Biometric Ignition and Vehicle Safety System - A Novel Approach to Reduce Vehicle Theft

Ashish Rasikkumar Dasani[*]

[*]UG Student, Bachelor of Technology-Automobile Engineering, Marwadi University, Rajkot (India)
(Email:- ashishdasani09@gmail.com)

Abstract

This project is focused on protecting cars from unwanted users and to prevent vehicle theft. Using a fingerprint security system provides access to only authorized persons. Usage of biometrics like fingerprints is very widespread and is common in factories, buildings, schools and colleges and many more applications. This project deals with the protection of the vehicle which leads to the development of the anti theft system in a car using a microcontroller.

A fingerprint sensor which is kept inside the vehicle is used to sense the fingerprint. Fingerprint sensor data reading obtained in the controller which is analyzed with the pre-assigned data. Identifying the person as the car owner or an authorized fingerprint, a user who can take control of the car, the engine ignition system starts. If it is an intruder, the engine never starts. Other security systems can be hacked, whereas in this case fingerprint is being used as the key which is unique for each and every person and therefore provides improved security.

Keywords: Vehicle safety, ignition system, biometric approach, vehicle theft, user fingerprint, advanced vehicle technology.

I. Introduction

As personal transportation has become the latest trend nowadays and so the demand and ownership of cars are reaching the sky. So as the number of cars increase in the market the chances of them being stolen also increases, there are various segments in every domain of vehicle bifurcated on various demands, luxuries, economically and much more. But the problem of the vehicle being stolen is common in every sector and every domain of automobile vehicles.

Car theft is a global problem that needs to be solved. Not to mention how stolen cars can be misused for various illegal purposes. Cars stolen by thieves are further used by them to commit some other criminal activity. Or can be used for stealing the original or rare parts. Many cars which are rare or high end are stolen and sold in illegal markets. Many times, a car is stolen and the thief drives it harshly (drink and drive too) on public roads or even worse, be the reason of a fatal accident injuring or killing innocent people on the road. In such cases a car owner due to his negligence is also held liable for the crime committed by someone else.

Car theft is done by various methods which includes breaking the car lock system, using a master key, or nowadays used method called "transponder key cloning". In this technique, a cloning device is used to copy the original key's unique code on a compatible blank key which can then bypass the immobilizer system of the car. For

cars with keyless entry systems, a technique called "relay theft" is also used. In this a broadcast transmitter emits the radio waves similar to that of a car key-fob and an amplifier amplifies the radio signals. Due to this, the car senses that its key-fob is in its predefined proximity and as a result the car gets unlocked and can be driven away.

Some thieves also use emergency lock unlocking tools like "Turbo Decoder" sold in European markets. It is legitimately used by locksmiths or blacksmiths for unlocking vehicles or homes in case the original keys are lost or stolen, and also used illegitimately by thieves for stealing vehicles. Car manufacturers install an alarm based security system which is mediocre at best and are not that effective enough. It only takes a few minutes for a burglar to deactivate the system. So a need for a more secure vehicle security system is pretty evident to avoid the increasing number of vehicle thefts worldwide.

So considering this as a major problem. It is very necessary to find a reliant and effective solution which not only solves the problem but also accompanies various other benefits along with it. Keeping that in mind various advanced solutions were found which serves our underlying purpose.

There are many existing solutions to avoid car thefts such as steering lock/gear locks. This does not need any electrical modifications. GPS trackers are also used. They are not effective in avoiding car theft but can significantly help to track down the car. It also has additional features like geofence tracking in which the owner can be informed about the car's location if it's out of its predefined range and can also inform local authorities.

There is also a next generation alarm system in which a car plays loud sounds or flashes headlight if there's any foul play with the car and the owner is also notified via app notification or SMS on their smartphone. Also there exists a way in which the lock is made of solid stainless steel, which

increases the anti-theft performance by three times. The thief will not be able to quickly destroy it because it is composed of solid, durable, and reliable stainless steel, making your car safer with simple and effective locking.

There are various solutions available using the human biometrics such as

- Iris scanner
- Retina scanner
- Face recognition
- Fingerprint scanner
- Voice recognition, etc.

These were the general solutions available till date in the market.

Human identification field is very significant and has undergone rapid changes with time. An important and very reliable human identification method is fingerprint identification. Fingerprint of every person is unique. So this helps in identifying a person or in improving security of a system. In the 21st century, the uses of biometric based systems have seen an exponential growth. This is because of tremendous progress in this field making it possible to bring down their prices. Biometrics is becoming a new state of the art method for security systems. Biometrics are used to provide secured access to major functioning systems like ATM, cellular phones, cars, laptops, offices, and other things that need authorized access. Biometric has made significant changes in security systems making them more secure than before, efficient and cheap.

After a detailed and profound research it was found that there are some innovations which use fingerprint scanners to enhance and develop their security system. A solution use license and helmet verification along with SFGdemo(controller),

using transmitter and receiver at helmets & at end , connected by bluetooth wherein a solar energy battery panel, a fingerprint collecting head and a machinery lock hole are installed on a surface of a shell body of a fingerprint lock body. Second solution uses Arduino uno, alcohol sensor ,fingerprint sensor, IR Sensor, engine startup sensor; it uses a helmet sensor and an engine sensor. Third solution uses a camera module, fingerprint sensor along with an ECU. Fourth solution uses a fingerprint sensor along with a VTD(vehicle tracking device) which has a GPRS system.

II. Methodology

A. Components used:-

1. Fingerprint Sensor
   The fingerprint module is a sensor with TTL (Transistor-transistor logic) UART(universal asynchronous receiver/transmitter) interface. The user can store the fingerprint data in the module and can configure it in 1:1 or 1: N mode for identifying the person. In this sensor- it works in both ways, when operating the system, it validates the fingerprint and checks it in the database. When you want to store a new fingerprint it scans your finger and adds it into the database.
   This module consists of optical fingerprint sensor, high-speed DSP (Digital Signal Processor), high-performance fingerprint alignment algorithm, high-capacity FLASH chips and other hardware and software composition, stable performance, simple structure, with fingerprint entry, image processing, fingerprint matching, search and template storage and other functions.

2. Microcontroller
   It is a low-cost, flexible, and easy-to-use programmable open-source microcontroller board that can be integrated into a variety of electronic projects. This board can be interfaced with other microcontroller boards too. Raspberry Pi boards and can control relays, LEDs, servos, and motors as an output. It can store various up to 127 accurate HD fingerprints.

3. Relay
   A relay is an electrically operated switch. It consists of a set of input terminals for a single or multiple control signals, and a set of operating contact terminals. The switch may have any number of contacts in multiple contact forms, such as make contacts, break contacts, or combinations thereof.

4. Jumper Wires
   A wire is a single, usually cylindrical, flexible strand or rod of metal. Wires are used to bear mechanical loads or electricity and telecommunications signals. A jump wire is an electrical wire or group of them in a cable with a connector or pin at each end. Wires are used to connect components to each other on the breadboard or other prototypes, internally or with other equipment or components, without soldering.
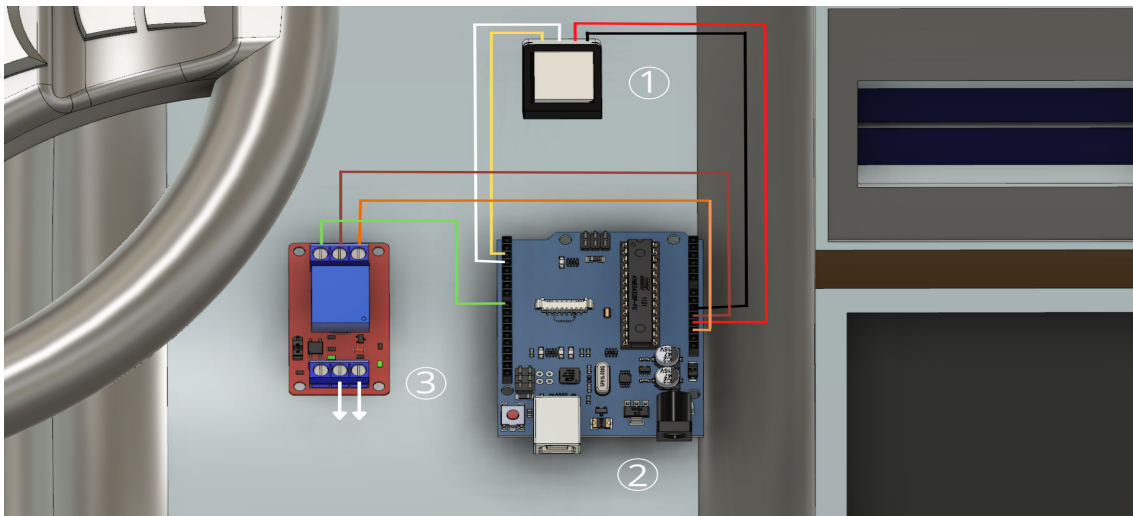
fig. 2.1 showing the components used

III. Working

A normal vehicle consists of a battery, fuse, ignition switch, relay, neutral safety switch, solenoid, starter motor. The purpose of the ignition system is to start the starter coil in the crank shaft and generate a very high voltage from the battery of the vehicle and send it to each spark plug which in turn ignites the fuel-air mixture in the engine's fuel combustion chambers. The mechanical system uses breaker points to interrupt their low voltage, high current function through the primary winding of the coil on the mechanical system will be exposed to mechanical wear form where they ride the internal combustion engine's camshaft to open and close, as well as oxidation and burning occurs at the contact surfaces from the constant sparking occurs at the internal combustion engine. They need regular functioning to compensate for wear, which is responsible for spark timing, and is subject to mechanical variations in internal combustion engines. Also the spark voltage depends on contact effectiveness, and poor sparking which can lead to lower engine efficiency and therefore reduces the engine's performance. By comparison with the electrical   system, a   mechanical contact breaker system has no control over an average ignition current of greater than 3A while still giving a reasonable service to engine's life, and this may limit the power of the spark in ignition and ultimate engine's speed and therefore Electronic   Ignition (EI) solves these problems. Digital electronic ignition systems are available for small engines from 100mm to 10000 mm. This ignition system is made possible by using low cost,   high   speed,   high   efficiency performance, and small footprint function of vehicle ignition.

Fingerprint sensors and controllers are combined together. The starting system of the vehicle is modified. The basic connection is from the ignition switch that supply voltage is given to the voltage regulator then to the continue to turn it on and off, when input is given in the

fingerprint sensor it scans the finger. Fingerprint match which will activate the relay that controls the starter relay. This will crank the engine. Then the fingerprint sensor will turn off. If no finger scan or finger image matches the database then the starting system is disabled and no cranking occurs. Fingerprint sensors here will activate or deactivate the starter relay to either prevent or allow cranking of the engine.

In this above anti-theft system the fingerprint module is used. Fingerprint processing includes two parts. They are fingerprint enrollment and fingerprint matching (the matching can be 1:1 or 1:N) type. For 1:1 matching type, the system will compare the finger which is enrolled with templates stored in the Module; for 1:N matching type, the system will search the total library file for the matching finger. In both types, the system will return the matching result, success or failure. In this project work 1:N type is used. There are eight pin connections in the fingerprint sensor.

Fingerprint sensor built inside the module scans the finger and verifies with the pre-loaded data and shows the result whether it is matched or not. The fingerprint module is connected and gives the data to the microcontroller. If the result matches then it makes the relay to supply voltage. If it is not matched then the relay is low and the supply has been stopped. Power input to the fingerprint module is DC 3.6V-6.0V. Working of fingerprint sensor for typical current it is: 100mA and for peak current it is: 150mA. For each different fingerprint a separate ID is given. New enrollment can be done with the help of the fingerprint scanning module (which works as an input) or it can be previously stored when uploading the program to the microcontroller.
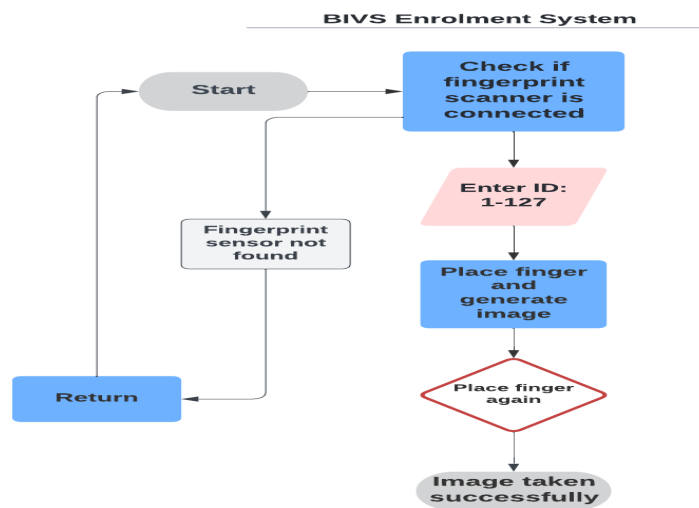

fig.3.1 flowchart displaying the process to enroll a new fingerprint.

To verify the authorized person's fingerprint, the fingerprint is scanned by the module which verifies it with the database stored in the controller and if the fingerprint scanned is an authorized one then

the relay gives a high command i.e, actuates a success and therefore cranking takes place and the engine starts whereas on the other hand it won't

BIVS Operating System

User input → Fingerprint Module → Scanning → Micro Controller → Fingerprint Match

Process Ends ← NO

Fingerprint Match → YES → Relay → Starter Motor → Ignition → Vehicle Starts
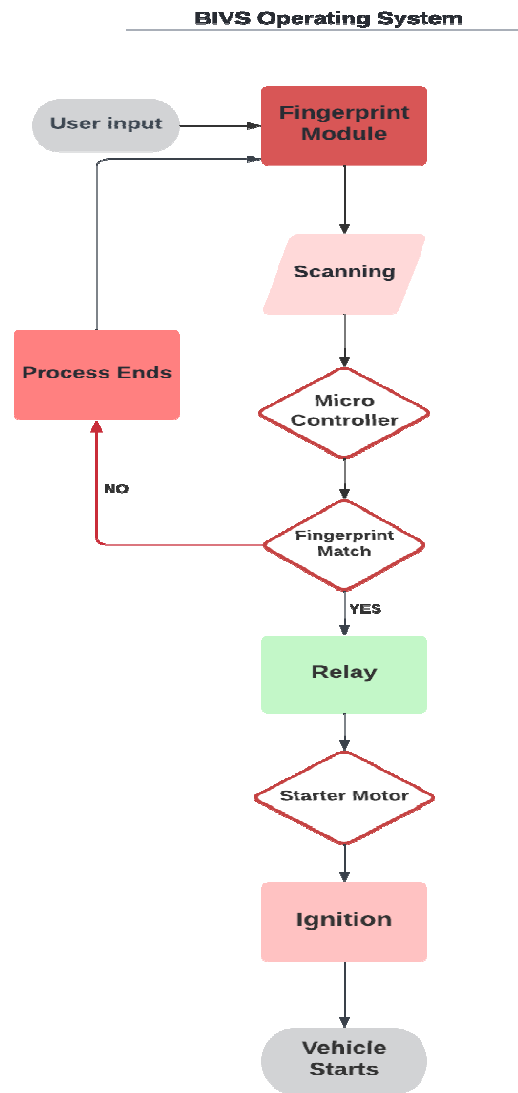
fig.3.2 flowchart displaying the operating cycle of the system.

As of now keys are being replaced by the push start buttons, this project has been implemented in two-wheelers having Push start buttons replaced with the fingerprint sensor and the same has been successfully

implemented in 4-wheeler cars. The cars having push start buttons and the cars with self-type ignition systems are both useful in this project and work properly.

In this project the hardware and the software both play an equal and important role.The working of ignition system remains the same and the changes are made by just taking off the Push start buttons from the bikes or mopeds, or by removing the key type self-system from the car and attaching the fingerprint module at the same, or by removing
the Push button that is replaced with the sensor module.

IV. Conclusion

Thus, the vehicle's engine cranking system is secured by an interfacing microcontroller, fingerprint sensor and relay which collectively forms the anti-theft system and provides   better protection from unauthorized persons. By using the biometric ignition system, security on automobiles is improved. Only the authorized user can access the vehicle. Unauthorized users are restricted from accessing the vehicle. This system is user-friendly and fast when compared to the conventional method of ignition using keys. Thus fingerprint identification enhances the security of a vehicle and makes it possible only for authorized people to start the car.

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