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**Presented by:**

- **Sek Ahmed Oussama**
- **Nid Mohamed Ali Elkames**


*Theme*

# HOME SECURITY SYSTEM BASED ON THE INTERNET OF THINGS

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| **Mr. KERTIOU Ismail** | MCB | Rapporteur |
| **Mr. GDIRI Samir** | …… | Rapporteur |
| …………………… . | ……. | President |
| …………………… . | ……. | Examiners |

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بسم الله الرحمن الرحيم

# الإهداء

هدي تخرجي الى سندي دليلي في الحياة إلى أبي الحبيب الذي لن أنسى فضلك أبداً ما حييت حفظه الله واطال عمره، والى القلب الكبير النابض بالحب والحنان، الى رمز العطف والحنان، الى من سيظل قلبي ينبضق لها حباً امي الغالية حفظها الله واطال عمرها، والى من بهم يشد ساعدي وتعلى همتي ،هم سندي وركائز نجاحي واخواتي .

صك احمد اسامة

# الإهداء

هدي تخرجي الى منبع الحب والحياة إلى روحك الطيبة إلى معنى الرجولة الحقيقية الى من علمني معاني كثيرة في الحياة الى من تربيت على يده أبي الحبيب الذي لن يأتي مثله أبدآ أبي رحمة الله عليك، وطيب الله ثراه، لن أنساك أبداً ما حييت ، والى القلب الكبير النابض بالحب والحنان، الى رمز العطف والحنان، الى من سيظل قلبي ينبضق لها حباً امي الغالية حفظها الله واطال عمرها، والى من بهم يشد ساعدي وتعلى همتي ،هم سندي وركائز نجاحي إخوتي واخواتي .

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## ملخص

ساعد تطور فكر الإنسان في تطور احتياجاته. وظهور مفهوم إنترنت الأشياء ، اكتسبت الأجهزة الإلكترونية ذكاءً وخصائص جديدة مثل : التفاعل. تتمتع هذه الأجهزة الإلكترونية باستقلالية القرار والذكاء والتفاعل مع المحيط. من خلال أجهزة استشعار متكاملة وإلكترونيات دقيقة. يحتاج هذا التطوير إلى وحدات تخزين كبيرة ، بالإضافة إلى سرعة معالجة البيانات التي يمكن استغلالها من قبل جميع الأشخاص عند الاتصال في نفس الوقت. هنا يبدو أن الحوسبة السحابية تلبي بعض احتياجاتها لتخزين ونقل البيانات على نطاق واسع. ورغم هذا التطور وظهور البيوت الذكية ، إلا أن محتويات هذه المنازل تتميز باستقلالية القرار والذكاء والتفاعل مع المحيط. ومع ذلك ، لم يتم استغلال هذه التقنية بشكل كامل ، لأن الناس لا يزالون يعانون من مشاكل بدائية مثل السرقة والحرائق والاختناق.

من خلال هذه المذكرة سنقوم بتصميم وتنفيذ المنزل الذكي القائم على تكامل إنترنت الأشياء والحوسبة السحابية ، ويمكن للمستخدم مراقبته والتحكم فيه عن بعد في حالة وجود خطر معين باستخدام بعض الأجهزة الدقيقة. بحيث سنستخدم بعض الحساسات الخاصة بالغاز و الدخان و درجة الحرارة وجهاز غسيبرري ع . بالاضافة الى اجهزة انذار .

**الكلمات المفتاحية** : إنترنت الأشياء ،الحوسبة السحابية ، سحابة من الأشياء، المنزل الذكي.

**Abstract**

The development of human thought helped in the evolution of his needs. And the emergence of the concept of the Internet of Things, electronic devices gained intelligence and new characteristics such as : interaction. These electronic devices have the independence of decision, intelligence, and interaction with the surroundings. Through integrated sensors and microelectronics. This development needs large volumes, in addition to the speed of data processing that can be exploited by all people when connected at the same time. Here cloud computing appears to fulfill some of its needs for large-scale data storage and transmission. Despite this development and the emergence of smart homes, the contents of these homes are characterized by independence of decision, intelligence, and interaction with the surroundings. However, this technology has not been fully exploited, because people still suffer from primitive problems such as theft, fires, and suffocation.

Through this memorandum, we will design and implement a smart home based on the integration of the Internet of Things and cloud computing, and the user can monitor and control it remotely in the event of a certain danger using some precise devices. So that we will use some sensors for gas, smoke, temperature, and a Raspberry Pi. In addition to alarms.

**Keywords** : internet of things ,cloud computing,cloud of things, smart home.

**Resume**

L'évolution de la pensée humaine a contribué à l'évolution de ses besoins. Et avec l'émergence du concept de l'Internet des objets, les appareils électroniques ont gagné en intelligence et en nouvelles caractéristiques telles que : l'interaction. Ces appareils électroniques ont l'indépendance de décision, l'intelligence et l'interaction avec l'environnement. Grâce à des capteurs intégrés et à la microélectronique. Cette évolution nécessite des volumes importants, en plus de la rapidité de traitement des données exploitables par tous lorsqu'ils sont connectés en même temps. Ici, le cloud computing semble répondre à certains de ses besoins de stockage et de transmission de données à grande échelle. Malgré ce développement et l'émergence des maisons intelligentes, le contenu de ces maisons se caractérise par l'indépendance de décision, l'intelligence et l'interaction avec l'environnement. Cependant, cette technologie n'a pas été pleinement exploitée, car les gens souffrent encore de problèmes primitifs tels que le vol, les incendies et la suffocation.

Grâce à ce mémorandum, nous concevrons et mettrons en œuvre une maison intelligente basée sur l'intégration de l'Internet des objets et du cloud computing, et l'utilisateur pourra la surveiller et la contrôler à distance en cas de danger certain à l'aide de certains appareils précis. Nous utiliserons donc des capteurs de gaz, de fumée, de température et le dispositif Raspberry Pi, en plus des dispositifs d'alarme.

**Mots-clés** : internet des objets,cloud computing ,nuage de choses, smart home.

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# GENERAL INTRODUCTION

Since the end of the last century, the Internet has been integrated into our daily lives to a large extent, which has increased its importance in the present time. It has evolved since that time, starting from simple static hypertext pages to the Internet of content (information, e-mail ...), then to the Internet of services where services were born, to the Internet of people or what we know as social media where people communicate with each other some.

In our time, the development of communication technologies increases in the number of objects connected to the Internet, these connected objects are embedded systems or a small computer that can be the size of a cash coin that can be integrated into anything in daily life, these objects can be integrated with any device in the home and these enable us The property of systems creating independent decisions. This is the production of the new paradigm of the Internet of Things (IoT).

As a result of this development, large-scale data storage and transfer results in some complementary technologies to meet these needs, and cloud computing has many advantages and services, from large storage units as well as the speed of data processing that can be exploited by all people when connected to the Internet.

In some urban environments, security intervention does exist, but it is less efficient when there is a security disturbance or fire. This is because the information received is not in real time. Non-real-time information slows down processing in the event of security disruptions, thefts, fires, and gas leaks. In addition to security officers, closed circuit television (CCTV) was installed to monitor the condition of the house. However, CCTV does not provide real-time notice when interference is recorded. If the homeowner does not see a CCTV monitor installed, the homeowner will not know about changes in the condition of the home. Therefore, we need a means (program) through which we can monitor and know the changes and accidents that occur in the house and that can alert us directly when we notice any person or the presence of other unexpected events such as theft, leaks, and others. This tool uses IoT technology, which can be controlled from anywhere with the help of internet connection and cloud storage [9].

Our project is not new. Manveer Joshi, V Sasikala.[25][17] This system was implemented using an Arduino board and communication technologies such as RFID and ZigBee as well as cloud computing. But there is no cooperation between the structure of the system and its components. In addition, each of them ignores the security aspect of their project, and this is what our observations are based on.

In this work, we will create a design and structure for a home monitoring and protection system from these accidents and sudden changes, by alerting the owner and taking security precautions in a timely manner. This system is based on the integration of cloud computing with the Internet of Things.

This work will be divided into four chapters :

- Chapter 1 :We describe an overview of the Internet of Things, and we mention each of its structure, characteristics, and areas of application in reality, and we mention some protocols, as well as the pros, cons, and challenges.

- Chapter 2 :We define the concept of cloud computing, and mention its types, characteristics, types of services, benefits and drawbacks. And we define what the cloud of things is and some of the challenges and problems.

- Chapter 3 : We mention some of the similar works and see what are their shortcomings. We propose a design for this system using UML diagrams .

- Chapter 4 : We give a description of the system and mention each of the hardware and software used, and we simulate and implement the proposed system .

# Chapitre 1

# INTERNET OF THINGS

## 1.1 Intrduction

In our time, the use of the Internet has become massive in various fields, and it has touched all corners of the world, and it affects human daily life in all fields. And with the advent of the Internet of Things, which is a global network based on standard communication protocols that allow interaction and integration between virtual and physical objects through the exchange of data and information.
In this chapter, we will define the Internet of Things and discuss and study its structure and characteristics. We will also see the various areas of its multiple applications, protocols and technologies for the rapid use of communication, and we will also address the challenge and the future direction of the Internet of Things, and conclude the chapter with a conclusion.

## 1.2 IOT Definition :

The Internet of Things (IoT) is a novel paradigm that is rapidly gaining ground in the scenario of modern wireless telecommunications. The basic idea of this concept is the pervasive presence around us of a variety of things or objects – such as Radio-Frequency IDentification (RFID) tags, sensors, actuators, mobile phones, etc. – which, through unique addressing schemes, are able to interact with each other and cooperate with their neighbors to reach common goals[4].

The Internet of Things (IoT) is an emerging global Internet-based information architecture facilitating the exchange of goods and services. The IoT has the purpose of providing an IT-infrastructure facilitating the exchange of "things" in a secure and reliable manner, i.e. its function is to overcome the gap between objects in the physical world and their representation in information systems. The IoT will serve to increase transparency and enhance the efficiency of global sup- ply chain networks[27].

Haller/Karnouskos/Schroth define the IoT as "a world where physical objects are seamlessly integrated into the information network, and where the physical objects can become active participants in business processes. Services are avail- able to interact with these 'smart objects' over the Internet, query their state and any information associated with them, taking into account security and privacy issues."[27]

Extending the initial application scope, the IoT might also serve as backbone for ubiquitous computing, enabling smart environments to recognize and identify objects, and retrieve information from the Internet to facilitate their adaptive functionality[27].

## 1.3 IOT Architecture :

The IoT architecture consists of five basic layers shown in Figure 1.1 :

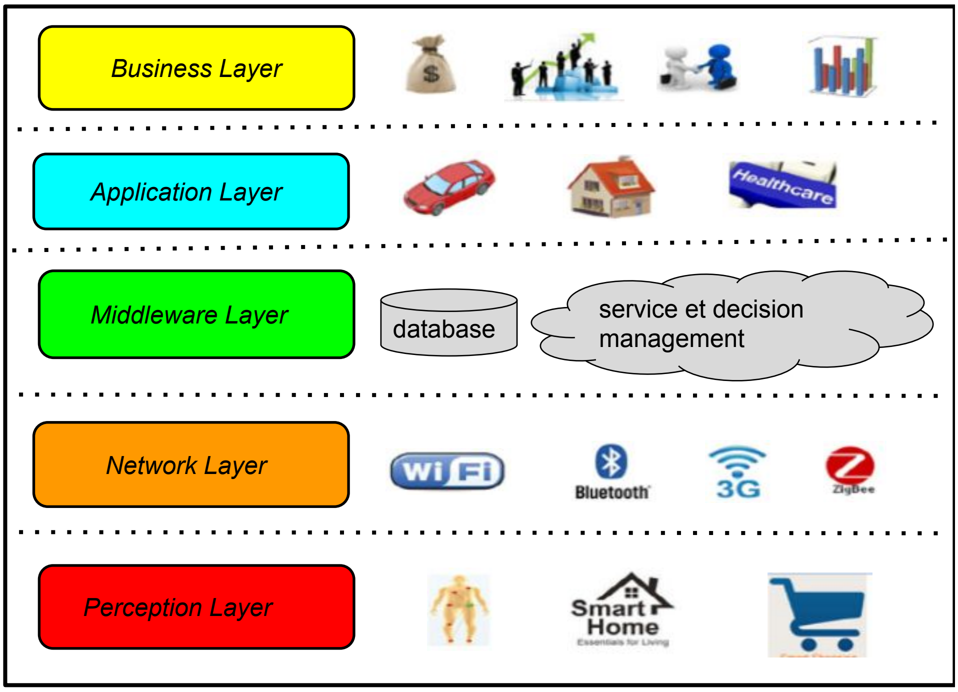


FIGURE 1.1 – The architecture of IoT

### 1.3.1 Perception layer :

It is also called the "Sensing layer", and it is the first layer of the Internet of Things architecture. It aims to obtain data from the environment using sensors and actuators. So that you collect information and process it, in order to transfer it to the next class.

Perception layer This layer is responsible for collecting information and identifying objects and includes some key technologies such as RFID, sensors, nanotechnology,and barcodes[8]

### 1.3.2 Network layer :

In the IOT network layer, the data obtained is forwarded and transmitted to various IoT devices over the Internet. In this layer are cloud computing platforms, Internet gateways, switches and routers...etc. It works using modern technologies and protocols such as WIFI, LTE, Bluetooth, 3G and Zigbee. Network gateways can also mediate between different IoT devices by collecting and transmitting data to and from different sensors

Network layer This layer is the most important layer in the IoT architecture. The function of this layer is to address all the objects and is responsible for transmitting the secure information between the other two layers as in OSI network model. Some protocols of communication and transmission of data are part of this network layer such as Bluetooth, ZigBee, and WiFi[8].

### 1.3.3 Processing layer :

Processing layer (or middleware layer) This layer is responsible for data manipulation which can be collected by objects over the network (store, analyze, and process). Thus, database software, intelligent processing, and ubiq- uitous computing are employed in this layer[8].

### 1.3.4 Application layer :

Application layer This layer is responsible for carrying commands from applications to the end-device actuators[8].. This layer realizes the Internet of Things applications for all kinds of industry, based on the processed data. And since applications increase the development of the Internet of Things, this layer is considered one of the basics for the broad development of the Internet of Things[12].

### 1.3.5 Business layer :

Business layer The layer has some different functions (a) it manages the IoT system and its applications and services ; (b) it receives data from the application layer to build models of business, flowcharts, and graphs (c) it provides privacy of users[8].

## 1.4 IOT Properties :

Some of the characteristics of the Internet of Things are the following [22] :
- **Interconnectivity :** The Internet of Things enables connecting anything to the global information and communication infrastructure.
- **Services related to connected objects :** The Internet of Things can provide services related to things within constraints, such as protecting privacy and semantic consistency between physical objects and virtual objects associated with them. In order to provide services related to things within the constraints of things, as both the technologies in the physical world and the information world will change.
- **Dynamic changes :** The state of objects changes dynamically ( sleeping and awake) as well as devices whose number can change dynamically. Including location and speed.
- **Heterogeneity :** In the Internet of Things, devices are heterogeneous They are based on different platforms and networks. They can Interact with other platforms for devices or services through different networks.
- **Enormous scale :** The number of connected objects will be increase next few years

which will make the management of the data generated and their interpretation more critical.

**- Safety :** Since it gives us various and special benefits, safety is another important characteristic of IoT technologies, and this includes the safety of personal data, the safety of our health, and the safety of physical well-being. Securing objects, networks, applications, and data flows.

**- Connectivity :** It stands for Network Accessibility and Compatibility. Access is placed on the network, while compatibility provides the shared ability to consume and produce data.

## 1.5 Areas Appliction of IOT :

There are many applications and services provided to us by the Internet of Things, which contribute to facilitating and improving human life in many areas in different ways, as shown in figure 1.2 [22], and we mention some of them :

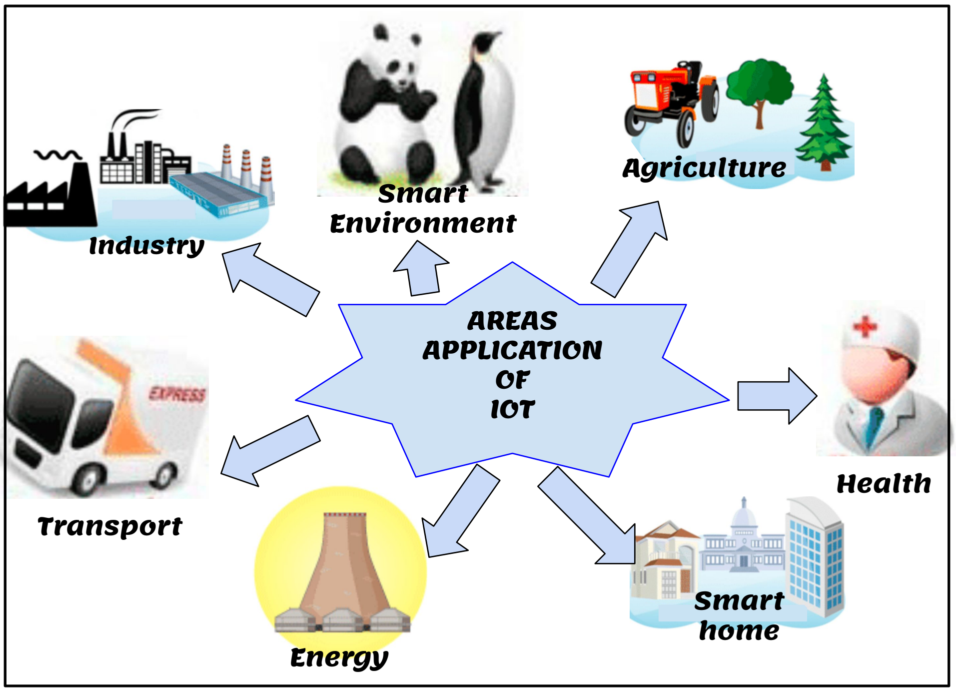


FIGURE 1.2 – Areas application of IoT

**- Health :** The IoT enables remote health monitoring and emergency notification systems. A very popular approach is to use portable techniques. These wearable devices can collect a range of health data, such as heart rate, body temperature and blood pressure, which can then be wirelessly transmitted to a remote site for storage and further analysis. It also enables telehealth/telemedicine, i.e. diagnosing or treating patients remotely [21].

**- Agriculture :** The IoT will enable better decision support in agriculture. The IoT will not only be used to optimize irrigation water, but also, this technology can be used to fight against pollution (air and water) and improve the quality of the environment in general.

**- Industry :** The application of IoT in industry is often referred to as Industry 4.0 or the fourth industrial revolution (Figure 1.3) [30]. The first industrial revolution took place in the 18th century when the steam engine mobilized industrial production. The second industrial revolution took place at the beginning of the 19th century, when electric power powered mass production. The third industrial revolution, or digital revolution, took place at the end of the 19th century when electronics and computers further automated production. Industry 4.0 relies on cyber-physical systems that tightly integrate machines, software, sensors, the Internet and users. It will create smart factories, where machines can use self-optimization, self-configuration and even artificial intelligence to perform complex tasks to deliver vastly greater cost savings and higher quality goods or services.[21]

**- Smart Home :** The smart home, or home automation, is an extension of building automation, with which we can monitor and control heating, ventilation and air conditioning (HVAC), lighting [121], appliances, tape security. By connecting all household appliances, we can automate many daily routines, such as automatically turning lights and heating on and off, starting or stopping cooking and washing, etc. With the smart grid and smart meters we can reduce energy consumptions and utility bills, and with security systems we can make the home safer by automatically detecting and hopefully deterring intrusions using various infrared, motion, sound, vibration sensors as well as alarm systems [61]. A smart home can also make the elderly and people with disabilities more comfortable and safer at home. With the IoT, we can collect and analyze data from the elderly and disabled to diagnose illnesses, predict potential risks, identify or prevent accidents such as falls, open or lock the door (or windows) remotely, and let family members monitor them remotely [61]. With the IoT, it is also possible to bring older and disabled people closer to the outside world and reduce their feeling of loneliness [21] .

**- Energy :** By integrating sensors and actuators, it is likely to reduce the energy consumption of all energy-consuming devices. The IoT will also modernize the infrastructure of the electrical industry, in order to improve efficiency and productivity [21].

**- Transport :** From connected cars to intelligent transport/logistics systems, the IoT can save lives, reduce traffic, minimize the impact of vehicles on the environment and improve road safety.

**- Smart Environment :** Prediction of natural disasters such as flood, fire, earthquakes etc will be possible due to innovative technologies of IoT. There will be a proper monitoring of air pollution in the environment[12].

## 1.6 IOT Protocols :

The Internet of Things uses different protocols. The main ones that will be mentioned regularly throughout the rest of this thesis are[13] :

### 1.6.1 HyperText Transfer Protocol (HTTP) :

HyperText Transfer Protocol (HTTP) This protocol is at the heart of the functioning of the Web as we know it. HTTP is based on Transmission Control Protocol (TCP) which makes it possible to establish a connection between the entities concerned. Establishing this connection can be expensive and HTTP is quite a verbose protocol which does not necessarily make it suitable for all IoT architectures. HTTP is also the basis of REpresentational State Transfer (REST) architectures which rely on HTTP protocol operations to define resource operations.

### 1.6.2 Constrained Application Protocol (CoAP) :

Constrained Application Protocol (CoAP) : is a protocol inspired by HTTP (it is based on the same types of operation) but uses the User Datagram Protocol (UDP). In addition, the size of the application packet is very limited in order to minimize the data exchanged on the network.

### 1.6.3 Message Queuing Telemetry Transport (MQTT) :

Message Queuing Telemetry Transport (MQTT) : is a publish/subscribe type protocol. In fact, MQTT clients will be able to publish messages on an intermediate server (broker) via subjects (topics) to which it is also possible to subscribe. It is thus easy to subscribe to a topic and to be notified when a new message is published. Multiple clients can subscribe to the same topic and post to the same topic.

### 1.6.4 ExtensibleMessaging and Presence Protocol (XMPP) :

Extensible Messaging and Presence Protocol (XMPP) est un protocole de communication en temps réel standard ouvert basé sur XML (ExtensibleMarkup Language). Il peut fournir une large gamme de services, notamment la messagerie instantanée, la présence et la collaboration. Il est décentralisé et dispose de fonctions de sécurité. Il est également extensible, ce qui signifie qu'il est conçu pour grandir et s'adapter aux changements. Le logiciel XMPP comprend des serveurs, des clients et des bibliothèques[21].

### 1.6.5 WebSocket :

WebSocket est un protocole de communication conçu pour les navigateurs Web et les serveurs Web, mais contrairement à HTTP, WebSocket fournit une communication en duplex intégral sur une seule connexion TCP. WebSocket est avec état, car le client et le serveur maintiennent une connexion pendant la communication. LeWebSocket permet une plus grande interaction entre un navigateur et un serveur Web, permet un transfert de données en temps réel et des flux de messages. À ce jour, WebSocket est implémenté dans tous les principaux navigateurs Web, par exemple Firefox 6, Safari 6, Google Chrome 14, Opera 12.10 et Internet Explorer[21].

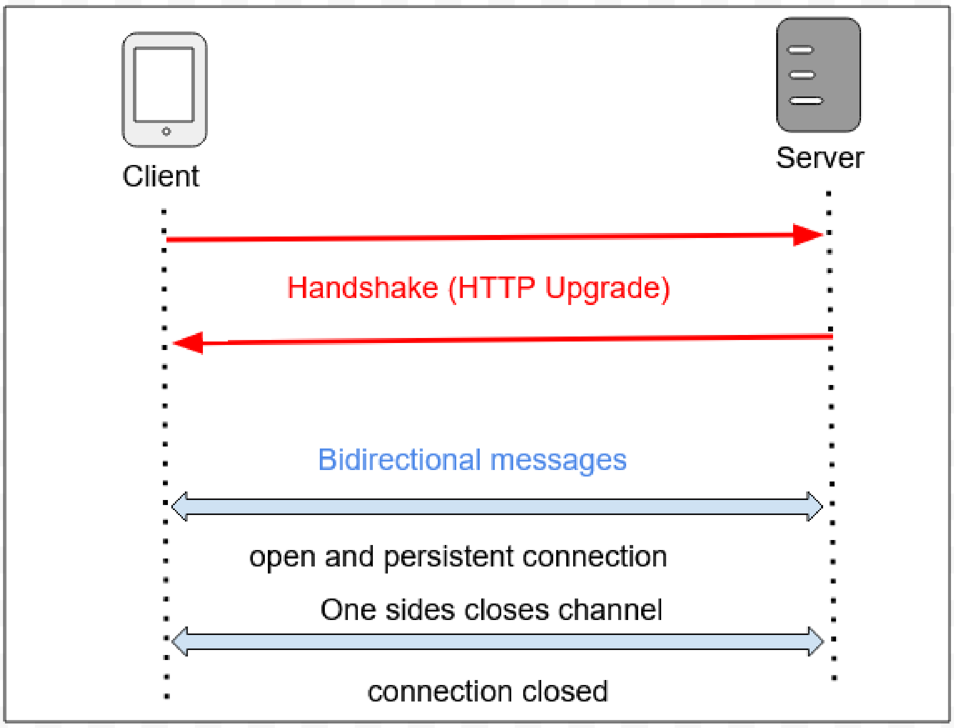


FIGURE 1.3 – The architecture of WebSockets

## 1.7 IOT advantages and disadvantages :

In this section, we mention the advantages and disadvantages of IoT applications [18].

**Advantages :**
The Internet of Things offers many advantages to users, among which we mention :

- provides personal safety and increased security for the development of the level of surveillance, so that it is possible to monitor and control the home using mobile phones.

- Staying in touch and virtually connected between family members always in the network.

- Effective use of electricity and energy.

- Improving the level of health care so that the patient can be monitored without the need to visit a doctor and treatment is provided in case of emergency.

- Multiple business processes such as shipping, location, security, asset tracking, inventory control, individual order tracking, customer management, marketing operations, personal sales, etc. can be efficiently performed using a proper IoT tracking system.

**Disadvantages :**
The Internet of Things also has its drawbacks despite its many benefits, and among the drawbacks it has is :

- Privacy becomes less so that hackers can hack into the system and can steal data.

- It may lead to unemployment so that people with a weak level are exposed to losing their jobs.

- Increased dependence on systems leads to a decrease in sports and physical activity.

## 1.8 Future challenges of the Internet of Things :

The application of the Internet of Things in the world faces a lot of challenges that need to be addressed. Like privacy, security, cost vs ease of use, interoperability, etc. Cloud computing integration is the most important for the future trends of IoT [22] :

### 1.8.1 Privacy and Security :

As the IoT become a key element of the Future Internet and the usage of the Internet of Things for large-scale, partially mission-critical systems creates the need to address trust and security functions adequately. New challenges identified for privacy, trust and reliability are :
- providing trust and quality of-information in shared information models to enable reuse across many applications.
- Providing secure exchange for data between IoT devices and consumers of their information.
- Providing protection mechanisms for vulnerable devices.

### 1.8.2 Cost Versus Usability :

IOT uses technology to connect physical objects to Internet. For IOT adoption to grow, the cost of components that are needed to support capabilities such as sensing tracking and control mechanisms need to be relatively inexpensive in the coming years.

### 1.8.3 Interoperability :

In the traditional Internet, interoperability is the most basic core value ; the first requirement of Internet connectivity is that "connected" systems be able to "talk the same language" of protocols and encodings. Different industries today use different standards to support their applications.with numerous sources of data and heterogeneous devices, the use of standard interfaces between these diverse entities becomes important. This is especially so for applications that supports cross organizational and various system boundaries. Thus the IOT systems need to handle high degree of interoperability.

### 1.8.4 Cloud Computing :

Integration between IoT and cloud computing allows for a challenge to create environments or smart cities that must be able to combine services offered by multiple stakeholders and scale to support a large number of users in a reliable and decentralized manner that is only provided by cloud computing [15].

## 1.9 Conclusion :

In this chapter, we presented and briefly described the Internet of Things in general by providing some definitions for it, as well as discussing its structure consisting of five layers. We also saw some of the applications and services provided by the Internet of Things. We saw the different protocols used in the Internet of Things as well. The platforms and we saw the benefits that they offer us and some of their disadvantages.
In the next chapter, we will introduce, discuss and study the concept of cloud computing and the kind of relationship it has with the Internet of Things.

# Chapitre 2

# CLOUD OF THINGS

## 2.1 Intrduction :

The emergence of cloud computing has had a great interest and impact in providing many services and advantages that give solutions to storage problems and access to data quickly.
In this chapter, we will define cloud computing, mention its characteristics and advantages, and discuss the types of cloud computing and types of services. As we will see, the complementary relationship that exists between the Internet of Things with cloud computing and the importance of integrating them, and most of the challenges in this integration.

## 2.2 Cloud Computing :

### 2.2.1 Definition Cloud Computing :

is a model for enabling 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 [10]

Cloud computing, the recent trend in IT, takes computing from desktop to the whole World Wide Web and yet, the user doesn't need to worry about maintenance and managing all the resources. User has to bear only the cost of usage of service(s), which is called, pay-as-you-use, in cloud computing terms. With this cloud computing, a smart phone can become a large data center. Cloud computing is extended form of distributed computing, parallel computing, and grid computing [2].

### 2.2.2 Characteristics of Cloud Computing :

Cloud computing systems satisfy many interesting characteristics that make them promising for future IT applications and services [24] :
- **On-demand self-service :** cloud services such as CUP time, Storage, network access, server time, web applications etc can be allocated automatically as required by the consumers without any human interaction
- **Cost effectiveness :** Services provided by the cloud service providers are very cost effective if not free. The billing model is pay as per usage ; there is no need to purchase the infrastructure and therefore lowers maintenance cost.
- **Broad Network Access (mobility) :** consumers can access cloud resources over the Internet all the time and from anywhere (i.e., ubiquitous) through different types of devices (e.g., mobile phones, laptops, and PDAs).
- **Resource Pooling :** physical and virtual computing resources are pooled into the

cloud. These resources are not dependent on location in the sense that the customer has no control nor has knowledge over their location.
- **Rapid Elasticity :** computing resources can be rapidly and elastically provisioned and released based on the demand of the consumer. Consumers view these resources as if they are infinite and can be purchased in any quantity at any time.
- **Measured Services :** cloud resources and services are monitored, controlled and optimized by the CSPs through a pay-per-use business model. Consumers utilize these services in a way similar to utilizing electricity, water and as.
- **Multitenancy :** a cloud provides services to multiple users at the same time. Those users share cloud resources at the network level, host level and application level, however, each user is isolated within his customized virtual application instance.
- **Scalability :** the infrastructure of cloud computing is very scalable. Cloud providers can add new nodes and servers to cloud with minor modifications to cloud infrastructure and software.
- **Reliability :** is achieved in cloud computing by using multiple redundant sites. High reliability makes the cloud a perfect solution for disaster recovery and business critical tasks.
- **Economies of scale :** in order to take advantage of economies of scale, clouds are implemented to be as large as possible. Other considerations are also taken to reduce cost such as locating the cloud close to cheap power stations and in low cost real estate.
- **Customization :** a cloud is a re configurable environment that can be customized and adjusted in terms of infrastructure and applications based on user demand.
- **Efficient resource utilization :** delivering resources only for as long as they are needed allows for efficient utilization of these resources.
- **Virtualization :** Cloud computing makes user gets service anywhere, through any kind of terminal. The resources it required come from cloud instead of visible entity. You can complete all you want through net service using a laptop or a mobile phone. Users can attain or share it safely through an easy way, anytime, anywhere. Users can complete a task that can't be completed in a single computer.

### 2.2.3 Types of Cloud Computing :

Recently, four types of models for cloud deployment have been identified in the cloud community as the following figure 2.1 [10] :

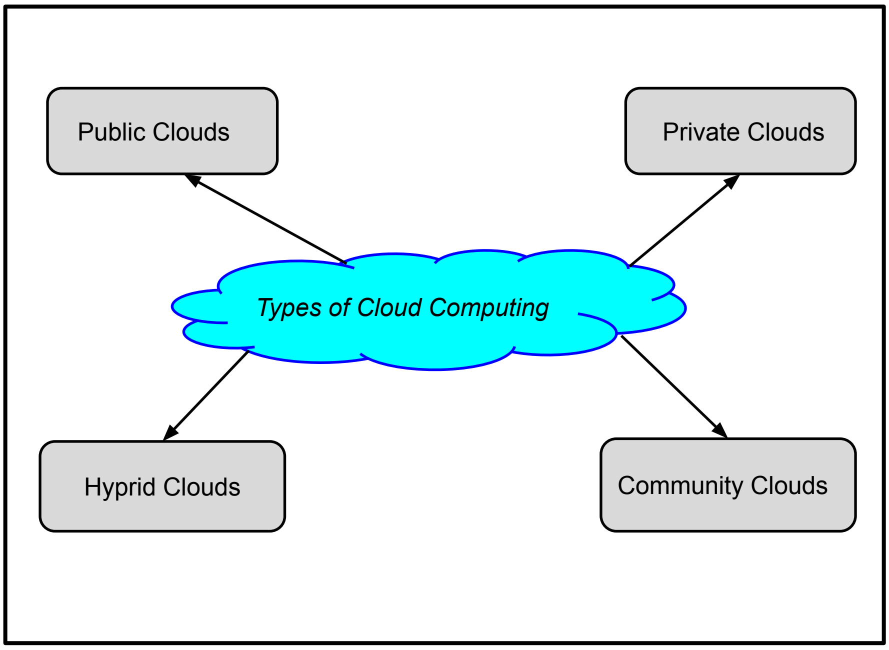


FIGURE 2.1 – Types of cloud computing

**- Public Clouds :**

It is the dominant type of the current cloud computing deployment model. Public clouds are used by public cloud consumers in general and the cloud service provider has full ownership of the public cloud through its own policy, value, revenue, costs and shipping model. Many popular cloud services are public cloud including Amazon EC2, S3, Google AppEngine, and Force.com.

**- Private Clouds :**

Cloud infrastructure belongs to and is operated by only one organization. It is operated by it or a third party regardless of whether it is on-premises or off-premises. One of the reasons for setting up a private cloud within the organization :

- Optimizing the use of existing internal resources.

- Security concerns, including data privacy and trust, also make the private cloud an option for many businesses.

- The cost of moving data from the on-premises IT infrastructure to the cloud The general is great.

- Organizations must have overall control and control over mission-critical activities.

- It could be the creation of a private cloud for the purpose of research and education.

**- Community Clouds :**

Cloud infrastructure is shared by many organizations as well as policies, requirements, values, and interests. It supports a specific community with shared concerns in a degree of economic scalability and democratic equilibrium. Cloud infrastructure can be hosted by an external vendor or within an organization in the community.

**- Hyprid Clouds :**

A cloud infrastructure is a configuration of two or more clouds (private, community, or public) that remain unique entities but are linked together by standard or proprietary technology that enables portability of data and applications (for example, cloud burst for inter-cloud load balancing). Organizations use the hybrid cloud model to optimize their resources to increase their core efficiencies by removing edge business functions to the cloud while controlling core activities in the enterprise through the private cloud.

### 2.2.4 Types of cloud services :

These services are generally categorized into three categories known as cloud service models. Cloud service models are a service-oriented architecture (SOA) that describes cloud services with different levels of abstraction. These models are shown in the figure 2.2 [10] :

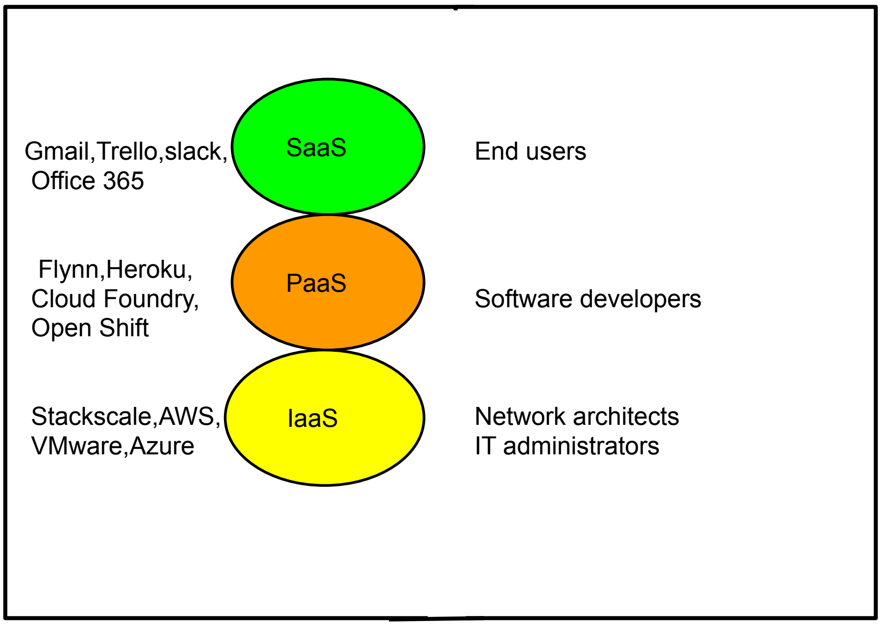


FIGURE 2.2 – Types of cloud services

**- Infrastructure as a Service (IaaS) :**

Infrastructure as a Service (IaaS). Cloud consumers directly use IT infrastructures (processing, storage, networks, and other fundamental computing resources) provided in the IaaS cloud. Virtualization is extensively used in IaaS cloud in order to integrate/decompose physical resources in an ad-hoc manner to meet growing or shrinking resource demand from cloud consumers. The basic strategy of virtualization is to set up independent virtual machines (VM) that are isolated from both the underlying hardware and other VMs. Notice that this strategy is different from the multi-tenancy model, which aims to transform the application software architecture so that multiple instances (from multiple cloud consumers) can run on a single application (i.e. the same logic machine). An example of IaaS is Amazon's EC2 [10].
IaaS provides computation and storage services on rental basis. Instead of purchasing expensive machines, servers, and storage devices, even for small tasks, user can outsource this task to the IaaS service provider. With storage in IaaS, not only the data is stored by the IaaS service, but also, it makes the data universally accessible over the Internet[2].

**- Platform as a Service (PaaS) :**

PaaS is a development platform supporting the full "Software Lifecycle" which allows cloud consumers to develop cloud services and applications (e.g. SaaS) directly on the PaaS cloud. Hence the difference between SaaS and PaaS is that SaaS only hosts completed cloud applications whereas PaaS offers a development platform that hosts both completed and in-progress cloud applications. This requires PaaS, in addition to supporting application hosting environment, to possess development infrastructure including programming environment, tools, configuration management, and so forth. An example of PaaS is Google AppEngine [10].
PaaS is providing a platform to build applications and services, with all the toolkits and resources required to do so[2].

**- Software as a Service (SaaS) :**

Software as a Service (SaaS). Cloud consumers release their applications on a hosting environment, which can be accessed through networks from various clients (e.g. web browser, PDA, etc.) by application users. Cloud consumers do not have control over the Cloud infrastructure that often employs a multi-tenancy system architecture, namely, different cloud consumers' applications are organized in a single logical environment on the SaaS cloud to achieve economies of scale and optimization in terms of speed, security, availability, disaster recovery, and maintenance. Examples of SaaS include SalesForce.com, Google Mail, Google Docs, and so forth. Data storage as a Service (DaaS) [10].
SaaS refers to application working over the Internet which is available for the user on pay-as-you-go basis . User does not need to store, install, and maintain the application.

Instead, only Internet connectivity is required to access the service that has been rented out by the SaaS service provider on the cloud[2].

### 2.2.5 Advantages of cloud computing :

Cloud computing provides many benefits, including [3] :

- Cost effective due to its high efficiency in use, maintenance and upgrade .

- Provides relatively unlimited storage capacity for data and information.

- Ease and simplicity of the process of backing up and restoring stored data .

- The process of customizing and integrating applications for cloud users according to their preferences is automatic, i.e. software integration is something automatic.

- Users can access information from anywhere with ease .

- Providing the advantage of a rapid deployment process is considered important.

### 2.2.6 Disadvantages of cloud computing :

Cloud computing also has its drawbacks despite its many benefits so companies, especially small businesses, should be aware of these aspects before entering into this technology. The main risks involved in cloud computing are [3] :

- The possibility of theft of sensitive data, as storing information in the cloud makes companies vulnerable to attacks and the threat of penetration from other parties..

- Small businesses rely on the reliability of their Internet connection.

- According to Anita Campbell, it is difficult to get customer service right away.

- Sometimes the system suffers from some serious malfunctions as this technology is always prone to outages and other technical issues.

- Security and protection are among the biggest problems in the cloud as the beneficiary when handing over the sensitive information of his company to a third-party cloud service provider. It is considered a major risk to the company.

## 2.3 Cloud of things :

As the number of connected devices is increasing rapidly, the amount of data will also increase. Storing this data locally and temporarily will no longer be possible. Rental storage space will be required. Moreover, this huge amount of data should also be used in the way it deserves. Data should not only be processed to form information and more than that, to form knowledge, but it should be a means of wisdom for the user. This requires more processing, which is not possible on the IoT end, where hardware is low cost and lightweight. Again, processing and calculation should also be available on a rental basis.

All this is possible with cloud computing. The Internet of Things and cloud computing that integrate creates a new paradigm called the Cloud of Things. The Internet of Things provides sophisticated means of communication with the wider world, the Web, through networks and devices everywhere. On the other hand, cloud computing provides scalable network access, the figure shows a comprehensive CoT connectivity pattern[1].

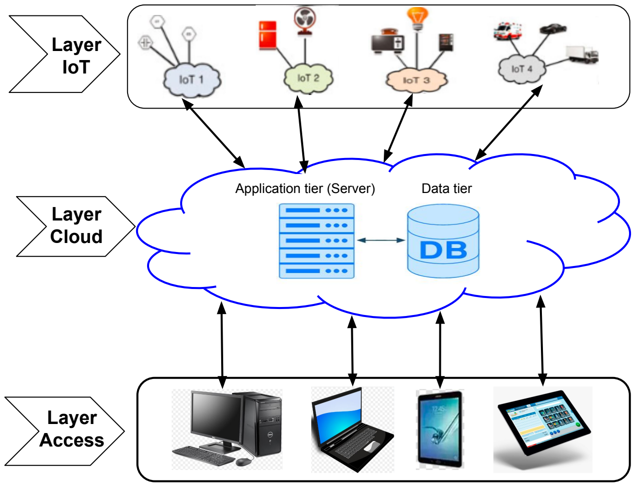


FIGURE 2.3 – Cloud of things

This figure provides a general picture of how cloud IoT communications are made. Different IoTs generate data that passes through each of the layers shown in Figure 1.2. The data is communicated through a communication channel. Figure shows. Various examples. The data eventually reaches the cloud which stores, processes and secures the data, according to the service requirements. Once the service is created, it is made available to the end user, who is on the other side of the cloud, at the access layer[1].
CoT will play an important role in this regard, not only in delivering the service, but also, managing it.

### 2.3.1 Challenges associated with the cloud of things :

It is not easy and not simple to allow anything to be part of the Internet of Things and then provide all the resources through cloud computing. There are barriers and issues that must be considered to allow CoT victory. Similar to data and resources, the cloud has to deal with a business point of view as well. CoT creates more business opportunities, and this makes it more vulnerable and a direct target for attackers. Identity protection is very important in hybrid clouds, as there is the core of the private and public clouds that companies use. In CoT, heterogeneous networks are shared, and are supportive of different types of data and services. Where the network must be characterized by the flexibility necessary to support all types of data according to the requirements and with support for the quality of service[1].

### 2.3.2 Some major problems :

We discuss some of the key issues associated with the cloud of things[1] :
**- Protocol Support :** For different things to be connected to the Internet, different protocols will have to coexist. Even if there are homogenous entities, for example a sensor IoT or Wireless Sensors Network, then there is still a possibility that sensors use different proto- cols, such as WirelessHART, ZigBee, IEEE 1451, Constrained Application Protocol (CoAP), and 6LOWPAN. As shown as an illustrative scenario , some of the protocols will be supported by the gateway device, while some other protocols might not be. With CoT, this problems is going to increase, specially because of mobile cloud computing accessibility. With smartphones and tablet computers, when vari- ous healthcare service and other sensors based applications are accessed, protocol support is going to play an important role. It all depends upon the gateway as well as the sensor being used. From the user's perspective, cheaper or easily available sensor would be a preference. Consequently, it cannot be guaranteed whether a newly added sensor will be successfully configured or not. One of the solutions to this kind of problem is mapping of standardized protocols in the gateway.

**- Energy Efficiency :** With the omnipresence of sensor networks and their connectivity with the cloud, this will inevitable lead to a lot of data communications, which consumes a lot of power. A typical wireless sensor node is composed of four components : sensing unit, processing unit, transceiver, and power unit. In case of video sensing, video encoding and decoding, power plays a vital role. Normally, video encoding is more complex,as compared to decoding. The reason behind this is that for efficient compression, the encoder has to analyze the redundancy in the video . It is not going to be suitable to have a temporary power supply, like batteries and have to replace them every now and then. With billions of sensors and low power devices, it is beyond possibility. Having efficient usage of energy and rather permanent power supply would be required. There should be means for sensors to generate power from the environment, like solar energy, vibration, and air . Likewise, effective sleep mode can be very handy in this regard as well. Another solution presented in is bringing cloud resources locally, known as Fog Computing. Fog refers to a localized cloud, which can be used for process offloading purpose for the underlying IoT devices.

**- Resource Allocation :** When IoTs of entirely different and unexpected things would be asking for resources in a cloud, resource allocation would be a challenge. In fact, it would be very difficult to decide how much a particular resource may be required by an entity or a particular IoT. Depending upon the sensor and the purpose for which sensor is being used, the type, amount, and frequency of data generation, resource allocation has to be mapped. Sending a sample packet from the newly added node can also be useful. One of the solutions is to bring a middleware, like Broker or Fog , which can perform all the resource management. Resource management algorithms can be implemented on the middleware and all the underlying devices are handled accordingly. With CoT, devices are going to communicate with the cloud. Therefore, cloud resources can also be managed at middleware layer.

**- Identity Management :**Communicating nodes over the Internet are identified uniquely. When objects are becoming part of Internet (IoT), they also need a unique identification. Similarly, in case of mobile devices, like mobile sensor nodes on vehicles, tablet computers, smartphones, and other objects, need to have identity mapping in the new network they have just entered. With CoT, the sensors become ubiquitously available, making identity more of a concern. Since IPv6 address space is believed to be enough to support even this kind of ubiquitous networking, assigning IPv6 addresses can be more than a reasonable way in this regard.

**- IPv6 Deployment :** If IPv6 is to be used for the identification of communicating objects, then formal deployment of IPv6 would also be an issue. Unless a proper, standardized, and efficient mechanism of IPv4–IPv6 coexistence is adopted, objects being assigned IPv6 would be of no great benefit. Since IPv4 and IPv6 are not directly interoperable, they have to be made to coexist. Most common mechanism is this regard is tunneling, but it incurs loss of data, because of heterogeneous fields in the headers of both of these IP versions . Tunneling also bears additional overhead of encapsulation and decapsulation, which may affect delay sensitive applications.

**- Service Discovery :** With Cloud of Things, the cloud manager or broker has the responsibility to discover new services for the users. In IoT, any object can become part of it at any moment and can leave the IoT at any moment. As mentioned earlier, IoT will also be consisting of mobile nodes. It would be an issue to discover new services and their status and update the service advertisement accordingly. For complex and bigger IoTs, there may be a need of IoT manager as well, which can handle the responsibility of managing the status of IoT nodes, track mobile nodes and keep the updated status of existing nodes and newly added nodes of its IoT. A uniform way of service discovery would be required for this purpose.

**- Quality of Service Provisioning :** As the amount of data increases and the type and unpredictability also comes into play, QoS becomes an issue. At any moment, any type and amount of data can be triggered. It may also be an emergency data as well. Dynamic prioritization of the requests would be required on the cloud side . QoS would mostly be measured in terms of bandwidth, delay, jitter, and packet loss ratio . Depending upon the type of data and its urgency to be sent to the sync node, QoS must be supported. A dynamic end-to-end QoS provisioning mechanism, using the Flow Label of IPv6 and Multi-Protocol Label Switching (MPLS) is discussed in

**- Location of Data Storage :** Location also matters for critical and latency or jitter sensitive services. Time sensitive data, like video, should be stored at the closest possible physical location to the user, so that delay is minimized. For multimedia data, nearest possible virtual storage server must be allocated. depicts an illustrative scenario .

**- Security and Privacy :** Security and privacy will become more of an issue with the kind of ubiquitous computing we are going to have in future. Data security would be an issue on the IoT side as well as on the cloud side. Similarly, in terms of privacy, more concern would be there. On Feb 01, 2013, it was read on The Independent , stating, "British internet users' personal information on major 'cloud' storage services can be spied upon routinely by US authorities". Thus, sensitive or private data must also be stored in a virtual storage server located inside the users country or trusted geographical domain, which can be a friendly country as well

**- Communication of Unnecessary Data :** When anything would be able to connect to the Internet and generate data, there is a possibility that at some stage it is no longer necessary to upload the data to the cloud or sync device.data to be sent. This kind of a gateway, we may call it 'smart gateway' would help in better utilization of network and cloud resources[2].

## 2.4 Conclusion :

In this chapter, we have touched on the concept of cloud computing, types of cloud services and their characteristics, as well as the concept of cloud of things (CoT) resulting from the integration of the Internet of Things with cloud computing to provide an improved and more useful service to the user and the effective use of resources. This integration includes some major challenges, so that The Internet of Things needs the cloud to store and process data, just as the cloud needs the Internet of things to deal with the real world to meet user needs.
In the next chapter, we will present a smart home design proposal based on cloud computing for connected things.

# Chapitre 3

# DESIGN

## 3.1 Intrduction :

In this chapter, we will work on proposing a design for a monitoring and control system in a smart home based on cloud computing for connected things, with the aim of protecting the home from a gas leak, a fire, or an attempted robbery. We will also see some similar works and their problems. A design modeling of this system will be designed using UML

## 3.2 Some similar work :

We'll take a look at using the Internet of Things in the smart home with or without the cloud

### 3.2.1 Using the Internet of Things in the smart home without the cloud :

In this thesis [14], which is titled A ZigBee-Based Home Automation System, an intelligent control system based on Internet of Things technologies has been created. This smart home control system uses an intelligent central controller to create a wireless frequency sensor and actuator network (WSAN). A series of controllers, such as switch modules and radio frequency controllers, are developed in WSAN in order to directly control various home appliances. Client computers, application servers, tablets or smartphones can also connect to the smart central console through a wireless router through the Wi-Fi interface. Since it has a WSAN as the lower control layer, a device can be added to or removed from the control system. The intelligent control system includes monitoring, appliance control and management, home security, statistics and energy analysis functions.

### 3.2.2 The use of the Internet of Things in the smart home by the cloud :

In this thesis [25], titled Creating a smart home based on integrating the Internet of Things with web services and cloud computing, a smart home system is created by integrating the Internet of Things (IoT) with web services and cloud computing, so that this system works by focusing on integrating intelligence into sensors and devices of smart network objects using Zigbee technology, and facilitating interactions With smart objects using cloud services and improving the efficiency of data exchange using the JSON data format. This system was implemented using the Arduino board as a microcontroller board to program different types of sensors and actuators and communication technologies such as RFID and ZigBee and in addition to cloud computing that allows us to save storage resources and computer to implement web applications.

In this thesis [17], a smart home framework using an airtight application protocol was proposed that allows a method to control sensors and actuators remotely. A smart home infrastructure that can be monitored and controlled online using CoAP has been proposed. Since wireless sensor nodes are limited devices in terms of processing power and memory, appropriate technologies must be used to achieve the specified Contiki OS. In addition, an empirical evaluation is carried out to obtain suitable protocols for MAC layer and RDC for Contiki OS MAC layer. Variable size, stack and application optimization to match the firmware is done in the sensor nodes memory.

In [17] [25] in terms of the architecture used, whose main and important limits relate to the static structure of the system design levels. There is also no cooperation between the structure and components of the system. In addition, the objects are heterogeneous due to the presence of different devices, and it can be said that they are not independent.

## 3.3 Description general of the système proposal :

### 3.3.1 Definition of smart home :

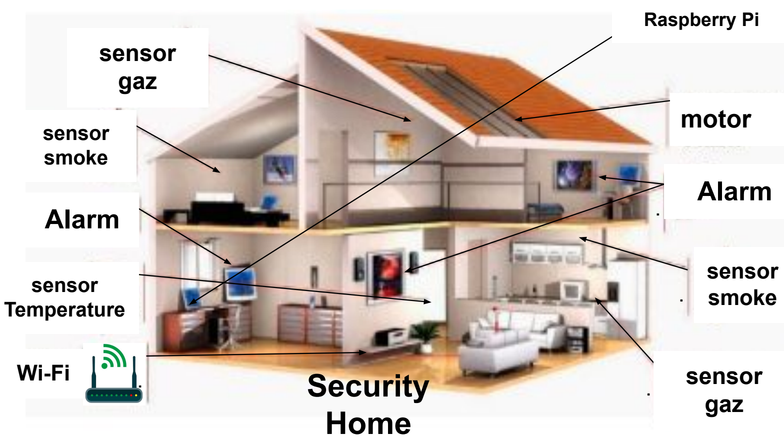


FIGURE 3.1 – Home security system

A smart home means that the home contains a smart home system that communicates with devices to complete specific tasks, and anyone can use the smart home system to program many of its tools, such as setting and monitoring the home security system and cameras, or alerting the presence of a fire or controlling devices such as the refrigerator, air conditioner, or The heating. Devices in a smart home are connected to each other via the Internet as Figure 3.1 shows, allowing the user to remotely control functions such as safe access to the home, temperature and lighting. It also has many advantages, including the following :

- Increase comfort and save time.

- Complete control with just one device.

- Sending notifications in the event of a problem or danger.

### 3.3.2 Objective :

To design this proposed system, we must rely mainly on cloud computing in order to store, analyze and visualize data and information collected from sensors, as well as our business and the ability to collect data from heterogeneous types of sensors and send them to the cloud for management and analysis for users who obtain them from By notice of the proposed system..

## 3.4 The method used in the design :

The Unified Modeling Language (UML) can capture a stunning array of processes and structures related to business and software. UML has such power that a modeler can use it for the general architecture of any construction that has both a static structure and dynamic behavior. A project can rely on UML as the standard language to express requirements, system design, deployment instructions, and code structure. The UML practitioner can capture ideas using visual tools, efficiently share these ideas with others, and effectively respond to change. UML provides a powerful set of tools to capture the lightning of information technology in a bottle. To achieve these wideranging capabilities, the language has features that do not apply in all circumstances. On a project using UML, the modeler will emphasize a subset of the potential diagrams. However, to know which features to emphasize on a project [11].

## 3.5 System Modeling :

To carry out the modeling process for this design, we go through some stages :

### 3.5.1 System Representatives and Tasks :

The proposed system for smart home design consists of four representatives, each of whom has a set of specific tasks, and the tasks may be for specific representatives or common to all representatives, so that the following table defines the representatives and their tasks :

| Actor | Task |
|---|---|
| User | - Monitor the condition of the house<br>- Control access to the house in the event of a risk of gas leakage or fire |
| Gas detector | Detection of a gas leak |
| Smoke detector | Detecting the presence of smoke resulting from a fire or electric spark |
| Actuator | - Receive, read and process data received from the sensors.<br>- Alert about the existence of danger by sending a message to the alarm device |

### 3.5.2 use case diagram :

In UML use case diagram, each use-case is a system function. Generally, a use case is defined as one basic course and several alternate courses in requirement analysis phase. A use-case course describes a sequence of interactions between actors with the system, which is a abstract template of a family of scenarios [20]. The figure 3.2 shows the general case diagram of the system to be designed :

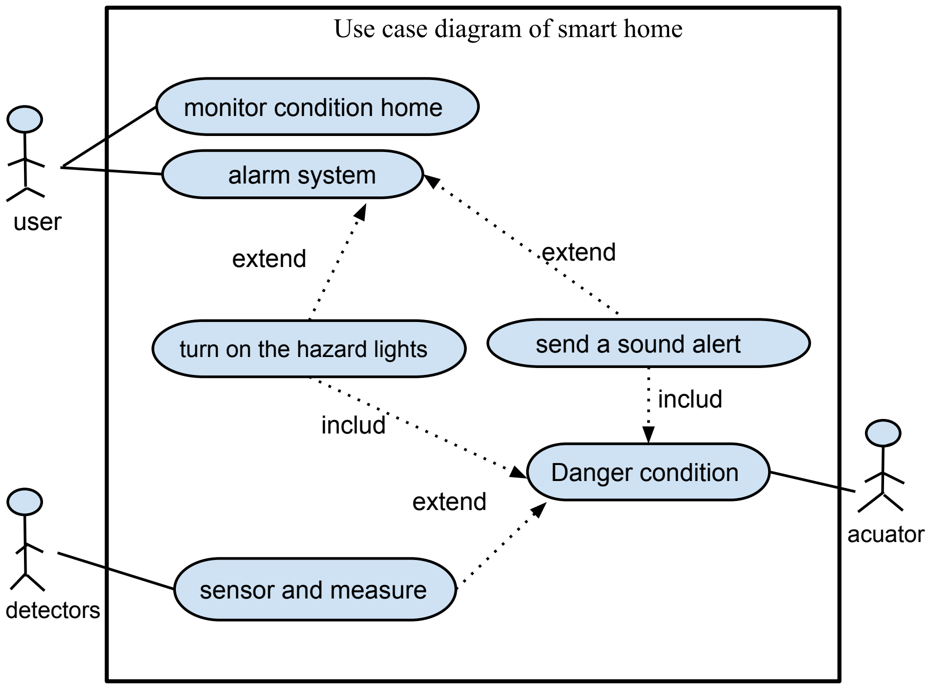


Figure 3.2 – Use case diagram of smart home

### 3.5.3 Sequence diagram :

Sequence diagrams are used to present the dynamic behavior of system design .a sequence diagram shows interactions between objects arranged in a time sequence.an sequence diagram is presented in system design phase to realize the corresponding use case course [20].

### 3.5.4 Activity diagram :

Activity diagrams are used to model and describe a use case. Where the actors involved are identified and the flow of events is described based on the use case diagram, the elements required to fulfill the respective functional requirements and the system responses during its execution are identified. It is possible to identify the objects involved in an activity and determine how their role and state will change[5] .

### 3.5.5 Representation of case, activity, and sequence diagrams :

**- The User :**

In the case of monitoring the system, user is able to :

- Explore the home system

- Receive notifications from the system

- Identify the type of danger.

Figure 3.3 represents the case diagram for the user :

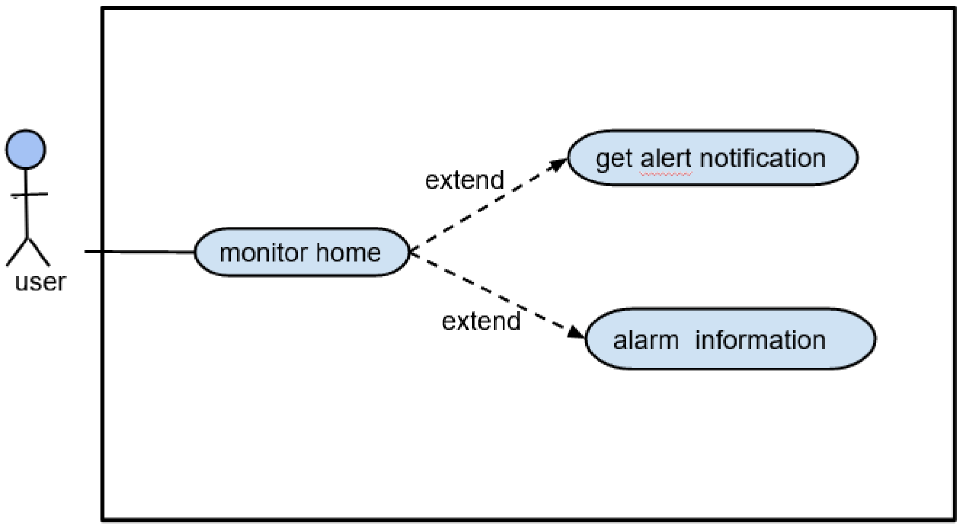


FIGURE 3.3 – User use case diagram

Figure 3.4 represents the activity diagram for the user :

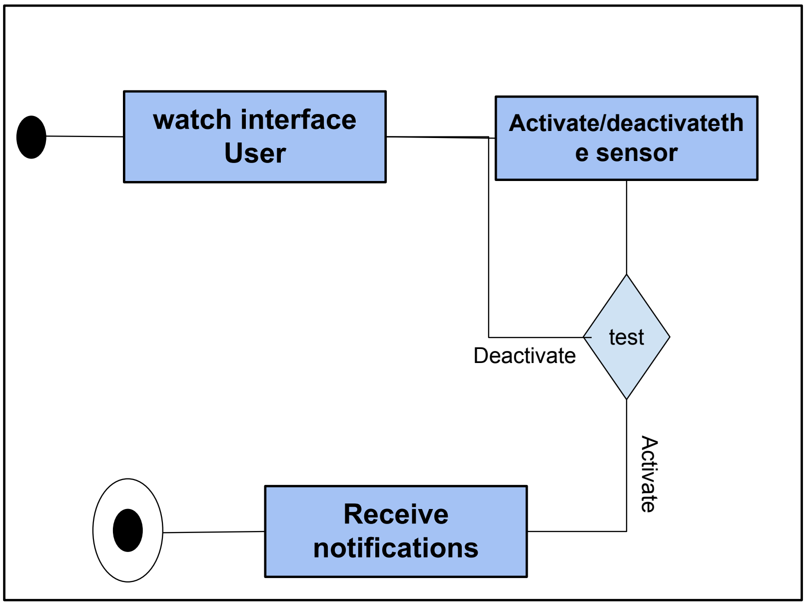


FIGURE 3.4 – Activity diagram for the user :

Figure 3.5 represents the sequence diagram for the user :

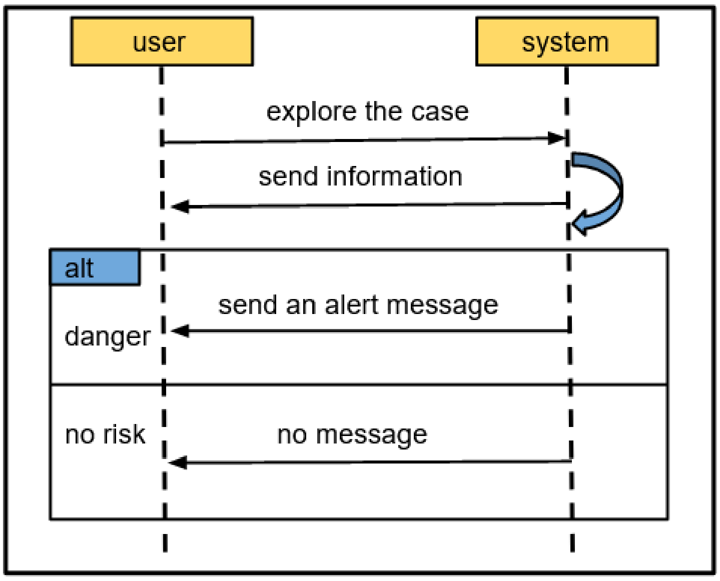


FIGURE 3.5 – User sequence diagram

**- The Detectors :**

In the case of gas sensor :

- Air type change detection

In the case of smoke sensor :

- detect temperature changes.

- Alert when an electric spark occurs.

The figure 3.6 represents the use case diagram for the detectors :

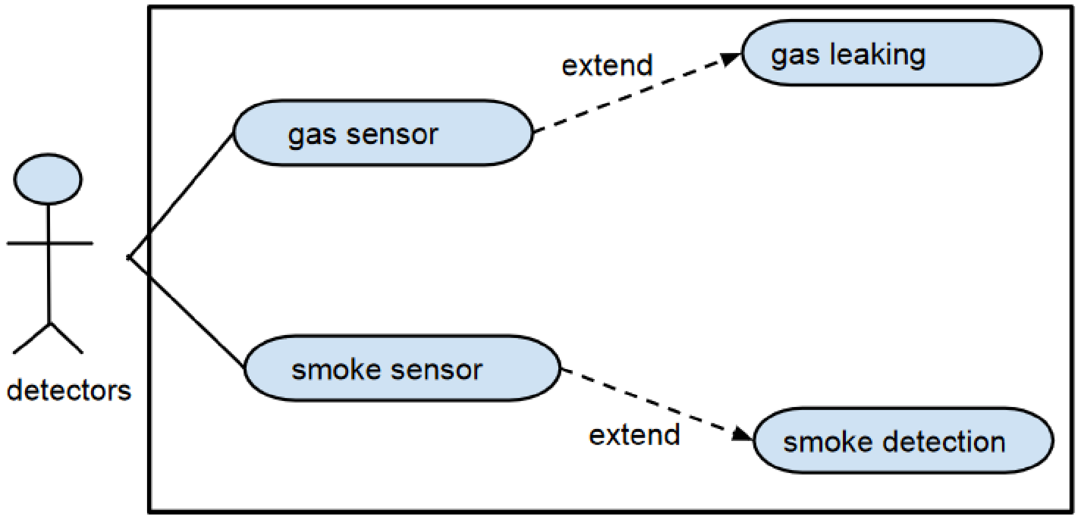


FIGURE 3.6 – Detectors use case diagram

Figure 3.7 represents the activity diagram for the detectors :

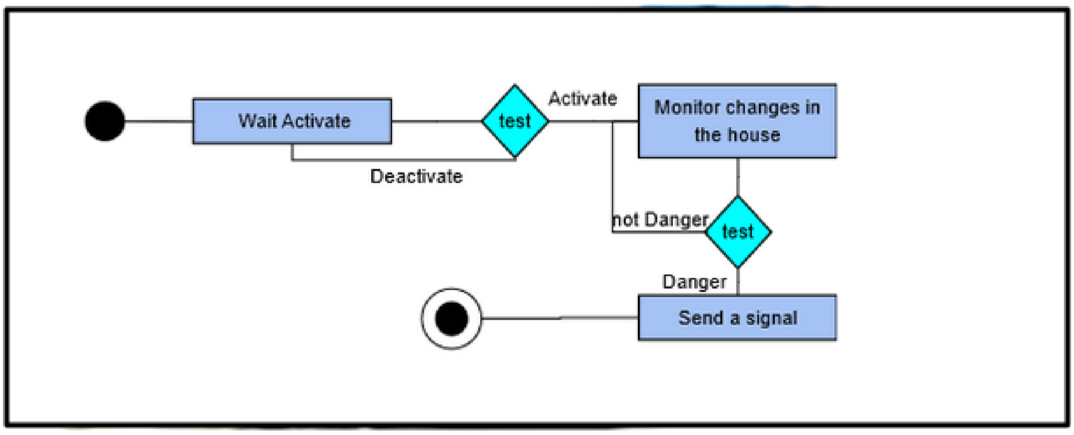


FIGURE 3.7 – Activity diagram for the detectors

Figure 3.8 represents the sequence diagram for the detectors :

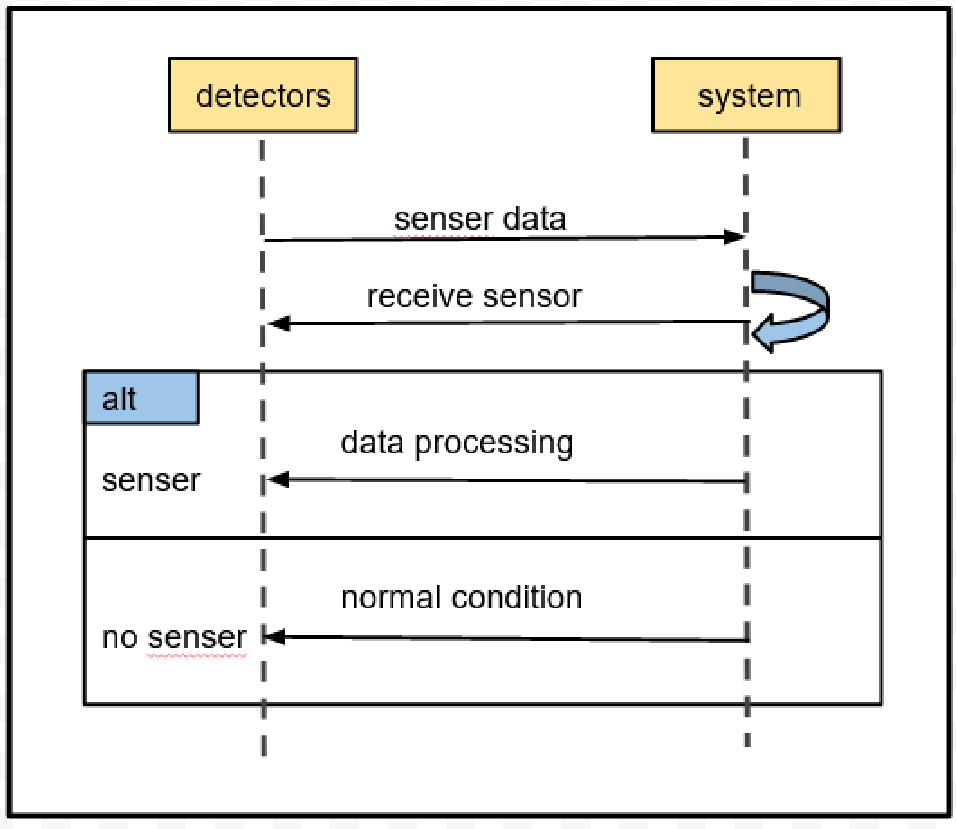


Figure 3.8 – Sequence diagram for the detectors

**The Acuator :**

The figure 3.9 represents the use case diagram for the acuator :

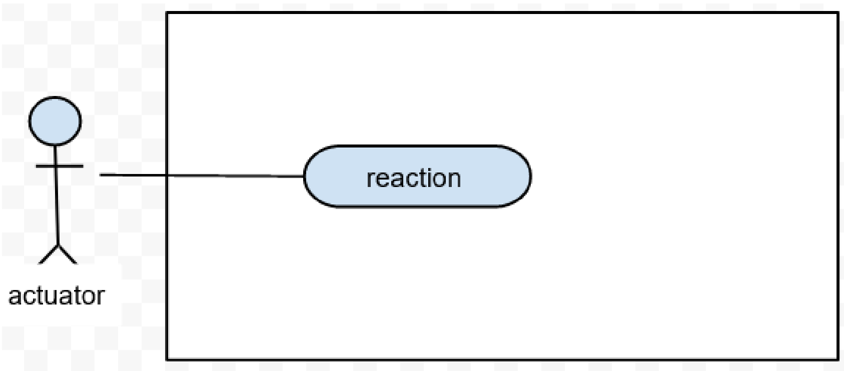


Figure 3.9 – Acuator use case diagram

Figure 3.10 represents the activity diagram for the acuator :

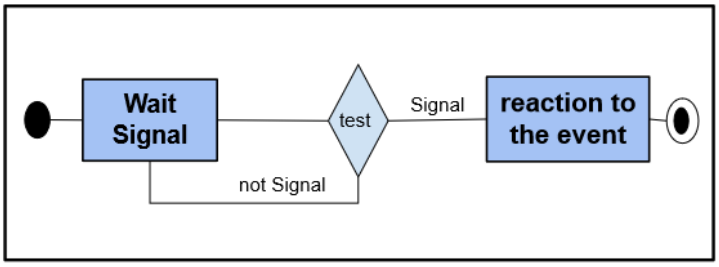


FIGURE 3.10 – Activity diagram for the acuator

Figure 3.11 represents the sequence diagram for the acuator :

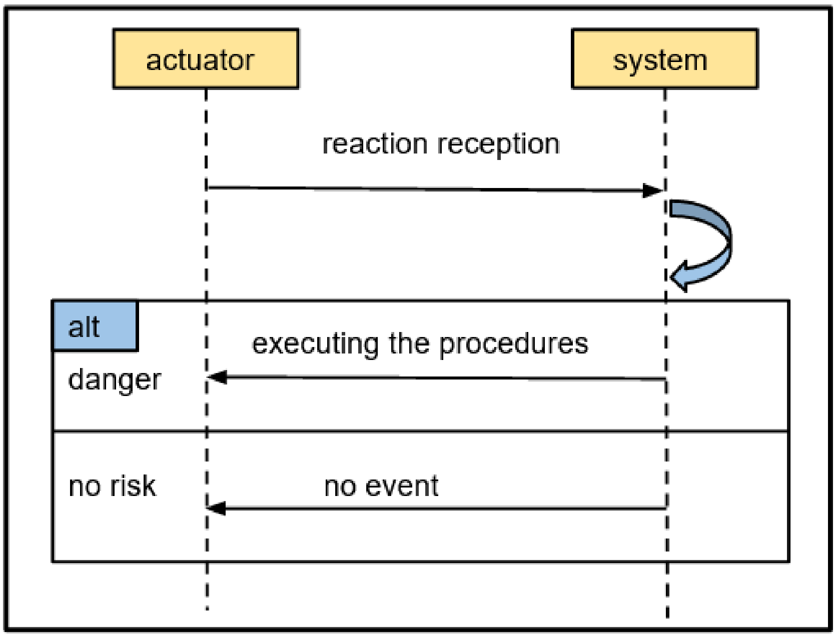


FIGURE 3.11 – Actuator sequence diagram

### 3.5.6 Class diagram

UML class diagrams allow us to model in a declarative way, with a structure that is consistent with the domain of application in terms of concepts and relationships between them [6]. These diagrams are the most common diagrams found in modeling object-oriented systems. In this work we will model the system using class diagram , as the following figure 3.12 shows :

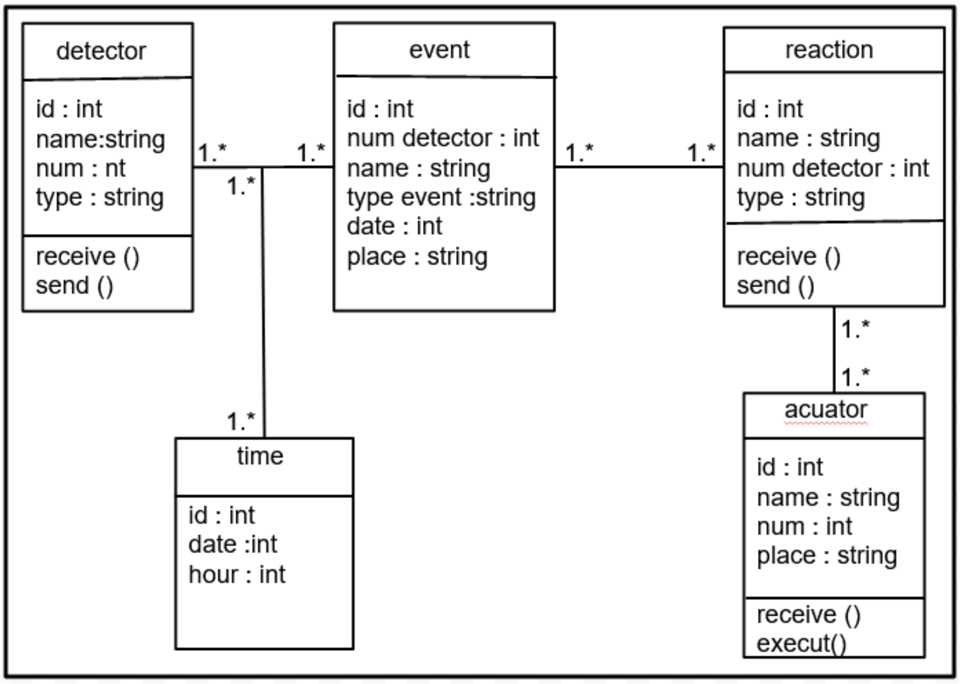


FIGURE 3.12 – Diagram class

## 3.6 Conclusion

In this chapter, we have covered some of the important details that make up the pillars of the project. We proposed a design and architecture for the smart home monitoring and control system using uml diagrams. We made sure to make use case diagrams and activity diagrams for the user system and class diagram from this stage. We move on to the next step, which is achievement step by step.
In the next chapter we will use this proposed design to implement it to ensure the effectiveness of the design.

# Chapitre 4

# IMPLEMENTATION

## 4.1 Intrduction :

In this fourth and final chapter, in which we will provide a definition of the system and give a structure to the system, and define each of the tools and devices used, whether physical or software that the system needs, and how to connect them. We will also implement simulations of the system on the phone and perform By giving the resulting interfaces, then we conclude the chapter with a conclusion.

## 4.2 Introducing the system :

In the process of developing a model for an IoT-based smart home security system. To show the IoT smart home system that can benefit the user and at the same time create a safe environment for the community. The designed system is an IoT-based smart home system security system that is equipped with a series of sensors consisting of temperature, smoke, gas, and motion that are controlled by a Raspberry PI that acts as a device manager. Raspberry PI acts as a command center and connects the system to the Internet. The reason the system uses both Raspberry-PI is simplicity, efficiency, and cost-effectiveness. The development successfully shows that it is possible to improve daily life by efficiently reducing human contact and increasing home security resulting in lower rates of crime and accidents. Besides, using the open source Flutter mobile app platform is proven to be as good as the architecture of other paid platforms as shown in figure 4.1.

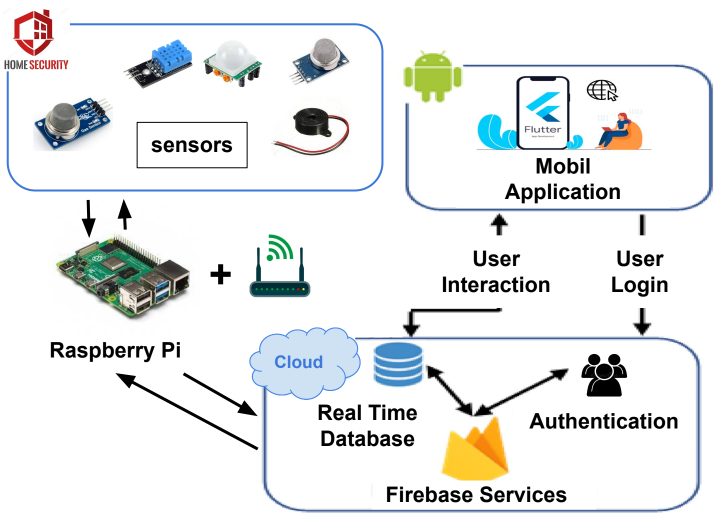


FIGURE 4.1 – Platform architecture system.

## 4.3 Software tools used :

At this step, software is installed used software.

### 4.3.1 Programming language DART :

DART is a programming language used for general purposes, as it is a language directed to purely objects and is easy to use, know programmers and expansion, has been developed by Google in 2011. The customer can also develop fast applications on any platform and can be used to create applications on one page and also aims to provide a platform Especially to support future needs and emerging program and devices and enable programmers to use the facilities provided by the new platforms [16] [26] as shown in figure 4.2.

FIGURE 4.2 – Logo Dart

### 4.3.2 Framework Flutter :

lutter is simply a smart phone application development package or SDK, specifically used for developing user interfaces or UI and using the Dart programming language for back-end programming, one of the most important things that have been focused on .[28]The key to it when developing Flutter is to make it a practical way to develop applications quickly and efficiently, as it is considered a very suitable solution for companies and developers who want to reach users on the Android and IOS platforms with the least effort and cost possible as shown in figure 4.3.

FIGURE 4.3 – Logo Flutter

### 4.3.3 Android Studio :

A platform for writing applications that makes it easier for developers to write the source code of Android applications, and also allows the developer to preview the appearance of his application on various screen sizes in real time during development, and facilitates the development of multilingual applications as shown in figure 4.4.

### 4.3.4 FireBase :

Firebase is a system to work through which mobile applications and web applications can be built for companies that require a real-time database, as well as instant messaging, user authentication, and storage. It is a combination of several Google services in

FIGURE 4.4 – Logo Android Studio

the cloud. It also handles server-side work when doing application development. Maintains harmony between developer and client by causing minimum delays in work [7][19] . Among the most important components or services provided by Firebase when developing a communication or chat application are[7] :

- **Real-time database :** It is a database hosted on the cloud. The data is stored in JSON format and is synced to each linked client continuously.
- **Authentication :** Firebase Authentication provides back-end services, easy-to-use SDKs, and real-time UI libraries to authenticate clients across an application. It supports authentication using passwords, email id or username, phone number, etc.
- **Firebase Storage :** Designed for application developers when storing and serving user-generated content, for example images or any other file. It provides security and protection when moving and downloading documents for Firebase applications. Firebase Storage is also supported by Google Cloud Storage, a storage service. Objects capable, basic and cost-effective.
- **Cloud Messaging :** Allows developers to reliably transmit messages at no cost. By sending notification messages to push user re-engagement and maintenance as shown in figure 4.5.

FIGURE 4.5 – Logo Firebase

### 4.3.5 Python :

Python is just one programming language of many. Just like human languages, there are many different computer languages, such as Java, LISP, PHP, and Perl and...let's not forget C or others, as well as useful things like UNIX scripting. Most languages are good at least one thing – for example, writing easily portable programs is a strong-point for Java and accessing databases and splicing them into webpages is the specialism for PHP. But underneath, all these languages are very similar at the core concept level – most have data in variables and functions (procedures, methods) to do stuff to that data.

Some languages even combine data and functions into bundles called objects, and others like LISP let you treat functions like variables, and vice versa. Python is a powerful, elegant programming language that is easy to read and to understand. It demonstrates most of these features common to lots of other languages and is useful for real-world applications, to boot! It's also free software, has one standard implementation, and a large and friendly community of hackers around it. Once you learn Python, every other language you want to learn should seem pretty familiar[23]..as shown in figure 4.6.

FIGURE 4.6 – Logo Python

## 4.4 hardware used :

At this stage several hardware devices are used for the home security system.

### 4.4.1 Raspberry Pi :

It is a series of small single-board computers (SBCs) developed by the British Raspberry Pi Company, created with the aim of furthering the study of computer science and providing an affordable platform for experimentation and prototyping.

The Raspberry Pi board is the size of a bank credit card and contains a processor, memory, input and output ports, and various connectivity options as shown in **(Figure 4.2)**. It works with the Linux operating system and accepts all distributions, but there is a special distribution for it called Raspberry Pi. It can be programmed using many programming languages, the most famous of which is Python. There are many versions of the Raspberry Pi 0, 1, 3, 4 (the version that we will work with in this project is the Raspberry Pi 3 version).

Raspberry Pi has gained great popularity due to its versatility as it can be used in home automation, robotics, control panels, and IoT systems as shown in figure 4.7.

### 4.4.2 Used sensor :

Sensor as an input device which provides an output (signal) with respect to a specific physical quantity (input).

FIGURE 4.7 – Logo Raspberry Pi

**- temperature and Humidity Combination Sensor DHT :**

It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin (no analog input pins needed). Its fairly simple to use, but requires careful timing to grab data as shown in figure 4.8.

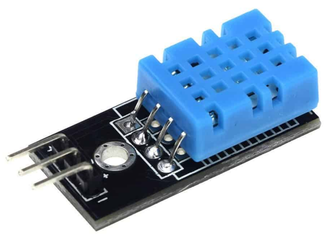

FIGURE 4.8 – Temperature and Humidity Sensor

**- Gaz sensor :**

The MQ-135 is a hazardous gas sensor used for air quality control and is suitable for detecting NH3 (Ammonia), NOx, alcohol, Benzene, smoke, CO2, etc as shown in figure 4.9.


FIGURE 4.9 – Gaz sensor :

**- Smoke sensor :**

The MQ2 sensor is one of the most widely used in the MQ sensor series. It is a MOS (Metal Oxide Semiconductor) sensor. Metal oxide sensors are also known as Chemiresistors because sensing is based on the change in resistance of the sensing material when exposed to gasses. as shown in figure 4.10.

FIGURE 4.10 – Smoke sensor

**- Passive Infrared Sensors (PIR) :**

PIR sensors allow you to sense motion, almost always used to detect whether a human has moved in or out of the sensors range as shown in figure 4.11.

FIGURE 4.11 – PIR

### 4.4.3 Used receptors :

An actuator is a part of a device or machine that helps it to achieve physical movements or external effect

**- Buzzer Alarm :**

Buzzers are electric sounding devices that generate sounds. Typically powered by DC voltage, they can be categorised as Piezo buzzer and magnetic buzzer as shown in figure 4.12.

FIGURE 4.12 – Buzzer Alarm

**- Stepper Motor :**

A stepper motor is an electromechanical device it converts electrical power into mechanical power. Also, it is a brushless, synchronous electric motor that can divide a full rotation into an expansive number of steps. The motor's position can be controlled accurately without any feedback mechanism as shown in figure 4.13.

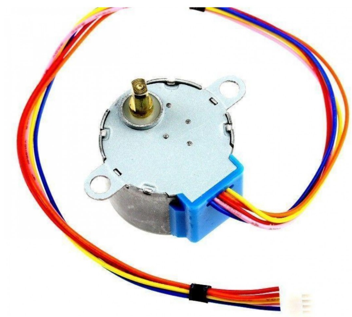

FIGURE 4.13 – Stepper Motor

## 4.5 Making the project( simulator) :

### 4.5.1 - Design the device :

**PIR sensor :**
There are a 3-pin PIR sensor, pin for VCC, output, and ground. The VCC pin is connected to the 5v pin on the raspberry pi, the output pin is connected to the GPIO Raspberry Pi pin, here is connected to pin 7 (GPIO4), and the ground pin is connected to the ground pin on the Raspberry Pi as shown in figure 4.14.

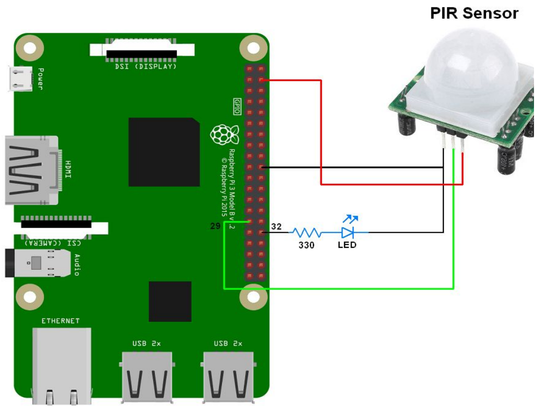


FIGURE 4.14 – Pir sensor with Raspberry PI

**Smoke sensor :**
the MQ2 sensor is connected to the Raspberry Pi. On the MQ2 sensor there are 4 pins namely VCC, ground, analog, and digital pins. Because Raspberry Pi 3 cannot read analog pins from the MQ2 sensor, an analog to digital converter is added as shown in figure 4.15.

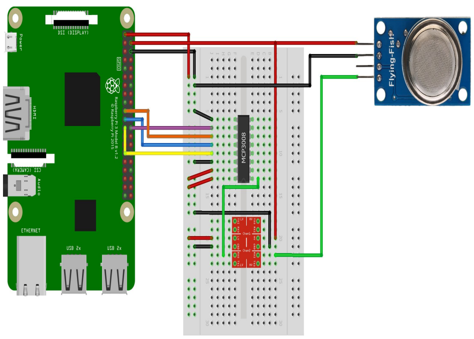

FIGURE 4.15 – Smoke sensor with Raspberry Pi

**Gaz sensor :**
connecting the Raspberry Pi Gaz Sensor which can be seen in Figure 4.16.

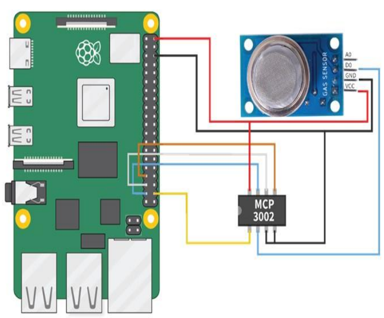


FIGURE 4.16 – Gaz sensor with Raspberry Pi

**Temperature sensor :**
connecting the Raspberry Pi Temperature DHT22 Sensor which can be seen in Figure 4.17.

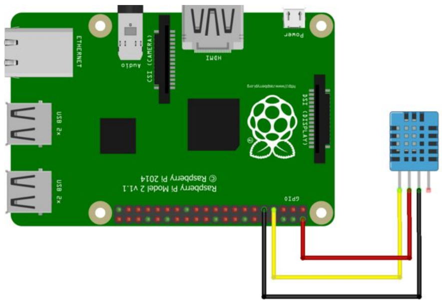

FIGURE 4.17 – Temperature sensor with Raspberry PI

**Stepper Motor :**
connecting the Raspberry Pi Stepper Motor which can be seen as shown in figure 4.18.

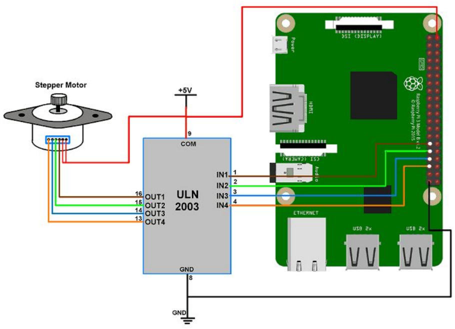


FIGURE 4.18 – Stepper Motor with Raspberry PI

**Buzzer Alarm :**
connecting the Raspberry Pi Buzzer Alarm which can be seen as shown in figure 4.19.

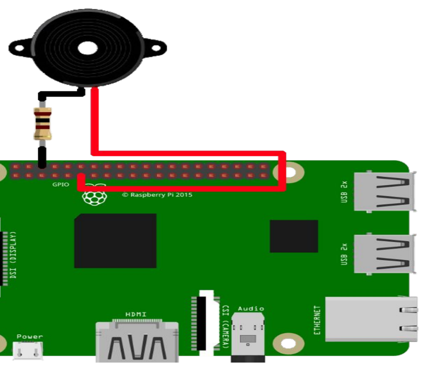

FIGURE 4.19 – Temperature sensor with Raspberry PI

### 4.5.2 - The coding programs :

**Input :** The code in (Fig. 4.10) shows the input declaration, i.e. the sensors declaration. We have announced four sensors, which will be planted in various parts of the house, where We used the RPi.GPIO library as shown in figure 4.20.

```
import RPi.GPIO as GPIO
import time
from firebase_admin import credentials, initialize_app, db

# Initialize variables
vGaz = 0
vSmoke = 0
vTemp = 0
vRip = 0

# Set sensor pins
GAS_SENSOR_PIN = 4
SMOKE_SENSOR_PIN = 17
TEMP_SENSOR_PIN = 27
PIR_SENSOR_PIN = 22
```

FIGURE 4.20 – The code the input declaration

**Firebase :**
Firebase configuration code to connect to the Firebase Realtime Database using the Service Account Key file. This section contains configuration information such as the correct path to the Service Key file and the database link as shown in figure 4.21.

```
# Initialize Firebase
cred = credentials.Certificate(serviceAccountKeyPath)
initialize_app(cred, {
    'databaseURL': databaseURL
})
ref = db.reference('/')
```

FIGURE 4.21 – Firebase configuration code

**Code Temperature sensor :**

Configuration code Connect the Temperature sensor to a Raspberry PI as shown in figure 4.22.

```
# Read temperature sensor data
temperature_value = GPIO.input(TEMP_SENSOR_PIN)
vTemp = int(bool(temperature_value))
ref.update({'vTemp': vTemp})
print("Temperature Sensor Reading:", vTemp)
```

FIGURE 4.22 – Code Temperature sensor with Raspberry PI

**Code smoke sensor :**

Configuration code Connect the smoke sensor to a Raspberry PI as shown in figure 4.23.

```
# Read smoke sensor data
smoke_value = GPIO.input(SMOKE_SENSOR_PIN)
vSmoke = int(bool(smoke_value))
ref.update({'vSmoke': vSmoke})
print("Smoke Sensor Reading:", vSmoke)
```

FIGURE 4.23 – Code Smoke sensor with Raspberry PI

**Code gaz sensor :**

Configuration code Connect the gas sensor to a Raspberry PI as shown in figure 4.24.

```
# Read gas sensor data
gas_value = GPIO.input(GAS_SENSOR_PIN)
vGaz = int(bool(gas_value))
ref.update({'vGaz': vGaz})
print("Gas Sensor Reading:", vGaz)
```

FIGURE 4.24 – Code Gaz sensor with Raspberry PI

**Code pir sensor :**

Configuration code Connect the gas sensor to a Raspberry PI as shown in figure 4.25.

```
# Read motion sensor (PIR) data
pir_value = GPIO.input(PIR_SENSOR_PIN)
vRip = int(bool(pir_value))
ref.update({'vRip': vRip})
print("Motion Sensor Reading:", vRip)
```

FIGURE 4.25 – Code pir sensor with Raspberry PI

### 4.5.3 - Application Interfaces :

Our application consists of several interfaces that the user can use and we will explain them. These interfaces are divided into three types, which I mention below :

**- Sing in Interface :**

interface Sing In to enter the program. This assignment helps the user to save data and the security of the application so that no one can tamper with the settings in your application as shown in figure 4.26.

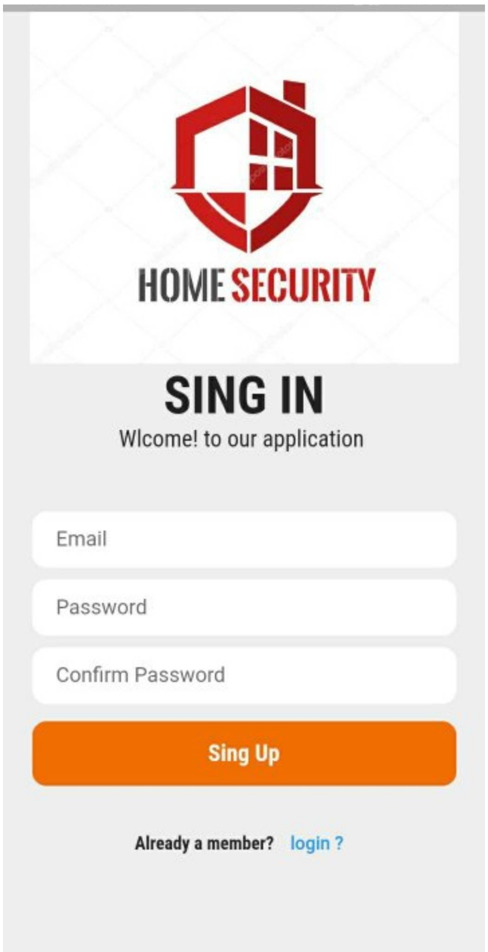


FIGURE 4.26 – Sing in interface

**- Home Interface :**

It is the main interface of the application, and it is the interface through which the user can modify the sensors by activating or deactivating them, and it also displays results from notificationsas shown in figure 4.27.28.

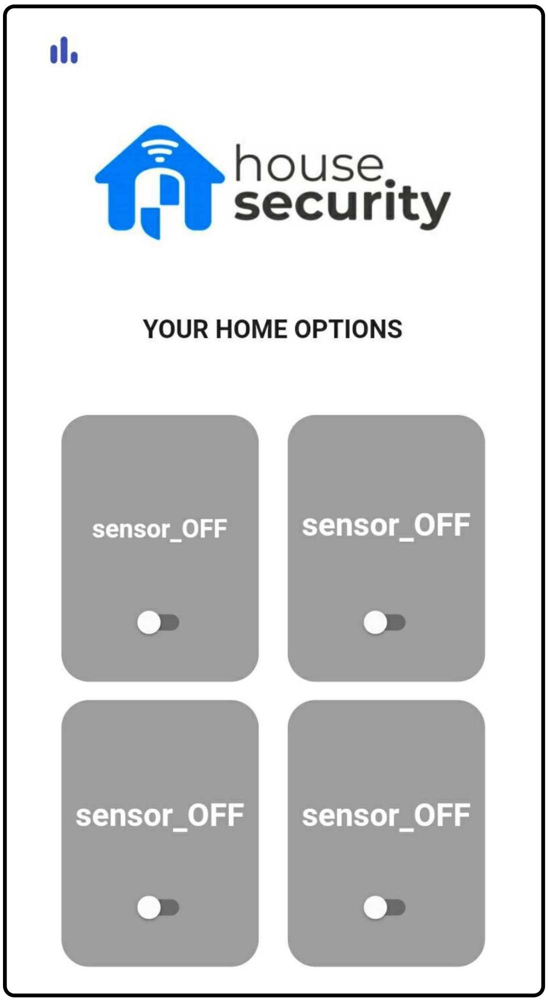


FIGURE 4.27 – Home Interface-1


FIGURE 4.28 – Home Interface-2

**- profile Interface :**
Through this interface, you know who is the owner of the open account in the application so that no application is modified for another person as shown in figure 4.29.

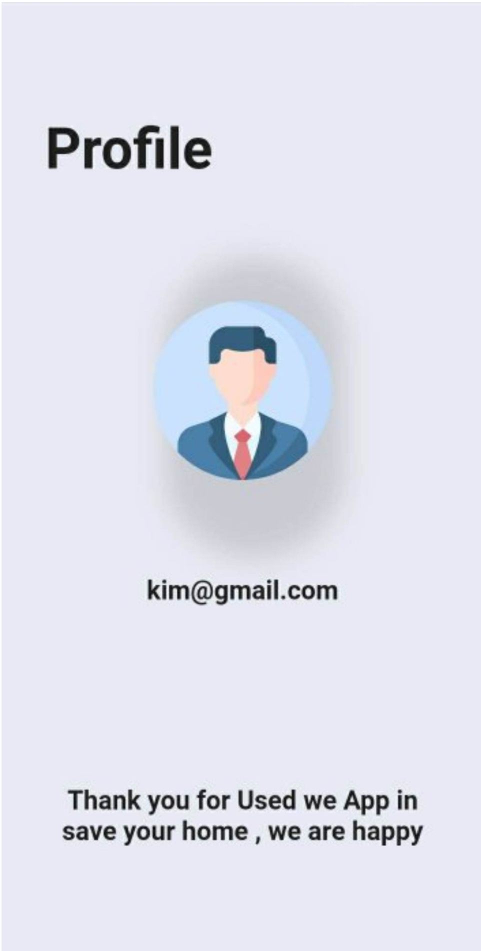


FIGURE 4.29 – profile Interface

## 4.6 Conclusion :

In this chapter, we have seen the steps and stages necessary to implement the system, by providing all the physical devices, whether sensors, connectivity devices, etc., as well as software devices. We have succeeded in doing a correct implementation of the system and giving a good picture of it by showing some interfaces despite the presence of some obstacles

# GENERAL CONCLUSION

New computing is characterized by new areas that represent the trend of technology such as cloud computing and the Internet of Things, which represent the future of information technology and big data that takes a large part of this new computing. However, this requires a system for monitoring, storing, processing and analyzing data, because traditional technologies are insufficient, and no longer allow analysis of the large and disparate volume of data, and the question that arises then is to know how and where this amount of data should be processed, at the level of the object or the cloud, for each It has advantages, disadvantages and limitations. In this work, we propose to design a monitoring system for IoT, and this design relies on cloud computing for its capabilities in storage, processing, and multi-tenancy, to make it easier for system users to control and monitor connected objects.

The system consists of three groups, so that cloud computing works on communication between the user and the system using communication protocols and technologies. This design also includes management of devices that can be of different types, and provides these devices to give more flexibility to users, and we also add real-time monitoring Remote control tools and notification and alert services that are controlled by rules and help provide the necessary protection. Besides, this proposed system can be used in various fields of monitoring and protection such as health care for patients, industrial and environmental monitoring of cities.

During our completion of this project, we invested all our knowledge in programming and what we had learned during the past years. In addition to learning new types of programming languages, and participating in training courses to learn how to deal with hardware for the first time for us, it was a beautiful experience and adventure.

We also encountered some problems in the completion of the required hardware, such as Raspberry PI and accessories, and we tried to compensate for this lack to complete the work, and the lack of experience in dealing with the hardware affected the achievement.

In the future and as perspectives for this work, we will consider the following extensions :

1. focus of our future work on smart home security ;
2. the link of a complete and general model of personnel security ;
3. Exploiting Internet of Things technology to create smart cities and put them on the ground.
4. developing the smart city and contributing to its safety ;

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