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Fingerprint Based Anti-Theft System for Vehicle Safety

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ABSTRACT: At present, the usage of vehicle has become a basic necessity for everyone. Besides, fortifying the vehicle against theft is also very important. Vehicle thefts, misplacing keys or losing keys are some serious issues faced by owners. In this paper, we are proposing a solution for these issues by using fingerprint anti-theft system for vehicle safety. A fingerprint of every person is unique, even identical twins don't have the same fingerprint. Because of this fingerprint recognition technique, we can annihilate fear of losing keys or misplacing keys. A fingerprint recognition technique allows accessing only those fingerprints that are stored in the library. In case of vehicle theft we use GPS technology for identifying the vehicle. In this paper we are also focusing on how to overcome the drunk and drive scenario. For this we are using an alcohol sensor, which detects the alcohol concentration in our breath.

KEYWORDS: Fingerprint Scanner, Microcontroller MSP430, GSM SIM900, GPS, Alcohol Sensor, Vibration Sensor

I.INTRODUCTION

Biometrics is an automated recognition of individuals based on their physical and behavioural characteristics. There are different types of biometrics which are classified on their physiological and behavioural characteristics. Examples using physiological characteristics are fingerprint, face, DNA, iris, hand. Examples of behavioural characteristics are voice, signature and key strokes.

Fingerprint biometric is one of the popular, ubiquitous, reliable, economical and efficient biometric technologies. Due to its versatility, fingerprint biometric is applicable. Fingerprint is popular because of its universality, uniqueness, permanence, acceptability, performance [3].

The main aim of this paper is to provide security to the vehicle from theft, to quash the drunk and drive scenario, to track the vehicle in case if the whole vehicle is theft and to have accident alertness to the respective person. Table 1 shows the statistics of vehicle thefts worldwide. Table 2 shows the worldwide statistics of drunk and drive accidents occurred in various years.

The block diagram of proposed system is shown in fig 1.

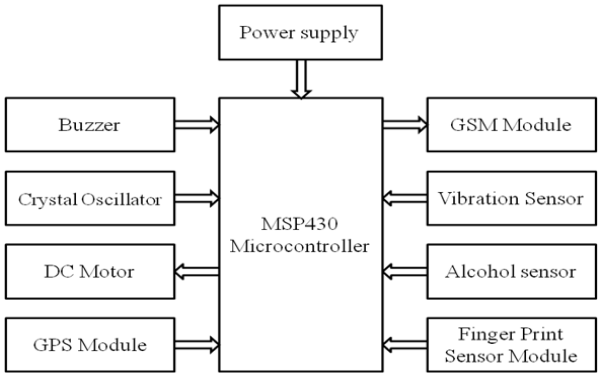

Fig1: Block Diagram

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Table 1: Worldwide Vehicle Thefts [4]

Country	Vehicle Thefts	Year
United States of America	721,053	2012
Mexico	208,491	2012
Italy	196,589	2012
Brazil	185,288	2012
France	178,200	2012
India	147,475	2010

Table 2: Worldwide Drunk and Drive Accidents [5]

Year	Accidents Occurred (in millions)
1993	123
1995	115
1997	116
1999	159
2002	159
2004	124
2006	161
2008	131
2010	112
2012	121
2014	111

II. HARDWARE DESIGN

The hardware modules used in this system are MSP430G2553 Microcontroller, Fingerprint Scanner Module, GPS Module, GSM Module, Vibration Sensor, Alcohol Sensor, Crystal Oscillator, DC Motor and Power Supply.

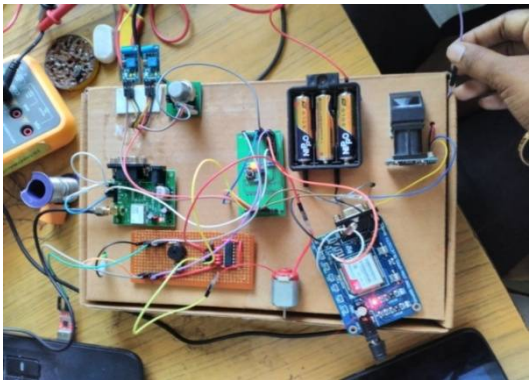

Fig 2: Hardware Design

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A.*MSP430G2553 MICROCONTROLLER:*

MSP430G2553 Microcontroller is the heart of the system, central unit of the system. It is a 20 PDIP package in that 16 are input-output (I/O) pins. The rest are test, reset, V_{cc} and Ground. There are two ports in the microcontroller. Each port is having eight pins each

The features of MSP430G2553 are

Operating voltage	: 1.8V to 3.6V
Timers	: 2
Power Saving Modes	: 5
Flash Memory	: 16 KB
RAM	: 512 Bytes
Comparators	: 8

B. FINGERPRINT SENSOR MODULE:

Fingerprint Scanner Module consists of two parts: Sensor and Scanner.
Sensor is an electronic device which captures the digital image of our fingerprint and Scanner will get an image of a person's fingerprint and will match that fingerprint with the fingerprints stored in the database.
Fingerprint processing consists of three steps: Enrollment, Verification and Identification.
In Enrollment, when the user keeps the finger on the scanner, the system will capture the image. From that image, the system will extract the feature. Using the feature, the system will generate the template.
In Verification, the user enters the finger through sensor and will generate a template of the finger. This template is verified with the template generated in enrollment process by 1:1 matching. If it is matched, it will store in the database.
In Identification, the system will generate a template, when the user keeps the finger and that template is compared with the stored templates by 1: N matching. If it is matched, then the subject is identified else not identified [6].

C. *GPS MODULE:*

GPS (Global Positioning System) is a satellite based navigation system, consisting of 24 satellites located into orbit. The system provides essential information to military, civil and commercial users around the world and is freely accessible to anyone through GPS receiver. GPS works in any weather circumstances at almost anywhere in the world. Normally there are no subscription fees or system charges to utilize the GPS. The bandwidth of GPS receiver antenna is 10MHz minimum [7].
GPS is used to detect the vehicle location and provide information to responsible person through GSM technology.

D. *GSM MODULE:*

GSM (Global System for Mobile communication) module is a second generation cellular standard developed to cater the voice services and data delivery using digital modulation. GSM Module is a specialized type of modem which accepts a SIM card operating on a mobile number over a network, just like a cellular network. It is a cell phone without display. It uses narrow band TDMA. It is secure and flexible with its functionalities.
The GSM is used for communication to the authoritative person regarding the status of the system like accident alertness and vehicle theft in the system.

E. *VIBRATION SENSOR:*

A vibration sensor is sensitive for vibrations which are measured by velocity, displacement and acceleration [8]. Vibration sensors works on electromechanical principle. Vibration sensors operate in accordance with electrodynamics principle and are used for measuring the bearing absolute vibration. Vibration sensors are used in our system for measuring and analysing any disturbances in the system.

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F. *ALCOHOL SENSOR:*

Alcohol sensor MQ-3 is suitable for detecting the alcohol concentration on your breath, just like a common breath analyser. It has high sensitivity to alcohol and small sensitivity to benzene. The sensitivity can be adjusted by potentiometer. Sensitive material is SnO_2, which has lower conductivity in the clean air. It has fast response time. Sensor provides analog output based on alcohol concentration. It is of long life and low cost. The drive circuit is simple with size 40x20mm.

G. CRYSTAL OSCILLATOR:

Crystal Oscillator is an electronic oscillator that uses mechanical resonance of vibrating crystal of piezoelectric material to create an electric signal with precise frequency. The crystal oscillator circuit sustains oscillation by taking a voltage signal from quartz resonator, amplifying and feeding back to the resonator. The frequency of 4.332 MHz is most commonly used crystal resonator and its multiples are also used.
Crystal Oscillator is used for giving precise clock frequency for the microcontroller MSP430G2553. The frequency used is 16MHz (4.332x4=17.328MHz, near to 16MHz).

H. DC MOTOR:

The prototype model uses DC motors. DC motors are part of electric motors using DC power as energy source. This device transforms electric energy into mechanical energy. The principle of DC motor is that when a current carrying conductor is placed in magnetic field it experiences mechanical force. The motor is connected through motor driver to the port of microcontroller.

I. POWER SUPPLY:

A power supply is an electronic device that supplies electric energy to an electrical load. A DC power supply is one that supplies a constant DC voltage to its load.

J. BUZZER:

The buzzer converts the received electrical signal it received into a vibration, which creates the buzzing sound. The higher the signal it receives, the more intense the vibration and the louder the sound are.

III. **SOFTWARE DESIGN**

The software used for designing the proposed system is Energia IDE (Integrated Development Environment).

Energia IDE:

Energia IDE is a free, portable tool set for the development of embedded applications on the microcontrollers. Energia IDE is simple and easy-to-use code editor and compiler with built in serial monitor/terminal. It is an open source and community driven IDE and software framework. Energia supports many Texas Instrument (TI) processors. It is portable and supports the in-line C, assembly and driven library base code. It is robust collection intuitive API's (Application Programmable Interface) for controlling the launch pad's I/O's (inputs/outputs).

IV. **WORKING OF THE SYSTEM AND RESULTS**

When the user enters the finger on the scanner, the system captures the image and will generate a template. That generated template is verified with the scanned authenticated users. If it is matched, then the vehicle starts. Then the system will check the alcohol sensor threshold value. If it is greater than the pre-programmed threshold value, then it will stop the vehicle. If it is less than the pre-programmed threshold value, it will check if any accident occurred or not. It will check the accident occurrence by using vibration sensors. There are two vibration sensors in the system, one at lock area and the other at fuel area. If both the vibration sensor values are greater than threshold value, then the

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accident is occurred else not. If any accident occurred, it may be minor or major. So, we placed a buzzer. When the accident occurred the buzzer automatically in ON. If it is small accident we need to OFF the buzzer, then the system considers it as a small accident. If the buzzer is not OFF, then the message is sent to registered number through GSM. If the fingerprints are not matched, then system checks if any theft has occurred. This can be known by using vibration sensor at the lock area. If vibration sensor value is greater than the threshold value, then the accident has occurred. The system will automatically send the theft alert message with location using GPS to the owner of the vehicle by using GSM. If the vibration sensor value is less than the threshold value it will wait for authenticated user to scan the finger.

The overall flowchart of proposed system is shown in Fig 3.

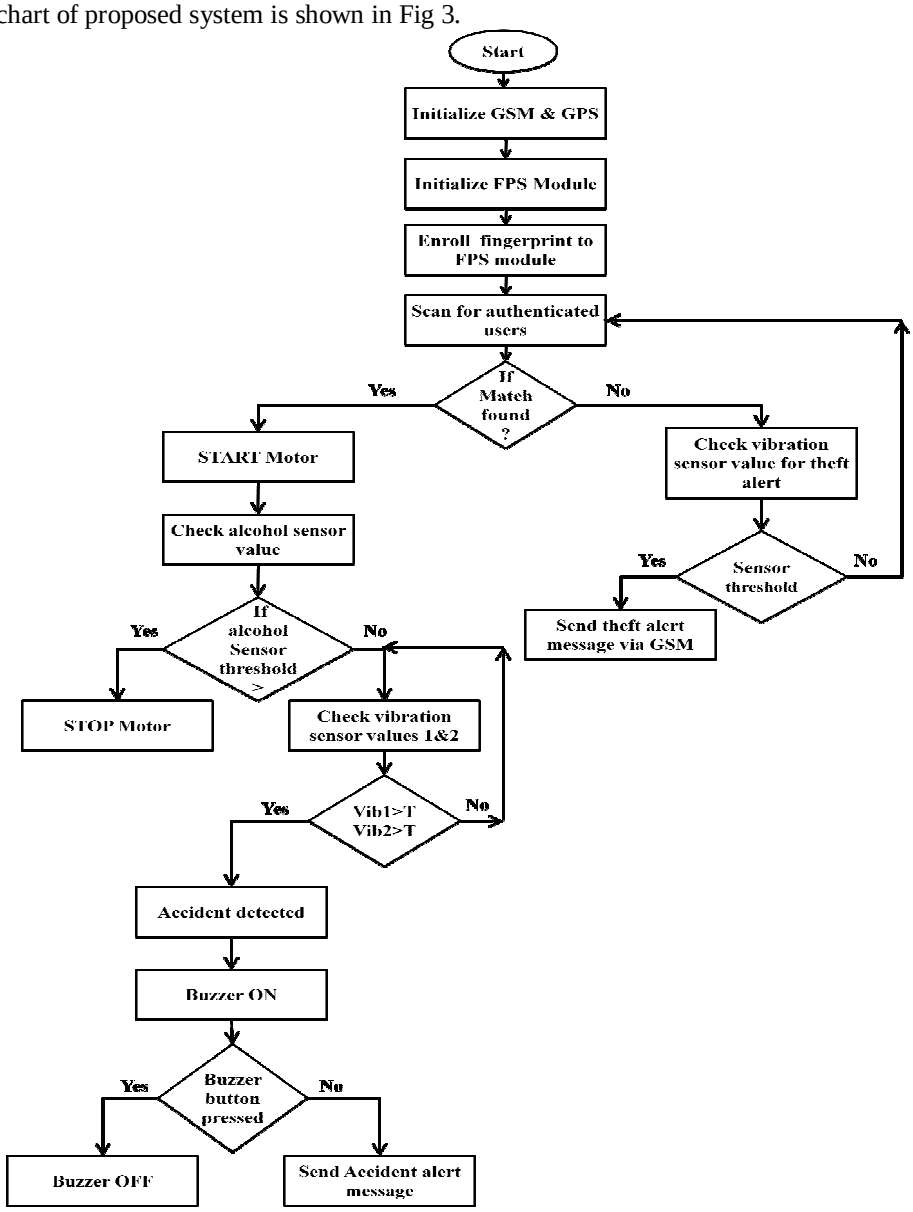

Fig 3: The overall flowchart of proposed system

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V.RESULTS

Fingerprint enrolling is shown in Fig 4, while fingerprint matching as shown in fig 5. Fingerprint enrolling is the process in which the ID of fingerprint is obtained. Matching of the fingerprint ID with the ID's in the database. The vehicle gets start if matching is observed, while it doesn't start if no matching.

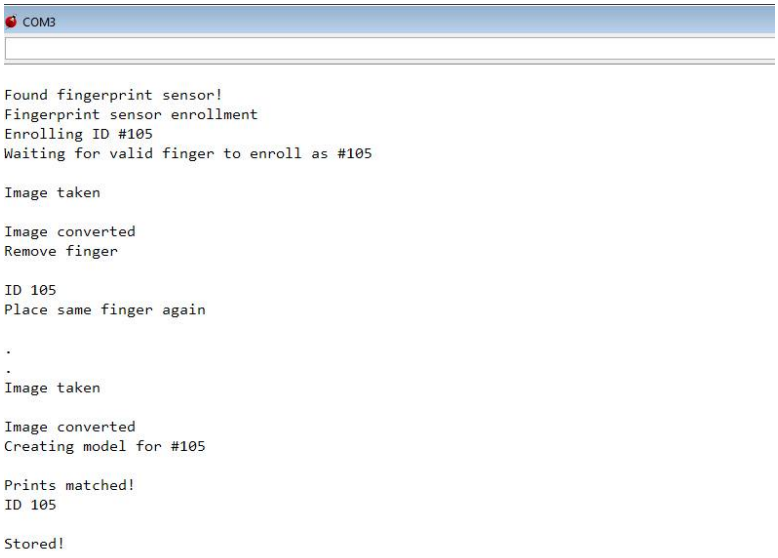

Fig 4: Output of Fingerprint Enrolling

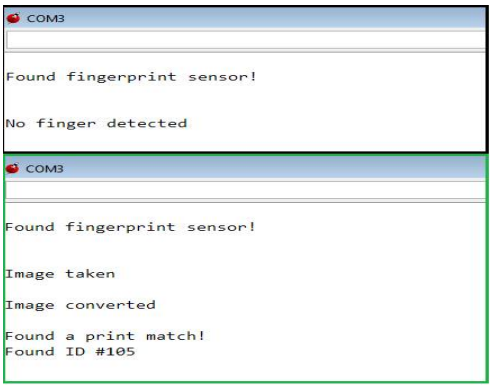

Fig 5: Output of Fingerprint Matching

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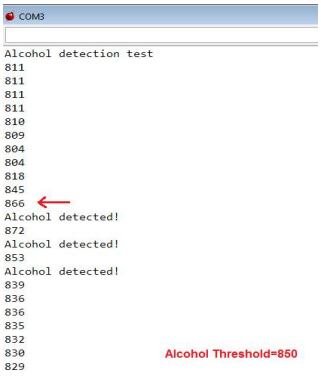

Fig 6: Output of Alcohol detection

The Fig 6 shows the output of the alcohol detection. If the alcohol sensor value is above the threshold, alcohol level is thus detected and the vehicle gets automatically stopped. Fig 7 shows the output of the vibration sensor. Vibrations are detected when any disturbances are occurred in the vibration sensor. Because of these vibration sensors we can detect the accident and theft occurrences. Fig 8 shows the output of theft and accident alertness via GSM and the alert is given to their concerned person. Fig 9 shows the output of GPS serial data, the latitude and longitude information in serial monitor.

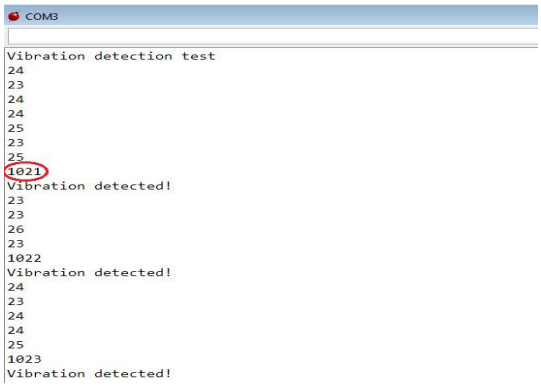

Fig 7: Output of Vibrations sensor

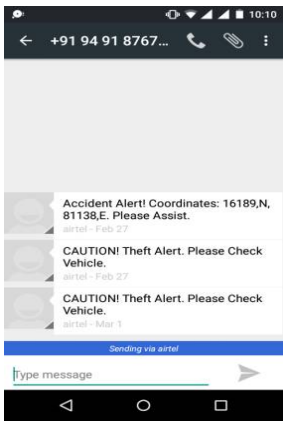

Fig 8: Output of accident and theft alertness via GSM

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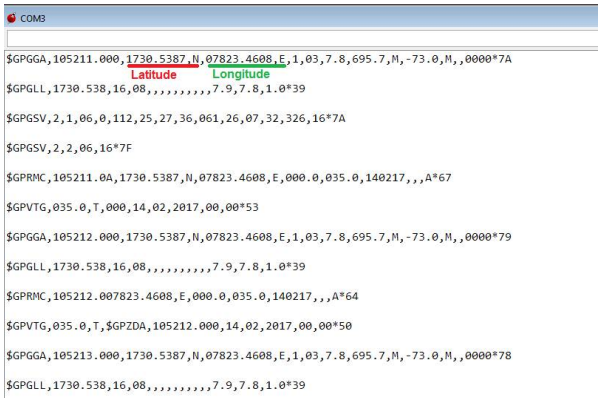

Fig 9: Output of GPS serial data

VI. CONCLUSION

Security is the pivotal for any system. Thus fingerprint identification enhances the security of the vehicle and makes it possible for only authenticated users. The proposed system is cheap and easy to use. This system brings innovation to the existing technology in the vehicles and also improves the safety features, hence proving to be an effective development in the automobile industry.

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