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Detection of Motorcycle Theft Using Force Sensing Resistor and Ultrasonic Sensor

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Abstract. This essay provides a technique for continued motorcycle surveillance to avoid theft of the bike at the moment. If someone attempts to steal the vehicle, the buzzer will alarm the surrounding and with the use of FSR and ultrasonic sensor theft is detected and the system will send a message/phone call and the car owner will be given the current location of the vehicle. GPS stands as a back-up so that we can have a complete track of the vehicle during the theft.

Keywords: Force Sensing Resistor (FSR), Global System for Mobile Communication (GSM), ultrasonic sensor, Global Positioning System (GPS), buzzer.

1. Introduction

With road congestion on the rise, two-wheelers are the preferred medium of transport for many Indians today [1]. There is much less chance of getting stuck in traffic-ridden roads when you are travelling on a bike. Another key reason why two-wheelers are popular amongst the so-called lower and even perhaps the upper middle class is because of their affordability factor. For many, bikes are a much more attainable transport option in comparison to cars [2].

Superbike enthusiasts have started purchasing expensive bikes as more and more world-renowned brands have set up shops in the country. Motorcycles have a higher chance of being stolen in comparison to a car [3]. Additionally, recovering stolen cars is a much more streamlined process than tracking stolen two-wheelers. The reason is simple. It is easier to dismantle the two-wheeler and hide it. A Times of India report stated that a vehicle is stolen every 15 minutes in New Delhi. The number of recovered vehicles has further dropped by 13%, as revealed by the Delhi police department [4].

The primary reason for thefts was a serious lack of parking space. Gurgaon had 3240 vehicles stolen in 2014 out of which 2580 were bikes and scooters. Mumbai reported theft of a whopping 2460 two-wheelers. Yet, only 720 of them were recovered by the police. The number of bike thefts is very much on the rise whilst the recovery rate remains low at 20 to 25% [5]. Any form of damage or destruction caused to the two-wheeler can have an effect on the entire monthly fiscal plan of the family. It can get even worse if the bike is stolen. Therefore, an effective anti-theft mechanism for a two-wheeler is mandated in present day scenario. Background of technologies behind autonomous vehicle in closed environment.

2. Existing System

Almost all the anti-theft security system used for motorcycles uses vibration sensors which is not much reliable on two-wheelers because a small jerk can trigger the sensor and can cause fault detection as thievery [6]. Other systems are using RFID [7] card which is next most popularly used



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system which provides security by using a card and its operation is questioned because it can be easily stolen or tampered. In some systems, GPS is used which is not much reliable [8] to detect the theft of vehicle at the moment of thievery.

With all these existing problems our objective of our project to create a low cost, reliable system which detects and prevents the thievery of the vehicle.

3. Components

3.1. Force Sensing Resistor

FSR allows the physical strain of pressing and weight to be detected. Below is the photo of FSR, the round part is the sensitive portion which senses the applied pressure [9]. They are made of two layers which are separated by a spacer. The sensitive part has active elements dots which get touched to semiconductor when external pressure applied which turns resistance down.



Figure1. Force Sensing Resistor

FSR shown in Figure 1 is a resistor which changes its resistance based on the pressure applied on it. FSRs are low cost and easy to use component. It gives ranges of response which can be used to track the continuous pressure applied [10].

FSRs consist of both conducting and non-conducting particles and conductive polymers that is the sensible component. These particles are shaped to minimize temperature dependency and improve their mechanically dependent properties to improve their longevity. The sub micrometer is a scale sub-micrometer.

3.2. Ultrasonic Sensor

For measuring distance through means of ultrasonic waves, Ultrasonic sensors are used. They work by emitting high frequency sound waves that are outside the ear range of humans. The waves are then transmitted backwards and the time required by the wave is measured from the object to the recipient [11]. This is close to the radar operating, where the time taken to return is used to measure the distance after reaching the item. The ultrasonic sensor is shown in Figure 2.

The sensor emits ultrasonic waves and the pulse from the target is recovered. By measuring the time between the emission and the receipt they measure the distance to the target.



Figure 2: Ultrasonic sensor

A transmitter and receiver are given by an optical sensor, but for emission and receiver a single ultrasonic element is used. A single oscillator emits and absorbs alternating ultrasound waves in an ultrasonic sensor [14].

3.3. Global Positioning System (GPS)

In this device, which also is attached to the microcontroller, a global positioning system (GPS) sensor is used. The Global Positioning System stands for GPS. The sensor is made up of a surface assembly chip where signals from GPS satellites can be interpreted using a small rectangular antenna that is often placed atop a GPS chip [12].



Figure 3: Global Positioning System sensor

GPS module shown in figure 3 is usually a small board with several extra components placed on the GPS sensor. GPS receiver contains data display and other memory modules that in addition to GPS module are used for data storage [13].

The three segments viz are composed of GPS system. Segment room, segment power, segment of customer. Around 31 satellites are located around 12,500 miles above earth in the orbit of a segment. Each satellite then circulates twice within 24 hours. The control section comprises stations for control, control and tracking.

3.4. Global System for Mobile for Communication (Gsm)

A protected and wireless framework is intended for GSM. The authentication of the user with a common key, challenge response and over-air encryption has been considered.



Figure 4: GSM Module

The creation of UMTS has introduced the Universal Subscriber Identity Module (USIM) which uses a broader authentication key to provide greater protection, even as shared authentication of the network and hence of the user [15]. The safety model provides anonymity and authentication but is limited to permit and non-repudiation power. Figure 4 is a GSM modem which is available in market. Table 1 specifies the overall component's specification.

Table1: Specification of the components used

Components	Name
------------	------

Force sensing resistor	FSR402
Ultrasonic sensor	HC-SR04
Global system for mobile communication(GSM)	SIM900A
Global Positioning system(GPS)	U-blox NEO-6M
Arduino	Arduino Uno (ATmega328P)

4. Proposed System

The system's primary aim is to deter theft of motorcycles in particular. The reason we have particularly took the motorcycle is because modern cars are not only highly sophisticated but also integrated with high security which a majority of motorcycles were lack of. Proposed device block diagram is shown in Figure 5.

As we have clearly identified the ways of stealing a motorcycle. We have designed our system to hold on to such circumstances and ensure the security of the vehicle. We know that almost all of the motorcycles have side lock. Thus breaking the side lock is the most common and anticipated way of stealing the vehicle. We have placed a Force sensing resistor on the framework of the vehicle which prevents the handlebar from rotating above 180 degrees.

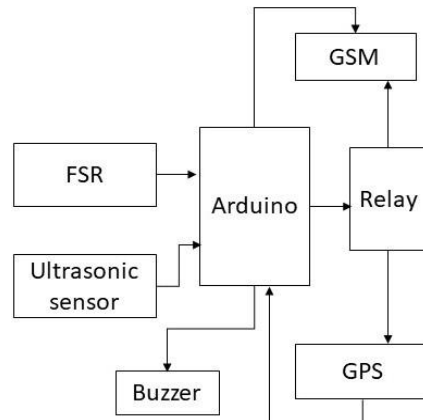


Figure 5: Proposed device block diagram

We have tested the situation and it is clear that breaking of the side lock requires immense force on the handle bar so once the side lock is being broken the handle bar rotate with same force towards the rotation restraining framework. By using the Force sensing resistor we can clearly distinguish the force on normal rotation of handle bar and the force required for breaking the side lock. If the force detected is higher than the threshold value of force sensing resistor the sensor will alert the microcontroller (Arduino UNO).

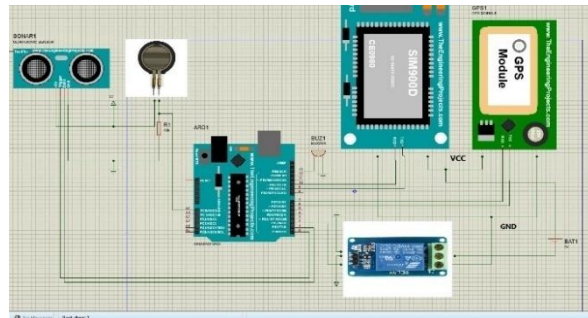


Figure 6: Circuit model of vehicle theft detection system

The circuit model of vehicle theft detection system is shown in Figure 6. The next common and popular way of stealing a motorcycle is by directly lifting the vehicle and loads it on any heavy vehicle to transport it to a safe place for further breaking of vehicle. To overcome the situation, we have to constantly monitor the distance between the lower part of the vehicle and the ground which is known as ground clearance level of a vehicle. By placing an Ultrasonic sensor in the lower part of the vehicle we can easily measure the distance between the grounds to lower part of vehicle. If someone try to steal the vehicle by lifting it, the distance measured by the sensor will be greater than the ground clearance level hence it is identified as theft and an alert is sent to the microcontroller.

If someone tries to tamper the ultrasonic sensor it will some max distance the ultrasonic sensor which is also greater than ground clearance and is identified as theft. If someone tries to block the ultrasonic sensor the distance is zero or some low values which are lower than ground clearance level hence it will also be detected as theft.

The next method is short circuiting the battery to start the vehicle. Since most of vehicles have side lock this method of stealing the vehicle is prevented by the Force sensing resistor itself. A relay is used to power the GSM and GPS during the theft. If the GSM and GPS are turned on all the time there will be a lot of power wastage. Whenever the relay receives the signal from Arduino it will power the GPS.

It will send the co-ordinates as a message to user through the GSM along with the alert message/call. The threshold levels in which the sensor activates is shown in Table 2.

Table 2: Threshold levels where sensors function

Sensors	Threshold values	Relay position
Ultrasonic	<15 cm	Off
	>15 cm	On
Force sensing resistor	<600	Off
	>600	On

The system's centre is the microcontroller. If it detects an alert from any one of the sensors it will fire the buzzer to get attention of the people nearby indicating the vehicle being theft. And it will also send an SMS to the owner about the theft along with the current location of the vehicle via GSM module.

5. Experimental Setup

At first we rotated the handle bar with a large amount of pressure. When this happens the relay supplies the power to GSM and GPS. The co-ordinates from the GPS is stored as a variable and sent to the gsm along with alert message /phone call (we have displayed it in the image shown in Figure 7).

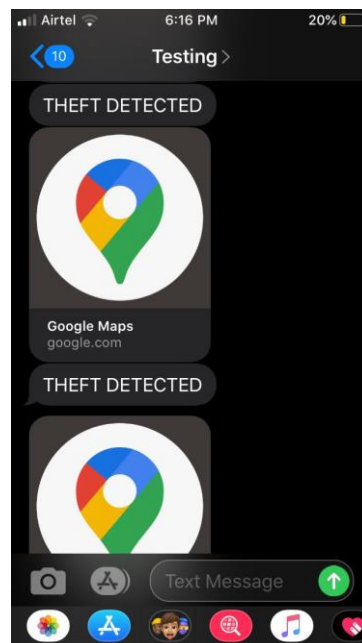


Figure 7: Message received to owner's phone from GSM

Then we lifted the vehicle to certain height when it crosses the threshold (ground clearance value) the same process repeats. As we have used an OR gate in the arduino code any change in any one of the sensors will result in whole process. The whole experimental setup is shown in Figure 8.

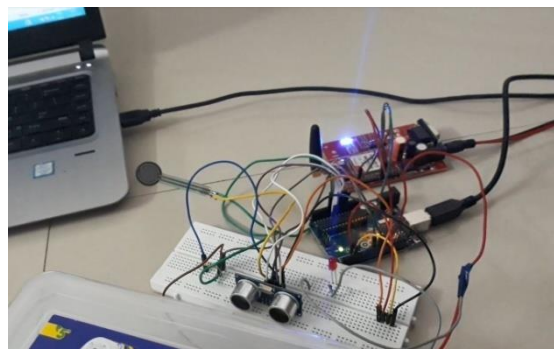


Figure 8: Experimental setup

6. Conclusion

We have developed a device in this paper that can quickly detect and track motorcycle robbery. This system can easily fit into a motorcycle without any modifications. This can be readily implemented with less effort and it can function to stop the thievery of two-wheelers and help people especially in rural areas who mostly rely on their vehicle for daily transport.

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