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LoRa Based Car Security System

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Abstract: **This project aims to secure the car from being stolen with new innovative features like verification of driver, remote shutdown features with the use of LoRa Wan technology. Today we have numerous technologies in car but the security is still a big question. The current records of the number of cars stolen are increasing every year. we propose a new system to strongly defend the different methods of theaters, with the help of LoRa-based car security system. The usage of latest LoRa technology helps the project to be completed with low cost and long-range effective security. The new proposed feature allows car owners to keep an eye on their cars from a distance with mobile application in case of stealing, unauthorized riddance. The main objective is to increase car security, safeguard vehicles against theft and minimize the number of incidents, more effectively. In general, the LoRa-system for car security provides a holistic solution to the problems of vehicle security, which are favorable to society, communities, and automotive businesses.**

Keywords: **LoRa WAN-Long range Wide area network, GPS- Global positioning system, ESP-32 Micro controller.**

I. INTRODUCTION

In the last few years, the issue of car theft has become a major problem in the many countries. Such alarming increase in vehicle thefts not only poses a threat to individuals' safety, but also leads to huge financial losses and emotional trauma of the one whose car was stolen and creates a social insecurity and puts a strain on the law enforcement resources. Implementing car security using technologies such as LoRa is not only a way of protecting individual investments but also a tool to make the community a safer place through reducing vehicle theft. One of the most viable solutions in the area of car safety is the LoRa (Long Range) technology due to the footprint of low power consumption and long-range communication which makes it appropriate for use in the car industry.

LORA:

LORA is a low-cost long-range communication device uses communication spread spectrum technology to send and receive signal over long range up to 10km, without help of GSM/telecom or internet data networks. LoRa signals are robust in noise area with lot of disturbances and support long range. LoRa wireless technology is ideal for applications with low data rate, minor amount of data transfer, data that can be transmitted from longer range, consume very less power for transmission and receiving data compared to technologies like Wi-Fi, Bluetooth, or ZigBee.

GPS:

GPS is global positioning system that provides satellite based current position of the car using geographical coordinates mapped to the local map of the state. By using GPS technology in locating a car, user can get the present location of car with high precision and helps to get safe and immediate access and share the same for security issues. A GPS module with continuous location tracking for the car is integrated and this leads to enhanced security measures.

ESP-32:

The heart of our system is the ESP-32 module that is the main controller that handles the smooth integration of different parts, like camera, GSM, GPS and LoRa. ESP -32 is a micro controller IC-SoC-system on chip with rich features to control multiple modules and large data with high speed.

II. LITERATURE REVIEW

A. Statement of the problem

With an increase in car theft cases, a make matter, which is a real trouble for car owners as well as the law enforcement agencies. Some cars in the market already have immobilizers & alarms but they cannot track the vehicles in real time & also the possibility of disarming the vehicle locks is possible. Our project is keen on addressing the challenges that may arise from handling car security by developing a LoRa-based car tracker which offers the advanced tracking and remote-control functions. The program will make it possible to control vehicles remotely, including the option to switch off the engine when the theft has occurred.

B. Related literature:

After a verifying the related projects and reference journals, we notice that the IVMS company provides a technology program that is safe and durable, and is ideal for car monitoring system with some security features. Such as car tracking, assess and report on vehicle activity which in turn reflects the continuous monitoring of driver's behavior and location and movements of car. Ut it does not have new features like identification of driver or theaters and comparison of driver face with others or else alarming system upon detection of theft.

Even an apple product called (AIR TAG) devices can send the location of your Air-Tag to iCloud and then the owner can use the Find My app and see the car location on a map. The whole process is anonymous and encrypted to protect your privacy and efficient as well, but it is not programmed to identify any kind of theaters or theft alarms.

Some research papers also include the basic idea of working of LoRa for security issues and its parameter estimation and analysis, which really helped to complete this project. we have provided unique methods of all old reference journal and already implemented ideas, as latest research areas are more challenging and life in future is going to be more unsecure.

III. METHODS & DESIGN

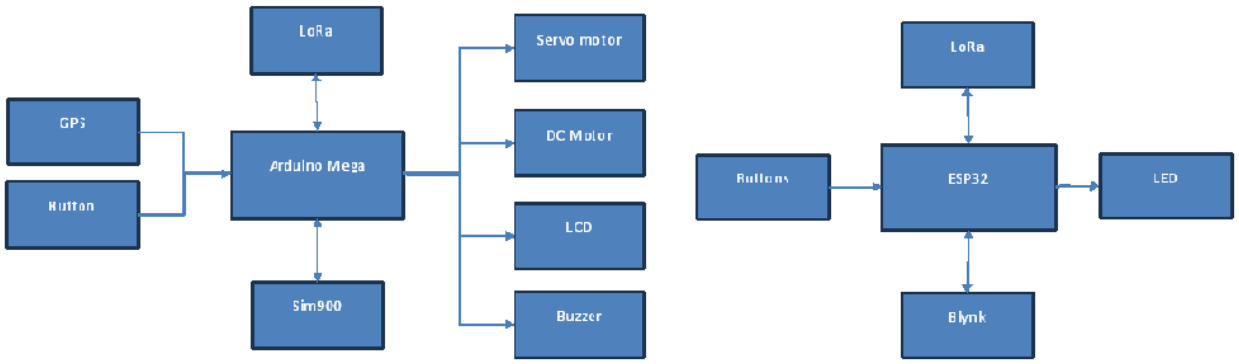

Fig. 1. (a.) Transmitter block diagram **(b). Receiver Block diagram.**

This transmitter block diagram in Fig.1. (a) illustrates the working principle of the circuit on the vehicle, where the GPS and the buttons are input devices. The GPS is a device that grants the exact latitude, longitude which defines the Location of the vehicle, and the button states if the vehicle is ON or OFF. Then these input devices pass the information to the microcontroller which is Arduino Mega 2560 that controls the information and do some process depending on the predefined rules. The controller then uses two devices for communication with the car owner and the authorities, LoRa for communication over a large distance (10Km) and SIM900 that use cellular network for communication. Hence after receiving the information and reading the data from the input devices a process will be done and the whole device will act using the output devices which are Servo motor (Door lock), DC Motor(engine), LCD display and a buzzer for warning and alerting.

The above receiver block diagram in Fig.1. (b) shows the working principle of the circuit on the car remote where the input is a few buttons for locking, unlocking and ON/OFF the car. The state of the buttons will be sent to the ESP32 which is a microcontroller that is small. The microcontroller communicates with the car using LoRa, And Bluetooth connection with the car owner mobile phone to show information on Blynk app. Lastly the LED that changes its color depending on the car state whether ON/OFF, Locked/Unlocked.

C. Transmitter module

The LoRa module and the buttons to start, lock, and unlock the engine are among the components that the application initializes. Next, inputs from engine switches, lock, and unlock are processed. The car will lock, transmit over LoRa to the car, and ultimately end if the input lock switch is set to yes; if not, it will return to the input lock switch. If the switch is unlocked, the car will probably unlock, send data via LoRa to the vehicle, and end. If not, it will likely press for three seconds before requesting a location; if not, it will return to the input unlock switch. Finally, when input engine switch pressed if for 3 second the car engine will switch on and send it via LoRa to the car and end, if no and the switch pressed for 3 second and the engine is on it will switch off the car engine and send it via LoRa to the car and end.

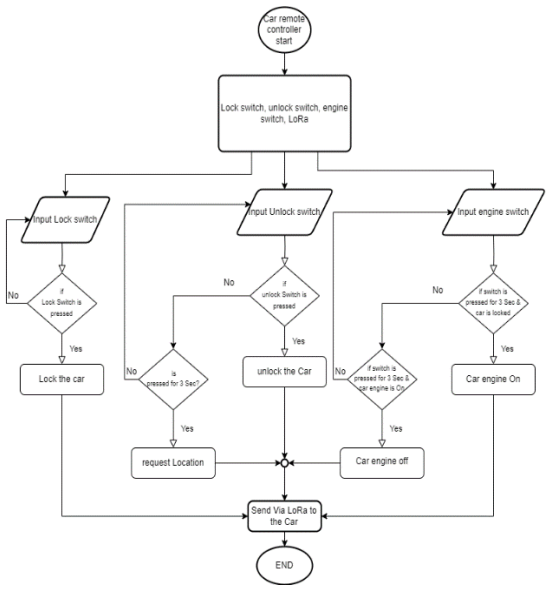

Fig. 2. Flow chart for transmitter Operation.

Table.1. Transmitter Operation

Buttons Nos	Status-On/Off	Lora	Blynk
Button 1	ON	ON	ON
Button 1	OFF	OFF	ON
Button 2	ON	ON	ON
Button 2	OFF	OFF	ON
Button 3	ON	ON	ON
Button 3	OFF	OFF	ON

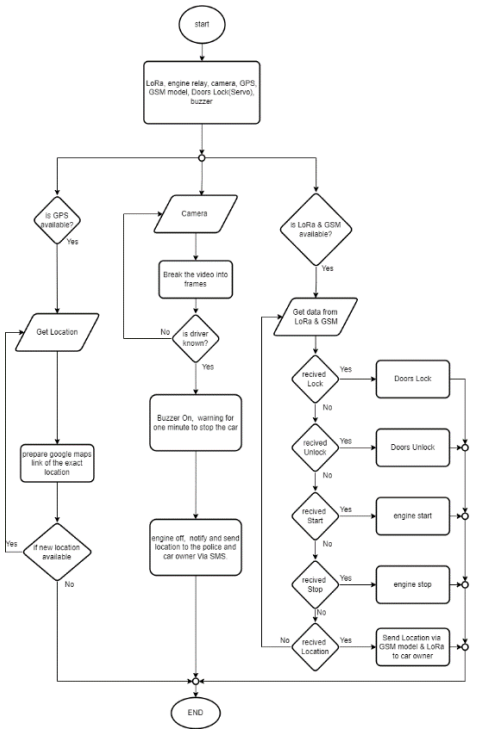

Fig. 3. Flow chart for receiver Operation.

Table.2. Receiver Operation

Status	Lora	GPS	GSM 900	Servo motor	DC motor	Buzzer
Initial	off	off	off	Locked	off	off
Lock	on	off	off	Locked	off	off
Unlock	on	off	off	Unlocked	off	off
start	on	off	off	locked	on	off
stop	On	off	off	Locked/ unlocked	off	off
Location	on	on	on	Locked/ unlocked	On/off	on
Thief	on	on	on	unlocked	off	on

D. Receiver Module

In the program of receiver module, a start initializes various components including GPS, SIM900 module, LoRa module, camera, car motor relay, car door lock (servo motor), and buzzer, assigning them to their respective pins. It then proceeds to monitor inputs from buttons, GPS, and camera, storing the received data temporarily for updating. If the camera detects an unidentified driver, the system triggers an alert, producing an audible warning through the buzzer, notifying both the car owner and relevant authorities. Subsequently, actions are taken to immobilize the car and facilitate its retrieval. Furthermore, the program responds to button inputs within the car by utilizing the LoRa module to communicate with a corresponding device in the vehicle. This communication enables functionalities such as locking/unlocking the car and controlling its ignition through the motor relay. In cases where the LoRa connection is unavailable due to range limitations, the system seamlessly transitions to utilizing the cellular network. This enables remote access via the car owner's mobile device, ensuring continued control and monitoring capabilities.

E. Functional testing

In the first case, when the device is in the silent state, the car is locked and the servo motor is in the standby state, and no message is sent, so the red light is on.

In the second case, when the button is pressed, the Arduino sends a message to the receiver that the car has been unlocked, so the servo motor moves 180 degrees.

In the third case, when the button is pressed, the Arduino sends a message to the owner and orders to the receiver that the car has locked again and started moving to lock and unlock the car, so the servo motor returns to the first state, the motor start to rotate and the lamp lights up in green.

In the last case, the input is sent to the receiver when the car stops, and the servo motor rotates 180 to open the car doors and the light returns to red as a warning that it has stopped.

In the transmitter module:

Button 1: represent the remote control of the car when it is Locked.

Button 2: represent the remote control of the car when it is unlocked & for location.

Button 3: represent the remote control of the car engine.

Lora: Act as transmitter to communicate with the car to apply the actions.

In the receiver module:

The status defines the received command or the current vehicle condition.

Locked means the Servo motor is on 0 degree.

Unlocked means the Servo motor is on 180 degrees.

IV. CONCLUSION

The security system developed for the car security in this project using LoRa has shown remarkable improvements in vehicle security, communication, reporting, alarming with user convenience, vehicle safety. The system's capability to remotely lock/ unlock the car, control the engine and to provide real-time updates of the status of the car particularly, makes the car's security better and gives the car owners peace of mind. The new system's use of LoRa and GSM900 modules ensures communication under all circumstances, even when the network is not available. The easy-to-use interface, with buttons and LCD screens, lets users interact with the system and get the essential information. Generally, the project has demonstrated the potential of LoRa technology in increasing car security where it has opened the way for future developments in the security of automotive industry.

V. RECOMMENDATIONS

To further enhance the effectiveness and usability of the LoRa-based car security system, the following recommendations are proposed:

• Community awareness programs to help share awareness among the community.

• To Inform public about the dangers of auto theft and the significance of installing of protection systems.

• Boost security with biometric authentication or device lock.

• Design a user-friendly interface with touchscreen display or voice command.

• Investigate advanced communication protocols to improve data transmission speed and reliability.

• Extend automated servicing features to include comprehensive maintenance tasks.

• Adopt data analytics for user-friendly information on driving habits, vehicle performance

• Integrate advanced security alert features for instant intrusion detection and automatic notification.

• Create a mobile application for convenient access to system features and status updates.

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