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Design and Fabrication of Smart Door Locking System with Internet of Things Enabled Home Automation System

Dr. K. Mariya Priyadarshini[1], A.Likith Aravind Swamy,[2] Chava Nikhil Sai [3], Mohammed Nusratulla[4]

Assistant Professor, Department of ECE, ALIET, JNTUK, Vijayawada, Andhra Pradesh, India[1]

Students, Department of ECE, ALIET, JNTUK, Vijayawada, Andhra Pradesh, India[2]

Students, Department of ECE, ALIET, JNTUK, Vijayawada, Andhra Pradesh, India[3]

Students, Department of ECE, ALIET, JNTUK, Vijayawada, Andhra Pradesh, India[4]

ABSTRACT: In India In light of current circumstances entryways (Doors) are controlled and opened using keys, Passcodes, Patterns, Keycards and Fingerprints. These systems can be cracked at some extent but using Face recognition system in which whole Face is used as access. Face is a complex multidimensional structure and needs great registering procedures for location and acknowledgment it is difficult to split. Face recognition systems have upgraded individual recognizing evidence and affirmation, expecting a basic part in individual, national, and overall security. The face is detected by using the viola jones method and face recognition is implemented by using the Local Binary Patterns Histograms. Face Recognition based on LBPH is to abridge the nearby structure in a picture by contrasting every pixel and its neighbourhood. Initially the authorized Faces are trained into a local database. These Database faces are compared with the captured test image. In the event that a face is perceived, it is known, else it is obscure. The door will open automatically for the authorized person due to the command of the Raspberry Pi to the door motor. Then again, Alarm will ring for the obscure individual. Keywords: Viola-jones, LBPH, Raspberry Pi.

KEY WORDS: Raspberry Pi, DHT sensor, Gas sensor, Water Level Sensor, Pi Cam, Blynk, Python.

I. INTRODUCTION

In India, amidst current circumstances, entryways are managed and accessed using various methods such as keys, passcodes, patterns, keycards, and fingerprints. While these systems may have vulnerabilities, the implementation of facial recognition technology offers a more robust solution. Facial recognition leverages the complexity of the multidimensional structure of the face, making it challenging to breach. This technology significantly enhances individual identification and authentication, playing a vital role in personal, national, and global security measures. The Viola-Jones method is employed for face detection, while the Local Binary Patterns Histograms (LBPH) technique is utilized for face recognition. LBPH simplifies the local structure in an image by comparing each pixel with its neighbors. Initially, authorized faces are trained and stored in a local database. When a test image is captured, it is compared with the faces in the database. If a match is found, the individual is recognized and granted access, triggering the Raspberry Pi to command the door motor to open automatically. Conversely, if the captured face is unrecognized, an alarm is triggered to alert of the presence of an unknown individual. Keywords include Viola-Jones, LBPH, and Raspberry Pi.

II. OBJECTIVE

The main objective is to detect the face of the individual who is trying to enter the house and to detect weather that person has the access to enter the house or not. This model proposes a cost-effective solution to the problem of security for the elderly people and make sure they don't face any danger, so that many lives will be saved.

III. EXISTING SYSTEM

In the existing system uses Arduino to detect the face and give access digitally through a smart phone which needs the elderly to give access to it but as some times the elderly people may not be able to give access to the person who wants to enter the house that will lead to the inability to enter the house and can cause some conflict.

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IV. PROPOSED SYSTEM

The proposed system overcomes the limitations of the existing system that are used for the detection of Face and allowing the access to the person. The proposed system automatically detects the face of the person when they come Infront of the Pi cam and matches the face with the face of the already given pictures. if the frames of the person infront of the Pi cam matches with the frames the person in the pictures given to it then it will allow the person the access to enter the house, if the face doesn't match then the alarm will ring. As an extension we also added the home automation for the convenience of the elderly people.
Hence the proposed system is efficient and cost effective.

V. BLOCK DIAGRAM

The fig 1 shows the block diagram of the proposed system.

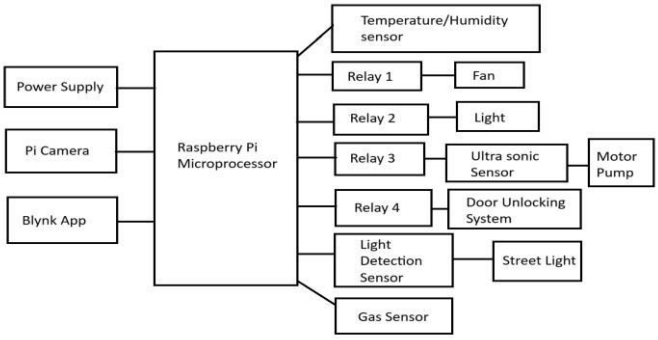

Fig -1: Block diagram

VI. SYSTEM DESIGN

6.1 Raspberry Pi

Fig -2: Raspberry Pi

Raspberry Pi is a series of small, single-board computers designed to be affordable, accessible, and versatile. These compact devices were created by the Raspberry Pi Foundation, a UK-based nonprofit organization, with the primary goal of promoting computer science education and enabling individuals to learn, experiment, and tinker with computing and electronics. Since its inception in 2012, the Raspberry Pi has gained widespread popularity, becoming a cornerstone in the world of DIY electronics, programming, and embedded systems.

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6.2 Raspberry pi OS

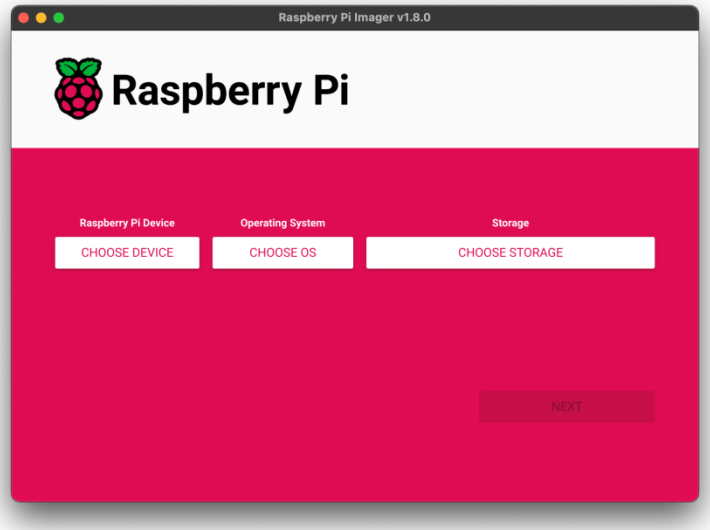

Fig -3 Raspberry pi OS

An operating system (OS) is a fundamental software component that serves as the bridge between computer hardware and the applications and users who interact with it. It is the core system software that manages the computer's resources, such as the CPU, memory, storage devices, and peripherals, while also providing a user-friendly interface for human interaction. The primary functions of an OS include task management, memory allocation, file system management, and input/output control. It acts as a control center, ensuring that multiple processes can run concurrently, sharing resources efficiently and securely. The OS abstracts the hardware complexity, enabling software applications to run on a wide range of hardware configurations without needing to be tailored for each specific setup. Whether it's a personal computer, server, smartphone, or embedded device, an OS is essential for the effective operation and management of computing systems. It plays a crucial role in ensuring that users can interact with their devices, run applications, and perform tasks with ease.

6.3 DHT Sensor

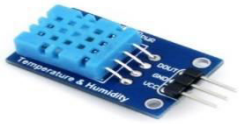

Fig -4 DHT sensor

The DHT11 sensor is a compact and cost-effective digital temperature and humidity sensor widely used in various applications, particularly in the field of electronics and IoT (Internet of Things). Developed by Aosong Electronics, this sensor is designed to provide accurate and reliable measurements of temperature and relative humidity. The DHT11 sensor consists of a humidity sensing component, a temperature measuring component, and an integrated analog-to-digital converter and signal conditioning circuitry. It communicates with microcontrollers through a single-wire digital interface, making it easy to integrate into projects. With its simplicity, affordability, and ability to provide basic environmental data, the DHT11 sensor is a popular choice for weather stations, home automation systems, and other projects where monitoring temperature and humidity is essential.

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6.4 Relay module

Fig -5: Relay module

A relay is an electromechanical switch that operates by using an electromagnetic coil to control the switching of one or more electrical circuits. It serves as an interface between low-voltage control signals, such as those from microcontrollers or digital logic circuits, and high-voltage or high-current loads, like motors, lights, or appliances. When a small voltage is applied to the coil, it generates a magnetic field that attracts a movable armature, which is mechanically connected to one or more switch contacts. This magnetic force causes the switch contacts to change position, either opening or closing an electrical circuit. Relays are crucial in situations where you need to isolate or protect low-voltage control systems from high-voltage or high-current loads, making them an essential component in automation, robotics, industrial control, and many other applications. They provide a safe and reliable way to control electrical devices remotely or based on specific conditions.

6.5 Making of PCB

One of the most discouraging things about making a hardware project is building the printed circuit board-PCB.it is sometimes possible to use strip board or some other pre-fabricated board but more often than not the circuit complexity and performance requires a proper PCB to be made .The good news is that due to improvements in printing and processing technologies it is now relatively easy to make inexpensive high quality PCB's at home.

WARNING-Making PCB's requires the use of Ferric Chloride(FeCi3) which is corrosive so avoid skin and eye contact .Remember safety-first so, use glasses, gloves and protective overalls .Ferric Chloride is also very good at distorting cloths weeks after you think you have washed it off. If you do get any on your skin then wash it off immediately with lots of water and soap.

6.6 Power Supply

Fig-6: Power supply 12V 1A

A 12V 1A SMPS (Switched Mode Power Supply) is an electronic device that provides a stable and regulated direct current (DC) output voltage of 12 volts with a maximum output current of 1 ampere. These power supplies are commonly used to deliver power to various electronic devices, such as routers, modems, LED lighting systems, and low-power electronics. The term "switched mode" in SMPS refers to the efficient switching technology it employs to

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regulate voltage and current, making it more energy-efficient and compact compared to traditional linear power supplies. The 12V 1A rating means it can deliver up to 12 watts of power, which is suitable for devices with relatively low power demands. These power supplies are known for their reliability and versatility, making them a popular choice for a wide range of applications in electronics and telecommunications. They ensure a steady and precisely regulated power source, which is essential for the reliable operation of electronic equipment.

6.7 Water Level Sensor

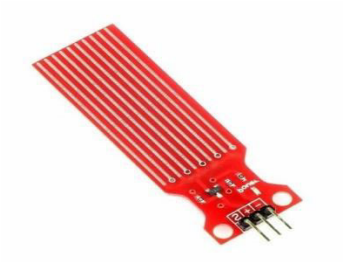

Fig-7: Water Level Sensor

A water level sensor is a specialized electronic device designed to detect and monitor the presence or height of water in a particular location, such as a tank, reservoir, or water body. These sensors can be used in a variety of applications, from managing water resources and controlling water levels in industrial processes to ensuring safety and preventing flooding. Water level sensors operate on various principles, including pressure sensing, capacitance, ultrasonic waves, or float switches. For example, a float switch-based water level sensor typically consists of a buoyant float that rises and falls with changing water levels. When the float reaches a certain height, it triggers a switch, signaling that a specific water level has been reached. These sensors are essential tools for maintaining water levels within specified limits, automating water pumping systems, and providing early warning in flood detection systems, contributing to water management, safety, and efficiency in numerous industries.

6.8 Pi Cam

Fig 8: Pi cam

The "Pi Camera" typically refers to the camera module designed specifically for the Raspberry Pi, a popular single-board computer. It's an accessory developed by the Raspberry Pi Foundation and other third-party manufacturers. The camera module connects directly to the Raspberry Pi board via a dedicated interface connector.

6.9 Gas Sensor

Fig 9: Gas Sensor

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Gas sensors work based on various principles, depending on the type of sensor and the target gas. Here, I'll describe the working principle of a commonly used gas sensor, the metal oxide semiconductor (MOS) gas sensor, which is often used for detecting gases like carbon monoxide (CO), methane (CH4), and various volatile organic compounds (VOCs).

Metal oxide semiconductor gas sensors typically consist of a metal oxide material such as tin dioxide (SnO2) as the sensing element.

When exposed to a target gas, the conductivity of the metal oxide changes, leading to a measurable electrical signal.
The sensing mechanism involves the interaction between the target gas molecules and the metal oxide surface, causing a change in the conductivity of the material.

VII. METHODOLOGY

The methodology for designing and fabricating a smart door locking system with Internet of Things (IoT) enabled home automation system involves several key steps:

1. Requirement Analysis: Understand the requirements of the smart door locking system and IoT home automation, including features such as remote access, security levels, integration with other smart devices, etc.

2. System Design: Design the overall system architecture, including hardware components such as microcontrollers, sensors, actuators, and communication modules. Decide on the communication protocols and interfaces for interaction between components.

3. Sensor Selection: Choose appropriate sensors for detecting events such as door status (open/close), presence detection (motion sensors, proximity sensors), and biometric identification (fingerprint, facial recognition).

4. Actuator Selection: Select actuators for controlling the door lock mechanism, such as electric motors or solenoids. Consider compatibility with the existing door hardware.

5. Microcontroller Programming: Develop firmware for microcontrollers (e.g., Arduino, Raspberry Pi) to handle sensor data acquisition, decision-making logic, and actuator control. Implement algorithms for features like facial recognition or fingerprint authentication.

6. Testing and Validation: Conduct thorough testing of the entire system to ensure functionality, reliability, and security. Test scenarios including normal operation, edge cases, and failure scenarios.

7. Prototype Fabrication: Fabricate the physical prototype of the smart door locking system, including housing for electronic components, mounting hardware for sensors and actuators, and integration with the existing door structure.

VII. CONCLUSION

In conclusion, the design and fabrication of a smart door locking system integrated with Internet of Things (IoT) enabled home automation represents a significant advancement in modern security and convenience. By utilizing a combination of technologies including facial recognition, Viola-Jones face detection, and Local Binary Patterns Histograms (LBPH) for face recognition, the system offers enhanced security features while simplifying access for authorized individuals. The implementation of a Raspberry Pi as the central controller facilitates seamless communication between the various components of the system, enabling automatic door unlocking for recognized users and triggering alarms for unrecognized individuals. Furthermore, the IoT integration allows for remote monitoring and control of the door locking system, enhancing convenience and accessibility for homeowners. Overall, this innovative solution represents a promising step towards the realization of safer and smarter homes in the era of IoT-driven automation.

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