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Design of Next Generation Auto Theft Prevention System

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Abstract—This paper introduces an design of next generation auto theft prevention system. As vehicles become more sophisticated, vehicle security systems must be stronger than ever before. A modern vehicle utilizes remote keyless entry system and immobilizer system as the main weaponry against vehicle theft. Project proposed here aims to design a next generation auto theft prevention system by adding significant enhancements and modernizing the existing system and thus try to overcome the drawbacks. There is a long list of features implemented in this project smart gravitational lock, cryptographic keyless entry, touch screen ignition, etc., The features are implemented with the help of 3-axis MEMS Accelerometer, 3-axis MEMS Magnetometer, IEEE 802.15.4 wireless networking protocol, TFT display, GPS Receiver, GSM cellular modem.

Keywords— Smart Gravitational Lock, Cryptographic Keyless Entry, Touch Screen Ignition, MEMS Accelerometer, MEMS Magnetometer, IEEE 802.15.4, GPS Receiver, GSM modem

I.INTRODUCTION

As vehicles become more sophisticated, vehicle security systems must be stronger then ever before. The increase in human-machine interactions in our daily lives has made user interface technology progressively more important. Physical gestures as intuitive expressions will greatly ease the interaction process and enable humans to more naturally command machines.

In this project, a miniature MEMS accelerometer based recognition system which can recognize various hand gestures like up, down, etc., in 3-D space is built. The recognition system consists of sensor data collection, segmentation and recognition.

The importance of accuracy in a positioning system has increasingly been stress for intelligent transport system applications based on position information, including advanced driver-assistance systems, electronic toll collection, intersection collision warnings, and traffic control. Today, the satellite-based Global Positioning System (GPS) is widely used for such applications because the GPS receiver provides vehicle position and velocity data in global coordinates.

However, a standalone GPS receiver cannot fulfil the positioning requirements of ITS applications due to the occasional temporary loss of satellite connection and signal errors. To provide continuous, accurate, and high integrity position data, the positioning system should be aided by additional sensors such as an inertial navigation system, vehicle motion sensors, digital road maps, cameras, radar.

The interruptions and degradations in Global Navigation Satellite Systems-based vehicular navigation solutions in dense urban scenarios such as urban canyons and tunnels lead to the fact that these solutions have to be augmented with other systems to achieve continuous and accurate navigation.

A low cost navigation device for land vehicles involving a reduced number of MEMS-based inertial sensors augmented with the measurements of the vehicle odometer and integrated with GPS and map data. This solution can be used in all environments including degraded GPS environments which routinely occur in urban and rural canyons.

II.EXISTING SYSTEM

i) Remote keyless entry system: refers to a lock that uses an electronic remote control as a key which is activated by a handheld device or automatically by proximity.

ii) Immobilizer: It is an electronic security device fitted to an automobile that prevents the engine from running unless the correct key or other token is present. This prevents the car from being "hot wired" after entry has been achieved.

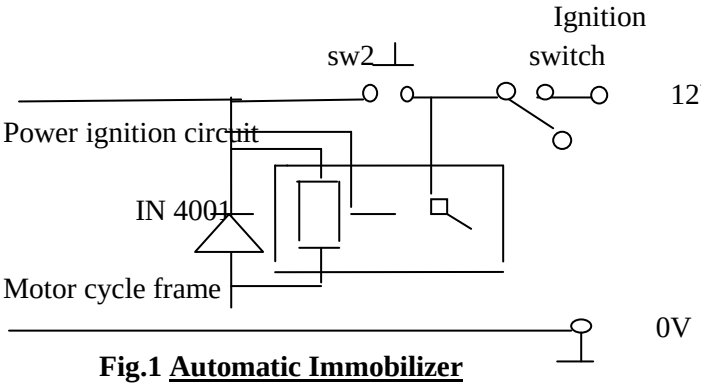

Fig.1 Automatic Immobilizer

Problems faced in existing system:

Due to the simple and poor nature of these security systems, auto theft incidents worldwide are on the rise. Here are some of the major problems with the existing auto theft prevention system.

i) It offers no protection when the key fob is stolen. So a smart key fob sold in the market is not actually smart.

ii) Vehicle tracking devices will not be able to locate a vehicle in GPS denied environments such as within buildings, underground and dense city regions, resulting in the loss of vehicle.

iii) The currently used motion and tilt alarms will alert the owner even for an unintentional touch by a passing person or an accidental hit by a ball from a playing child.

iv) Limited or to be accurate no central user interface to configure and customize the vehicle security system.

III.PROPOSED SYSTEM

The project proposed here aims to design a next generation auto theft prevention system by adding significant enhancements and modernizing the existing system and thus try to overcome the above drawbacks.

It consists of two units namely,

1. Smart key fob unit
2. Vehicle unit

These units consists of the following features

Working:

Smart Gravitational lock:

The system is armed automatically when the driver moves away from the vehicle. It is disarmed only when a specific gesture is made in the hand-held wireless key fob. The 3D gesture is made in mid-air and can be reprogrammed by the user on the fly.

The air gesture is recognized using a 3-axis MEMS Accelerometer that senses the gravitational force exerted upon it. A stolen key fob thus cannot be used to enter into the vehicle without performing the secret gesture. The password is stored in an external non-volatile memory.

Cryptographic Keyless Entry:

If the gesture is valid the key fob transmits a unique encrypted code that changes every time when this gesture is made. RC4 Stream Cipher Cryptographic algorithm ensures the safety of the data transmitted. The key fob communicates with automotive vehicle unit using IEEE 802.15.4 wireless networking protocol. This prevents thieves from detecting the static codes which were used in older keyless entry systems.

Touch screen Ignition:

A dual layer keying approach is followed during vehicle ignition process. This consists of software and hardware keys. A unique touch gesture is made on the 65k color touch screen TFT Display that acts as the software key.

The system verifies this and then accepts the hardware key which is the actual key fob normally used. This feature can be temporarily disabled and enabled via SMS send by the owner. This is useful in situations such as when someone (like a mechanic) other than the owner wants to handle the vehicle and the owner does not want the other person to know the secret onscreen password.

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Adjustable Motion Alarm Sensitivity:

The vehicle unit constantly monitors the vehicle motion after being armed (locked). The integrated motion sensing subsystem measures the vehicles three dimensional position and detects any unauthorized motion if the vehicles is moved or tilted that exceeds a threshold level.

When someone tries to break into the vehicle forcibly, the alarm triggers the siren and head lamps and sends an SMS to the owner.

Ubiquitous Vehicle Tracking:

GPS and GSM technologies enable the vehicle owners to track and monitor the vehicle with cell phone at anytime from anywhere. The important enhancement in this feature is its ability to inform the vehicle position even during a GPS outage using dead reckoning method.

This is achieved with the help of inertial navigation sensors that consists of a 3-axis MEMS Magnetometer and a 3-axis MEMS Accelerometer which will act as a tilt compensated compass module.

Car finder:

When the owner approaches the vehicle, the system automatically verifies the code from remote key and the vehicle emits a head light flash and horn beep to show its presence. It assists the owner to locate the vehicle in a parking lot where several vehicles are parked.

GPS Fencing:

This feature restricts the vehicle movement within a particular area. For example, if the owner wants the car to move only within a particular city, once it moves out of city borders the owner would immediately receive an SMS alert as to the current location of the vehicle.

The interesting feature here is the fence radius can be programmed by the user in the touch screen display. This flexibility allows the user to set a virtual fence that can be at building level, street level, city level or state level.

Remote Fuel Cut-off:

This feature is very useful especially in case of auto theft. if the vehicle is somehow hacked into and taken, you can send message that will slowly cut-off the fuel supply, thereby disabling the vehicle. A servo Motor controlled valve is used to cut the fuel supply.

Both the vehicle unit and the smart key fob unit use LPC1313, a 32-bit ARM Cortex-M3 microcontroller from NxP Semiconductors.

The following to block diagram shows the smart key fob unit and vehicle unit.

Smart key fob unit:

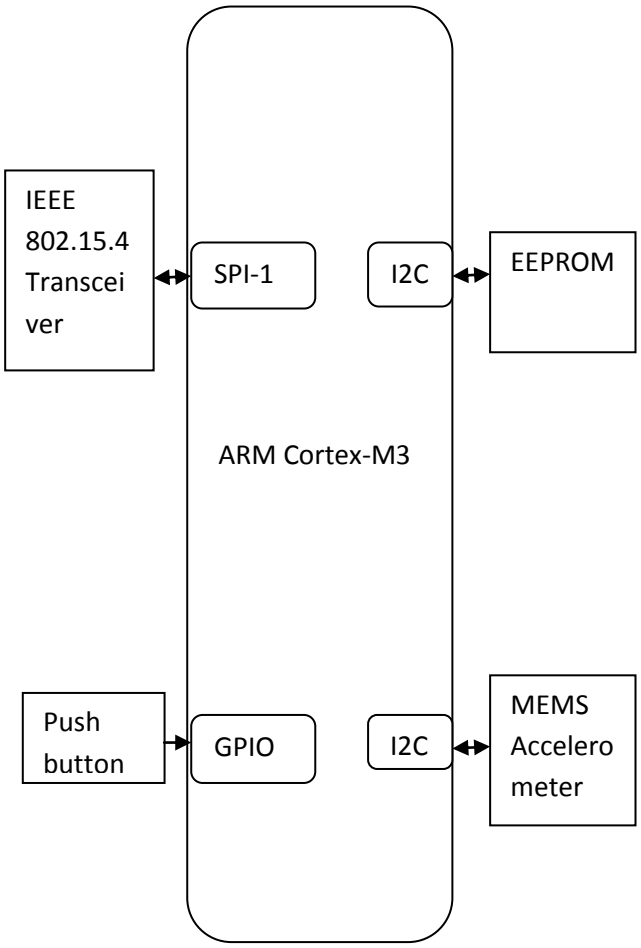

Fig.2. Smart Key fob Unit

Vehicle unit:

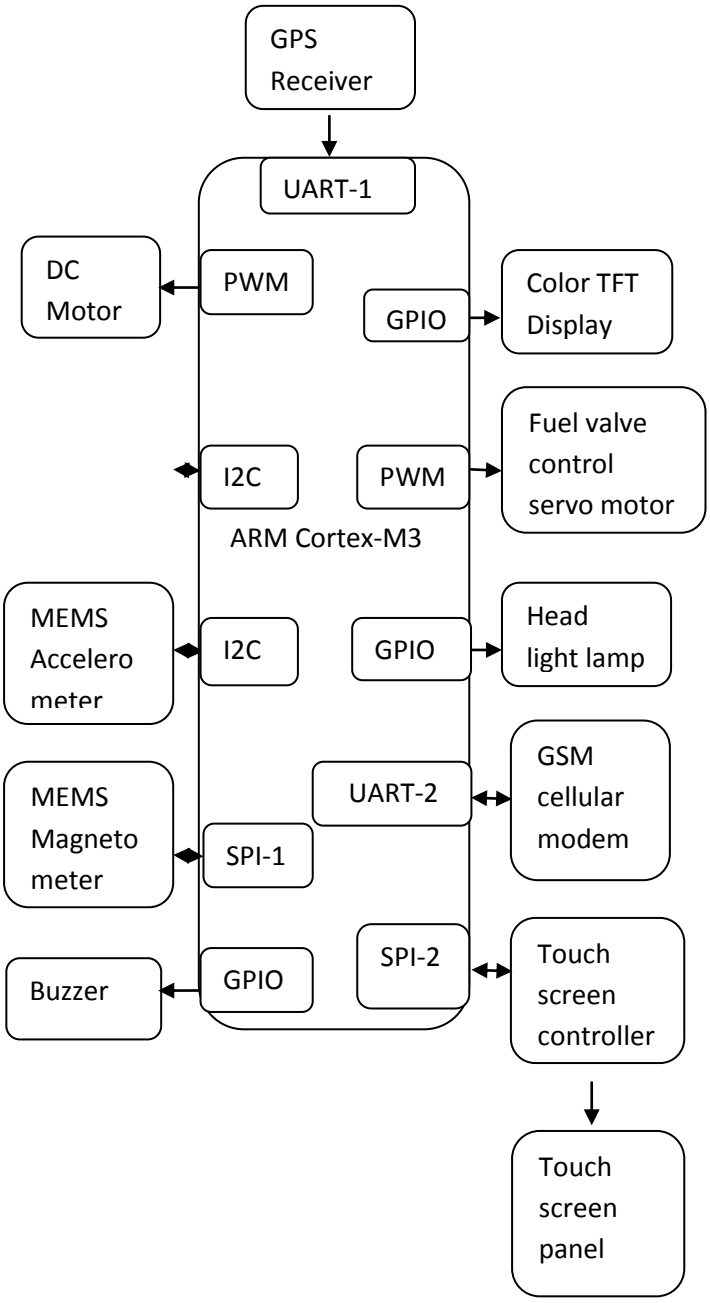

Fig.3. Vehicle Unit

IV.CONCLUSION

This approach described here presents a technique to prevent the vehicle theft by implementing smart gravitational lock, cryptographic keyless entry, adjustable motion alarm sensitivity, and also used for track and monitor the vehicle by owners at anytime from anywhere.

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