Microcontroller Based Automotive Vehicle Anti- Theft Braking System

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Abstract. An estimated 300 million vehicles was stolen every year around the world. This has become a national problem today which also has some solutions. To solve this problem we have many options using microcontroller is the best option. In this project we demonstrated microcontroller based automotive braking system. Beside that it can also able to send the location of vehicles. The first one is introduced as the security system and second one is reporting system. For the first system we used microcontroller PIC16F887. Again the reporting system is based on the Global Positioning system (GPS) and Global System of Mobile (GSM) network. A vehicle can be tracked through GPS. This overall system not only brings a solution of prevent stealing vehicles but also show a practical use of GPS and GSM network. The proposed issues on this project are, making it useable for the vehicle, less expensive, and more accurate. In this era of modern technologies, when machines have become indispensable and each second translates into advancement, such microcontroller based anti-theft system can make life secure with a rise in human productivity.

Keywords: Microcontroller, PIC16F877A, GPS, GSM, Proteus, Mikroc Pro.

1 INTRODUCTION

Anti-Theft systems have been in existence since individuals began stealing other people's property and have evolved in order to stop increasingly complex methods of theft. The first anti-theft devices to be built were all mechanical devices and were generally locks of various kinds. These have evolved over the years and are still in fashion today. These include steering wheel locks, tire locks, hood locks, gear shift locks, ignition/steering wheel column locks, to mention a few. However, in recent years, crime has become more sophisticated leading to the invention of electronic based car anti-theft systems. They can be divided into three main groups: car alarms, vehicle tracking systems and immobilizers. In this paper we put forward an efficient car anti-theft system with improved features to reduce car-jacking or automobile from being stolen. [1]

The device can aid the prevention of attempted crimes, such as committing armed robbery, hit and run, using a stolen car to transport illegal goods and of course stealing the car itself. Many cars are being stolen in every year all over the world. Plenty of attempts have been made to equip with anti-theft devices, many of which did not succeed because of the lack of existing resources for the implementation of innovative ideas, or the devices just failing to capture the market with their outrageous costs of installation and maintenance.

The defining feature of our device is that it can be activated from any remote location. We aim to do this by making use of mobile communication technology. Our device will consist of a cell phone, embedded in the car, which is connected to a microcontroller. From this microcontroller, the device will manipulate one major systems in the car to immobilize it; the braking system.

2 GPS and GSM

The Global Positioning System (GPS) is a space-based satellite navigation system that provides location and time information in all weather conditions, anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites [2].
A GPS receiver calculates its position by precisely timing the signals sent by GPS satellites high above the Earth. Each satellite continually transmits messages that include:

- The time the message was transmitted and
- Satellite position at time of message transmission.

The receiver uses the messages it receives to determine the transit time of each message and computes the distance to each satellite using the speed of light. Each of these distances and satellites' locations defines a sphere. The receiver is on the surface of each of these spheres when the distances and the satellites' locations are correct. These distances and satellites locations are used to compute the location of the receiver using the navigation equations [3]. Basic GPS measurements yield only a position, and neither speed nor direction. However, most GPS units can automatically derive velocity and direction of movement from two or more position measurements.

GSM (Global System for Mobile communications) is an open, digital cellular technology used for transmitting mobile voice and data services.
The GSM standard was developed as a replacement for first generation (1G) analog cellular networks, and originally described a digital, circuit-switched network optimized for full duplex voice telephony [4]. This was expanded over time to include data communications, first by circuit-switched transport, then packet data transport via GPRS and EDGE. GSM supports voice calls and data transfer speeds of up to 9.6 kbps, together with the transmission of SMS (Short Message Service).GSM operates in the 900MHz and 1.8GHz bands in Europe and the 1.9GHz and 850MHz bands in the US. GSM services are also transmitted via 850MHz spectrum in Australia, Canada and many Latin American countries [5]. The use of harmonized spectrum across most of the globe, combined with GSM's international roaming capability, allows travelers to access the same mobile services at home and abroad. GSM enables
Individuals to be reached via the same mobile number in up to 219 countries. GSM systems provide a number of useful features:

- Uses encryption to make phone calls more secure
- Data networking
- Group III facsimile services
- Short Message Service (SMS) for text messages and paging
- Call forwarding
- Caller ID
- Related to 2.5G and 3G

3 BRAKING SYSTEM

A brake is a mechanical device which inhibits motion. Most commonly brakes use friction to convert kinetic energy into heat, though other methods of energy conversion may be employed [2]. For example regenerative braking converts much of the energy to electrical energy, which may be stored for later use. Other methods convert kinetic energy into potential energy in such stored forms as pressurized air or pressurized oil [6]. Eddy current brakes use magnetic fields to convert kinetic energy into electric current in the brake disc, fin, or rail, which is converted into heat. Still other braking methods even transform kinetic energy into different forms.

Brakes are generally applied to rotating axles or wheels, but may also take other forms such as the surface of a moving fluid. Some vehicles use a combination of braking mechanisms, such as drag racing cars with both wheel brakes and a parachute, or airplanes with both wheel brakes and drag flaps raised into the air during landing.
There are many types of brakes such as:

- Frictional Brakes
- Pad/Shoe Brakes
- Pumping Brakes
- Electromagnetic Brakes
- Disk brakes

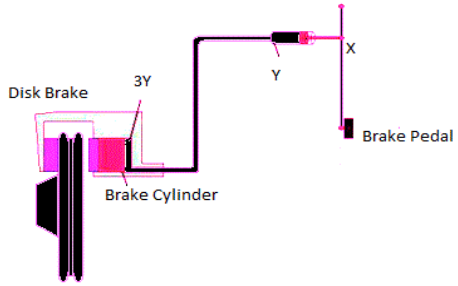

Figure 1: Simple Brake System (Disk Brake)

4 FLOW CHART

Before starting the implementation and the simulation of the project circuit it is necessary to make an algorithm or drawing the flowchart. Because a fruitful flowchart or an algorithm can makes the path easier to implement a circuit both virtually and practically. In this project flowchart was drawn by the software known as "Paint". This flowchart shows the way how the circuit done the overall work

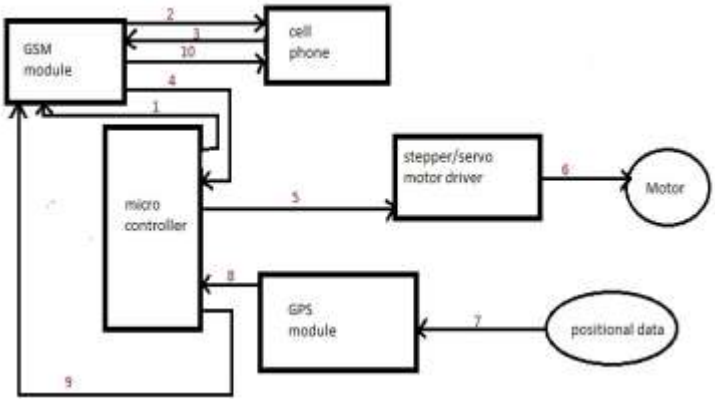

Figure 2: Flow Chart of this Project

The line, numbered "1" show after starting the vehicle an electric signal will be sent from microcontroller to GSM module. The 2nd line shows that signal sent as an SMS to cellular phone. The 3rd line shows after getting the SMS a phone call will be sent from cellular phone to GSM

module. The4th line shows, after getting that call by the module it will send another signal to the microcontroller. The 5th line shows the microcontroller will send the command to the motor driver. The 6th line shows motor driver drive the motor as its command. After that the 7th line shows the positional data will gathered by the GPS.

5 SOFTWERE SIMULATION

Software simulation of microcontroller project we need Protues VSM software for design the main circuit and MikroC Pro for coding.

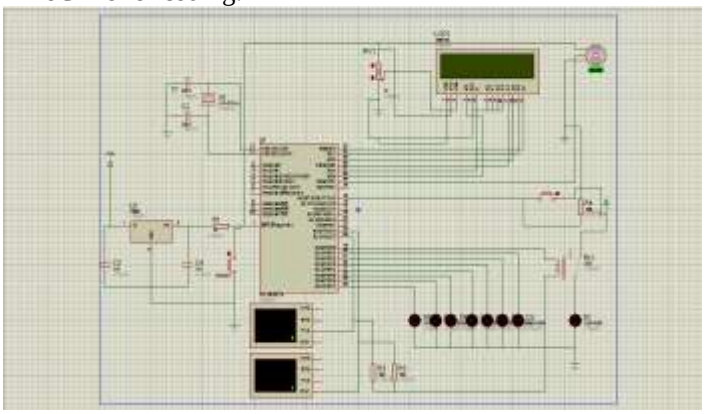

Figure 3: The main circuit diagram

Here a microcontroller PIC16f887 have used as the main control unit of the overall circuit. An LCD display LM016L has used to display the output as example the text which will send by this system. Basically over here display is not needed actually. We have attached the display only to check that is our circuit is working or not. The stepper motor is representing the main braking part of vehicle by which we control the braking system. The relay is used for controlling the engine ignition power. The D1 LED used here for showing the power condition of engine. That means engine is running or not. Since Proteus has no GPS or GSM module so we have used virtual terminal over here for cellular application.

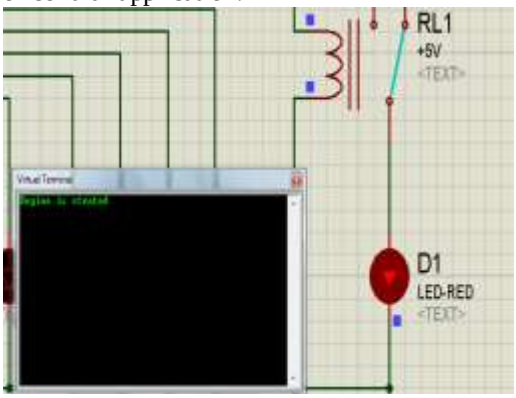

Figure 4: Starting the engine

In this figure the D1 LED showing that the engine is already started. By this time microcontroller sent a SMS to the user's phone with the text "Engine is started". The text of phone represents by the virtual terminal.

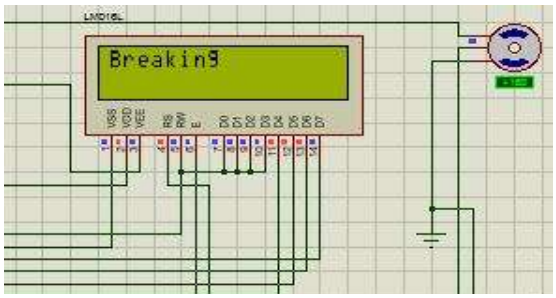

Figure 5: Braking operation after getting the call

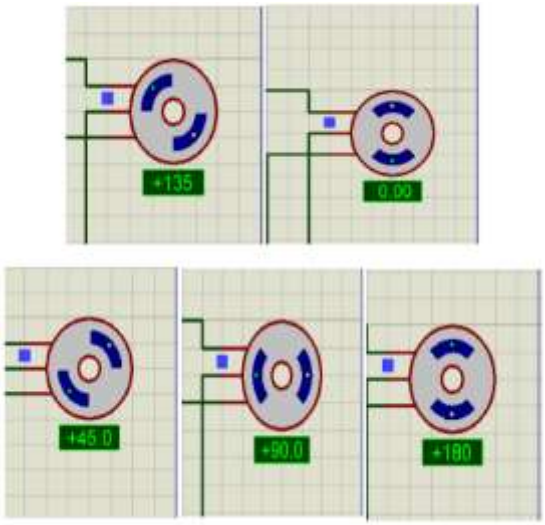

Figure 6: Rotation of Servo Motor in different angels.

Use stepper motor for stepwise brake. After the call of owners the signal goes to GSM module. Then it creates a string named 'RING' in microcontroller. This string used to on stepper motor. Then stepper motor rotate 5 different angles between 0 to180 degrees then brake the vehicle. Stepwise brake is necessary because certain brake can damage vehicles.

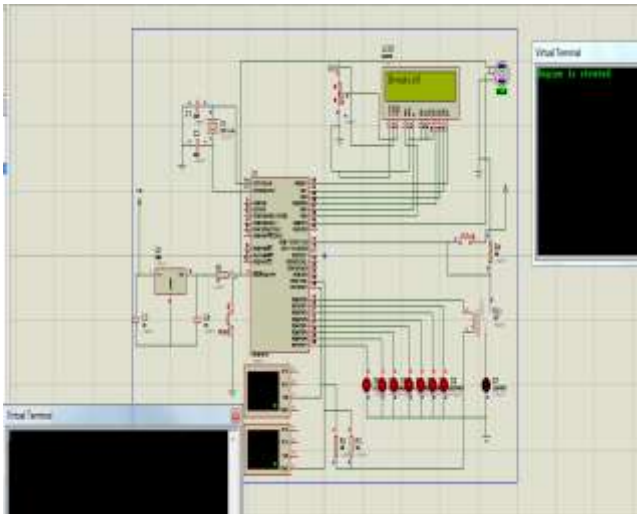

Figure 7: After simulation the main diagram of the project

6 HARDWERE SIMULATION

Hardware implementation is the key part and the hardest part of this project. The main part of this project is to interface different types of module with microcontroller such as GPS/GSM module, Motor driver, etc. After successful software simulation; all necessary components were assembled together. Hardware implementation was done according to the circuit modeled in proteus.

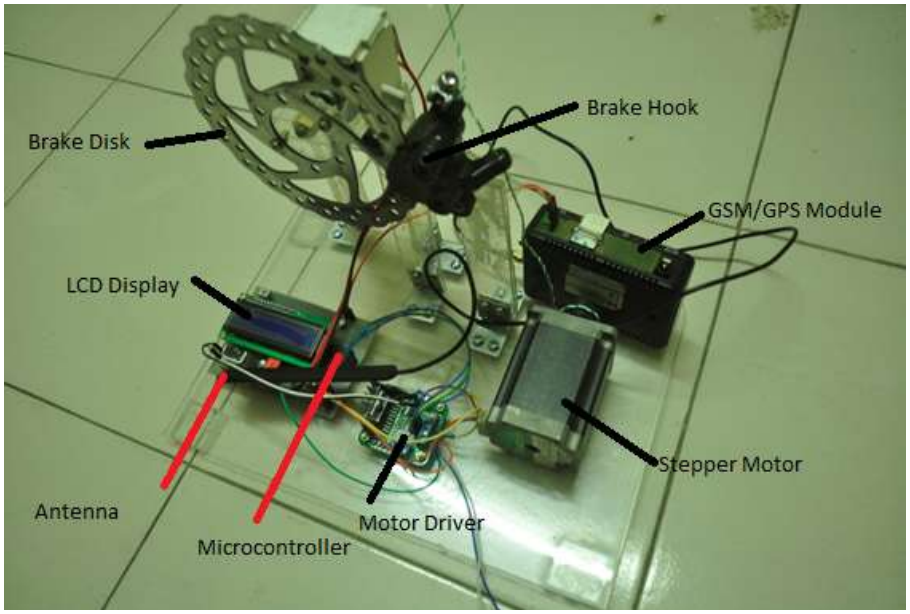

Figure 8: Projection view of Hardware Implementation

From this picture we can get a better idea of our project. First thing is that the whole frame was made by plastic sheets. We have used glue and holding jaw to make it more robust. The black piece which is lying on the stand, its name is brake hook.
Which is connected to the stepper motor. The circular disk is the brake disk which is coupled with the brake hook. Another black piece which is rectangular shaped and also lying on the base is the GPS/GSM module. By which the system send SMS, get phone calls and also gather the positional value. Two red lines indicate the microcontroller and the module Antenna. Stepper motor is lying on base as we can see from the figure. It is coupled with the brake hook. After getting the call this motor will start to rotate and it close the hook slowly. The motor driver serves the motor. It takes command from the microcontroller and then it drives that command to the stepper motor. At last the LCD display which is lying on the microcontroller. It shows is the circuit working or not.

7 CONCLUSION

This project was intended to design and implement a simple and low cost anti-theft system. To implement this project, we used microcontroller as a platform and local materials for low cost. Our target was to design a system in such a way that its components will be able to prevent the vehicle for stolen. Microcontroller code was deployed here. The whole system operates automatically. So it does not need any expert person to operate it. It is not so expensive. We succeeded in building a small and low cost microcontroller based antitheft system. Our project has much more scope for future research and development. Though it is a project, we hope some modification in this project will lead to a reasonable diversity of usage.

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Biographies

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