ASSIGNMENT 1

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Student declaration I certify that the assignment submission is entirely my own work and I fully understand the consequences of plagiarism. I understand that making a false declaration is a form of malpractice.			
		Student's signature	

Grading grid

P1	P2	P3	P4	M1	M2	M3	M4	D1

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TABLE OF CONTENTS

List of figures

LO1: ANALYSE WHAT ASPECTS OF IOT ARE NECESSARY AND APPROPRIATE WHEN DESIGNING SOFTWARE APPLICATIONS

P1: EXPLORE VARIOUS FORMS OF IOT FUNCTIONALITY

I OVERVIEW OF THE INTERNET OF THINGS

1. IOT DEFINITION

Despite the popularity of the IoT system and the high acceptance of this new technology globally, a precise definition does not exist. But the IoT concept describes the networking capabilities of many types of objects in the environment, not just computers. These objects can act smart and exchange data with decent devices with negligible human involvement (Kim et al., 2019).

2. IOT APPLICATIONS

The applications of IoT in today's digital society are growing very fast in many areas, promising to bring great value to our lives. With newer wireless networks, superior sensors, and revolutionary computing capabilities.

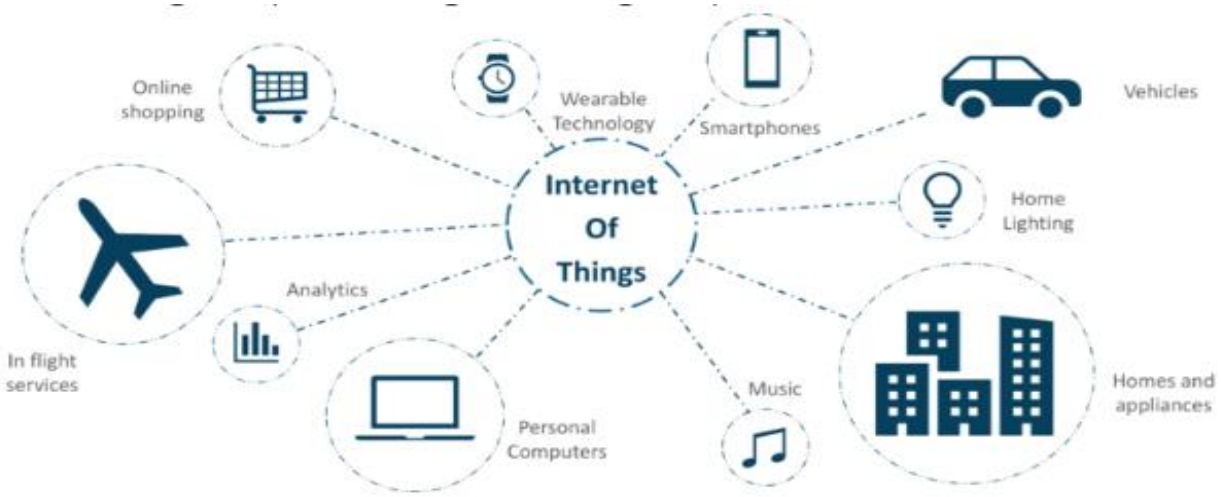

Figure 1: Applications of IoT

IoT applications are expected to equip billions of everyday objects with connectivity and intelligence. It has been widely deployed, in various fields, namely (Upasana, 2020) :

- Wearables
- Smart home application
- Health care
- Smart cities

- Agriculture
- Industrial Automation

2.1. WEARABLES

It can be said that wearable products are a feature of IoT applications and perhaps one of the earliest industries that have implemented IoT in their services.

Wearable devices today offer a lot of modern features as well as very useful for users. Some of the first functions that wearables have provided are related to identification and security. Some advanced devices even include some biometric capabilities (such as activating fingerprints, so only the badge owner can use it to open a locked door) to improve security.

Health and fitness-oriented wearables that provide biometric measurements like heart rate, sweat level, and even complex measurements like blood oxygen levels are also available. Technological advances may even allow alcohol concentration or other similar measurements to be made via a wearable device.

Wearables can also be allowed to automatically connect devices around the house. Perhaps you have a preferred light level when watching TV from a particular chair. You can turn on the TV and your wearable can help adjust the lighting level from the LEDs connected in the room.

2.2. SMART HOME APPLICATIONS

When it comes to an issue related to IoT, the first thing that comes to mind is probably the smart home. The smart home can also be considered as the application of IoT that resonates globally and is most searched on the Internet with IoT applications. Just imagine when you are not at home, you can still turn off the devices in the house, unlock friends for home or track your assets remotely via the camera system, so that partly gives us See the significant benefits of smart homes. Smart homes will help us save time and effort and always create a peace of mind about safety.

Figure 2: Smart Home

2.3. HEALTH CARE

One of the most expected applications when IoT appears is the improvement of the current human health care system. Internet of thing has great potential in the "health care industry", we often call it with IoMT (Internet of Medical Things), applications in this field help improve the quality of health care, reduce Minimize stress for health professionals, enabling patients to be treated at home without visiting the hospital.

In fact, technology cannot prevent aging or eliminate chronic diseases, but at least makes health care easier accessible. Medical diagnostics and medical examinations will be delivered to patients' homes, reducing the need for hospitalization and avoiding hospital overcrowding.

Figure 3: Health care application

2.4. SMART CITIES

As mentioned above, the smart home is one of the most searched IoT applications on the internet. In fact, when a series of smart homes appear, smart cities are formed as a necessity. Because the city is made up of houses, apartments, office buildings with electricity, water, and transportation.

Key features of a smart city include high levels of information technology integration and comprehensive application of information sources. The essential components of urban development for a smart city should include smart technology, smart industry, smart services, smart management, and smart life. The Internet of Thing application is to install sensors (RFID, IR, GPS, laser scanners, etc.) for everything and connect them to the internet through communication protocols to exchange information and communications for transmission. Location gain, smart tracking, monitoring, and management.

Figure 4: Smart Cities

2.5. AGRICULTURE

The BI Intelligence survey expects the adoption of IoT devices in agriculture to reach 75 million by 2020, an increase of 20% per year. At the same time, it is expected that the size of the global smart agricultural market will triple by 2025, reaching $15.3 billion (up from a little over $5 billion in 2016) (Meola, 2020).

The development of blockchain technology is progressing towards IoT and could be important in the agricultural sector because of its ability to provide important crop data to companies. Farmers could use sensors to collect crop data, written on the blockchain, and include determinants as well as salt and sugar content and pH.

Figure 5: Agriculture application

2.6. INDUSTRIAL AUTOMATION

The Internet of Things (IoT) in the automation industry is proving to be a game-changer for automation companies. Industrial automation companies using IoT solutions can reap new benefits. Internet of Things (IoT) helps create new technologies to solve problems, increase operations, and increase productivity. The IoT here can prove to be a game-changer with solutions for all of the following areas in its arsenal.

- Digitizing factory
- Monitor product flow
- Inventory management
- Safe and confidential
- Quality control
- Optimize packaging
- Optimizing supply chain and logistics

3. ADVANTAGES AND DISADVANTAGES OF INTERNET OF THINGS (IOT)

- ***Advantages*** (Drew, 2016)***:***
  - IoT technology helps to unify digital devices, Self-assimilates data in controlling daily tasks without human intervention. Moreover, the machine-to-machine communication also maintains transparency throughout the process.
  - Machine-to-machine interaction brings better efficiency, allowing people to focus on other tasks.
  - IoT will help reduce congestion problems that cause problems for the system thereby saving costs and resources.

- IoT allows physical devices to connect and communicate better, which creates higher quality control.
- Instant access to data will help solve problems as well as make decisions quickly and accurately.

- ***Disadvantages*** (Drew, 2016)***:***
  - Connecting all devices together via the internet can put our privacy and information security in the hands of hackers.
  - Currently, there are no specific standards for IoT compatibility in the world. This can make communication between manufacturers becomes difficult.
  - The complexity in technology because IoT is a large, diverse network, a software or hardware failure can have disastrous consequences.
  - IoT is growing and everything is becoming automated, which can reduce the need for unskilled employees at workplaces.

P2: REVIEW STANDARD ARCHITECTURE, FRAMEWORKS, TOOLS, HARDWARE AND APIS AVAILABLE FOR USE IN IOT DEVELOPMENT

II COMPONENTS OF IOT

1. ARCHITECHTURE

According to (Stokes, 2018) the diagram of IoT system architecture consists of 4 stages:

- Sensors and actuators
- Internet getaways and Data Acquisition Systems
- Edge IT
- Data center and cloud.

1.1. NETWORKED THINGS (WIRELESS SENSORS AND ACTUATORS)

The processes of this phase will bring the sensors into the IoT architecture framework to get information about the appearance that can be actually processed.

For actuators, this process goes even further - these devices can interfere with physical reality. For example, they can turn off the lights and adjust the room temperature.

Figure 6: Sensors and actuators

1.2. INTERNET GETAWAYS AND DATA ACQUISITION SYSTEMS

At this stage the system will synthesize the captured sensor data and convert the analog data into numbers. The importance of this stage is to process the huge amount of information collected at the previous stage and force it to the optimal size for further analysis. Besides, the necessary transformation of time and structure occurs here.

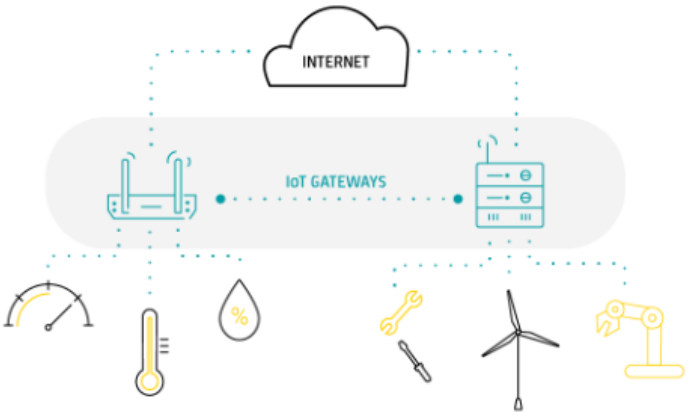

Figure 7: IoT Gateways

1.3. THE APPEARANCE OF EDGE IT SYSTEMS

The Stage 3 is closely previously linked stages of building the IoT architecture. The prepared data is transmitted into the world of IT. Here edge IT systems in particular perform advanced analyzes and pre-processing. For example, it refers to machine learning technology and visualization. At the same time, there may be some further processing here, ahead of the stage into the data center.

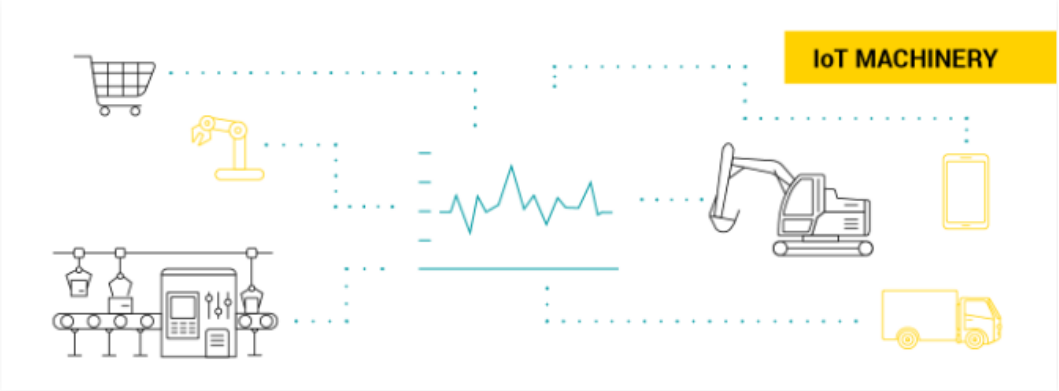

Figure 8: Edge IT systems

1.4. DATA CENTER AND CLOUD

This phase allows for a thorough processing, along with subsequent feedback revisions. Both IT professionals and OT (operating technology) skills are needed here. In other words, this phase included the highest ranked analytical skills, both in the digital and human world. Therefore, to ensure in-depth analysis, data from other sources can be included here.

Figure 9: Data center and cloud

2. FRAMEWORK

According to the research of (Huang & Yu, 2018) IoT Framework is an important part of a large IoT ecosystem, helping to promote and link all the elements in the diagram. It allows device management, handles software and hardware communication protocols, collects / analyzes information, improves information flow and smart application functionality.

An IoT framework will include the following layers:

- ***Product Infrastructure layer:*** This layer covers all products for the hardware and software of the IoT system. The software here is software built with the purpose of controlling, using and helping develop IoT devices. Hardware here refers to the chips or embedded devices that build a complete IoT product.

- ***Sensor layer:*** The sensor layer is responsible for recognizing everything and collecting data from them. The data collected by these sensors can be about location, air changes, environment, etc.
- ***Connectivity layer:*** The communication protocols needed to transfer information from devices to the cloud. The most popular protocol that can be mentioned is the TCP / IP protocol.
- ***Analytics Layer:*** analytics layer that collects data from sensor devices and converts it into meaningful data.
- ***Smart Apps layer:*** integrate all other layers together and support different business decisions. It is the interface between the last IoT device and the network. IoT applications such as smart homes, smart health, smart cities, etc.It has the right to provide services to the applications.

3. TOOLS

According to (Kim et al., 2019) IoT tool is a network or connection of devices, media, devices that apply embedded electronics, appliances, buildings and more. This assists in the collection and exchange of different data types. It also helps users remotely manage devices over the network.

In today's technology world, many of the Internet of Things solution companies are creating hardware and software designs to help IoT developers create new and worthy IoT devices and applications. attention. It can be mentioned as Arduino and Raspberry Pi.

Arduino is an open source electronic platform based on easy-to-use hardware and software. Arduino boards can read inputs - light on sensors, fingers on buttons or Twitter messages - and turn it into outputs - activate the engine, turn on the LED, publish something online (Arduino, n.d.).

Figure 10: Arduino Uno

The Raspberry Pi is a cheap credit card sized computer that
plugs into a computer monitor or TV and uses a standard keyboard and mouse. It is a small device capable of allowing people of all ages to explore computing and learn to program in languages like Scratch and Python. It is capable of doing everything you expect a desktop to do, from browsing the internet and playing high-resolution videos, to creating spreadsheets, word processing and playing games (RaspberryPi, n.d.).

Figure 11: Raspberry Pi

4. HARDWARE

The most important hardware of IoT system can be mentioned as sensors and actuators.

Sensors in IoT systems are devices capable of detecting and responding to the system from data obtained outside the physical environment. Inputs can come from different sources such as light, temperature, motion and pressure. Sensors provide valuable information and if they are connected to a network, they can share data with other connected management systems and devices. The image below shows some of the current sensor types:

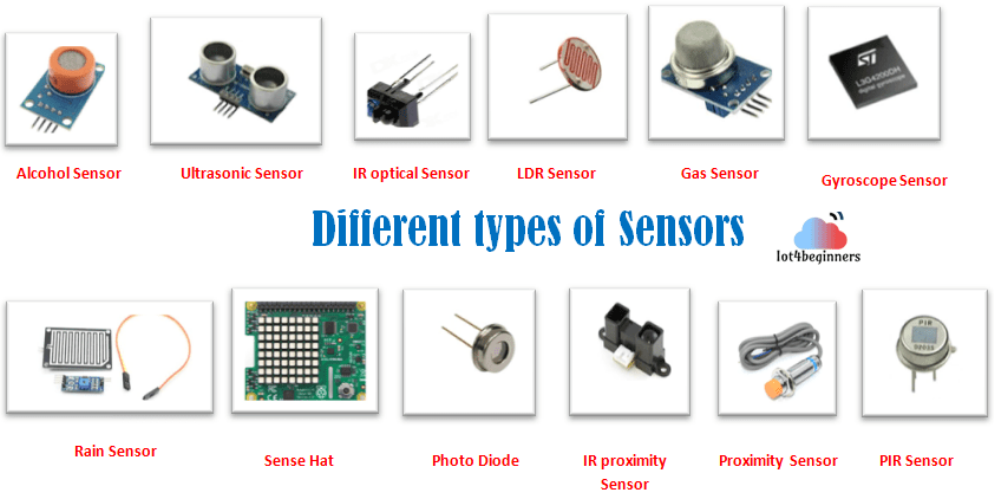

Figure 12: Different types of Sensors

Actuator is an IoT device that can change one or more properties of a physical entity in response to the information received. Actuators may be based on hydraulic, pneumatic, electric, thermal or mechanical means, but are increasingly controlled by software.

Figure 13: Actuators

5. SOFTWARE

If hardware is the physical body of the IoT system, software is its soul. The software of the IoT system is a development process on the server side of the programmer, it will tell the whole system what its task is?

Currently we can use a lot of programming languages to build an IoT system like C / C ++, Java, Python, etc. And depending on the project, there will be each suitable language to We use it so that the system is optimal.

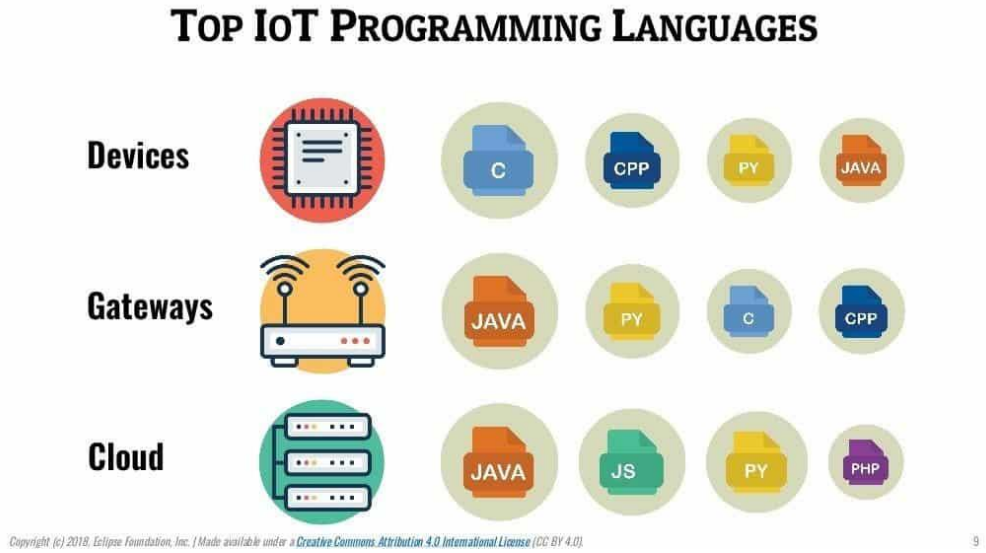

Figure 14: IoT programming languages

6. NETWORK PROTOCOL

The network protocol in IoT systems is set up to determine the transmission of data obtained from sensors to devices in a network. It basically allows connected devices to communicate with each other, regardless of the differences in their internal processes, structures or designs.

The simple network will include some of the following main components:

- Equipment - including computers, printers, routers and servers.
- Media - includes cable or wireless connections.
- Services - includes software that supports operations, such as email archiving.

LO2 OUTLINE A PLAN FOR AN APPROPRIATE IOT APPLICATION USING COMMON ARCHITECTURE, FRAMEWORKS, TOOLS, HARDWARE AND APIS

P3 INVESTIGATE ARCHITECTURE, FRAMEWORKS, TOOLS, HARDWARE AND API TECHNIQUES AVAILABLE TO DEVELOP IOT APPLICATIONS

III IOTS PROTOCOL

1. APPLICATION PROTOCOLS

The application layer is responsible for formatting and presenting data. HTTP is the most common protocol used in the application layer. However, HTTP is not suitable in resource-constrained environments because it is extremely heavy and therefore incurs a large parsing cost. Therefore, many alternative protocols have been developed for the IoT environment. Some IoT application layer protocols have been developed such as CoAP, MQTT, SMQTT, etc.

2. CONSTRAINED APPLICATION PROTOCOL (COAP)

CoAP is based on HTTP protocol and was designed by the IETF Constrained RESTful Environment (CoRE) working group and launched in 2013.

Designed to address the needs of HTTP-based IoT systems and like HTTP, it also follows the client-server model. Clients can GET, PUT, DELETE or POST information resources over the network. CoAP relies on User Datagram Protocol (UDP) to establish secure communications between endpoints. By allowing for broadcasting and multicasting, UDP can transfer data to multiple servers while maintaining communication speeds and low bandwidth usage, which is suitable for wireless networks typically employed in resource-constrained M2M environments.

There are four types of messages defined in CoAP:

- Confirmable (for reliable transmission)
- Non-confirmable (for unreliable transmission)
- Piggyback (acknowledgment)
- Separate (reset)

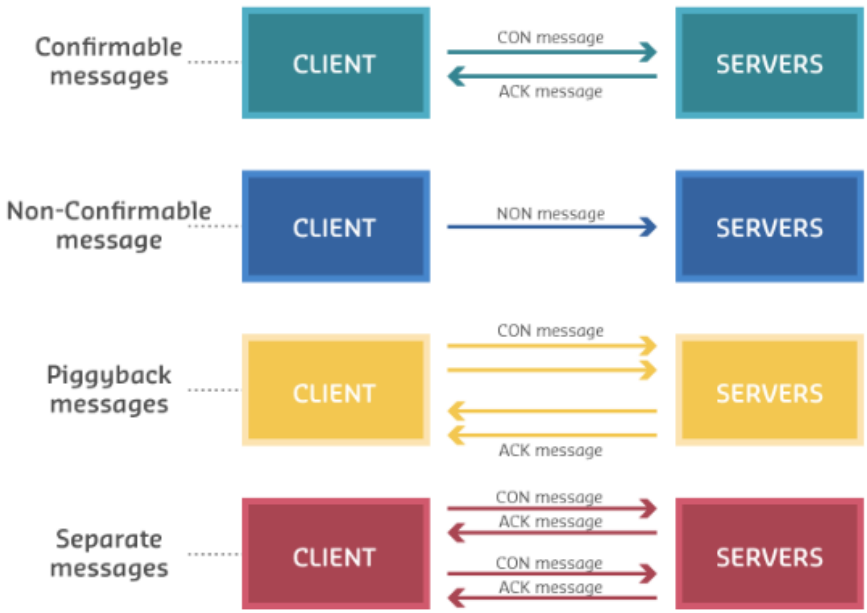

Figure 15: Constrained Application Protocol (CoAP)

3. MESSAGE QUEUING TELEMETRY TRANSPORT (MQTT)

MQTT is a publish / subscribe delivery protocol used for Internet of Things devices with low bandwidth, high reliability and ability to be used in unstable networks. In 1999, MQTT was introduced by IBM and by 2013, it was standardized by OASIS (Hillar, 2017).

Designed for battery-powered devices, the MQTT's architecture is simple and lightweight, providing low power consumption for devices.

Based on TCP-IP protocol and designed to operate in limited bandwidth, it is specially designed for unreliable communication networks in response to the growing problem of energy objects. Low-priced low sized has appeared in the network in recent years

The three components of the MQTT network are:

- publisher (client);
- subscriber (client);
- message broker (server).

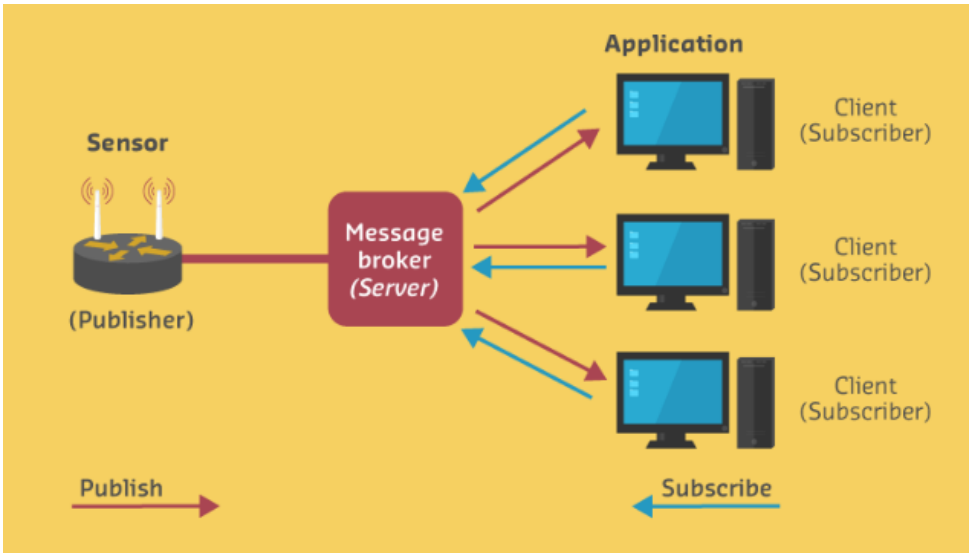

Figure 16: MQTT Architechture

4. DATA DISTRIBUTION SERVICE (DDS)

Among the internet protocols, the IoT Messaging Protocol - DDS or Data Delivery Service is a standard for high-performance, scalable and real-time communication between machines.

The protocol does not require any network mediation software, so publishers can disclose information on specific topics (like temperature sensors that can determine the current temperature of a location). And the management protocol itself to provide subscribers (such as mobile devices displaying the current temperature of a location).

Although not a typical IoT solution, DDS still finds its application in a number of industrial IoT deployments, such as air traffic control, smart grid management, autonomous vehicles, and delivery systems. pine, robot, etc.

P4 DETERMINE A SPECIFIC PROBLEM TO SOLVE USING IOT

IV SPECIFIC PROBLEM TO SOLVE USING IOT

1. INTRODUCTION ABOUT PROBLEM

I believe this is a problem that many families have encountered, that is when they hang their clothes or any outdoor furniture and, in the meantime, the whole family is out and no one is at home. Suddenly it rained and there was nothing to cover the clothes that were left outdoors, they would eventually get wet.

Figure 17: Clothes in the rain

2. PROPOSED SOLUTION

To overcome this problem, our solution is a **Smart Roof** equipped with rain or water sensors. A special feature of this system is the ability to lower the roof automatically when the sensor senses rainwater without the need for human intervention. The sensor is very sensitive so we will no longer have to worry about starting out home but afraid it will rain.

3. HOW IT'S WORK?

Our Smart Roof system currently operates based on water sensors and works automatically without any human intervention. The system uses Servo motors to control the roof, which means it will lift the roof up and down if a sensor identifies it as rain.

V SELECT IOTS COMPONENT TO SOLVE THE PROBLEM

1. SELECT COMPONENTS

This is a small project, so we will use the following hardware and software to develop the Smart Roof system:

- **Tools:** About the tool we decided to choose Arduino Uno to design this system because Arduino is a very popular tool today and is an open source electronic platform based on easy-to-use hardware and software.

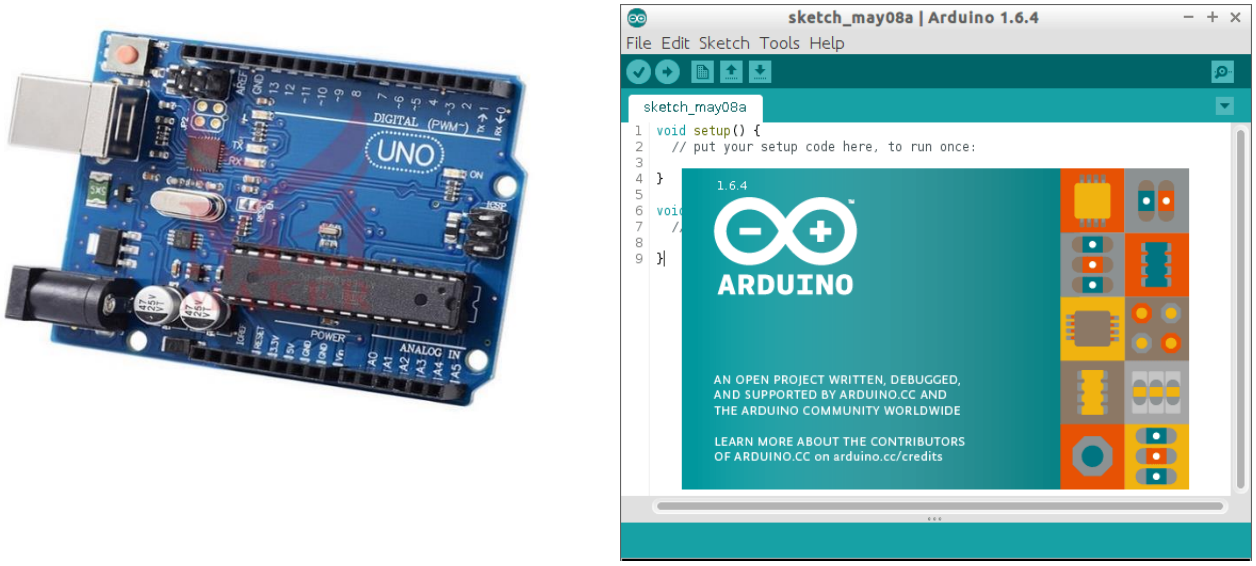

Figure 18: Arduino Uno Tool for system

- **Hardware:** Hardware-based systems include Water Sensors and Servo Motors. The water sensor will be used to identify the rain and send data to the system so that the Servo motor can lift or lower the roof.

Figure 19: Sensor and Actuator

- **Software:** We choose the C ++ language to develop software in the Arduino IDE.
- **Network connection:** I will use TCP / IP to transmit signals, use WiFi to keep the system running. I chose them because this protocol is very popular and the security is also very good.

2. APPLICATION AND DEVELOPMENT PLAN

Next, I will present the project development plan and introduce the tools to be applied to the system.

In addition to the automatic mechanism of the system via water sensor, we can also control the system remotely via an internet connection.

Design Planning	Discription
IoT Design product	Smart Roof
Intended function	To improve the convenience for families, we will not need to be too concerned about outdoor furniture will get wet if it rains.
Outline of the process	The rainwater sensor will determine the weather and the roof's automatic mechanism will be lowered if it rains. Moreover, we can control this system via internet connection.
Required devices to be connected	
Sensor	Water Sensor
Actuator	Automatic roof mechanism
Intermediate Devices	Microcontroller with sensor, Servo Motors
Type of data	Data is stored in the cloud and automatically accessed via WiFi
Programming Required	
Device function	Programmed to collect data via rainwater sensor. Data retention for 24 hours.
Network connection requirements	The process of sending data from the sensor device to the central processor and then returning the results must be fast, so make sure the network connection, stability and efficiency.
Data Management	The data needs an algorithm to accurately determine and qualify to lower the roof if it rains.
Security and Privacy considerations	
Device	Need to attach to the roof to ensure the roof will fall when it rains.
Data	The data is stored personally, data theft cannot occur

VI CONCLUSION

This report addresses practical concepts and applications of IoT along with specific examples. The presentation of plans and product development for a practical problem is also discussed with each step such as problem identification, problem analysis and presentation of how the system works.

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