

Implementation of a Secure Ignition Control System with GPS Tracking and Two-Factor Authentication

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Abstract - Nowadays, vehicle theft is becoming more common, especially because many vehicles still use simple key-based ignition systems. These keys can be easily lost or duplicated, which makes them unsafe. To solve this problem, we designed a secure ignition system that uses two levels of authentication along with GPS tracking. In our system, the user must first verify their fingerprint and then enter a password using a keypad. Only when both are correct, the vehicle will start. Arduino UNO is used to control all the components. A GPS module is used to track the vehicle location, and NodeMCU ESP8266 sends this data to the cloud so that the user can monitor it. This system increases security and helps in tracking the vehicle easily.

Key Words: Vehicle Security, Fingerprint, Password, GPS, Arduino UNO, ESP8266, IoT

1. INTRODUCTION

Vehicle security is a big concern today. Even now, many vehicles depend on traditional keys, which are not very safe. Keys can be copied or stolen, and this makes it easy for unauthorized people to access the vehicle.

To improve this situation, we used a two-step authentication method. In this project, the system first checks the fingerprint of the user. If it matches, then the user has to enter a password. This double security makes it much harder for anyone to misuse the vehicle.

Along with this, we added GPS tracking so that the location of the vehicle can be known at any time. Using ESP8266, this information is sent to the cloud, and the user can check it remotely. Arduino UNO works as the main controller and connects all the parts together.

2. LITERATURE SURVEY

[1]. Arduino-Based Systems

Mazidi and his team explained about Arduino in embedded systems. Arduino is very simple to use. It does not need high programming knowledge. Even beginners can understand it easily. Because of this, it is used in many student projects. Arduino boards are low cost and easily available. It can connect with many devices like sensors, displays, and modules. It works

as the main controller in many systems. It takes input and gives output based on the program. In security systems, Arduino is very useful because it can control multiple components at the same time. In our project also, Arduino UNO is used as the main controller. It connects all parts and controls the working of the system.

[2]. GPS Technology

Kaplan explained GPS in a simple way. GPS means Global Positioning System. It works with the help of satellites. These satellites send signals to the GPS receiver. From these signals, the location is calculated. The location is given in the form of latitude and longitude. GPS is used in many applications like maps, navigation, and tracking. In vehicles, GPS helps to know the location at any time. It is very useful in case of theft. If a vehicle is stolen, GPS helps to find it. But GPS cannot stop theft. It only gives location details. So, GPS should be used along with security systems for better results.

[3]. Arduino Programming

Simon Monk explained about Arduino programming. Arduino uses simple code which is easy to understand. The programs are called sketches. These sketches are written in Arduino software. After writing the code, it is uploaded to the board. The board then works according to the program. Arduino also supports many libraries. These libraries make coding easier. Because of this, Arduino is widely used in real-time applications. In our project, Arduino programming is used to control fingerprint checking, password entry, LCD display, and other operations.

[4]. Embedded Systems

Axelson explained about embedded systems and their use. An embedded system is designed to perform one task. It is a combination of hardware and software. These systems are reliable and work continuously. They are used in many areas like home automation, industries, and security systems. In vehicle systems, embedded systems help to control sensors and other devices. They respond quickly to inputs. This makes them useful in real-time applications. Our project is also an embedded system where Arduino controls all components.

[5]. GPS and GSM Tracking Systems

Lwin (2019) developed a system using GPS and GSM. In this system, GPS is used to find the location, and GSM is used to send the location to the user. The user receives the location through messages. This helps in tracking the vehicle. It is useful when the vehicle is stolen. But this system mainly focuses on tracking. It does not stop unauthorized access. So, even though the vehicle can be tracked, theft is not prevented.

[6]. Vehicle Security Using GPS and GSM

Sharma and Kumar (2018) worked on a system where GPS and GSM are used together. In their system, when someone tries to access the vehicle, a message is sent to the owner. This gives an alert. It also provides location details. This system improves awareness. But it still depends on a single level of security. It does not use advanced authentication methods. So, it is not completely safe.

[7]. GPS-Based Vehicle Tracking System

Kumar and Ramesh(2017) developed a system that gives continuous location updates using GPS. This system is useful for tracking vehicles in real time. It helps in finding stolen vehicles quickly. But it does not prevent unauthorized users from starting the vehicle. It only works after the vehicle is taken. Biometric systems like fingerprint recognition improved security to some extent. However, most of them worked alone and did not include tracking or remote monitoring.

In recent years, IoT-based systems became popular because they allow real-time monitoring. Still, many systems do not combine authentication and tracking together. So, there is a need for a system that provides both strong security and tracking in one place.

3. EXISTING SYSTEM

Most vehicles today use key-based ignition systems. These systems are simple but not secure. Keys can be duplicated easily, and locks can be opened using basic tools.

Some vehicles use remote keys, which are more convenient. But these systems can still be hacked, as the signal can be captured. RFID systems also have similar problems because their signals can be cloned.

GPS tracking systems are helpful, but they only work after the vehicle is stolen. They do not prevent theft. GSM systems can send alerts, but they do not stop unauthorized access.

The main issue with all these systems is that they use only one level of security. If that fails, the vehicle can be accessed easily. Also, most systems are not connected properly, which reduces overall effectiveness.

4. PROPOSED SYSTEM



Fig-1: Proposed System

In our project, we combined different technologies to create a better security system. Arduino UNO is used as the main controller.

The system uses a fingerprint sensor as the first level of authentication. After successful verification, the user has to enter a password using a keypad. If both are correct, the system allows the vehicle to start.

A GPS module is used to track the vehicle location continuously. The NodeMCU ESP8266 sends this data to the cloud, so the user can monitor it anytime.

We also used an LCD display to show messages like “Access Granted” or “Access Denied.” A buzzer is used to give alerts when wrong inputs are entered. A DC motor is used to represent the ignition system in our project model.

Block Diagram:

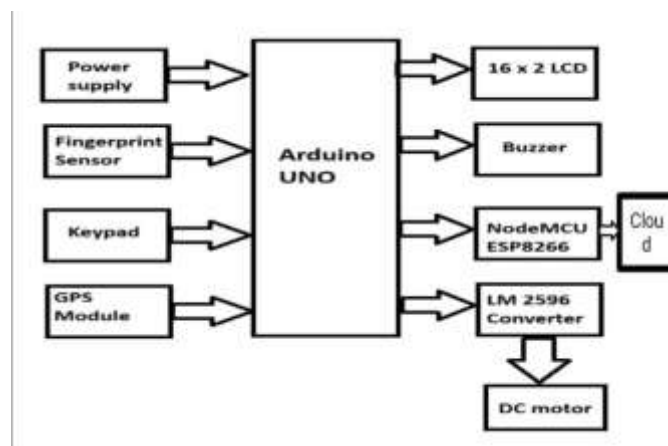


Fig -2: Block Diagram of the Circuit

Working:

When the system is turned on, Arduino initializes all components. The user places a finger on the sensor. If it matches, the system asks for a password. If both are correct, the motor turns ON. If not, access is denied and the buzzer is activated. GPS tracking continues in the background.

5. RESULTS AND DISCUSSION

We tested the system in different conditions to check its performance. The fingerprint sensor worked well and was able to identify users correctly in most cases. The password added an extra level of protection.

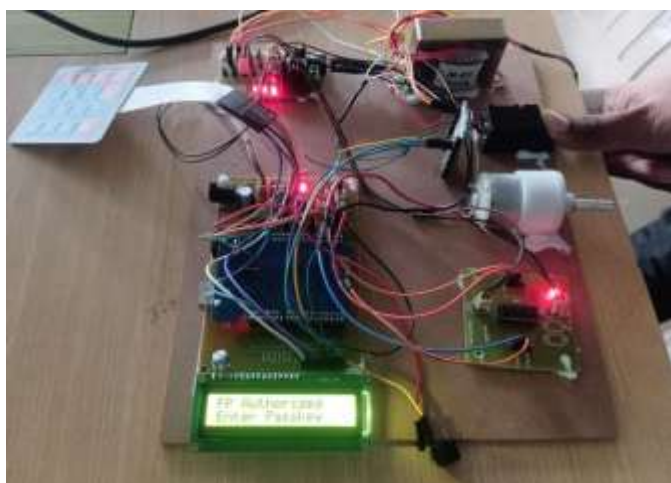


Fig -3: Working model of the system where the fingerprint is verified first

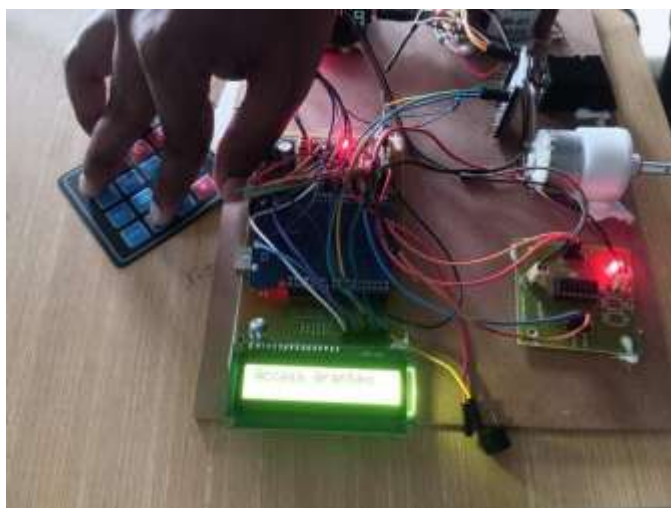


Fig -4: then a password is entered, and the motor turns ON while the LCD shows the status.

Because of the two-step authentication, it was very difficult for unauthorized users to access the system. The GPS module provided accurate location data, and the ESP8266 sent the data to the cloud without much delay.

The buzzer responded immediately when wrong inputs were given, and the LCD clearly displayed the system status. Overall, the system worked smoothly and gave better results compared to existing methods.

6. COMPARISON

System Type	Security Level	Authentication Used	Main Issue	Remarks
Key-Based System	Low	Key	Key can be lost or copied easily	Not secure
RFID System	Medium	RFID Tag/Card	Signal can be cloned	Somewhat safe
GSM System	Medium	No proper authentication	Only sends alerts, no control	Limited use
Proposed System	High	Fingerprint + Password	Very difficult to break	Highly secure

Fig -5: Comparison Table

7. CONCLUSIONS

In this project, we tried to make a better system for vehicle security. The main idea was to reduce theft and make the vehicle safer. We used simple components so that the system is easy to understand. Instead of using only a key, we used two steps for security.

First, the fingerprint is checked. After that, the user has to enter a password. Only when both are correct, the system allows the vehicle to start. This makes it more safe compared to normal systems. In key systems, anyone can copy the key. Sometimes keys are also lost. Because of that, vehicles can be easily stolen. But in our system, it is not that easy. Fingerprint is different for every person. Password adds one more level of protection. So, the system becomes stronger. We also added GPS in our project. This helps to know the location of the vehicle. Even if the vehicle is moved, we can track it. With ESP8266, the data is sent to the internet. So, the user can check it from anywhere. This is useful in real situations.

Arduino UNO is used as the main part. It connects all the components together. It controls the working of the system. During testing, the system worked well. Fingerprint sensor was able to recognize properly. Password checking also worked without problem. When wrong input was given, buzzer turned ON. LCD showed correct messages clearly. Motor turned ON only after correct input.

So, we can say the system is working properly. It is simple and not very costly. Anyone can use it easily. When we compare with old systems, this is better. Old systems use only one level of security. But here we used two levels. Also, tracking is available in our system. So, it gives more safety and control. Overall, we are satisfied with the result. We were able to

complete the project successfully. It helped us to learn many new things. We understood how components work together. We also learned practical implementation.

In future, this system can be improved more. New features can be added to make it better.

8. FUTURE SCOPE

In the future, this system can be improved by adding a mobile application for easy control and monitoring. Facial recognition can also be added as an extra security feature.

Other features like SMS alerts, geofencing, and AI-based detection can make the system more advanced and user-friendly.

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