soil [20].

And this figure 2.2 showing the broiler production cycle

Figure 2.2: The broiler production cycle. [20]

2.4 Conditions to be adhered to in raising broiler chickens

2.4.1 The barn

Before construction

Before building any barn the following conditions must [18]:

- The presence of roads facilitates the process of transporting materials.
- Building a barn near the farm in order to monitor the chickens at the right time.
- Building the barn near the water source and electricity source.
- Avoiding noise and disturbances because of their direct impact on growth and production.
- Presence of water drainage channels.
- Abundance of shade trees.
- Away from wind sources.
- Distance from quarries and industrial projects.

During construction

The following conditions must be observed [20]:

- Avoid building in high humidity and unhealthy lands where diseases spread.
- Avoid building on highly crowded land to avoid noise that negatively affects chicks.
- The longitudinal side of the barn is parallel to the monsoon direction
- The building is completely identical to the plan, whether with regard to the floor, ceiling, insulation, the number of windows, which represent 10% of the total area.
- The use of moisture and heat insulating building materials.
- The height ranges between 2.7-3 meters to ensure the quality and regularity of ventilation.

The following (figure 2.3) drawing is shown before and during constructin

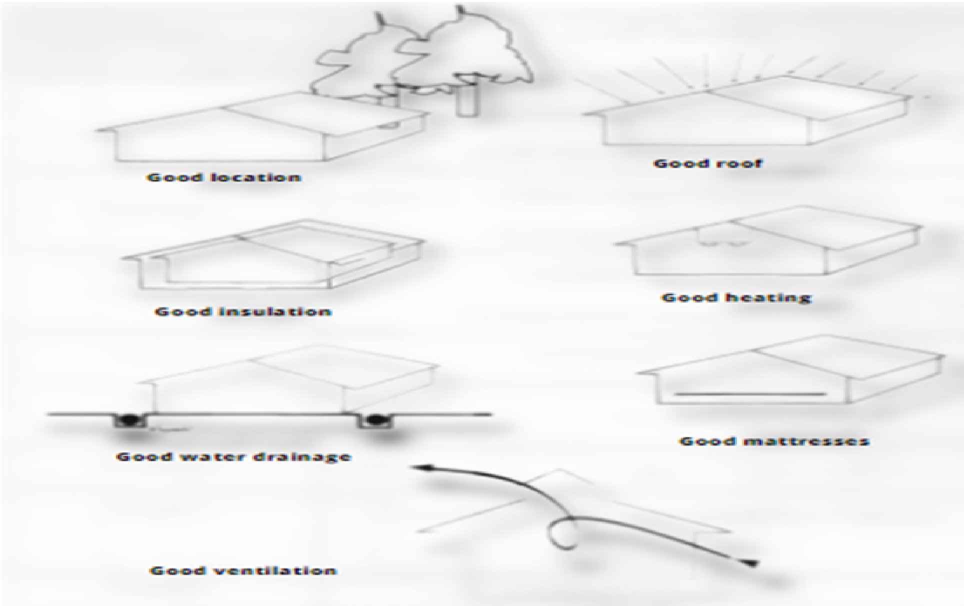

Figure 2.3: Before and During construction. [18]

2.4.2 Preparation at the launch stage

Breeding plan

The educator must develop a plan for education that [20]:

- Taking into account the number of birds that can be bred and marketed, with specifying the date of reception and marketing (all entry / all exit).
- Preparing the barn 36 hours before receiving the chicks.
- Caution must be taken when transporting and receiving chicks, because their fall can lead to damage at the joint level.

Type of chicks

The health and safety of the chicks must be in accordance with the following standards [19]:

- Absence of pathological and respiratory symptoms.
- The weight of the chicks should be equal to the average weight of 35 mg when they leave the hatchery
- Chicks should be placed under heaters at a temperature close to hatchery.

- The chicks must be homogeneous and of acceptable quality.

Number of birds per square meter

Respecting the density of birds per square meter is an important factor in breeding broiler chickens. Any increase in this density can lead to health problems and slow growth of the birds. The density can be determined on factors such as humidity, ventilation and other factors because it contributes to raising and lowering the temperature and this is to facilitate eating and drinking. Without hardships, and the density is as follows [18]:

- The starting stage: 20 chicks per square meter.
- Growth stage: 10 chickens per square meter.

What to consider when receiving

• The breeder must take into account the temperature of the chick at hatching, and therefore he must prepare the barn 36 hours before the arrival of the chicks, and the temperature of the barn is close to the temperature of the chick at hatching [18].

• The breeder must be careful when he transfers the chicks from the hatching laboratory to the breeding barn, because the fall of the chick can lead to injury [18].

• Any foreign person must be prevented from entering the barn, and this is to avoid the transmission of any infection with germs that cause diseases that are difficult to control [18].

2.4.3 Stages of raising broiler chickens

Usually, the stages of raising broiler chickens are divided into three sections, namely [20]:

• **Starting phase** The first stage is incubation, which lasts a maximum of two weeks, and it is the most important stage in raising broiler chickens, as it requires a warm, dry environment and heat lamps to maintain the temperature.

• **the second stage** is the growth stage that begins at 2-3 weeks of age and continues until the desired size is reached, and requires a specially designed poultry house and a specially prepared diet.

- **The third and final stage** is the finishing stage which lasts for 2-3 weeks and includes giving the chickens a final diet designed to reach the required size and weight, access to clean water and keeping them in a clean, dry environment.

2.4.4 Things to consider in raising broiler chickens

The heating

Heating is an important and vital factor in poultry farming, so that the temperature of the chicks received from the hatchery is 35 degrees, which is the same temperature they need when they arrive in the barn, so that the chicks are not exposed to a cold, and this temperature gradually decreases with growth. The appropriate temperature for her body is 28 degrees Celsius inside the hall and 32 to 35 degrees under the fireplace so that the fireplace is located 1.20 meters from the floor [19].

The needs of broilers decrease in terms of heating in the growth stage and the selling stage, due to the growth of feathers, so that starting from the fifth week, heaters are removed and the room temperature remains between 18 and 21 degrees until sale. Measurement with a thermometer. The cold air affects the chickens and causes them fear and anxiety, and the irregular temperature inside the hall makes the chickens gather in large numbers in certain places [18].

Where the following figures show the behavior of the chicks with the change of temperature

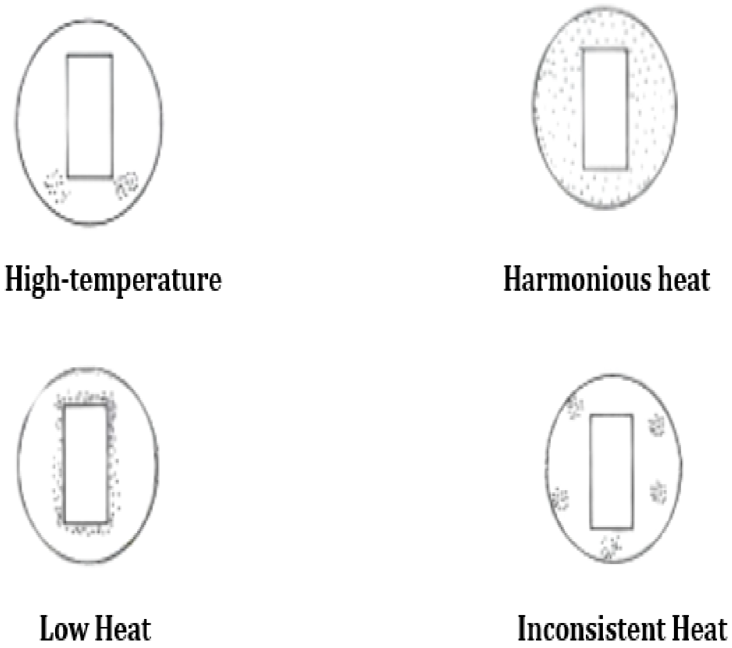

Figure 2.4: Behavior of the chicks with the change of temperature.[18]

Feeding

In poultry feed, most attention is paid to protein products, given the importance of protein as a major component of biologically active compounds in the body. It also helps in the formation of body tissues, for the renewal and growth of the body, as it starts from the first day of the age of the hen and continues until the end of the second week of the age of the chicks and chicks, and one chicken needs 3000 calories per day in the starter diet to obtain the energy needed for growth.

The starter diet is provided to chickens, divided into eight meals per day, at a rate of 15 grams of feed each time, and the starter diet should consist of a group of proteins, vitamins and minerals according to the following table [21].

In the second stage of rearing, which ranges from 15 days to 42 days, a period in which the chicks grow rapidly if the correct conditions are met, and the weight increases steadily during this time. This period and this increase is directly related to the quality of the feed provided to the chickens. In terms of the amount of energy it contains and the percentage of proteins, vitamins and others. The more energy the chicken finds, the fatter it becomes, the higher the feed consumption, and thus the higher the costs. Then comes

Tableau 2.1: Table of proteins and vitamins and minerals.[20]

Food item	Value	Unit
Crude protein, CP	23.00	%
Metabolizable Energy, ME	3000	KCal/ kg
Calcium, Ca	1.00	%
Phosphorus (Pavailable)	0.48	%
Dl-Methionine	0.55	%
L-lysine	1.44	%

the final stage (the end)when the specified age approaches technically and economically. The weight reaches 1.8 kg, so that it is intended for sale.

You start using the growing diet from the beginning of the third week of the chicken's life until the end of the fourth week. Chickens in the growing diet stage need 2965 calories or energy per day to complete growth and throw meat, as chickens need more at this stage for other nutrients such as protein, vitamins and mineral salts. Provide chickens with five or six meals a day, at a rate of 15 grams for each meal, which contains the necessary nutrients [21].

Tableau 2.2: Table of proteins and vitamins and minerals. [20]

Food item	Value	Unit
Crude protein, CP	21.00	%
Metabolizable Energy, ME	3100	KCal/ kg
Calcium, Ca	0.94	%
Phosphorus (Pavailable)	0.44	%
Dl-Methionine	0.53	%
L-lysine	1.29	%

In the last stage in raising live chickens, and it starts from the fifth week to marketing it, as the chickens' energy needs decrease during this period, as they need 2800 calories. The nutritional value of chicken diet in the final stage consists of nutrients according to the following [21].

Tableau 2.3: Table of proteins and vitamins and minerals. [20]

Food item	Value	Unit
Crude protein, CP	21.00	%
Metabolizable Energy, ME	3100	KCal/ kg
Calcium, Ca	0.94	%
Phosphorus (Pavailable)	0.44	%
Dl-Methionine	0.53	%
L-lysine	1.29	%

Figure 2.5: Nutrition. [22]

Drinking

During the hatching process, the chick loses about 0.1 water per hour, and for this reason it must be provided with drinking water at temperatures ranging from 16 to 20 during the first two days, and in sufficient quantity. It is better to provide 50 g sugar and one gram of vitamin G in 1 liter of water during the first 24 hours. An amount of water, and the stripes should be cleaned daily [18].

The provision of clean and potable water is a crucial factor for the health and good growth of chickens, whether during the growing period or for sale, as it helps to avoid bacterial diseases and infections. The water can be changed regularly to keep it clean and avoid the spread of diseases, and it is preferable to use properly treated and purified water. Nutritional supplements can be added to the water to ensure adequate mineral salts and vitamins [23].

Figure 2.6: Drinking.[24]

Humidity

Humidity, which is the ratio of water to water vapor present in the atmosphere, because of its great impact on the growth of poultry, especially broiler chickens, as the humidity in the first period of its life is low, which helps panting performance. Practical, as this process helps them to withstand high temperatures, as a result of their loss of water through the loss of water vapor to the surrounding atmosphere, and the appropriate humidity ranges between 50 to 70% in the first days. Where the breeder must maintain this rate suitable for poultry pens, as low humidity rates lead to many problems that directly affect poultry.

But if the humidity reaches less than 30%, then this leads to the volatilization of dust, which affects the respiratory system of poultry. Humidity has a direct relationship with temperature, especially during the incubation period. The higher the relative humidity, the lower the temperature, and the lower the relative humidity, the higher the temperature [25].

Vaccination

The breeding period for broilers is usually 6 to 8 weeks, leaving little time for the development of a mature immune system. Broiler chicks (including organic chicks) are vaccinated against many different diseases. Some infectious pathogens (such as salmonella) can also be transmitted via the egg (vertical transmission) from the breeding hen to the chicks. The most common vaccines used are against Newcastle disease virus, and infectious bronchitis virus. 3 Vaccines are usually delivered by spray, drinking water, oocyte, or injection (most common route under the skin) [26].

Figure 2.7: Vaccination. [27]

Ventilation

Ventilation is to secure the right amount of oxygen in the atmosphere surrounding the bird inside the barn, which achieves efficient work of the heart and lungs and ideal conditions for conversion. Ventilation is one of the most important elements for the success of raising chickens, and any negligence in this aspect can lead to [28]:

- Low conversion rates and weights of broiler chickens.
- Low levels of herd immunity and not reaching ideal levels.

- Lack of oxygen, increased pressure on the bird, and the emergence of diseases of poor care.
- High percentage of gases in the barn (carbon dioxide and ammonia gas).

Bedding

A clean, dry living environment is essential to raising healthy poultry. The bedding provides a comfortable surface for chickens to rest on and helps absorb moisture and odors. Good bedding should be free of toxins, dust and mold. Several types of bedding options are available, including straw, sawdust, and sand. Wood chips have been a good choice for poultry for many years. Sand is another option that is growing in popularity. Easy to clean and does not harbor bacteria. No matter what type of bedding is used, it is essential to keep it clean and dry. Dirty bedding can harbor bacteria, parasites, and fungi that can cause disease. Wet bedding can also lead to respiratory problems and foot infections [29].

Lighting

Light is the most important environmental factor for birds. It is an integral part of vision, including visual acuity. Light allows the bird to establish a rhythm and synchronize many basic functions, including body temperature and various metabolic steps that facilitate feeding and digestion. Equally important, light stimulates the secretory patterns of several hormones that greatly control growth, maturation, and reproduction. In the following table, you will find light intensity and lighting hours for the age of the chickens [30].

Age (days)	Light Intensity (lx)	Photoperiod (L= Light, D= Dark) (Broiler)
0-7	20	23.0L:1.0D
8-14	5	16.0L:8.0D
15-21	5	16.0L:3.0D:2L.3D
22-28	5	16.0L:2.0D:4.0L:2.0D
29-35	5	16.0L:1.0D:6.0L:1.0D
36-49	5	23.0L:1.0D

Figure 2.8: Table showing light intensity and lighting hours by age.

Surveillance

Continuous monitoring is one of the most important things that the breeder must take into account because it allows him to avoid dangers that affect broiler chickens, especially in the early stages, and to intervene in a timely manner. For this, some basics must be followed to obtain good breeding, including [31]:

- Feed drinkers are cleaned and the rest of the feed is changed and replaced in the afternoon during the staging phase.
- Measurement of maximum and minimum temperatures, humidity and ammonia percentage.
- Monitor the distribution of birds inside the barn and the ventilation conditions.
- Monitoring hygiene, the abundance of drinking water, the rate of increase in drinking water, and measuring its consumption.
- Observe birds for change in behavior, and switch in feather quality. Multiple death statistics.

Hygiene and disinfection of the barn

Effective cleaning and disinfection of poultry houses at the end of the production cycle is a critical step in reducing infection pressures in broiler flocks and preventing zoonotic and endemic foodborne diseases. In addition, the remaining organic residues (faeces, feathers, etc.) must be properly disposed of prior to disinfection as they have a detrimental effect on disinfectants. In addition, the organic matter that remains after cleaning can form a physical barrier that protects microorganisms from disinfectants. For this, the following must be followed [23]:

- Moving equipment and removing bedding and dust from ceilings and walls.
- Thoroughly clean all equipment and the coop with a good cleaner, then spray the walls and floor with the pump.
- Use a rodent repellent (Vatran).
- Cleaning the outside of the barn.
- After making sure that the operation was successful and the barn dried, whiten the

walls and more quicklime on the floor.

- Before closing the barn, place in front of the entrance an appearance in the form of a solution.

The rest period of the barn is 15-18 days.

Marketing

1 - Selling them directly to consumers, whether by transporting them to markets or various commercial stores.Or supply it to restaurants, hotels and other food establishments [18].

2 - Online sales and home delivery [18].

3 - Wholesaling to dealers, distributors or retailers to citizens. Breeders must adhere to the quality and food safety necessary to market broiler chickens, and meet the requirements of the local market [18].

Some things must be taken into account during this stage. Among the measures to be taken [18] :

- Availability of water up to the stage of transportation.
- Serve food so that feeders are empty 4-6 hours before moving food.
- Reducing the optical density.
- Remove all devices that hinder the process.
- Provide adequate ventilation.
- Avoid noise and stimuli so that the chickens do not fall on each other.
- Push the chickens to congregate in small places in a quiet way.
- Hold the chicken with one leg from the underside, and hold 3-5 chickens depending on the weight.

2.4.5 An example of a national company in raising broiler chickens

Figure 2.9: EURL POULTECH. [32]

EURL POULTECH

It is an Algerian company based in the state of Bordj Bou Arreridj, a pioneer in the processing of modern and technological broiler breeding wards that rely on the best systems in the field of feeding, drinking, heating, ventilation and practical control by means of smart devices, where the technical study is considered a way to the success of the project, as a comprehensive plan is drawn up for the external shape of the hangar, which is Through it, fans and ventilation windows were placed, as well as cooling equipment and its system [32].

1- Feeding system: POULTECH provides an automatic feed distribution system of high Italian quality that ensures fair and rapid distribution of feed and prevents its loss, in addition to easy cleaning.

2- Watering system: POULTECH provides an automatic water distribution system with Dutch technology. This system ensures that the water is distributed throughout the pavilion. It also keeps the floor tidy and water waste free. It is the perfect solution for dispensing medications and additives for less moisture and water.

3- Heating system: The heating system provides the appropriate temperature according to the age of the chicken inside the house.

4- Lighting system: The lighting system provided by Poltech provides a good view of the chickens inside the house, which facilitates the process of moving inside the house, eating and drinking, and also ensures high lighting at the lowest possible cost.

5- Ventilation system: Ventilation is the most important element in good and healthy education. The Poltech uses two ventilation systems, the lower ventilation system, which uses low-pressure fans to push the gases out, in addition to automatic ventilation windows that work with the fans periodically, regardless of their degree. Maximum ventilation system, as this system uses another device, large fans remove excess heat and pass cool air through cellulosic cooling cells along the length of the barn.

6- Automatic control system: POULTECH provides high-quality Spanish automatic control devices that allow complete control of ventilation, heating, alarms, and the general atmosphere inside the house.

Objectives of EURL POULTECH

POULTECH aims through all of this to [32]:

- Promoting and developing the poultry breeding sector.
- Orientation from the traditional method to the modern.
- Keeping pace with modernity and technology applied globally.

Ventilation and Cooling

Ventilation is an essential element in poultry farming due to its significant importance in reducing respiratory problems that affect chickens during their growth stages to achieve the highest possible productivity with the highest conversion rate. Ventilation is a periodic process where specialized tools and fans are used to enter and extract air from the poultry house, following proper scientific methods. This process allows the removal of the hot air layer surrounding the chicken's body, as excessive heat beyond the maximum limit can cause respiratory diseases. This process also removes moisture and maintains good quality air and litter on the floor [32].

Ventilation in chicken houses goes through stages:

Minimum ventilation: This is the first stage of the ventilation process, which usually starts in the early days of the chicken's life, where the fans run for 30 seconds and stop automatically for 270 seconds. This timing gradually increases with the chicken's age and changes in internal conditions. This ventilation is carried out by a negative pressure system through air inlets with the help of fans that pull air in and an automatic control system that works to achieve optimal negative pressure [32].

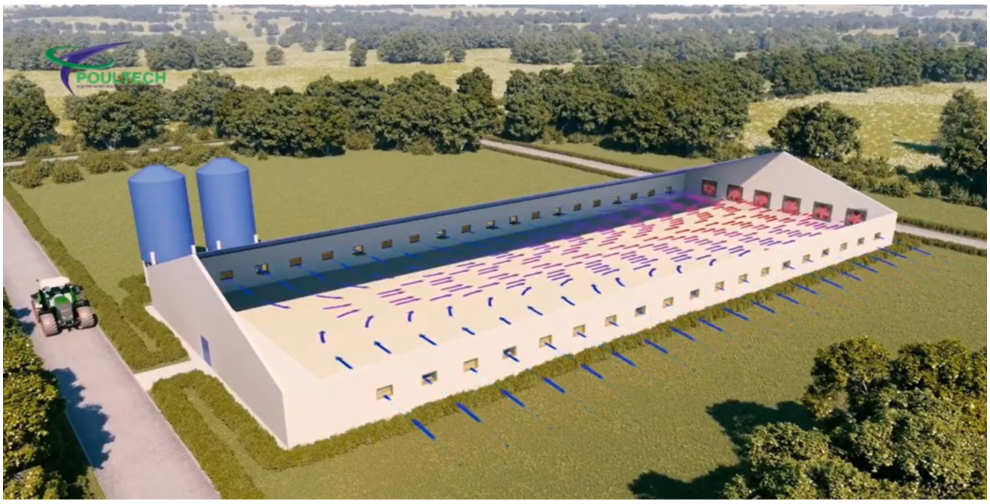

Figure 2.10: Ventilation in the Minimum case. [32]

Transitional stage: This is the period between minimum ventilation and maximum ventilation, where this system starts with one direct fan, then we add another fan directly or timed, and so on, to operate a larger number of fans, taking into account the environmental conditions inside the house. This stage aims to increase the exchanged air inside the house without the need to increase the airspeed above the chicken. The fans work to change the air every two minutes, to achieve a rate of up to 25% of what we obtain in summer ventilation, giving excellent control over the temperature[32].

Maximum ventilation: When the fans reach 50% of their capacity, the process moves to the third stage. This process depends on adjusting the fluctuating effects of heat, where the airspeed reaches 2.5 meters per second to be able to extract the excess heat from the entire house. This system uses curtains directed to evaporative cooling cells or a fogging system, depending on the temperature level. The aim is to achieve an optimal temperature level and good air quality for the chicken[32].

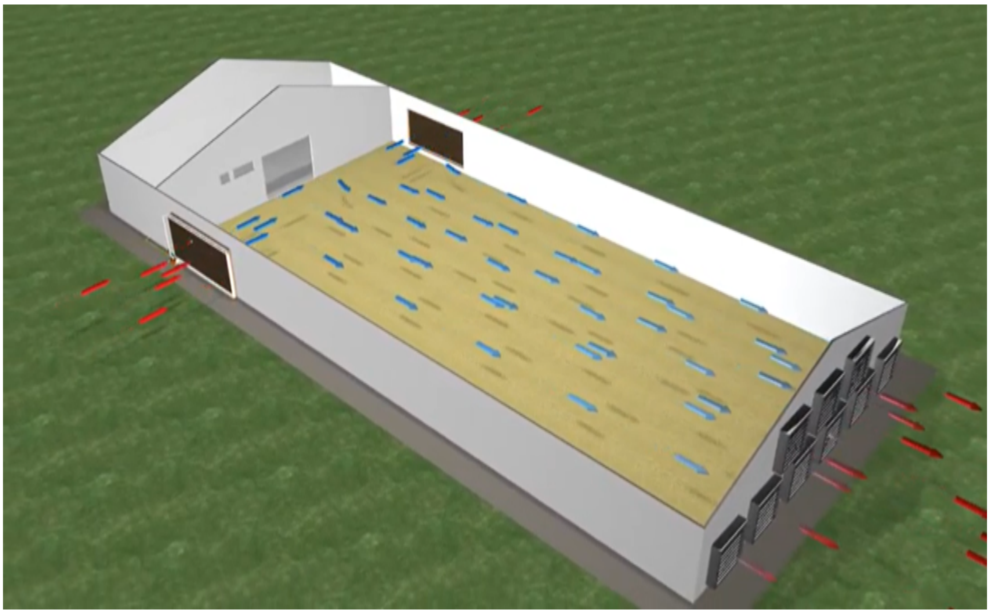

Figure 2.11: Ventilation in the Maximum case. [32]

The operation of the fans in this system depends on the temperature setting that they are adjusted to. If the humidity drops below 70%, the air speed must be increased to reach 2.5 meters per second. If the temperature rises above 30 degrees, the cooling system should be activated. The cooling system is based on the rate of evaporation of the moisture on the cell sheets. Heat is required for this process, which is obtained from the hot air falling onto the cells. Good evaporation is achieved through the continuous operation of the pumps and by monitoring and adjusting the humidity with the thermometer inside the barn, so that it does not exceed 70%. This process is called evaporative cooling [32].

2.5 Criticism

In light of our Pol Tac study, we noticed a few things that we can summarize as:

- Its use of hybrid technology, for example, watering, German technology, feeding, Italian technology, monitoring system, Spanish technology, etc...

- The suctions that remove the air are programmed in advance according to the age of the chicken, meaning that they are fixed and programmed according to the need.

2.6 Challenges facing broiler breeders

There are many problems and challenges facing the educator, the most important of which are:

- Lack of experience among poultry breeders.

- Most poultry breeders, especially broiler chickens, rely on primitive methods of raising chickens.

- The problems of transporting chicks, especially when the distance is large between hatchery lab and the breeding barn, which leads to exposure to diseases.

- Controlling the appropriate temperature and humidity according to the age of the chicken, which are two important factors in the success of the breeding project.

- Problems with how to cool during the summer, because dependence on electricity costs a lot.

- Problems with power outages and the lack of auxiliary transformers.

- The lack of the necessary ventilation for chickens that lead to respiratory diseases.

- The problem of controlling lighting, its intensity, and how to distribute it according to each stage.

2.7 Suggested Solutions

Of these problems facing broiler breeders, we will try to solve some of them, according to their importance and according to the capabilities currently available by using modern technologies and making them automatic, where the concept of the Internet of Things will be introduced, and this is by using specific types of sensors. This system consists of:

1- Temperature and humidity control using suitable sensors capable of measuring temperature and humidity over the entire coop (DHT11). The sizes of the hangar must be taken into account so that we can determine the number of sensors required, as the sensors send data for analysis to the Raspberry data analyzer, where the latter performs the following:

- If the temperature and humidity levels are appropriate, then there will be no events.

- If the rate of temperature and humidity is high... he turns on the fans to expel air from the barn in order to adjust the temperature and humidity and make it suitable.

Note: The temperature and humidity sensor is reinforced with a sensor for measuring the percentage of carbon dioxide gas and a sensor for measuring the percentage of ammonia in the hangar, where each area has different types of sensors to give more accurate data and high efficiency.

2- Ventilation In addition to the fans to remove the air, we create windows, where air is entered into them and the air is removed through exhaust fans, which leads to the ventilation process in order to get rid of the excess moisture resulting from the overcrowding of chickens and the resulting exhalation and increase oxygen inside the barn .

3- Cooling: In the summer, the ambient temperature is very high (above 30 degrees) in addition to exhalation (gasping), which leads to an increase in carbon dioxide gas and also an increase in ammonia gas that is emitted from the broiler, affecting broiler chickens, so the ventilation process will not work. Therefore, we will move to ventilation with cooling, by using the cooling rings along the hangar instead of the windows in the normal ventilation, which leads to the entry of cold air into the barn room.

4- Light is an important factor in the physiological processes of poultry, especially for broilers, as it allows the bird to establish the rhythm and synchronize many basic functions, including body temperature and various metabolic steps that facilitate feeding and digestion. We will install smart bulbs with light sensors to give the appropriate intensity for each A stage .

5- We create a Aplication Web and Mobile that automatically monitors all previous operations and makes them manual in case any of the devices or sensors are damaged.

Chapter 3

Design and implementation

3.1 Introduction

In this chapter we will use what we learned from Chapter 1 (Internet of Things) and Chapter 2 (Poultry Farming) to create an integrated and practical system that is not very expensive, so that the system must also provide ease of use for farmers who are less technically skilled, and reduce the time it takes farmers They can take action to control conditions in the environment and can control them from anywhere else.

This chapter is divided into two parts:

- A visual section that contains a general and detailed plan and details of the proposed solutions and diagrams.

- An applied section, which includes everything related to the applied side, i.e. programming languages...etc

The proposed model is based on certain types of sensors, Aduino, web and mobile applications, and cloud computations.

3.2 General architecture

This architecture shows the general form of remote control of barns, using modern technologies (Internet of Things) so that the data obtained from the sensors (temperature, humidity, light intensity, carbon dioxide gas, ammonia gas) are saved in real-time and Store this data in the cloud (database) and exploit it in different programs (mobile applications, web applications...etc).

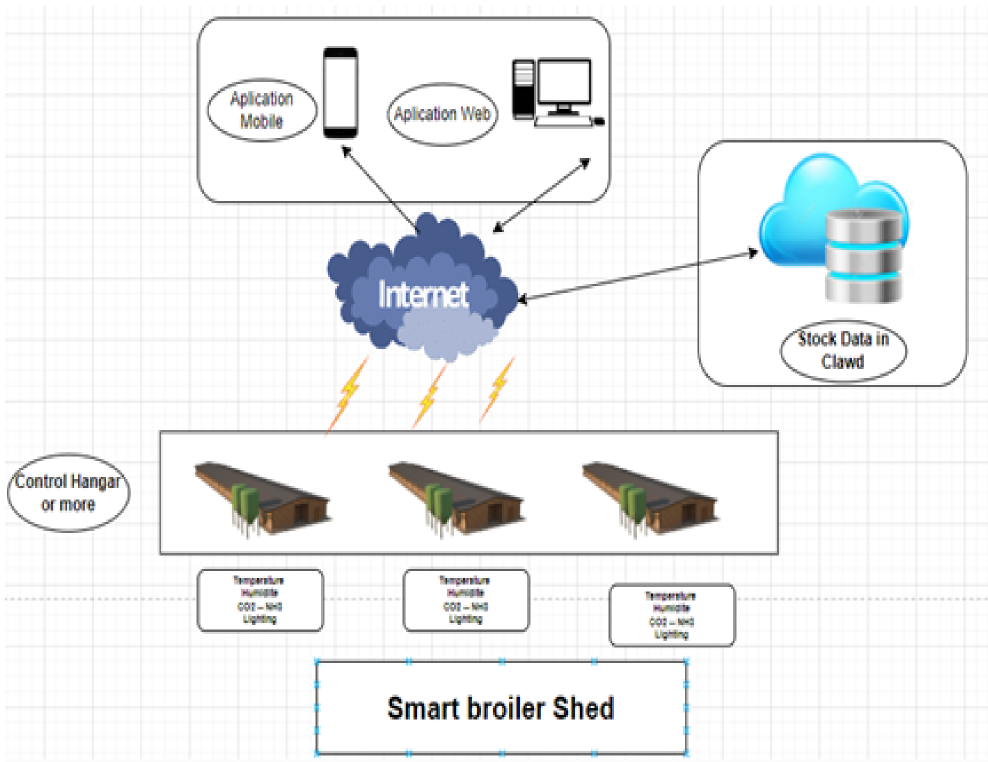

Figure 3.1: General architecture of solution

3.3 Detailed architecture

In this architecture it is shown in detail what happens in one barn, in which there are many electronic boards (Arduino):

Arduino boards for transmitting sensor data.

- Electronic boards (Arduino) connected to various devices (control).

* The number of these panels varies from one coop to another (the length and width of the breeding area or the needs of a customer).

* Each of these electronic boards contains three sensors which are:

- DHT11 is sensitive to temperature and humidity
- LDR light intensity sensitive.
- MQ-135 sensor for carbon dioxide and ammonia.
- ESP01 WiFi Board
- Arduino receives this data from the sensors, and it is sent via the ESP01 WiFi board to the online cloud, where the data is saved and exploited in different programs

such as web and mobile programs, and this is done in real-time.

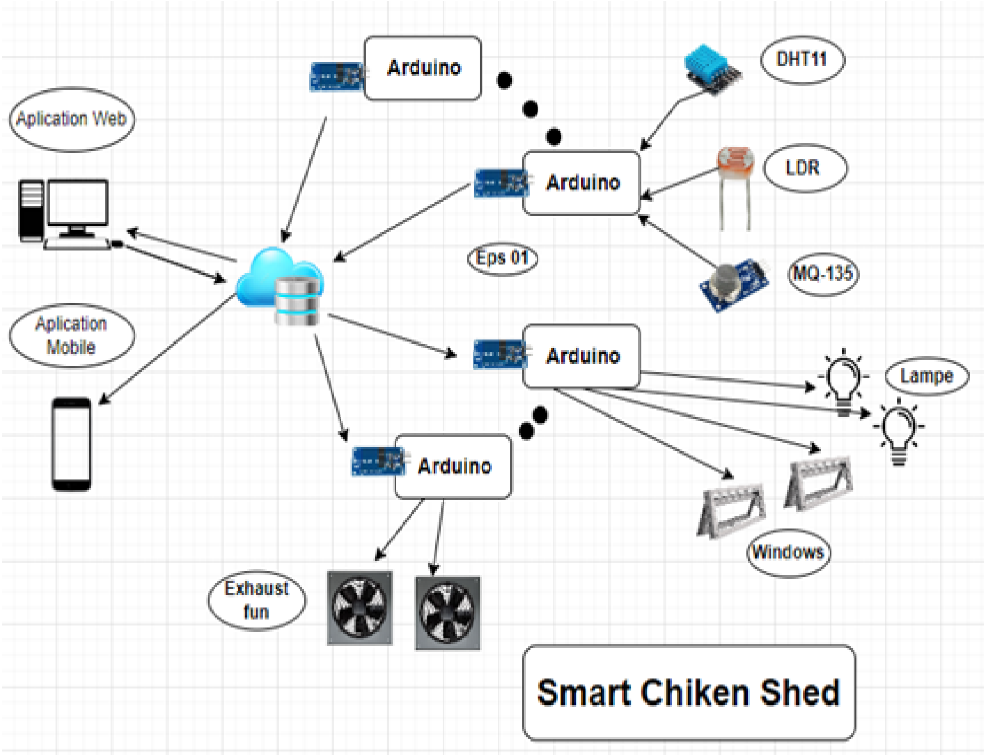

Figure 3.2: Detailed architecture of solution

3.4 Solution discription

3.4.1 Control temperature

Temperature control is one of the basic elements that have a major reason for the success of broiler chicken breeding, especially in its early stages, as it needs a certain temperature close to that which it was before hatching, which is 35 degrees, and this degree decreases during the growth period. to 28 degrees for chickens. As for the chicken shed, the temperature before receiving the chickens must be 28 degrees Celsius, and this degree decreases every week by one degree until it ranges between 20 to 22 degrees Celsius. The chicken shed is divided into areas with a radius of at most 2 meters, which is the distance in which the temperature, humidity and other sensors can capture information from the surroundings. We can know the number of Arduino boards and sensors according to the length and width of the breeding house, which is the maximum number. Their number is according to the customer's request. Each of these areas consists of an Arduino electronic board, and sensors, which is a DHT11 temperature and humidity sensor, MQ-135 ammonia and carbon dioxide gas, and a LDR light sensor, so that information and data are transmitted to the cloud (database) via the board Esp01, where the cloud database is exploited for:

• A web program where the latter reads data from the cloud and gives commands in case of inappropriate data, for example, excessive temperature (more than 28 degrees inside the house) so that it gives commands to the air inlets and air intake window Get rid of excess heat and moisture via an electronic board Arduino, where the boards that contain the sensors are separated from the control boards of the various devices. • Portable software that only reads and displays data.

Both programs (web and mobile work in real time)

Note :

As for the other sensors, their proportions are fixed as follows:

- Humidity percentage Humidity is in the range between 50 to 70%.
- The recommended ammonia percentage does not exceed 20 PPM.
- The recommended carbon dioxide level does not exceed 2.5%.

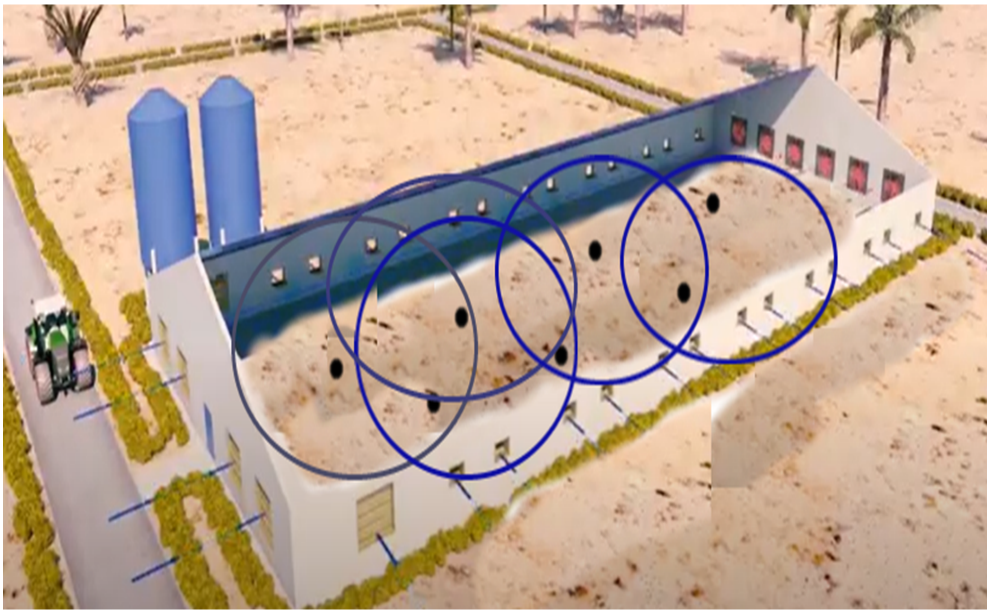

Figure 3.3: Temperature and humidity control. [32]

3.4.2 Ventilation

An essential factor for raising chickens, as this process aims to renew the air inside the breeding house, which also aims to protect chickens from suffocation due to excessive heat or gases that cause suffocation, such as carbon dioxide, which is produced by exhaling chickens or Ammonia gas produced by the chicken itself . Where it consists where the ventilation process is in two stages, the stage of normal ventilation and the stage of ventilation after cooling .

The normal ventilation stage

where this process takes place in normal periods, i.e. the temperature of the shed is slightly high, so that hoods are used to extract the air and windows through which the air enters, according to the temperature and humidity taken from the sensors, so that the temperature is 28 degrees inside the shed, this decreases One degree every week, and that that depends the length of the breeding period (seven weeks on average) to 21 degrees in the final week. The process begins with using one extractor to remove the air, and the higher the temperature, the more extractors we use until we reach the use of all air extractors. The air enters from the outside through windows that help to renew the air inside the breeding house, which removes gases such as carbon dioxide and ammonia gas produced by the chickens, especially during the growth period, in order to keep the chickens from diseases and suffocation, and the ventilation process also aims to reduce the humidity The excess in the amber and the moisture of the litter, in order to protect the chickens from diseases and insects resulting from moisture.

Figure 3.4: Ventilation

Stage of ventilation with cooling

In the summer, especially in our southern regions, the temperature is very high, and who leadsso that most chicken breeders do not work in the summer, because the chicken is very sensitive to the great heat, Which leads most of the to to death, and also the regular ventilation process is useless. Because the air entering through the windows is very hot, which in turn affects the chicken, in addition to the high cost of electricity using air conditioner. From this point of view, we decided on a practical solution that solves this problem, so that in the summer we close the windows to let the air in and replace them with openings with cooling cells, which in turn enter cold air through them into the hangar, as these cells reduce the temperature in the normal state to seven degrees Celsius, and this is considered A good solution for chicken breeders. It is an ideal solution to increase the humidity of the air in the summer, especially in the southern regions, the weather is usually dry, and this negatively affects the chickens.

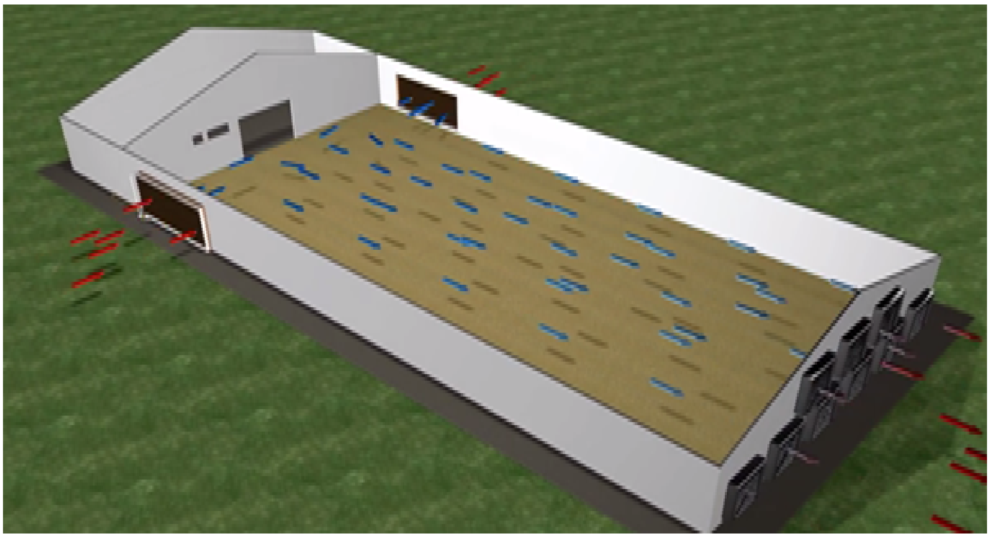

Figure 3.5: Cooling

3.4.3 Lighting

Lighting is one of the basic environmental factors in raising broiler chickens. Since the period of fattening broiler chickens is limited, which is seven weeks in average, the latter needs lighting day and night, so that it must be fed day and night, especially in the early periods of breeding. It is preferable to use artificial lighting (such as electric lamps) instead of natural lighting (sunlight) to control the duration of lighting and its distribution, and any negligence in the lighting program, as this affects the growth of the weight of the birds, which leads to an increase in the breeding period. For this, the breeder must follow the following:

Figure 3.6: Lighting

- Lighting for a period of 22 to 23 hours, as this program is followed from the first week of life until the chicks get used to the waterers and feeders, and the lights are turned off from one hour to two hours in the afternoon until the latter recognizes the darkness, especially if a sudden power outage occurs, and this is to prevent the accumulation of chicks or birds, which It results in a great death of chickens, especially chickens of old ages.

From this point of view, the Light Intensity is 3.5 watts per square meter for the incubation period.

- The lighting period decreases to 16 hours, and the darkness period increases to 6 hours, and in is the second week and The intensity of lighting remains the same in the first week.

- In the third week, the lighting will be in the form of a program, as follows:

16 hours of light and 3 hours of darkness and 2 hours of light and 3 hours of darkness.

- In the fourth week, the lighting program will be as follows: 16 hours of light and 2 hours of darkness and 4 hours of light and 2 hours of darkness.

- In the fifth week, the lighting program will be as follows:

16 hours of light and 1 hour of darkness and 6 hours of light and 1 hour of darkness

- In the last week, the lighting will be as follows: 22 hours of light and 2 hours of darkness

- the intensity of lighting decreases to 1.5 watts per square meter from the beginning of the second week to the last week, i.e. the growth period and the pre-sale period. The following table shows the details

Tableau 3.1: Table of lighting

Age (days)	Ligth W/ M^2	Photoperiod (L= Ligth , D= Dark)
0-7	3.5	23.0 L / 1.0 D
8-14	3.5	16.0 L / 8.0 D
15-21	1.5	16.0 L / 3.0 D /2.0 L / 3.0 D
22-28	1.5	16.0 L / 2.0 D /4.0 L / 2.0 D
29-35	1.5	16.0 L / 1.0 D /6.0 L / 1.0 D
36-49	1.5	23.0 L / 1.0 D

3.5 Detailed explanation of applications

3.5.1 Web Application

We can divide it into:

Registration for the first time

where the user enters the user name, e-mail, and password and presses the “Login” button, where he searches for the name in the customer database, if any, first, where:

- Either the user exists, the system gives a notification that the user exists, or this name and information has been used.
- The user does not exist so the new user has been registered in the database.

Login page

Where the user enters the username and password and presses the login button, where he searches for the name in the customer database, if any, first, where:

- The user does not exist, then it is notified that the user does not exist, and is asked to re-enter or create a new account.
- The user exists and is entered on the main UI page.

Main interface page

This page contains a side menu consisting of:

Dashboard : On the dashboard page, the user selects the number of farms, then the number of barns in each farm, then the number of partial barns in each barn whose data he wishes to see. The most recent value of the data sent from the transmitter in the pre-selected total or partial coop is displayed. Curves showing the evolution of values over time are also shown.

Device control: On the device control page, the devices that belong to the partial fold that is defined in the control panel are displayed, namely lights, windows, fans and cooling pads.

Batch setup : In Batch setup, current active and inactive batch are shown. batch are added, modified, or deleted.

List of barns : Existing barns, their divisions and farms to which these barns belong are displayed in the barns list.

Device Manager : In Device Manager, devices belonging to partial pens are shown, where new devices can be added, activated, deactivated or deleted.

Analytics : In the analytics, analyzes of temperature, humidity, percentage of ammonia and carbon dioxide in the atmosphere are displayed.

3.5.2 Mobile Application

We can divide it into :

Login page

where the user enters the username and password and presses the login button, where he searches for the name in the customer database, if any, first, where:

- The user does not exist, then it is notified that the user does not exist.
- The user exists and is entered on the main UI page.

Select Barn

After the system verifies the user, sends him automatically. Then, it takes him to the next interface, where he chooses the barn to be monitored on his farm or searches for it by the serial number of the barn.

The main interface

fter the user selects the hangar, he is taken to the main interface, where he finds:

- Data page for real-time temperature, humidity, carbon dioxide, ammonia and light intensity (update in real-time).
- A page with all devices (lights, windows, fans) with a description of their status (on

- off).

- A page that contains the client's profile with all his information and his farm.

3.6 A practical example of a barn

3.6.1 Description

We will try to provide an applied example in a barn in the first week, where we will assume that this barn is 20 meters long and 11 meters wide, as it is divided into parts, each part is 5 meters long and 5 meters wide, as shown in figure 3.7.

We can calculate the number of chicks since we have a maximum of 20 chicks in a square meter, so each area contains 100 chicks, and since we have 8 areas in the example, the total number of chicks is 800 as a maximum. And as we know that the maximum capacity of the sensors to take data from the perimeter is 2 meters as a maximum.

From this data we can determine the maximum number of Arduinos we can use in this example, which is 17 Arduinos :

- Eight Arduinos for transmitting sensor data.
- Eight Arduinos boards connected to the device inside the region.
- Arduino board connected to the exhaust fans.

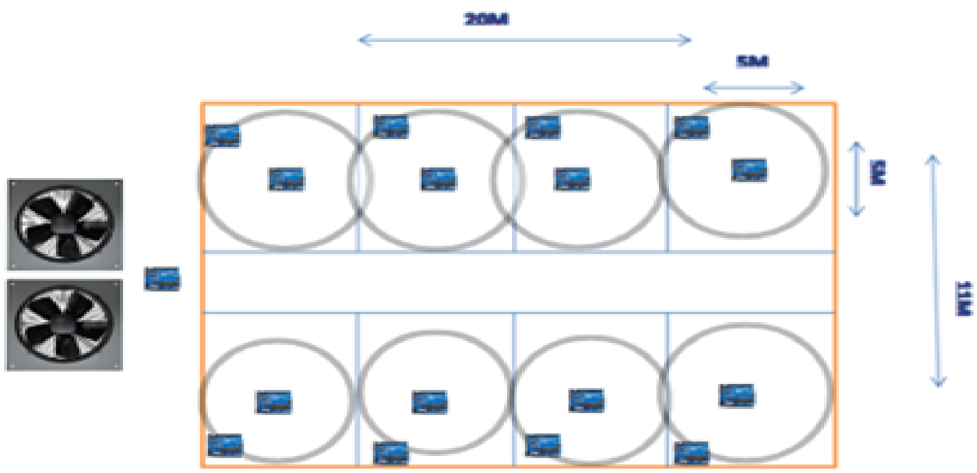

Figure 3.7: A practical example of a barn

The minimum number of Arduino boards is 9

- Four Arduinos for transmitting sensor data.
- Four Arduinos boards connected to the device inside the region.
- Arduino board connected to the exhaust fans.

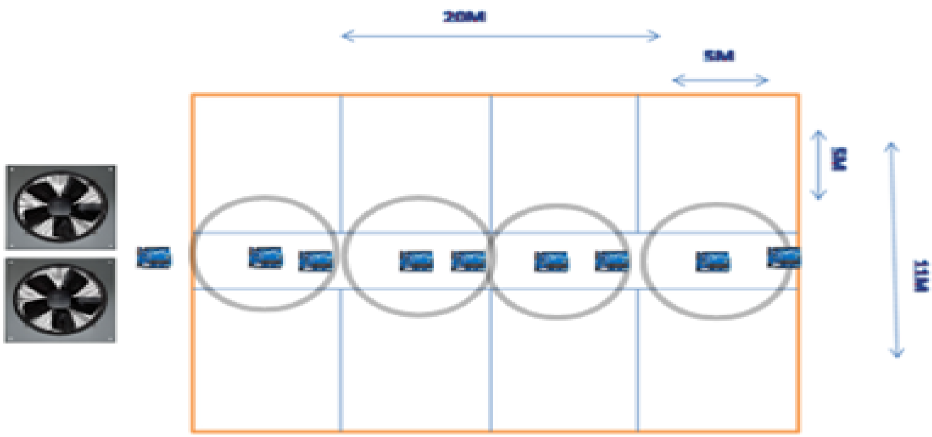

Figure 3.8: A practical example of a barn

Each Arduino has three sensors: a temperature and humidity sensor, a DHT11 sensor, a light intensity sensor, an LDR sensor, and a carbon dioxide and ammonia sensor, the MQ-135.

From this point of view, we can say that we were able to cover the entire breeding area in order to see any change in temperature, for:

Knowing the areas where the temperature is high and the areas where the temperature is low and controlling the temperature where the hot areas open windows and the other does not.

- We can also know the behavior of chickens in each region according to the temperature.

We can estimate the total Arduino cost as follows:

The cost of one Arduino with sensors and a wifi board = 6000 dinars

- 17 Arduino * 600 = 102000 DZD. (Max)
- 9 Arduino * 600 = 54000 DZD. (Minimum)

And :

- Web Application

- Mobile Application
- Cloud hosting

3.7 Sequence diagram

The sequence diagram is used to show the exchange of messages between the system and the external actors or between different parts of the system, and thus to obtain a view of the steps in a use case that shows the sequence of interactions very clearly. . And for this we have used UML sequence diagrams, which make it possible to represent the exchanges and interactions between the user and the objects of the system. We will present later the set of sequence diagrams in our system.

3.7.1 Web application sequence diagram

”Creation account” Scenario

The figure 3.9 represents the diagram that shows the creation of the account

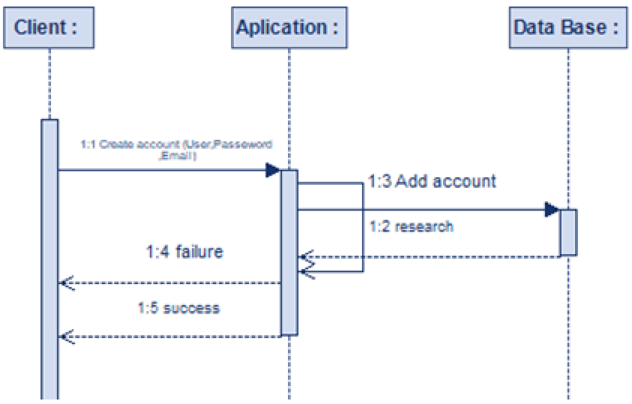

Figure 3.9: Sequence diagram ”Creation account” Scenario.

Authentication Scenario

The figure 3.10 represents the diagram that shows Authentication

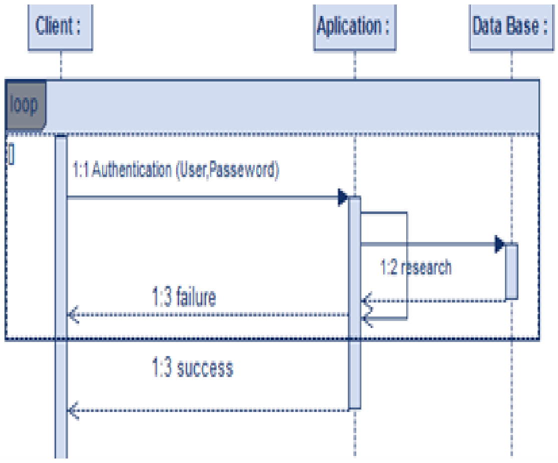

Figure 3.10: Sequence diagram for Authentication Scenario.

"Creation Farm" Scenario

The figure 3.11 represents the graph that shows the stages of creation the farm

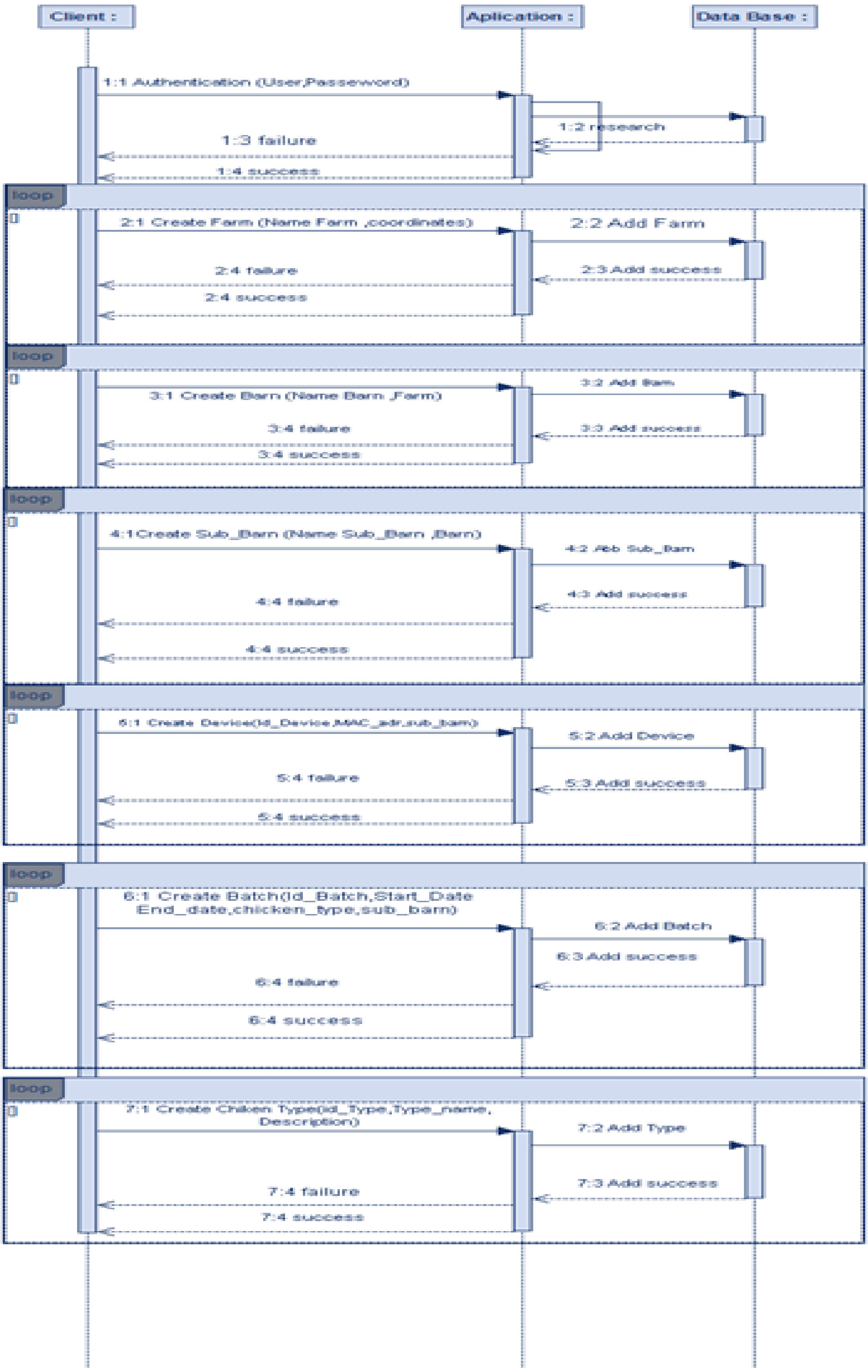

Figure 3.11: Sequence diagram "Creation Farm ".

"Select and update" Scenario

The figure 3.12 represents the graph that shows Select and update

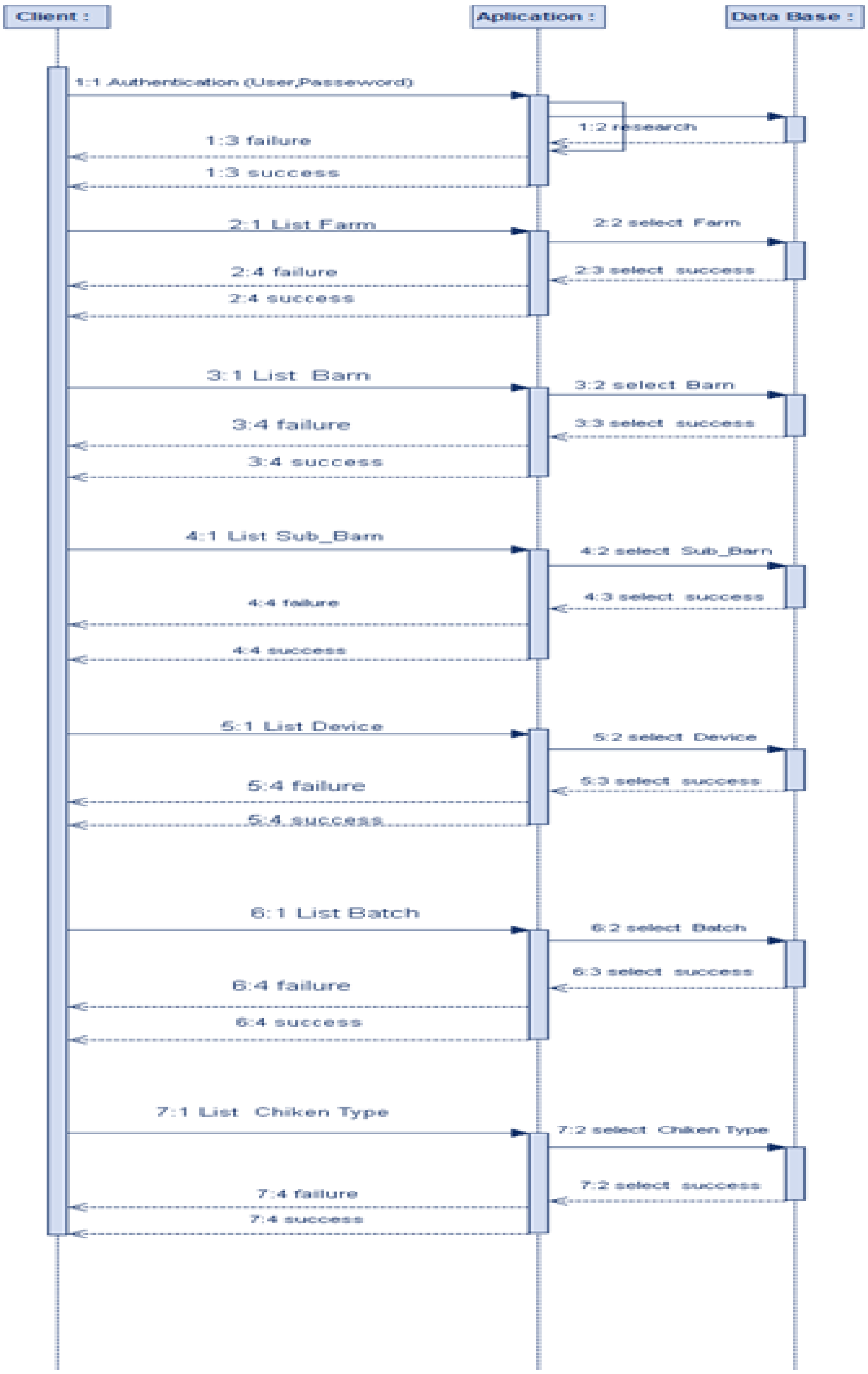

Figure 3.12: "Select and update" Scenario.

3.7.2 Mobile Application Sequence diagram

The figure 3.13 represents the graph that shows Sequence diagram of mobile application

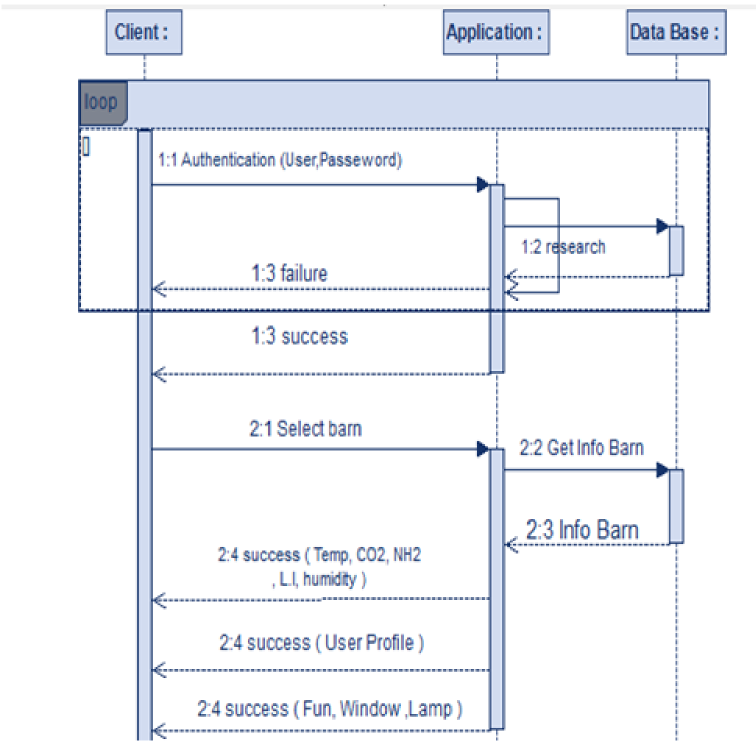

Figure 3.13: Mobile Application Sequence diagram.

3.8 Use Case diagram

A use case diagram is a graphical representation that is used to give an overview of the functional behavior of a system as it allows to describe the interaction between the actor and the system. Therefore, we must define the use cases performed by the users (client and administrator), as shown in the following figure :

3.8.1 Web Application Use Case Diagram

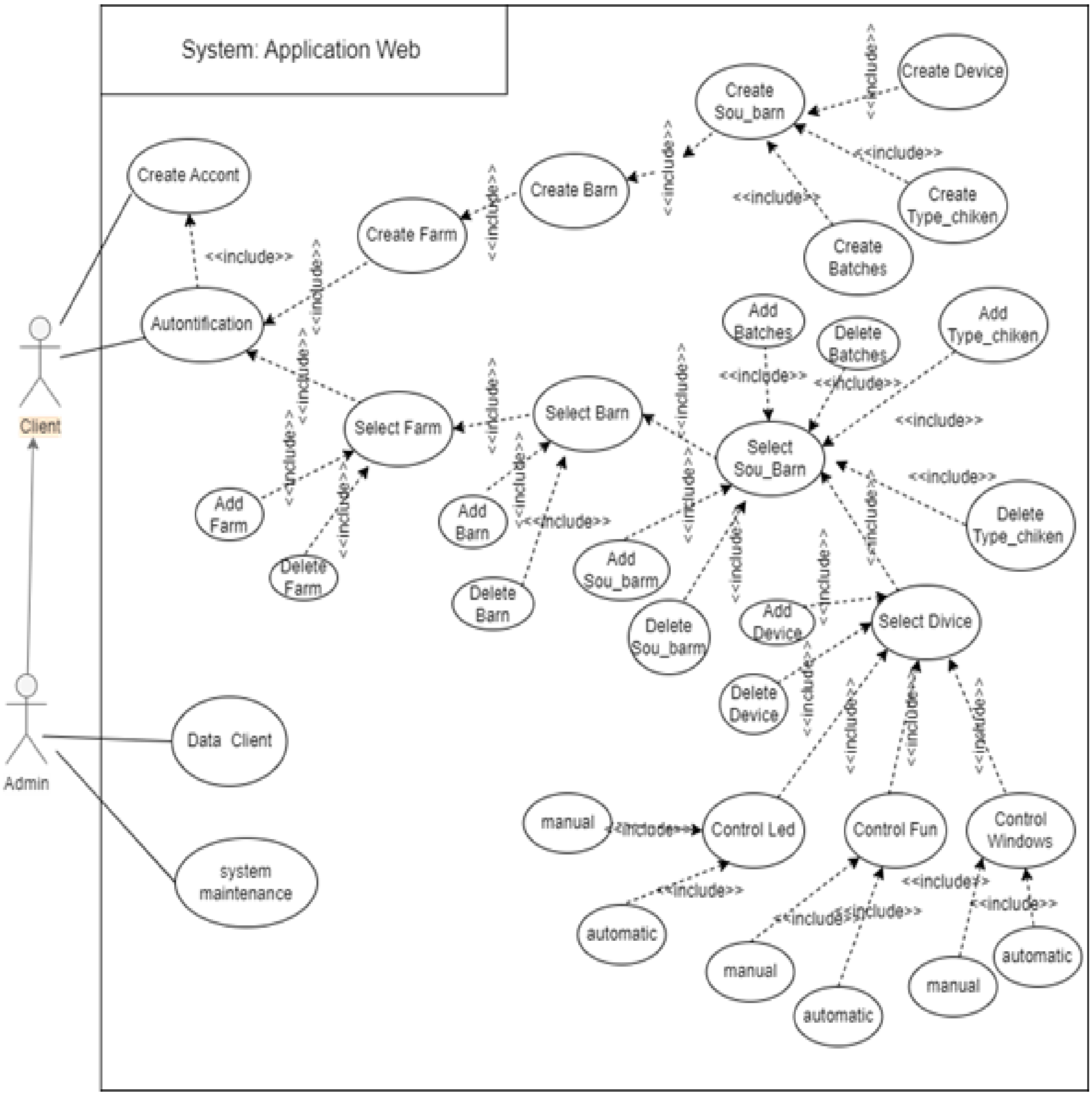

Figure 3.14: "Web Application" Use case diagram.

Operations performed by user

Creation Account

The new user enters a username, email, and password, where the system searches the database for customers. If it does not find a matching username and email, the process is successful.

Authentication

The user enters his email and password, and the system checks the authentication so that:

- If the email or password is incorrect, the system will display a failure message and ask To enter the correct information.

- Otherwise, it jumps to the specified page.

Creation Farm

- After the system verifies the user it automatically sends him to the dashboard, where a farm or several farms are created according to his needs.

- After creating the farm, it moves to the establishment of the barn or barns, according to each farm.

- The user (admin) divides the breeding area in the barn into areas according to his needs.

Then it creates devices in each area.

- The user (administrator) chooses the type of chicken to be raised and the breeding period according to each type .

Select and Update

- After the system checks the user, it automatically sends it to the dashboard, where the user selects the farm to monitor, and then immediately selects the barn within this farm and also selects the area to monitor.

Where the system receives data from the database in the cloud, which in turn takes data from the sensors in the barn in real time (temperature, humidity, ammonia, carbon gas, and light intensity), whether in the total barn or in each of area selected.

Control Devices

- After the system checks the user, it automatically sends it to the dashboard, where the user selects the farm to monitor, and then immediately selects the barn within this farm and also selects the area to monitor.

Where the user can send Arduino commands in that area and make it control the various devices (windows, lighting intensity, and fans) manually in case the system does not respond or an automatic hardware failure occurs.

Data history

All the updated data extracted from the sensors are stored inreal-timee in the database in order to be exploited in various statistics or to be exploited and studied by people.

Operations performed by Admin

The admin performs all the operations mentioned above and more than that :

Data Client

Where the user contacts the administrator and gives him all his information in order to retrieve the data on the account in case the account is lost or stolen.

System maintenance

Where the admin periodically handles the errors in the system or the deficiencies in the system that appear with the use and takes the user's requests into account to make it an integrated system. The admin develops and updates the system as required by the market and user requests.

3.8.2 Mobile Application Use Case Diagram

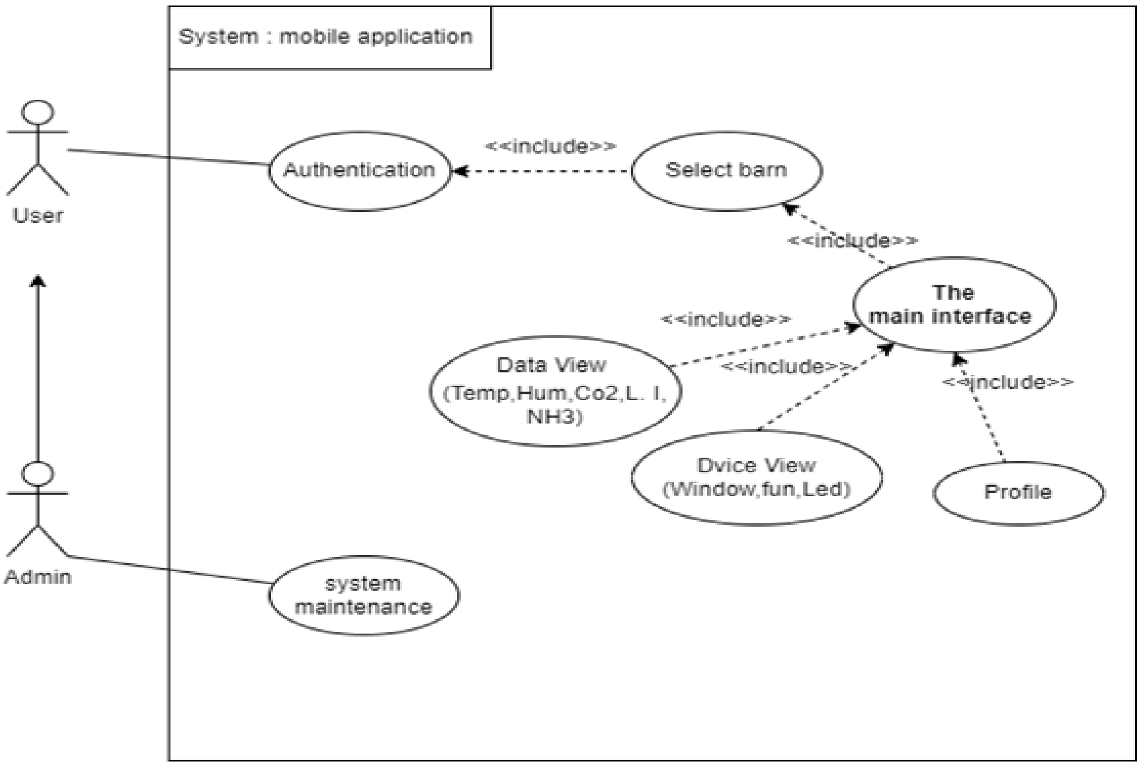

Figure 3.15: Use case diagram for mobile application.

Operations performed by user

Authentication

Where the user enters the user name and password and presses the login button, where he searches for the name in the customer database, if any, first, where :

- User does not exist, then it is notified that the user does not exist.
- The user exists and is entered on the next page.

Select Barn

After the system verifies the user, sends him automatically. Then, it takes him to the next interface, where he chooses the barn to be monitored on his farm or searches for it by the serial number of the barn .

Main Interface

After the process of selecting the barn to be monitored, we go directly to the main interface, which consists of:

- A page containing data for the data rate of temperature, humidity, light intensity, ammonia and carbon dioxide in the barn with real time updates.
- A page that contains the devices that you control remotely (windows, fans, and lamps) With its status (on - off).
- A page containing the user's profile and all his farm information .

Operations performed by Admin

The admin performs all the operations mentioned above and more than that :

System maintenance

Where the admin periodically handles the errors in the system or the deficiencies in the system that appear with the use and takes the user's requests into account to make it an integrated system.

The admin develops and updates the system as required by the market and user requests.

3.9 Diagram Class

The following figure shows the Class diagram of our main database :

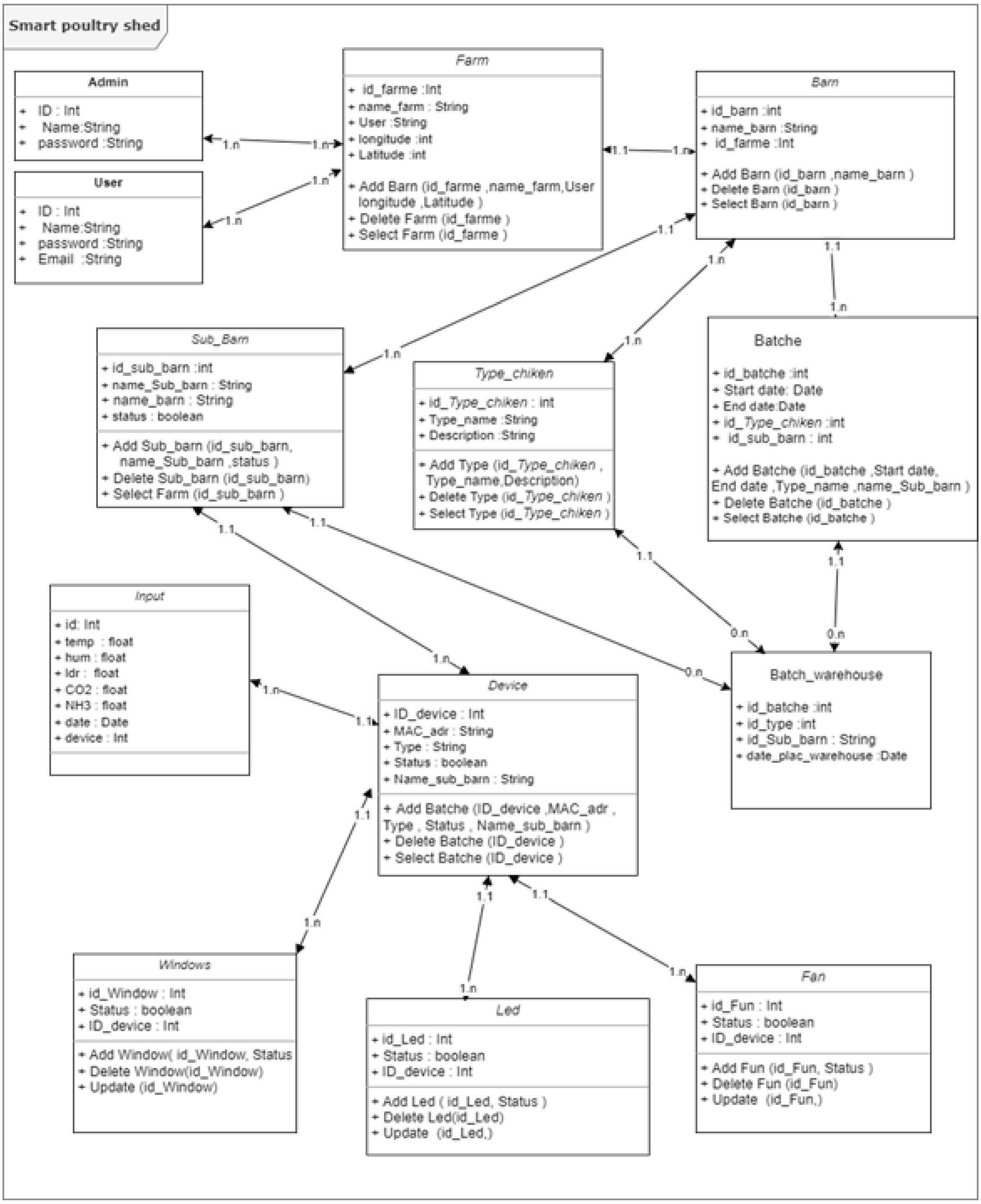

Figure 3.16: Diagram Class.

- A Client (Admin) can own one or more farms , and The Farm can be owned by one or more people.

- A farm can have one or more barn, and The barn is within one farm.
- A barn can have one or more batches, and batche available in only one barn.
- A barn can have one or more sou-barn, and sou-barn It only exists in one barn.
- A barn can have one or more chicken type, and The type of chicken is in one or more barns.
- Sou-barn can have one or more devices, and device It only exists in one sou-barn.
- Device can have one or more inputs, and input it only exists in one device.
- Device can have one or more windows, and windows it only exists in one device.
- Device can have one or more funs, and fun it only exists in one device.
- Device can have one or more leds, and led it only exists in one device.

3.10 Implementation

In this part, we have explained the design part of our system and the steps we followed to develop and implement our IoT solution. First, we will provide brief definitions of the development tools used in implementing our system such as the programming languages used and development tools, and second, we will introduce the electronic equipment used to deploy our system.

3.10.1 Programming languages

HTML

”HyperText Markup Language” is the most basic building block of the Web. It defines the meaning and structure of web content. Other technologies besides HTML are generally used to describe a web page’s appearance/presentation (CSS) or functionality/behavior (JavaScript) [33].

CSS

”Cascading Style Sheets” (CSS) is a stylesheet language used to describe the presentation of a document written in HTML or XML (including XML dialects such as SVG, MathML, or XHTML). CSS describes how elements should be rendered on screen, on paper, in speech, or on other media. CSS is among the core languages of the open web and is standardized across Web browsers according to W3C specifications [33].

JavaScript

JavaScript (JS) is a lightweight, interpreted, or just-in-time compiled programming language with first-class functions. While it is most well-known as the scripting language for Web pages, many non-browser environments also use it, such as Node.js, Apache CouchDB, and Adobe Acrobat. JavaScript is a prototype-based, multi-paradigm, single-threaded, dynamic language, supporting object-oriented, imperative, and declarative (e.g. functional programming) styles [33].

Bootstrap

Bootstrap is a free and open-source web development framework. It’s designed to ease the web development process of responsive, mobile-first websites by providing a collection of syntax for template designs. In other words, Bootstrap helps web developers build websites faster as they don’t need to worry about basic commands and functions. It consists of HTML, CSS, and JS-based scripts for various web design-related functions and components. Bootstrap’s primary objective is to create responsive, mobile-first websites. It ensures all interface elements of a website work optimally on all screen sizes [34].

SQL

SQL (Structured Query Language) is one of the oldest computer programming languages for relational databases. It is also the most popular. Thanks to this language, it is possible to query the data through queries on a database. Information can also be updated and organized. Data can be added or deleted. In addition, SQL makes it possible to create or modify the structure of a database system, to optimize it, and to control access to it.

Rather than compiling information in spreadsheet software like Microsoft Excel, SQL can compile and manage vastly greater volumes of data. Millions or even billions of cells of data can be processed without loss of performance [35].

PHP

"Hypertext Preprocessor" An extremely popular scripting language that is used to create dynamic Web pages. Combining syntax from the C, Java, and Perl languages, PHP code is embedded within HTML pages for server-side execution. It is commonly used to extract data out of a database on the Web server and present it on the Web page. Originally known as "Personal Home Page," PHP is supported by all Web servers and widely used with the MySQL database [36].

Dart

Dart is a programming language used to develop applications with Flutter. Dart is a modern, object-oriented, strongly typed language that was developed by Google in 2011. Dart was designed to provide an alternative to existing programming languages such as JavaScript and Java, while providing fast performance and a simplified development experience. Dart offers advanced features such as strong typing, anonymous functions, abstract classes, etc. Dart is also optimized for object-oriented programming, which makes it ideal for building complex applications with a clear and well-defined architecture. Additionally, Dart is easy to learn and understand for developers who already have programming experience with other object-oriented languages such as Java or C#. One of the key benefits of using Dart with Flutter is that Dart code is compiled to native code, rather than interpreted code. This means that Flutter apps developed with Dart have fast performance and improved power efficiency because they don't require real-time code interpretation by a virtual machine [37].

3.10.2 Development tools and frameworks

Visual studio code

Visual Studio Code is a lightweight but powerful source code editor which runs on your desktop and is available for Windows, macOS, and Linux. It comes with built-in support for JavaScript, TypeScript, and Node.js and has a rich ecosystem of extensions for other languages and runtimes (such as C++, C#, Java, Python, PHP, Go, and NET) [38].

Android Studio

Android Studio est l'environnement de développement intégré de la plate-forme Android de Google. Les versions d'Android Studio sont compatibles avec certains systèmes d'exploitation Apple, Windows et Linux. Avec la prise en charge de Google Cloud Platform et de l'intégration d'applications Google, Android Studio offre aux développeurs une boîte à outils bien fournie pour créer des applications Android ou d'autres projets, et fait partie intégrante du développement Android depuis 2013 [39].

Flutter

Flutter is an open-source mobile application development framework created by Google. It allows to create mobile applications for Android and iOS with a single code base. It uses the Dart programming language, also created by Google, and offers advanced features for developing rich and customizable user interfaces. Applications developed with Flutter are fast, and powerful, and provide a smooth and enjoyable user experience. The framework is becoming more and more popular in the mobile application developer community thanks to its ease of use and great flexibility [37].

There are several reasons why developers choose to use Flutter Among them :

- Cross-platform development.
- Rich and customizable user interface.
- Modern programming language.
- community and support.

Arduino IDE

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions, and a series of menus. It connects to the Arduino hardware to upload programs and communicate with them [40].

3.10.3 Free domain hosting (000WebHost)

Web hosting is a service that stores your website or web application and makes it easy to access it from different devices, such as desktops, mobile devices, and tablets. Web hosting providers maintain, configure, and run physical servers that you can rent to store your files. Website and web application hosting services also provide additional support, such as security, website backup, and website performance, which saves you time and allows you to focus on the core functionality of your website.

3.10.4 Electronic Equipment

ESP32 WROOM32

Here is a small development board compatible with Arduino IDE and programmable in MicroPython. The big advantage of this card is that it offers a Bluetooth connection and an on-board Wifi connection. It is therefore ideal for developing connected objects, whether to create a server to host a website or communicate via Bluetooth with a smartphone application or via Wifi with another microcontroller [41].

Figure 3.17: ESP32

The characteristics of this model of ESP32 :

- Microcontrôleur: Espressif ESP32 (monté sur puce ESP-WROOM-32)
- Microprocesseur: Tensilica Xtensa Dual-Core 32-bit LX6
- Fréquence d'horloge: 80 à 240 MHz (réglable)
- Mémoire Flash: 4MB
- ROM: 448 kB
- SRAM: 520 kB
- Alimentation: 5 à 9V
- Dimensions 55 x 28 x 13 mm

NodeMCU V3

Nodemcu ESP8266 V3 is a dev Wi-Fi board designed to be exploited in IoT projects. It is based on the ESP8266 chip. Also a voltage regulator has been added, as well as a USB programming port. So you can program with LUA or via the Arduino IDE. Its use is very simple widespread, there is a whole community and documentation that allows you to easily exploit in electronic projects outside via Wifi. This version contains an additional memory size of 32 MB. Suitable for large projects [42].

Figure 3.18: NodeMcu

Technical characteristics :

- Processeur: ESP8266 à 80 MHz (3,3 V) (ESP-12E)
- 4 Mo de mémoire FLASH (+32 Mo)
- Bouton RESET

- Entrée d'alimentation externe VIN (20 V max)
- WiFi 802.11 b/g/n
- Régulateur intégré 3.3 V (500 mA)
- Convertisseur USB-Série CH340G / CH340G
- Fonction de réinitialisation automatique
- 1 entrée analogique (1,0 V max)

DHT-11

Monitoring the weather is a daily necessity, that's why we have designed a system that records the temperature, humidity, and light inside the hangar. These parameters will then be displayed in an OLED (64*48) and used to perform the following automatic actions:

Figure 3.19: DHT11

MQ-135 Sensor

The MQ-135 sensor is commonly used to measure air quality and detect gases such as ammonia, carbon dioxide, benzene, alcohol, and other harmful substances. In a poultry shed, monitoring air quality is important for the well-being and health of the birds.

Figure 3.20: MQ-135

Relay module 4 channel

This 8-relay module provides all the features necessary for rapid implementation but above all eight relays are capable of supporting 10A at 250V AC. As designed, it works with 3.3v and 5V logic systems (so Arduino, Raspberry, Micropython, etc). What we appreciate the most is the protection offered by the Optocouplers and the possibility of dissociating the power supply circuit of the relays (JD-VSS) from that of the control logic (VCC)... it indeed enough to remove the JD-VSS jumper and power the 5V relays via the JD-VCC pin. Practical, it will provide galvanic isolation (the high-voltage circuit is never in contact with the control circuit) as well as protection for your electronic control circuit (in case short-circuit, your microcontroller is electrically protected) [43].

Figure 3.21: Relay module 4 channel

Servo motor

The TowerPro SG90 (or SG92R, successor which sometimes replaces it), often referred to as a ”mini servo” motor is a micro servo motor widely used in the world of model making. This is also the model available in the motor + motor shield assortment.

Very light with 9 grams and an amplitude of 180°, it will be ideal to animate your projects from a microcontroller such as Arduino.

Its standard 3-wire Graupner plug (see tutorial section) and its 5-volt supply voltage make the Tower Pro directly usable on an Arduino. Indeed, the Servo.h library available in the default installation of Arduino IDE is largely sufficient to control the TowerPro [44].

Figure 3.22: Servo motor

Ventilatur

This 'high flow' fan is equipped with a brushless motor that does not fear wear.

Technical characteristics :

- 50mm ventilation (without grid)
- Rated voltage: 12v
- Speed: 4700 rpm @ 12v
- Noise: 25.6 dBa at 1m @ 12v

LDR

The light sensor is a passive device that converts this ”light energy”, whether visible or in the infrared portions of the spectrum, into an electrical signal output. Light sensors are more commonly referred to as ”photoelectric devices” or ”photo sensors” because they convert light energy (photons) into electricity (electrons).

Figure 3.23: LDR

3.10.5 Electronic schema

This smart system consists of two main units, one for sensing and the other for executing.

- Receiver (execution) : The receiver controls peripheral devices such as lamps, fans, windows, etc.

Schema of the Transmitter Transmitter (Sensor Module)

This module is responsible for retrieving all real-time data of the partial barn, such as temperature, humidity, ammonia, carbon dioxide, and other sensors. Then all the data will be sent to the cloud by IoT protocols to display on the dashboard.

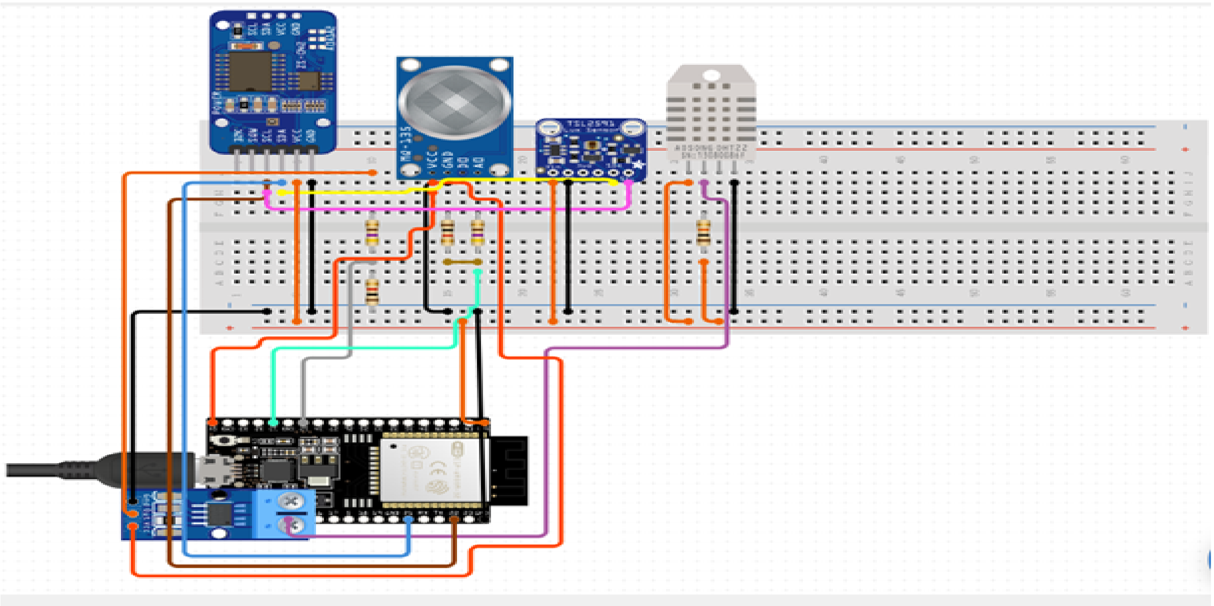

Figure 3.24: Schema of the Transmitter

Schema of the receiver

Where it receives orders from the system so that it controls the devices connected to it, such as fans, windows, and lamps, using a WiFi module (for example, opening the fans to remove air from the barn).

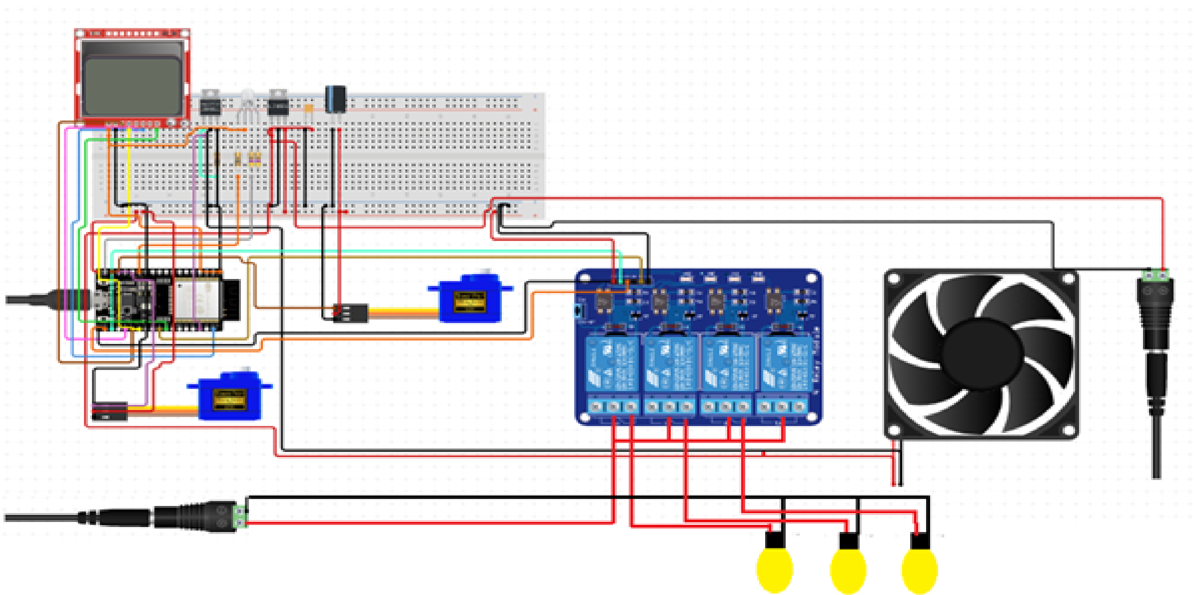

Figure 3.25: Schema of the receiver

3.10.6 Some functions of the system

Display environment variables

In this function, the average values of the input environment variables (temperature, humidity, and CO2 And the percentage of ammonia and the intensity of light) are displayed from the database in the cloud to the control panel in real time.

```
Function: Display_inputs_barn ( )
var :
count: (entier)
Begin
        id_barn=select_barn();
        sub_barns = Bring_list_sub_barns(id_barn);
        ForEach (sub_barn in sub_barns ) id_device = get_device(sub_barn.id).id;
        inputs=get_inputs(id_device);
                temp=inputs.temp;
                hum=inputs.hum;
                co2=inputs.co2;
                nh3=inputs.nh3;
                listtemp=listtemp+temp;
                listhum=listhum+hum;
                listco2=listco2+co2;
                listnh3=listnh3+nh3;
                count=count+1;
        EndFor;
        Displayinputsbarn(listtemp/count, ... , ....);
End
```

Figure 3.26: Display environment variables

Function to view environment variables for the partial hangar

This function displays the environment variables in the partial enclosures that were previously selected, where each enclosure consists of several sub-enclosures, and each of them consists of a device connected to several sensors, as it is displayed in the form of graphic curves for each sensor in real time.

```
Function: Display_inputs_subbarn ( )
Begin
        id_subbarn=select_subbarn();
        id_device=get_subbarn_where(id_subbarn);
        online_Inputs = BringOnlineInputs(id_device);
        ForEach (Input in online_Inputs)
                DisplayInputsOnTheDashboard( Input);
        EndFor;
End
```

Figure 3.27: Function to view environment variables for the partial hangar

Control of peripheral devices

The system can control devices automatically or change them manually, as this function controls peripheral devices such as lamps, windows, and fans, by updating the status

```
Function: controlled ( )
Begin
        id_led=select_led();
        statu=statuschange_led();
        update_led(id_led,statu);
End
```

Figure 3.28: Control of peripheral devices Fonction

3.10.7 Web Application interfaces

Registration page

This page consists of :

- Empty boxes to enter information as user name, email, and password and press the registration button ”Sign up”, where the system searches the database for user name and email. If it finds a match, it notifies you that the name or email is present(change user name or Email).
- If you already have an account press ”sign in”, the page will take you directly to the login interface.
- Check box to exit the page.

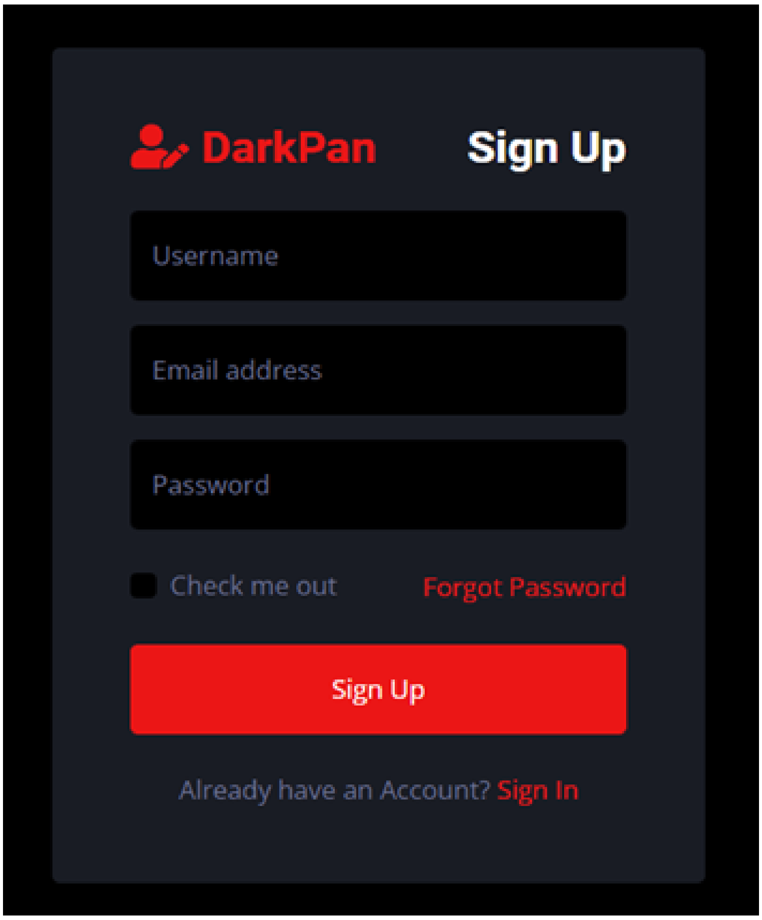

Figure 3.29: Registration page

Login page

This page consists of :

- It is the page designated for users who have an account, where the user enters his name and password, where the system searches for the name and password and presses a button « sign in» in the database.
- If he does not find a match, he informs him that the name or password contains an error, and he is requested to retype it.
- In the absence of an account, the user presses a button ”sign up” to take him to the new account registration page.
- Check box to exit the page.

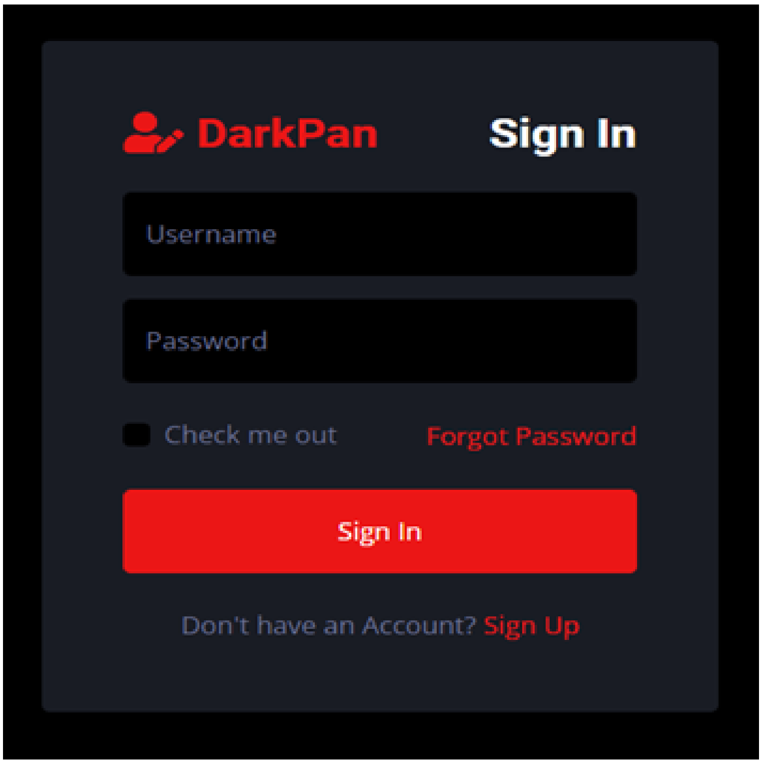

Figure 3.30: Login page

The main interface

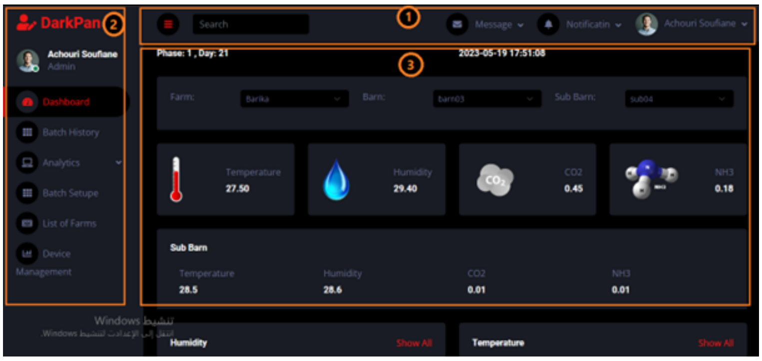

Figure 3.31: The main interface

In the event that the login process is successful, the system will take you to the main interface, where the latter consists of :

(1) Navigation bar (page header) at the top of the page From (left to right): Hamburger menu button to move the sidebar In or out, search button, notification drop-down, message drop-down User drop-down list.

(2) Sidebar on the left side of the page, organized into a website logo at the top, below that, username, then links to other pages of the website (Payments History, Analytics,

Setup Defenses...etc).

(3) The main content is in the middle of the page :

Dashboard

Figure 3.32: The main interface

After the login page, the dashboard page will appear, consisting of:

(1) Collection of selection lists:

(a) Farm selection list: In this list, the farm is selected to be onitored and information displayed.

(b) Dangerous selection list: In this list, the barn is chosen for View its information and control its peripheral devices.

(c) Partial barn selection list: In this list, a selection is made Partial barn to be displayed, its information in real-time and display Curves of evolution of environment variables.

(2) The set of average values of the environment variables for the barn:

(d) Temperature: The average of the most recent temperature values is displayed heat in the barn.

(e) Humidity: The average of the most recent humidity values are displayed in the barn.

(f) Carbon dioxide percentage: the average of the most recent values is displayed Carbon dioxide gas in the barn.

(g) Percentage of ammonia: The average of the most recent values of ammonia is displayed in the barn.

(3) The set of environment variable values for the partial barn:

(h) Temperature: The latest temperature value is displayed in Partial barn.

(i) Humidity: The latest humidity value is displayed in Partial barn.

(j) Carbon dioxide percentage: the latest gas value is displayed Carbon dioxide in the partial barn.

(k) Percentage of ammonia gas: The most recent value of ammonia gas is displayed in Partial barn.

Figure 3.33: Dashboard

Set of Graphical Curves:

(1) Temperature evolution curve: the evolution rate of partial barn temperature values is displayed.

(2) Humidity evolution curve: The evolution rate of humidity values in the partial barn is displayed.

(3) CO evolution curve: the evolution rate of CO values in the partial fold is displayed.

(4) Ammonia gas evolution curve: The evolution rate of ammonia gas values shows ammonia in the partial fold.

A group of control tables : When selecting a barn from the list of barns, the control tables are filled in with the devices in this barn, where three types of control tables emerge:

(1) Lighting control table: displays all lamps in the barn and the name of the partial barn to which this lamp belongs is displayed with the ID of lamp and its status (on/off).

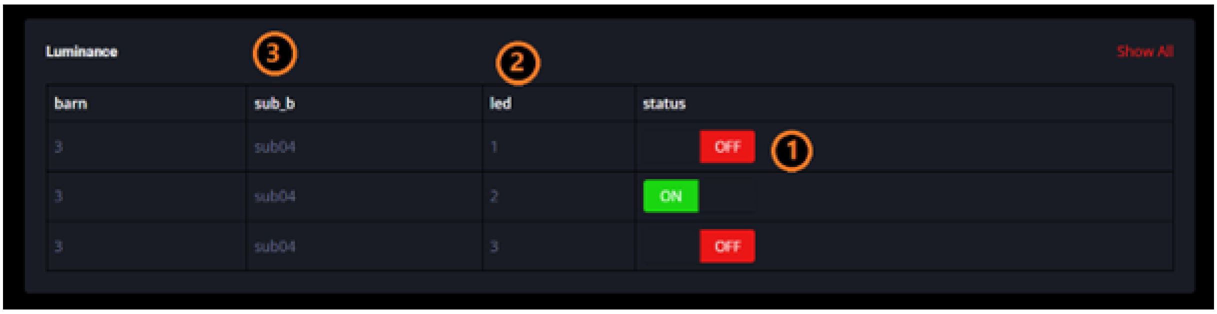

Figure 3.34: Lighting control table

(2) fan control table: Shows all the fans in the barn and the name of the partial barn these fans belong to is displayed along with the fan ID and status (on/off).

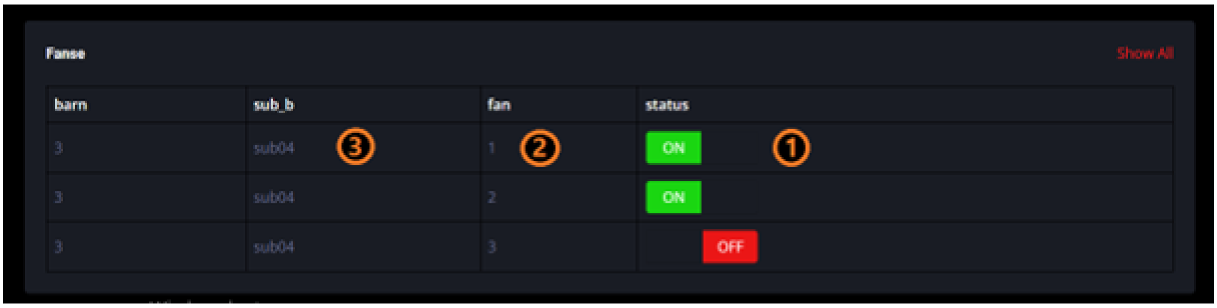

Figure 3.35: Fan control table

(3) Window control table: Shows all the windows in the barn and the name of the partial barn these windows is displayed along with the window ID and status (on/off).

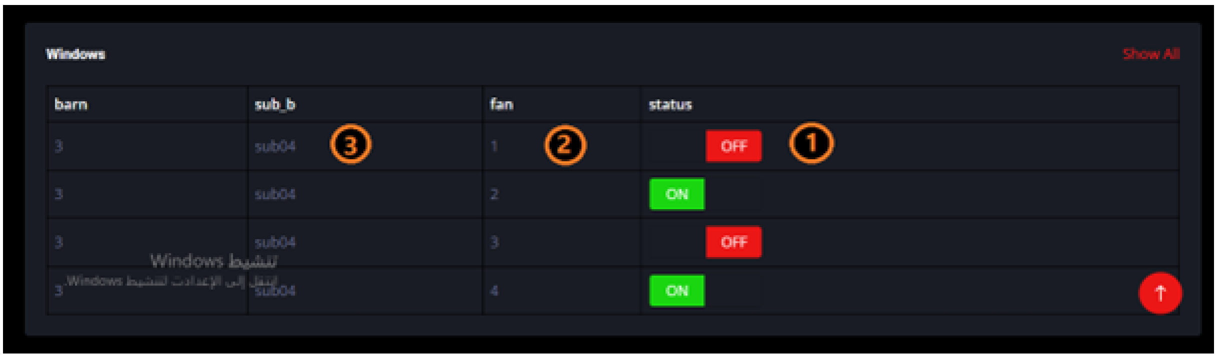

Figure 3.36: window control table

Batch History page This page contains a list of all finished payments, that is, those payments that have passed the period of cultivation and have been terminated and placed in a data warehouse. Where the columns of this list contain the event ID, the batch ID, the breeding start date, the end date, the type of chicken, the batch, the name of the partial coop in which they lived, the date of termination or entry into the data warehouse.

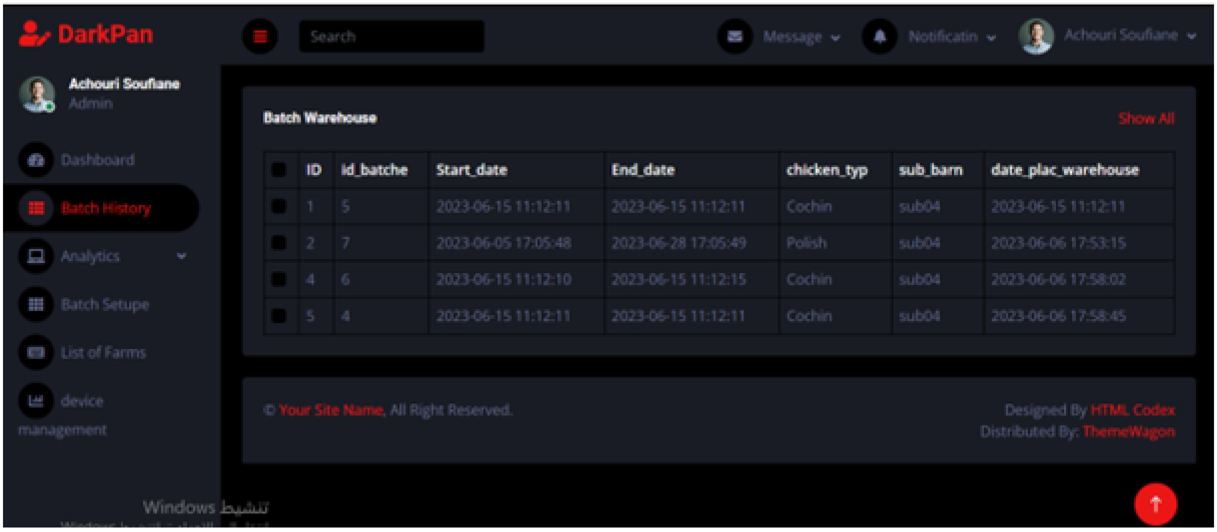

Figure 3.37: Batch History page

Batch Setupe page

- A list that displays the current payments that are under care at the present time and their various information. This list contains buttons to view and change the status of the payments.

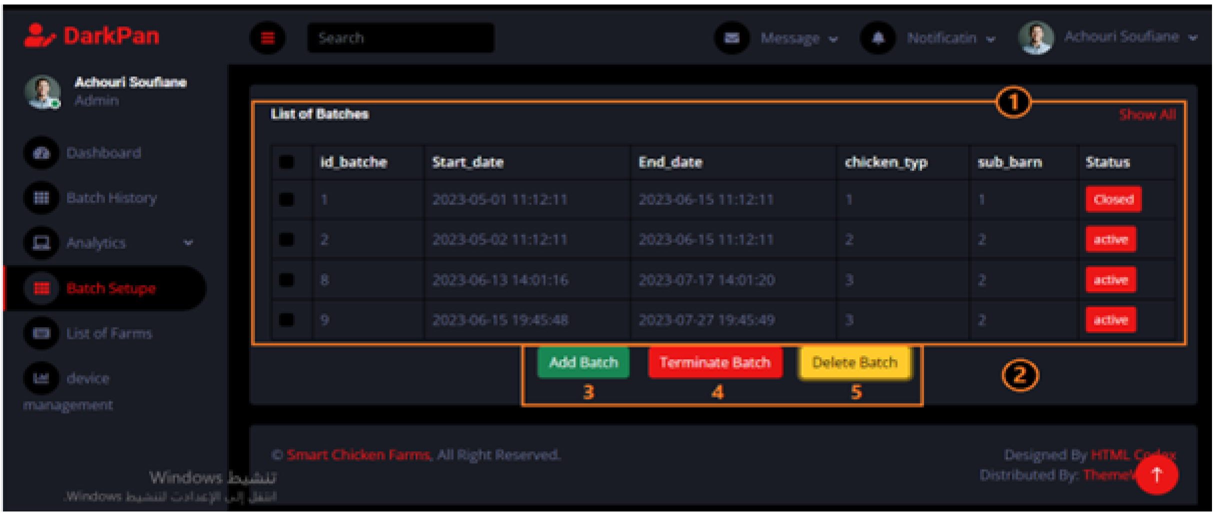

Figure 3.38: Batch Setupe page 1

- A group of buttons:

(1) Batch Add button: The importance of this button lies when there is a need to add new batches for breeding and supervision. When pressed, the entry for starting the batch, the entry for the end of the batch, and the type of chicken and coop are displayed.

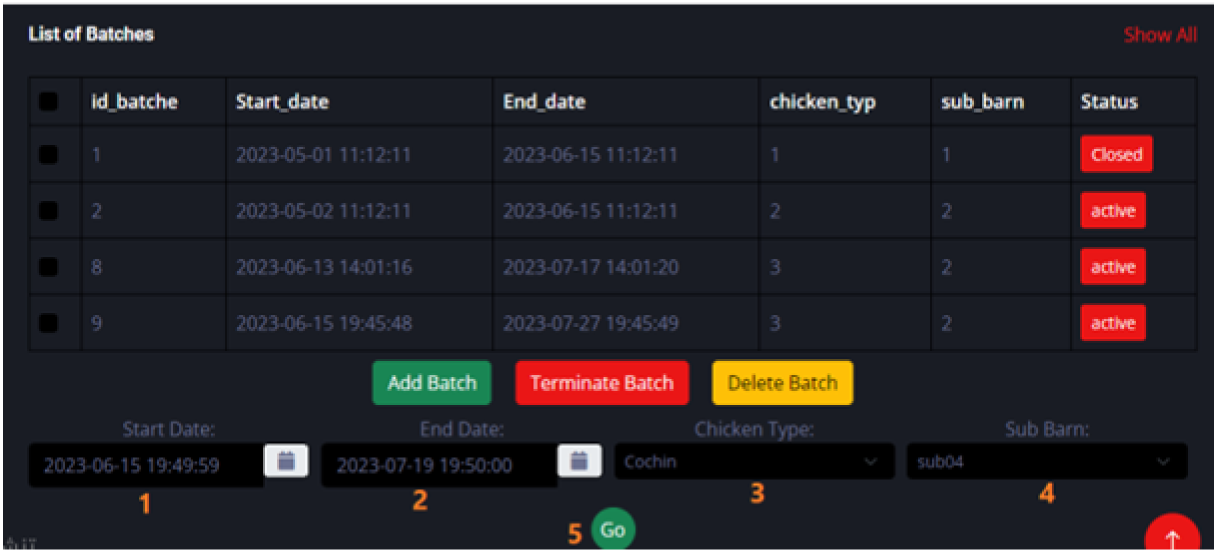

Figure 3.39: Batch Setupe page 2

(2) button End batches: When you press the button End batche, a selection menu appears to choose the payment to be completed and transferred to the data storage.

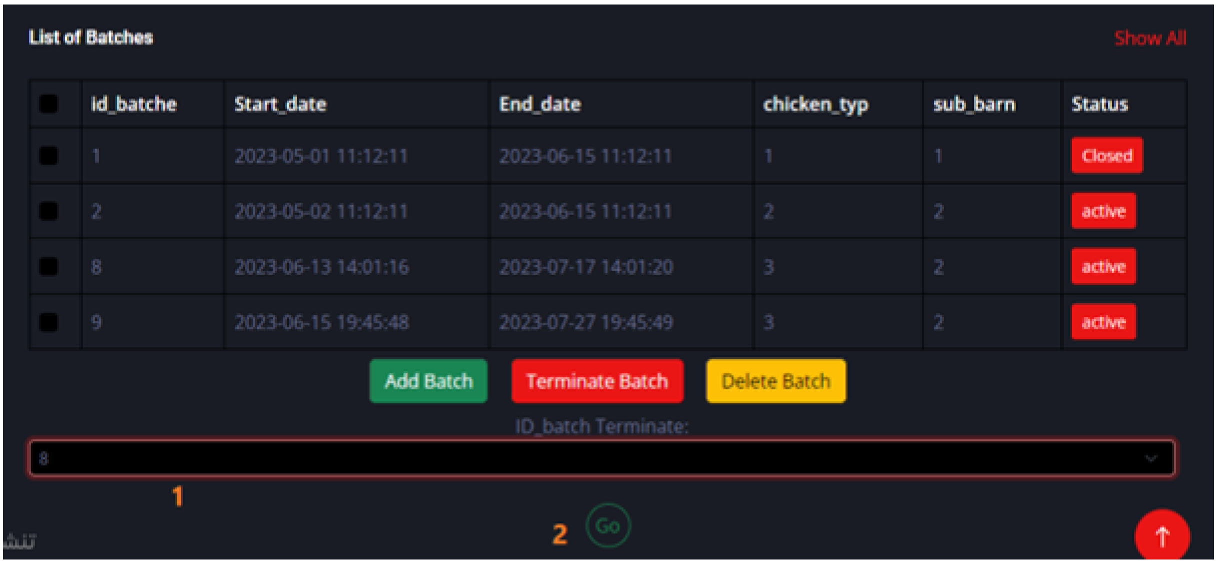

Figure 3.40: Batch Setupe page 3

(3) Batch Delete Button: This button is pressed when a payment needs to be deleted in specific circumstances or errors in entering this payment information.

Device Management page

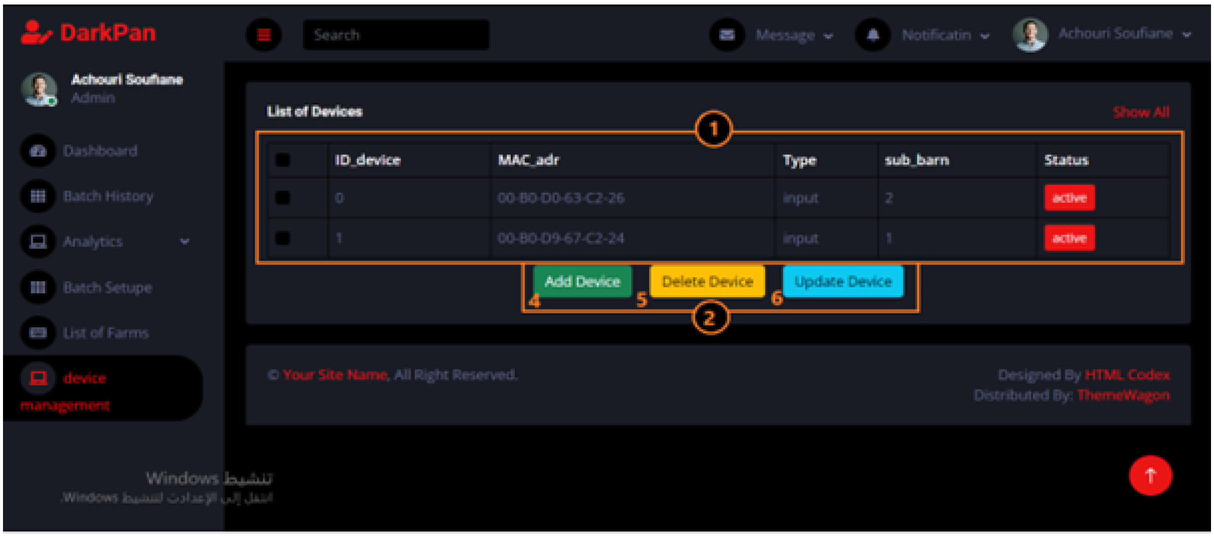

Figure 3.41: Device Management page

(1) A list containing the devices used in transmission and implementation with different Its information and a button that shows the status of this device with the ability to change the status by clicking on This button.

(2) A group of control buttons.

(4) Add new devices button: when pressed, the items appear The following

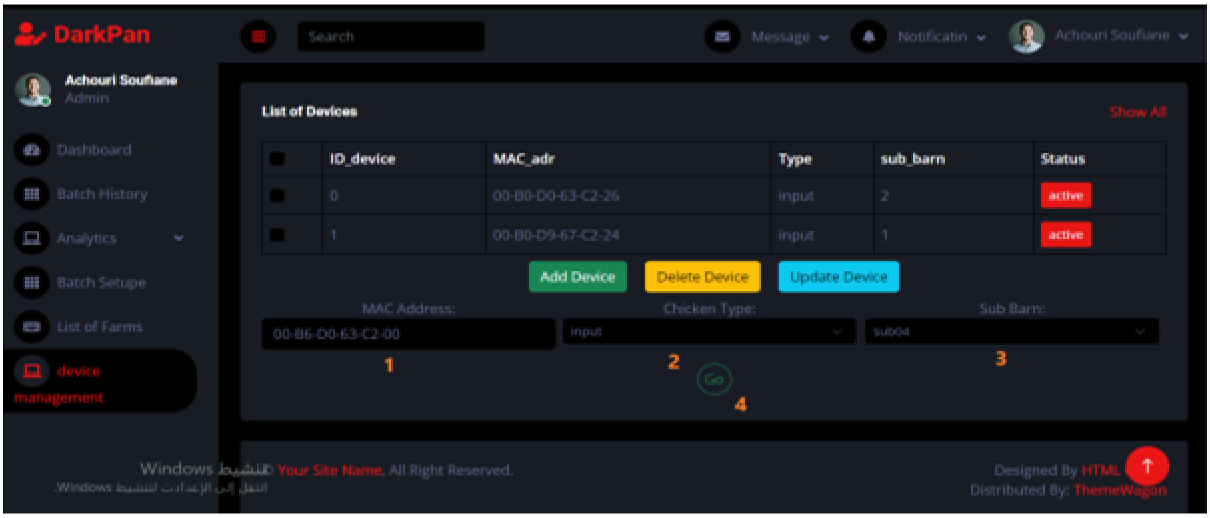

Figure 3.42: Device Management page 2

1: Enter the text of the input device address.

2: A drop-down list to choose the type Device.

3: A drop-down list to choose the partial barn in which the device will be placed It has.

4: confirmation button.

(5) Delete device button: By pressing this button, the following items appear:

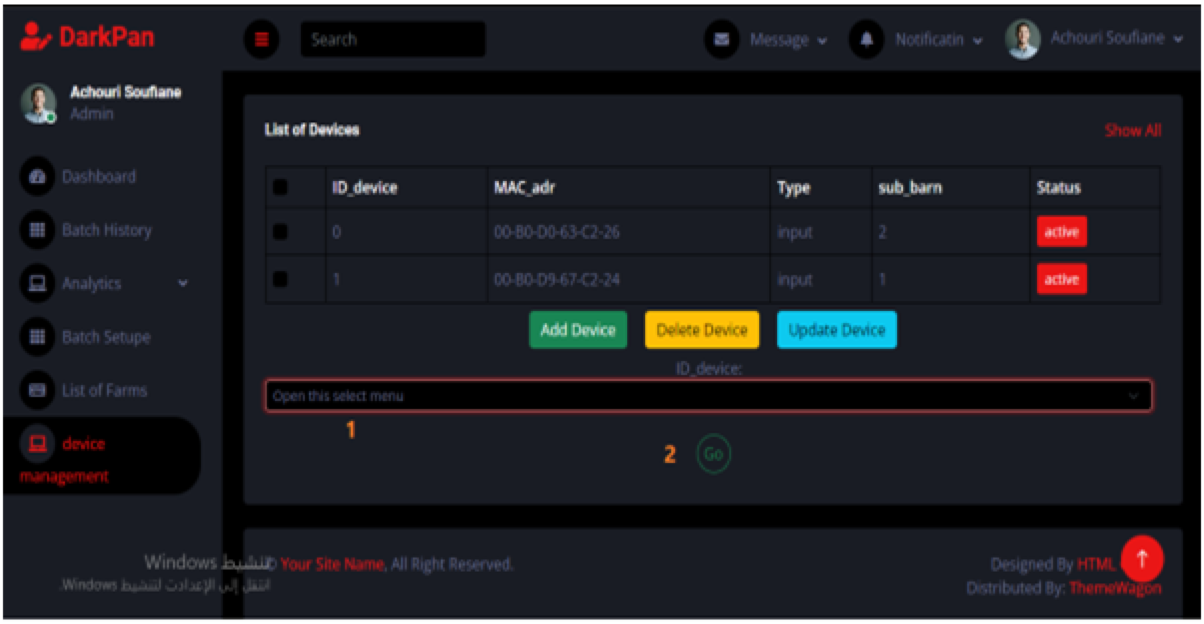

Figure 3.43: Device Management page 3

1: A menu to choose the gallery of the device to be deleted.

2: Confirm button.

(6) Device Update button: This button is used to select the partial barn to which this device belongs.

3.10.8 Mobile Application interfaces

The login interface

the login interface, where the user can enter his user name and password. When the login button is pressed, the system searches the database. • If the information is correct, you will be taken to the next page.

• If the information is wrong, an alert message will appear. The information entered is incorrect.

Also on this page is a second special icon for our Facebook and Instagram pages.

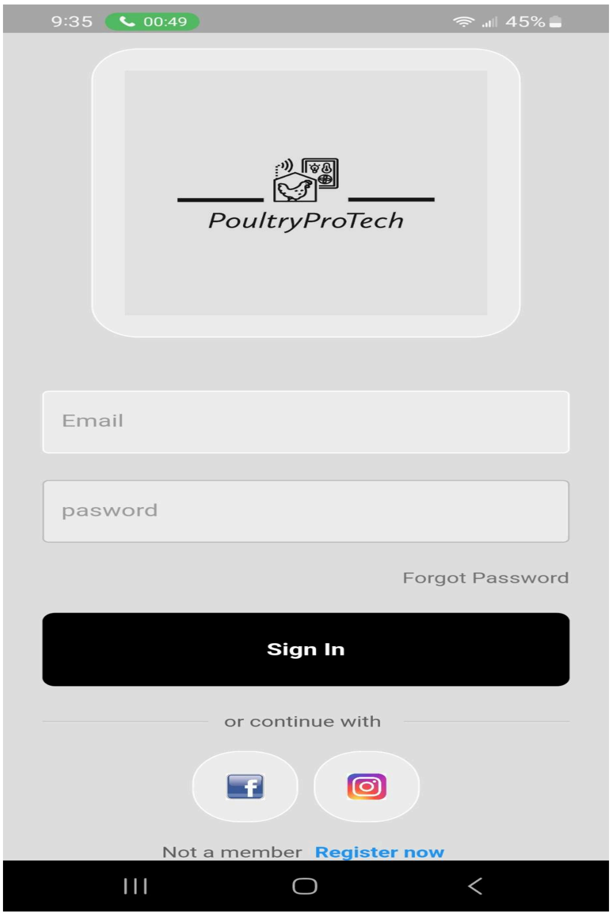

Figure 3.44: Login interface

Barn selection page

In the case of logging in, the second interface appears for choosing barn and for which the user wants to see information about it from among the barns he owns.

It is also possible to search directly for the barn through the search bar where the barn number is entered.

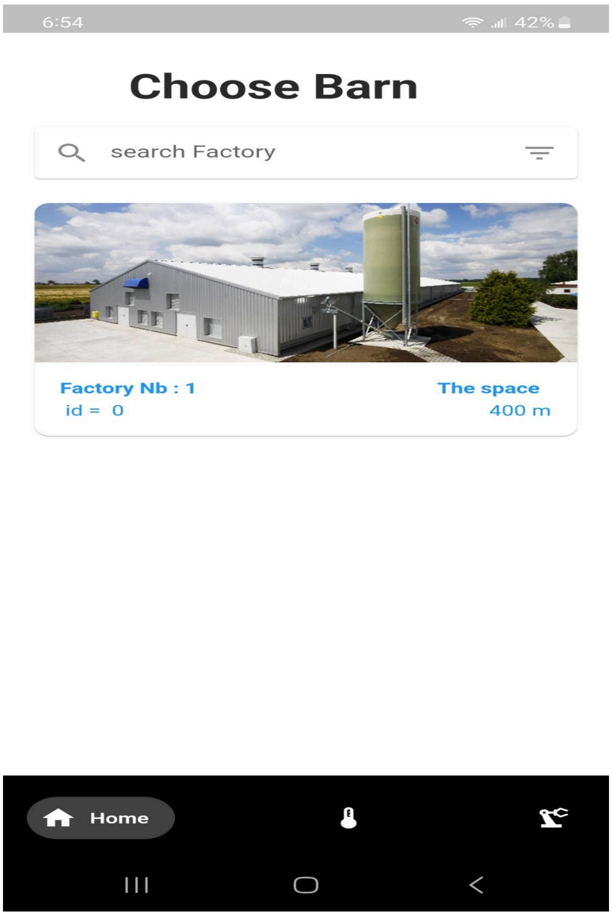

Figure 3.45: Barn selection page

Display data

After the process of selecting the barn to be monitored, the data interface displays the vital elements pertaining to that barn, which are temperature and humidity, ammonia and carbon dioxide, lighting, and ammonia level. These results are average results for this barn at Real-time.

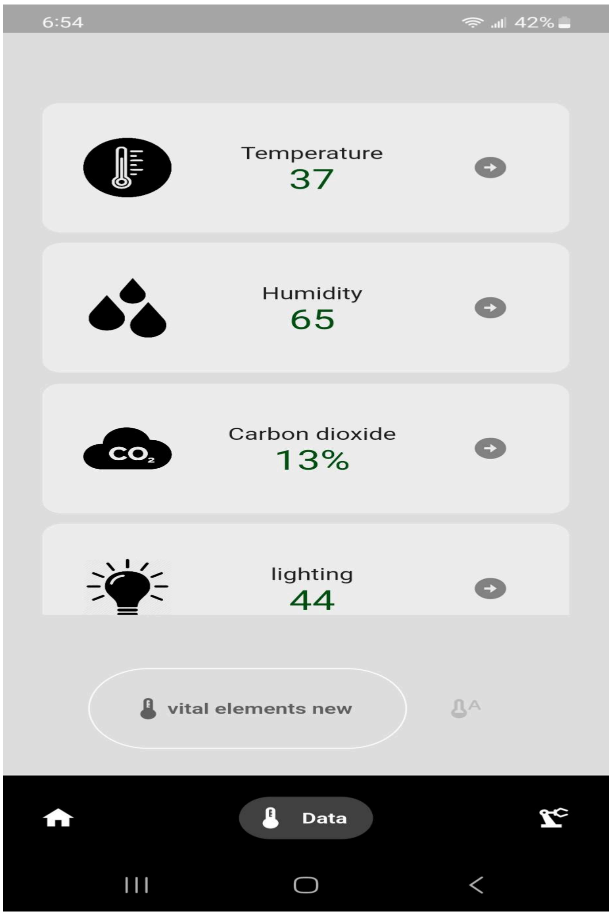

Figure 3.46: Display data

Hardware display

This interface contains equipment such as lighting, windows, and fans in that barn, where they are numbered so that the user knows to which area they belong, and their status is displayed, either in operation or not.

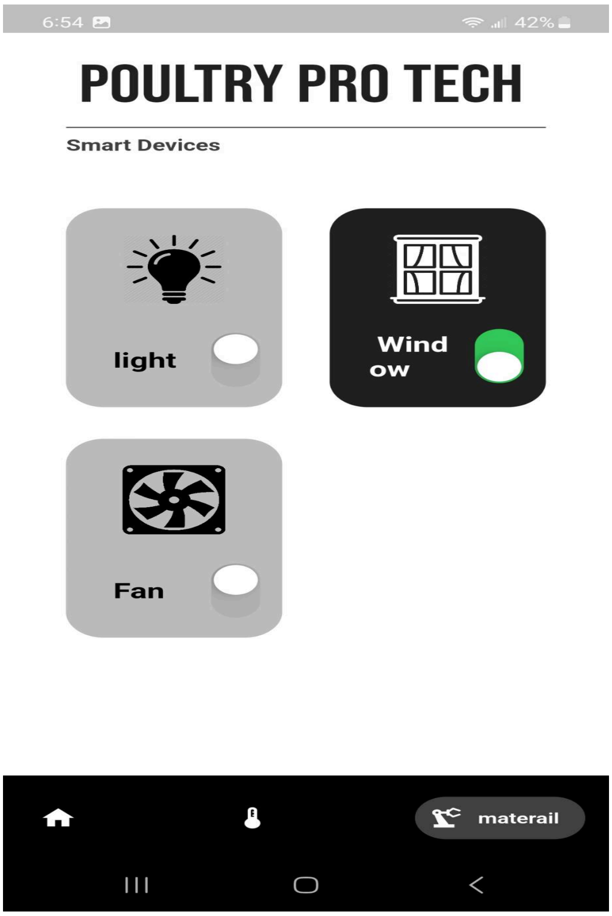

Figure 3.47: Hardware display

General Conclusion

General Conclusion

The Internet of Things has known rapid development and growth, which has led to a revolution in all fields, and this development has a tremendous impact that will change the lives of many, as new technologies infiltrate our daily lives and in many areas, and smart breeding poultry is a priority, especially in our region, and the terrible increases in this vital material and the situation that defines it The world due to severe food shortages. And one of the challenges facing the poultry breeder is maintaining a constant temperature and humidity, as one of the great obstacles facing the breeder, especially in our southern region, which is known as a summer temperature of up to 50 degrees Celsius, and as it puts the breeder in a big problem where most poultry breeders do not They can work at a high temperature, while others are shocked by the high cost of electricity due to refrigeration. And based on the principle of Internet of Things (IOT), we established our project, where it helps poultry farmers to overcome the problems of controlling temperature, humidity and light intensity in the poultry house, and also by remote control, where poultry farmers can control one or more barns at the same time via web and mobile application And automatic control of devices such as fans for air outlet, windows for the air inlet and light intensity, and the system can manually control appliances.

prospects

Unfortunately, we were unable to introduce cooling, heating, feeding and watering due to limited time and electronic resources. In the future, we will try to focus on developing the system so that it is world-class.

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