DESIGN AND DEVELOPMENT OF INTELLIGENT SECURITY SYSTEM USING FACE RECOGNITION AND SMART DIGITAL WIRELESS WEIGHING CIRCUIT (SDWWC) FOR PREVENTING VEHICLE THEFT

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Abstract : The main aim of this study is to design and develop intelligent security system using face reconition which involves the use of software connected with camera in order to detect human face, bluetooth that helps to control vehicle remotely, Raspberry pi, Global Positioning System (GPS) module and smart digital wireless weighing circuit. Due to the high number of reports on vehicle theft happening in Nigeria, diferent studies were conducted in order to prevent such theft by using face recognition system which detects face of any intruder who attempts to steal vehicle by sending alarm or SMS to the vehicle owner about the security system of his vehicle, but this security system has limitation when intruder closes his/her face. Therefore, this study indends to introduce smart digital wireless weighing circuit to the existing security system in order to add protection to vehicles by registering the weight/mass of the vehicle users using tolrance of ±3kg and range of 100g to 180kg so that any person/introder who sits to drive vehicle that is not nearly equal to the programmed weight, the system informs the owner remotely. Therefore, this paper provides two solutions that are smarter and cheaper as such include face identification using face reconition and weight detection using smart digital wireless weighing circuit.

Keywords: Intelligent Security System, Face Rcognition, Weighing Circuit, Vehicle Theft.

I. 0 INTRODUCTION

Increase in the rate of crime in Nigeria and many countries in the world requires complex technological approach in order to find solution. Several solutions were proposed and implemented successfully in several areas such as security access control in which biometric security system has been for long implemented in order to avoid users impersonation. Other existing security solutions include voice regnition technology, face recognition technology, alarm system and Closed Circuit Television (CCTV). Two among the solutions have been widely used in security sytem, these are Vehicle alarm system that makes sound to notify owners of vehicle their vehicle security condition and Closed Circuit and Television (CCTV) placed at the areas where vehicles are packed. The vehicle refers to cars in this study in which their theft still increases on daily basis as reported by Nigerian security bodies, as such leads to the introduction of security system for preventing vehicle theft (Abrams, 2021).

In order to overcome the current problem being faced by vehicle users on the issue of theft, an additional intelligent security system should be introduced to the vehicles in order to avoid such problems since the

current vehicle security system is not enough to tackle the issue of theft. Example can be seen in the study conducted by Petit and Shladover (2014), which showed that the alarm system introduced to vehicles is not enough to be a complete security system of such vehicles. Another study by Khan, Byun and Park (2020) showed that, Closed Circuit Television (CCTV) does not serve as a guaranteed security system to vehicles.

The aim of this study is to design and develop intelligent security system using face recognition and smart digital wireless weighing circuit, this involves the use of face recognition system which involves application that detects human face using camera, Global Positioning System (GPS) module, bluetooth and Raspberry Pi. A simlar study was conducted by Elkhail, Refat, Habre, Hafeez, Bacha and Malik (2021) but the limitation of his study is that any intruder who closes his face when stealing vehicle, he/she cannot be detected by the security system application. That is why this current study intends to introduce smart digital wireless weighing circuit in order to fill in the existing gap by designing another circuit that serves as an adition to the face detection where weight of all users of vehicle will be registered with tolerance of error for about ±3kg and the programmed weight of the reeal vehicle users must be from 100g to 180kg. The weighing circuit detects any variation of the known weight.

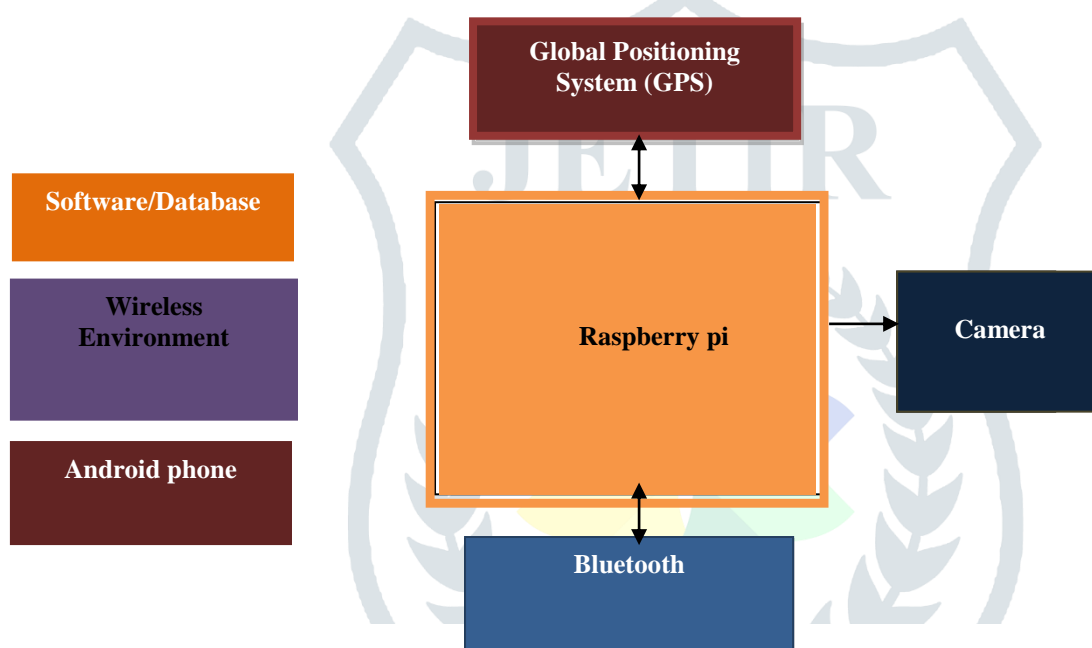## 2.0 The Existing Vehicle Intelligent Security System

Fig. 1. Existing Security System

2.1 Raspberry Pi

Gamess and Hernandez (2022) stated that Raspberry Pi consists of single-board computers of low cost. The Raspberry Pi has several models as can be seen in Table 1

S/N	Raspberry Model	Memory Range	GPIO	Year Released
1.	Raspberry B, A, B+, A+	256-512 MB	26 pin	2012 - 2014
2.	Raspberry Pi 2	1GB	40 pin	2015
3.	Raspberry pi zero W & 2W	512 MB	40 pin	2017 & 2021
4.	Raspberry Pi 3 B, A+, B+	512 MB-1GB	40 pin	2016 - 2018
5.	Raspberry pi 4 B/A & 400	1GB – 8GB	40 pin	2019 - 2020
6.	Raspberry pi Pico & W	264 KB	40 pin	2021 - 2022
7.	Raspberry Pi 5	4GB – 8GB	40 pin	2023

Table 1: Raspberry Model

Several studies were conducted on the old versions of the Raspberry pi such as Raspberry B, B+, A, A+, 2 and zero W as seen in table 1 but the current study focuses on the recent Raspberry pi pico which was introduced in 2022.

2.2 Bluetooth

Bluetooth is a part of Raspberry Pi that is found as an in-built device. In order to have high level of wireless connectivity, onother Bluetooth is introduced for proper security of vehicle. The security system

allows vehicle owners to remotely control or disable their vehicles when any strange incidence occur (Prinon, 2023). The intelligent security system uses two smart phones and the actual security database which is attached to one smartphone while the second smartphone is handled by the vehicle owner. When any intruder attempts to steal vehicle, there are two things to happen. The first thing is to send text message that will serve as a signal for disabling the ignition system of such vehicle. The other method uses an automatic call in order to remotely cut off diesel or petrol of such vehicle.

2.3 Global Positioning System (GPS)

Global Positioning System formally called NAVSTAR serves as a network that uses satellite and other programmed devices that receive signals in order to find specific location of vehicle for monitoring purpose (Bhatta, 2021). GPS has three main elements as principle of operation namely: space segment, control segment and user or receiver segment.

2.4 Face Recognition

Face reconition serves as a security system to vehicles by verifying user facial characteristics using digital images and video. The reconition uses camera to distinguish user's face by comparing it with the one in the database (Kortli, Jridi, Al Falou & Atri, 2020).Face recognition is one of the types of biometric security system that uses software to log in the user facial characteristics in order to see whether it matches the driver's facial characteristics. Face recognition is one of the kinds of biometric security, other include fingerprint, iris recognition and voice recognition.

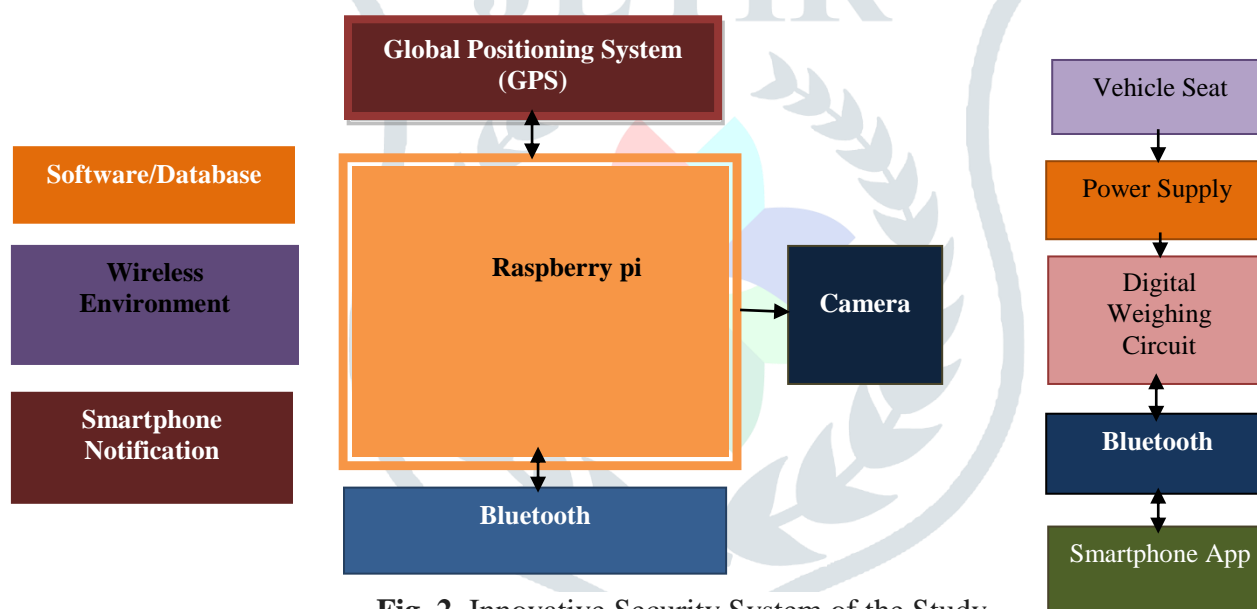## 3.0 The Proposed Vehicle Intelligent Security System

Fig. 2. Innovative Security System of the Study

4.0 Results

The above proposed innovative vehicle intelligent security system has two functions; the first function is to detect the faces of car users and store such footages in a database with the help of Raspberry pi, camera, Global Positioning System (GPS), software and smartphone. The second function is detect the weight of the vehicle users as an additional security to the vehicle and store it in database so that when any intruder with different weight covers his face to steal such vehicle the security system will automatically detect the differential weight by comparing it with the stored original weight of the users using $\pm 3kg$ as a tolerance for error or variation. The digital wireless weighing circuit (DWWC) is to be placed under vehicle seat, it also uses bluetooth, smartphone application and power supply. The function of Global Positioning System is to detect position of vehicle. This intelligent security system is programmed in such a way that it automatically stops the vehicle when it experiences unusual activities and inform the real vehicle user via text messge from his phone.

4.1 Working Principle of the Proposed Intelligent Security System

Face recognition works as human beings identify their friends or family members with certain facial characteristics such shape of their mouth, chick, nose, forehead, eyes and entire face anatomy. Face

recognition specifically works on algorithms scale adapted from the work of Kosalendra, et'al (2021) as shown below:

Step 1: The weight of the vehicle user is detected by DWWC as he/she sits on the driver's seat, the digital weighing circuit is programmed from 100g to 180 kg.

Step 2: After detecting weight by DWWC, the bluetooth transmits the weight digits wirelessly to the main software and moblie application of the vehicle user.

Step 3: The Bioelectric Impedence Analysis is used to compare detected weight to that of software of the regular car users.

Step 4: If the weight the detected weight resembles that of the stored one in a software, then no action is takes place.

Step 5: If the detected weight does not resemble the stored one, text message is sent through the Bluetooth to inform vehicle user about irregular attempt.

Step 6: The face the vehicle user is next to be detected by the face recognition system.

Step 7: The image is converted into Joint Photographic Experts Group format.

Step 8: If the detected image resembles that of the stored one in sosftware, then no action takes place.

Step 9: If the image does not resemble the stored one, text message is sent through bluetooth to inform vehicle user about the theft attempt.

Step 10: The image of the intruder is sent through WhatsApp platform.

Step 11: The vehicle engine is disabled through SMS and similarly abled through SMS sequentially.

Step 12: Location of the car is obtained through SMS by GPS.

4.2 CXONCLUSION

Design and development of Intelligent security system using face recognition and smart digital wireless weighing circuit was designed to prevent theft by unauthorized vehicle users through the use of face recognition, Raspberry pi, Bluetooth, Global Positioning Module and smart digital wireless weighing circuit. The Intelligent security system uses image to detect the face of vehicle user and compare it with the one stored in database or software to see if it resembles the image of the real owner of the vehicle for purpose of providing security to thr vehicle. On the other hand, the smart digital wireless weighing circuit was used in this study to detect the weight of vehicle owners in order to compare it with the weight of anyone who attempts to start the vehicle. In addition, the smart digital wireless weighing circuit serves as an additional security to the vehicle as some intruders cover their faces during their illegal operation.

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