DEPARTMENT OF COMPUTER SCIENCE AND TECHNOLOGY

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CROWD-SOURCED ROAD MAPPING

By

Group 10

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1 ABSTRACT:

In today's world it has important to know whether the roads we are travelling on are safe, children friendly, or comfortable for people with disability. Crowd-Sourced Road Mapping system simplifies this problem by giving you the information about the way or a road prior to your journey so that you can choose a different way or prepare yourself to prevent any kind of accident. It will tell you the information of the intensity of bumps and potholes on that road. This will help you to decide beforehand whether to go on a particular road and estimate the time taken through a road. Also knowing the inclines on path whether it's a hilly slope or downward inclination can help you to manage the speed or kind of vehicle used. Throughout the way the intensity of Wi-Fi signal is also mapped on the map which is useful in today's world. The software makes use of MQTT protocol, which enables access to the data of the sensors from any place. It can used for monitoring or controlling, whenever required.

Figure 1: CROWD SOURCED ROAD MAPPING

2 ABOUT THE SYSTEM:

Crowd-Sourced Road mapping system is aimed at obtaining information or input from all the sensors that help in detecting the quality of road and terrain, and that data can be used to map the terrain on google maps, typically via the Internet. It uses various sensors to monitor different variables of the road like bumps, potholes, Wi-Fi strength based on defined threshold values, collects all the data and map the terrain of the path on the map. This system uses a MQTT protocol which is a lightweight messaging protocol for small sensors and mobile devices, optimized for high latency or unreliable networks, making it a smarter device which send data to the internet after a period.

3 USER INTERFACE

The system provides an online dashboard to manipulate the data and interpret accordingly through various graphs and then filtering to map it on the google maps. User can open the site, monitor different variables, and see the logs. To use this system so map the terrain in your array, just plug the adapter into the pi and put it on the back of bike and ride through the roads, then data will be sent to the sever through MQTT automatically.

4 SOFTWARES REQUIRED:

Software1: DESCRIPTION

Software2: DESCRIPTION

5 MATERIALS/COMPONENTS REQUIRED:

1) Spark fun 9dof MPU9150 Accelerometer
2) Spark fun 9dof MPU9150 Gyroscope
3) Brigosha GPS
4) Mediatek Wi-Fi wireless module
5) Raspberry Pi
6) Power bank
7) Jumper wires

6 DESIGN AND IMPLEMENTATION:

6.1 **HARDWARE MODULE:**

The system mainly consists of three modules:

6.1.1 Accelerometer & Gyroscope:

The MPU-9150 is the world's first integrated 9-axis Motion Tracking device that combines a 3-axis MEMS gyroscope, a 3-axis MEMS accelerometer, a 3-axis MEMS magnetometer and a Digital Motion Processor™ (DMP™) hardware accelerator engine. The MPU-9150 is an ideal solution for handset and tablet applications, game controllers, motion pointer remote controls, and other consumer devices. The MPU- 9150's 9-axis Motion Fusion combines acceleration and rotational motion plus heading information into a single data stream for the application.

Accelerometer Features: The triple axis MEMS accelerometer in MPU-9150 includes a wide range of features:

- Digital output 3-axis accelerometer with a programmable full scale range of +-2g, +-4g, +-8g, +-16g.
- Integrated 16 bit ADCs enable simultaneous sampling of accelerometers while requiring no external multiplexor
- Orientation detection and signaling

- Tap detection and High- G detection.

Gyroscope Features: The triple axis MEMS accelerometer in MPU-9150 includes a wide range of features:

- Digital output X-, Y-, Z- axis angular rate sensors with a user programmable full-scale range of +-250, +-500, +-1000, +-2000 degrees/sec.
- External sync signal connected to FSYNC pin supports image, video and GPS synchronization.
- Improved low frequency noise performance.
- Digitally programmable low-pass filter.

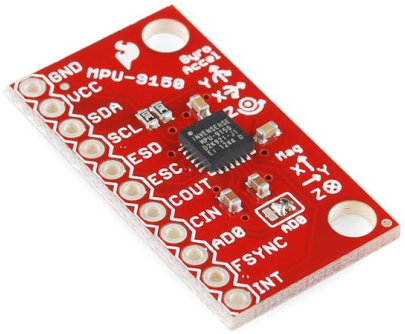
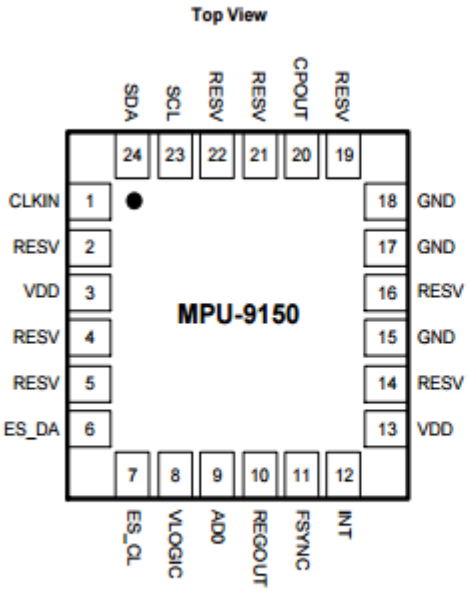
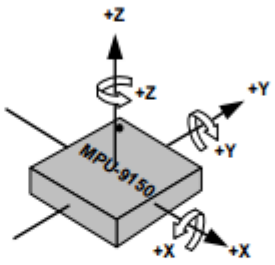


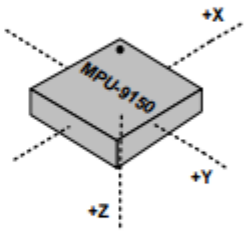
Figure: MPU9150



LGA Package
24-pin, 4mm x 4mm x 1mm



Orientation of Axes of Sensitivity and Polarity of Rotation for Accel & Gyro



Orientation of Axes of Sensitivity for Magnetometer

6.1.2 GPS:

The GPS by brigosha technologies is mounted with the GPS receiver module with embedded patch antenna. It enables ultra-high performance in the most stringent applications and solid fix even in harsh GPS visibility environments. The module provide complete signal processing from internal antenna to serial data output in NMEA messages.

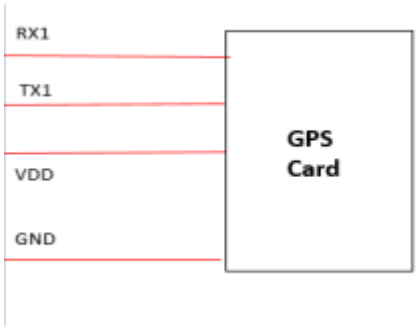
Source Code

The source code shown below is the firmware to be flashed in the microcontroller of raspberry pi. The source code is commented for better understanding.

```
#include <stdlib.h>

#include "EAB_Library.h"

/*** GLOBAL VARIABLES ****/

/*-------------------------------------------------------------------------*/
void main(void)
{

    /*** INTITALIZE OSCILLATOR, PERIPHERAL & HARDWARE ***/
    Oscillator.SetFreq_8MHZ();              // Select system clock at 8 MHz

    Serial2.Open(9600);                     // Select UART2 at 9600 Baud Rate
    Serial1.Open(9600);                     // Select UART1 at 9600 Baud Rate

    /*** PLACE THE REPETITIVE TASKS IN THIS LOOP ***/
    while(1)
    {
        /*** SEND THE RECEIVED DATA ON SERIAL PORT ***/
       if(Serial1_RxFlag)                   // Check Receiver1 Flag
        {
            Serial2_SendByte(Serial1_ReadByte());    // Transmit via UART2
            Serial1_RxFlag=0;               // Clear the Flag
        }
    }
}
/*-------------------------------------------------------------------------*/
```

Connection Description

GPS card is connected to raspberry pi with RX, TX, VDD and GND pins. It is recommended to set the operating voltage of the raspberry pi to 3.3 V for GPS card. Once GPS card is connected with raspberry pi, power on the pi. Make sure to make correct connections with proper pins. RX of GPS is connected to TX of pi and Vice-versa.



6.1.3 WI-FI MODULE:

MediaTek RT5370 is a system on a chip (SOC) with a USB 2.0 interface for 802.11n Wi-Fi at data rates up to 150Mbit/s. RT5370 features integrated 802.11n baseband and MAC (media access control), power amplifier and low-noise amplifier, along with both transmit-receive and antenna diversity switches. Together with an optimized RF architecture and baseband algorithms, RT5370 gives superb performance and reliable throughput with low power consumption.

Wi-Fi module Features:

- 802.11n (2.4GHz)
- 1T1R with 150Mbit/s PHY data rate
- Antenna diversity switch
- USB 2.0 Interface
- Advanced power management

Figure: Wi-Fi module with pi

7 PROGRAMMING THE SENSORS AND PI:

7.1 **Reading Sensor values**

We used three sensors: AMGP, GPS and Wi-Fi as part of the project. We implemented the project on Raspberry Pi.

7.1.1 AMGP

7.1.2 GPS

7.1.3 Wi-Fi

7.2 **Main Sensors Source Code**

7.2.1 AMGP

7.2.2 GPS

7.2.3 Wi-Fi

8 PROBLEMS FACED AND SOLUTIONS

- Interfacing brigosha amgp with raspberry pi: We got the data but due to no proper documentation, we could not interpret the data properly so we had to shift to other imu.
- Brigosha GPS: We could not find the pin map of the GPS for connection to pi. We then found the image of GPS connected to EAB board and then found the pin map of EAB board.
- Wrong connection of RX, TX in GPS: We saw wrong connections of RX, TX and put Rx of GPS to RX of pi and same with TX. Due to which we were getting no data. So later we changed it.
- Sparkfun razor 9dof imu did not work: We had to upload a firmware on the imu as it was another microcontroller mounted on it. So for that we need FTDI cable which was not available, so left it.

9 LIMITATIONS

- Limitation1
- Limitation2