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Theme

An approach to monitoring system based on cloud for IoT

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ملخص

في الاونة الاخيرة، ازداد استعمال الكائنات المتصلة التي تعد قلب أنترنت الاشياء هذه الاخيرة دخلت في جميع جوانب الحياة لتسهيل حياتنا اليومية ،وبالرغم من سهولة استخدامها وتكلفتها القليلة الا انها تعاني من عوائق تكنولوجية (كوحدة التخزين الصغيرة و بطء المعالجة ...الخ) .من جهة اخرى الحوسبة السحابية تمتلك وحدات تخزين كبيرة وتستطيع معالجة الكم الهائل من البيانات. ان الهدف من عملنا هو اقتراح نموذج لنظام مراقبة وتحكم مبني على دمج الحوسبة السحابية مع انترنت الاشياء لتقليص القيود والعوائق وتوسيع نطاقها من جهة ،ومن جهة دمج الحوسبة السحابية مع العالم الحقيقي ويكون هذا الدمج على مستوى بروتوكول الاتصال بين البوابة و الحوسبة السحابية والتطبيق وقاعدة البيانات، لاثبات فاعلية النموذج قمنا بتجسيد نظام مراقبة على مزارع الدواجن باستعمال المستشعرات الجوية ولوحة الكترونية أو-اس-بي ٣٢ بتقنية الواي-فاي مدمجة ، من اجل مراقبتها والتحكم بها عن طريق الانترنت باستعمال خدمات الويب امازون .

الكلمات المفتاحية: الحوسبة السحابية ، انترنت الاشياء ، نظام مراقبة ، لواقط

Abstract

Recently, the use of connected objects, which are the heart of the ”Internet of things”, has increased in all areas to facilitate our daily lives. Despite its ease of use and low cost, it suffers from technological obstacles (such as small storage, slow processing, etc.). On the other hand Cloud computing, has large storage units and can handle the vast amount of data ,the aim of our work is to propose a model for a system of control and control based on the integration of cloud computing with the Internet of things to reduce and expand restrictions and barriers on the one hand and the integration of cloud computing with the real world. This integration at the level of communication protocol between the portal and cloud computing, Data, to prove the effectiveness of the model We implemented a monitoring system on poultry farms using air sensors and an ESP32 board with integrated WIFI for monitoring and control over the internet using AWS services.

Keywords: Internet of things,Cloud computing,Sensor,Monitoring system

Résumé

Récemment, l’utilisation des objets connectés, qui sont au cœur de «l’Internet des objets», a augmenté dans tous les domaines pour faciliter notre quotidien. Malgré sa facilité d’utilisation et son faible coût, il souffre d’obstacles techniques (tels qu’un stockage réduit, un traitement lent, etc.). Le cloud computing, d’un autre côté, a de grandes unités de stockage et peut gérer une grande masse de données .Le but de notre travail est de proposer un modèle pour un système de contrôle et de contrôle basé sur l’intégration du cloud computing avec l’Internet des objets pour réduire et élargir les restrictions et les barrières d’une part et l’intégration du cloud computing avec le monde réel . Cette intégration au niveau du protocole de communication entre le portail et le cloud computing, Data, pour prouver l’efficacité du modèle ,nous avons mis en place un système de surveillance sur les fermes avicoles à l’aide de capteurs d’air et d’une carte WIFI intégrée ESP 32 pour la surveillance et le contrôle sur Internet à l’aide des services AWS.

Mots clé : Internet des objets,Cloud computing,capteur ,System du surveillance

Dedication

I dedicate this work to

My mother and father, May Allah bless him. source of my happiness and success in life.

To my brothers, and my sisters

for their unconditional support and encouragements to pursue my interests.

To my extended family and the many friends, who have been so supportive and encouraged

the fulfillment of this work.

To all those who believed in me and pried for my success.

Salah

Dedication

First of all, I thank "ALLAH" the lord of the world

who grants me his guidance and help me to achieve my aim to accomplish my extended essay.

I dedicate this work to whom I owe everything, to my parents, the two candles of my life,

who help and encourage me a lot to succeed in my studies from school to university.

With a great happiness and gratitude,

I dedicate it to my lovely sisters

And my dearest brothers.

To my nephews Abdurrahman, Omar and Dhiaa

and my sweetly nieces Zineb and Fatma Zahraa.

and to all my friends

Finally, I would like to dedicate it to my family and all those I know and love

but I have not mentioned their names.

Azzeddine

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In the name of ALLAH, the Most Gracious, the Most Merciful

we thank ALLAH for his majesty for all his gifts.

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For his patience and support .

Finally, we would like to extend special thanks to all who help us and support us to achieve this aim.

CONTENTS

ABBREVIATION

IOT	internet of thing
M2M	Machine to Machine
XML	Extensible Markup Language
EXI	Efficient XML Interchanges
MQTT	Message Queue Telemetry Transport
AMQP	Average Symbol ErrorRate
HTTP	Hyper Text Transport Protoco
RFID	Radio Frequency Identification
NFC	Near Field Communication
IaaS	Infrastructure as a Service
PaaS	Platform as a Service
Saas	Software as a Service
CoT	cloud of thing
API	application programming interface
AWS	Amazon Web Services

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GENERAL INTRODUCTION

Since the 1990s, the Internet has been integrated and important in our daily lives. It has evolved since that time, from simple static hypertext pages to Internet of content (e-mail, information...), then to Internet of services where services were born, to the Internet of people or what we know as social media where people communicates with one another.

Nowadays , the development of communication technologies increase in number of connected objects to the Internet , this connected objects are embedded systems or microcomputer can be with size of money coin can be integrated in any things in daily life such as freezer , air conditioner ,this is produce the new paradigm of Internet of Things (IoT).

This evolution generate large volume of data storage and transmitting what produced the needed to complementary technologies for meet these needs the cloud computing has many advantages and services, including large storage units and the speed data processing that can be exploited by all people through Internet connection.

This work proposes a design and architecture of monitoring system based on integration of cloud computing with Internet of things to get rid of its limitations such as a small storage and low speed processing and monitoring it remotely .

We divide this work into four chapters:In the first chapter, we describe an overview on Internet of things , in the second one we define the concept of cloud computing , in the third we propose a design of approach for monitoring system based on integration of Cloud and IoT. In the last we implement our proposed approach on case of study .

CHAPTER I

OVERVIEW FOR IOT

Introduction

Today the Internet has more expansion, has touched every corner of the world, and is affecting human daily life in all areas.
We are now entering a new age of connectivity where a very wide variety of things will be connected to the web, We are entering the age of the "Internet of Things"
In this chapter we will give define IoT and characteristics and we will divide smart thing to (sensor and actuators and getaway) and define sensor actuators and we will give characteristics of sensor and types of actuators. The getaway use protocols and technologies for communication and we will describe the most used protocols and technologies then comparison between them, we will explain five layer architecture of IoT and we will give example of most application of IoT, finally we will touch on challenge and future direction of IoT.

1.1 M2M Definition

Before define the IoT we will define the M2M paradigm because They have a great relationship between them:

For[13] Machine to Machine (M2M) is paradigm which in communication is executed without human intervention it use for connecting object to IT core network that communication automatically or on remote request. The communication M2M need to network that acts as access middle.

M2M is in full swing to moving to IoT but it has many challenges that prevent it from matching the IoT M2M uses just 'machines' and the transition from a communication to a view centered around devices[4].

1.2 IoT's Definition

The first define of IoT was coined by a member of the Radio Frequency Identification (RFID) development community in 1999, and it has recently become more adaptive to the real world because of the growth of mobile devices, and ubiquitous communication[19].

The IoT has many definition by different researchers, we will see its most popular definitions :

P.Sethi and al[23] define The Internet of Tings (IoT) as a paradigm in which objects equipped with sensors, actuators, and processors communicate with each other to serve a meaningful purpose.

Atzori and al[5] say that *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.*

With Patel[19] *The Internet of things is a kind of network to connect anything with the internet based on stipulated protocols through sensor devices to conducting information and communication exchange.*

From this definitions we can define the IoT as transform things from the real world into the digital world by sensors device that collect information from the real world such as temperature, light etc, and connect to the Internet by wire or wireless communications to process and store this information.

1.3 IoT's Characteristics

The IoT paradigm has six principal characteristics[24] are:

a) Interconnectivity: the IoT guarantee the interconnecting of anything with the global information and communication infrastructure.

b) Heterogeneity: in the IoT the objects are heterogeneous as based on different hardware platforms and networks. They can interact with other object or service platforms through different networks.

c) Dynamic changes: The state of object change dynamically (sleep, wake up) as well as the context of objects including location and speed. Also, the number of devices can change dynamically.

d) 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.

e) Safety: As traditional network the safety is another characteristics in the IoT technologies,this includes the safety of personal data and the safety of physical well-being. Securing the objects, the networks, the applications and the data streaming.

f) Connectivity: Connectivity its mean the ability of connect, send and receipt data over the network.

1.4 The Thing components

the principal element in the IoT,is also known as connected object is composed into gateway and sensor /actuator in this section we will describe the components of things and its types, then the technologies and protocols used for communication between them :

1.4.1 Sensor

A sensor is a smart devices that converts a physical or chemical measures into a electrical signal[19]

1.4.1.1 Sensor Characteristics

IoT sensors have many characteristics wich are described in[**?**]:

- The ability to take measurements such as temperature, air quality, speed, humidity, pressure, flow, movement and electricity etc.
- a capacity of memory, enabling them to record a certain number of measurements.
- ability to measure the physical property and convert it into electric signal.
- Sensors are grouped according to their objective such as environmental sensors, medical sensors, home appliance sensors.

There other characteristics such as:

- Data filtering
- Smart detection
- Dynamic range
- Limited noise
- Minimum interruption
- Higher reliability

1.4.1.2 Wireless sensor networks (WSN)

Most devices require connectivity to the sensor gateways. This can be in the form of a Local Area Network (LAN), Personal Area Network (PAN) but there is sensors that do not require connectivity to sensor gateways, just using Wide Area Network

(WAN) to connectivity to back-end servers/applications [19] they can cooperate with RFID systems for improve their work. This sensors form networks commonly known as wireless sensor networks (WSNs). wireless Sensor networks are composed of a potentially high number of sensing nodes, and communicating in a wireless fashion. wireless Sensor networks use Special nodes (sinks) for employed to gather results for each device.[7]. Wireless sensor networks (WSNs) provide various useful data and using in many areas such as healthcare, government and environmental services[7].

1.4.2 Actuators

An actuator is a component of a machine that is responsible for moving and controlling a mechanism or system, for example by opening a valve. In simple terms, it is a "mover". An actuator requires a control signal and a source of energy.[16].

1.4.3 Gateways

IoT gateways are specified hardware used to connect the user to the network, allowing the conversion of data between the short distance communication protocols to the traditional communication network. The gateway is supposed to support different types of sensor nodes, multiple communication protocols, both wireless or wired, and provide a set of unified informations for the application or user, making these only responsible for data processing,and has the function with safety protection and prevent outside intrusion.[11][29]

1.4.3.1 Communication protocols

a) WebSocket: is protocol communication it basic from http protocol it provides bidirectional, full-duplex communications channel that operates over HTTP through a single socket.

The WebSocket protocol has two parts(figure1.1) Handshake consists of a message from the client and the handshake response from the server The second part is data transfer , websocket uses TCP as a default transport protocol TLS/SSL for security[25]

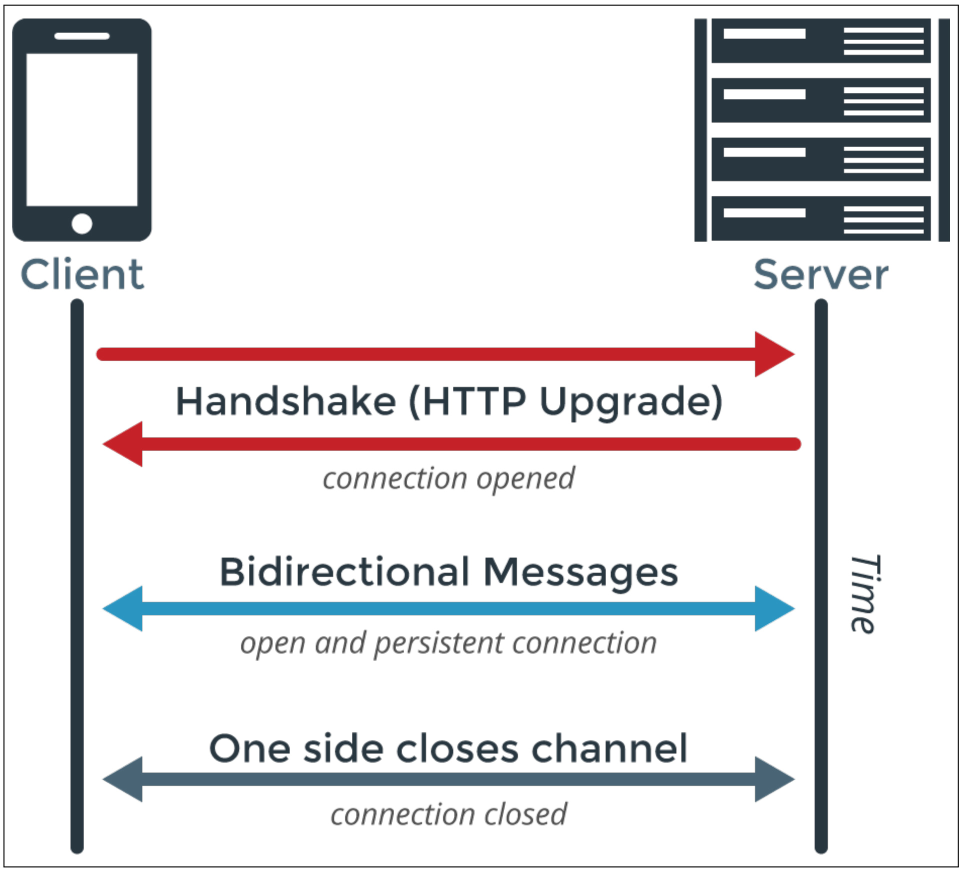


Figure 1.1: The architecture of WebSockets

b) Message Queue Telemetry Transport (MQTT) : MQTT is M2M communication protocols, it was introduced in 1999. And It was developed by IBM[18]

It is provide clients ability to be publishers or subscribers and the server works as a broker to which clients connect through TCP. Clients can publish or subscribe to a topic(figure 1.2). This communication takes place over the broker whose work to coordinate subscriptions and also authenticate the client for security.[23]

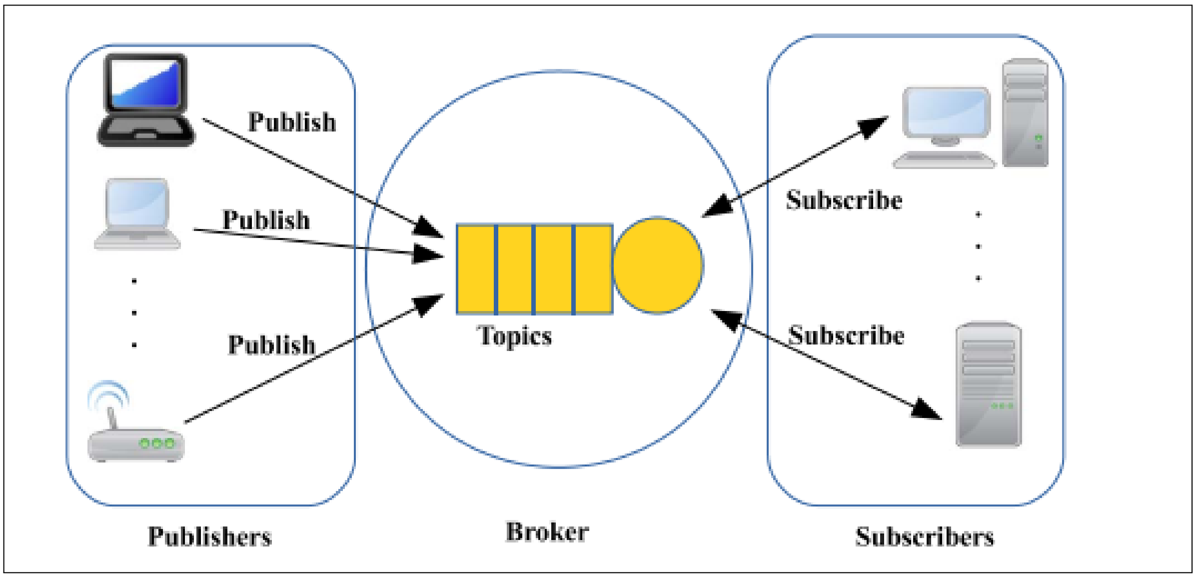


Figure 1.2: The architecture of MQTT[3]

c) Hyper Text Transport Protocol(HTTP): HTTP is a web messaging protocol, it was originally developed by Tim Berners-Lee. Then It was developed by IETF and W3C and published as a protocol in 1997.

HTTP uses request/response RESTful Web architecture. Server sends data through the URI and client receives data over particular URI. HTTP is based to text and don't care about define the size of header and message size.

HTTP uses TCP as a default transport protocol and TLS/SSL for security[18].

d) Advanced Message Queuing Protocol (AMQP) : AMQP is anouther IoT protocol communication, it was developed by John O'Hara at JPMorgan Chase in London, UK in 2003.It able uses both request/response or publish/subscribe architecture for messaging[18].

AMQP communication system requires that either the publisher or consumer creates an "exchange" with a given name and then broadcasts that name. Publishers and consumers use the name of this exchange to discover each other.Subsequently,a consumer creates a "queue" and attaches it to the exchange at the same time. Messages received by the exchange have to be matched to the queue via a process called "binding"[18].

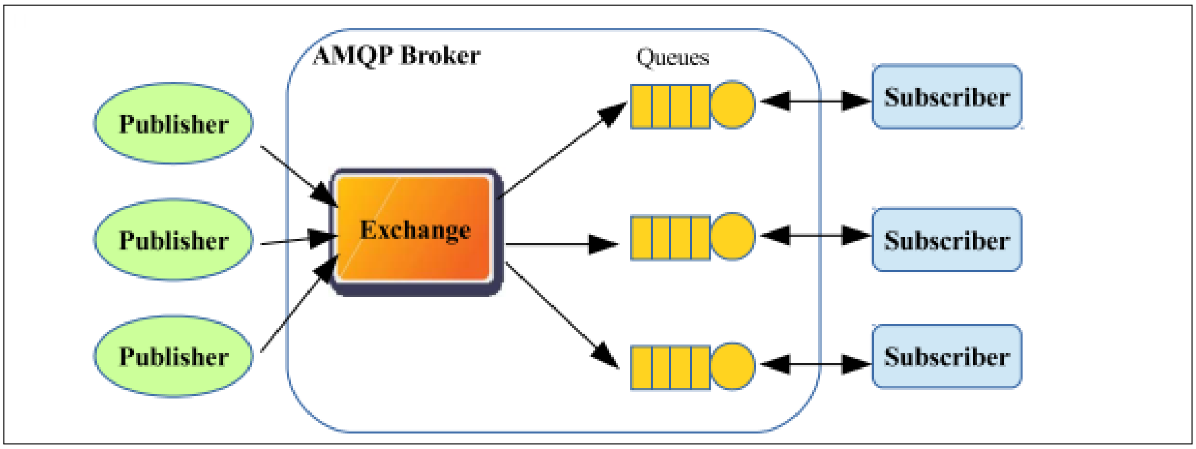


Figure 1.3: The architecture of AMQP[3]

1.4.3.2 protocols comparison

protocols	AMQP	websoket	MQTT	HTTPRest
Transport	TCP/IP	TCP/IP	TCP/IP	TCP/IP
Messaging	Publ/Sub	Request/ Response	Publ/Sub	Request/ Response
Header Size	8 Byte	2 Byte	2 Byte	Undefined
Security	TLS/SSL, IPSec, SASL	TLS/SSL	TLS/SSL	TLS/SSL

Table 1.1: Table comparison between IoT protocols

In the table above we do comparison between the IoT protocols based on transport and messaging protocols,message header size and security algorithm, the AMQP protocol is the most secure because its use many security algorithm but have big header size, Websocket and MQTT are same only different on messaging protocols.

1.4.3.3 Communication Technologies:

There are many technologies such as : Wi-Fi, Bluetooth, Z-wave, RFID and Near Field Communication (NFC).

a) RFID: Radio Frequency Identification is the first Communication technology realized for the M2M concept (RFID tag and reader)[3] it's used to transmit the thing (or person) identity via wireless communication[16].

The range of RFID (10 cm to 200 m) Where The RFID reader can transmits a query signal to the tag and receives a signal from the tag, which in turn is moved to the database for identify objects based on the reflected signals[3].

b) NFC: Near Field Communication (NFC) is a short range wireless technology a distance of (4–10 cm) operates over a frequency band of 13.56 MHz[16] NFC protocol classification into two modes of operation, which are active mode and passive mode. In the active communication mode all devices uses their own energy to produce magnetic fields to transmit the data. In the passive communication mode only device produce magnetic fields and the other devices uses[8].

c) Zigbee: Zigbee another communication protocol was developed by the Zigbee alliance, which works for reliable, The range of Zigbee mostly between (10–100 meter)[23] and most of feature of Zigbee are low cost, low data rate, relatively short transmission range, scalability, reliability, and a bandwidth of 250 kbps[16] Zigbee uses in star, and trees, and can be as a router and mesh[23].

Devices in a Zigbee network classification into three types: FFD (Fully Functional Device), RFD (Reduced Functional Device) and Zigbee coordinator[23].

d) Bluetooth: Bluetooth wireless technology is an inexpensive, short-range (range of 10 - 100 meters.) And generally communicate at less than 1 Mbps and Bluetooth uses specification of IEEE 802.15.1 standard. It is used for creation of Personal Area Networks (PAN). A group of Bluetooth devices sharing a common channel for communication is called piconet.This piconet is able of 2 - 8 devices at a time for data sharing, and that data may be text, picture, video and sound[16].

Parameter	RFID	NFC	Zigbee	Bluetooth
Standard	RFID	ISO/IEC 14443A/B, JIS X-6319-4	IEEE 802.15.4	IEEE 802.15.1
Frequency	125 kHz, 13.56 MHz, 902-928 MHz	125Khz 13.56Mhz 860Mhz	2.4 GHz	2.4 GHZ
Network Discovery	Proximity	P2P	WPAN	WPAN
Data Rate	4Mbps	212 or 424 kbps	250 kbps	1Mbps
Range	200m	10-100cm	10-100m	15-30m
Encryption	RC4	RSA AES	AES	E0 Stream AES-128

Table 1.2: Table of comparison between IoT technologies

1.5 IoT Architecture

There are many architectures proposed by different researchers, the architecture of IoT needs to cover many factors like scalability, interoperability, reliability, security and privacy but generally, the architecture of IoT is divided into five layers:[14].

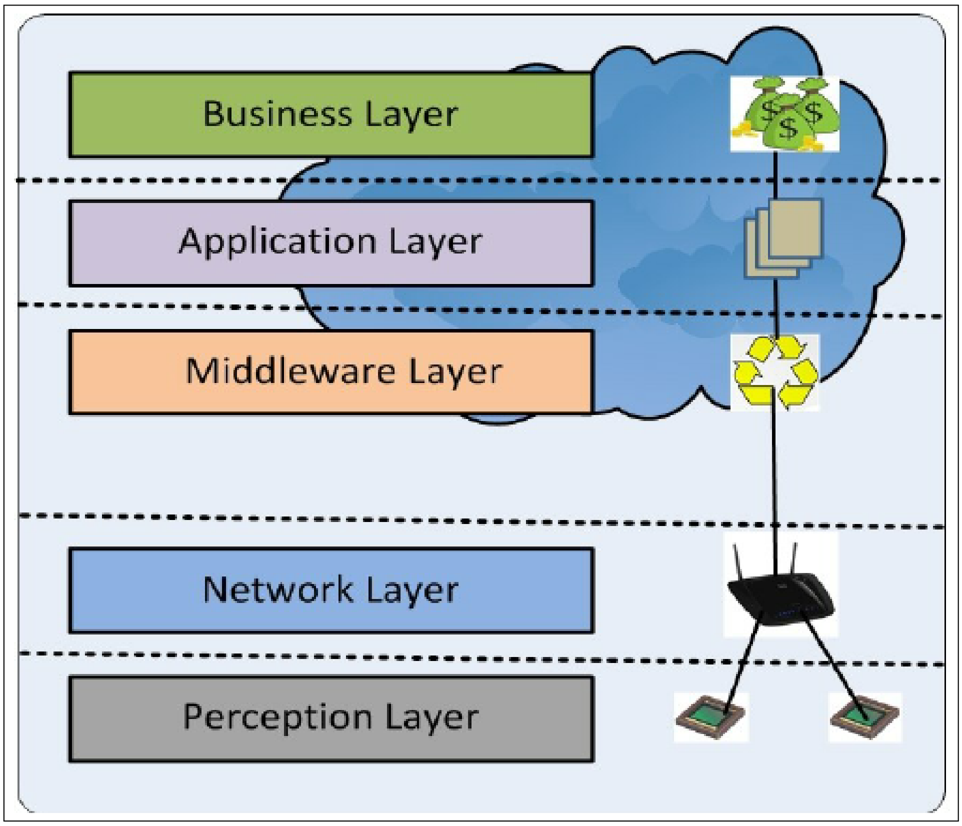


Figure 1.4: Five layer IoT architecture[2]

a) The perception layer is the physical layer, which has sensors for sensing and gathering information about the environment. It senses some physical parameters (temperature, humidity, light. . . etc)or identifies other smart objects in the environment[14].

b) Network layer This layer transfer the information from smart objects to the Middleware layer to processing this information. The transmission medium can be wired or technology or wireless like 3G,RFID, ZigBee,NFC etc[14].

c) The middleware layer It stores, analyzes, and processes huge amounts of data that comes from the transport layer. It can manage and provide a diverse set of services to the lower layers. It employs many technologies such as databases, cloud computing, and big data processing modules[23].

d) The application layer offer the services requested by users. it can give a temperature and air humidity measurements to the user who asks for that data. The application layer covers many areas of life such as Smart home, building, transportation, industrial automation and smart[3].

e) The business layer This is responsible for the management whole IoT system such as the applications and services. It provide business models, graphs, flowcharts etc based on the data received from Application layer[14].

1.6 Application areas of IoT

there are many applications of the IoT, it enter into all areas of daily life such as cities, Environmental monitoring and Health-care etc. Below are some of the IoT applications[19].

1.6.1 Smart cities

we can use the IoT to manage smart cities like a Transport, discovering emergency routes, smart Parking etc.

a) Transport: Smart transport applications can daily traffic management in cities by smart devices and smart processing of information collected by those devices the main aim of smart transport systems is to minimize traffic congestion, ensure and and minimize accidents by properly routing the sensor[23].

b) Smart Parking: The main aim of smart parking is making residents able to identify and reserve the closest available spaces and that is done by real-time monitoring of parking spaces availability in the city[19].

1.6.2 Environmental monitoring

Use in many cases such as weather and water scarcity monitoring etc.

a) Air Pollution Control: The objective of this monitoring is to control carbon dioxide emissions from factories, toxic gases emitted from cars and farms[5].

b) Water scarcity monitoring: The IoT can help to detect the water scarcity at different places in same time by. The networks of sensors, and even be used to alert users about Existence stream of water[14].

1.6.3 Health-care

A lot of are the benefits offer by the IoT to the healthcare domain The most important of these applications medical applications and Dental monitoring etc[5] .

a) Medical applications: The main aim of medical applications is for try to saving lives or improving the quality of life[14].

b) Dental monitoring: By connecting a toothbrush with Bluetooth to give the smart-phone information about the teeth, which in turn sends the doctor to examine that information[19].

1.7 open challenges and future of IoT

Applicate the vision of the IoT in real world is not an easy task because it have lot of challenges that need to be addressed. such as privacy and security, interoperability, scalability, performance etc and the cloud computing integration is most important future directions of IoT.

1.7.1 Security and Privacy

Security another challenge for the IoT application because IoT don't has a common standard or architecture for security[19] and the widely scale usage of the Internet of Things creates a critical challenge about security functions adequately[3] The define of privacy is deeply into our civilizations, is recognized in all legislations of civilized countries[5] And, challenges identified for privacy, are: offer trust and fineness of information in published information models to enable reuse through lot of applications.[19]

1.7.2 Scalability

Number of smart devices in increasing so IoT applications should be scale for to manage this devices and Processing huge amount of data that these devices receive[23].

1.7.3 Performance

Performance is a big challenge of IoT because it is responsible to evaluation Performance of many components and many missions such as processing speed, communication speed,but the lack of a thorough performance evaluation for IoT applications is still an open challenge[3].

1.7.4 Cloud computing

An integration of IoT with Cloud computing it is critical challenge in creation of smart environments or smart cities it needs to be able to combine services offered by multiple stake holders and scale to support a large number of users in a reliable and decentralized manner which is only provided by cloud computing[12].

Conclusion

This chapter has given a brief description of what is the IoT and explain the most principle component of the IoT and the connected thing which composed of gateway and sensor and actuator which have many types and many characteristics, we exposure to the technologies and protocols of communication used by gateway and compare between them by many characteristics and we have explained five layer model architecture, and we given examples for application areas of IoT such as environmental monitoring and healthcare and we touched the most of challenge and future of IoT such as Scalability, Security, Privacy and cloud computing

CHAPTER II

CLOUD OF THINGS

2.1 Introduction

Now days Cloud computing provides elastic services, high performance and scalable data storage for a big daily live increase the number users and resources.Cloud computing systems provide a large scale infrastructure for computing has high performance that is dynamically adapts to the user and the application needs and like we said in precedent chapter Internet-of-Things (IoT) has emerged as a new paradigm with an ever-increasing number of things to be connected to the Internet. Different from the conventional paradigms, so in this chapter we will define cloud computing , types of cloud computing, services models and the most characteristics of cloud . We will see possibility of integrating the IoT with cloud computing and how important is to integrate them , and we will define the most uses platforms and most of challenge in this integration .

2.2 Cloud computing

2.2.1 Cloud Computing Definitions

A number of computing researchers and practitioners tried to define Cloud Computing in different ways. we cite this generic definition from NIST [17] :

Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared configurable computing resources (networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction

2.2.2 Characteristics of cloud computing

Cloud computing provides several salient features that are different from traditional service computing, which we summarize below[28]:

a) Shared resources: the ability provide the services to many users. that's why cloud computing can easily provide the facility like scale up and down the resources on demand[31].

b) multi-tenancy Cloud computing is divided into several layers and each layer Focusing only on the specific targets associated with this layer and therefore making it multi-tenancy[28].

c) Broad network access : it is mean the ability are available over the network and accessed over standard mechanisms that promote use by heterogeneous platforms such as mobile phones, laptops .[31].

d) Flexibility: is Provide computing resources to users quickly, as needed, without human intervention[31].

e) Measured service: cloud computing provide control and optimize automatically resource employment by leveraging a metering ability at a certain level of abstraction favorable to the type of service such as storage, processing, bandwidth, etc. use, control and reporting of resources can be monitored, providing transparency for both users and service providers[17].

f) Self-organizing: The importance of the self-mapping feature of cloud computing is to allocate or de-allocate resources when required and Service Providers are enabled for Manage their resource consumption according to their needs also High agility that enables service providers Rapid response to rapid changes in service demand it is another advantage of self-regulation.[28].

2.2.3 Service Model

The main service model is constituted from three cloud service , known as the SPI model , which stand for software as a service (SaaS) , Platform as a Service (PaaS), and Infrastructure as a service (IaaS)

2.2.3.1 Infrastructure as a Service

User can directly use infrastructure components such as storage,firewall,network[30] also user is able to publish and run software, such as operating systems and applications. The user does not manage or control the implicit cloud infrastructure but has control over operating systems, storage, and publish applications[17].

2.2.3.2 Platform as a Service

providing platform layer resources, such as operating system support and software development frameworks[28] The user's ability is to publish to the cloud Infrastructure created by the user PaaS can not manage or control cloud infrastructure, including network and servers Operating systems, or storage, but has control over published applications[17].

2.2.3.3 Software as a Service

The ability provided to the user is to use the provider's applications running on a cloud infrastructure. The applications are accessible from various user devices through either a user interface, such as a web browser , or a program interface. The user does not manage or control the implicit cloud infrastructure including network, servers, operating systems, storage, or even individual application capabilities[17].

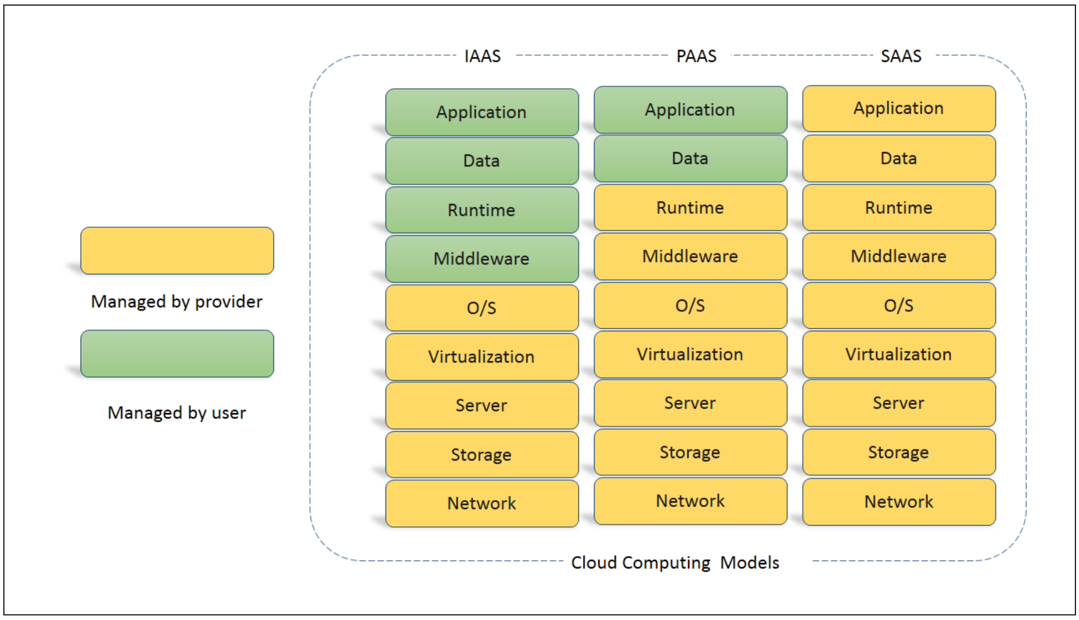


Figure 2.1: Services management by cloud computing model

2.2.4 Types of clouds

There are different types of clouds according to provided service ,some are interested in lowering operation cost, while others may prefer high reliability and security[17].

2.2.4.1 Public clouds

In a public cloud or external cloud since it exists externally to its end user[20] It exists on the premises of the cloud provider[17] Is a cloud in which the resources of their providers are provided like services to the general public.
Public clouds provide many of key benefits to service providers, such as no initial capital investment on infrastructure and shifting of risks to infrastructure providers. Public clouds don't have the ability to control over data, network and security settings[28].

2.2.4.2 Private clouds (local clouds)

private cloud or internal clouds[28] it may exist on or off premises provide exclusive use by a single community cover many consumers . It may be owned, managed, and operated by the organization, a third party, or some combination of them[17].

2.2.4.3 Community cloud

Community cloud is one where the cloud has been organized to serve a common function or purpose. it may be for one organization or for several organizations, but they share their common mission , policies , regulatory,compliance needs and so on a community cloud may be managed by the constituent organization or by a third party[30].

2.2.4.4 Hybrid clouds

A hybrid cloud is a combination of public and private cloud Hybrid clouds provide great flexibility more than public and private clouds. Specifically, they offer control and security over application data Significantly compared to public and private clouds, while still facilitating on-demand [30].

2.3 Cloud of thing "CoT"

Internet of things has some technological limitations such as storage, processing, and networking , which makes them need to take advantage of the practically unlimited resource they possess cloud computing these technological constraints. The cloud can provide an ideal solution for managing and configuring Internet of thing as well as implementing applications and services that exploit the things or data they produce.
On the other hand, the cloud can benefit from IoT by expanding its scope to deal with things in the real world, providing new services in a large number of real scenarios [7].

2.3.1 Integration challenges

Integrating cloud with IoT It is not going to be that simple. t is related to several factors such as Performance Reliability. Big data Energy efficiency Security and privacy that have to be taken care of to allow CoT prevail[1].

2.3.1.1 Performance

Performance of Cloud of thing applications is at multiple levels like Communications, computing and storage aspects The main challenge of performance is access to the cloud

When it is mobility Required services must be performed With high interaction[7].

2.3.1.2 Heterogeneity

Heterogeneity it is critical challenge in Cloud of thing is related to the wide heterogeneity of devices and communication technologies operating systems, platforms of cloud computing , and services available for example IoT is a very complicated because it has a many heterogeneous communication technologies such as RFID ,NFC, Zigbee etc . that lead unable clouds to interact with this heterogeneous modules or communication technologies Cloud computing platforms are also a concern because cloud services come with proprietary interfaces and the integration of resources and custom sorting are properly based on The specific providers are not easy[21].

2.3.1.3 Reliability

Reliability concerns typically arise in the context of smart mobility and publish cloud of thing applications in resource-constrained environments Resulting in many difficulties like networking and communication is often intermittent or unreliable[7].

2.3.1.4 Big data

The number of devices is on the rise will arrive to approx 50 billion will be networked by 2020 this leads to a massive flow of data at the level of cloud computing and store it for long time and perform complex analyses on it. Snugly is a critical challenge[7].

2.3.1.5 Energy efficiency

Energy efficiency it is an other challenge of cloud of thing for example connectivity the cloud computing with sensor networks everywhere will lead to a lot of data communication, which consumes a lot of energy[1].

2.3.1.6 Security and privacy

When IoT applications move into the cloud computing arise many challenges like[7]. Data security is big challenge on IoT side and on cloud side[1]. The system displays several possible attacks[7]. Multi-tenancy can also compromise security because lead information leakage[7].

2.3.2 Cloud of thing platforms

The cloud computing connects devices such as PCs, smart phones, sensors , .etc and can compile resources hosted from these devices by Cloud of thing platforms such as Amazon Web Services, Microsoft, Google, etc[30].

2.3.2.1 Amazon Web Services (AWS)

Amazon dominates the users cloud market. They were the first to Conversion cloud computing into a commodity way back in 2004. Amazon Web Services (AWS) is a groups of cloud services,such as offering cloud-based computation, storage and other functionality that enable organizations and individuals to publish their applications and services on an on-demand basis Amazon Web Services' offerings are accessible through protocols communication like a HTTP, and SOAP etc. Pricing in AWS IoT is based on messages sent and received . Each interaction between a sensors device and a server.Considered as a message. [1].

2.3.2.2 Microsoft Windows Azure

Microsoft is has ability to take their Internet of Things cloud services very seriously because they divide into of three components and each of them provides a specific group of services to cloud users. Windows based environment Responsible for running applications and storing data on servers SQL Azure provides data services in the cloud based on SQL Server .NET Services offer distributed infrastructure services to cloud-based and local applications. The pricing in Windows Azure is done in 4 levels based on how much data your sensors devices will generate. [2].

2.3.2.3 Google Cloud Platform

[1] aws , what is aws? , https://aws.amazon.com/what-is-aws,Last visited:Avril 10 ,2018

[2] Microsoft Windows Azure , Microsoft Windows Azure documentation , https://docs.microsoft.com/azure,Last visited:Avril 12 ,2018

Google Cloud Platform has ability to take their Internet of Things cloud service,by Using services of Google such as processing data , analytics, and machine intelligence Their focus is on making things easy and fast and secure for users , Using this platform also to advantage of Google's private global fiber network to fast to communicate Pricing on Google Cloud is based on time basis. It is usually cheaper than Amazon Web Services Google has its own IoT operating system (based on Android). [3].

2.3.2.4 ThingSpeak

ThingSpeak is open source Internet of Things application and API (application programming interface) based on public cloud for collect data analysis and actuation and storing and retrieving from sensors device which uses HTTP to communicate with Internet or via a Local Area Network. ThingSpeak uses JSON and XML formats for integration into applications. [30].

[3]Google Cloud , overview , https://cloud.google.com/docs/overview,Last visited:Avril 12 ,2018

2.3.2.5 Comparison between IoT Clouds

Cloud Provider	Protocols	Languages and SDK	Pricing	Free/ Trials
AWS	MQTT, HTTP, Web Sockets	Java, Python, PHP, C++	Based on sent messages and accepts	12 month trials
Azure	MQTT, HTTP	Java, Swift, python, C, PHP	Based Generated data	300$ in 12 month
Google	MQTT,HTTP	Java, Python, NodeJS, Ruby, Go, .NET	Based on Time	200$ in 12 month
ThingSpeak	HTTP	Ruby , JQuery	Free	free

Table 2.1: Comparison table between IoT cloud providers

From the table above depending the cost we can conclude that the best cloud is ThingSpeak, but it has limitation with programming languages and platforms, in other side AWS cloud use many communication protocols and support lots of programming language and SDKs, it give 12 month trial license.

2.4 Related works

The application of IoT in monitoring, particularly in environmental monitoring and base on cloud computing , has been addressed in several research papers.

In[26] the author presents a prototype of an Integrated Cloud-Based Wireless Sensor Network (WSN) developed to monitor pH, conductivity and dissolved oxygen parameters from wastewater discharged into water sources. To provide real-time on line monitoring and Internet of Things (IoT) capability, the system collects and uploads sensor data to ThingSpeak cloud via GPRS Internet connectivity with the help of AT commands in combination with HTTP GET method. Moreover, the system sends message alert to the responsible organ through GSM/GPRS network and an SMS gateway service implemented by Telerivet mobile messaging platform. In this prototype, Telerivet messaging platform gives surrounding communities a means of reporting observed or identified water pollution events via SMS notifications.

In[9] design a corrosion monitoring system based on the cloud platform , which combines the electrochemical technology, automatic detection technology and cloud computing technology, so the remote monitoring of grounding grid corrosion is realized. The system can use the Internet to send the collected data to the cloud platform at any time, the relevant personnel can monitor the corrosion status of the grounding grid through the mobile terminal.

Other study[**?**], author designed a smart home system which includes low-cost sensor parts and a finger robot. This system can be used to control home appliances, such as air conditioners to keep the residents in a comfortable environment. Without the need of additional sensors only by using CO2 sensors, this system can provide information such as the room the resident is in, or if he/she is at home or not. As a result, we show a working system and the CO2 sensor is able to judge the position of the resident, and we are even able to understand the movement path of the resident.

This studies have limitation witch the mosts are the absence of access management and domain specification, this studies are only applied on specific domain such as corrosion detection[9] smart home[**?**]

2.5 Conclusion

From this chapter we concluded that both the IoT and cloud computing are complementary because the IoT needs the cloud to store and process data. On the other hand, the cloud needs the IoT to deal with the real world the integration of the IoT with the cloud computing is the ideal solution to meet customers' needs This integration is called cloud of thing Cot and most platforms cot is amazon web service (aws) and Microsoft

Windows Azure ,Google Cloud Platform ...etc and we given the most challenges of this integration such as performance and reliability and security.

CHAPTER III

PROPOSED DESIGN

3.1 Introduction

In this chapter, we propose a design and an architecture of monitoring and controlling system based on cloud computing for the connected things.The modeling of design will be designed using UML

3.2 Objective and motivation

3.2.1 Objective

Our proposed design is based on cloud computing for storing ,analyzing and visualizing data and information collected from sensors ,our works offer the ability of collecting data from heterogeneous sensor types and sending it to cloud for managing and analyzing for users which consult it or get a notification from proposed system .

3.2.2 Motivation

The client-server model introduced in the 1980s offered a central repository for shared data while personal computers and work-stations replaced terminals, allowing individuals to run programs locally. The client / server model is certainly the most used model for building applications and networks. This model has the disadvantage of increasing the traffic on the network and requires a permanent connection. For this, we propose a system that is based on cloud computing architecture for covering client/sever model disadvantages by Cloud computing services in part ,and building generic monitoring system for Internet of things in other part.

3.3 Proposed approach

3.3.1 Description

The monitoring system is system witch to monitor and control specified values depend the requirement of customer or to control an other pre-installed system for collecting information about it's capability , also for visual the evolution of values over time. In our case we give an approach for IoT monitoring system based on cloud computing witch provide to minimize the system hard and software requirement compare to traditional computing paradigm witch need for install all the required software and hardware at every employee's computer. Storing the required software and data on the cloud server is sufficient. This in turn reduces the cost and space (both physical space and storage space) required to install them.

Cloud Computing give the ability to access data anywhere and anytime. While in traditional computing, the user can access his data only on the system in which he has stored it. If the user has to access the data in another system, he needs to save it in an External Storage Medium. This difficulty is avoided in the case of cloud computing, because the only requirement is a system with Internet and Cloud User Interface.

3.3.2 System Modeling

3.3.2.1 Define Actors and Tasks

the proposed approach content for four actors each one have collection of tasks,The tasks may be for specified actors or shared for all actors , the next table define the actors and his tasks:

Actor	Task
Node	• sensing and Sending data to IoTCloud system • Process action request from system
Visitor	• Real-time system view
User	• Real time view of system • Logging System • Exporting data
Supervisor	• Monitoring the IoT system • Controlling the nodes
Administrator	• Manage profiles and roles for all system contributor • Manage and configure the nodes network

Table 3.1: List of Actors and related tasks

3.3.2.2 Global use cases

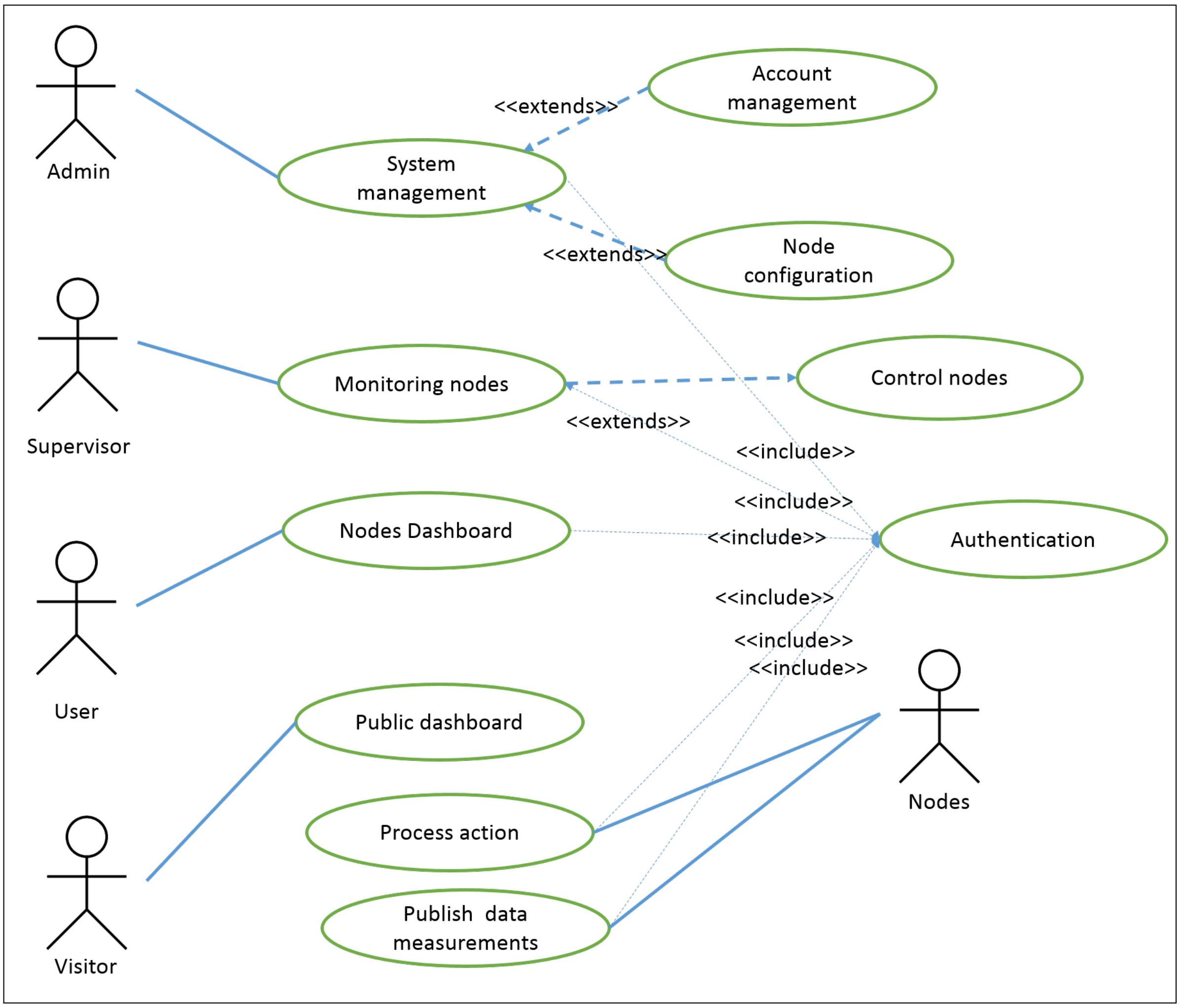


Figure 3.1: General use case diagram

3.3.2.3 Administrator use-case

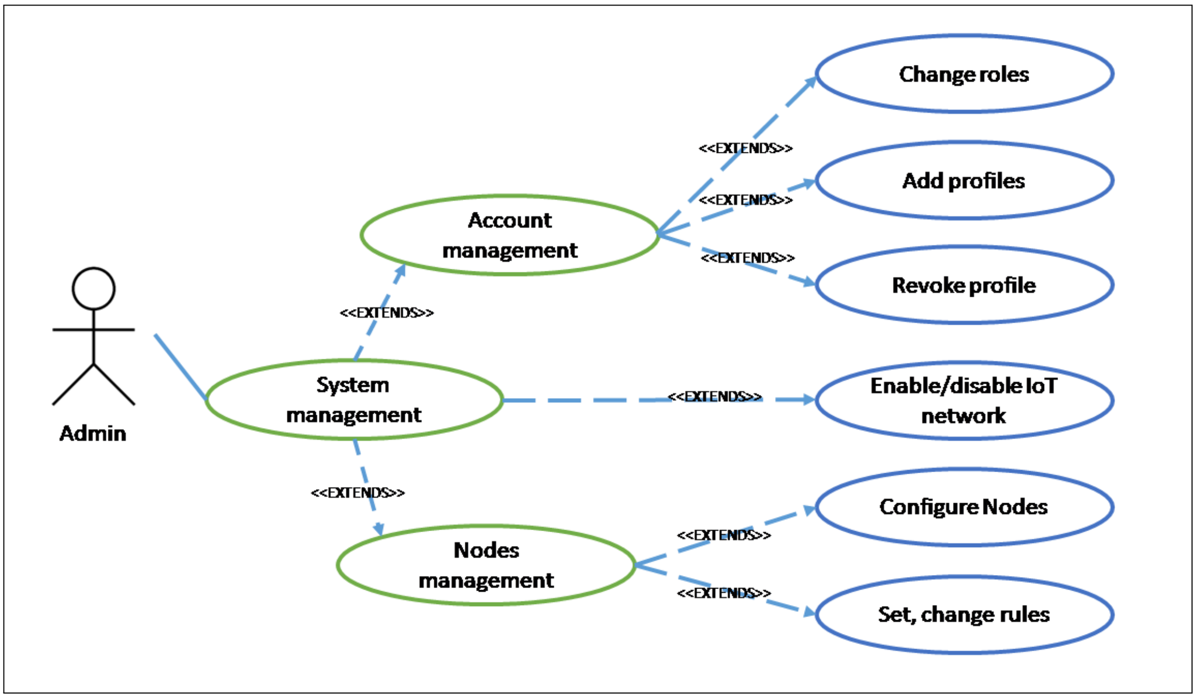


Figure 3.2: Adminstrator use case diagram

- **System management:** build system based on pre-installed sensor network and connect it with the IoT System setup control panel for the system consumer.

- **Node management:** connect a smart object, change its state, set its rule data transmission time ,sleeping and wakeup times.

- **Account management:** in this task the administrator can create user account for new costumer (Supervisor or visitor) and give them their role and privileges.

3.3.2.4 Supervisor use-case

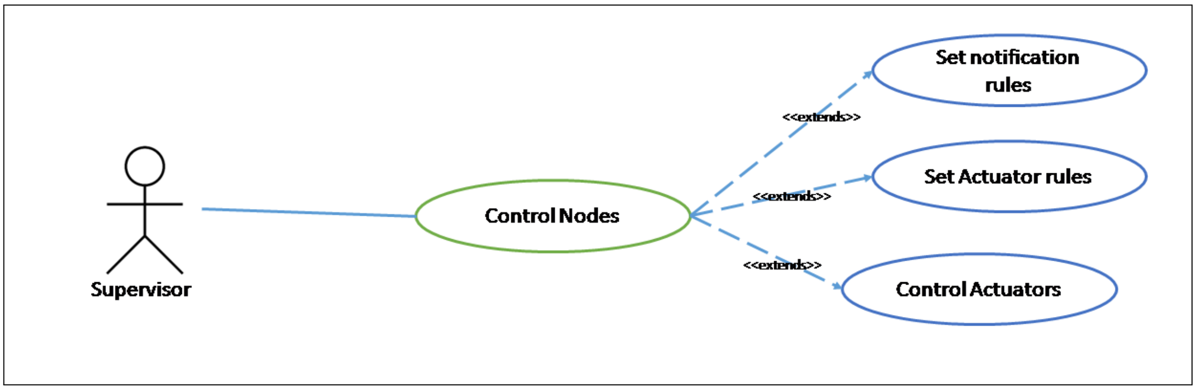


Figure 3.3: Supervisor use case diagram

The supervisor is a type of system consumer witch can do tasks that are permitted by system administrator

- **General control:** control System functionally and setup the reaction of actuators bc setting rules
- **Remote control** control actuator remotely when the action is not automatized
- The Supervisor can work as Visitor, so he can do the tasks of visitor

3.3.2.5 User use-case

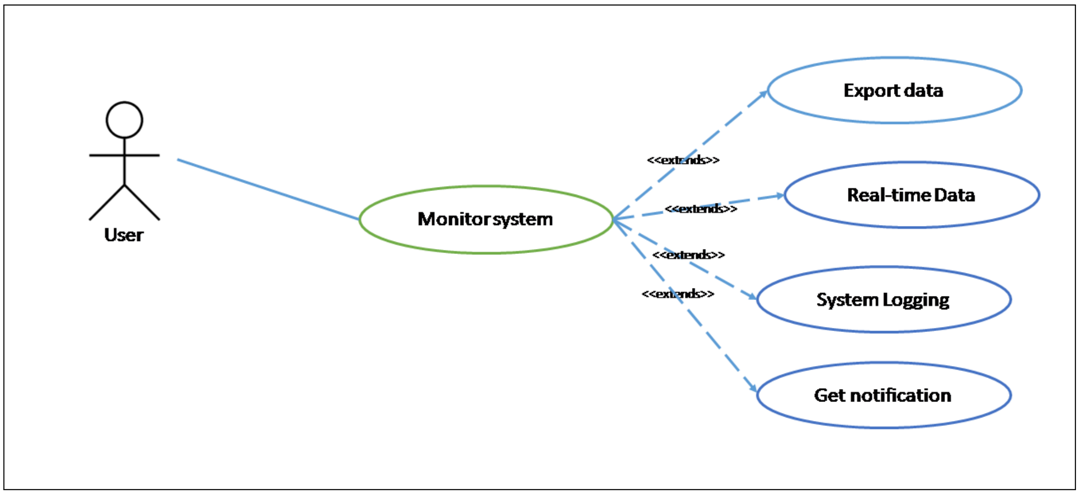


Figure 3.4: User use case diagram

In monitoring system use case the user able to :

- Receipt notification from System
- Make a real time view of system
- explore system logging

3.3.2.6 Visitor use-case

The visitor is the lowest human actuator his privileges are very limited

- Receipt notification from System
- Make a real time view of system
- explore system logging

3.3.2.7 System Sequence

the interaction between the component of system refreing to the action exchange between system entities ,the sequence of interaction is resumed in next table:

Action	Description	Sender	Receiver	Format
authen	Login into system	All actors	system	[id:"id", password:"password",]
authen-true	Accept authentication	System	All actuators	[id:"", password:"", response:"success"]
authen-fail	Refuse authentication	System	Actors	[id:"", password:"", response:"fail"]
command	Invoke an action	System	node (actuator)	[id-rec:"", command:" "]
notif	Send notification to end point and users	System	Users	[id-recv:"id", message:"password"]
rule-conf	Configure rule of notification and reaction	Supervisor, Admin	System	[id-node:"id", rule:""]
send-data	Send data measured	node (sensor)	System	[id:"", password:"", type:""]

Table 3.2: System interactions List

3.3.2.8 Sequence Diagram

A sequence diagram is an interaction diagram that emphasizes the time ordering of messages. it shows a set of objects and the messages sent and received by those objects. The sequence diagrams is used to illustrate the dynamic view of a system[6].

a) Authentication interaction

(1) The Actors(Administrator, supervisor or nodes) send authentication request to the IoT-cloud system

(2) the system receive the authentication data and test it with profiles list

(3) If the Data is accepted (credential) send accepting message to the actors

(4) The actor receive the accepting response and start the other tasks depending his role in system.

(5) if authentication data is false so refuse it and send "Ref-auth" message to the actors

(6) The actor receive the the "refuse authentication message"

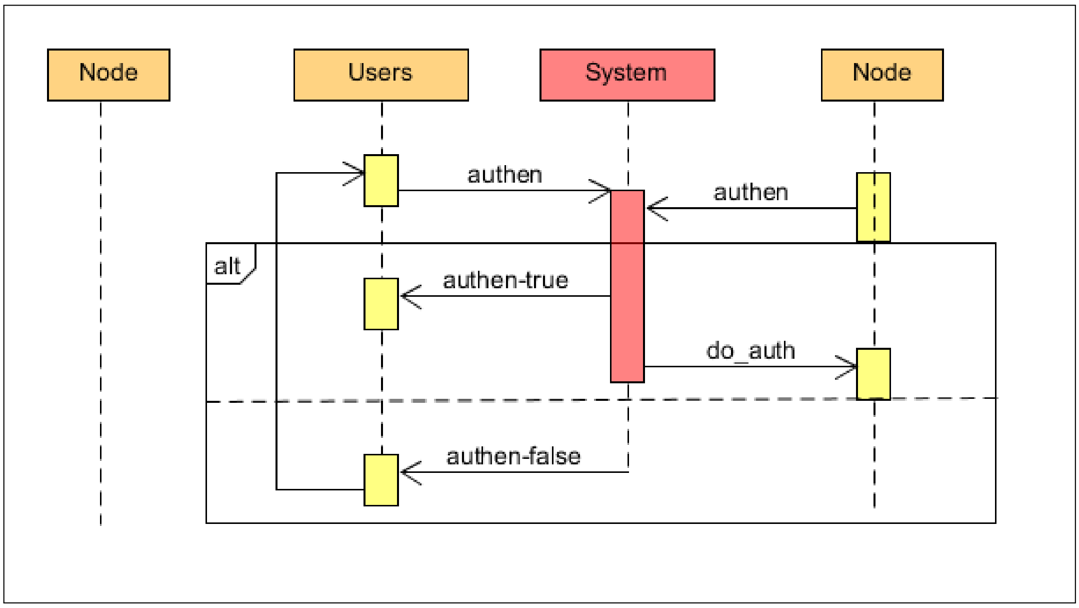


Figure 3.5: Sequence Diagram : case "Authentication"

b) Notify interaction After doing the authentication the interaction of nodes can like below:

(1) The nodes(Exactly the sensor) sensing the environment and convert it to numeric data , then send it to IoT-cloud system

(2) the IoT-Cloud receive the data ,store it,make analytic

(3) If the Data is accepted (credential) send accepting message to the actors

(4) The actor receive the accepting response and start the other tasks depending his role in system.

(5) if authentication data is false so refuse it and send "Ref-auth" message to the actors

(6) The actor receive the the "refuse authentication message"

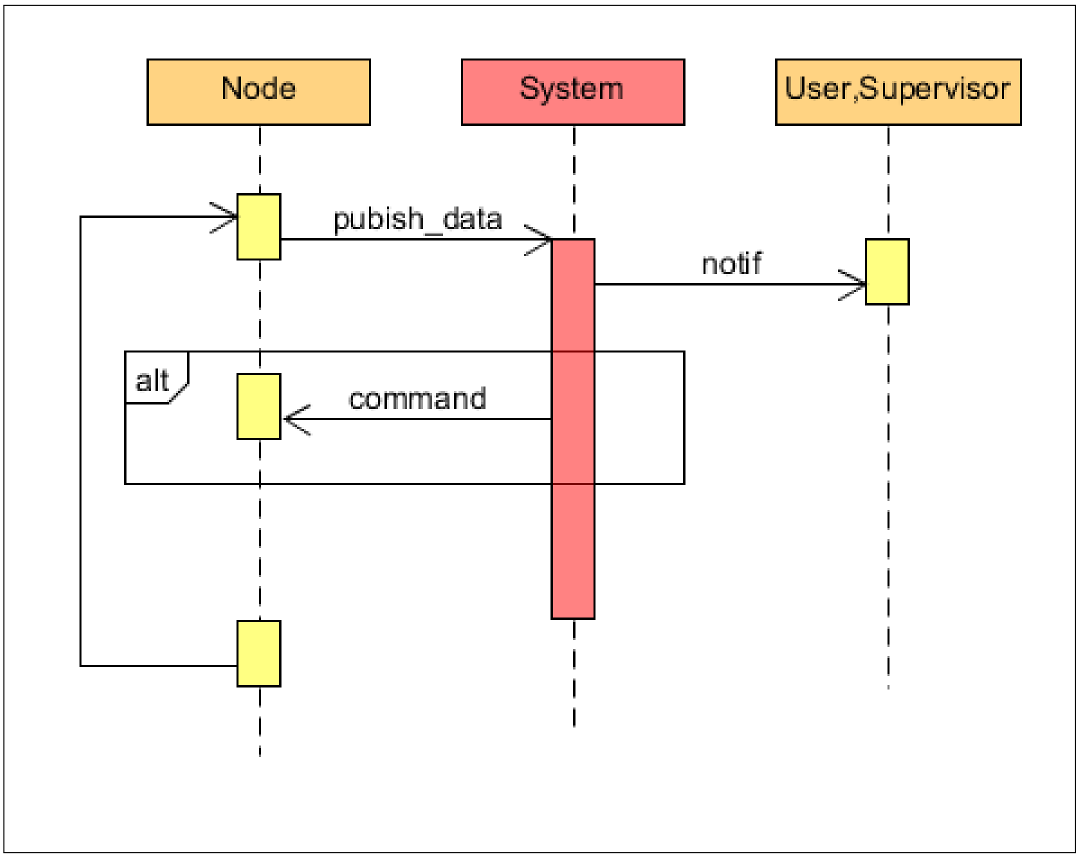


Figure 3.6: Sequence Diagram : case "Notifiy"

c) Control interaction After doing the authentication by supervisor the sequence of interaction listed below :

(1) The supervisor consult the state of system , to decide what need to change and what not

(2) He Send message of command content the job of actor

(3) After node do the job , it reponse to the supervisor about the change in system

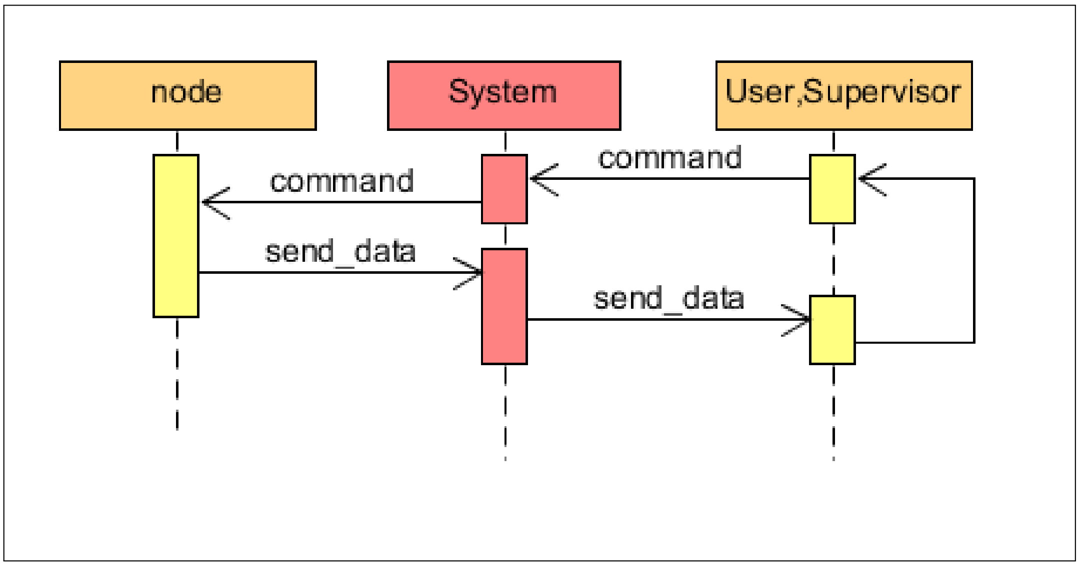


Figure 3.7: Sequence Diagram : case "Control "

3.3.2.9 Class Diagram

A class diagram shows a set of classes, interfaces, and collaborations and their relationships. These diagrams are the most common diagram found in modeling object-oriented systems. [6] in our case we use this diagrams for modeling the statics component in the three units of system (Nodes-cloud-user) witch communicate between theme by communication module:

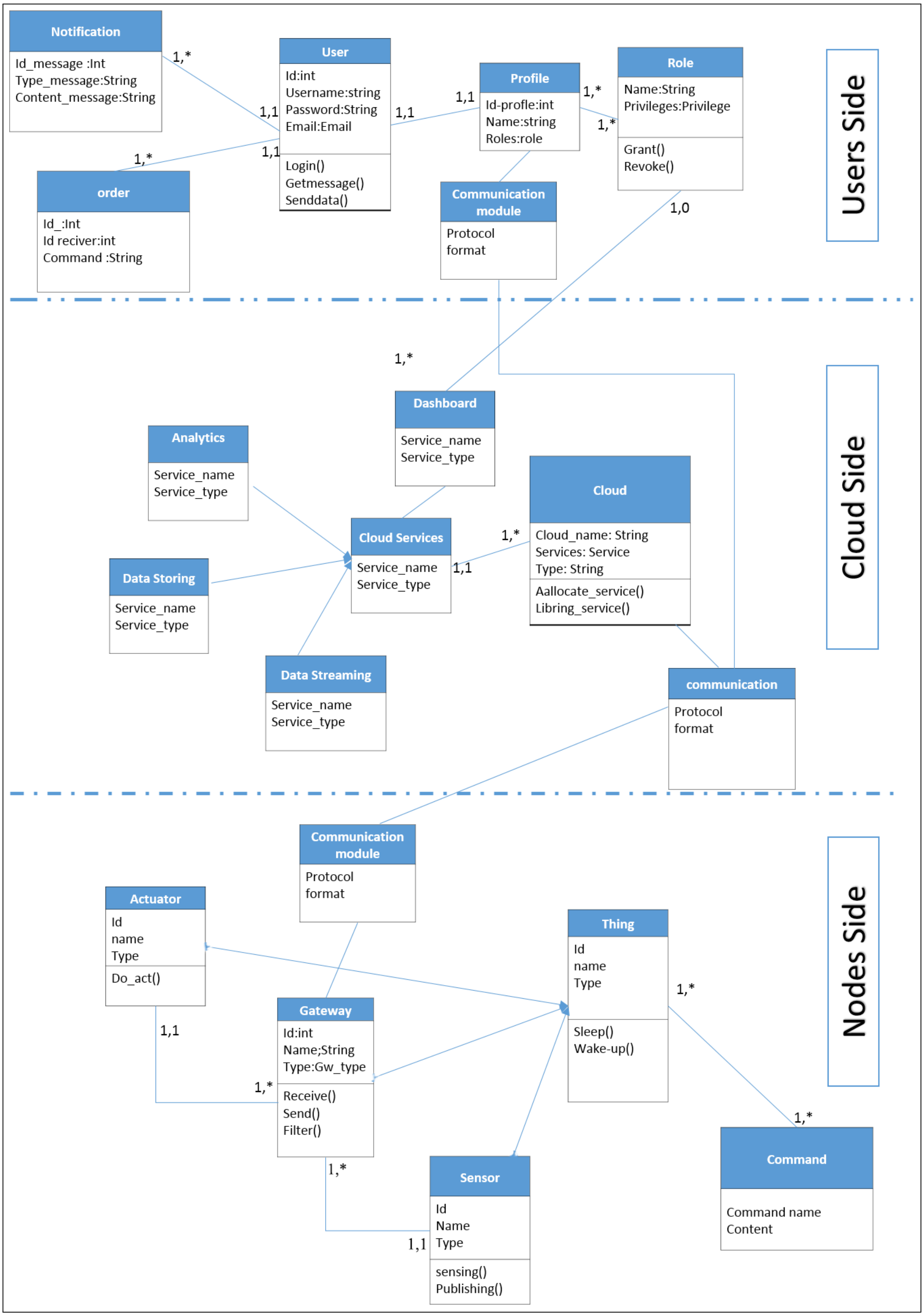


Figure 3.8: System modeling by class Daigram

3.3.3 System Architecture and components

in our proposed system there are three principals units are:nodes unit,cloud unit, and users Unit.

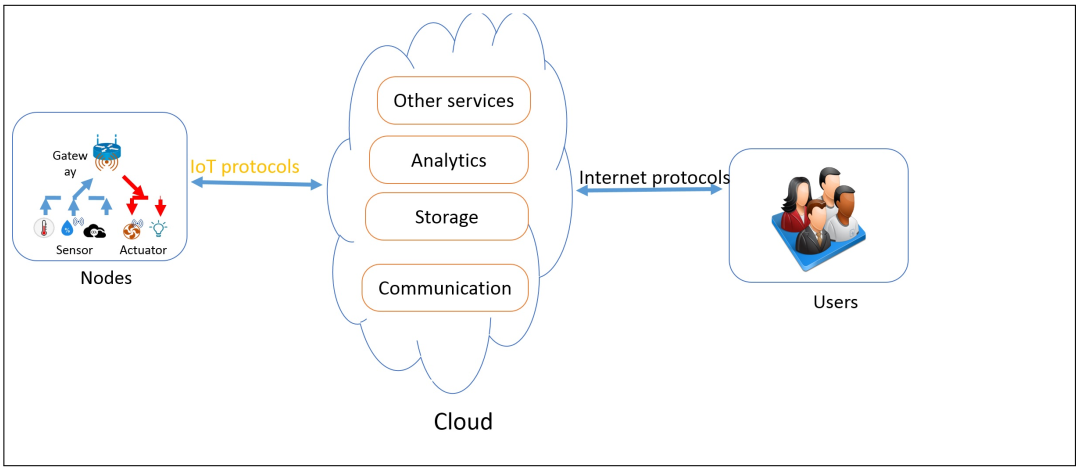


Figure 3.9: Architecture and components of System

3.3.3.1 Nodes unite

The nodes unit is the connected things witch can be sensor or actuator The role is sensing environment variables then send it to cloud for manipulation it there so we can the nodes have many function in our system we will describe each one in chronological order

(1) Sensing :transferring the value of environment into digital value for be able to manipulate using informatics system

(2) Communication: its mean send and receive data to and from cloud using protocols of communication specified for internet of things like COAP,MQTT or web protocols like HTTP

(3) Actuating :When data received from cloud it have a mean of order or command this command for changing internal or external states , the internal state like power-on or power-off and the external state means the state of environment like turning-on heater or alarm

3.3.3.2 Cloud units

In our system the cloud has big role and its represent a middle-ware between the smart objects and users we use some functionally of cloud for system are:

(1) Receiving and Storing: receiving data from sensors in many data format and storing it in cloud for acceding to there in any other time , or making analytic and make decision or send a notification for user

(2) Analytic: analytic function its mean collecting data and extract the information for making decision in system

(3) Decision: make decision is depending the information extracted or received from sensors and the rules sets by user.

(4) Notification : same time the system cant make decision or need the help of human for making decision because of that we add notification function for our system .

(5) Commanding: sending a order to nodes for making change in state

3.3.3.3 Users units

the novel paradigm for user management in proposed system that there is many level of users in our work we propose three type of users:

(1) Supervisor: the supervisor have only two roles :

- Get notification from cloud via terminals .
- Invoke action in specified nodes.

(2) Controller: the controller have the listed roles :

- Set notification and action rules cloud via terminals .
- View data logs and analytic from sensor.
- add / remove Supervisor account
- Invoke action in nodes.

(3) System manager : a system manager can manage full system ,this list represent roles of system manager:

- Add user: the manager can add user account and set its roles in system
- Remove user : removing user account also possible by manager.
- Change roles : the system manager can change the role of users

3.4 Conclusion

in this chapter we proposed a design and architecture for monitoring system and module there using uml diagrams (use case, sequence and class diagrams).

in next chapter we will use that proposed design for implantation in case study (chicken farm) for assure the effectiveness of design.

CHAPTER IV

IMPLEMENTATION

4.1 Introduction

In the previous chapter, we proposed an architecture based on cloud computing for IoT monitoring system. To illustrate the different ideas and concepts included in the proposed architecture,we will use this architecture as a basis for a case study in a real environment. The goal is to unfold the main aspects of our architecture on a concrete example in order to show the feasibility and highlighting of our ideas.

In This chapter we will define the case study,the principal parameters and our objectives .We will explain the installation and configuration Hard and soft included their description for each unit on the architecture that we will need in our architecture to eventually go through the steps of implementing our architecture

4.2 Case Study

Poultry farming includes all the processes of raising birds for farming meat or eggs for food.. Worldwide production of chickens has witnessed massive growth over the last years to fulfill worldwide consumer demands. Environmental parameters inside the chicken farms such as temperature,humidity, level of CO 2 , ammonia , etc are critical increase the growth of chicken and production of farm .

4.2.1 Controlled parameters

a) The temperature The temperature of the chickens house should be between 16 and 24 C [10]. At higher temperatures, the birds consume less food and convert the feed less efficiently. At inverse case, birds eat more feed to keep normal body temperature. When bird feed is converted to heat energy, bird growth is reduced and mortality increases.

b) The Humidity The relative humidity for optimal growing is between 50% and 70% [10]. High humidity results in favorable conditions for microbial pollution growth in chickens farm result of increases the generation of ammonia (NH 3) and CO2 .

c) Air Quality The air quality is very crucial for the birds since bad air quality increases mortality rate [10]. However, carbon dioxide and ammonia are the most important gases to measure, The upper critical level for ammonia is 20 ppm (parts per million) and for CO2 is 2500 ppm. CO2 is produced by the breath of the birds themselves and by the gas heaters. NH3 is the result of the chemical reactions due to the decomposition and the fermentation of the excrements inside the house.

4.2.2 System objective:

Objective of our work is implementing a smart chicken farm system using proposed approach witch is integrating IoT solution with cloud computing .

The System is able to measure in real time the principal parameters include Water and feed level will be controlled and monitored ,all used sensor are connected with gateway to communicate with Cloud.

4.3 Architecture

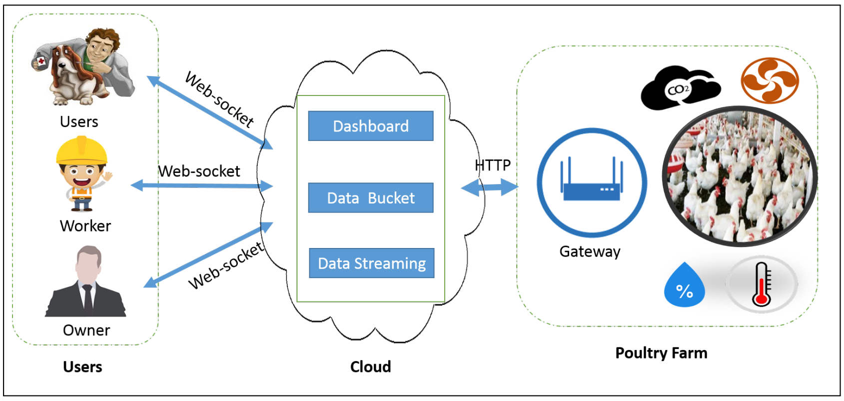


Figure 4.1: Pultry control and monitoring architecture

4.3.1 Node Side

4.3.1.1 Prototype Board : ESP32 Dev-kit

The board ESP32-DevKitC is a bread-board friendly, ready to use solution for testing and educational purposes.witch is extremely popular for the design in many IoT related projects ESP32 is a better solution which can be implemented in more complex projects ,witch support both C programming language (With Arduino)and micro-python.

- **Name**: ESP32 DevKit
- **Microcontroller**: Tensilica 32-bit Dual-core CPU Xtensa LX6
- **Operating Voltage:** 3.3V
- **Digital I/O Pins (DIO):** 28
- **Analog Input Pins (ADC):** 8
- **Analog Outputs Pins (DAC):** 2
- **Flash Memory:** 4 MB
- **SRAM:** 520 KB
- **Clock Speed:** 240 Mhz
- **Wi-Fi:**IEEE 802.11 b/g/n/e/i WEP, WPA/WPA , or open
- **Price:** 4.61 $ =

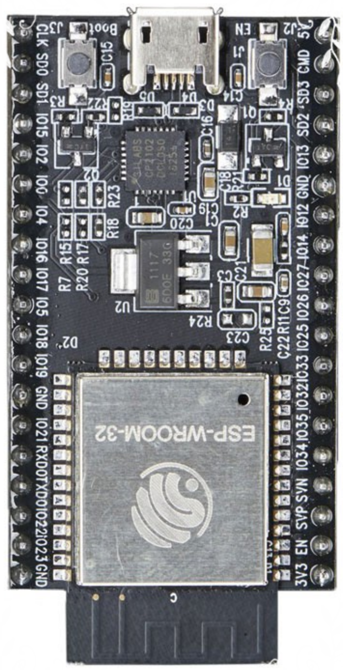


Figure 4.2: ESP32 Devkit Specifications

4.3.2 Used sensors

a) Temperature and Humidity Sensor : The DHT11 is a basic, digital temperature and humidity sensor. It uses humidity sensor for sensing surrounding air, and spits out a digital signal on the data pin Its easy to use, but requires careful timing to grab data.

b) 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.

c) Level sensor: HC-SR04 is range sensor. This sensor provides 2cm to 400cm of non-contact measurement functionality with a ranging accuracy that can reach up to 3mm. Each HC-SR04 module includes an ultrasonic transmitter, a receiver and a control circuit.

4.3.2.1 Used actuators

a) Relay is an electromagnetic switch which is powered by a small current that acts as a lever or as the switch itself. This makes it possible to allow relatively small electric currents to leverage and control much larger electrical currents.

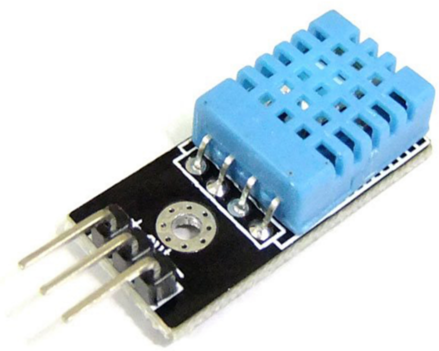


Figure 4.3: Tempurature and Humidity sensor

Figure 4.4: Air quality sensor

Figure 4.5: Relay Actuator

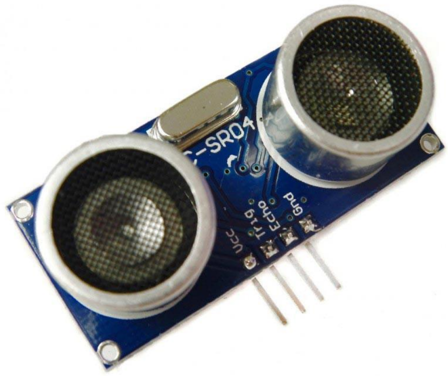


Figure 4.6: level sensor

4.3.2.2 Implementation Circuit

For implementation of gateway and connecting it with sensors and actuators we use the free simulation tools "Fritzing " to illustrate the full schema of node

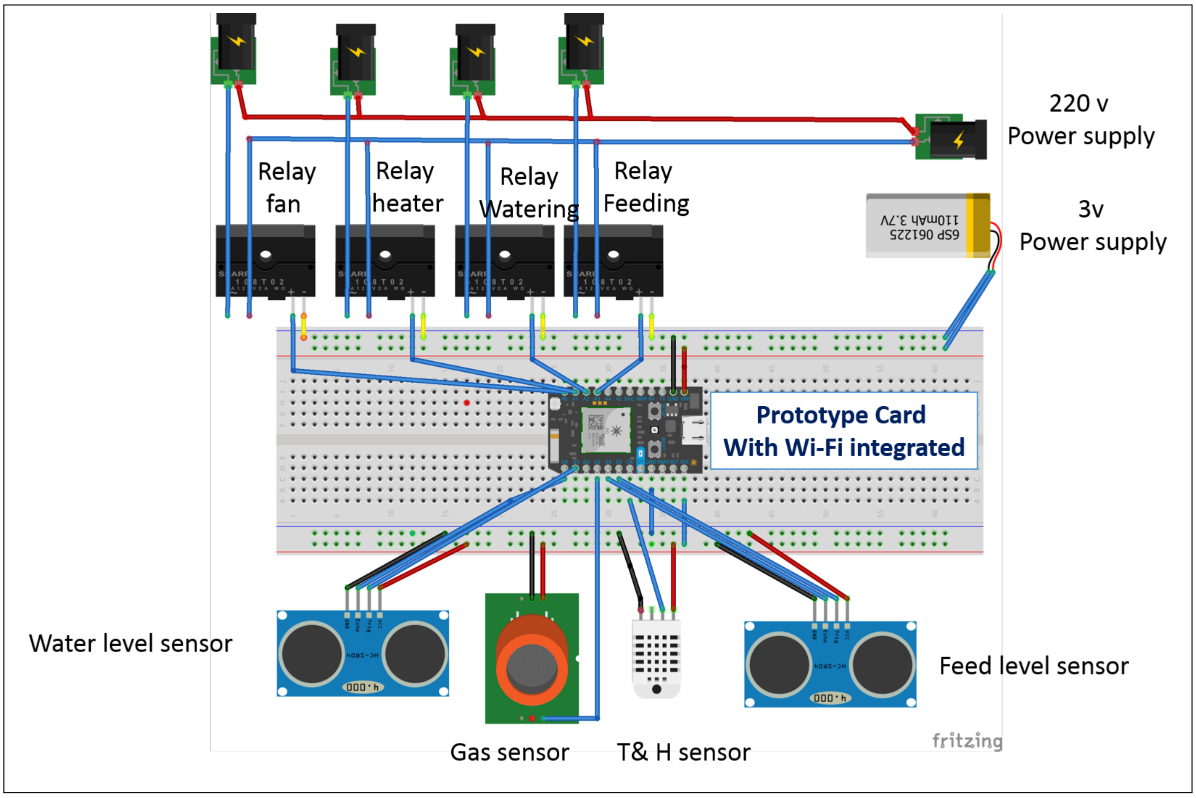


Figure 4.7: Node: Connecting betwwen Gateway , sensors and actuators

4.3.2.3 Arduino Programming language (C)

The Arduino programming language is language for the arduino prototype boards and other compatible it include a lot of libraries based on C, wich is a high-level and general-purpose programming language that is ideal for developing firmware or portable applications. Originally intended for writing system software, C was developed at Bell Labs by Dennis Ritchie for the Unix Operating System in the early 1970s.

4.3.2.4 JSON

JSON (JavaScript Object Notation) is a lightweight data-interchange format. It is easy for humans to read and write. It is easy for machines to parse and generate. It is based on a subset of the JavaScript Programming Language, Standard ECMA-262 3rd Edition - December 1999. JSON is a text format that is completely language independent but uses conventions that are familiar to programmers of the C-family of languages, including C, C++, C-Sharp, Java, JavaScript, Perl, Python, and many others. These properties make JSON an ideal data-interchange language. [1].

4.3.2.5 implementation program

The implementation of programs using Arduino consist two main function :The Setup and loop function , the first one launch one when the device start, and the second looping until device stop working,other other function such as temperature and humidity measure are implemented

a) Library and Variable definition

```
/******************Used Library *****************************/
#include <WiFiClientSecure.h>
#include <ThingerESP32.h>
#include "DHT.h"
/******************Used Global Variable*****************************/
#define DHTTYPE DHT11
#define USERNAME "nani39"
#define DEVICE_ID "dd"
#define DEVICE_CREDENTIAL "HELLOOO"
#define SSID "INTERNET-ETUDIANT"
#define SSID_PASSWORD "00000000"
#define heater 14
#define fan 12
#define DHTPIN 13
const int trigPin = 22;
const int echoPin = 23;
const int trig2Pin = 19;
const int echo2Pin = 21;
// defines variables
long duration;
int distance;
DHT dht(DHTPIN, DHTTYPE);
ThingerESP32 thing(USERNAME, DEVICE_ID, DEVICE_CREDENTIAL);
/******************Function for returning int variables ********************
```

Figure 4.8: Library and Variable definition

b) Setup function

[1]Json.org , Introducing JSON , https://www.json.org,Last visited:May 03,2018

```
void setup() {
    pinMode(heater, OUTPUT);
    pinMode(fan, OUTPUT);
    pinMode(trigPin, OUTPUT); // Sets the trigPin as an Output
    pinMode(echoPin, INPUT); // Sets the echoPin as an Input
    pinMode(trig2Pin, OUTPUT); // Sets the trigPin as an Output
    pinMode(echo2Pin, INPUT); // Sets the echoPin as an Input
    thing.add_wifi(SSID, SSID_PASSWORD);
    Serial.begin(115200);
  /****************** DATA Sending ******************************/
  int ON=1;
  thing["heater"] << [](pson& in){
                if(in.is_empty()){in = (bool) digitalRead(heater);}
                else{digitalWrite(heater, in? HIGH : LOW);}
              };
  thing["fan"] << [](pson& in){
                      if(in.is_empty()){in = (bool) digitalRead(fan);}
                       else{digitalWrite(fan, in ? HIGH : LOW);}};
  thing["temperature"] >> [](pson& out){out = tem();};
  thing["humidity"] >> [](pson& out){ out = hum();};
  thing["level_water"] >> [](pson& out){out = dis01();};
  thing["level_food"] >> [](pson& out){out = dis02();};
  thing["gaz"] >> [](pson& out){ out = gaz();};
  }
/****************** end setup ******************************/
```

c) Loop function

```
/******************** loop function  ********************************/

void loop() {
delay(10000);
thing.handle();
}
```

Level Sensing function

4.3.3 Cloud

In the cloud side we use : Aws EC2 service , with ubuntu server operating system and the thinger.io iot platform

4.3.4 Amazon Elastic Compute Cloud(EC2)

Amazon Elastic Compute Cloud (Amazon EC2) provides scalable computing capacity in the Amazon Web Services (AWS) cloud. Using Amazon EC2 eliminates your need to invest in hardware up front, so you can develop and deploy applications faster. You can use Amazon EC2 to launch as many or as few virtual servers as you need, configure security and networking, and manage storage. Amazon EC2 enables you to scale up or down to handle changes in requirements or spikes in popularity, reducing your need to forecast traffic.[2].

4.3.5 Features of Amazon EC2

Amazon EC2 provides the following features:

(1) Virtual computing environments, known as instances

(2) Amazon Machine Images (AMIs):Preconfigured templates for instances.

(3) instance types: Various configurations of CPU, memory, storage, and networking capacity

(4) instance store volumes :Storage volumes for temporary data that's deleted when stop or terminate instance.

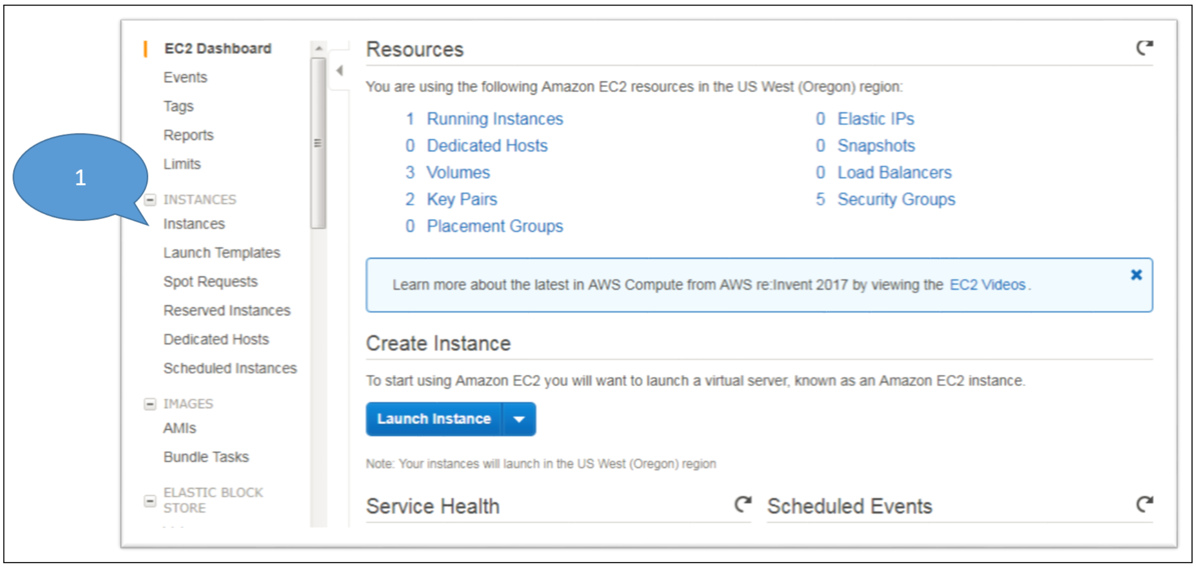
(5) Regions and Availability Zones: Multiple physical locations for resources

(6) A firewall : that enables you to specify the protocols, ports, and source IP ranges that can reach your instances using security groups

(7) adress IP: Static IPv4 addresses for dynamic cloud computing

[2]Amazon AWS ,What Is Amazon EC2?,https://docs.aws.amazon.com/AWSEC2/latest/UserGuide/concepts.htmlLast visited 02-05-2018

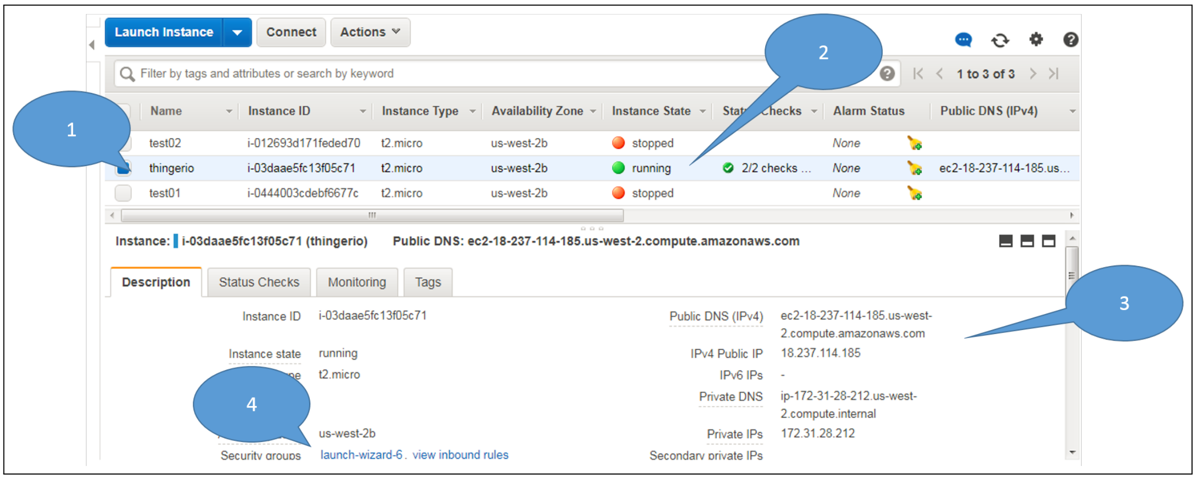
4.3.5.1 EC2 service dashboard



The EC2 dashboard show used resource status, in the left side the menu of available actions,in our case:

-1- Show or create instance of EC2 service

4.3.5.2 EC2 Instance dashboard



The Instance dashboard have many elements are:

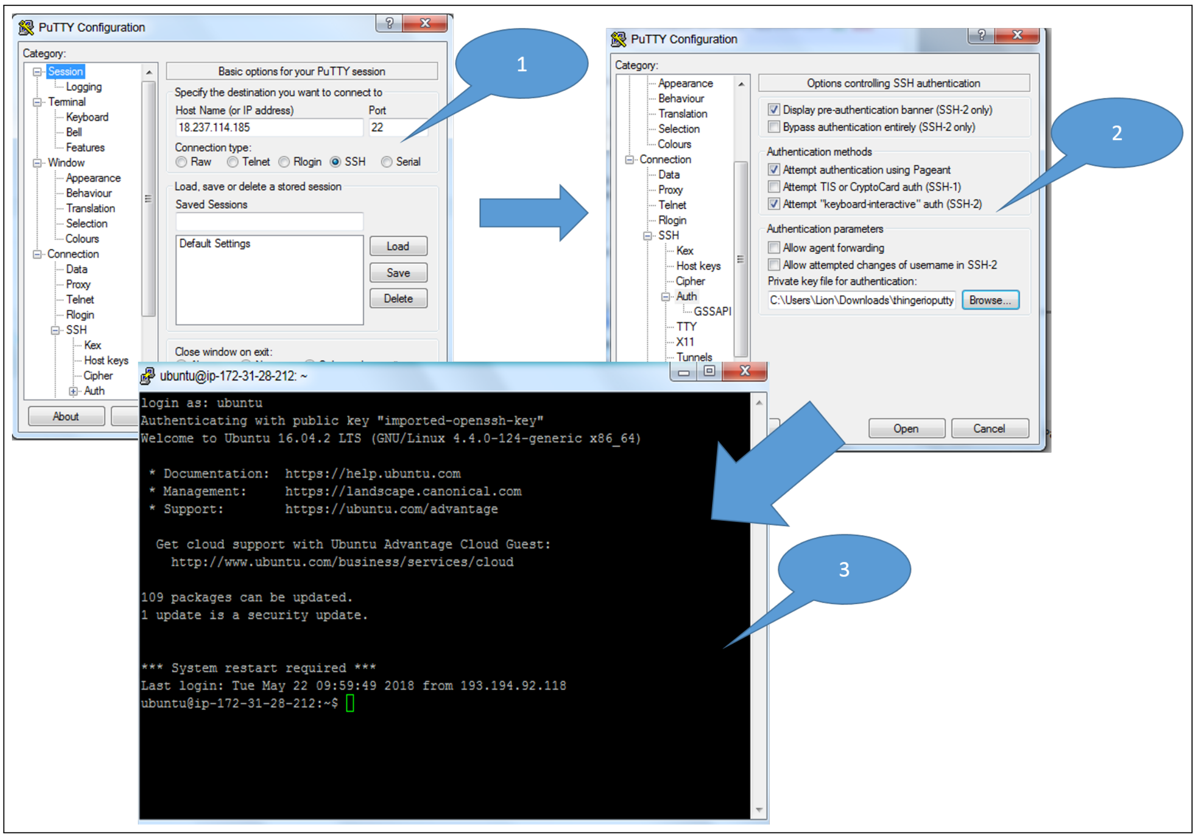
(1) The instance name, with type and location

(2) The stat of instance : Running , Stopped or terminated witch mean will be dropped

(3) The Addresses of instance for remote access and communication via ip4,ip6 public and private

(4) The Security Groups: Setting access ports via HTTP, SSH or any other TCP protocols

a) Access to instance



For Remote access to instance , SSH or telnet client tools needed such as putty

(1) setting The ip address of instance witch received from instance dashboard , and 22 for ssh connecting

(2) the Authentication file getted from aws when creating the instance , uploaded for authenticate the connection

(3) Putty Window appear, now can install any packages using terminals command

4.3.5.3 IoT Platform :"Thinger.io"

The Thinger.io is an Open Source Platform for Internet of Things(IoT) applications which use Web socket for connecting with devices and API for controlling the end devices, bandwidth saving while transmission of data , it is possible to connect almost any micro-controller to Thinger.io platform with an application of WiFi, Ethernet, GSM, GPRS , etc. may be connected to this open source cloud platform. It provides variety of services like it shows the statistics for device connection, data transmission, it creates real time dashboards for the devices connected, allows third party service communication.[15]

4.3.5.4 Ubuntu server

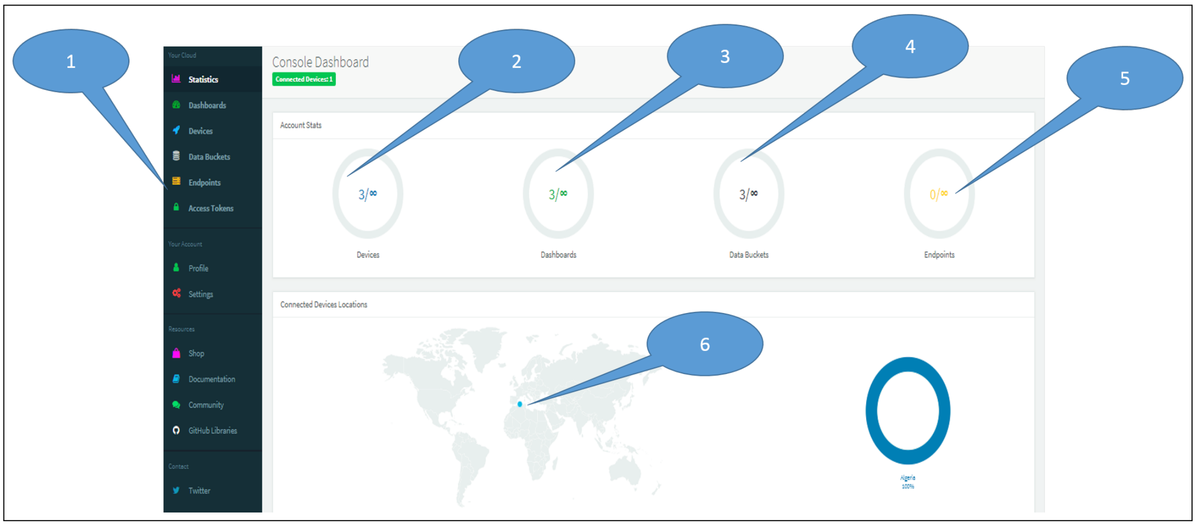
Ubuntu is a free and open source operating system and Linux distribution based on Debian. Ubuntu is offered in many editions: Ubuntu Desktop for personal computers, Ubuntu Server for servers and the cloud .... Ubuntu server edition uses the same APT repositories as the Ubuntu Desktop Edition. The differences between them are the absence of an X Window environment in a default installation of the server edition The server edition uses a screen-mode, character-based interface for the installation, instead of a graphical installation process. This enables installation on machines with a serial or ”dumb terminal” interface without graphics support.[3].

4.3.6 Users

a) Farm owner The holder of poultry farm monitor and control the nodes notification and reaction such as fan , heater water and feed pump anywhere using smart phone or PC with internet connection.

b) Owner dashboard

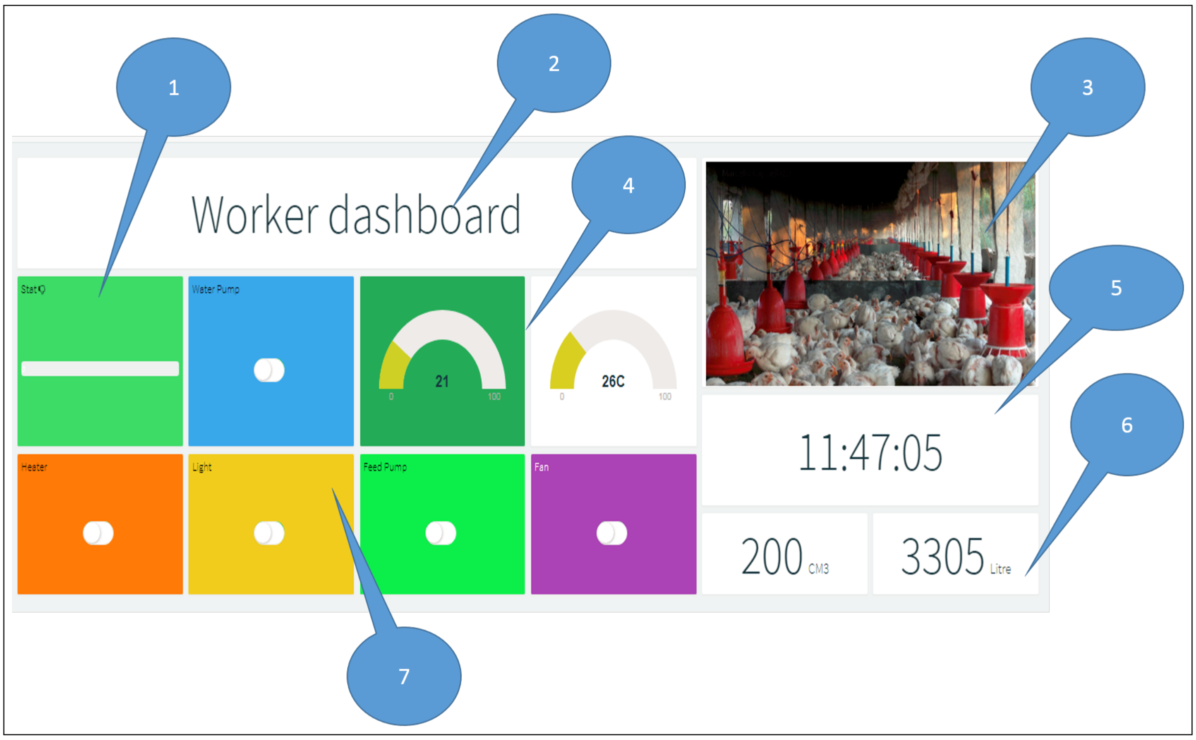
[3]WIKIPEDIA , Ubuntu (operating system) , https://en.wikipedia.org/wiki/Ubuntu_(operating_system), Last visited May 03,2018”



In owner dashboard there area listof functions such as : device managemant , data buckets, end points and dashboards,in main side arethe statistics about devices (2) and dashboard (4) data buckets (3) and the end points (5) also connected devices location shown in down side

c) Farm worker in other side the worker in poultry farm monitor and control the system in and out of farm such as opening and closing ventilation windows switch pump on or off ,etc .

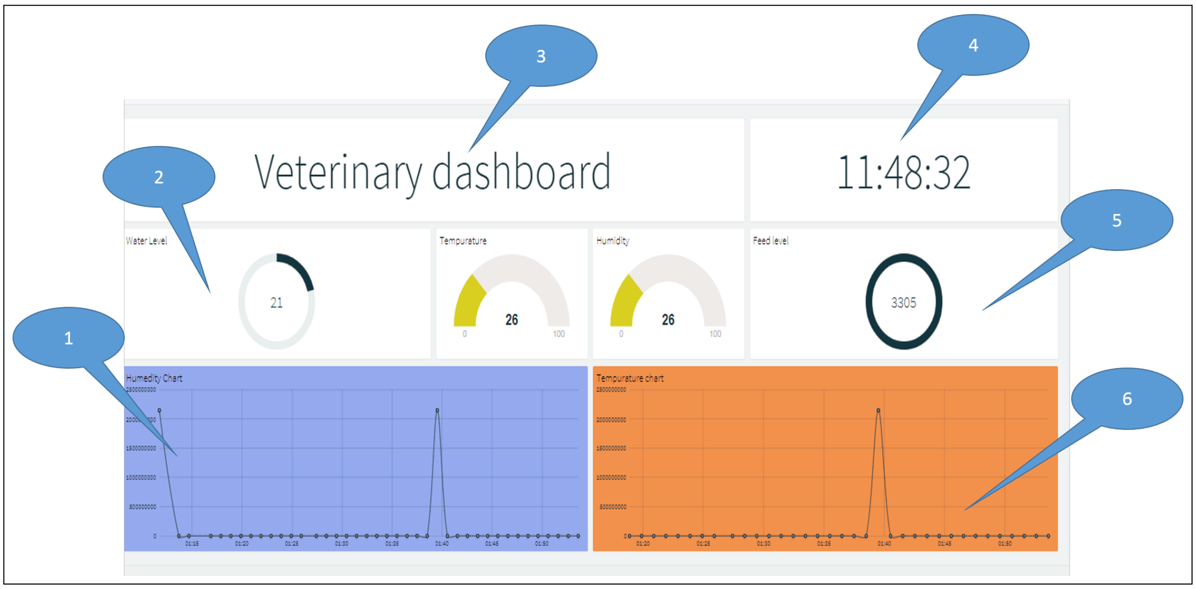
d) Worker dashboard



in worker dashboard (2)System state (1), ¡Farm view using ip camera and the measured parameter , on left of clock(6) , and the feed and water level monitored with the ability to control the Light , fan etc using switches buttons (7)

e) Veterinary Remotely the Veterinary get notification of system state and exploit it logging for helping and give advices to the both worker and

f) Veterinary dashboard



The veterinary has the ability to see the real time (2,5) and historique of environmental parameter (1,6) via his dashboard

4.4 Conclusion

In this chapter, Successfully we implement a monitoring system for chicken farm using EC2 service from aws, We face many problems in prototyping such as material rareness (Sensors,boards..etc)inscription in cloud require international payment card.

This is not then end of our work ,it just the beginning for integrating IoT with cloud,we will implement system in more life area such as industry and health care.

GENERAL CONCLUSION

In a few years, the "Internet of Things" revolution has become the future of information technology, but this requires a data monitoring, storage, processing and analysis system. This work we propose a design of monitoring system for IoT , this design based on cloud computing for its capabilities of storage and processing and multi tenancy , to facilitate for the system users the controlling and the monitoring of connected things .

The design consist of three parts Thing (node) ,Cloud and user witch can communicate between them using protocols communication and technologies trough the gateways.

The design is includes devices managements witch can be of heterogeneous or homogeneous types, this management is based on roles and privileges to give more flexibility for users.Also, we add a realtime monitoring, remote control tools and notification services controled by rules.

Beside that, the most powerful advantage of our proposed design, it's generic, i.e. the design can be used in the most of monitoring domain such as industry health care environmental monitoring.

In the light of this work, we can cite the following perspectives:

- Use more cloud services,
- reinforce the security technics in our system
- add more comunication protocols: Coap, MQTT.
- extend the rules system by semantic web tools such as Ontology

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