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IoT-based Smart Door Lock System with Remote Access using Raspberry Pi

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ABSTRACT: One of the biggest issues for those whose job schedules need them to be away from home a lot is home security. The frequency of thefts, robberies, lock picking, unwarranted intrusions, and threats against personal property has significantly grown recently. The development of the Internet of Things (IoT) has improved many items that we use on a daily basis. Its use in lock systems offers a ground-breaking method for home security and makes it possible for humans to have more automated locking and unlocking systems for their homes. This study proposes a smart door lock mechanism that can be fully monitored and operated from a distance using a smartphone. A Raspberry Pi with an HD camera attached turns on and powers up when a visitor pushes a calling bell/push button at the door, alerting the owner with a message. By sending the visitor a pre-set password, the owner can easily remotely open and lock the door based on his willingness.

KEYWORDS: IoT, Smart Bell, Raspberry PI, Home Security, Digital door lock system; home automation; GPRS; Sensor node

I. INTRODUCTION

Technology now permeates every aspect of people's lives. It has an impact on many aspects of daily life and enables better social interaction, simple transportation, the capacity to indulge in entertainment and media, and aids in the development of medicine. Many individuals are now dependent on technology for communicating with friends and storing and retrieving information like photographs, movies, papers, and music. This is because of the invention of various devices like cell phones and laptops. Many devices use the World Wide Web as a standard interface to make daily life easier for many people [1]. The Internet has been a trailblazer in offering quick fixes for a variety of issues and giving the capacity to connect all remote locations, which has significantly reduced costs and energy usage. Home automation, often known as an intelligent home, is the introduction of technology into the home environment to ensure the comfort and safety of its occupants. The Internet of Things is a technology that is used to analyze and implement home automation.

The completion of this project is a significant step towards the creation of smart homes and communities. With the growing popularity of online shopping combined with the more traditional methods of delivery, we have come to the realization that it is a huge annoyance for both the client and the delivery person if the person to whom the package is being delivered is not present at their residence when it is being delivered [2]. This rule applies not only to strangers but also to close friends and family members who might drop by unexpectedly. The fact that we are unable to get a good view of the person who is on the outside poses another potential security risk. The elderly population is another common target for robbery and other forms of criminal activity. Therefore, the two-pronged problem that has been recognized is as follows: There is no intelligent way for the owner of the house to be told about the guest in the event that he is outside or unable to hear the bell, and there is no intelligent way for the owner of the house to speak with the visitor at the door and give them instructions in the event that they are unable to hear the bell [3].

The use of the microprocessor known as Raspberry Pi to power the smart doorbell provides a solution to the issue of guests being unattended in the event that the responsible party is not present. This smart doorbell will notify you on your smartphone whenever the doorbell rings, and it will also allow you to view who is at your door at any time and from any location. The most significant feature is the ability to live stream the footage of your front door to your device, regardless of whether that device is a mobile phone, a laptop, or even a television, depending on how the Raspberry Pi has been configured. The Internet, of course, is being used as a medium. [4] The 'Face Recognition' module that is incorporated into the system can differentiate between a known visitor and an unfamiliar visitor, and it can then enable or disable notifications depending on the user's preference settings.

II. LITERATURE REVIEW

In recent years, most sectors have focused on machine learning, artificial intelligence, big data analytics, and IoT-based projects to make things easier and smarter. [5] These became needed for digitalizing with a lot of security tools, making our daily locks smart and making locks movable with a stepper motor. They also need a digital number pad to get user input and an infrared or Bluetooth module to operate all these devices. Face recognition door locks don't need a stepper motor and detect faces using saved photographs in the application programme. We removed unneeded stepper motor and driver components from previous models. We now offer unmatched facial detection to open and close the door. It opens the door with a relay module and solenoid lock and is distinctive and easy to operate [6].

Smart Locks using micro SBCs, The system is comprised of two primary components: an Embedded Control Unit (ECU) that is integrated within the door lock to facilitate the implementation of the security system, and a Remote Control Unit (RCU) that serves as a software framework loaded on a user's smartphone. The door accessibility is facilitated by the presence of an Electromagnetic door lock module. The detection of motion and the collection of images are accomplished through the utilization of a PIR sensor, also known as a Passive Infrared Sensor and a camera module [7]. The system employs a controller interface system that incorporates Raspberry Pi, a collection of compact single-board computers (SBCs), known for their affordability and energy efficiency. When a visitor's movement is detected, a Camera module that is attached to a Raspberry Pi device captures photographs. These images are saved on the system, and email notifications are delivered to the user's device. The authorized user possesses the capability to manipulate the system and is also able to access a real-time video feed from the camera module via their mobile device. The system additionally enables relevant authorities to provide directives for voice messages or notifications upon the identification of a visitor or invader [8].

The project known as "Dash Bell: A Low-cost Smart Doorbell System for Home Use" gives homeowners the opportunity to enhance the level of safety provided by their existing doorbell setup. This project makes use of cutting-edge technology, including Amazon Web Services (AWS), MySQL, and cloud computing. Due to the fact that the notification is delivered via a buzzer whenever the doorbell or dashbell is pressed, this project is not primarily intended for individuals who have a hearing impairment. It provides a live feed on the application, and users have the ability to either accept or decline the offer to save data in the cloud [9]. The fact that connections are formed using Wi-Fi and internet connections makes it an expensive endeavour. This is also one of the factors that contributes to the high cost. They intend to deploy neural networks in the not-too-distant future so that the doorbell itself will be able to recognise the individual at the door and determine whether or not to let them in.

This Smart Door detects nearby users through Bluetooth. This smart door lock system is meant to govern entrance unlocking in busy settings like offices. This project needs a microcontroller, Bluetooth transmitter, and smartphone. The user application will only connect with the lock through Bluetooth to detect close users. Separate cloud-based communication channels will connect the lock and application to the API. The API accepts requests and sends commands to the digital lock or feedback to the user app. Strong Bluetooth signals for accurate user detection are needed to unlock the door only for authorized users. This is done through Bluetooth beacons. Bluetooth-specific Beacons have modest processors, batteries, and antennae [10].

It is proposed in the paper titled "IOT Smart Bell Notification System: Design and Implementation" that the services offered by smartphones and home or building network systems should be combined. Its purpose is to enable remote access to an Internet of Things-based doorbell in order to monitor visits in real-time. When there is an attempted break-in within the property, the system will assist in identifying the intruder by using evidence from the CCTV cameras [11]. If there is ever a trespass on your property, this approach will be helpful in gathering the proof you need to instantly report it to the authorities or your home security company. The authors believe that this system has the potential to be further enhanced by the addition of voice recognition and facial recognition features because doing so will only serve to strengthen the system overall.

III. SYSTEM OBJECTIVE

The primary goal of the system is to mitigate the risk of unauthorized entry into residential or commercial structures. It aims to achieve this by enabling remote monitoring and control of access to residences, so offering a more secure and economically efficient approach to door-locking systems. Additionally, the system seeks to address the limits and disadvantages associated with current security systems. In the context of access control, it is necessary for individuals

requiring entry to possess a physical key and ensure its safekeeping. However, it is important to acknowledge the inherent risks associated with this method, as there exists a possibility of key loss, theft, or unauthorized duplication. Despite the owner's desire to grant access in their absence, the existing conventional system lacks the capability to remotely provide certain people with access without the physical keys.

IV. SYSTEM REQUIREMENT

[1] Raspberry Pi: The Raspberry Pi is a credit-card-sized, low-cost computer that can be plugged into a TV or computer monitor and uses a keyboard and mouse that are standard in most other computers. It is a competent tiny gadget that enables individuals of all ages to explore computing and to learn how to program in languages such as Scratch and Python. The device is called a Raspberry Pi.



Fig. 4.1: Raspberry Pi

[2] Raspberry Pi camera: Since April 2016, the original Camera Module for the Raspberry Pi has been replaced with the Raspberry Pi Camera Module v2. In comparison to the Omni Vision OV5647 sensor that was found in the first camera, which only had 5 megapixels, the v2 Camera Module features a Sony IMX219 sensor that has 8 megapixels. It connects to the Raspberry Pi's CSI port with a ribbon wire that is 15 centimetres long.



Fig. 4.2: Raspberry Pi

[3] GSM Module: A GSM module or a GPRS module is a chip or circuit that will be used to establish communication between a mobile device or a computer machine and a GSM or GPRS system. This communication can take place over a cellular network or over a general packet radio service (GPRS).



Fig. 4.3: GSM Module

[4] ARDUINO SECURED DOOR: The doors are accessible via information technology, which will be of great assistance to proprietors in monitoring their assets. Arduino is an open-source, hardware- and software-based, user-friendly electronic platform. Arduino panels can receive inputs from light sensors, fingers, buttons, and Twitter. It is matched with the existing database and grants access to the correct users. In this article, the authors have used a password consisting of digital buttons to secure the door. Internet of Things (IoT) commonly refers to the Internet connection of non-traditional devices such as computers and smartphones. Automobiles, domestic appliances, and even

heart monitors can be connected online. In the coming years, as the Internet of Things expands, more devices will be added to this list.

[5] IR Sensor: An infrared sensor, often known as an IR sensor, is a piece of electronic equipment that can measure and detect the presence of infrared radiation in its environment. In the year 1800, an astronomer by the name of William Herchel made the unintentional discovery of infrared radiation. While he was using a prism to separate the different colors of light and measure their respective temperatures, he found that the temperature immediately after the red light was the highest. Even though it exists on the same electromagnetic spectrum as visible light, infrared light cannot be seen by humans because its wavelength is far greater than that of visible light. Infrared radiation is emitted by everything that generates heat (that is, everything that has a temperature that is greater than approximately five degrees Kelvin).

V. SYSTEM REQUIREMENT

The Internet of Things (IoT) offers a multitude of advantages, which can be utilized to the advantage of workers, large organizations, and even regular sources. Taking advantage of this to integrate IoT into existing safety systems could be beneficial. Aside from the fact that the objective of the project is to integrate IoT into safety structures so that gestures may be noticed, one of the benefits of the project is that you will be able to observe and receive alerts in the event that an event takes place at the individual's residence. The proposed security system is comprised of a passive infrared (PIR) sensor that can identify the presence of a person even when the building's owner is not there. In addition to that, there is a vibration sensor that can detect the vibration caused by an intruder trying to force open the door. Additionally, an alarm will go off in the event that the burglar enters an incorrect passcode into the system. The buzzer will sound an alarm for everyone in the immediate area if any of these events take place. In addition, the status of the owner will be automatically updated within the program thanks to the Wi-Fi module.

In the system that is being proposed, we will have a database where authorized people will be listed by registering their faces. This will ensure that unauthorized people will not be able to enter the home unless the owner gives them permission to do so. If the intruder's face does not match any in the database, the system will send an email to the owner with a picture of the intruder along with a one-time password (OTP). If the intruder enters the OTP correctly, the door will unlock; otherwise, it will remain locked. The camera will be activated whenever someone presses the calling bell switch, and it will take a picture of the person who pressed the switch.

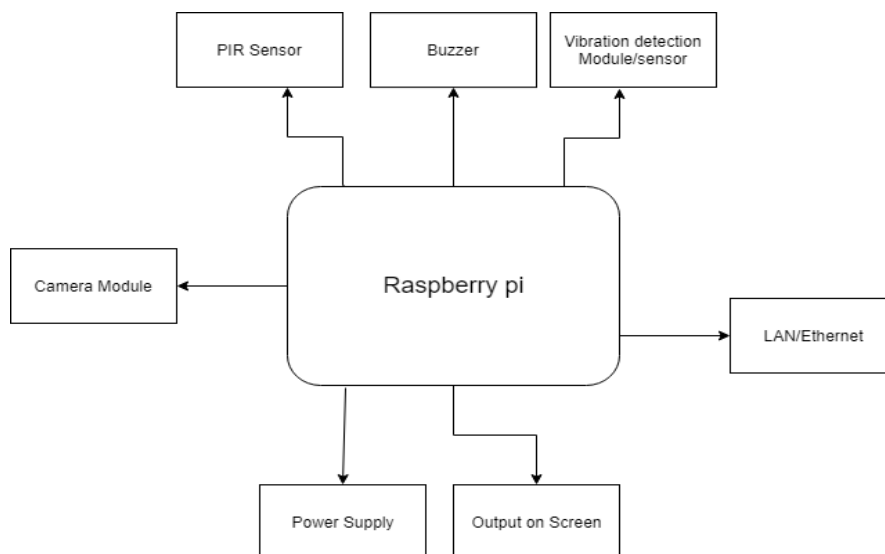


Fig. 5.1: Block diagram for the proposed system

IoT in individuals being a part of this world has several advantages, which can be of assistance to individuals, large businesses, and even regular sources. Taking advantage of this to integrate IoT into existing safety systems could be beneficial. In addition to the fact that the objective of the project is to include IoT into safety structures in order to

recognise gestures, one of the benefits of the project is that individuals will be able to observe and receive alerts in the event that a particular action takes place in their own home. The proposed security system is comprised of a passive infrared (PIR) sensor that can identify the presence of a person even when the building's owner is not there. In addition to that, there is a vibration sensor that can detect the vibration caused by an intruder trying to force open the door. Additionally, an alarm will go off in the event that the burglar enters an incorrect passcode into the system. The buzzer will sound an alarm for everyone in the immediate area if any of these events take place. Through the application, the Wi-Fi module will immediately provide the owner with an update on their state.

Connecting each component to Arduino Uno is the first step. Associating the Arduino compiler with the Arduino Uno and its accompanying components is the second step. Start dumping the code into Arduino Uno once it is connected to the Arduino compiler. After completing step 3's setup of the Arduino. There are numerous activities available, and it is the easiest to use. Later, a group of lines of code will appear when Arduino begins to stack. This will continue until the boot process is complete. The device then uses the provided secret key in conjunction with the provided code to start the engine.

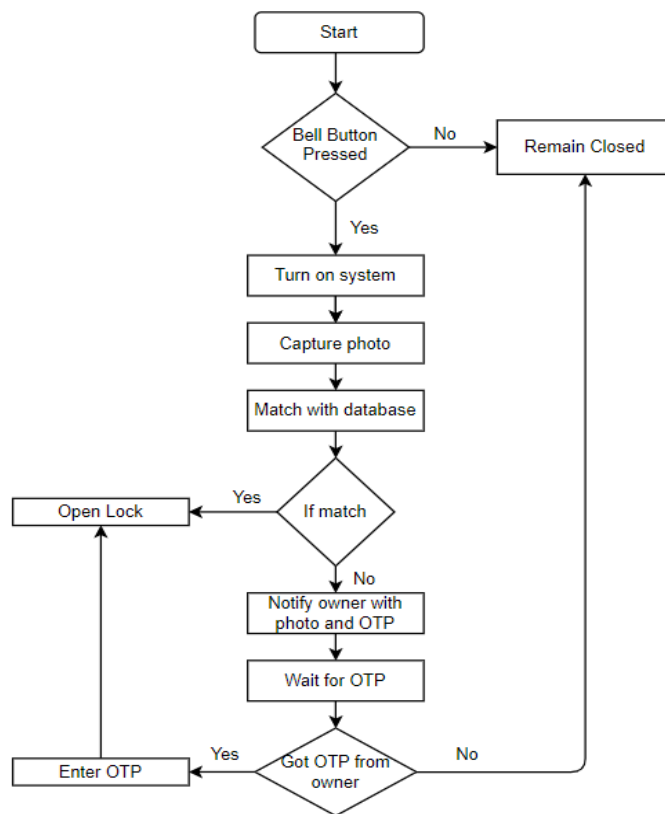


Fig. 5.2: Flowchart for the proposed system.

VI. CONCLUSION

The entire project takes a fresh look at the classic bell in comparison to the cutting-edge technology that makes use of the Internet of Things. Our homes are unquestionably more monitored and protected now that Raspberry Pi, cameras, sensors, and a variety of other essential modules are being utilized. The usage of this technology will unquestionably result in an increase in the safety of our homes. We suggested a network of real-time smart doors as a means of facilitating communication between customers and their home security systems. We employed a Raspberry Pi embedded system, which is installed on the door of a house so that we could deliver an effective solution to our customers. The system is dependent on video technology, which is an exceptionally well-liked form of technology for the provision of safety and security in urban areas. Raspberry Pi was chosen as our embedded system device of choice because of its robustness and dependability, making it ideal for tackling difficult and hard jobs. Making use of the

Internet of Things (IoT) and incorporating it into our day-to-day lives may be accomplished by merging the two technologies that are used in the system. These technologies give numerous benefits to boost the efficiency of communication between visitors and the owner of the house, as well as the safety of the home.

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