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RESEARCH ARTICLE

A MASSIVE VEHICLE THEFT CONTROL SYSTEM USING EMBEDDED AND MOBILE TECHNOLOGIES

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Abstract

To prevent or deter the unauthorized appropriation of vehicles, vehicle-theft control unit should be used. Automobiles can be designed with vehicle-theft control unit by making use of Embedded and Mobile technologies. The developed vehicle-theft control unit makes use of a mobile phone that is embedded in the vehicle which in turn interfaced to Engine Control Unit of the vehicle through Ethernet. The vehicle being stolen can be stopped by using GPS and GSM feature of the mobile phone. The owner sends the message to the mobile which is embedded in the vehicle which has been stolen and this in turn controls the vehicle by locking the working of the engine immediately. The engine can be unlocked only by the owner of the vehicle by sending the message again. This vehicle-theft control unit also consists of Lock, Spray and Alert mechanism to provide a better vehicle security. The main goal behind the design is to develop a massive vehicle security system using Embedded and Mobile technologies.

I. INTRODUCTION

Modern Automobiles, contains large number of Electronic Control Systems as a consequence of constant growth in technology. The growth of automotive electronics satisfies customer's wish for better safety and improved emission control and also for low fuel consumption and greater comfort. Electronic Control Units (ECUs) are increasingly being deployed in automobiles to control one or more electronic subsystems to realize various functions.

When someone drives a car there are many signals that are passed between the various ECU's embedded inside the car. Output signals from an Electronic Control Unit contain information about the current state of the car as the driver interacts continuously with the car. A modern day automobiles can consists up to 80 ECU's, sensing parametersof the automobiles [2]. This rapid and complex exchange of signals ensures the proper functioning of the car.

Automotive industry uses Ethernet as the 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 most automobile manufacturers have also started implementing Ethernet based vehicle automation. Ethernet is used in engine management to connect several ECUs [2].A vehicle tracking system combines the installation of an electronic device in a vehicle, or fleet of vehicles, with purpose-designed computer software atleast at one operational base to enable the owner to track the vehicle's location. Collecting data in the process from the field and deliver it to the base of operation. The terms cover a range of products which, by use of communications technology, or a combination of technologies, identify a stolen vehicle and its real-time location and present this information to a Systems Operating Centre (SOC) or to the police.

Tracking systems also continue to update the data and differentiate between a particular stolen vehicle and all other vehicles, which may or not be stolen. It is recognized that such systems may be a facility within fleet management/logistics systems or part of services known as vehicle telemetric. Modern vehicle tracking systems commonly use GPS technology for locating the vehicle and also other types of automatic vehicle location technology can also be used. Vehicle information can be viewed on electronic maps via the Internet or specialized software.

II. ETHERNET

Ethernet is most commonly used in automobiles to transport a variety of high-speed data [2]. Ethernet is a packetized system, where information is transferred in packets between nodes on various parts of the network. Ethernet is bidirectional, and the speed possible on any individual link decreases as the number of nodes on the system increases. Still, Ethernet can transport data over a link 100 times faster than a CAN bus. Ethernet is good for mid-bandwidth communications in applications such as navigation systems and vehicle control. Ethernet would be an ideal choice to replace other interfaces in recent automobiles. Some vehicles today are using Ethernet for data-intensive requirements such as backup cameras and entertainment systems. The growing number of electronic control units (ECUs) in the automobile - up to 80 in some vehicles - in addition to increased networking in the automobile and between the vehicle and its environment, is placing new demands on automotive networking technologies. Drivers and passengers want access to the vehicle network from their mobile devices

There might be one network that deals only with engine control and diagnostics, a second network that handles backseat entertainment and the audio system, and another network that handles driver-assist functions such as vision-enhancement cameras. In the end, Ethernet provides greater capacity than the CAN bus, at the expense of greater complexity

III. PROPOSED SYSTEM

Commercially available anti-theft vehicular systems are very expensive. The paper act towards with the design & development 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 /GPS technology. The proposed system, installed in the vehicle can be easily controlled by the owner of the vehicle by sending a message from his/her mobile to the vehicle engine by interfacing with Ethernet 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 interfacing GSM modem that is interfaced with the ECU 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. 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 (ECU). When the vehicle is stolen, owner will send a message to the mobile which is embedded in the car showing the exact location using GPS. To stop the vehicle, owner sends a message to control system placed in vehicle as an ECU that automatically stops the flow of the fuel in the vehicle by sending message through Ethernet 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.

Once the vehicle engine is controlled by user text message through Ethernet, the Lock, Spray and Alert mechanism gets triggered. Firstly the Lock mechanism gets activated, where all the locks of the vehicle goes locked letting the suspect who stole the vehicle not to escape from the vehicle. Secondly the Spray mechanism gets activated, where a small amount of anesthetic dosage is sprayed so that the suspect feels drowsy, this helps to prevent any harm which may be caused by the suspect to the vehicle. Finally the Alert mechanism gets activated, where an alert message will be sent to the cops to alert them that a suspect has been spotted. This alert message will be deployed earlier to the

vehicle-theft control unit and this will be sent through GSM module. The Lock, Spray and Alert mechanism is triggered by Ethernet which is interfaced to the Engine Control Unit.

A. Existing System

Uni-tracking Vehicle Tracking Unit has the ability to integrate the GPS tracking system with existing vehicle alarm or provide alarm features when someone is tampering with owner 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.

B. Drawbacks of Existing System

The main disadvantage 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 no way controlled by the existing systems, thus exposing the vulnerability of a system that provides only tracking.

IV. DESIGN OF VEHICLE-THEFT CONTROL UNIT

The block diagram of the proposed system is as shown in Fig. 2.The design & development of the proposed system carried out in two modules, first the design of module to retrieve the 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 Vehicle-Theft Control Unit. Fig.2 accomplishes the various control units of the vehicles are connected to one another through Ethernet Bus. The Vehicle-Theft Control Unit locks/unlocks the vehicle engine by sending text message through mobile to Ethernet Bus from the owner's mobile through GSM.

A. Location Retrieval of the Vehicle

Location of the vehicle is a two way process. Initially latitude and longitude of the vehicle is to be obtained from the satellites. Obtained latitude and longitude is used for further computation of geographical address by invoking goecoder. The owner can retrieve the location only upon sending a solitary message. This solitary message is set by the owner before deploying the system. Only upon receipt of corresponding message code, the application would start the service. As an acknowledgement, the owner is sent with latitude, longitude and the geographical address. Mobile network is a matter of concern as only in presence of substantial network coverage solitary message and its receipt is possible. Design of location retrieval module takes into consideration both the network factor and user code authentication. Only upon receiving an authenticated code that has been defined earlier, the owner is sent the location. Hence user code authentication is also considered.

B. 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 module is receiving a message from the owner to perform further action. Another design parameter considered is authenticating the genuine nature of the message. Design involves processing the message only if it is from the owner. Even if the locking code is known to others, locking cannot be performed. Owner thus has a discrete control over the ignition of the engine. The crux of the design involves controlling the ignition the engine being at a remote place by sending a message.

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 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. 3.

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.

V. EXPERIMENTED RESULTS

The results are obtained after carrying out the experimentation by using the following hardware components. The component includes Android Based Phone, Micro Controller, Relay Circuit, GSM Module, GPS Module and LCD Display. Fig. 4 shows Micro Controller, Relay circuit, GSM and GPS Module and LCD Display are interfaced on a single board and embedded on single board which is embedded to a vehicle as a control unit. The relay is connected to the Vehicle Engine Unit of the Automobile. When "<11>" message sent by the owner of the vehicle to the mobile embedded in the control unit, the controller displays the message in the LCD and the GPS location of the vehicle is sent to the owner. When "<22>" message is sent by owner, this invokes the relay that is connected to the vehicle engine which will stop fuel flow thus locking the vehicle engine by sending message through the Ethernet.

Fig.1. Basic Ethernet Bus

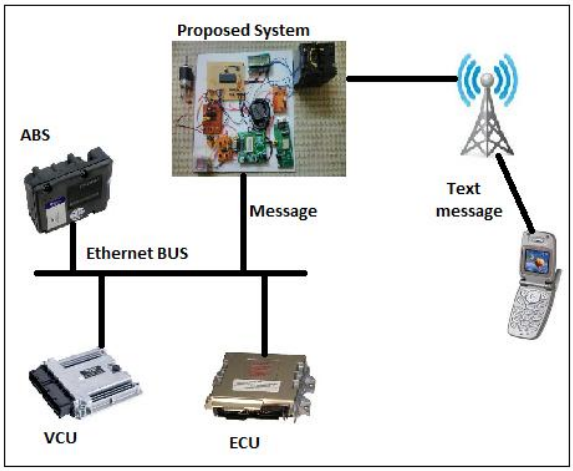

Fig.2. Proposed system

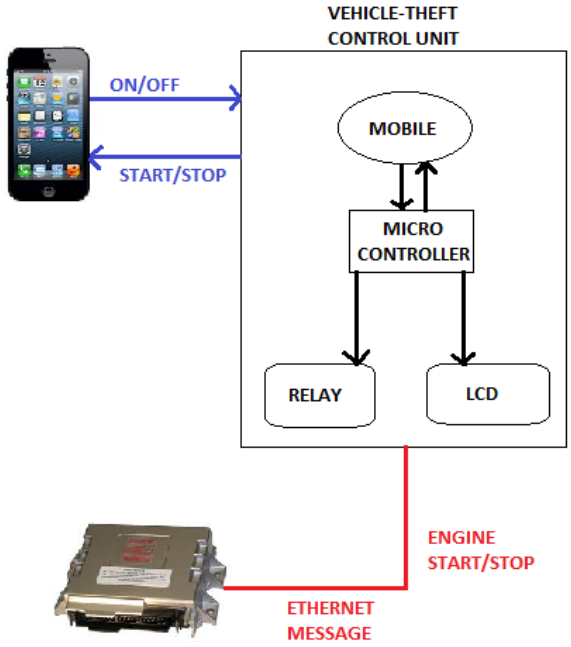

Fig.3. Fuel flow control module

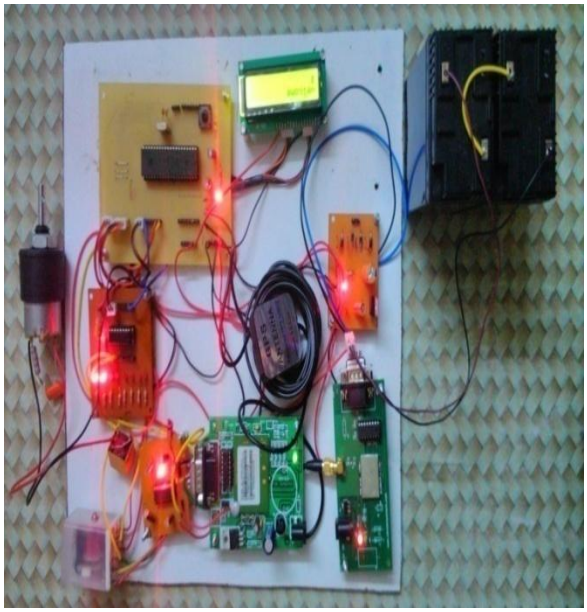

Fig.4. Developed Kit

Once when the engine is locked the Lock, Spray and Alert gets triggered automatically which is in turn is shown by glowing LED's Similarly when "<33>" message sent by the owner of the vehicle to the mobile embedded in the control unit, the controller displays the message in the LCD 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 Ethernet.

Owner Message	Vehicle Speed
<11>	0
<11>	10
<11>	20
<11>	30
<11>	40
<22>	0
<22>	0
<22>	0
<22>	0
<22>	0
<33>	0
<33>	10
<33>	20
<33>	30
<33>	40

Table 1: Table of results with owner's message and vehicle speed

VI. CONCLUSION

The Proposed System vehicle-theft control unit can be implemented in any automobiles as one of the vehicle's electronic control unit which will be connected to the Ethernet as one more node. The developed system is less expensive vehicle tracking control system that could be implemented on any vehicle since the system is developed by using mobile and GSM and GPS technology which is operated by sending and receiving messages. The vehicle engine ignition system can be controlled by reading the message received.

The system consists of two modules one is GSM module and the other is Android module. The owner of the vehicle interacts with GSM module by sending and receiving messages. The Android module uses GPS system to retrieve the location details of the vehicle. So that the owner can get location details and using which the owner could track the vehicle easily. GSM module is the simple communication channel that uses existing network providers. So, mobile network is essential for the functioning of the system. Vehicle-Theft Control Unit installed controls the vehicle engine unit when it receives message from owner through Ethernet. Since Ethernet is used as in-vehicle network, the transfer of data from one unit to another unit reliable and efficient. The Lock, Spray and Alert mechanisms are very new ideas implemented in this paper which helps to provide a massive vehicle security system. 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 provides an easier and featured tracking system. Also helps the owner of the vehicle to have an easy remote control of the theft vehicle.

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