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Prototype Implementation of Vehicle Tracking and Localization with Face Recognition Vehicle Ignition Lock System

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***Abstract* - The face recognition–based vehicle ignition system effectively replaces the conventional key mechanism by using the authorized user's facial identity for authentication. Both advanced convenience and improved security can be achieved through automotive electronics. Raspberry Pi computer equipped with a camera to capture photo of face images and process facial images. The system identifies authorized users based on stored facial data and unlocks the ignition automatically upon recognition, providing a secure and convenient access control solution. A GPS module with a 9600 baud rate is used to receive the data from the satellites. The device can be installed in a concealed or appropriate section of your vehicle. Once set up, the vehicle can be tracked through a mobile phone by sending the code to the SIM card inserted in the GSM modem. The system will then automatically send the vehicle's location to your phone via SMS.**

Keywords: Raspberry Pi, Face Detection System, GSM, Camera, GPS.

I. INTRODUCTION

The face recognition–based vehicle ignition system effectively replaces the conventional key mechanism by using the authorized user's facial identity for authentication. Both advanced convenience and improved security can be achieved through automotive electronics.

In the present era, smart vehicles are no longer limited to being symbols of luxury but have evolved into a necessity. Due to the intense competition among automobile manufacturers, the integration of innovative features in each new model has become a key strategy for success. Consequently, numerous corporate organizations and academic institutions worldwide are actively engaged in continuous research and development to introduce advanced functionalities. Among these, vehicle security has emerged as one of the most extensively explored domains.

A high-security system is needed in day-to-day life which can protect and save us from security deft. Today we have so many issues related to this which can be solved by updated technology. We have moved from fingerprint to face recognition to enhance security. Facial recognition is already being used in various industries and corporate sectors. The ignition lock system is mainly based on face recognition. A good quality camera is used to detect the images and trained the system and stores the processed data in the databases. If the image is matched with the user/owner/admin then open the lock otherwise an unauthorized person then not open the vehicle ignition lock. This will improve the whole security system. Our daily life is all about smart devices.

The project focuses on developing a facial recognition-based car security system using a Raspberry Pi. It introduces enhanced security functions tailored for modern vehicles like Tesla. In this setup, the Raspberry Pi serves as the central control unit of the system. The advanced security mechanism ensures that only verified users are permitted to access and operate the vehicle.

II. PRESENT THEORIES AND PRACTICES

With the ever increasing city holdings of cars, the huge number of cars raises problems of its own there are more and more car thefts, lost and violations of rules which are given serious attentions, so requirements are that Transportation needs more improvement. The key technology Of Transportation is Vehicle positioning System, while the key of which is positioning System. Now days the most widely used positioning system is the Global Positioning System of America (GPS), which is a system consisting 24 satellites whose searching area embrace the globe. It can ensure that more than 4 satellites will be observed at one time, no matter what time it is or where you are, thus making sure that they can collect the longitude and latitude of the view point, and furthermore realizing the function of navigation, positioning, and time service. The design of this Vehicle positioning System Based on ARM a combination of GPS and GSM can upload the information of the vehicle such as the position and speed to the Monitoring centre in time, to make it convenient

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to control the traffic. Users can use the password to track vehicles, for security and anti-robbery and check the vehicle position. The new intelligent mobile vehicle location system is designed to meet this need [3].

III. METHODOLOGY

In the presented system, a raspberry pi based 8 MP camera is employed for facial detection. The camera acquires real-time images and video streams, which are subsequently processed by the Raspberry Pi for authentication and security analysis. In a car security setup, GPS module is used to receive real time location of vehicle in the form of latitude and longitude which is inserted into SMS. The GSM module is integrated to provide essential information about the vehicle. The GSM modem can quickly send SMS alerts either to a registered mobile phone or a designated server. This ensures that both the vehicle owner and the police are notified immediately in case of any issues.

IV. THEORETICAL ANALYSIS

This system builds a new intelligent vehicle tracking/checking system based on ARM embedded processing technology, processing technology of digital image, vehicle identification technology, GSM wireless mobile telecommunication technology, GPS positioning technique and anti theft mechanism [4].

This system has the following features:

1) Image capture: When the system works, the camera on the dash board of the car collects the data automatically and saves it in the buffer [5].

2) Vehicle license recognition: The system recognizes the vehicle license by digital image data and if not match with predefined values the vehicle will be locked and control unit display the message on LCD- “please register the vehicle” & indicate using buzzer & indicator and data will be sent to the PC. In PC image processing is done by using software. If driver license cannot match, then PC will display the message “Car /vehicle is stolen”, and display vehicle location with help of GPS module. Also send the command to control unit to block the car [5].

3) Communication function: The vehicle checking terminal communicates with the client/user by the SMS message on the GSM.

4) GPS positioning: The system can correctly send the position and time of the checking vehicle to the client/user centre by GPS positioning, therefore, the terminals can be coordinated properly [5].

Block Diagram:

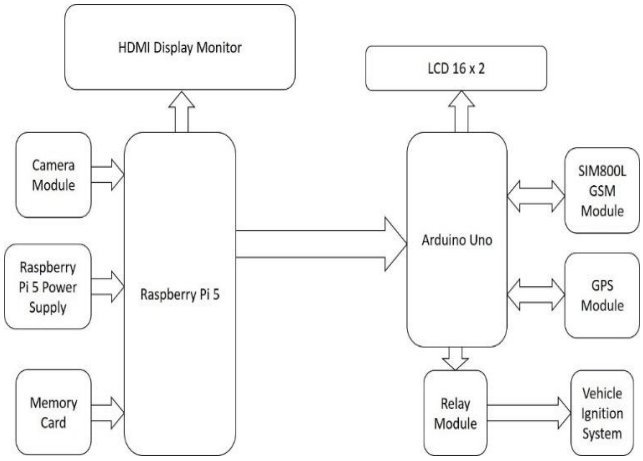


Figure 1: Vehicle Tracking and Localization Control Terminal Unit Using Raspberry pi at Vehicle End

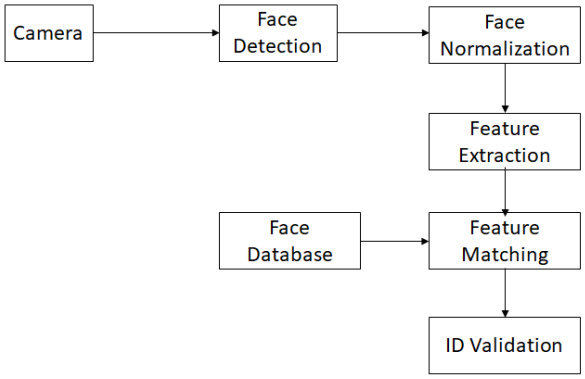
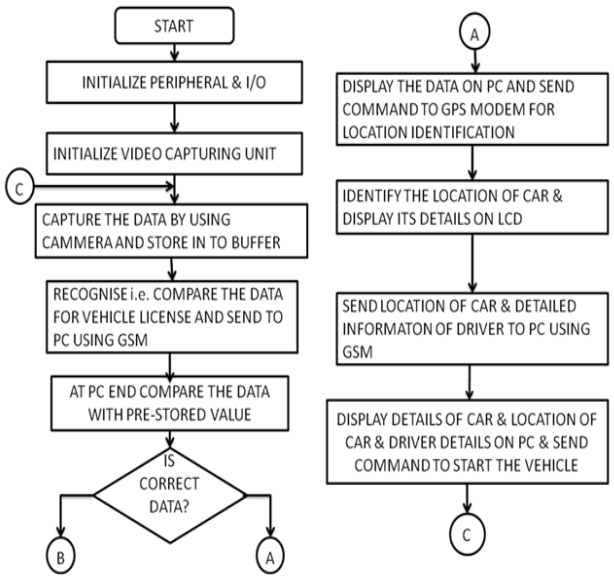


Figure 2: System flow diagram of face detection

Flowchart:



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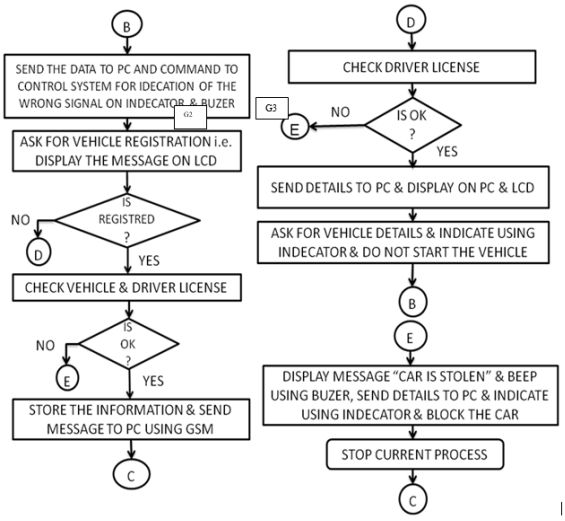

Figure 3: System flow diagram

Software Design:

Our software design process for this system involved python programming Language for designing and programming. Code verification and analysis will be done using Thonny software.

V. RESULTS

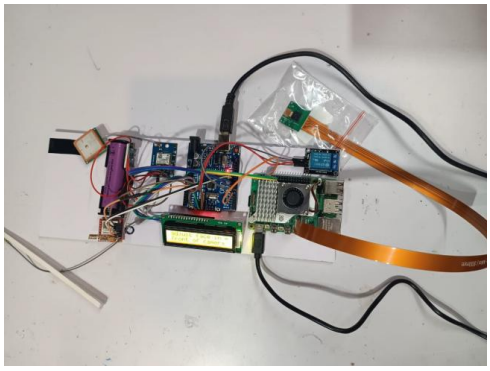

Figure 4: Complete Experimental Setup

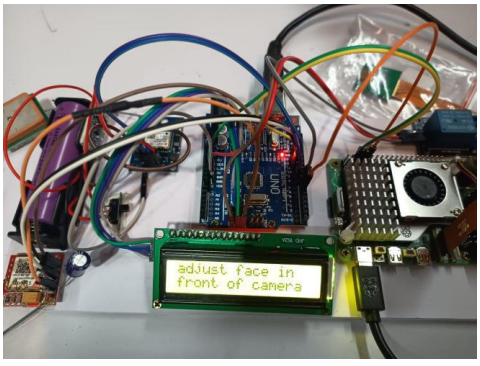

Figure 5: Display message for person to adjust face in front of camera for authentication

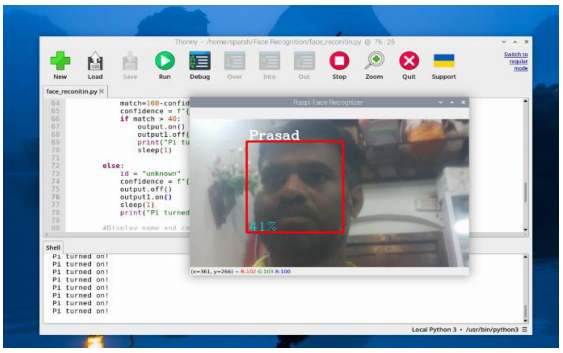

Figure 6: Raspberry pi face recognition and detection process for authentication of valid person to start vehicle ignition system

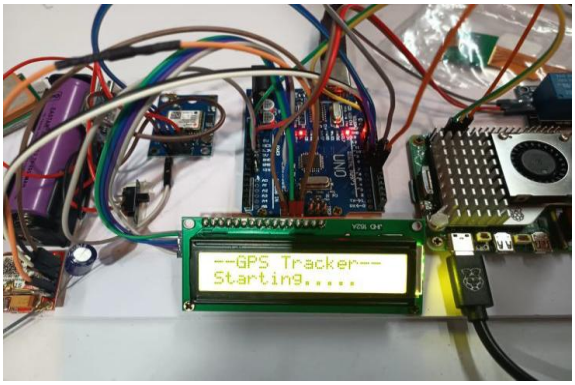

Figure 7: GPS tracking started once the authentication of valid person processed

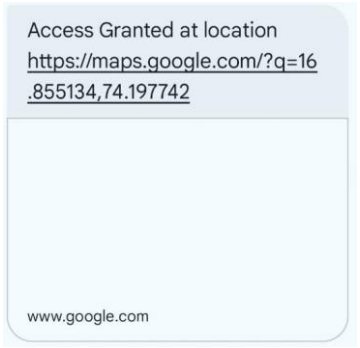

Figure 8: If face recognition and detection of person is valid then above message sent to owner

Figure 9: If face authentication fails then above message sent to owner

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VI. CONCLUSION

The proposed Real-Time Vehicle Tracking System offers a comprehensive and efficient solution to challenges faced in the automobile industry. By integrating advanced hardware components such as the ARM microcontroller, SIM900A GSM/GPRS module, GY-NE06MV2 GPS module, and LCD display, the system establishes a strong foundation for reliable real-time tracking and communication. On the software side, the use of the GPS library for GPS data processing and GSM AT commands for SMS transmission ensures accurate data management and dependable communication.

This approach, with its focus on scalability, interoperability, security, and ease of use, addresses the limitations of existing in-vehicle monitoring systems and provides a more robust and user-friendly tracking solution.

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