GPS-BASED OBJECT TRACKING SYSTEM USINGFIREBASE APPLICATION FOR HAULAGE TRANSPORT

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Abstract

There are many objects in various field such as transportation, industry and smartphone that can be tracked. The purpose of this thesis is to analyze the performance of Global Positioning System (GPS) tracking system using Firebase application for haulage transport object. The current location of the object is monitored by the administrator on website. The content on the website is a database and visualization of coordinates for maps. This final task is designed as a tool that connects between a microcontroller and a GPS module as well as map visualizations of the coordinate points received by the GPS module. This tool has a tracking system function in which the database is continuously updated until power is depleted. In general, components used to allow the tracking process to occur are the Global Positioning System (GPS) receiver, Raspberry Pi as microcontroller, and computer as the control unit. This tool is applied to the truck to protect the appliance from rain and also provide tracking function. By using a Global System for Mobile Communications (GSM)-based modem, the tool can work with a relatively long range of distances. As for the tracking function found from the Neo-6M module which is a tool equipped with an antenna so that it can receive the Coordinate point of the satellite, the Coordinate point received by the Raspberry Pi directly in the database where the database is configured in Firebase realtime-database (FRD).

Keywords: Raspberry Pi, GPS, GSM, FRD.

1. Introduction

GPS is a satellite navigation system used to determine the ground position ofan object or ”object tracking”. GPS consists of a network of 24 satellites, eachsatellite radiate radio signals that a receiver device installed track, trip distance,distance to destination, sunrise and sunset time. Because of era development, GPS isavailable in a smartphone, transportation, computer, notebook and also modified ina small chip. For the location of the device, it is self can be able tracked by InternetProtocol (IP) address, Media Access Control (MAC) address, Global system formobile communications (GSM), and phone number.

Nowadays, there is many people do not know about performance of GPS, show-ing map without know the coordinate it makes location not exposed in Realtime, not1 2accurate of longitude and latitude on the map. By utilizing technology from GPSwhich has been integrated with micro controller, this thesis intends to analyze theperformance of GPS by decrease the delay, modifying the cloud server and exposedthe location in Real-time mode.

1.2 Problem Formulation

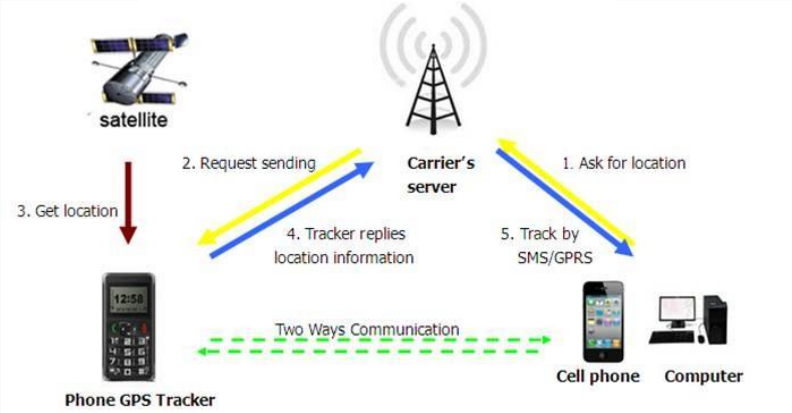
The problem in this thesis is the transportation of haulage that can still be lost,stolen, accident, and out of the tracking lane. This thesis needs to design applicationwhich the data can be shown as

a real-time condition. This thesis offers a solution tomake private application that can be monitored by the user. In the usual tracker ap-plication, the user is only able to track it own devices, without supervision, the usercannot report himself to the security in case of an accident and stolen. This thesis isa solution to make tracking applications and is monitored in real-time condition.

2. Basic Concept

2.1 Mechanism Of Object Tracking

Object tracking is one of the most frequently used methods in several companiesdealing with the transportation of package, and package delivery. The purpose ofobject tracking is to track the location of the object, track object loss, and monitor-ing. A device that receives a location is called a GPS (Global Positioning System), GPS can be implemented on any device that has minimal specifications such as a microcontroller. In Figure 2.1 explained the object tracking mechanism in general,when the device sends a request to search for a location, GPS receives the locationof the satellites in outer space and sends the recorded location to the requesting device.



(Source: Alarm Sistemleri Antalya, ”Mobile Tracking Live”)

Figure 2.1 Raspberry Pi 3 model B

2.2 Global Positioning System

Global Positioning System (GPS) is a system to determine the location on theearth surface with the help of synchronization of satellite signals. This signal isreceived by a receiver on the surface and is used to determine its location, direction,and time. In Figure 2.2, GPS module used is a GPS NEO-6M. This module is used toacquire the location and can also provide timely information, continuously withoutrelying on certain time and weather.

Figure 2.2 Neo-6M

The location Output on the GPS itself is ex-pressed at a point of coordinates longitude and latitude where the coordinate pointcan be used to display the location where the GPS presence.

2.3 Raspberry Pi

Raspberry Pi in Figure 2.3 is an SBC (Single Board Computer). Raspberry Pican do almost anything that can be done by computers with Linux operating systemssuch as making servers, making programs with various languages, one of which is ahigh-level language like Python. Raspberry can run a GUI-based operating system,so it can use it to perform standard activities such as browsing, listening to music,watching movies and playing games.

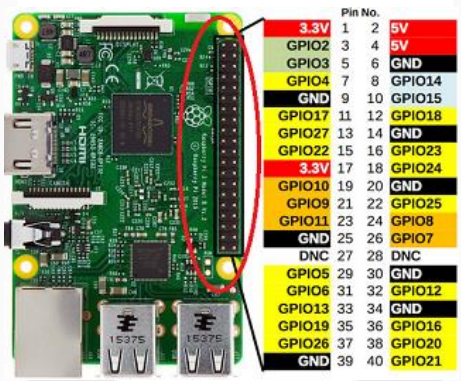


Figure 2.3 Raspberry Pi

2.4 Modem 4G LTE

This modem uses a system from GSM which requires a connection card that issupported by the provider to access the Internet. 4G LTE is the Fourth GenerationLong Term Evolution. This is a combination of two different terms and has its standard. G stands for generations alias generation. Huawei E3772 is the modemt hat used.

This modem is a communication system for connecting raspberry pi andthe GPS module. The modem that used is inFigure 2.4.

Figure 2.4 Huawei E3372

3. Work System

From Figure 2.5 shows the flow chart of the tracking system design that usesthe Raspberry Pi as a processor to process data from the modules used. Turn onthe Raspberry Pi need time around 20-30 second until the GPS Module antennareceive location. Neo-6M is GPS modules are used to send information in the form of coordinates based on their actual location. The system starts by configuring theRaspberry Pi with GPS module and Modem to connect to the IoT platform. TheGPS module reads the data in the form of transportation coordinates at that time.If the system successfully receive the coordinate, the coordinate sent directly to theIoT platform continuously. Power off the Raspberry Pi to stop the tracking process.

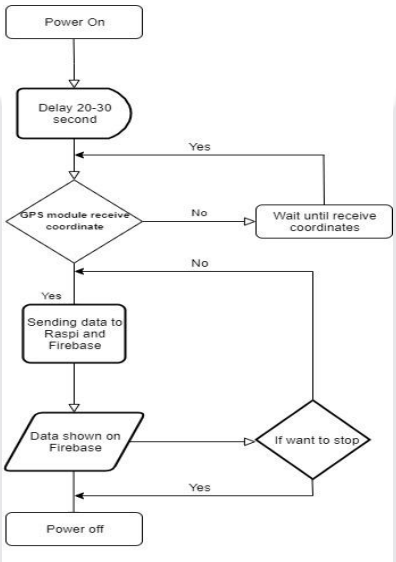


Figure 2.5 Tracking Flowchart

3.1 Neo-6M Configuration

Neo-6M is serial communication, the connection must undergo a sprinting. Tx from Neo-6M plugged into Raspberry pi Rx. in Figure 3.4 is the detail explanation. Raspbian used the UART (Universal Asynchronous Receiver-Transmitter) as aserial console and it is need to turn off that functionality. Replace the contents inside:

1. /boot/cmdline.txt$' file into '$dwc_otg.lpm_enable=0 console=tty1 root=/dev/mmcblk0p2 rootfstype=ext4 elevator=deadline fsck.repair=yes rootwait quiet splash plymouth.ignore-serial-console

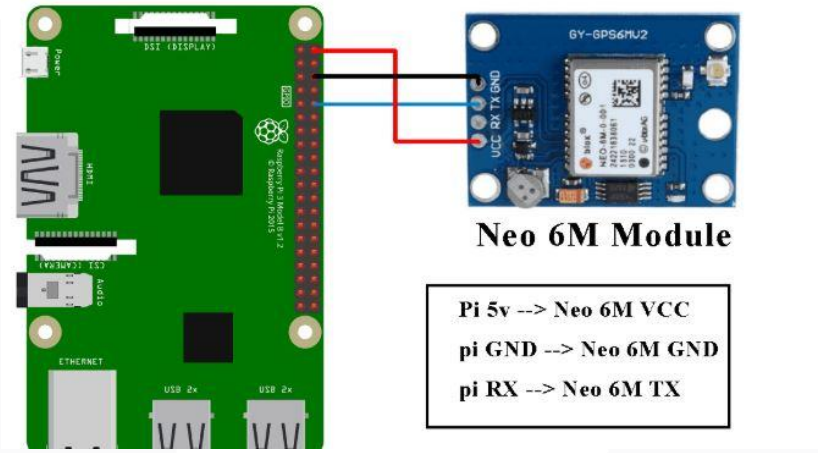


Figure 3.1 Dataset Training Results

Before write the python code to get the GPS data it needs to set up a few things. Default Raspberry Pi uses the serial port for this “console” login. To use the serial port to get data from the GPS module it needs to disable the console login. There are two serial ports in Raspberry pi 3: serial 0 and serial 1. between those serial port will point to GPIO pins 14 and 15, it has to use serial 0.

3.2 Modem Configuration On Raspberry Pi 3

Modem is a media communication system that is used to connect the GPS mod-ule on the Internet so that it can transmit coordinate data to the Cloud Server. Con-figuring a modem on

a Raspberry Pi 3 relies on the ISP and what modem is used,each ISP has a configuration difference. The first step required is to check whattype of modem to use and look for references to the USB port of Raspberry Pi 3available for the modem used and activate the modem inside the port of RaspberryPi 3. Create a custom config file for ”usb_modeswitch” on the Raspberry Pi. Extractsome more information for ”usb_modeswitch” config file so that it can available todo the switching manually. Replace the extract codes on the terminal window into:

1. tar -xzvf /usr/share/usb_modeswitch/configPack.tar.gz 19d2/:2000
2. Open “/etc/usb_modeswitch.conf “ file add the information that obtained and type “sudo leafpad /etc/wvdial.conf” to write the wvdial config file preview in figure 3.6 and connect to the internet with command wvdial “3gconnect”

```
Init1 = ATZ
Init2 = ATQ0 V1 E1 S0=0 &C1 &D2 +FCLASS=0
Init3 = AT+CGDCONT=1,"IP","internet"
Stupid Mode = 1
Modem Type = Analog Modem
ISDN = 0
Phone = *0853...#
Modem = /dev/gsmmodem
Username = { }
Password = { }
Baud = 460800
```

Figure 3.2 Wvdial Configuration.

3.3 Merging All Configuration

All configurations need to be merged in case of completing the project to run, on the 3.4 image link URL of Firebase listed, it is a project that is initialized directly from the website. Using a Python library makes the configuration implemented automatically. So to send any real-time data from a GPS Neo-6M to Firebase is simply called so all processes are done simultaneously. The serial library is a library of GPS modules with serial communication type, string library is a library for variables that are called or given information, pynmea2 library is a library whose function is to parse data (to divide), JSON library is a library of data exchange between Raspberry Pi and Firebase, and the OS library isa library for calling functions called ’os’.

```
 GNU nano 3.2                                                    gpsmark3.py

import serial
import time
import datetime
import string
import pynmea2
import json
from firebase import firebase
import os

Cmd1 = 'sudo wvdial telkomsel'
Cmd2 = 'sudo route add default dev ppp0'
time.sleep(20)
os.system(Cmd1)
time.sleep(5)
os.system(Cmd2)
time.sleep(5)


firebase = firebase.FirebaseApplication('https://gpstracker-172ed.firebaseio.com/', None)

while True:
    port="/dev/ttyAMA0"
    ser=serial.Serial(port, baudrate=9600, timeout=0.5)
    dataout = pynmea2.NMEAStreamReader()
    newdata=ser.readline()

    if newdata[0:6] == "$GPRMC":
        newmsg=pynmea2.parse(newdata)
        lat=newmsg.latitude
        lng=newmsg.longitude
        unixtime=time.time()
        #unixtime=unixtime+25200
        x =  { "lat": float("%.6f" %lat),
               "lng": float("%.6f" %lng),
               "time": int(unixtime)}
        print(x)
        firebase.post('location', x)

        time.sleep(30)
```

Figure 3.3 Merging Configuration.

3.4 Accuracy Result

The shift that occurs when the GPS module sends the data Coordinate it issmaller due to the data transmission that continues to occur after a 1-second op-eration of the program. It can be seen in Figure 3.3 shifts that occur is below 100 meter although the speed of the vehicle touches 80 km/h. It can be expressed forhigh speed and with the interval of data transmission in 1-second, the accuracy that can be by Neo-6M including high.

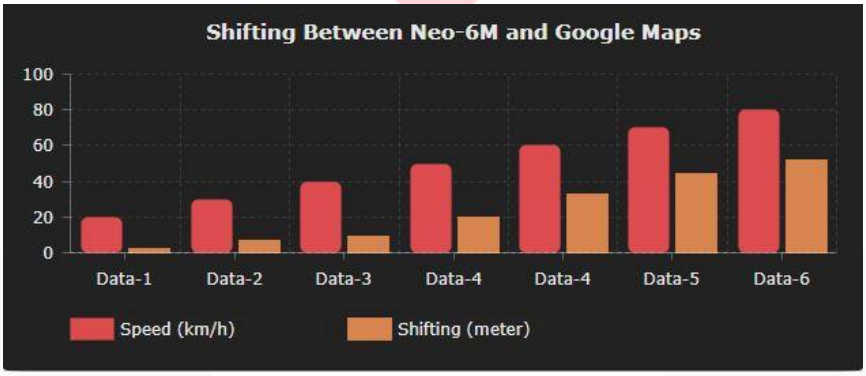


Figure 3.3 Accuracy Graphic.

4. Conclusion

From the test results of the data transmission system from GPS module whichis integrated with Raspberry Pi to the IoT platform that has been done at this under-graduate thesis, obtained a few conclusions as follows:

1. To obtain the location of a device is done by utilizing the Neo-6m GPS mod-ule that serves to obtain a coordinate point that is integrated with the Rasp-berry Pi as a data processor.
2. API obtained from Firebase is directly encoded on the back-end website sothat sending and retrieving data between the GPS module and Raspberry Pican be connected to the IoT platform so that maps visualization can be done.
3. To obtain accuracy data, the modem is required to be connected to a Rasp-berry Pi USB port-1 whose program has been configured, so that the GPSmodule can send and receive coordinates obtained from the antenna (the co-ordinate number is not 0).
4. The configuration is made as well as back-end and front-end on the websitevisualization so that the data in the database is continuously updated automat-ically on the website so that it can be visualized on the website frontend.

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