CELL PHONE BASED MOTOR VEHICLE SECURITY SYSTEM

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ABSTRACT

This system is designed to lock and unlock the vehicle Engine Control Unit (ECU) and Electronic Fuel Injection (EFI) system including the doors through the cell phone. Avoiding Vehicle Theft is making buzz in present automobile industry. Design and Development of a theft control system for an automobile, can be achieved by making use of Global System for Mobile feature of mobile phone. The developed system makes use of an mobile phone that is embedded in the vehicle with an interfacing to Engine Control Module(ECM) through Control Area Network (CAN) Bus, which is in turn, communicated to the Engine Control Module (ECM). The vehicle being stolen can be stopped by using Global System for Mobile feature of mobile phone and this information is used by the owner of the vehicle for future processing. The owner by dialing the secret locking number to the security system embedded or/sends the secret message to the security system which is embedded in the vehicle which has stolen which in turn controls the vehicles engine by locking the working of the engine immediately.

The developed system accepts the message and broadcasted to the Vehicle Network through Control Area Network Bus. The vehicle can only be started if the owner of the vehicle resets and unlocks the security system via the mobile phone. The mobile phone in this case, actually acts as a remote control which is not limited to any distance. If the main battery has been disconnected or tampered by the thief, the system is equipped with its own back up alkaline battery to enable the system remains energized for duration of

three weeks. The backup battery is carefully, securely and well hidden such that it cannot be easily seen and noticed by the thief. The goal behind the design is to develop and implement security for vehicles and embedded system to communicate with engine of the vehicle.

*Keywords—**Controller Area Network Bus, Engine Control Unit, Mobile Phone/* **Global System for Mobile***, Theft Control Unit***

BACKGROUND

Due to high levels of car theft crimes reported in the country, the system was invented and developed by Whyson Jr. Mumba in conjunction with Information and Communication University School of Engineering.

This innovation came as a result of trying to mitigate the car theft cases which were so rampant and frequently reported in parts of the country. Some of the cars which were reported stolen had well equipped alarm security systems installed on them of which the car thieves were able to disarm and drive away without the consent of the car owners. The common car alarm security systems installed in most cars have remote controls which are limited to a certain specified radius and have no back up batteries to power the security system when the main car battery is tampered with. This limitation on certain car alarm systems advantages the car thieves as they can easily disarm and reset the system without difficulties. The Cellular Phone Monitored Car Immobilizer Security System is pact with necessary features that will offer high level of security to your car.

I.0 INTRODUCTION

These day's vehicle theft cases are higher than the past and owner of the vehicles need to give extra protection with reliable anti-theft device. Vehicle Electronic control unit ensures the best guarantee to protect your vehicle from different kinds of unauthorized cases. It is a vehicle security device that offers excellent protection to your motor vehicle. A vehicle with Electronic control unit security system helps the user to lock and unlock engine and doors at the press of a button on the phone. Mainly two types of Electronic control unit are used in Auto industry - Manual Electronic control unit and Automatic Electronic control unit that ensures smooth and secured operation, although this system could not prove to provide complete security and accessibility of the vehicle in case of theft, hence avoiding this in present automobile industry. Design and development of a theft control system for an automobile, can be achieved by making use of Global System for Mobile (GSM) feature of mobile phone. ***The proposed system makes use of a mobile phone that is embedded in the vehicle with an interfacing to Engine Control Module through Control Area Network Bus, which is in turn, communicated to the Engine Control Module***.

Automotive industry uses Controller Area Network as in-vehicle network for the Engine Management, the body electronics like door and roof control, air conditioning and lighting as well as for the entertainment control. Nowadays all most every vehicle manufacturers have also started implementing Control Area Network Busbased vehicle automation. The vehicle being stolen can be stopped by using Global System for Mobile

(GSM) feature of mobile phone and this information is used by the owner of the vehicle for future processing. The owner sends the message to the mobile which is embedded in the vehicle which has stolen which in turn controls the vehicles engine by locking the working of the engine immediately. It is observed that the vehicle theft is a global problem. Nobody would like his/ her vehicle to get stolen. The vehicle manufacturers installed a minimum standard security system such as an alarm- based security system.

The proposed system accepts the call/message and broadcasted to the Vehicle Network through Control Area Network Bus. The engine can be unlocked only by the owner of the vehicle by calling mobile phone embedded in the vehicle or by sending the message again.

The main goal behind the design is to introduce mobile communication and develop security system for vehicles and embedded system to communicate with engine of the vehicle.

The system is intended to provide a feature that would control the movement/speed of the vehicle by (engine lock/unlock) only upon receipt of a predefined code from the owner, who may be at a remote place by using mobile phone technology.

Today's Automobiles, invariably comply with digitalcontrol systems as a consequence of constant growth intechnology. Recent Vehicles contains large number ofElectronic Control Systems and already there are largenumbers of Electronic Control Units present.The growth ofautomotive electronics is the result parties of the customerswish for better safety and greater comfort and also for otherrequirements like improved emission control and reduced fuelconsumption.

Electronic Control Units (ECUs) are increasingly beingdeployed in automobiles to control one or more electronicsubsystems to realize various functions.When someone drivesa car there are many signals that are passed between the variousElectronic Control Units embedded inside the car. Output signals from anElectronic Control Unit contain information about the currentstate of the car as the driver interacts continuously with the car.A modern day automobiles can consists up to 80Electronic Control Units,sensing and taking tabs of the various parameters of theautomobiles. This rapid and complex exchange of signalsensures the proper functioning of the car.

2.0 PROBLEM STATEMENT

The existing available anti-theft vehicular systems are very expensive. Unit racking Vehicle Tracking Unit has the ability to integrate the Global system for mobile and Global Positioning Satellite tracking system with existing vehicle alarm or it provide alarm features when someone is tampering with vehicle. It allows detecting the security threat before the vehicle is driven away and gives the ability to track the vehicle over the internet. The ability to track the vehicle over the internet is done by utilizing Global Positioning Satellites. Data such as Global Position, Speed Velocity and Time (PVT) are transmitted over the Cellular network. The information transmitted from the tracking device is disseminated and stored on your private confidential account or sent over the wireless network. The data is cross referenced on a street level map for viewing. The positioning information provided is cross reference to the closest geographic address and displayed in residential /commercial address format.

The main drawback of the existing system is that the system provides only a broad layout of the geographical address, providing and does not provide street wise address. Speed of

the vehicle and engine is not controlled by the existing systems, thus exposing the vulnerability of a system that provides only tracking.

3.0. PROJECT OBJECTIVES

The main idea behind the design is to introduce the Mobile technologies into the embedded system. The designed unit is very cost effective. The entire designed unit is on a single chipElectronic Control Units (ECU). When the vehicle is stolen, owner will send a message to the mobile which is embedded in the vehicle showing the exact zone/location using global system for mobile. To stop the vehicle, owner sends a message to control system placed in vehicle as an Electronic Control Units that automatically stops the flow of the fuel in the vehicle by sending message through CAN Bus thus automatically engine speed reduce to zero.

Many modern vehicle tracking devices combine both active and passive tracking abilities. The proposed system is very reliable, when a cellular network is available and a tracking device is connected it transmits data to a server; when a network is not available the device stores data in internal memory and will transmit stored data to the server later when the network becomes available again.

The proposed system carried out in two modules, first the design of module to retrieve the zone/location and second module to control the vehicle engine by either to lock or unlock the engine by sending ON/OFF message from the user to the Theft Control Unit. Once, the vehicle is being stolen, the information is being used by the vehicle owner for processing, where by sitting at a remote place, a message is sent to the interfacing global system for mobile (GSM) modem that is interfaced with the Electronic Control Units which is installed in the vehicle. By reading the signals received by the mobile, the engine is locked automatically and speed of the vehicle reduced to zero. Again it will come to the normal condition only after entering a secured password by the owner of the vehicle.

Accomplishes the various control units of the vehicles are connected to one another through control area network bus. The theft control unit locks/unlocks the vehicle engine by calling/sending text message through mobile phone to Control Area Network Bus from the owner's mobile phone through Global System for the Message (GSM).

4.0. PROJECT RATIONALE

Cell phone based security Vehicle Automation (Cell phone based Locking and Unlocking of theft vehicles using Control Area Network) system project is applicable in Zambia and technically feasible. Firstly, most information security professionals in Zambia improve and concentrate on storing and sharing sensitive information in form of media that is deemed secure hence leaving loophole to vehicles theft security.

5.0. PROPOSED SYSTEM

The paper act towards with the design and implementation of a Theft Control System for an automobile,which is being used to prevent or control the theft of a vehicle.The developed system makes use of an embedded system and GSM Mobile technology. The proposed system, installed in thevehicle can be easily controlled by the owner of the vehicle bydialing/sending a message from his/her mobile to the vehicle engine by

interfacing with Controller Area Network bus and GSM modem. Once, the vehicle is being stolen, the information is being used by the vehicle owner for further processing, where by sitting at a remote place, a message is sent to the interfacingGSM modem that is interfaced with the Engine Control Unit which is installedin the vehicle. By reading the signals received by the mobile, the engine is locked automatically and speed of the vehicle reduced to zero. Again it will come to the normal condition only after entering a secured password by the owner of the vehicle.

The main idea behind the design is to introduce the Mobile technologies into the embedded system. The designed unit is very cost effective. The entire designed unit is on a single chip (Engine Control Unit). When the vehicle is tempered with, owner will receive an alert and Dial the mobile which is embedded in the vehicle tolock and unlock to control system placed in vehicle as an Engine Control Unitthat automatically stops the flow of the fuel in the vehicle by sending message through Controller Area Network Bus thus automatically engine speed reduce to zero.

Many modern vehicle tracking devices combine both active and passive tracking abilities. The proposed system is very reliable, when a cellular network is available and a tracking device is connected it transmits data to a server; when network is not available the device stores data in internal memory and will transmit stored data to the server later when the network becomes available again.

Vehicle tracking has been accomplished by installing a box into the vehicle, either self-powered with a battery or wired into the vehicle's power system. For detailed vehicle locating and tracking it is still the predominant method but many companies are increasingly interested in the emerging cell phone technologies that provide tracking of multiple entities, such as both a salesperson and their vehicle. These systems also offer tracking of calls, texts and Web use and generally provide a wider range of options.

5.1. LIMITATIONS OF THE SYSTEM

The system solely depends on the mobile network providers for its operation therefore, if there is no network the system cannot operate. Hence difficult to track and communicate with the vehicle.

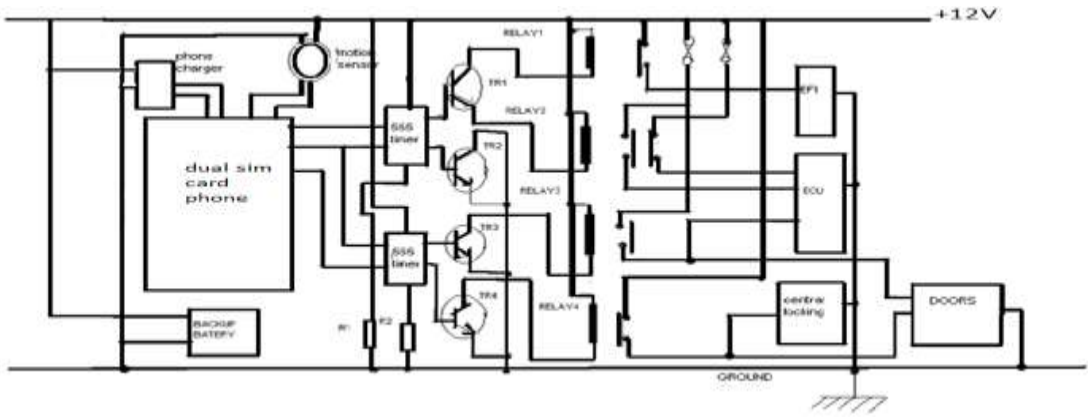
5.2. THEFT CONTROL UNIT (TCU)

The proposed theft control system provides a facility to control the further movement of the vehicle. The system is intended to provide a feature that would control the speed of the vehicle by (engine lock/unlock) only upon receipt of a predefined code from the owner, who may be at a remote place by using mobile phone technology.

5.3. CONSTRUCTION OF THE SYSTEM

With reference to the circuit diagram shown in figure below, basically the system comprises a Dual Sim Card Mobile Phone, transistors, 555 timers Integrated Circuits (ICs), diodes, resistors, capacitor and relays which are interconnected as shown in the diagram. The Dual Sim card phone is modified, soldered and installed in such a way that it receives wireless signals through dialing and converts them into electrical switching signals to activate the locking mechanism of the system which results into locking the Electronic Computer Unit (ECU) for the vehicle. When the computer unit is locked, this

results into activating the central locking system of the vehicle, disabling ignition system and fuel system of the vehicle. Hence the vehicle is completely disabled and cannot be started again. The functions of the dual SIM card mobile phone is to receive the signal for locking the vehicle and the other one is for receiving the signal for unlocking the vehicle. The system is equipped with a backup alkaline battery which is trickle charged every time you switch ON your vehicle. The purpose of this battery is to keep the security system energized for a longer period even though the main battery is disconnected. The diagram below shows it's lay out.



5.4. OPERATION OF THE SYSTEM

The principle operation of this security system depends on the mobile network. Once the system is installed, it will remain active for the rest of the life span of the vehicle.
Any time you enter your vehicle, it will always communicate to you by dialing your phone automatically.
The locking of the vehicle is done through dialing the secret locking number to the security system. Once the vehicle is locked through the phone it cannot be started unless the vehicle owner unlocks it via the mobile phone. The system has two operation options depending on the customer's demand.
The first option is to **restrict the system**. With this option, the system can be programmed in such a way that, it can only accept specific phone numbers assigned to it. This means that the system will only recognize the signals from phones whose numbers have been programmed in the system. This is done to prevent unnecessary stray interference to the system.
The second option is to **generalize the system**. With this option, the system will recognize any phone call communicating to the security system via the secret dialing number. This means that, you can use any cell phone including the land phones to immobilize, lock and unlock your vehicle. The advantage of this option is that, you can lock and unlock your vehicle using any mobile phone including the land phone provided you know the unlocking and locking secret codes to the system.

5.5. DESIGN & DEVELOPMENT OF THEFT CONTROL UNIT (TCU)

The block diagram of the proposed system is as shown inFig. 3.

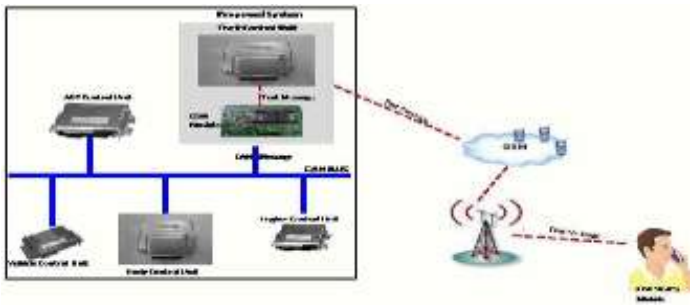


Fig.3. Overview of the Proposed System

The design & development of the proposed system carried out in two modules, first the design of module to open and close vehicle doors and second module to control the vehicle engine by either to lock or unlock the engine by sending **ON/OFF** message from the user to the Theft Control Unit. Figure.3 accomplishes the various control units of the vehicles are connected to one another through Controller Area Network Bus. The Theft ControlUnit locks/unlocks the vehicle engine by Dialing or sending text message through mobile to Controller Area Network Bus from the owner's mobile phonethroughGlobal System for Mobile Communications (GSM).

6.0. IGNITION / FUEL FLOW CONTROL OF THE VEHICLE

Design of ignition/fuel flow control module involves a stimulus to drive the process. This stimulus is obtained through an owner's message. Upon receiving the location of the vehicle, the owner can either stop or start the ignition of the engine. The design parameter that is considered in this moduleis receiving a message from the owner to perform furtheraction. Another design parameter considered is authenticatingthe genuine nature of the message. Design involves processingthe message only if it is from the owner. Even if the lockingcode is known to others, locking cannot be performed. Ownerthus has a discrete control over the ignition of the engine. Thecrux of the design involves controlling the ignition the enginebeing at a remote place by sending a message.

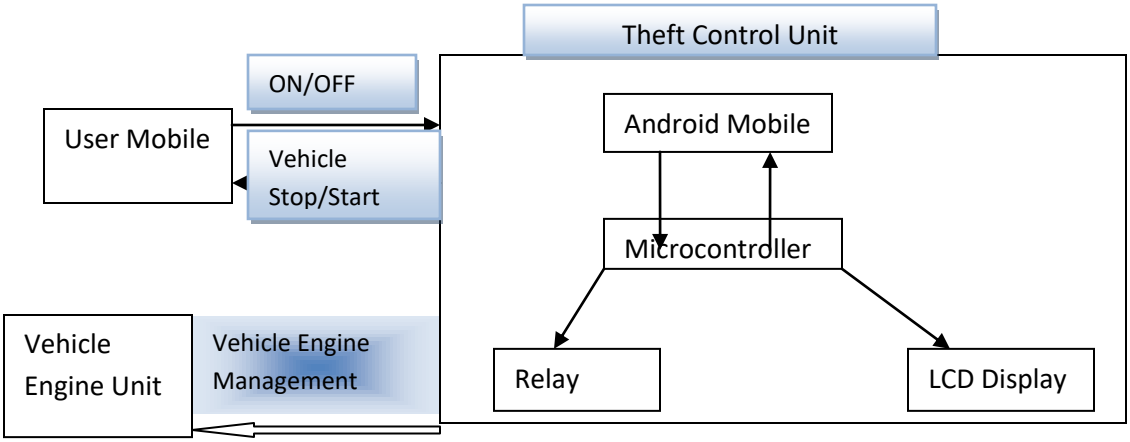


Fig.5. Block Diagram of the engine ignition control module.

Upon receiving the message and verifying its authentication, the micro controller installed on the vehicle would send a signal to the relay to lock or unlock the engine.

A SIM card on Global System for MobileCommunications**(**GSM) module installed on the vehicle would receive the message and would forward it to the micro controller. A MAX232 would perform the action of both driver and receiver to forward the message to and from the micro controller as shown in Fig. 5.
An LCD display is used to notify the changes. Corresponding messages would be display on the LCD when a new message is received, when locking or starting the engine is performed. This kit however is not essential for actual deployment of the system and is used only for demonstration purpose.

7.0. EXPERIMENTED RESULTS

The results are obtained after carrying out the experimentation by using the following hardware components.
The component includes Android Based Phone, ARM Controller, Relay Circuit, and Global System for MobileCommunicationsModule, and liquid-crystal display. Fig. 6 shows ARM Controller, Relay circuit, Global System for MobileCommunicationsModuleand liquid-crystal display(LCD) Display are interfaced on a single board andembedded on single board which is embedded to a vehicle as a control unit. The relay is connected to the Vehicle Engine Unitof the Automobile.

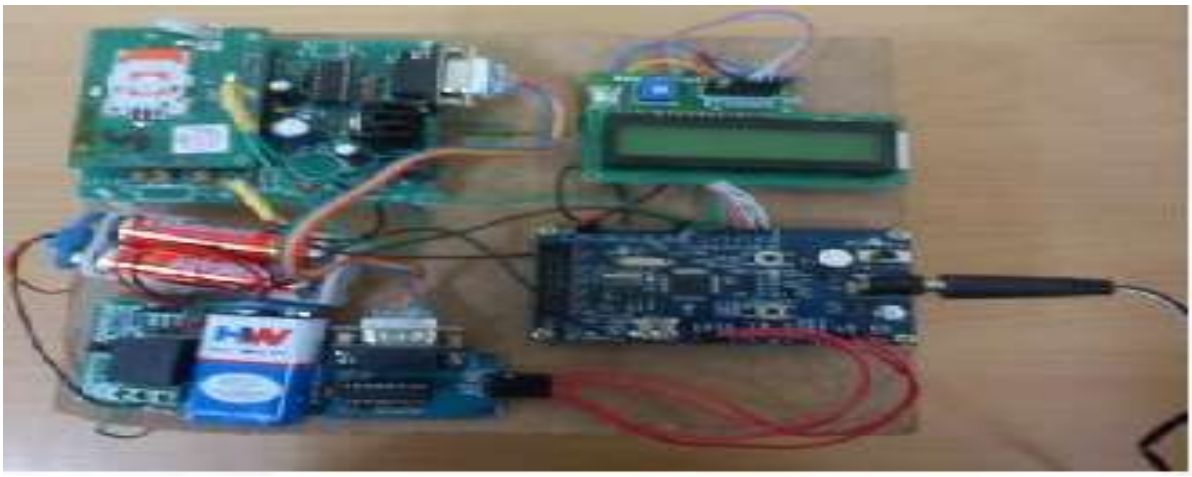


Fig.6. Hardware Kit embedded to the vehicle.

When “OFF” message sent by the owner of the vehicle tothe mobile embedded in the control unit, the controller displaysthe message in the liquid-crystal displayas shown in Fig. 7(b) and invokes therelay that is connected to the vehicle engine which will stopfuel flow thus locking the vehicle engine by sending messagethrough the Controller Area Network Bus in the Controller Area Network readable format. Similarly when “ON” message sent by the owner of the vehicle to the mobile embedded in the control unit, the controller displays the message in the liquid-crystal display as shown in Fig.7(a) and invokes the relay that is connected to the vehicle engine which will in turn allows the fuel flow by unlocking the vehicle engine by sending message through Controller Area Network Bus.

(a) 

(b) 

Fig.7. (a) LCD displaying “ENGINE ON” message,
Fig.7. (b) LCDdisplaying “ENGINE OFF” message.

Messages “ON” and “OFF” are converted into signal 0 and1. When signal=1, it means engine is locked, speed of the vehicle is reduced to zero irrespective of drivers input. If thesignal=0, it means engine is unlocked it behaves normally asper the drivers input. This illustrated by plotting a graph asshown in Fig. 8 by the considering the values present in Table1.
When engine is in normal condition, speed of the vehicledepends on drivers input but when the engine is locked, speedof the vehicle is 0 but it cannot be changed by the driversinput.

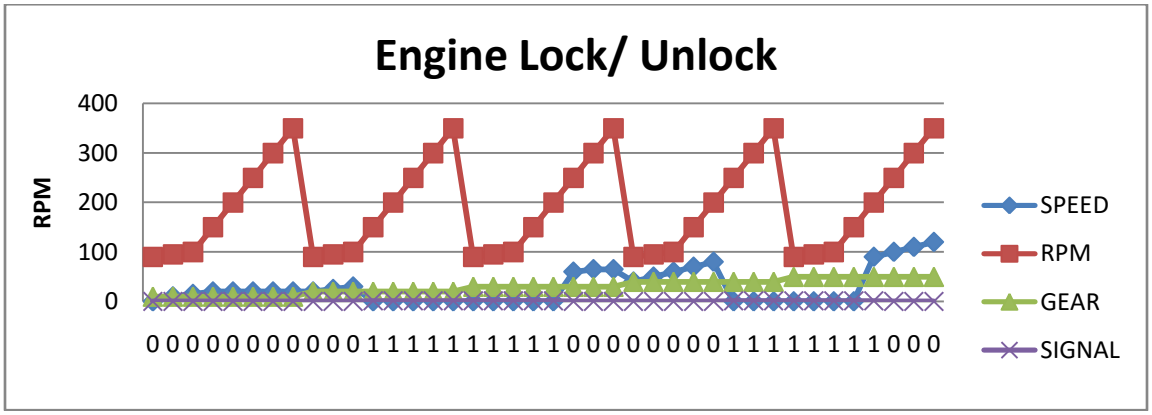


Fig.8. Graph representing Engine status of a vehicle.

8.0. CONCLUSION

The Proposed System Theft Control Unit can beimplemented in any automobiles as one of the vehicle’s electronic control units which will be connected to the Controller Area Network Busas one more nodes. The developed system is less expensivevehicle tracking control system that could be implemented onany vehicle since the system is developed by using mobile andGSM technology which is operated by sending and receivingmessages.
The vehicle engine ignition system can be controlledby reading the message received. The system consists of two modules one is GSM moduleand the other is Android module. The owner of the vehicleinteracts with GSM module by sending and receivingmessages. GSM module is the simple communicationchannel that uses existing network providers. So, mobile network is essential for the functioning of the system. Theft Control Unit installed controls the vehicle engine unit when it receives message from owner through

Controller Area Network Bus. Since the Controller Area Network Bus is used as in-vehicle network, the transfer of data from one unit to another unit reliable and efficient. Therefore, the integrated system handles different functions such as locking vehicle engine by stopping fuel flow in to the engine, getting location details through GPS network and sending it to owner of the vehicle.

The Proposed system can be deployed on any automobile, less expensive and ignition of an engine can be controlled being at the remote place, encompasses some advantages of the system. Therefore, the Mobile based Vehicle Theft control Unit(TCU) provides an easier and featured tracking system. Also helps the owner of the vehicle to have an easy remote controlof the theft vehicle.

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