

IoT Enabled Smart Door Locks

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Abstract: Home security is one of the major challenges faced by individuals who are frequently out of home due to their work schedules. Percentage of thefts, robbery, lock picking, unnecessary intrusion and threat to personal belongings have substantially increased in the recent times. The advent of Internet of things (IOT), have found its use in the upgradation of things we come across in our daily life. Its application in lock system, provides a revolutionary means for home security and facilitates human kind for more automated locking and unlocking system for their residences. The paper gives an overview of the recent technology used for making the door locks accessible from a smart device (like a Smart Mobile Phone), and use of means like GPS tracking and Bluetooth Connectivity for an automated Door Lock System. Sensors, cameras, alert messages, visitor identification and other features make Smart Locks a step higher than the traditional key system people all across the world have been using for several generations. IOT foreshadows the future, where everyone and everything will be connected to the internet and Smart door locks are proving to be a part of it.

Keywords: IOT, Digital, Smart, Door, Lock, Security, Internet, Home, Technology, Thefts, Keyless

I. INTRODUCTION

The Internet of things (IoT) describes physical objects or groups of physical objects that are embedded with sensors, detectors, processing capabilities and other technologies that connect and interchange data with other devices and systems over the internet or other communications networks [2]. Enhancing home security using smart home can be done in a number of ways, including installation of smart, customized door lock with the use of IOT technology. In apartments or complexes, for an owner having many keys for each and every apartment, car or gate he owns, maintaining entry to authorised persons only is a problem. If the keys are in case lost, along with the costs involved in fabrication, duplication and distribution of keys, security issues are still present.



Figure 1: Smart Door Lock System

This study summarizes the use of IOT and application of smartphone communication technology to open or close the door locks remotely through authentication. Several examples of digital door lock systems have already existed, such as camera-based door security systems, doors with digital keypads for password authentication, fingerprint detection, smart card, and proximity or location detection.



Figure 2: Digital Door Lock

Smart locks provide users the ability for locking and unlocking their door without a key, without geographical restrictions, as well as distribute virtual keys to visitors. [3] IoT-enabled smart locks provide sensors to operate keyless entry devices that allow users to access doors remotely, through a smartphone or other Internet connection compatible devices. In the broadest definition, a sensor is a device, module, or a sub-system whose purpose is to detect motion or changes in its surroundings and send the information to other electronics, mostly a computer processor. More than one such sensors can be manufactured as micro sensors using Micro- Electromechanical System (MEMS) technology. MEMS is a miniature machine that has both electronic and mechanical components. They usually consist of a central unit in the form of integrated chip like microprocessors, that processes data and several components that interact with the surroundings.

II. LITERATURE SURVEY

Many researches and experiments lead to the various different ways to develop a IOT Based Smart Lock Systems. IOT technologies like NodeMCU and Arduino are also used in different forms to fulfil the need of smart, digital locking system. NodeMCU is an open source firm-ware which can connect objects and let data transfer using Wifi-protocol. [9] Arduino boards are open source electronics that are able to read inputs such as light on a sensor, a finger on a button, or a message and turn it into an output for further alerts or processes [7]. Some projects are carried out by researchers and developers to modernize the digital and smart lock systems using different techniques supplementary to IOT.

2.1 Smart Locks using micro SBC's

The system consists of two components, Embedded Control Unit (ECU) which is embedded at the door lock where security system is implemented and Remote Control Unit (RCU) which is a framework installed on user smart phone [1]. An Electromagnetic door lock module is present to operate the door accessibility. A PIR sensor (Passive Infrared Sensor) and Camera module are used to detect motion and capture images respectively. The system uses controller interface system with Raspberry Pi (a series of small single-board computers (SBCs)) which is low cost and consume smaller amount of power. Whenever some visitor motion is sensed, Camera module connected to Raspberry Pi capture images, along with saving the image on the system email alerts are sent to the user device. The authorized user can control the system and can also view live stream of camera module through their Smart Phone. The system also facilitates concerned authority to send command for voice messages or alerts when visitor or intruder identified.

2.2 Smart Locks using GPS tracking

In this research, a GPS-based smart door lock is designed. [3] The ultimate aim of this implementation is to design a door lock system that is automated and does not need manual input for locking and unlocking, while also being secure. The door lock works like a switch, taking into account the user's proximity from the door. A Central Control Module is embedded in the door for a more secure coordination of the system and for providing a robust mechanism for locking and unlocking the system. Two separate programs are required to operate the lock, the one inside the microcontroller and the android software on user smart phone to transmit GPS coordinate of the user to the system at door. The system can

embed itself in the local area network of the home surroundings, which enables extra security layers and restricts access to the system only through the network.

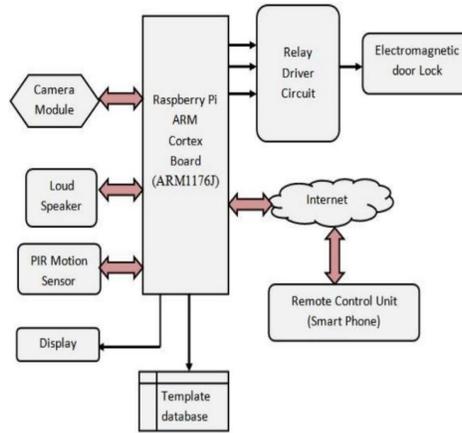


Figure 3: Smart Door Lock System using Micro SBC's

The Android application that serves as user interface of the system, periodically detects the GPS coordinates of the user device and sends it to the server to be compared with the house's GPS coordinates. If the distance is less than the set proximity in meters, the application will send command to the control unit to unlock the house, which will be passed on to the hardware for door unlocking. On the contrary if the proximity does not meet the set distance, the system will remain in its locked state. Facilities like alert messages on unnecessary intrusion and visitor motion detection are also provided similar to the manual input smart locks.

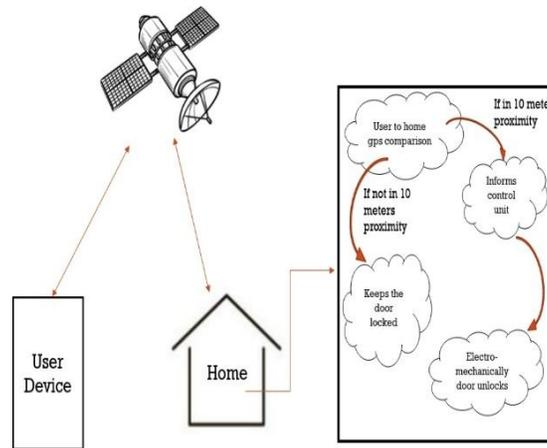


Figure 4: Smart door lock using GPS tracking

2.3 Smart Locks using Bluetooth Connectivity

This Smart Door uses Bluetooth [5] for sensing nearby user. This smart door lock system is mainly designed to have control over unlocking the entrance even at places with rush like office workplaces. This project rely on three major hardware components: a microcontroller unit, a Bluetooth transmitter and a smartphone device. The user application will communicate via Bluetooth to the lock only to tell if a specific user is nearby. Both the lock and the application will have separate communication channels that securely transmits to the API via a cloud service. The API will accept various requests and either send commands back to the digital lock and/or feedback response to the user application. For the door to only unlock itself for authorized people, strong Bluetooth signals for accurate user detection must be used. This is

achieved by implementing Bluetooth Beacons. These Beacons contains small processors, batteries, antennas and are specialized for handling Bluetooth communications.

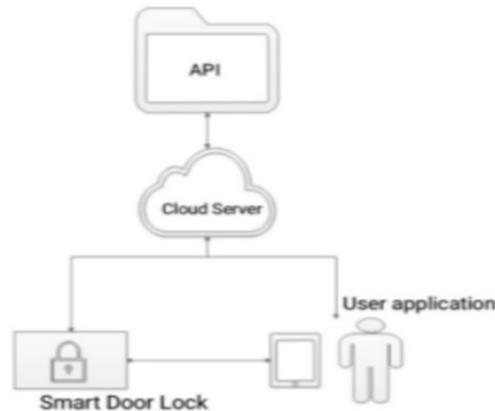


Figure 5: Smart Door Lock System using Bluetooth Connectivity

III. FUTURE SCOPE

The data sent and received of existing Smart Door Lock system is vulnerable to unauthorized access and hacking [4]. If the network between user and smart lock is achieved by opening the smart door for the external signals, it provides least security to the data being transferred. Second alternative is to use an intermediate server in the cloud to hold the status of the lock that will be actually modified, while it is monitored by the Smart Lock to execute the request. But it poses another type of concern, [6] their security is probably much stronger than the first option, but they are also the target of 99% of all serious hackings, so the risk is still high. Also control is in the hands of a third party which provided the Smart Lock system. Threats to data selling and manipulation are to be considered. Blockchains can be used for data security in these systems. Blockchain is another emerging concept in the Technological field, it consists of blocks which are connected in the form of a chain through hash codes. Each block contains the hash of its preceding block, which makes it nearly impossible to access data through any unauthorized intruder. If any information is attempted to be changed in a certain block, its hash code changes and thereby every block thereafter will have the wrong hash code. Blockchain can be used as a cloud server to remotely access the home device, only the owner of the blockchain account that deployed the smart contract is the one allowed to execute it and to operate the smart lock, which means that the system is completely secure, as no successful attempts of cracking a blockchain wallet have been reported to date.

IV. CONCLUSION

Through the study of one of the Emerging trends in Technology- IOT Based Smart Door Locks and reviewing the research experimentations of researchers, various advantages of this system could be noted:

1. Smart locks are compatible with other smart devices, which can provide implementation of a smart home or workplace.
2. Users can ensure the safety of their residences, even when not present there physically.
3. Authorization access can be given or revoked to visitors and service providers for particular time or permanently.
4. Notification of door unlocking is sent for user to verify its them. Thereby giving more security if someone succeeds in unlocking the door through false means.
5. They eliminate the threat of lock picking, robbery, unauthorised intrusions and other local threats a household or other fraternities might be facing.

But every technology has some pros and cons, so the following disadvantages can be noted through this study:

1. The Lock System is highly reliable on the user Smartphone. In case of phone failures, extra efforts are needed to be put, to access the home using backup system.

2. Batteries and Electricity are prone to die at certain point, backup System is required for such cases or the other option is to damage the lock.
3. The System is comparatively expensive as the production costs are also high.
4. Even if development is being made to reduce data hacking, the probability of hack attacks, through networks is an issue that cannot be ignored.

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