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Research Article

Wireless Fingerprint Motor Vehicle Ignition With GPS Tracker

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ABSTRACT

As motor vehicle theft has increasingly become a widespread problem, so too has the necessity for improved security precautions correspondingly expanded. Innovative solutions are required because traditional ignition systems have failed to deter theft. In order to increase security and facilitate vehicle recovery, this study suggests a wireless motor vehicle ignition system incorporating GPS tracking and fingerprint identification technology. Dangers to owners and citizens alike stem from the worsening matter of motorcycle removal, driven by mislaid keys and insufficient surveillance setups. To end the spreading difficulty of vehicle removal and to make sure protection, it is crucial to handle these problems. The fruitful execution of this arrangement has the capability to reinvent motorcycle security and supply a workable answer for the matter of auto removal.

Keyword—Mobile, Wireless Fingerprint, Motor Vehicle, Ignition, GPS Tracker, Android Phone, Micro Controller, Application.

I. INTRODUCTION

Motor vehicle theft has become a more widespread issue in recent years, costing owners inconvenience and money. According to the data from the PNP–Highway Patrol Group (HPG), the number of four-wheelers and motorcycles stolen during the first nine months of last year reached 222 and 1,649 units, respectively (Illagan, 2021).

Conventional ignition devices have shown to be ineffective at deterring theft because thieves can easily get around them. This has heightened the need for motorcycle ignition systems that are safer and more effective. A fingerprint scanner will be a part of the system, and it will be used to authorize access to the motor vehicle. Only anyone with the proper authorization will be able to start the motor vehicle thanks to the integration of the fingerprint scanner with the ignition system. Moreover, the system will have GPS tracking, enabling the owner to monitor the motorcycle's whereabouts in real-time. In the event of theft, this feature will be especially helpful because it will make it easier to find the motor vehicle.

With the use of wireless communication technology and a microcontroller unit, the suggested system will be able to communicate data to the owner's smartphone. The system will be made to be user-friendly, offering a straightforward interface for the owner to control the system and keep track of the motorcycle's condition.

The issue at hand is the rise in carnapping, which has a number of causes, including the simplicity of misplacing a motorcycle key and the absence of adequate monitoring systems for the location of the vehicles. The safety and security of the owners as well as the general public are at risk because of these problems, which have made it simpler for thieves to steal motorcycles. If these issues aren't resolved, the number of carnapping will probably keep rising, making motorcycle owners and the general public feel unsafe and fearful.

The successful implementation of the proposed system will provide a more secure and efficient method of motorcycle ignition, ensuring that only authorized individuals can access the motor vehicle. The device will also enable tracking of the motor vehicle location, which will lessen theft and improve the likelihood of recovery in the event of theft. Ultimately, the goal of this thesis is to advance the subject of motorcycle security and offer a workable fix for the issue of motor vehicle theft.

A. Objectives of the Study

1) General Objectives

The general objectives of this study are to create a wireless motor vehicle ignition system that makes use of GPS monitoring and fingerprint identification technology. The suggested system intends to offer a high level of security against theft and a way to find the motorcycle's whereabouts if it is stolen.

2) Specific Objectives

The project's specific goals included:

- To develop a system that will secure the motorcycle from carnapping.
- To develop a system that will automatically start up the motorcycle using mobile app.
- To develop a system that will reliability track and identify the specific location.

B. Significance of the Study

The study of Wireless Fingerprint Motorcycle Ignition with GPS Tracker holds significant value in terms of vehicle security, convenience, tracking, and environmental sustainability. The study of wireless motor vehicle ignition using fingerprint with GPS tracker holds significant value in terms of vehicle security, convenience, tracking, and environmental sustainability. The use of biometric technology, such as fingerprint recognition, offers an advanced level of security, preventing unauthorized access to vehicles, and reducing the incidence of car theft. This technology can enhance safety measures, allowing only authorized individuals to access the vehicle, and providing a reliable means of identifying drivers in the event of an accident.

Drivers may conveniently start their cars without a physical key thanks to wireless ignition technology. This function removes the danger of lost keys and provides a more practical method for starting the car. Real-time car position tracking is possible thanks to GPS tracker technology. With the use of this technology, fleet managers will be able to track the whereabouts of their vehicles and make sure they are being used effectively. By lowering fuel waste, the wireless ignition system with GPS monitoring technology can further support environmental sustainability. When the car is sitting still, the system can shut off the engine and then restart it when the driver is ready to move on. This function lowers carbon emissions, conserves gasoline, and enhances air quality.

Thus, the result of this study will also benefit the following:

Motor Vehicle Owners – The system will help motor vehicle owners secure and track motor vehicles against the theft.

Police – They will benefit from the system by reducing the rampant cases of carnapping.

Researcher – The system will help the researcher to develop their skills, practical experience that surely usable for them in future.

Future Researcher – This will help future researchers with comparable studies to obtain information on the study's results, which may then be used as a template to adapt their own research.

C. Scope and Limitation

1) Scope of the Study

The purpose of this project is to develop a system that will provide motor vehicle owners with theft protection. This suggested system aims to make it possible for users to access motor vehicles via a smart phone. By using an application, users can control a number of motor vehicle features and track it using GPS. Users will be able to start or turn on a vehicle's ignition using fingerprint of an android smartphone. In addition, if the Bluetooth connection to the application is lost or out of the range is, the vehicle also enters anti-theft mode.

2) Limitation of the Study

This study is intended to motor vehicle owners. The proposed system will only work with android cellphones and internet connection is required. The Bluetooth connection's maximum connectivity distance is 10 meters. In addition, the number of fingerprints depends on the android smartphones being used.

II. THEORETICAL FRAMEWORKS

A. Review Of Related Literature

According to Kashyap, et al. (February 2019) GPS system using android app and the goal of this paper is to present the design and implementation of a tracking and localization system based on android phones, able to find persons in case of accident and give a set of necessary information for rescue. The System sends the GPS coordinates to database periodically, display the coordinate on a map and computes the shortest route to the accident site.

As stated by Kalambhe, et al. (2020) a GPS tracking system provide all information about the tracking be live exact location of a college buss vehicle. The tracking system uses geographic position and time information from the GPS. In order to track the movement of the college bus Google Maps used for mapping the location.

The GSM modem locate the GPS location and sends it to the server using GPRS. The integration of GPS and GSM first established using SMS as a method of circulating GPS coordinates. The GPRS technology will transmit location and will facilities be using computer connected to website.

Anti-Theft Offline GPS Tracker has been introduced in this paper to meet up the demand for secure use of important technological gadgets i.e., laptop, mobile phone, etc. It is developed in a way so that if any gadget gets stolen or gets lost, it can track even if it is offline. The tracker will be connected with the battery of the device where it is installed. So, even the device is switched off, it can gain power from the recharged battery from the device. Anti-Theft Offline GPS tracker is designed to locate the place of location offline, of the object with which the GPS-Tracker will be attached. It will send a text message containing the Google Map link of the location to a given phone number when asked. By this, the gadget can be identified with its location point. We have followed almost all the procedures of the product development process from getting customer preferences to designing and finalizing the product. Material selection and cost analysis have also been done based on the mass production of the product. This product feature's exact location & real-time tracking, quick and continuous reply, rechargeable battery, easy to carry and cost efficient (Ghosh et al, 2020).

Dulmen, et al. (2017) Stated the spatial mobility of disadvantaged populations in order to enhance our understanding of transport poverty. It is based on participatory GPS tracking data collected in peripheral rural regions in Czechia and Germany. The data provide information on the two-week mobility of 61 socially disadvantaged study participants belonging to the following groups: (a) the lone elderly, (b) the labor market disadvantaged, and (c) single parents. The quantitative analysis utilizes group comparisons of activity space metrics. The results show that the mobility of disadvantaged people varied little between countries and regions, which indicates that individual social disadvantage mattered more than regional spatial disadvantage. Daily mobility depended on individual mobility strategies, and on people's embeddedness in social networks. The mobility patterns of socially disadvantaged groups differed, and showed considerable within-group variability. Our analysis finds that the effects of car access depended on the respondents' levels of social disadvantage; and that a car was not a merely a transport variable, but a socially conditioned variable. Understanding how automobility in rural peripheries is mediated by social ties, and how it can both enable and constrain chances for social participation, is essential for developing measures aimed at reducing transport poverty.

GPS positioning technology and GSM wireless communication technology have been widely used in the military field and urban transportation and other civilian areas. Aiming at the singularity of handheld positioner function on the market, this paper designs a combination device of handheld positioner and tracker. By extracting GPS navigation information frame parameters and GSM wireless data transmission. The realization of the tracker in the TFT LCD screen real-time display itself and the tracking side (i.e., the position of the relative position information) function, completed conversion from latitude and longitude coordinates to Cartesian coordinates. The device can be used for the loss of items, the elderly children tracking and geo-location data mapping, data accuracy, easy operation (Ge, et al. 2016).

According to Kanani, et al. (2019) internet of Things (IoT) is the technology that helps in communication between machines, circuits, and different types of devices. This feature has applications in the health care industry to benefit as sensors, actuators, and hardware support the technology behind IoT. In the health care sector, in case of an emergency, it is very crucial to know the exact location of the patient so that different critical health care services can be made available at the right time and place. This problem can be solved by using GPS coordinates. In this paper, an IoT device is made which locates the exact GPS coordinates of the patients to the server.

An alternative solution to prevent motorcycle theft, which has been increasing recently, particularly in large cities in Indonesia. One problem, for the police and the owner are how to track a stolen motor vehicle. Consequently, a system was built to provide a solution by creating a web-based application and using Global System for Mobile (GSM)-based communication with a Global Positioning System (GPS) module and an accelerometer sensor as a vehicle tracker. The embedded system hidden in the motor vehicle also aims to detect any hard impact from a collision or fall; it then sends the GPS coordinates to individuals who need to be contacted in case of an emergency. The web-based system collects the GPS coordinates of the motor vehicle on a periodic basis to allow tracking to determine the location of the vehicle if stolen. Setup, activation, and tracking of a motor vehicle can be performed by vehicle owners using an Android-based mobile phone. This study reviews the literature and laboratory studies to determine the system settings that will be connected to the internet as an implementation of the Internet of Things. The results are expected to help owners locate their vehicles and provide assistance requests when accidents occur (Liawatimena & Linggarjati, 2017).

According to Hariyanto, et al. (2018) the development of the era improves electronic technology to support human needs for transportation. Many vehicles created have the latest and most sophisticated features. The growth of vehicle production is increasing. One of them is a motorized vehicle. It also affects criminal acts that will increase, such as cases of vehicle theft. Motor vehicle theft cases often occur. It is because there is still a lack of security systems contained in the vehicle. Even though the vehicle is equipped with an anti-theft system, this does not affect theft. Generally, motorized vehicles currently only use dual and electric keys. The importance of a tracking device to see the location of the car will be very influential to monitor the existence of the vehicle. Tools such as GPS Tracker are one that can be used to reduce the theft of a vehicle. This review will discuss GT06N during installation in a vehicle. This GPS can help vehicle owners always be aware of the

existence of vehicles anywhere, whether from SMS or the Internet. GT06N already supports real-time location with excellent accuracy.

As stated by Htwe, et al. (2019) the location tracking system is the combination of the Global Positioning System (GPS) and the Global System Mobile communication (GSM) technologies via the microcontroller. It is used to detect the GPS location of vehicles or any objects which are attached to a tracking device. The proposed system made good use of popular technology that combines a smartphone with an Arduino UNO. GPS is a satellite-based navigation technology that provides accurate location and information. The GSM module is used to transmit and receive an update from the object location to a database. Data from the numerous satellites are received by GPS receiver in the National Marine Electronics Association (NMEA) protocol form. The system SMS contains latitude and longitude of the location of the object. The NMEA code consists of a combination of information. Arduino is linked to the GPS and the GSM module in the serial connection. The GPS receiver sends data to Arduino. Then, Arduino instructs the GSM module to send the location data to the GSM enable device in a short message form. Thus, by using the tracking system, it is easy to calculate and get the estimate location and time for the vehicle to reach a given destination.

Fingerprint

Gulhane and Badhe, (2017) Stated that fingerprint recognition is one of the methods to identify between two or more persons. This method is commonly applicable in many industries, The technology provides higher security than traditional methods such as signature, pins, smart cards etc. With the help of features which are extracted from human fingerprints the input image is analyzed and compared with database to find authorized person.

Detailed human fingerprints, almost unique, are difficult to change and are permanent on an individual's life, making them suitable as long-term signs of human identity. They may be employed by the police or other authorities to identify individuals who wish to conceal their identity, or identify incapacitated or deceased persons and therefore cannot identify them, as in the aftermath of a natural disaster. Fingerprints images are very important data type due to wide applications requiring this type, so extraction a fingerprint identifier is a vital issue (Hindi et al, 2020).

As stated by Muhammed and Pais, (2020) fingerprints are the most popular and widely practiced biometric trait for human recognition and authentication. Due to the wide approval, reliable fingerprint template generation and secure saving of the generated templates are highly vital. Since fingers are permanently connected to the human body, loss of fingerprint data is irreversible. Cancelable fingerprint templates are used to overcome this problem. This paper introduces a novel cancelable fingerprint template generation mechanism using Visual Secret Sharing (VSS), data embedding, inverse halftoning, and super-resolution. During the fingerprint template generation, VSS shares with some hidden information are formulated as the secure cancelable template. Before authentication, the secret fingerprint image is reconstructed back from the VSS shares. The experimental results show that the proposed cancelable templates are simple, secure, and fulfill all the properties of the ideal cancelable templates, such as security, accuracy, non-invertibility, diversity, and revocability. The experimental analysis shows that the reconstructed fingerprint images are similar to the original fingerprints in terms of visual parameters and matching error rates.

Finger-vein-based biometric technology has received wide attention and has made some positive achievements in improving the performance of personal identification. This article intends to provide an overview on the existing finger-vein-based biometric methods from the four steps of finger-vein recognition methods, including image acquisition, image preprocessing, feature extraction, and matching. After brief introduction of image acquisition and preprocessing, the applications of feature extraction method are summarized as: template-based method, representation-based method, and learning-based method. Moreover, deep-learning-based methods have been analyzed and discussed (Hou, et al. 2022).

According to Ren, et al. (May 2022) compared with single biometric recognition, multimodal biometric recognition based on fingerprint and finger vein has been widely considered because of its convenient sample collection, high security and accurate recognition. However, according to our investigation, there is no public dataset of fingerprint and finger vein collected at the same time. The existing work uses fingerprint datasets and finger vein datasets from different sources for research, besides the researcher’s data from building their own equipment, which lacks consideration of practical applications.

Despite the large body of work on fingerprint identification systems, most of it focused on using specialized devices. Due to the high price of such devices, some researchers directed their attention to digital cameras as an alternative source for fingerprints images. However, such sources introduce new challenges related to image quality. Specifically, most digital cameras compress captured images before storing them leading to potential losses of information. This study comes to address the need to determine the optimum ratio of the fingerprint image compression to ensure the fingerprint identification system’s high accuracy. This study is conducted using a large in-house dataset of raw images. Therefore, all fingerprint information is stored in order to determine the compression ratio accurately. The results proved that the used software functioned perfectly until a compression ratio of (30–40%) of the raw images; any higher ratio would negatively affect the accuracy of the used system (Alsmirat, et al, 2018).

Yang, et al. (2019) stated that biometric systems are increasingly replacing traditional password- and token-based authentication systems. Security and recognition accuracy are the two most important aspects to

consider in designing a biometric system. In this paper, a comprehensive review is presented to shed light on the latest developments in the study of fingerprint-based biometrics covering these two aspects with a view to improving system security and recognition accuracy. Based on a thorough analysis and discussion, limitations of existing research work are outlined and suggestions for future work are provided. It is shown in the paper that researchers continue to face challenges in tackling the two most critical attacks to biometric systems, namely, attacks to the user interface and template databases.

Wireless Ignition

Haider A., et al. (2017), Stated that a novel car ignition system to replace the traditional wired technology and enhance vehicle security. It also allows the user to set a password of his/her choice to keep the system protected. A theft alarm that goes ‘’ON” when an unusual activity is sensed and/or when the wrong password is attempted to unlock the system is integrated in the system.

As stated by Brito, et al. (2020) wireless Sensor Networks (WSN) can be used to acquire environmental variables useful for decision-making, such as agriculture and forestry. Installing a WSN on the forest will allow the acquisition of ecological variables of high importance on risk analysis and fire detection. The presented paper addresses two types of WSN developed modules that can be used on the forest to detect fire ignitions using LoRaWAN to establish the communication between the nodes and a central system. The collaboration between these modules generates a heterogeneous WSN; for this reason, both are designed to complement each other. The first module, the HTW, has sensors that acquire data on a wide scale in the target region, such as air temperature and humidity, solar radiation, barometric pressure, among others (can be expanded). The second, the 5FTH, has a set of sensors with point data acquisition, such as flame ignition, humidity, and temperature. To test HTW and 5FTH, a LoRaWAN communication based on the Lorix One gateway is used, demonstrating the acquisition and transmission of forest data (simulation and real cases). Even in internal or external environments, these results allow validating the developed modules. Therefore, they can assist authorities in fighting wildfire and forest surveillance systems in decision-making.

According to Abdul and Bipin, (2017) in order to start a gasoline-air mixture, an ignition mechanism is needed. Vehicles with internal combustion engines, such as cars, buses, and other public transportation vehicles, use ignition systems to start their engines. These systems have a wide range of applications.GPS and GSM modem regulate the ignition arrangement of an automobile by voice call and may also locate the vehicle in the event that it goes missing.

Automobile theft is on the increase worldwide. Efficient ways of combatting car theft and ignition system hotwiring need to be developed. This paper presents the deployment of RFID technology for automatic automobile access. The proposed system uses high frequency (HF) RFID readers and tags to enable a more secure way of accessing an automobile’s ignition system. The proposed smart ignition key uses an eight (8) pin code technique that enables the ignition of the vehicle to be accessed via keypad after RFID authentication. This is a unique security feature that prevents vehicle theft and hotwiring, the proposed system was implemented, tested and it works efficiently to design (Mattews, et al. 2018).

Related Studies

According to Munagala, et al. (2019, April) the use of fingerprints for vehicle ignition, as opposed to the conventional method of using keys. The fingerprint recognition software enables fingerprints of valid users of the vehicle to be enrolled in a database. Before any user can ignite the vehicle, his/her fingerprint image is matched against the fingerprints in the database while users with no match in the database are prevented from igniting the vehicle. Control for the ignition system of the vehicle is achieved by sending appropriate signals to the parallel port of the computer and subsequently to the interface control circuit.

Vehicles provide comfort, fast and hassle-free journey but at the same time, lack of parking spaces, and absence of effective antitheft architecture make this commuting an irksome task. The proposed work aims to build an effective antitheft system for vehicles using the existing infrastructure. Design modifications are not required for vehicles, so this system has backward compatibility and all old vehicles can be a part of this system with an addition of the proposed device. It also emphasizes all the aspects that make commuting a laborious job and provides appropriate solutions to make the journey safe, and reliable. This system emphasizes the fact that existing transportation infrastructure such as check posts, and toll plazas should be used for the implementation of the Internet of Things (IoT). An affordable IoT device is set up on the said infrastructure and also in the existing vehicles. The proposed system covers two aspects – the primary aspect of automated registration of new vehicles on registration booths or when it passes through the check post for the first time and the other important aspect is making the vehicle theft-proof. So, if one realizes that vehicle is stolen, in real-time, the complaint can be registered and the Vehicle can be stopped at the check post, all events being automated with the help of IoT (Thorve & Subhedar, 2022).

More, et al. (2021) Stated that as variety of urban cars is growing very increasingly with the economy, and considering the individuals are becoming a lot about vehicle thievery which creates larger market for anti-vehicle theft products. After that A lots of anti-theft devices are being installed in vehicle but result is still unsatisfactory. Since every kind of devices has its own drawbacks therefore, enhanced system has been proposed in this paper to ensure the vehicle safety and track of vehicle in the event of theft of vehicle.

As stated by Hidayat, et al. (2019) the vehicle's anti-theft system is a module used to protect motor vehicles from theft by using three layers of security. The first layer uses a registered fingerprint for user authentication that can enable the machine on. The second one uses a GPS tracker to recognize where the position of the vehicle. The third one of security uses a remote engine cut-off system to shut down the machine remotely using the Android app.

According to Pani, et al. (2022) to develop a smart ignition security system. A fingerprint sensor is used for motorcycle access in the proposed system, and a relay will be used for controlling ignition. The fingerprint sensor is a dependable fingerprint sensor that collects accurate fingerprint data. The status will be displayed on the LCD. This brilliant achievement is accomplished with the help of a microcontroller.

Alsayaydeh, et al. (2019) stated about building a prototype of vehicle ignition using fingerprint sensor. This system can prevent the vehicles from being stolen. It is developed to control the ignition of the vehicle through the fingerprint scanner. This system consists of GSM SIM 900 that connects to the Arduino which is the microcontroller of the project. To make sure the system is secure, only authorized fingerprint is paired with the Arduino to start the ignition. Vehicles ignite when the enrolled fingerprint is matched against the fingerprints in the database while users with no match in the database are prevent from igniting the vehicle. A theft alarm from buzzer, a notification to the owner's mobile phone via GSM SIM 900 and status display in the LCD are the appropriate signal to the owner.

Further enhancement that we made is using finger-print module, to start the ignition of the vehicle. The whole module is placed inside a vehicle whose location is to be known and tracked in real-time. When we request to track the location of the vehicle, the GSM module in the tracking system sends a message to the owner mentioning the exact place of the vehicle through Latitude and Longitude. If some unauthorized person tries to start the vehicle, we will get a message regarding it, then we will send a message STOP to switch-off the vehicle engine. A microcontroller will be used to control the GPS and GSM/GPRS modules. Actually, here the GSM module communicates with the micro controller for switching off vehicle's engine with a single alert message. By this the users will be able to continuously monitor a moving vehicle on demand (Sankeerthana, et al. 2018).

According to Bukola (2020) that integrates Global Positioning System (GPS), Global System for Mobile Communication (GSM) and Biometrics technologies (i.e. fingerprint) for user identification and authentication. Theft security of vehicles in common parking places has become a matter of great concern Thus, a system capable of identifying and tracking the geographical location of a remote vehicle, which requires constant surveillance of the vehicle is needed. GPS and GSM modules were utilized to prevent theft and to determine the exact location of vehicle and a fingerprint reader module to identify authorized persons and thus start the engines.

As Stated by Agrawal, et al. (2019) a unique method of automobile security where a government-issued authorized driving license is mandatory for a person to drive the vehicle. Each individual has to scan the fingerprint and input the driving license number before they are allowed access to start the engine. For this purpose, the license data would be stored on a cloud platform and there would be a temporary database for offline retrieval as well. When the entered fingerprint matches the data saved (either trusted users, offline data on Raspberry Pi micro-controller, or cloud backup of driving license data), the user is granted access to drive. If an unauthorized person tries to gain access to the vehicle, the owner and police would be informed with the location of the car through an SMS (Short Message Service) using GPS (Global Positioning System), GSM (Global System for Mobile Communication System) and the ignition system of the vehicle will not start. For emergency override, the owner is allowed to add a passkey that can be manually entered to start the car. The system is implemented using Raspberry Pi 3: Model B, which has an R307 fingerprint scanner, an LCD screen, a keyboard for data input, and GSM-GPS Module, attached to it with jumper cable wires. Owing to its easy installation on the dashboard and low pricing, it can be easily implemented in each vehicle. The proposed novel model implementing a Raspberry Pi 3: Model B-based on driving license data for vehicle safety was successfully tested and its working prevents underage, unlicensed individuals from driving an automobile.

As the vehicles are precious things they need to be protected precisely, no matter how secure the parking area is there is always a possibility of vehicle theft. Unlicensed drivers are the main cause of fatal accidents on the roads. By taking these points into consideration, a vehicle safety and security system is designed. This proposed system consists of raspberry pi board, USB camera, fingerprint module, alcohol sensor, relay with a motor. When a person enters in to the vehicle, the system will check the driver license by facial recognition system which contain eigenface algorithm. The camera captures the image of the driver and compares it with the existing database. If it matches, the system will move further for fingerprint verification. The fingerprint module is the key for the vehicle ignition. If the fingerprint matches with the existing enrolled dataset, then ignition of the car is turned ON. If the person face is not matched fails in facial recognition the system will use Simple mail Transfer protocol SMTP server and sends an email alert to the vehicle owner and the buzzer will ring. If the person fails in fingerprint verification or in alcohol detection, then the vehicle ignition will not be turned ON, buzzer will ring (Bhargav, et al. 2022).

B. Conceptual Framework

The concept of this study is to design existing system which is to secure motor vehicle by using fingerprint of an android smartphone.

Figure 1 shows the total concept of the study.

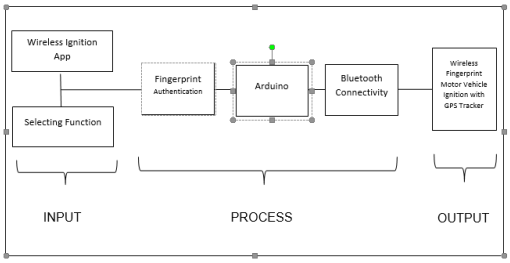

Figure 1: Conceptual Framework

The conceptual framework shows a summary of the functions of the system. The input indicates where the data is obtained from wireless ignition application. The process looks like this: fingerprint authentication, Arduino and Bluetooth connectivity. Finally, the result shows "Wireless Fingerprint Motor Vehicle Ignition with GPS Tracker".

B. Definition Of Terms

The definition of terms discusses about the meaning of words use in the system. For the purpose of citing, it is very important to understand the following terms:

Motor Vehicle – A is a self-propelled vehicle intended for use on roads, highways, and other public and private locations.

Fingerprint – An imprint or mark left by a person's fingertip on a surface, especially when used to identify people thanks to their distinctive whorls and lines.

GPS Tracker – Stands for Global Positioning System incorporates a system of satellites in orbit around the Globe and tools that can be used to locate an object or a person.

III. OPERATIONAL FRAMEWORKS

A. Materials

A Wireless Fingerprint Motorcycle Ignition with GPS Tracker used the following requirements to develop the application to function.

1) Software Specification

The software specification that was used in developing the application are:

Components	Specifications
Operating System	Android 5.0 and up and Windows 10 OS
IDE	Arduino IDE, Visual Studio Code and Kodular.io
Programming Language	C++ and PHP
Database	Mysql and Firebase

2) Hardware Specification

• Arduino Uno
• HC-05 Bluetooth Module
• 4CH/8CH Relay
• Sino GPS tracker
• At least Intel core i3 or AMD Ryzen processor (Computer or Laptop)
• At least 4gb ram (Computer or Laptop)
• Android Smartphone running Android OS version 5.0 (API level 18+)

B. Methods

Software Development Methodology

The Waterfall Model was the first Process Model to be introduced. It is also referred to as a linear-sequential life cycle model. It is very simple to understand and use. In a waterfall model, each phase must be completed before the next phase can begin and there is no overlapping in the phases.

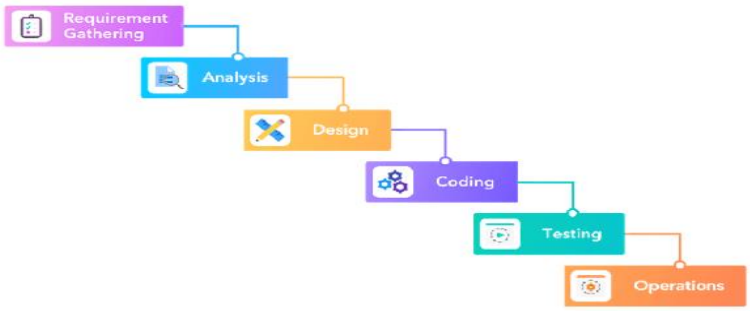

Figure 2: Waterfall Software Development Methodology

The researcher used Waterfall model for its very easy to understand and use, and it is the earliest SDLC approach that was used for software development. The whole process of software development life cycle is divided into each phase. Typically, the outcome of one phase acts as the input for the next phase sequentially.

Requirement Gathering
The researcher gathers and analyze the process in terms of the manual operation used by the traditional motor vehicle.

Analysis
The researcher planned the process of the system using the information gathered. Thus, to improve the operation the researcher used a wireless fingerprint motorcycle ignition with GPS tracker.

System Design
The researcher made the design as uncomplicated to use by some user that unaffected to the system, and also won't give them confusion. Thus, the system had its own database to ensure the data input and will monitor the user.

Coding
The researcher aligned the system to some average users and to use the system more reliable and will function properly.

Testing
The researcher tested the application to find the error and repair it along the way to avoid technical problems, when its times of deployment.

Operation
The researcher piloted a demo that the system that's being developed adapt the requirements indicated. Therefore, the development of this system implements a user limitation according to the access level of the user. After the application implemented, the developer will maintain hardware, software, also the system will be up to date and ensure that all parts are functioning and working properly. The system will be being observed by the programmer, when it comes the system encountered error while on use, it will immediately be repaired.

C. Context Diagram

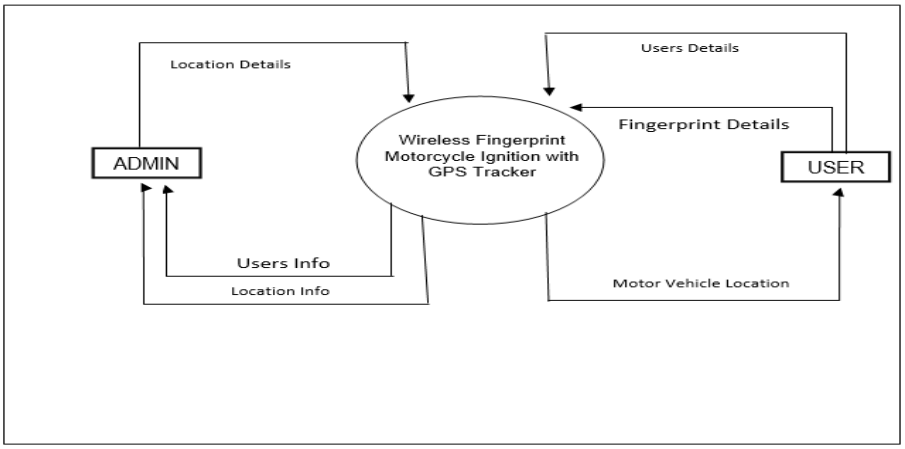

Figure 3: Context Diagram

The process of the data gathering and systematic operation on the application. Whereas, it shows that the users can input detail and fingerprint through application and admin can provide the location detail.

D. Use Case Diagram

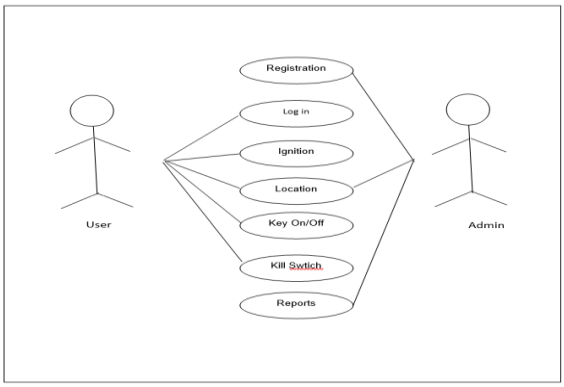

Figure 4: Use Case Diagram

In diagram above, where it shows that user can login, and can use the following features like ignition, location, key on/off and kill switch. And admin can register, view location and show reports.

E. System Flowchart of Existing System

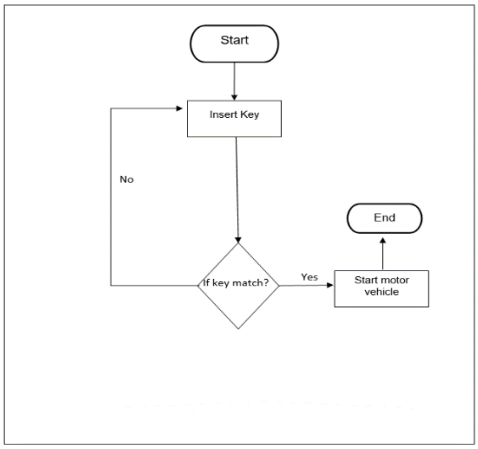

Figure 5: System Flowchart of Existing System

The diagram above shows the manual operation of the existing system. Whereas, the user will insert the key that match the motor vehicle and start.

F. System Flowchart of Proposed System

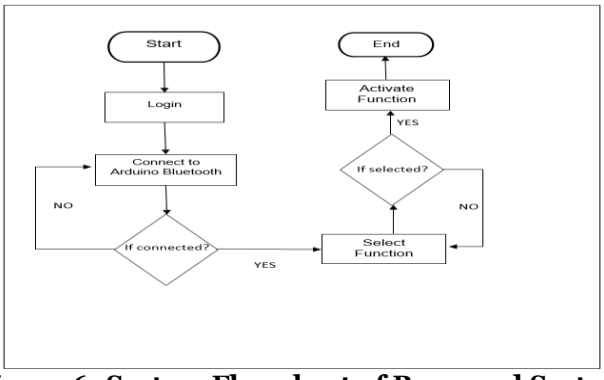

Figure 6: System Flowchart of Proposed System

The diagram above shows the systematic operation of the proposed system. Whereas, the user will open android application and will log-in accounts. After log-in user can control the motor vehicle by selecting its function.

G. Entity Relation Diagram

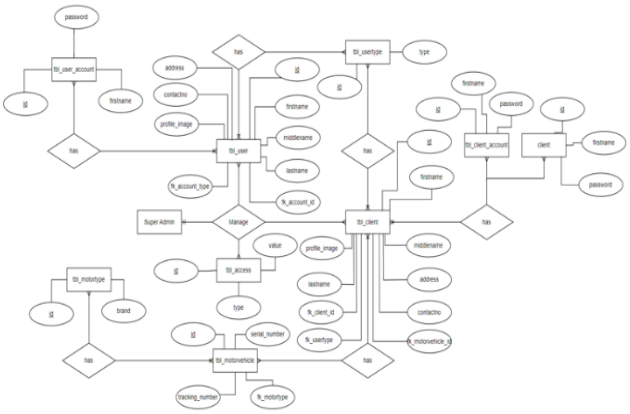

Figure 7: System Flowchart of Proposed System

The diagram above shows the relationship between one object to another object. Super Admin can manage many tbl_user, tbl_client and tbl_acess. Also, the object has their very own entity.

G. Data Flow Diagram

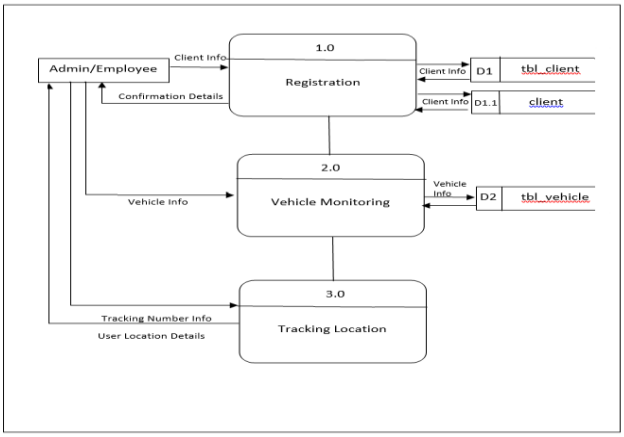

Figure 8: Data Flow Diagram

The diagram above shows admin or employee registers the client and it will save on the database same as well on vehicle. Tracking location show to the admin or employee the location of the client.

H. Database Schema

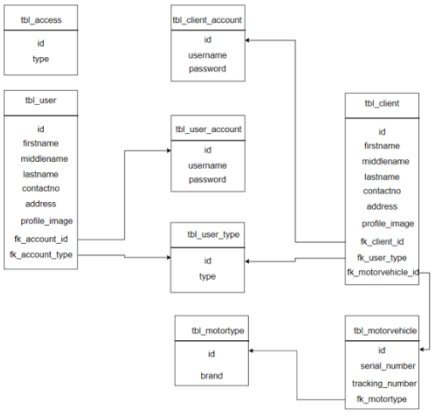

Figure 9: Database Schema

The diagram above shows that the tbl_user is connected to the tbl_user_account and tbl_user_type. Also, the tbl_client is connected to tbl_user_type, tbl_client_account and tbl_motorvehicle.

I. System EnvironmentMobile Application Output and User Interface Design

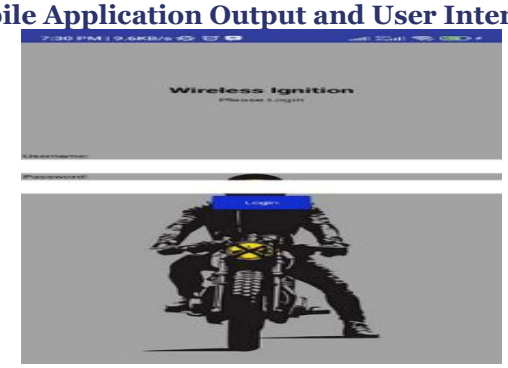

Figure 10: Login Interface

Figure 10 shows the application's login form, where users can enter valid username and password in order to proceed in main screen.

Figure 11: Main Screen

Figure 11 shows the main screen of the application, where users can control the motor vehicle using this application.

Web Application Output and User Interface Design

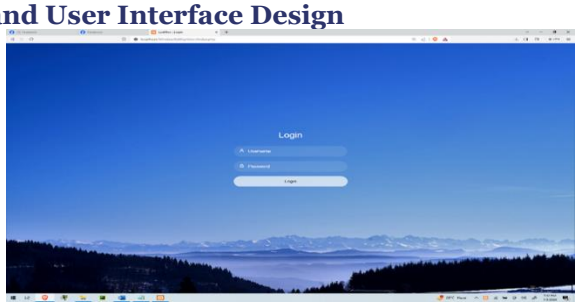

Figure 12: Login Interface

This is login form of the admin where the user enters his/her username and password to access the website.

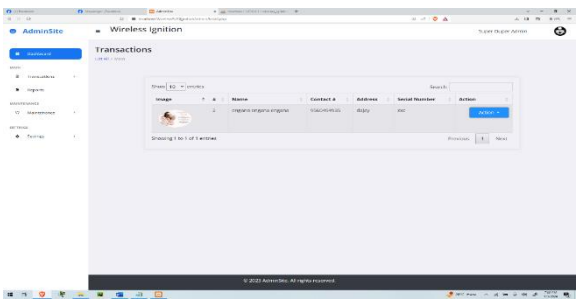

Figure 13: Website Monitoring

This website will monitor every transaction made by both the admin and the employee.

J. Statistical Treatment

The formula for calculating the weighted mean is as follows:

$$\text{Weighted Mean} = \frac{\sum (x_i\, w_i)}{\sum W_i}$$

xi is the value of the variable (in my study the system evaluation results).
wi is the weight corresponding to each value.
∑ Represents the sum over all values..

K. Interpretative Scale used to Interpret the Mean

Interpretation	Range of Mean
Strongly Agree	5
Agree	4
Neither Agree nor Disagree	3
Disagree	2
Strongly Disagree	1

a questionnaire constructed as a five-point Likert rating scale with the following equivalents: 1 - strongly disagree; 2 - strongly disagree; 3 - neither agree nor disagree; 4 - agree; 5 - strongly agree.

L. Evaluation Tool/Questionnaire

FUNCTIONALITY	**Statement/s**	**SA 5**	**A 4**	**F 3**	**D 2**	**SD 1**
Suitability	The system helps the user in summarizing the records for each customer or employee.					
Security	The system can only be accessed by authorized users.					
RELIABILITY	**Statement/s**	**SA 5**	**A 4**	**F 3**	**D 2**	**SD 1**
Real-Time Performance	The system Gps tracker provide a real time location.					
Maturity	The system reaches its full functionality upon first implementation.					
USABILITY	**Statement/s**	**SA 5**	**A 4**	**F 3**	**D 2**	**SD 1**
Understandability	The system uses words that can be understood easily and has buttons that you can easily know what it does.					
Learnability	The system can be easily learned by the establishment due to its user-friendly interface.					
Attractiveness	The system has a very minimalist and user-friendly design that is pleasing to the eyes.					
Operability	The system is capable to run all of its capabilities into full use.					
EFFICIENCY	**Statement/s**	**SA 5**	**A 4**	**F 3**	**D 2**	**SD 1**
Time-Behavior	The system responds easily right after every transaction you make.					
Resource Utilization	The system uses database to collect data and information.					
MAINTAINABILITY	**Statement/s**	**SA 5**	**A 4**	**F 3**	**D 2**	**SD 1**
Stability	The system remains stable for a long period of time.					
Testability	The system has undergone various examinations and test runs before implementing to ensure the quality and efficient functionality.					
Changeability	The system can by iterated by the future developer by accessing the source code.					
PORTABILITY	**Statement/s**	**SA 5**	**A 4**	**F 3**	**D 2**	**SD 1**
Adaptability	The system can adapt its GUI at any screen resolution.					
Conformance	The system can perform its capabilities on what the establishment wants to do without hassle.					
Install ability	The system's installer is independent and given by the developer.					

Orosco, M. (n.d.). Web-Based Thesis/ Capstone Project Defense Evaluation System of the CCS Biñan. https://www.uphsl.edu.ph/.
https://www.uphsl.edu.ph/research/COMPUTER%20STUDIES/OROZCO,%20Michael%20M/WebBased%20Thesis%20Capstone%20Project%20Defense%20Evaluation%20System%20of%20the%20CCS%20Bi%C3%B1an.pdf

IV. RESULTS AND DISCUSSION

The goal of this capstone project is to create an Android application that will secure and track the motorcycle of a user. The application is constructed using the Kodular.IO for the android application and Arduino IDE for the hardware as the development environment, with design principles and code maintainability.
The integration of a wireless fingerprint scanner with the ignition system for motor vehicles has yielded promising results in terms of functionality, reliability, usability, efficiency, maintainability and portability. The system's evaluation reveals strong performance across, with an impressive overall rate of 4.91. These results underscore the potential of the wireless fingerprint motor vehicle ignition system, offering both security and user satisfaction in a reliable and efficient package.

A. Testing and Evaluation

FUNCTIONALITY	**Statement/s**	**SA 5**	**A 4**	**F 3**	**D 2**	**SD 1**	**Weighted Mean**
Suitability	The system helps the user in summarizing the records for each customer or employee.	**20**	**0**	**0**	**0**	**0**	**5**
Security	The system can only be accessed by authorized users.	**19**	**0**	**1**	**0**	**0**	**4.9**
RELIABILITY	**Statement/s**	**SA 5**	**A 4**	**F 3**	**D 2**	**SD 1**	**Weighted Mean**
Real-Time Performances	The system GPS tracker provide a real time location.	**16**	**4**	**0**	**0**	**0**	**4.8**
Maturity	The system reaches its full functionality upon first implementation.	**18**	**2**	**0**	**0**	**0**	**4.9**
USABILITY	**Statement/s**	**SA 5**	**A 4**	**F 3**	**D 2**	**SD 1**	**Weighted Mean**
Understandability	The system uses words that can be understood easily and has buttons that you can easily know what it does.	**18**	**2**	**0**	**0**	**0**	**4.9**
Learnability	The system can be easily learned by the establishment due to its user-friendly interface.	**18**	**2**	**0**	**0**	**0**	**4.9**
Attractiveness	The system has a very minimalist and user-friendly design that is pleasing to the eyes.	**19**	**1**	**0**	**0**	**0**	**4.95**
Operability	The system is capable to run all of its capabilities into full use.	**19**	**1**	**0**	**0**	**0**	**4.95**
EFFICIENCY	**Statement/s**	**SA 5**	**A 4**	**F 3**	**D 2**	**SD 1**	**Weighted Mean**
Time-Behavior	The system responds easily right after every transaction you make.	**17**	**3**	**0**	**0**	**0**	**4.85**
Resource Utilization	The system uses database to collect data and information.	**20**	**0**	**0**	**0**	**0**	**5**
MAINTAINABILITY	**Statement/s**	**SA 5**	**A 4**	**F 3**	**D 2**	**SD 1**	**Weighted Mean**
Stability	The system remains stable for a long period of time.	**17**	**3**	**0**	**0**	**0**	**4.85**

Twenty (20) Marbel Universal Trading Inc. customer are responsible for analyzing the system's accuracy, reliability, and efficiency because they are able to spot mistakes when one feature is malfunctioning.
The system features are broken down into a checklist form for system correctness, and each feature is listed separately so that each can be tested one (1) time.

B. Result

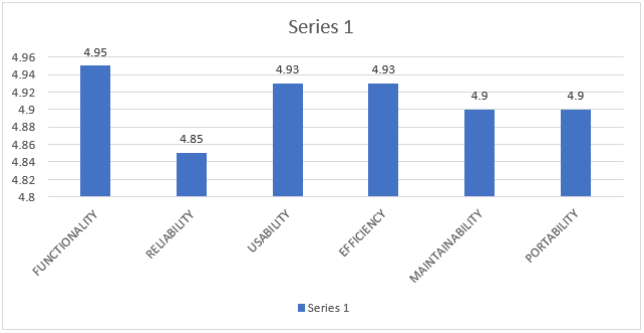

Figure 14: Result

Overall Evaluation Result of the Capstone Project Defense Evaluation System

Testability	The system has undergone various examinations and test runs before implementing to ensure the quality and efficient functionality.	**19**	**1**	**0**	**0**	**0**	**4.95**
PORTABILITY	**Statement/s**	**SA 5**	**A 4**	**F 3**	**D 2**	**SD 1**	**Weighted Mean**
Adaptability	The system can adapt its GUI at any screen resolution.	**18**	**2**	**0**	**0**	**0**	**4.9**
Conformance	The system can perform its capabilities on what the establishment wants to do without hassle.	**17**	**2**	**1**	**0**	**0**	**4.8**
Install ability	The system's installer is independent and given by the developer.	**18**	**2**	**0**	**0**	**0**	**4.9**

Figure 14. presents the overall evaluation results of the system were strongly agreed by the respondents with the highest weighted mean 4.95. However, the reliability of the system was only agreed by the respondents with the lowest weighted mean 4.85. The final evaluation survey reflects of the system on how it is to be conducted. The results show that the customer of the Marbel Universal Trading Inc., is in favor for the said system based on the result that the developer had for survey.

C. System Evaluation Report

Interpretation	Range of Mean
Strongly Agree	5
Agree	4
Neither Agree nor Disagree	3
Disagree	2
Strongly Disagree	1

a questionnaire constructed as a five-point Likert rating scale with the following equivalents: 1 - strongly disagree; 2 - strongly disagree; 3 - neither agree nor disagree; 4 - agree; 5 - strongly agree.

The evaluation presented above provides a comprehensive analysis of a system across various dimensions, including functionality, security, reliability, usability, efficiency, maintainability, and portability. Each aspect is rated on a scale from 1 to 5, with 5 indicating the highest level of satisfaction.

In terms of functionality, the system excels in helping users summarize records for both customers and employees, earning a perfect score of 5. This indicates a robust capability in meeting the primary objective of the system. Furthermore, the system's security is commendable, ensuring that only authorized users can access it, resulting in a high rating of 4.9.

Reliability is measured through real-time performance and maturity. The system's GPS tracker provides real-time location, scoring a 4.8. Additionally, the system reaches its full functionality upon the first implementation, showcasing a mature and reliable structure, earning a 4.9.

Usability metrics include understandability, learnability, attractiveness, and operability. The system uses easily understood language and buttons, making it user-friendly and earning a weighted mean of 4.9. Its minimalist design is both attractive and pleasing to users, resulting in a high rating of 4.95. The system is easily learned by establishments, and its operability allows for the full utilization of its capabilities, both contributing to a weighted mean of 4.95.

Efficiency is evaluated based on time behavior and resource utilization. The system's quick response after each transaction earns it a score of 4.85, and its effective use of a database for data collection results in a perfect score of 5 for resource utilization.

Maintainability is assessed through stability and testability. The system remains stable over an extended period (4.85), and its rigorous testing before implementation ensures quality and efficiency, earning a high rating of 4.95.

Portability considerations encompass adaptability, conformance, and install ability. The system adapts its graphical user interface to various screen resolutions, resulting in a weighted mean of 4.9. It also conforms to the establishment's requirements without hassle (4.8), and its independent installer provided by the developer contributes to a high rating of 4.9.

In summary, the system demonstrates excellent performance across various dimensions, with particular strengths in functionality, security, usability, efficiency, maintainability, and portability. These positive evaluations suggest a well-designed and robust system that meets the needs of its users effectively.

V. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

This chapter provides an overview of the researcher's results, a recorded conclusion, and recommendations to improve the proposed system and future researchers.

A. Summary

The research initiative points towards a wirele-ss ignition system for automobiles infused with GPS locating and fingerprint recognition technology to handle the growing issue of auto theft. Incorporating a fingerprint reader within the ignition device ensures that only preapproved individuals can fire up the vehicle, thereby considerably boosting its security. By consistently tracking the car's where-abouts using GPS technology, we can deter theft and expedite recovery if a theft occurs. The proposed system's precision, dependability, and performance were thoroughly analyzed, and the results hint at its possibility of providing both safety and user contentment. For future refinement, suggestions include the integration of intelligent computing components for personalized security solutions and the addition of remote vehicle disabling features for increased theft prevention and accelerated recovery processes.

B. Conclusions

A secure and reliable method of authorizing access to the motorcycle is promised by the integration of a fingerprint scanner with the ignition system. The vehicle can only be started by people who have the appropriate authorization, greatly lowering the risk of theft. Furthermore, with GPS tracking's inclusion one gains live observations allowing owners to maintain a near watch over their motorcycle's current location. In the unfortunate event of theft, this feature is crucial for facilitating quick recovery efforts.

C. Recommendations

While contemplating potential technological innovations on the horizon, carefully designing an intelligent network of processors and self-learning software to regulate ignition mechanisms could reap forthcoming advantages through streamlining operations. Through consistently monitoring and analyzing behavioral patterns over time, the system could develop a more personalized and nuanced understanding of its owner's habits, allowing it to recognize anomalous activities and protect private information with ever-greater acuity. This would involve the system recognizing not just the owner's fingerprint but also their typical usage patterns, such as the time and locations where the motorcycle is usually started. Should the network observe any irregularities, for example an effort to initiate the motorcycle at an abnormal hour or in an unfamiliar place, it may ignite an alarm or necessitate additional validation, further bolstering protection.

Another valuable add-on for this system could be the integration of remote immobilization capabilities. Should theft occur, the app would allow the owner, through their phone, to disable the motorcycle's engine from afar, ensuring the thief could not flee the stolen vehicle. This feature would not only deter theft but also increase the chances of recovery, as the stolen motorcycle would remain immobilized until authorities arrive.

Additionally, integrating real-time video surveillance through connected cameras on the motorcycle could provide visual evidence in case of theft attempts, aiding law enforcement in identifying and apprehending thieves. These enhancements would take motorcycle security to the next level, offering comprehensive protection and peace of mind for owners.

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