IMPLEMENTATION OF ACCELEROMETER SENSOR AND GPS MODULE FOR SMART BIKE DESIGN

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Abstract

Bicycles are one vehicle that is quite popular for exercise. The lack of parking space for bicycles made bicycles vulnerable to theft. This equipment is able to provide a security system and provide the location of the bike when the bike had been stolen. This device consists of an Android application and the application of two modules, namely accelerometer and GPS to be processed in the microcontroller Arduino UNO. This bike is able to provide information such as SMS when the bicycle displaced and also sends the coordinates of the location on google maps to be displayed to the smartphone applications created using MIT App Inventor 2.

Keywords: GPS, Arduino UNO, *Accelerometer.*

1. Introduction

1.1 Background

With more and more vehicles on the highway such as cars and motorcycles, making the highway becomes jammed and crowded so that sometimes there are many accidents. Generally, people prefer motorcycles and cars as vehicles to travel to a place because quickly and also practical, the increase in the number of vehicles will continue to increase in line with the increase in population growth in the world. Most of the vehicles used are motorcycles and cars. The availability of buses and other public transport in the value has not been able to provide the needs of the community as a vehicle to travel somewhere because it is less convenient. The need for alternative vehicles that can be used to replace the role of motorcycles and cars. Higher pollution rates result from emissions of emissions from vehicles. Therefore, bicycles can be an alternative vehicle that can overcome potential congestion and air pollution for use in Indonesia, especially in developing areas, densely populated areas, and areas with high congestion levels by using bicycles as a vehicle for traveling. Bicycles have not been in great demand in Indonesia because of their unsecured safety but the bikes do not pollute as well and can make healthy as it can be a means to exercise while traveling to a place. From these problems, it is necessary to make a hardware in the form of equipment or designs to build and increase public interest to use the bike. The system that will keep his bike safe from thieves. This bike will also be equipped GPS to

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track the coordinates of the bike when it has been stolen by displaying on google maps the bike owner's smartphone.

From here the author thinks to complement or refine the innovation by going to research and manufacture the equipment entitled **"IMPLEMENTATION OF ACCELEROMETER SENSOR AND GPS MODULE FOR SMART BIKE DESIGN"**

1.2 Problem Formulation

Problems faced in writing this project can be formulated as follows:

1. How to design a smart bike that can detect vibration as an indicator to move position?
2. How to design the smart bike that can give a warning if the smart bike in the move?

1.3 Research Objectives

The purpose of writing this thesis are:

1. Can use and create a system that can be likened to the bike.
2. Can use and create a system that can transmit coordinate position information when there is burglary.
3. Can design and create a system that can display coordinates on Google maps with the interface on the Smartphone.

1.4 Problem Limitation

To avoid the widespread problem, the problem is limited only to the following:

1. GPS coordinate readings using MIT Apps Inventor software
2. Not discussing the absence of GPS signal.
3. Control system that be used is Arduino UNO

2. Method

The equipment will be made is a smart bicycle-based microcontroller, this smart bike can overcome the security for bicycles and cyclists. Planning and research is done by looking at the deficiencies in previous research. As for previous research about smart bike are :

1. Fahraini Bacharruddin, Department of Electrical Engineering, University of Merchu buana, with the title: smart helmet system for cyclists.
2. Tobar, Department of Electrical Engineering, Politeknik negri semarang, with the title: Design of microcontroller motorcycle security system via SMS

2.1 Accelerometer

The accelerometer is a sensor used to measure the acceleration of an object. Dynamic accelerometer and statistics accelerometer. Dynamic

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measurement is the measurement of acceleration on moving objects, while statistical measurements are measurements of Earth's gravity.

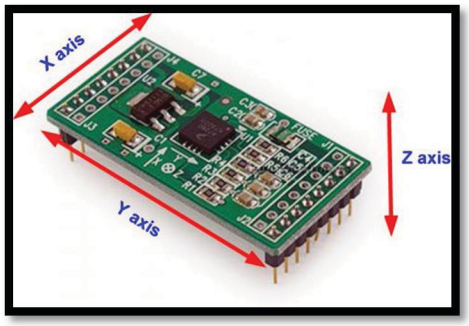

Image 2.1 Accelerometer Sensors

The working principle of the accelerometer is the working principle of acceleration per burden that is released, the load moves with an acceleration until certain conditions will stop. If something shakes it then the load will swing back.

2.2 *Global Position System (GPS)*

Understanding GPS is a navigation that uses satellites to be able to provide position instantly. Speed and timing information are almost anywhere in the world, under any weather conditions. While the equipment receive satellite signals that can be used by users is generally called GPS tracker, using this equipment allows users to track the position of a vehicle, fleet or car in real time

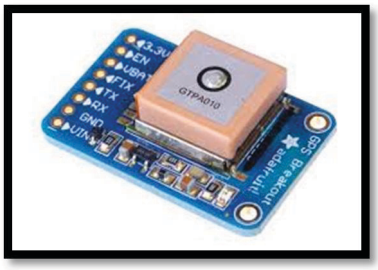

Image 2.2 *Global Position System (GPS)*

2.3 800L GSM SIM Module

Usability of 800L GSM SIM module ,for SMS gateway and pulse server. GSM Module is a device that can replace the function of the phone. This module supports dual band communication at 900/1800 MHz (GSM900 and GSM1800) frequencies, making it flexible for use with SIM cards from various mobile phone operators in Indonesia. The advantages of GSM Module are as follows.

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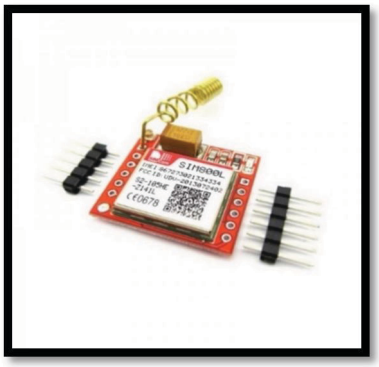

Image 2.3 800L GSM SIM Module

2.4 Arduino UNO

Arduino UNO is a microcontroller board based on Atmega 328. Arduino Uno has 14 input/output pins which 6 pins can be used as PWM output (Pulse Width Modulation), 6 analog inputs, 16 MHz crystal insulator, USB jack power connection, head ICSP, and the reset button. The Arduino Uno is built from the same basic elements.

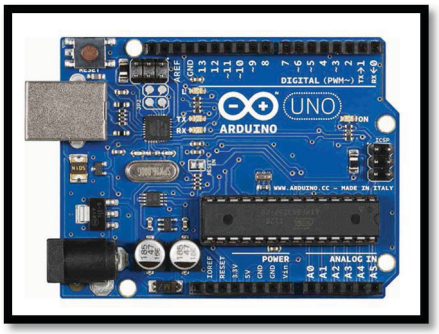

Image 2.4 Arduino UNO

3. Result and Discussion

3.1 Research Variables

The research variables used in writing and research on this project, among others

3.1.1 Vibration

Examination of vibration value using Accelerometer sensor is only done in the event of a shift resulting in an unacceptable value received by the sensor.

3.1.2 Coordinate

Coordinate is a result point of intersection between latitude and longitude indicating an object be it a person, location or building in a location in field or earth with on the map.

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3.2 Model architecture scheme

In this chapter will be discussed about the block diagram and the working principle of the equipment in implementing Accelerometer Sensor and GPS module.

3.2.1 Block diagram

To facilitate the design of the equipment in need of block diagram, accelerometer system and GPS module to design the block diagram of the bike shown in Image 3.1.

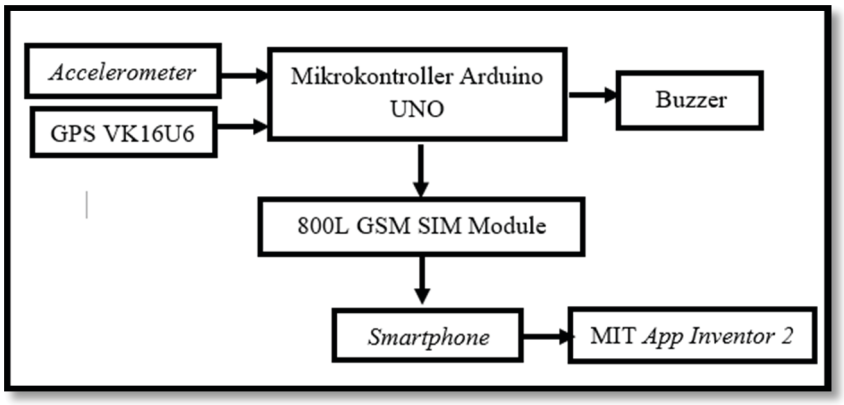

Image 3.1 Block Digram

3.3 The working principle of the Device

The accelerometer sensor acts as a sensor to detect the movement of the bicycle which be programmed in the microcontroller and then the buzzer will sound, Microcontroller will also send a message to the GSM modem then GSM modem will send the message automatically to the smartphone in the form of an automatic message or short message.

MIT App Inventor is used to forward data from GSM and GPS modules in the form of coordinate data that will be displayed on the Smartphone.

3.4 Testing and Analys

After the design and manufacture of the equipment is completed, then the system tested to determine whether the equipment has been designed and made working properly as planned. The tests include hardware and software testing. The tests were conducted to compare the theoretical design results with experimental or test results. From the test results can be known whether the equipment has worked in accordance with the desired specifications such as in equipment planning.

3.4.1 Accelerometer Sensor Testing

The ADXL335 accelerometer sensor acts as a sensor to detect a vibration or movement occurring in a vehicle. This sensor has a parameter of gravity (g).

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3.4.1.1 Determining the value of gravity Accelerometer Sensors

The MMA7361 accelerometer sensor test is done by viewing the output from the sensor in the form of ADC (Analog To Digital Converter) value which has been converted to voltage and then converted again into gravity unit (g) on each X, Y, and Z axis.

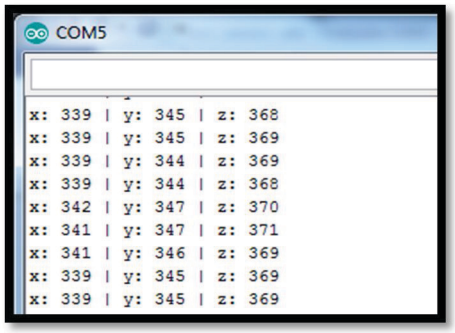

Image 3.2 Condition The value of the ADC axis x, y and z

The value of ADC will be converted to g value by first modified to a voltage value by using the formula:

$$Vout = \frac{value\ ADC\ X\ Vref}{1023}$$

The Vref value is the reference voltage at the AREF pin of Arduino UNO of 5V. Then the voltage value will be converted to millivolt (mV) multiplied by 1000 and converted to g value by dividing by 206. According to the MMA7361 Accelerometer sensor datasheet, that sensor sensitivity is 206 mv / g. The calculation results are as follows:

X axis value is 340

$$\text{Vout}=\frac{340\ \text{X}\ 5}{1023}=1{,}66\ \text{V}$$

$$\text{g}=\frac{1{,}66\ \text{X}\ 1000}{206}=8{,}05\ \text{g}$$

Thus the value of g on the X-axis at rest is 8.05 g
Y axis value is 344

$$\text{Vout}=\frac{344\ \text{X}\ 5}{1023}=1{,}68\ \text{V}$$

$$\text{g}=\frac{1{,}68\ \text{X}\ 1000}{206}=8{,}15\ \text{g}$$

So the value of g on the Y axis at rest is 8.15 g
Z axis value is 369

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$$Vout = \frac{369 \text{ X } 5}{1023} = 1{,}80 \text{ V}$$

$$g = \frac{1{,}80 \text{ X } 1000}{206} = 8{,}73 \text{ g}$$

So the value of g on the Z axis when silent is 8.73 g

3.4.2 Testing of the 800L GSM SIM Module

800L GSM SIM Module Test can be done when it has Installed with the SIM card and there should be a signal. Test results as shown below:

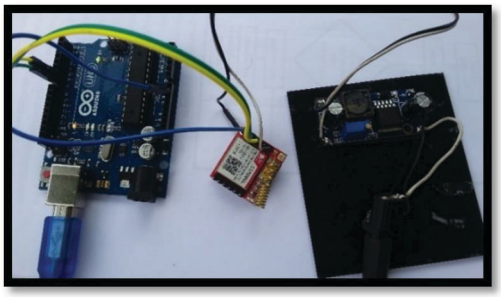

Image 3.3 Test 800L SIM GSM Module

After the program is Installed then 800L GSM SIM Module will send a message to the number that has been put. The programming language used in testing GSM Module is the C language shown in Image 3.4

```
void setup() {
  Serial1.begin(9600);
  Serial1.println("AT+CMGF=1");
                          delay(1000);
  Serial1.println("AT+CMGS=\"No tujuan Pengiriman SMS\"\r");
  delay(1000);
  Serial1.println("Sepeda Terpindah");
  delay(1000);
  Serial1.println((char)26);
  delay(1000);
}

void loop() {
}
```

Image 3.4 Program Code to Test GSM module

After the program is uploaded and then the message received by the no destination in accordance with the message written in the program code and uploaded into the Arduino as shown in Image 3.5

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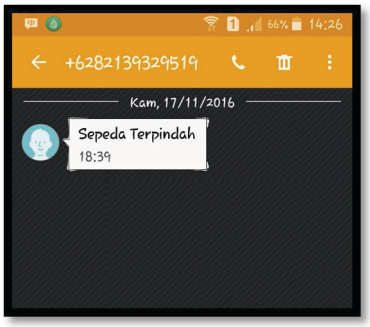

Image 3.5 Text message From GSM Module

3.4.3 Testing of VK16U6 GPS Module

To know that the GPS module can receive coordinate signals and display longitude and latitude

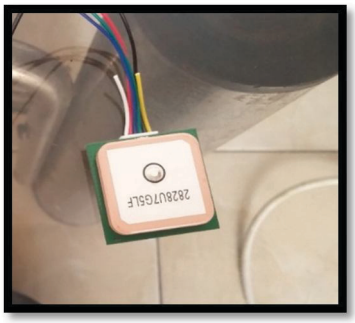

Image 3.6 GPS Module

Image 3.6 is a circuit used during testing. When the Arduino monitor series receives data from the GPS module it will appear raw GPS data which is still a degree minute that must be processed first before it can be used as in Image

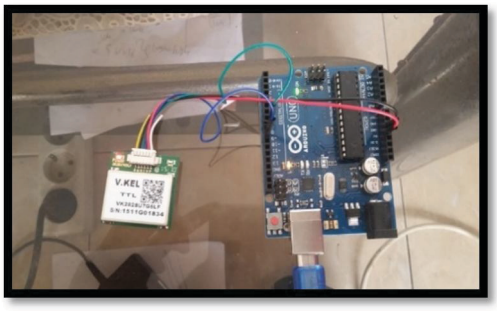

Image 3.7 Installation of VK16U6 GPS Module with arduino UNO

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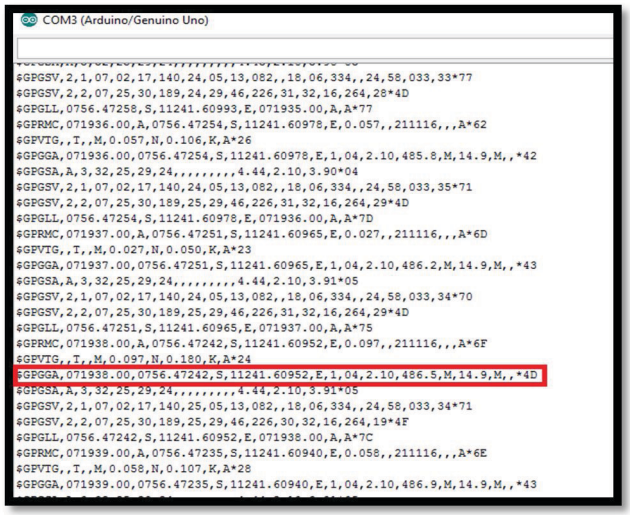

Image 3.8 Results of testing the GPS module with Arduino UNO serial monitor

From the above test results to get the coordinates obtained raw GPS data which will have to be processed to get the actual latitude and longitude so get the position more accurately, for example:

$GPRMC,091932.00,0754.47146,S,11241.60579,E,1.05,1.50,505.M,14.9,M,,*46

Tabel 3.1 Testing Results of GPS Module

	GPS Data	explanation (dd,mmm)
Latitude	0756.47146	756.47146 LB
Longitude	11241.60579	11241.60579 LS

For Latitude Longitude (dd, mmmm) change it by:

$$\frac{56.47146}{60} = 0.94119 \text{ LB}$$

So the change is in dd form, dddd becomes 7.94119
For South Latitude (dd, mmmm) the same way:

$$\frac{4160579}{60} = 0.69342 \text{ LS}$$

So the change is in dd form, dddd becomes 112. 69342

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Tabel 3.2 Data Change Result dd, mmm To dd, dddd

	dd,mmm	dd,dddd
Latitude	7 54.94626	7.94119 LB
Longitude	112 37.91291	112.69342 LS

After obtained the value of latitude and longitude in Table 3.2 then matched with the coordinates on Google maps as in Image 3.10

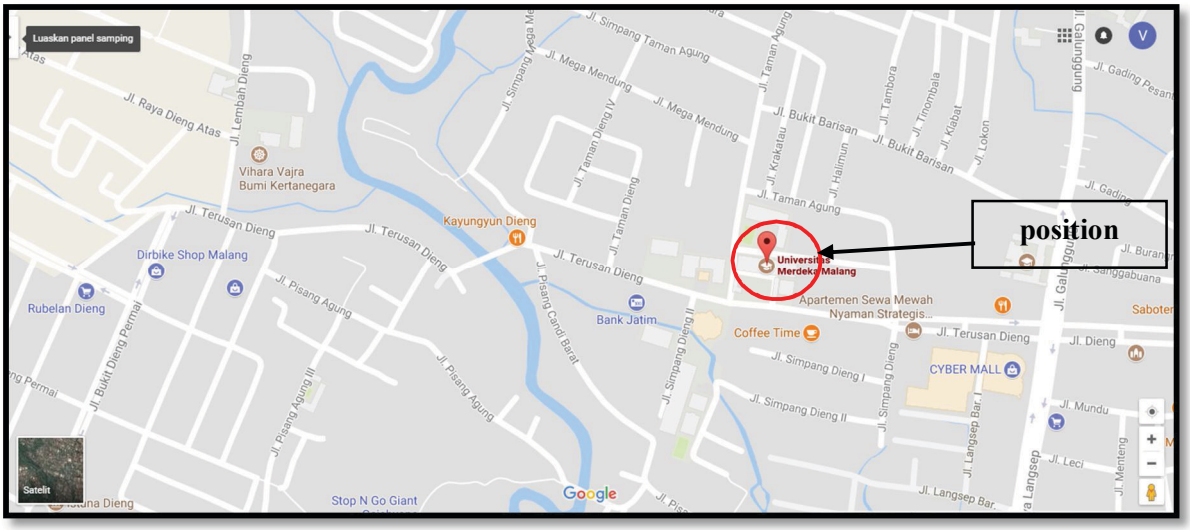

Image 3.10 Image On Google Maps

3.4.4 Application Testing MIT App Inventor 2

The process of sending messages from Arduino via GSM Module to Android smartphone. On the Android smartphone, the message will be displayed on an app. Creation of Android app using app inventor 2 is an online application to create Android applications with the program as follows:

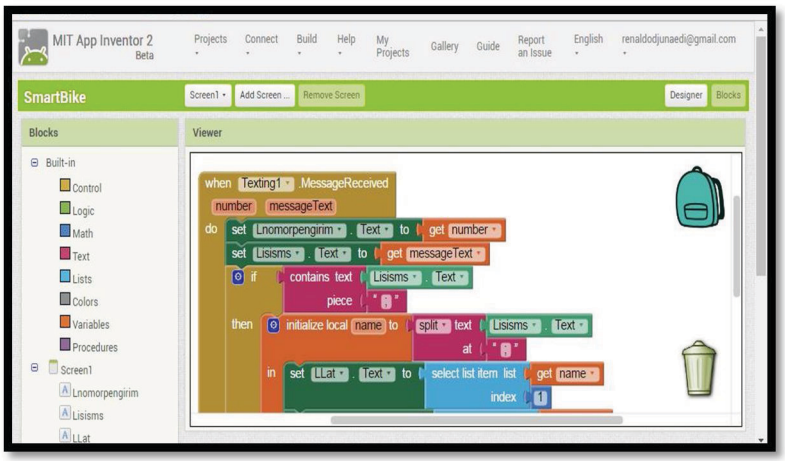

Image 3.11 MIT *App Inventor 2* Program

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Image 3.13 is a continuation of the program shown in Image 3.12

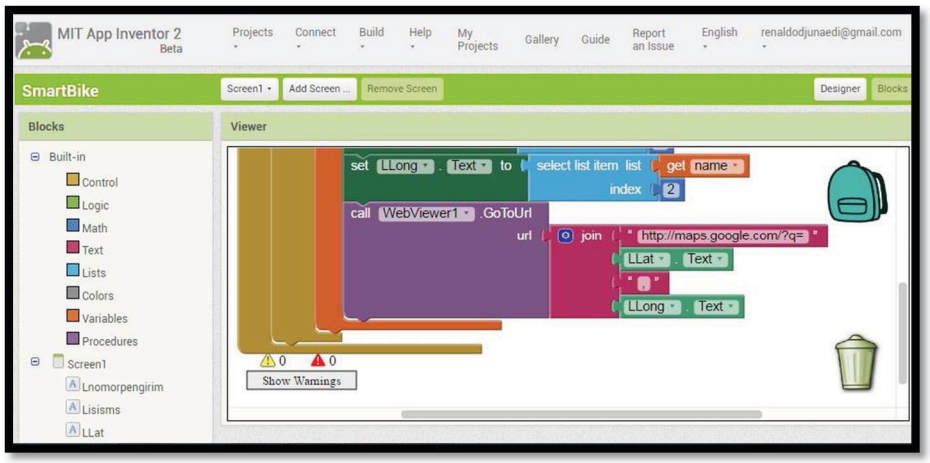

Image 3.12 MIT *App Inventor 2* Program

Next In Image 3.12 is the interface display on the Smartphone

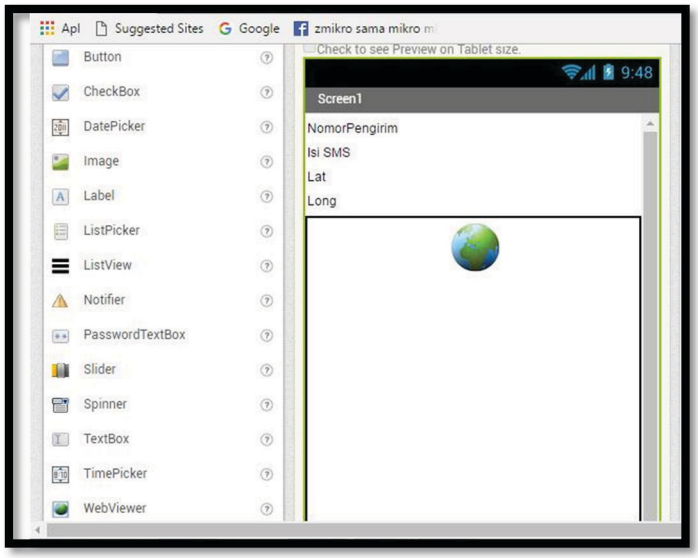

Image 3.13 MIT App Inventor 2 interface display for SmartPhone

After the application is completed then downloaded to the smartphone and image 3.13 is the image when the application has been run on the smartphone.

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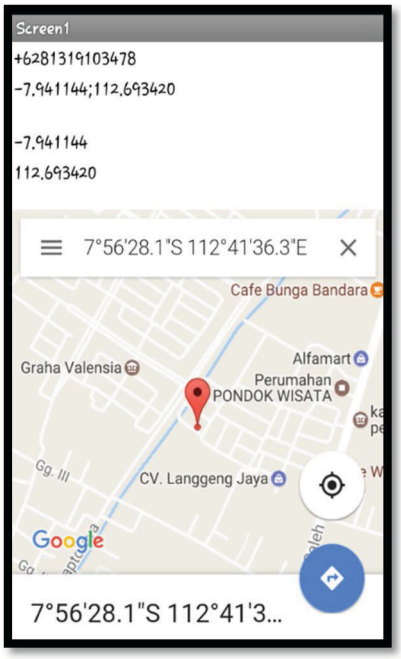

Image 3.14 Results from MIT App Inventor 2

4. Conclusion

Based on the design, testing, analysis of the purpose of the research then concluded as follows:

1. Smartbike can detect vibration as a sign of switching position using accelerometer sensor with the value of vibration limit on X axis = 8,05 g, Y = 8.15 g, Z = 8.73 g

2. Smartbike can give the warning if vibration value on X, Y and Z axis exceeds boundary value. A warning of Buzzer and SMS that contains the location coordinates of the GPS module data

3. Android app created using MIT App Inventor 2 with web view object to show the location of smart bike on google map

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