# ANTI-MOTORCYCLE THEFT WITH CHAIN KEY AND CUT OFF ENGINE SECURITY SYSTEM (A.C.C.E.S.S)

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***ABSTRACT***

Motorcycles are the most popular vehicles due to their relatively low cost and their ability to bring people from point A to point B in the least amount of time. In the market, there are many options for motorcycle security such as disc locks with alarms, steering wheel lock, heavy duty steel chains etc. Motorbike locks are considered the commonly used security accessory. The project utilized two motion sensors in order to detect if someone tampers the vehicle. The device would send SMS notifications to the owner. In addition, the alarm would be triggered to alert the owner and the people around the vicinity. When the motor was stolen, the owner has the capability to cut-off the engine using SMS and the remote key. The device would also determine the location of the vehicle using GPS module and GSM as a means of communicating. Through the use of Arduino MEGA, GPS, GSM, Accelerometer and Ultrasonic Sensors it can provide a security mechanism that will notify the owner when the motor was stolen, it provides a combination switch that cannot be easily bypassed by thieves and an alarm feature and tracker that allows the owner to locate its motorcycle.

***Keywords***

*Anti-motorcycle theft, Cut off Engine, remote key, Ultra Sonic sensor, Accelerometer sensor, GPS module, GSM module*

## 1. INTRODUCTION

Motorcycles are the most popular vehicles due to their relatively low cost and their ability to bring people from point A to point B in the least amount of time. In the market, there are many options for motorcycle security such as disc locks with alarms, steering wheel lock, heavy duty steel chains etc. Motorbike locks are considered the commonly used security accessory. The bike is chained to an immovable object such as a parking anchor, a post or another bike. The disc locks use the holes in a motorcycle's brake disc. When in place, the lock blocks the vehicle from being moved in either forward or reverse direction.

As stated by Szegezi and Keskkula (2011), designed and developed a Motorcycle Alarm with GSM Technology in Sweden. The idea was to implement a motorcycle alarm system that will contact the owner on his/her mobile phone in case someone tampers with the motorcycle. For

the sensing motion, they used two sensors- the tilt sensor and accelerometer in different prototype. As studied by Abu (2010), the Motorcycle Anti-Theft System (MATS) reduced the false alarm as the main objective. In this motorcycle anti-theft system, the main sensor is a mercury tilt sensor. The sensor will be placed on the bike's center stand, side stand and on the handle. For the result, when the double stand is lifted up or the handle is being turned out, the system will trigger when the mercury touch their two lids and the buzzer will on. The change of degree for the mercury will be more accurate and it will trigger the alarm.

The main goal of the design project was to develop ACCESS that utilizes the ARDUINO MEGA 2560. The microcontroller was used to have a bigger capacity of flash memory and so that the built- in EEPROM can handle lengthy code. Specific objectives was to be able to have a good communication between GSM module when registering cellphone number and researchers needs more digital and analog pins to control other devices. The design project aimed to notify the owner through SMS and give alert through alarm when the ultrasonic and accelerometer sensors have been disturbed; it also provided the cut off engine which prevents the motor to start when the vehicle was motor napped. The project also included the objective of retrieving the location of a vehicle using Global position system (GPS) to pinpoint the location and Global System for Mobile (GSM) as a means for communicating with the vehicle after a theft attempt.

The concept of ACCESS was coined; a device that produced noise through the use of alarm if the accelerometer sensor and ultrasonic sensor are disturbed. The accelerometer sensor detected motion in x, y z axes. The ultrasonic sensor was attached at the front fender bar of a wheel. It detected the movement of the wheel. Both sensors should be true in order to run the system, the GSM sends Short Message Service to inform the owner. The owner needs to insert the right key to be able to start the engine. The remote key would be able to activate/deactivate the security modules installed in the vehicle. In case of motor napping, the owner would send a text via SMS to the GSM module in the motorcycle and the GPS module would send back the location of the vehicle to the owner.

## 2. METHODOLOGY

The researchers utilized the System Architecture Methodology as shown in Figure 1. Inputs are data signals that are fetching by input devices such as the RF Remote, Ultrasonic sensor and Accelerometer to the Arduino Mega to be processed to achieve system objectives while the output is the outcome of each input taken. The GPS and GSM modules need to be initialized to acquire satellite and network signals in order to function both modules so it can locate the position of the motorcycle. Ultrasonic sensor and accelerometer are the one who detects if there are movement occurs in the motorcycle. The GSM Module immediately sends SMS to inform the owner that there is someone who tamper or moves the motorcycle from its original place and ready to receive SMS containing the owner request code. The GPS is always active, if the owner wants to know the motorcycle's location or after a theft attempt, owner has the capability to retrieve its position and can cut off the engine using SMS.

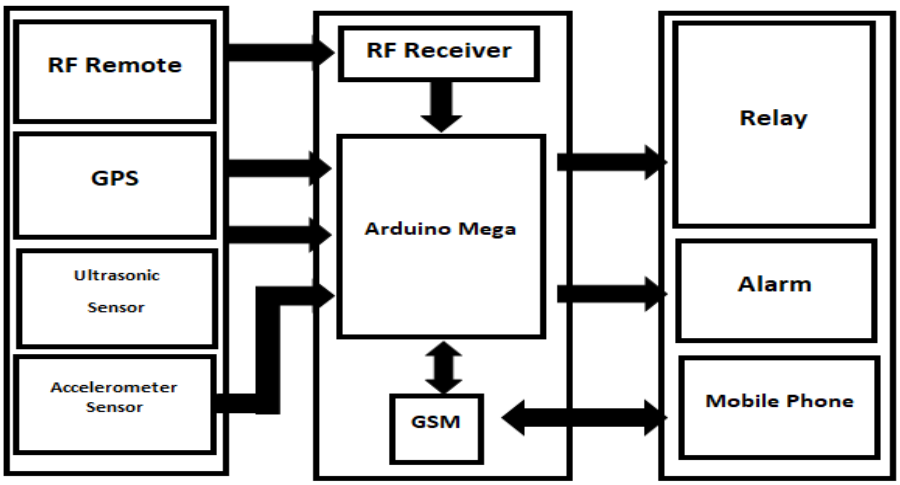


Figure 1. System Architecture

### 2.1. Hardware Components

The developed ACCESS used components such as accelerometer sensor, alarm, GSM module, GPS module and ultrasonic sensor. The project utilized two motion sensors in order to detect if someone tampers the vehicle. The device would send SMS notifications to the owner. In addition, the alarm would be triggered to alert the owner and the people around the vicinity. When the motor was stolen, the owner has the capability to cut-off the engine using SMS and the remote key. The device would also determine the location of the vehicle using GPS module and GSM as a means of communicating.

## 3. RESULTS AND DISCUSSIONS

The main power source of the project is from the 12-volt battery of the motorcycle. From that point, there was switch to turn on and turn off the device. It has a led indicator which is connected to digital pin. The 9-volt voltage regulator that will supply the Arduino Mega then the 5-volt voltage regulator that supply the other components, particularly the GPS Module that operates at 5-volt source, two relay modules and ultrasonic sensor. The two sensors were connected to the analog pins because it has a larger value ranging from 0 to 1023 and it is appropriate to use, unlike digital pins that has only two outputs 1 or 0. For those other devices, they were connected to digital pins. The GSM module has its own voltage source coming from the lm317 voltage regulator and has a potentiometer to provide its constant and stable 4 volts output because Sim800L GSM may not function effectively if the desired output is not followed. The remote wireless module needs a 12-volt power source and has a pulldown resistor connected to ground. This was for the button of the remote switch, it holds the logic signal near zero volts that prevent from hanging circuit. The single pole double throw switches were connected to the ignition switch to not easily bypass the direct connection to the engine.

### 3.1 GPS Testing

The module was able to determine the location of the motornapped vehicle and the GSM module sends it to the owner. The researchers conducted the GPS testing in order to test the its functionality and determine its validity if it was able to receive GPS signals without difficulty in different areas and weather conditions like sunny, cloudy and heavy rain. The GPS' Led serves as an indicator if the component is working or not working. When its start to blink, it points out that the module is ready to transmit data. The test was conducted in different areas

and locations. The open area is where the GPS antenna has a line of vision in the sky. While close areas are anything that block the signal such as buldings, roofs etc.,

Procedures (1) Setup the device by connecting it to the power source and by connecting the wires. (2)Turn on the device through the switch. (3.) Wait for the signal to stabilize, the GPS indicator LED will blink if the signal has been confirmed. (4) To verify the GPS, use the SMS to request its current location by texting the SMS code "location". (5) If the device system gives the location, it means the module is working.

Based on the results, the GPS Initialization time is dependent the signal gathered. The type of Area and weather condition have a great effect on the initialization time of the module. The table shows that open area and good weather gives the GPS acquire faster reception on signal. While the Rainy and close area gives the module longer time to fetch signal. Table 3.1 shows also the location of the GPS module by coordinates and the link address of map location.

Table 1. Testing the Global Positioning System

| **Trial** | **Weather Condition** | **Type of Area** | **GPS Initialization Time** | **Data Received** |
|---|---|---|---|---|
| 1 | Sunny | Open | 4.83 sec | Longitude: 120.312347<br>Latitude: 16.640319<br>Map Location:<br>http://map.google.com/?q=<br>16.640319, 120.312347 |
| 2 | Cloudy | Open | 4.99 sec | Longitude: 120.312339<br>Latitude: 16.640329<br>Map Location:<br>http://map.google.com/?q=<br>16.640329, 120.312339 |
| 3 | Rainy | Open | 6.1 sec | Longitude: 120.312339<br>Latitude: 16.640342<br>Map Location:<br>http://map.google.com/?q=<br>16.640342, 120.312339 |
| 4 | Sunny | Close | 6.71 sec | Longitude: 120.312324<br>Latitude: 16.640371<br>Map Location:<br>http://map.google.com/?q=<br>16.640371, 120.312324 |
| 5 | Cloudy | Close | 6.74 sec | Longitude: 120.312324<br>Latitude: 16.640361<br>Map Location:<br>http://map.google.com/?q=<br>16.640361, 120.312324 |
| 6 | Rainy | Close | 7.47 sec | Longitude: 120.312339<br>Latitude: 16.640409<br>Map Location:<br>http://map.google.com/?q=<br>16.640409, 120.312339 |

### 3.2 GSM Testing

The researchers conducted also a GSM testing, another major module in the system, to be able to test its functionality if the owner can send and receive SMS. The objective of the module is to provide accurate information through Short Message Service from the device installed in the vehicle. The researchers did the testing by registering the mobile number of the owner. Different network providers were used to test the functionality of GSM.

Procedures: (1) Insert your SIM card, either Globe or Smart network provider. (2) Setup the device by connecting it to the power source and by connecting the wires. (3) Turn on the device through the switch. (4) Wait for the GSM LED indicator to blink that means GSM is ready. (5) To test the device if it is working text the SMS Code "register <pin>" wait for the confirmation message of the system. (6) If the system replies the confirmation it means the module is working.

Table 2. Global System for Mobile Communication

| **GSM Network Provider- (Smart and Globe)** | | | |
|---|---|---|---|
| Trial | Owner | SMS Received and Send (Yes/No) | Message Received |
| 1 | Smart | Yes | Number was successfully added! |
| 2 | Globe | Yes | Number was successfully added! |

### 3.3 Sensors Testing:

Procedure for accelerometer sensor: (1) The Arduino should contain a code that will monitor the readings coming from the sensors. (2) To determine if the value will change, open the Arduino software, go to serial monitor. (3) Put the device in a flat surface for its stability. Monitor the reading. The values should be constant. (4) Lift up the device. The readings should change its initial value. And when it goes back to the previous position, the value will also return to its initial state.

Procedure for ultrasonic sensor: (1) Place the sensor at the front fender bar of the motorcycle. It should be faced toward the spokes of the wheel. (2) Move the motorcycle. Using also the serial monitor, check the values coming from the sensor. The value should change if the spoke is aligned to the sensor. Table 3 shows the sensors capability to change its initial values and back to its original state when there's a movement detected.

Table 3. Sensors movement detection

| **No. of trials** | **Is sensor's value change? (Yes/No)** | |
|---|---|---|
| | **Accelerometer** | **Ultrasonic** |
| 1 | Yes | Yes |
| 2 | Yes | Yes |
| 3 | Yes | Yes |

### 3.4 Alarm Testing:

Procedure: (1) Set up the ultra-sonic sensor and accelerometer sensor. (2) After series of testing on both sensors, add the alarm for the output when both sensors are disturbed. (3) The GSM should also send a SMS for notification. (4) Move the motorcycle. Monitor the value of the sensors. This is the gathered data from the different trials of sensor. The expected results were attained. From the data collected, there's a result that the alarm would trigger even one of the sensor disturbed. This is because of the inaccurate calibration of the sensitivity of both

sensors and also with the GSM module, there's a one test that the module didn't send a message maybe because of poor signal of the network or the problem with the code arrangement. However, the researchers properly readjust the said problems for the improvement of the project.

Table 4. Sensor, alarm and GSM testing

| No. of Trials | Is sensor's value change? (Yes/No) | | Trigger alarm? (Yes/No) | Send Message? (Yes/No) |
|---|---|---|---|---|
| | Accelerometer | Ultrasonic | | |
| 1 | No | No | No | No |
| 2 | No | Yes | Yes | Yes |
| 3 | Yes | No | No | No |
| 4 | Yes | Yes | Yes | Yes |
| 5 | Yes | Yes | Yes | Yes |
| 6 | Yes | No | No | No |
| 7 | Yes | Yes | Yes | No |
| 8 | Yes | Yes | Yes | Yes |
| 9 | Yes | Yes | Yes | Yes |
| 10 | Yes | Yes | Yes | Yes |

### 3.5 Locating:

The researchers installed the GPS module in the motorcycle to retrieve the location of the vehicle. The registered number of the owner will send the SMS code "Location" in order to asked for the position of the vehicle. The researchers declared reference points (latitude and longitude) to be able to compare the coordinates that the system is presenting.

Table 5 shows the result of the coordinates presented by the device. The table also display the latitude and longitude of the reference point chosen by the researchers. The result were shown in Figure 2 that the GPS module is not presenting the same coordinates in the reference point, but it produces coordinates approximately 200 meters; close enough value from the exact coordinates of the reference point.

Table 5. Global Positioning System results

| No of trial | Reference point (latitude and longitude) | System (latitude and longitude) |
|---|---|---|
| 1 | Ika's Dorm, San Fernando City, La Union (16.6401232, 120.3109461) | http://map.google.com/?q= 16.6406900, 120.3116000 |
| 2 | SLC, San Fernando City, La Union (16.6378, 120.3139) | http://map.google.com/?q= 16.6401232, 120.3109461 |
| 3 | Lorma Colleges, San Fernando,La Union (16.6315, 120.3180) | http://map.google.com/?q= 16.6293130, 120.3135990 |
| 4 | MANNA Mall, San Fernando City,La Union (16.6268, 120.3193) | http://map.google.com/?q= 16.6286146, 120.3180120 |
| 5 | CSI Mall, San Fernando City,La Union (16.6293, 120.3223) | http://map.google.com/?q= 16.6336920, 120.3262710 |

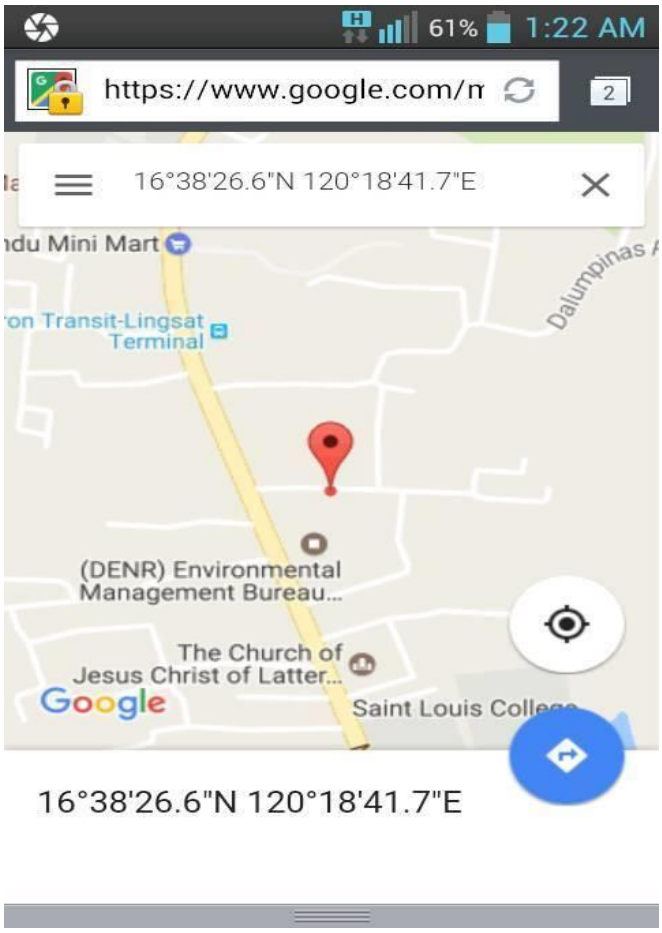


Figure 2. Map location of the tested motornapped vehicle

### 3.6 Register Mobile number:

The owner of the motorcycle must register his/her mobile number in order to have access in utilizing the system. The admin has the right to add and delete mobile number and remoting the system. To register follow the procedures below:

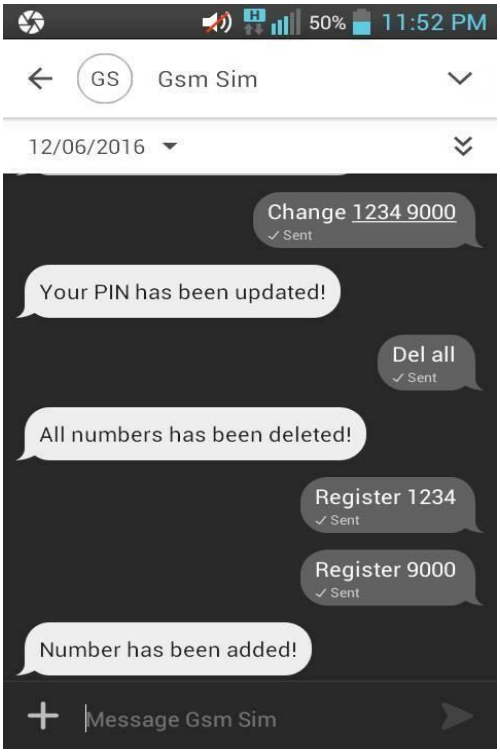


Figure 3. Register Mobile Number

## 3. CONCLUSIONS

With the increasing number of motorcycles on the road, there has been a marked increase in the number of crimes involving vehicle theft. According to Regional Highway Patrol Group- Unit I, because of lack of security, numerous theft cases are enlisted. The design is intended for those motorcycle owners that need an additional assurance to keep their motorcycle protected from the thieves through the use of an automated system. Based on the analysis and results of testing, the researchers concluded that the project Anti-motorcycle theft with Chain key and Cutoff Engine Security System is reliable and efficient device that can add security to motor vehicles. Through the use of Arduino MEGA, GPS, GSM, Accelerometer and Ultrasonic Sensors it can provide a security mechanism that will notify the owner when the motor was stolen, it provides a combination switch that cannot be easily bypassed by thieves and an alarm feature and tracker that allows the owner to locate its motorcycle.

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