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REAL TIME VEHICLE LOCKING AND TRACING USING GPS AND GSM TECHNOLOGY

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Abstract

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. These systems prevent unauthorized access of the vehicle to a certain extent but are not a foolproof one. Due to the simple and poor nature of these security systems, auto theft incidents worldwide are on the rise. The project proposed here aims to design a next generation auto theft prevention system by adding significant enhancements and modernizing the existing security features and thus try to overcome the above mentioned drawbacks. There is a long list of features implemented in this project which is described below.

Index Terms

Cryptographic keyless entry, gravitational lock, GPS, MEMS accelerometer, MEMS magnetometer.

Introduction

Vehicles become more sophisticated, vehicle security systems must be stronger than ever before. Specific communication standards are under process for car-to- car (C2C) and car-to-infrastructure (C2I) communication so as to allow the vehicle to communicate with neighbouring vehicles and the systems installed on the pathways. This could help vehicles sync with traffic rules (speed limit zones) as well as avoid collisions by getting prior information on breaking of vehicle moving ahead. As the vehicles become smarter, the data traffic inside the in-vehicle networks also increases dynamically. Some of the major problems with the existing auto theft prevention system are: • It offers no protection when the key fob is stolen. So a smart key fob sold in the market is not actually smart. • 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.

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Features and its Description

The following modules are implemented in this project.

Smart Gravitational Lock

The system is armed automatically when the driver moves away from the vehicle. It is disarmed only when a specific password 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 keyfob thus cannot be used to enter into the vehicle without performing the secret gesture. The password is stored in an external non-volatile serial EEPROM memory.

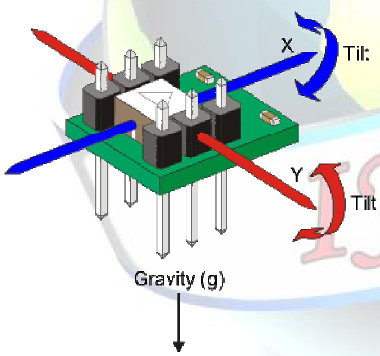

Fig 1 (Gravitational Lock)

Cryptographic Keyless Entry

If the gesture is valid the keyfob 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 keyfob 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. The wireless packets are also used to measure the proximity of the keyfob to the vehicle.

Fig 2 (Cryptographic Keyless)

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.

The sensitivity of this function can be adjusted on the touchscreen display GUI to effectively avoid any false warnings that are common with existing vehicle security systems. When someone tries to break into the vehicle forcibly, the alarm triggers the siren and head lamps and sends an SMS to the owner.

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Block Diagram:

(Locking)

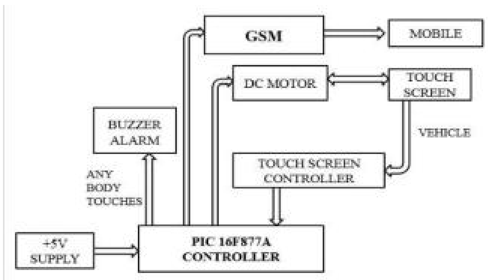

Fig 3 (Block Diagram)

Ubiquitous Vehicle Tracking

GPS and GSM technologies enable the vehicle owners to track and monitor the vehicle with cellphone 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. This feature is known as car finder and it assists the owner to locate the vehicle in a parking lot where several vehicles are parked.

Fig 4 (Car Finder)

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

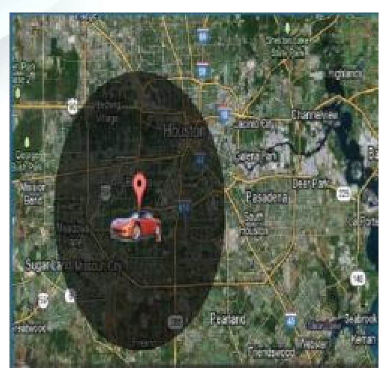

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Fig 5 (Car Fencing)

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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.

Fig 6 (Remote Fuel Cut Off)

BLOCK DIAGRAM (Tracking)

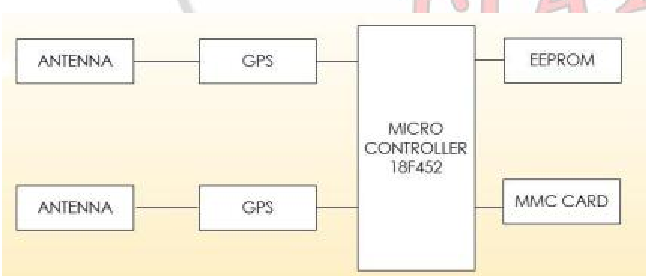
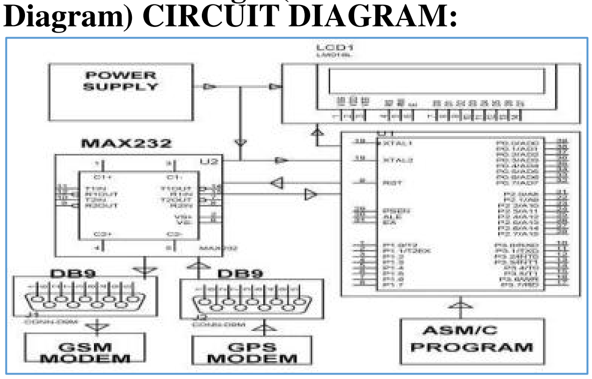


Fig 7 (VTS Block Diagram)

CIRCUIT DIAGRAM:



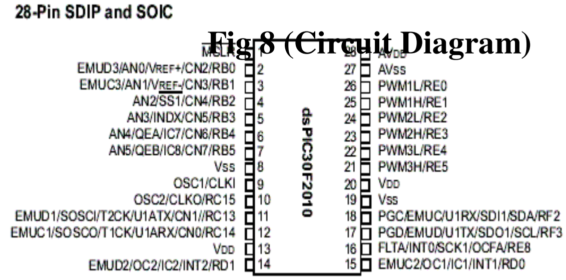


Fig 8 (Circuit Diagram)

TABLE 1-1: PINOUT I/O DESCRIPTIONS

Pin Name	Pin Type	Buffer Type	Description
AN0-AN5	I	Analog	Analog input channels.
AVDD	P	P	Positive supply for analog module.
AVSS	P	P	Ground reference for analog module.
CLKI	I	ST/CMOS	External clock source input. Always associated with OSC1 pin function.
CLKO	O	—	Oscillator crystal output. Connects to crystal or resonator in Crystal Oscillator mode. Optionally functions as CLKO in RC and EC modes. Always associated with OSC2 pin function.
CN0-CN7	I	ST	Input change notification inputs. Can be software programmed for internal weak pull-ups on all inputs.
EMUD	I/O	ST	ICD Primary Communication Channel data input/output pin.
EMUC	I/O	ST	ICD Primary Communication Channel clock input/output pin.
EMUD1	I/O	ST	ICD Secondary Communication Channel data input/output pin.
EMUC1	I/O	ST	ICD Secondary Communication Channel clock input/output pin.
EMUD2	I/O	ST	ICD Tertiary Communication Channel data input/output pin.
EMUC2	I/O	ST	ICD Tertiary Communication Channel clock input/output pin.
EMUD3	I/O	ST	ICD Quaternary Communication Channel data input/output pin.
EMUC3	I/O	ST	ICD Quaternary Communication Channel clock input/output pin.
IC1, IC2, IC7, IC8	I	ST	Capture inputs. The dsPIC30F2010 has 4 capture inputs. The inputs are numbered for consistency with the inputs on larger device variants.
INDX	I	ST	Quadrature Encoder Index Pulse input.
QEA	I	ST	Quadrature Encoder Phase A input in QEI mode. Auxiliary Timer External Clock/Gate input in Timer mode.
QEB	I	ST	Quadrature Encoder Phase A input in QEI mode. Auxiliary Timer External Clock/Gate input in Timer mode.
INT0	I	ST	External interrupt 0
INT1	I	ST	External interrupt 1
INT2	I	ST	External interrupt 2
FLTA	I	ST	PWM Fault A input
PWM1L	O	—	PWM 1 Low output
PWM1H	O	—	PWM 1 High output
PWM2L	O	—	PWM 2 Low output
PWM2H	O	—	PWM 2 High output
PWM3L	O	—	PWM 3 Low output
PWM3H	O	—	PWM 3 High output
MCLR	I/P	ST	Master Clear (Reset) input or programming voltage input. This pin is an active low Reset to the device.
OCFA	I	ST	Compare Fault A input (for Compare channels 1, 2, 3 and 4).
OC1-OC2	O	—	Compare outputs.
OSC1	I	ST/CMOS	Oscillator crystal input. ST buffer when configured in RC mode; CMOS otherwise.
OSC2	I/O	—	Oscillator crystal output. Connects to crystal or resonator in Crystal Oscillator mode. Optionally functions as CLKO in RC and EC modes.

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TABLE 1-1: PINOUT I/O DESCRIPTIONS (CONTINUED)

Pin Name	Pin Type	Buffer Type	Description
PGD PGC	I/O I	ST ST	In-Circuit Serial Programming data input/output pin. In-Circuit Serial Programming clock input pin.
RB0-RB5	I/O	ST	PORTB is a bidirectional I/O port.
RC13-RC14	I/O	ST	PORTC is a bidirectional I/O port.
RD0-RD1	I/O	ST	PORTD is a bidirectional I/O port.
RE0-RE5, RE8	I/O	ST	PORTE is a bidirectional I/O port.
RF2, RF3	I/O	ST	PORTF is a bidirectional I/O port.
SCK1 SDI1 SDO1 SS1	I/O I O I	ST ST — ST	Synchronous serial clock input/output for SPI™ #1. SPI #1 Data In. SPI #1 Data Out. SPI #1 Slave Synchronization.
SCL SDA	I/O I/O	ST ST	Synchronous serial clock input/output for I²C. Synchronous serial data input/output for I²C.
SOSCO SOSCI	O I	— ST/CMOS	32 kHz low power oscillator crystal output. 32 kHz low power oscillator crystal input. ST buffer when configured in RC mode; CMOS otherwise.
T1CK T2CK	I I	ST ST	Timer1 external clock input. Timer2 external clock input.
U1RX U1TX U1ARX U1ATX	I O I O	ST — ST —	UART1 Receive. UART1 Transmit. UART1 Alternate Receive. UART1 Alternate Transmit.
VDD	P	—	Positive supply for logic and I/O pins.
VSS	P	—	Ground reference for logic and I/O pins.
VREF+	I	Analog	Analog Voltage Reference (High) input.
VREF-	I	Analog	Analog Voltage Reference (Low) input.

Legend: CMOS =CMOS compatible input or output Analog= Analog input
ST =Schmitt Trigger input with CMOS levels O= Output
I =Input P = Power

dsPIC30F Motor Control and Power Conversion Family*

Device	Pins	Program Mem. Bytes/ Instructions	SRAM Bytes	EEPROM Bytes	Timer 16-bit	Input Cap	Output Comp/Std PWM	Motor Control PWM	A/D 10-bit 500 Ksps	Quad Enc	UART	SPI™	I²C™	CAN
dsPIC30F2010	28	12K/4K	512	1024	3	4	2	6 ch	6 ch	Yes	1	1	1	–
dsPIC30F3010	28	24K/8K	1024	1024	5	4	2	6 ch	6 ch	Yes	1	1	1	–
dsPIC30F4012	28	48K/16K	2048	1024	5	4	2	6 ch	6 ch	Yes	1	1	1	1
dsPIC30F3011	40/44	24K/8K	1024	1024	5	4	4	6 ch	9 ch	Yes	2	1	1	–
dsPIC30F4011	40/44	48K/16K	2048	1024	5	4	4	6 ch	9 ch	Yes	2	1	1	1
dsPIC30F5015	64	66K/22K	2048	1024	5	4	4	8 ch	16 ch	Yes	1	2	1	1
dsPIC30F6010	80	144K/48K	8192	4096	5	8	8	8 ch	16 ch	Yes	2	2	1	2

* This table provides a summary of the dsPIC30F2010 peripheral features. Other available devices in the dsPIC30F Motor Control and Power Conversion Family are shown for feature comparison.

CONCLUSION

The proposed solution describes a nonspecific person gesture recognition system by using MEMS accelerometers. The recognition system consists of sensor data collection, segmentation and recognition. Since the standard gesture patterns are generated by motion analysis and are simple features represented by 8 numbers for each gesture, the recognition system does not require a big data base and need not collect many gestures made by different people. This improves the recognition accuracy. The concept of Cryptographic keyless entry and Touch screen ignition system gives a secured and an authenticated control over the automotives. The integrated navigation solution is very competitive for vehicle navigation with low-cost sensors. This solution can be used in all environments including degraded GPS environments which routinely occur in urban and rural canyons.

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