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A Research Paper on Raspberry Pi Face Id:Smart Facial Recognition

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Abstract: It is impossible to exaggerate the role that facial recognition plays in modern security and surveillance. The demand for a dependable and reasonably priced system is growing as a result. We want to know if it's possible to install a facial recognition system that uses conventional facial detection methods and is based on a Raspberry Pi. offering a novel approach to expedite student attendance records while enhancing security. This Python-developed system uses the Haar Cascade algorithm, a USB camera, and an OLED display as examples of modern technology.

It guarantees accurate and perceptive facial recognition, presenting "Known" or "Unknown" according to unique identifications. When someone approaches the gate, an ultrasonic sensor is used to detect it, which triggers the camera to begin processing images. The idea uses a fast Class 10 SD card and a strong power supply system to enable effective data handling and streaming. In the end, our project serves as a powerful instrument for extremely precise facial recognition, improving the effectiveness and security of facial recognition.

Keyword: Raspberry Pi, Haar Cascade, Facial Recognition.

I. INTRODUCTION

Conventional means of identifying oneself depend on outside elements like keys and passwords, which are easily misplaced or forgotten. Contrarily, biometrics provides a solution by making use of each individual's distinct biometric characteristics. With fingerprints, palm prints, handwriting, and other biometric identification choices, this technology has attracted attention worldwide.

facial features, vein patterns, and even vocal rhythms. Of all these biometric techniques, facial recognition is unique because of its many benefits:

1. Non-Invasiveness: Facial recognition is a non-invasive identifying technique because it doesn't require physical touch to get images.

2. Individuality: Since each person's face texture is the outcome of a nearly random morphogenetic process during gestation, it is extremely unlikely that two people with similar facial textures will coincide.

This distinctiveness helps explain the method's remarkable accuracy and low occurrence of false positives.

3. Stability: Compared to other biometric identification techniques, facial features are more stable since they stay largely constant throughout an individual's life.

Facial recognition has been the subject of in-depth study and a wide range of applications, especially in the security and attendance management domains, because to its non-intrusiveness, uniqueness, stability, and low false recognition rate. It is noteworthy that the majority of recognition systems have historically been PC-based. However, the weight, size, and high power consumption of personal computers limit their portability. Consequently, there's been an increasing amount of interest in creating more portable and effective facial recognition systems.

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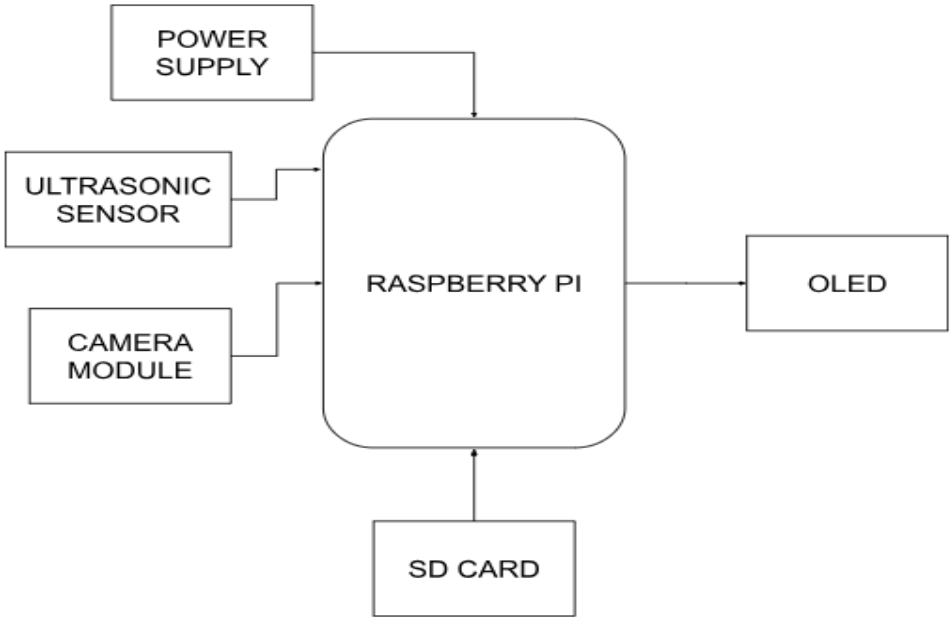

Fig. Block Diagram

- **Raspberry Pi:** The central computing unit that controls and manages the entire system.
- **USB Camera:** Used for capturing images for further processing.
- **Ultrasonic Sensor:** Detects the presence of a person near the gate to activate the camera.
- **Power Supply:** Provides the necessary 5V, 2A power to the Raspberry Pi and other components.
- **OLED Display:** Displays "Allow" or "Not Allow" based on person identification results.
- **Class 10 SD Card:** Used for fast streaming and storage of data.

II. WORKING

The project begins with the initiation of the system code, wherein all modules are initialized. The first step involves detecting the presence of an individual using the ultrasonic sensor. This sensor measures the distance to determine if someone is within its range. Once a person is detected, the system proceeds to capture their image using the USB camera. The captured image is then processed through various operations, including the application of the Haar cascade algorithm, which is a popular technique for object detection in images. This algorithm analyzes the image to identify facial features and determine whether the individual is known or unknown based on the database stored in the system. Subsequently, the system displays the output indicating the identification status of the individual—whether they are recognized as known or categorized as unknown—on the OLED screen. The entire process is implemented using the Python platform with OpenCV for coding, providing an accessible and efficient framework for facial recognition and identification tasks

III. ALGORITHMS AND SOLUTIONS COMPARISON

Every approach to the facial recognition problem, including Eigenface, Fisherface, and Local Binary Patterns Histogram, has pros and cons of its own. Thus, depending on the requirements of a project, the offered methods are now used in conjunction with one another. Usability of the algorithm is highly dependent on the intended purpose, even though its recognition rate may be benchmarked.

situations in which it is used. OpenCV is the foundation for facial recognition, which has been developed for a long time, whereas Open Face and Open BR are relatively recent, according to research on open-source solutions that are now accessible. The subsequent methods do address many facial recognition issues as well. Open Face is experimenting with a distinct neural network approach, whereas Open BR, for instance, is heavily focused on rapid algorithm prototyping.

Since Open Face and Open are likewise unconventional solutions, they provide relatively little in the way of project implementation learning opportunities.

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Additionally, OpenCV was created with real-time applications in mind. Since real-time appliance through the camera stream is the project's main goal, this feature is essential to the project's success. Delbiaggio's studies on the face According to recognition algorithm benchmarks, Eigenface and Fisherface follow with lesser recognition accuracy, while OpenFace and LBPH have the highest recognition accuracy on a test set of five distinct people with 40 photographs each. Therefore, the combined research finds that the LBPH method should be used to provide accurate results for facial recognition, and that OpenCV should be used for learning and real-time adaptation.

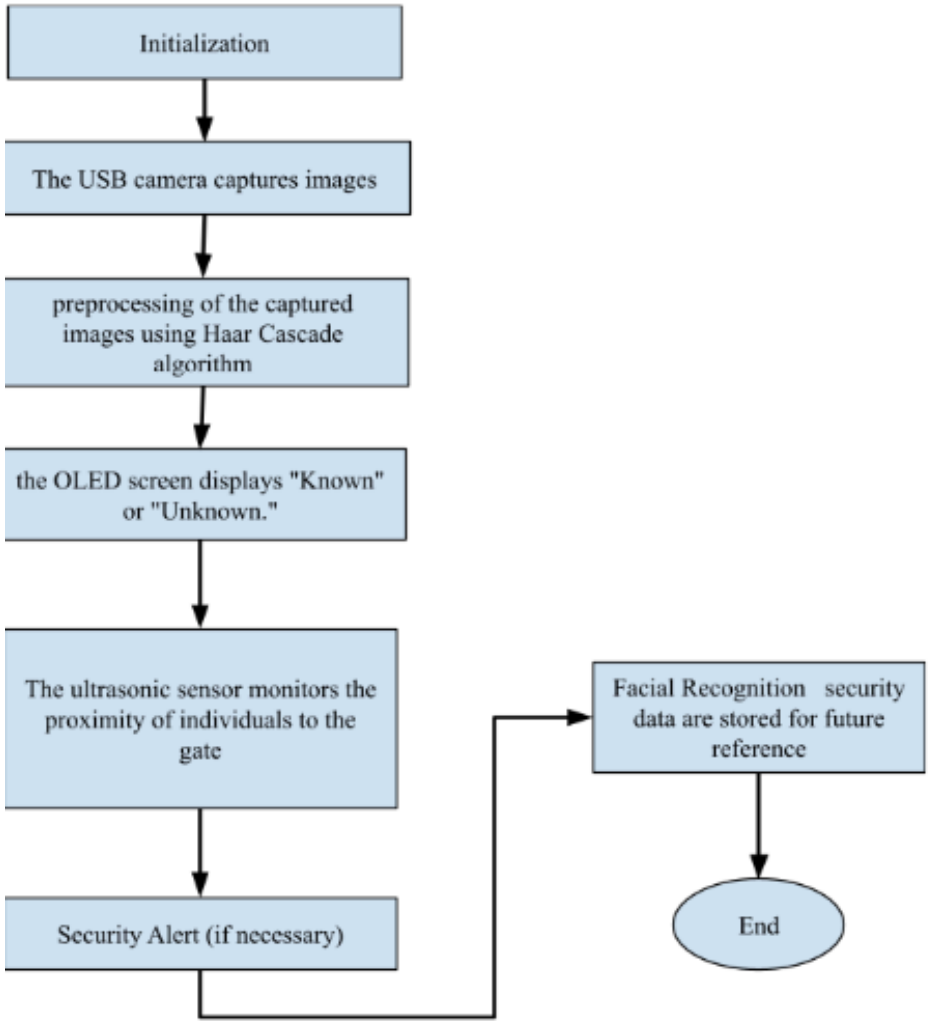

Fig. Flowchart

IV. HAAR CASCADE ALGORITHM

One essential use of computer vision technology is face detection. In order to precisely find faces or objects inside images—whether they be static photos or real-time video streams from cameras—algorithms must be developed and trained. This technology is used in many different contexts, including airport security systems, where it is essential for person identification. Before moving on to identification, the software first finds and recognizes certain traits on the face. Similar to this, face detection algorithms are used by social media sites like Facebook to recommend tags for people in pictures. while augmented reality capabilities, like the ability to apply virtual face masks, are made possible by apps like Snapchat. Moreover, face detection is a prerequisite for user authentication in smartphone security systems like Face ID. In order to make it easier to identify kids for branch entry, a method for finding faces has been put in place in this project. Classifiers, which are algorithms created to determine if an area in a picture contains recognized or unknown objects, are used in face detection. For this, OpenCV uses Haar Cascades as a classifier.

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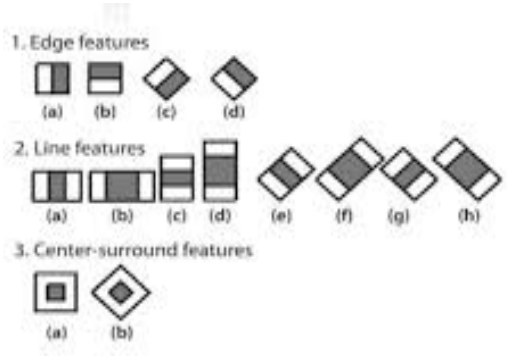


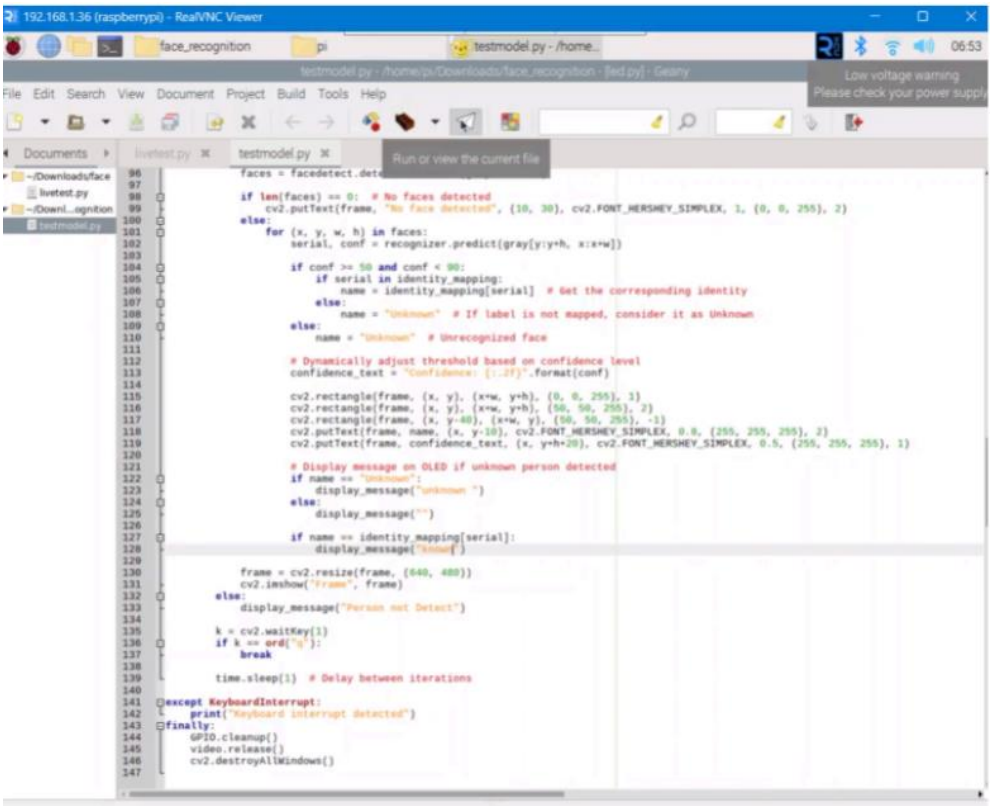
Face Detection determines the locations and sizes of human faces in arbitrary (digital) images.

In **Face Recognition**, the use of Face Detection comes first to determine and isolate a face before it can be recognized.

V. IMPLEMENTATION & RESULT

The implementation of the Raspberry Pi Face ID project involves Three Key steps:

Step 1: Code Execution: Initially, the code built by us needs to be executed on the Raspberry Pi
Step 2: Person Detection with Ultrasonic Sensor: The ultrasonic sensor is utilized to detect the presence of a person by measuring the distance. This information is displayed on the system.



Step 3: Face Capture with USB Camera: A USB camera is employed to capture the face of the detected person. If the person is recognized as known, their identity is displayed. If not, they are categorized as unknown.

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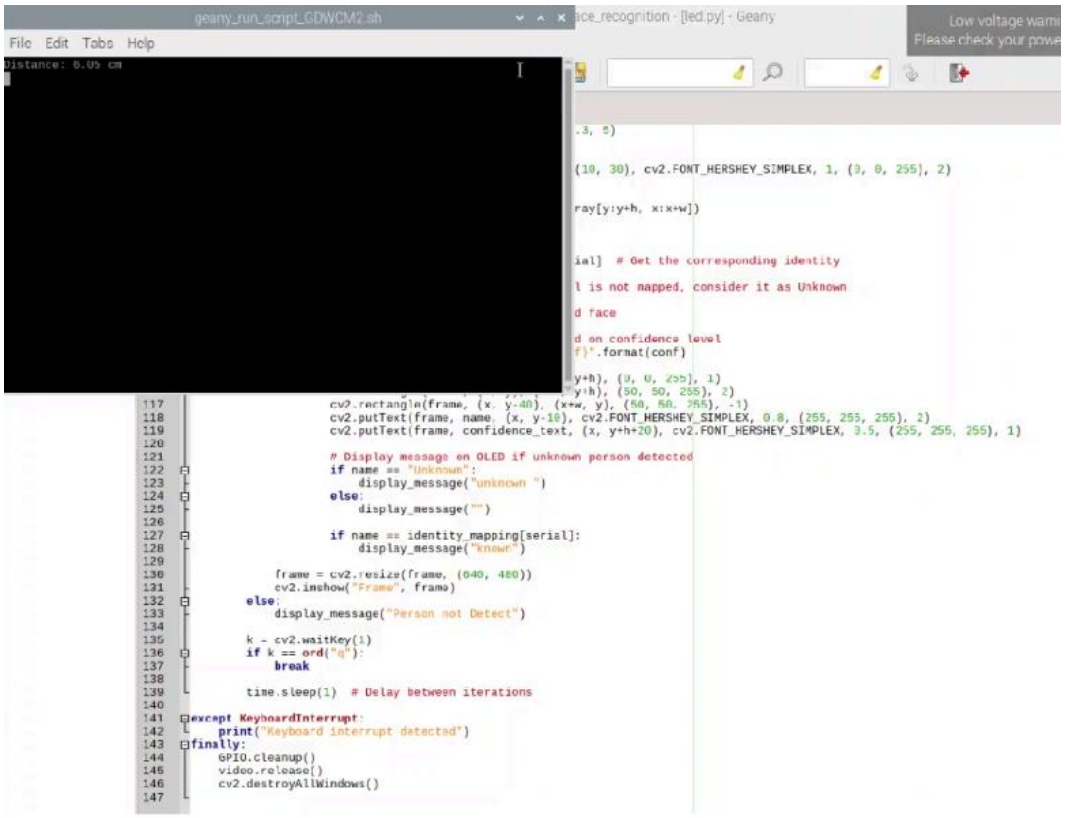

VI. RESULT

The project objectives are met by the successful installation of the facial recognition system, which also incorporates extra functionality to augment its capabilities. An ultrasonic sensor is integrated for person detection in addition to hardware elements like the OLED display and USB camera, adding another degree of efficiency and security. The system accurately identifies and distinguishes between known and unknown people in real-time by using the Haar cascade algorithm for face recognition. As soon as someone is found, Their facial image is taken by the USB camera and processed by facial recognition techniques, such as the Haar cascade method. Instant identification is made easier by the rapid presentation of the person's identify on the OLED screen if they are identified as known. On the other hand, unidentified people are classified as unknown.

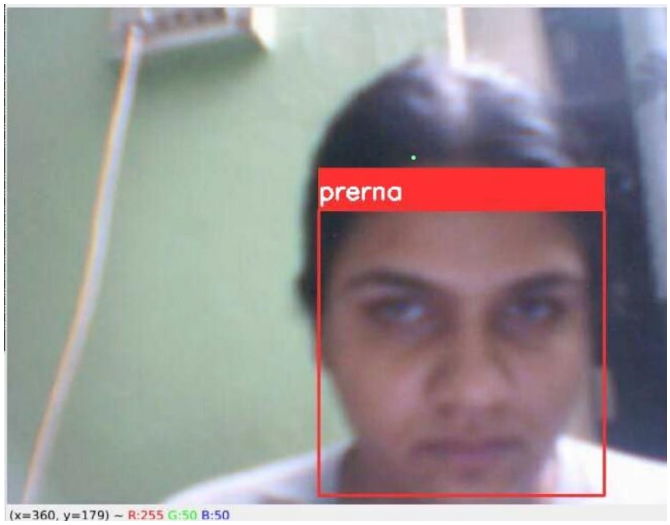

Fig shows the Known Image Recognition

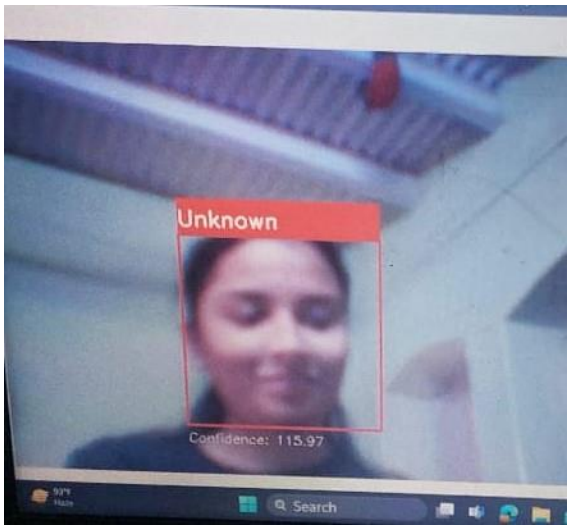

Fig shows the Unknown Image Recognition

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VII. CONCLUSION

To sum up, "Raspberry Pi Face ID: Smart Facial Recognition" offers a novel and revolutionary approach to the facial recognition industry. Through the use of cutting-edge technology, such as Convolutional Neural Networks, it efficiently automates and improves the process of facial recognition. This system aims to provide accurate and effective facial monitoring by doing away with manual processes, giving real-time recognition data, and enhancing security through sophisticated facial recognition. In the end, it serves as a lighthouse of modernization, simplifying the facial recognition industry and clearing the path for a safer and more effective future.

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