FACULTY OF ENGINEERING

SCHOOL OF COMPUTING

SEMESTER 1/20212022

SECP1513 – TECHNOLOGY INFORMATION SYSTEM

SECTION 02

PROJECT – PHASE 1 (PROJECT PROPOSAL)

[IoT- SMART LOCK]

LECTURER:

DR. IZYAN IZZATI BINTI KASMANI

GROUP NO: 03

Name	Matric ID
ANG YI QIN	A21EC0163
YEW RUI XIANG	A21EC0149
LAU YEE CHI	A21EC0042
FONG KHAH KHEH	A21EC0026

TABLE OF CONTENT

1.0 Introduction

1.1 Project Background

Locks are the foundation of home security for centuries. In today's society, many people are very conscious of home safety. To ensure security, most people buy locks to prevent theft and break-ins in order to reduce the risk of property loss and ensure personal safety. However, the majority of people use traditional locks with low security protection. A well-functioning lock will protect your home very well. Therefore, we decided to introduce a smart lock that has the convergence of cloud computing and Internet of Things (IoT) technology.

Smart locks are keyless locks that allow you to open or lock your door without using physical keys. They can be controlled remotely by using a smartphone app. With the advanced technology development, most people have a smartphone. Therefore, we believe that most people are well placed to use smart locks in daily life.

1.2 Problem Definition & Suggestion of Potential Clients

In the locks market, traditional locks and password locks are currently the most purchased. However, the security protection of these two types of locks are very low. Traditional locks are not automated and must be engaged manually in order for the locking mechanism to operate. It needs a key to lock or unlock the door. We need to duplicate many keys in order to prevent the key loss.

Password based door lock is a lock that uses the Arduino Uno system and once you enter the correct password, you will be able to unlock your door. However, we need to remember the password of the lock. Once you forgot the password, you are not allowed to unlock your door. Both locks have low security protection because whoever has your key or whoever knows your password will be able to unlock your door.

Therefore, smart locks ensure you have a high security protection in your home. The smart locks allow you to unlock your door by using retina, fingerprint. You are also allowed to use a smartphone application to remote your door.

The clients of the smart locks can be your neighbors, relatives, family members or friends because smart locks can be applied in your home. This smart lock is for the mass market and can be owned by everyone who wants to improve the security of their home.

1.3 Proposed Solution

The proposed solution is to create smart locks with the convergence of IoT-based technology and cloud computing technology that will improve the security of the gates and doors by providing an automated and convenient security management system that is efficient, easy to handle, and updated in real-time.

The smart lock performs security functions as it is less likely to be broken into by thieves or outsiders and protects the expensive items in your house. The smart lock is a digital lock that has dual types system------biometric lock system and smartphone application system. A biometric lock system is a system that users activate these locks with their fingerprint or retina. A smartphone application system is a system that allows users to use the application on their phone to unlock the door.

To illustrate, the fingerprint sensor and retina sensor will be designed in the smart lock. Furthermore, an application also will be created for the smart lock.They can be controlled remotely using a smartphone application. The application will have a lot of functions such as unlocking records and remote updates. As a result, all the designs of the smart lock are for improving the security system and anti-theft system.

1.4 Goals

The smart locks are able to ensure the clients' home security by improving the security system. It can decrease the risk of the burglar or robber breaking in and avoid the clients from property loss. The smart lock is equipped with an easy-to-use smartphone app. This ensures many clients can understand and handle the app easily. The smart locks also need to have convenient features such as we just need to use your fingers to remote the door. Furthermore, the smart locks are able to provide a biometric recognition system. By comparing to the traditional locks, smart locks have high security protection.Therefore, nobody can easily break in.

2.0 Internet of Things (IoT)

2.1 Introduction to IoT

In the year 1999, a member of the Radio Frequency Identification (RFID) development community invented the concept of IoT (Internet of Things). Due to the growth of cloud computing, data analytics etc, IoT is rising unexpectedly which is applicable to the practical world. Nowadays, there is a very high demand for the development of Internet applications and IoT has become the major technology to produce various useful Internet applications.

The definition of IoT is a network of all physical objects that are connected to the Internet. It is a system that interconnects the computing devices, machines, objects, human or animals with unique identifiers and the ability to transfer and collect data over a network without any human interaction. There are three categories for IoT, which is people to people, people to machine and machine to machine. Furthermore, IoT not only included computers' networks, but it also included numerous types that have evolved into a huge number of devices such as cameras, home appliances and buildings. Smart Home, Smart Cities, Connected Car and wearables are some of the examples of IoT applications.

Undoubtedly, IoT is the prompt growth of the Internet that helps us to ease our task in a faster way. The rise of the Internet of Things enables the system to connect to the physical object to be able to collect and exchange data from time to time using embedded sensors. Speakers, refrigerators, air conditioners and other electrical devices that we commonly use in our daily life are connectable to the IoT.

2.2 Smart Door Lock

Smart Door Lock is conducted as one of the IoT devices in Smart Home. It offers additional functionality through compatibility with other IoT devices, smart assistants, and Smart Home Management System. A smart door lock can be used in many different places such as campuses, houses, offices, and others for improvement of the safety system. With the use of smart door locks, people can enter the places or provide others access without requiring the traditional key. Instead, the people can enter the places by using their smartphone or get access with the recognition of the biometric scanner such as fingerprints scanner or iris scanner. It also can receive and collect all the data such as user information, the time entering or leaving the room and so on. This helps the authorize to monitor access and all the collected data will be stored in database or cloud computing. It will send a piece of alert information to

the authorized person for different events it monitors and some other critical events related to the status of the device.

Smart door locks have provided many benefits compared to traditional key locks. One of the significant benefits is that smart door locks are more secure than traditional key locks. This is because smart door locks are not easy to break and it also can record data about the time and people enter/exit through the door. Other than that, smart door lock does not require traditional keys for the purpose of unlocking or locking the door. This might prevent the people from forgetting to bring along with keys when they need to enter a room.

3.0 Iot Architecture Planning in Smart Lock System

3.1 Basic Structure of IoT Architecture

The IoT architecture is designed to help enterprises leverage the interconnectivity of smart devices and their systems which is important for the processes of data collection, filtering, and transfer to edge infrastructure and cloud-based platforms. In the basic structure of IoT architecture, there are 3 major layers involved, which are Application Layer, Network Layer and Perception Layer. These layers are further discussed below:

1. Application Layer: This layer is placed at the top of the architecture which is responsible for delivering application-specific services to users. In our case, this layer is used to interpret and store the collected data.

2. Network Layer: It is the middle piece of a layer in architecture, responsible for connecting to other smart devices, network devices, and servers for transmitting and processing processed information presented by the sensor layer. It is considered the most important layer in the system.

3. Perception Layer (Sensor Layer): This physical layer is considered the lowest layer amongst the three layers and is implemented at the bottom of the IoT architecture. In this layer, physical devices are communicated through smart devices like sensors and actuators for sensing and gathering information from the environment.

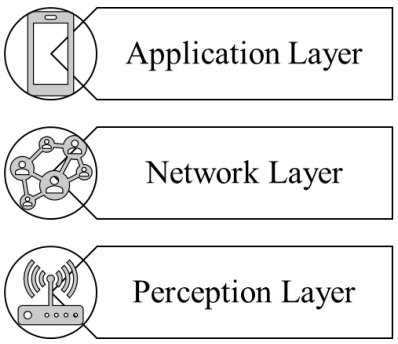

Figure: Basic Structure of IoT Architecture

3.2 Basic Structure of Smart Lock

The Smart Lock consists of major components: an electronic device capable of receiving instructions to unlock/lock the door, a mobile device (Smartphone Application) for sending instructions, and a remote web server handling database. For database applications handled by the webserver (AWS), we will have a further description of cloud computing and its architecture involved in our Smart Lock. Besides, there are two common network system designs for our Smart Lock: the DGC model (Device-Gateway-Cloud) and DIC (Direct Internet Application).

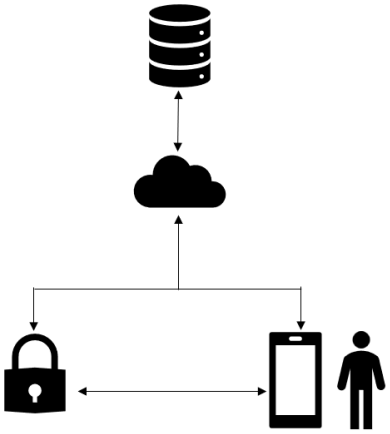

Figure: Naive Overview of Smart Lock System

3.3 Computing Concept

Currently, there are many computing concepts like "Grid computing", "Cluster computing" and "Cloud computing". In our design, we'll be choosing cloud computing. Cloud computing is a computing standard where several entities of a system are connected to a private or public network. It provides dynamically scalable support and foundation for application, data, and file storage for our application.

3.3.1 Cloud Computing Architecture

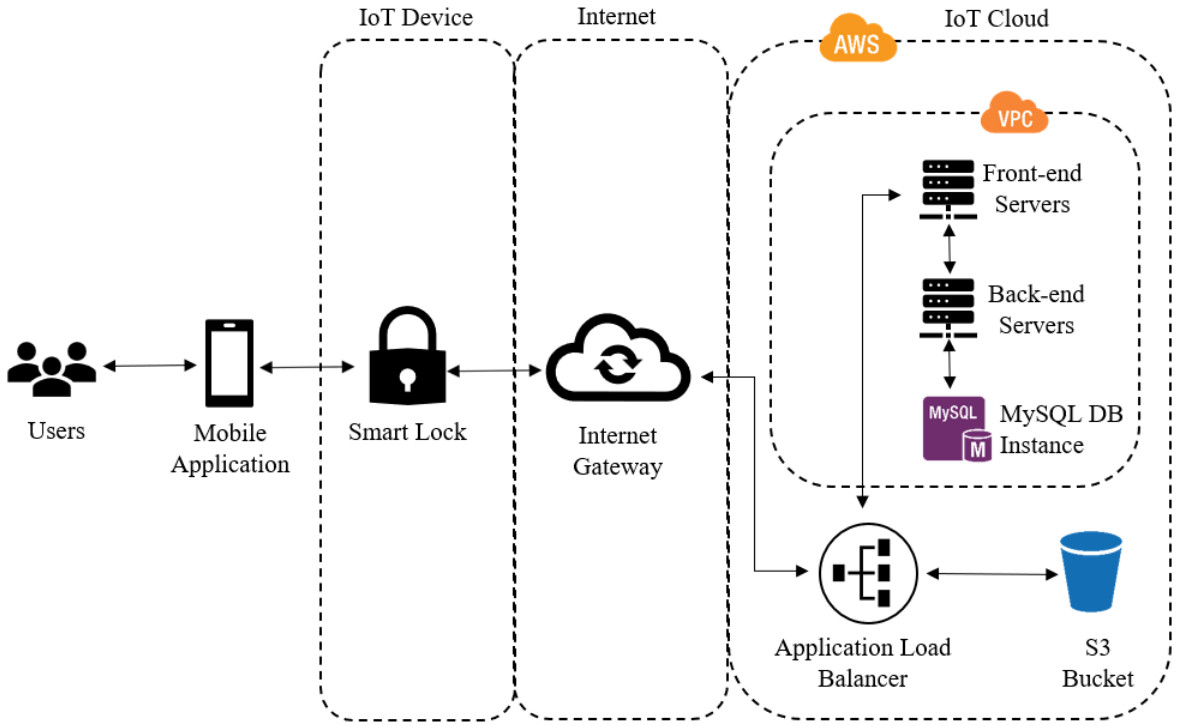

Figure: IoT Cloud Computing Architecture

Below are further explanations on each element in IoT Cloud:

Front-end Server – The main function performed by the front-end server is to channel the requests from the clients and it takes care of generating the database views through database read operations using a completely stateless architecture. And hence, this helps in providing accurate information at all times. Besides, the front-end server is an extension of the back-end server which is designed to provide scalability. Multiple front-end Servers can be connected

to a back-end server and each Front-end server can have multiple clients connected to itself in a distributed setup.

Back-end Server – The back-end server runs the code behind, receiving requests from the clients and sending the appropriate response back to the clients. For the database, the back-end server will persistently store all of the data for the application.

MySQL DB Instance – In our design, MySQL DB instance is used to create a MySQL DB instance and connect to a database by using AWS Management Console (Amazon Relational Database Service under database section).

Application Load Balancer – Load balancing is essential in a cloud environment with multiple web services, and hence, Application Load Balancer plays an important role as a feature of Elastic Load Balancing. It allows developers to configure and distribute incoming end-user traffic to applications based in AWS public cloud.

S3 Bucket – S3 Bucket is a public cloud storage resource available in Amazon Web Services' Simple Storage Service (S3). Basically what S3 Bucket does is provide object (file) storage through a web interface for storing, protecting, and retrieving data within resources, so-called "buckets".

3.4 Network System Design

3.4.1 Direct-Internet-Connection (DLC)

The system will implement the Direct Internet Connection (DIC) network design. By following the DIC the system can bypass security challenges such as Revocation evasion and Access Log evasion. This is avoided because the lock device is directly connected to the internet via Wi-Fi instead of relying on the user endpoint for an internet connection. If the device has a direct established connection to the API and database it can instantaneously log events and revoke illegitimate digital keys. Hence, the DLC network system enables the process of transferring data to become faster than other networks.

3.4.2 Device-Gateway-Cloud (DGC)

However, we have to plan a backup network design for unpredictable emergency cases like sudden black-out and natural disasters which may cause DLC network systems cannot to work in the proper way. Therefore, we come to our backup plan by using the Device-Gateway-Cloud network. DGC relies on the user interaction point (Mobile application) to act as a gateway to the internet. Generally what DGC does is serve as a wireless access portal to give Smart Lock access to the Internet by connecting the user's devices to Cloud IoT Core through HTTP protocol.

4.0 Conclusion

Undeniably, IoT has prompted growth in the 20th century. Most of the systems nowadays are linked with IoT which can ease our jobs in our daily life. Thus, the smart door lock is then implemented which is connected to the IoT which can protect the users more compared to the traditional key lock. Before the implementation of this smart door lock, it is important to know deeply about IoT in order to produce a high quality product which can keep the users in the most safe condition.

In our project, we have designed a smart door lock that may replace the traditional door lock. The smart door lock implemented can be unlocked using many ways, that is fingerprint recognition sensor, hidden key lock, NFC sensor, unlock using application and other ways. The alarm system enhances the security of the owner of the houses, companies, or other departments. All in all, the smart door lock is easy to use, while it brings numerous benefits to the users compared to the traditional door lock.

5.0 References

How Do Smart Locks Work? (2019, March 4). Vivint. Retrieved December 15, 2021, from https://www.vivint.com/resources/article/how-do-smart-locks-work

IoT based Smart Door Lock System using NodeMCU. (2020, January 21). IoT Design Pro. Retrieved December 15, 2021, from https://iotdesignpro.com/projects/iot-based-smart-door-lock-system-using-nodemcu

KRISTOFFER DJUPSJÖ. (n.d.). *IoT Security Applied on a Smart Door Lock Application*. DiVA. Retrieved December 15, 2021, from https://www.diva-portal.org/smash/get/diva2:1216681/FULLTEXT01.pdf

López, P. -., & Peña, I. (n.d.). *Internet of Things: Architectures, Protocols, and Applications*. Hindawi. Retrieved December 15, 2021, from https://www.hindawi.com/journals/jece/2017/9324035/

Reed, H. (2017, February 20). *Smart Locks vs Traditional Locks: What's More Secure?* United Locksmith. Retrieved December 15, 2021, from https://unitedlocksmith.net/blog/smart-locks-vs-traditional-locks-whats-more-secure

Reynolds, I. J. (2020, July 23). *IOT Architecture: 3 Layers, 4 Stages Explained*. Zibtek. Retrieved December 15, 2021, from https://www.zibtek.com/blog/iot-architecture/

Smart Retina Door Lock. (n.d.). System Technology Services Ltd. Retrieved December 15, 2021, from https://stsbiz.ca/product/smart-retina-door-lock/