

IoT based Vehicle Authentication using Fingerprint and Anti-Theft Detection

Subhashree Rath¹, Dr Dhanalaksmi M², Nageshwaran G³, Rakshith C⁴ and Suriya R L⁵

¹⁻⁵New Horizon College of Engineering/CSE, Bengaluru, India

Email: subhashree.rath0@gmail.com, {mdhanalak72, nagesh22801, rakshithchandrashekar368, suriyarl491}@gmail.com

Abstract—The way we engage with technology in the real the internet of things (IoT) has revolutionized. IoT has enabled a diverse variety of possibilities across industries including health- care, transportation, manufacturing, and more by connecting common things to the internet and allowing them to gather and exchange data. IoT combined with web technologies has proven its efficiency. GSM, GPS based monitoring and theft prevention system for vehicles. Vehicle tracing and monitoring inlive time is being created in order to trace the vehicles in real time. A biometric authentication system to access vehicle is the best way to prevent theft and unauthorized access. In general, the deployment of IoT in the real world has improved productivity, safety, and user experiences across a range of applications and sectors.

Index Terms— Internet of Things (IoT), vehicle tracking, security, Web Technologies, GPS, GSM.

I. INTRODUCTION

The network of interconnected machines, gadgets, and things that are attached with sensors and internet or network connection, enabling them to gather and share data make the IoT or internet of things. Many different industries and sectorshave used this technology, including:

1. Smart Homes: With the help of smartphones or voice assistants, IoT equipment like smart thermostats, lights, and security systems can be controlled and automated, enhancing both convenience and energy efficiency.
2. Healthcare: IoT devices can be used to track vital signs and give real-time health data to healthcare providers, enabling better patient care and illness management. These devices include wearable sensors and health monitors.
3. Industrial Automation: IoT sensors may be used to track and improve production operations, lowering downtime and boosting productivity. This covers tools like supply Chain management, quality assurance, and predictive maintenance.
4. Smart Cities: IoT devices can be used to control and monitor city infrastructure, such as traffic, public transit, and utilities, enabling more effective resource usage and raising inhabitants quality of life in general.
5. Agriculture: Farmers can optimize crop productivity and use less water by using IoT devices to monitor soil moisture, temperature, and other environmental parameters.
6. Logistics and transportation: IoT devices can be used to track the location and state of items as they are being transported, allowing for more effective and economical supply chain management. These are only

a handful of the many uses for IoT technology, and the possibilities for boosting productivity, cutting expenses, and improving user experience are practically endless.

In order to track a vehicle's location and other factors, IoT devices like GPS trackers can be installed within the vehicle. For real-time monitoring and analysis, this data can be transferred to a central server or cloud-based platform. This data can be used by fleet managers to optimize routes, lower fuel costs, and boost overall operational effectiveness. IoT devices can also be used to track vehicle performance and anticipate maintenance requirements, minimizing downtime and enhancing safety. IoT devices can be utilized in vehicle authentication to guarantee that only authorized persons can access and operate automobiles. For instance, IoT-enabled keyless entry systems can employ biometric sensors to authenticate users based on their proximity to the vehicle. This enhances general security by reducing theft and unlawful usage of Vehicles. The network of everyday objects such as phone, refrigerators, smartphones, smart doors, patient monitoring equipment, and other monitoring devices that are connected to one another is an example of IoT. The RFID scanner, Radio frequency identification tag, actuator, and network connection that these devices are connected to allow them to interchange or gather and push or communicate data to a remote or virtual or cloud server. The term "Internet of Things" refers to this technology.

IoT is essentially a synthesis of various core technology platforms and has several levels of connection. Various level requirements call for various levels of security solutions [1]. Flexibility in monitoring and regulating physical assets and personal data has recently taken on essential importance. Physical mobility that is transportation has simplified it, for the general population to travel, but they have also become hazardous in a number of ways. As a result, this paper has suggested a real-time vehicle tracing and monitoring system. The team of researchers in this paper also worked on developing a system that can use an Arduino Uno R3, a GSM device, and a GPS device to track and trace the precise and exact position of the car in any given area. The gadget also has a display that shows the information about the user and their vehicle's current location. Also, two programmes are used to display the data: Freeboard is used to display the same information as a publicly accessible map, and the trend of the vehicle's trip is displayed using longitude as well as latitude points by ThingSpeak. Findings demonstrate that consumers may easily track the location of their vehicle using a mobile phone and the Internet. In-depth real-time testing was done on the entire system, and it has proven to be successful in assisting subscribers in identifying their vehicles at risk of theft. [2]. People are looking for more intelligent solutions to remotely protect and monitor their assets as a result of new technologies and advancements. Thus, GPS-based monitoring systems are currently widely utilized for fleet management, tracking of children and pets, tracking of airplanes, tracking of any personal property, and tracking of vehicles. This paper introduced a smart theft protected car mechanism that uses the IoT to track any vehicle with this attachment whereabouts in real-life from anywhere. The GPS which is short form of Global Positioning System, Global System for Mobile Communication (GSM)/General Packet Radio Service (GPRS), and Microcontrollers are utilized in the implementation of this system to allow users to conveniently monitor their automobiles [3].

II. RELATED WORK

Based on test results and discussions, investigators concluded that vehicles have a double security system in place. This system is able to differentiate an RFID tag relying on ASCII data and information saved to switch on the automobile and is capable of providing data on the whereabouts of the vehicle. When a car is taken, the security system has an emergency safety mechanism that uses GSM connection to turn off the engine. Environmental factors and the system's time delay have an impact on the accuracy of the information. With an average of 5.6 seconds pause in preparing and an average pause or lag time of 1.6 seconds, the overall waiting time of the device's structure could be endured without compromising the system's efficacy. Acquiring inaccuracy 4.067 percent on the voltage of resource system demonstrates the soundness of the voltage source system [4]. Any unauthorized person who tries to access the car will be secretly recorded on video, so the owner can park it without worrying about theft or another misuse. The owner of the car can readily view these photographs on a computer or mobile device and then forward them to the police as proof.

Without using any additional costly expenditures or complexity, we were able to achieve driver surveillance using this robust security approach. This extra feature offers both driver and accident monitoring in addition to accident alerts. This device quietly keeps an eye on both the driver and the vehicle [5].

In a research paper [6], a novel approach to evaluating the IoT-based vehicle tracking system's quality was proposed. As car accidents are on the rise and vehicle tracking systems are crucial in large cities, this module was created to watch the vehicle's temperature, the driver's alcohol consumption, and any signs of sleepiness or drowsiness. The security and service quality have both increased because to this work survey. The Internet of

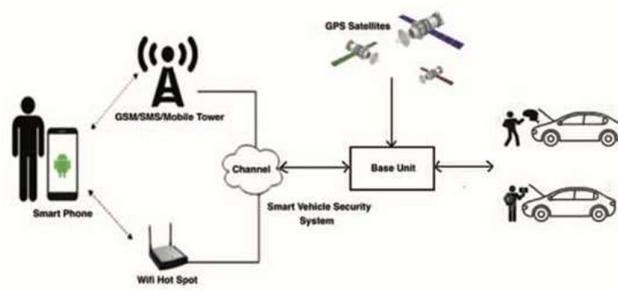


Fig. 1. Implementation of the Wireless Vehicle Security System (WVSS) using Internet of Things. According to [4]

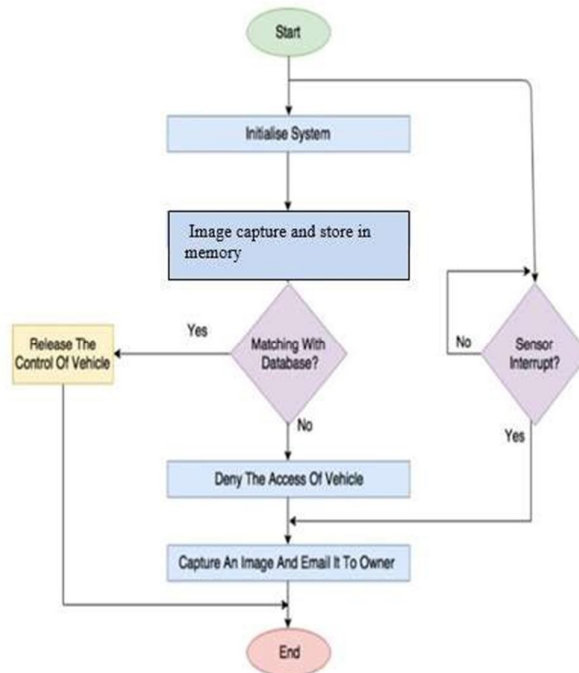


Fig. 2. Flow Diagram of the proposed structure in [5]

Parameter	Normal Value	Value above the Normal Value	Status / Indication
Temperature	Up to 43 ^o C	> 43 ^o C	Alert Driver by Alarming through buzzer
Blink of eye	3-4 Blinks / 10 sec.	> 4 Blinks / 10 sec or No Blinks	Stop the Vehicle Intimation to the Owner
Alcohol Consumption	Up to 30%	> 30%	Stop the Vehicle, Intimation to the Owner

Fig. 3. Observations according to [6]

Things (IoT), an emerging technology, has helped car monitoring systems in the real world overcome obstacles. Table below shows the observations by the scholars. Researchers and team used a combination of GPS and

GPRS to capture data about the driver's health, the engine's temperature, and any irregularities. The vehicle's temperature sensor keeps track of temperature changes and alerts the driver when the engine motor is getting too hot. The driver's drowsiness and alcohol intake levels are monitored by the alcohol sensor.

Tracking of assets, vehicle maintenance, and espionage, the recovery of snatched vehicles, and all those other uses have made widespread use of vehicle monitoring structure. A new generation of vehicle monitoring structure is being developed as a result of improvements in contemporary using innovations such as ubiquitous computing and of course the IoT, which are in addition to the accessibility of affordable equipment basic unit. In this paper, authors introduce Vehicular Monitoring and Tracking Using Opensource approach, VERTIGUO, a automobile tracking mechanism based on GPS, GSM with GPRS tools that is precise, reliable, adaptable, affordable, and with more features. Our vehicle monitoring and tracing solution architecture is freely accessible for the research group to test, explore with, and add new features—unlike standard COTS (Commercial Off The Shelf) car tracking systems, which are locked and limited to cellphones and PCs. We employ our understanding of freely available hardware platforms to construct the hardware (HW). The software architecture enables the tracking of vehicles using websites and web apps for smartphones, tablets, and PCs, as well as through Short Messaging Service on conventional GSM-based normal phones. All mobile phones will be able to use this program as long as they are connected to a GSM network. Researchers outline their system architecture, model, and field trial findings in this paper [7]. It was put to the test to see how well a GPS, fingerprint authentication, and GSM-based smart vehicle security system would function. The system is run by a web-based Android mobile application developed in Java using the Android Studio IDE. The last location of the car's data can be obtained from the database in cases where there is a loss of network coverage while tracking the vehicle, and the approximate locations of the vehicles can then be determined. This is accomplished by integrating the real-time database housed in the cloud with the security system's C-Secure application. During testing, the system was shown to be capable of remotely demobilizing the car in real-time using SMS commands and mobile applications over cellular networks and the internet. When a car is being stolen, the driver can safely get out and use any mobile device to send commands and remotely switch off the power, which will stop the car from moving and give the owner a chance to be back in control. The precise location of the car could be ascertained when the precise latitude and longitude coordinates were acquired and entered into the Google Map Fragment in the C-Secure Application interface created for the system. The smart theft prevention security system's fingerprint authentication capability can be supplemented with additional biometric identity technologies, such as face recognition, to improve security and efficiency. Other technologies are also usable, including radio frequency (RF), recording cameras, and some touchscreen-based programs. The device can be utilized in real-time in trucks that distribute petrol, transportation or courier operations for monitoring cargo, and transportation companies. It extends beyond merely auto security. Using a customized version of a web-based Android smartphone application tracking fragment, anyone may follow their loved ones. [8].

III. METHODOLOGY

The system makes use of NodeMCU (ESP8266) as a microcontroller unit. Fingerprint or biometric sensors, GPS and GSM sensors make the system more reliable. IoT Clubbed with Web Technologies to access real-time data remotely is one of the major novel factors of the system. The fingerprint module is used for authorization purposes. If the registered fingerprint is used it will open the door, for unauthorized fingerprint, it sends SMS via GSM with GPS coordinates. For each successful scan, the user's data is pushed to a web server. The login time and coordinates are noted and displayed on a webpage. The IoT-based solution may be useful for controlling system. Thus, the suggested model is intended to improve adaptability and strengthen the systems. The IoT-based vehicle authentication system can be implemented with the battery of the vehicle which is to be connected to the 24/7 available Wi-Fi network. The primary controller is set to automatically access to the available network and be connected to the auto power supply in order to prevent the Wi-Fi connectivity from disconnecting.

IoT integration with security or vehicle authentication systems that use fingerprints has a number of potential advantages. These are a few significant benefits: Improved Security: Because each person's fingerprints are distinctive, fingerprint-based authentication is a very secure means of identification. It is feasible to develop a highly secure vehicle authentication or security system that is challenging to penetrate by merging this technology with IoT. IoT technology allows for remote access to authentication or security systems for vehicles, which can be particularly helpful when the car is parked in a far-off place or a big parking lot. Vehicle owners can easily verify themselves and gain remote access to their vehicles with remote access. Real-Time Monitoring: It is possible to identify any unwanted entry attempts in real time by using IoT technology to monitor the vehicle

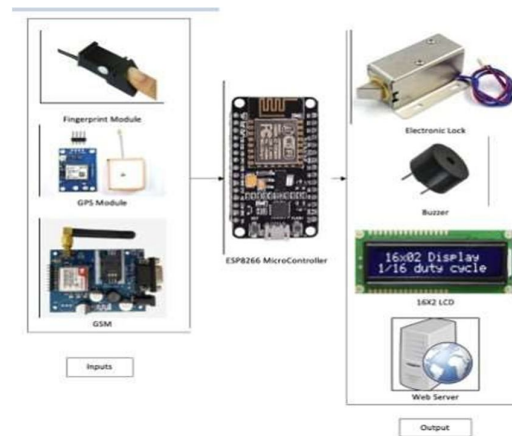


Fig. 4. block diagram

security system. This could aid in avoiding theft or other security lapses. Integration with Other Systems: IoT technology is easily combined with other systems, including GPS tracking and security cameras, to offer a full security solution for the vehicle. IoT integration can enable real-time monitoring and integration with other security systems, as well as a highly secure and practical solution for vehicle owners when combined with fingerprint-based vehicle authentication or security systems.

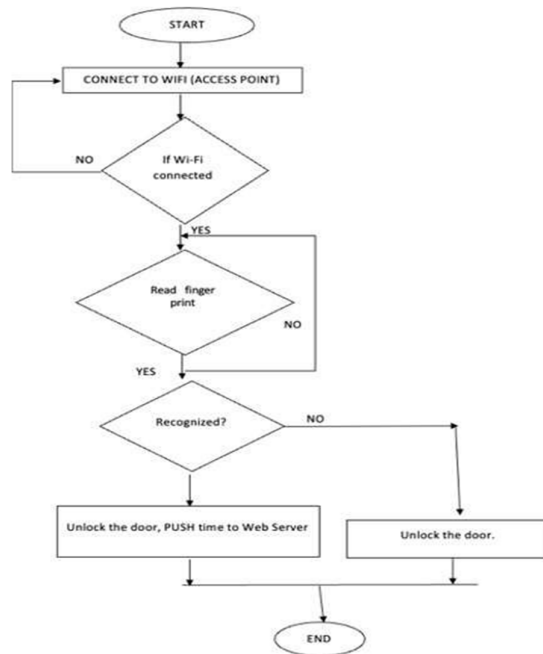


Fig. 5. Flow of the system

Hardware modules

A. Microcontroller

A microcontroller, often known as an MCU (microcontroller unit), is a miniature computer that is housed on a single MOS IC chip. It is similar to, but simpler than, an architecture on a chip (SoC), which might include a microcontroller among its parts. A microcontroller has several CPUs (processor cores), memory, and configurable I/O peripherals. With the open-source NodeMCU firmware, there exist concepts for prototype boards. The name "NodeMCU" is created by fusing the words "Node" and "MCU" (micro-controller unit). In actuality, the firmware rather than the related development kits is what is meant by "NodeMCU" in this context.



Fig. 6. ESP8266/ NodeMCU

B. GPS Component

Small processors and antennas found in GPS modules are used to directly receive data from satellites using specific RF frequencies. From there, it will get data from various sources, including timestamps from all visible satellites. It comes with an inbuilt 25x25x4mm which is capable of detecting satellite.



Fig. 7. GPS: Neo 6m

C. GSM Module

A device that employs GSM cellular telephone technology to offer a wireless data connectivity to a network is known as a GSM modem or GSM module. Mobile phones and other devices that communicate with mobile telephone networks use GSM modems. To link their gadget to the network, they need SIMs.



Fig. 8. GSM Module

D. Fingerprint Sensor

A digital fingerprint sensor is an authentication tool that is used to recognize and verify a person's fingerprints in order to grant or deny access to a physical space or computer system. With a fingerprint sensor module, identity can be confirmed.

E. Electronic Lock

Locking devices that lock and unlock using an electric current are called electronic locks. This current has the option of being fail-safe or fail-secure and can use a solenoid, electromagnet, or motor. In the event of a power outage, fail- safe locks will automatically unlock while fail-secure locks will remain locked.



Fig. 9. Biometric / Fingerprint sensor



Fig. 10. Electronic Lock Module

F. Buzzer Module

A mechanical, electromechanical, or piezoelectric (piezo for short) audio signaling device is a buzzer or beeper. It is an electronic part that can be linked to outputs and, when its signal is HIGH, emits a tone.



Fig. 11. Buzzer Module

G. 16X2 LCD

With a 16x2 LCD, there are 2 lines that can each display 16 characters. Each character on this LCD is presented using a 5x7 pixel matrix. The 224 different characters and symbols that can be displayed on the 16 x 2 intelligent alphanumeric dot matrix display. Command and Data registers are the two registers of this LCD.



Fig. 12. 16X2 LCD

Vehicle's real time			
Sl No	Location	Date	Time
1	https://goo.gl/maps/vf8GyortHM3yUE6K7	08/04/2023	04:07 PM

Fig. 13. Screenshot of SMS Received on Phone

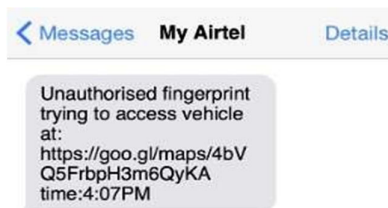


Fig. 14. Screenshot of the webpage for successful login

IV. RESULTS DISCUSSIONS

When tested with an authorized fingerprint, the door gets unlocked. On testing with an unauthorized fingerprint, we receive an SMS via the GSM module. On each successful fingerprint scan, the data is pushed over to the

cloud and displayed on the webpage. With these we were able to demonstrate real time vehicle authentication system module using GSM, GPS, Fingerprint and IoT.

FUTURE SCOPE

The project's scope can be expanded in the future to include other components like fuel monitoring, driver behavior analysis, and remote vehicle control. Additionally, it can be linked with external systems to offer extra features like insurance and emergency services. The system can also be improved for security and performance to accommodate more users and cars. In order to aid businesses in better understanding their vehicle usage and streamlining their processes, the project can also be expanded to include more powerful analytics and reporting functions.

ACKNOWLEDGEMENT

We want to sincerely thank our HOD, our project head, and the teachers for their time and care throughout and after the research paper writing process.

REFERENCES

- [1] Mohammad S. Obaidat, Soumya Prakash Rana, Tanmoy Maitra, Debasis Giri, and Subrata Dutta, "Biometric Security and Internet of Things (IoT)," Springer 2019
- [2] Abdullah H. Alquhali, Mardeni Roslee, Mohamad Y. Alias, Khalid S. Mohamed, "IOT Based Real Time Vehicle Tracking System," 2020 IEEE
- [3] Mohammad Salah Uddin, Md. Mohiuddin Ahmed, Jannat Binta Alam, and Maruf Islam, "Smart Anti-Theft Vehicle Tracking System for Bangladesh based on Internet of Things," Proceedings of the 2017 4th International Conference on Advances in Electrical Engineering (ICAEE) 28-30 September, Dhaka, Bangladesh
- [4] Mithileysh Sathiyarayanan, Santosh Mahendra, Rajesh Babu Vasu, "Smart Security System for Vehicles using Internet of Things (IoT)," 432 Second International Conference on Green Computing and Internet of Things (ICGCIoT) 2018 IEEE.
- [5] Mahesh R. Pawar, Imdad Rizvi, "IoT Based Embedded System for Vehicle Security And Driver Surveillance," Proceedings of the 2nd International Conference on Inventive Communication and Computational Technologies (ICICCT 2018) IEEE Xplore Compliant - Part Number: CFP18BAC-ART; ISBN:978-1-5386-1974-2.
- [6] A. Anusha, Syed Musthak Ahmed, "VEHICLE TRACKING AND MONITORING SYSTEM TO ENHANCE THE SAFETY AND SECURITY DRIVING USING IOTA," 2017 International Conference on Recent Trends in Electrical, Electronics and Computing Technologies. IEEE.
- [7] Thiagarajan Manihatty Bojan, Umamaheswaran Raman Kumar, Viswanathan Manihatty Bojan, "Designing Vehicle Tracking System- An Open Source Approach," 2014 IEEE International Conference on Vehicular Electronics and Safety (ICVES) December 16-17, 2014, Hyderabad, India
- [8] Akinwale Bukola, "Development of an Anti-Theft Vehicle Security System using GPS and GSM Technology with Biometric Authentication," Volume 5, Issue 2, February – 2020 International Journal of Innovative Science and Research Technology ISSN No:-2456-2165. IJISRT
- [9] Tahsin Attar, Prajakta Chavan, Vidhi Patel, Megha Gupta, Debajyoti Mukhopadhyay, "An Attempt to Develop an IOT based Vehicle Security System," 2018 IEEE International Symposium on Smart Electronic Systems (iSES) (Formerly iNiS)
- [10] A. Anusha, Syed Musthak Ahmed, "Biometric car security and monitoring system using IOT," 2019 International Conference on Vision Towards Emerging Trends in Communication and Networking (ViTE- CoN)
- [11] S. Rath, S. Kumar, V. S. K. Guntupalli, S. M. Sourabhand S. Riyaz, "Analysis of Deep Learning Methods for Detection of Bird Species," 2022 Second International Conference on Artificial Intelligence and Smart Energy (ICAIS), 2022, pp. 234-239, doi:10.1109/ICAIS53314.2022.9742798.
- [12] S. Rath, V. M. Deshmukh, R. Manzoor, S. Singh and S. J. Singh, "IoT and ML based Flood Alert and Human Detection System," 2022 4th International Conference on Smart Systems and Inventive Technology (ICSSIT), 2022, pp. 132-137, doi:10.1109/ICSSIT53264.2022.9716441.
- [13] Zhigang Liu, Anqi Zhang and Shaojun Li, "Vehicle Anti-Theft Tracking System Based on Internet of Things," International Conference on Computer and Communication Engineering (ICCCE 2010), pp. 15, May. 2010.