

GPS DEVICES

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ABSTRACT

The Global Positioning System (GPS) is a Global Satellite Navigation System. A network of satellites that continuously transmit coded information in the form of signals, which makes it possible to precisely identify a location (latitude, longitude, altitude) on the earth by measuring distance from the satellites with the help of GPS receivers. In this Project we are going to develop interactive Software integrating speech recognition and speech synthesis. It will have in build information about the map of the place will guide a person displaying his current location with respect to the map. It will guide a person to reach the destination from a place (source) in the shortest path along the roads in the right direction with the help of voice. In this project we are using Dijkstra's shortest path algorithm to implement this shortest path [cas, ewwa]. Garmin USB 18 GPS receiver is used for this purpose which on integration with Franson GpsGate produces the data in the Standard NMEA 0183 proprietary format [apr, ino] and dumps the output into the virtual ports created by the GpsGate. Java API listens to the virtual ports created by the GpsGate to get input data (latitude, longitude) from it. In this project we are going to develop a software, by generating a partial map of IIS campus, including speech synthesis and speech recognition to guide a person from a point (source) to the destination along the road with the help of that software.

1. INTRODUCTION

There are two major satellite navigation systems in the world. First one is GPS and the second is GLONASS.

The Global Positioning System (GPS) is a Global Navigation Satellite System (GNSS) developed by the United States Department of Defense. It uses a constellation of between 24 and 32 Medium Earth Orbit satellites that transmit precise microwave signals that enable GPS receivers to determine their current location, the time, and their velocity. Its official name is NAVSTAR-GPS [ceg, ewwb].

The Global Navigation Satellite System (GLONASS) is based on a constellation of active satellites. The system is a counterpart to the United States Global Positioning System (GPS) and both systems share the same principles in the data transmission and positioning methods. GLONASS is managed for the Russian Federation Government by the Russian Space Forces [enw].

Similar satellite navigation systems include the upcoming European Galileo positioning system, the proposed COMPASS navigation system of China, IRNSS of India, and DORIS of France [ceg, ewwb].

Motivation and problem definition

Now a day's research is going on implementing software's for Devices like Garmin GPS devices, Magellan GPS devices, Tremble GPS devices for better user friendly to use in various fields given in section 2.7. So we are interested in implementing a software integrating with speech processing and speech synthesis, which guides a person in the correct path to reach destination place from a place(source) in a particular area or map(as given in the abstract)using dijkstra s shortest path algorithm.

In this project we gave a brief explanation about how the GPS works and what are the errors in the GPS signals and techniques used in improving the accuracy and the protocol architecture of Garmin GPS 18 receiver [ggi06]. And also explained the ways of getting data from the Garmin GPS 18 receiver and how to check its accuracy and software implementation algorithm to follow the shortest path from the source to the destination in the given map or specific area. Here we are taking IIS campus as the map. All the figures are placed in the appropriate places.

2. LITERATURE SURVEY

2.1 Working of GPS

The current GPS consists of three major segments. These are the space segment (SS), a control segment (CS), and a user segment (US).

2.1.1 Space segment

The space segment (SS) comprises the orbiting GPS satellites or Space Vehicles (SV) in GPS parlance. The GPS design originally called for 24 SVs, eight each in three circular orbital planes, but this was modified to six planes with four satellites each. The orbital planes are centered on the Earth, not rotating with respect to the distant stars. The six planes have approximately 55 ° inclination (tilt relative to Earth's equator) and are separated by 60 ° right ascension of the ascending node (angle along the equator from a reference point to the orbit's intersection). The orbits are arranged so that at least six satellites are always within line of sight from almost everywhere on Earth's surface.

GPS Signal

Each satellite transmits low power radio signals on several frequencies (designated L1, L2, etc.). Civilian GPS receivers listen on the L1 frequency of 1575.42MHz in the UHF band. L2 with 1.2276 GHz frequency and is used in the military purpose as it contains protected code. The signal travels line of sight, means it will pass through the clouds, glass and plastic, but will not go through most solid objects such as buildings and mountains.

2.1.2 Control Segment

The control segment controls the GPS satellites by tracking them and then providing them with corrected orbit and clock information.

2.1.3 User segment

User segment simply the GPS receiver.

2.2 How to determine the location?

Every satellite contains the information about its position and speed and its sensing range. A GPS receiver estimates its distance from the satellites by the signal that it receiving. At the same time receiver assumes as its current position is located on the surface of sphere centered at the satellite. There are several spheres one for each satellite. The receiver position is the place where these spheres intersect.

2.3 How the signal is timed?

Every GPS satellite has atomic clocks. The signal that is coming out is random sequence; each part of this is different from every other, called pseudo random code. This random sequence is repeated continuously. All GPS receivers know this sequence and repeat it internally. Therefore, satellites and the receivers must be in synch. The receiver picks up the satellites transmission and compares the incoming signal to its own internal signal. By comparing how much the satellite signal is lagging, is the travel time. If we multiply this time with the light speed we will get the distance from the satellite.

2.4 Sources of GPS signal errors

Factors that can degrade the GPS signal and thus accuracy are: 1.Ionosphere and troposphere delays 2.signal multipath3.Receiver clock errors 4.Number of satellites visible 5. Satellite geometry/shading 6.Intentional degradation of the satellite signal [Cor00].

2.5 Techniques used to improve accuracy

As mentioned above certain atmospheric factors and other sources of error can affect the accuracy of GPS receivers. DGPS (Differential Global Positioning Service) is a navigational system using the GPS system of satellites that circle the earth plus ground stations with limited signal range. The combination provides greater accuracy than GPS alone. DGPS requires receivers for both GPS and DGPS signals. Garmin GPS receivers are accurate to within 15 meters on average. Users can

also get better accuracy with Differential GPS (DGPS), which corrects GPS signals to within an average of three to five meters [Cor00]. Newer Garmin GPS receivers with WAAS (Wide Area Augmentation System) capability can improve accuracy to less than three meters on average. Wide Area Augmentation System, or WAAS, is a new satellite-based navigation system built by the U.S. government (FAA) for boating and supplementary navigation for aircraft. Other countries are developing compatible systems: the Japanese Multi-functional Satellite Augmentation System (MSAS), and the Euro Geostationary Navigation Overlay Service (EGNOS). Eventually, GPS users around the world will be able to get accurate position data using similar systems.

2.6 NMEA

2.6.1 NMEA standard

NMEA stands for “national Marine Electronics Association” is an association dedicated to the education and advancement of the marine electronic industry and the market which it serves.

2.6.2 NMEA0183 Standard sentence format

These sentences start with a dollar sign. The NMEA 0183 standard sentence formats received by Garmin USB 18 is given below:

GGA- Global Positioning System Fix Data

GLL-Geographic Position, Latitude / Longitude and time

RMC-Recommended minimum specific GPS/Transit data

VTG-Track Made Good and Ground Speed

GSA- GPS DOP and active satellites

GSV-GPS Satellites in view

2.7 GPS Applications

Nowadays GPS is used in many fields like Timing, Roads and highways, space, aviation, agriculture, marine, railways, environment, public safety and disaster relief, surveying and mapping, recreation

2.8 GPS Receiver

2.8.1 Garmin USB 18

In this project we used Garmin USB 18. It is a 12 parallel channel, WASS enabled GPS receiver in USB 2.0 full speed version. This type of Garmin USB 18 produces the data in Garmin propriety format [gpr]. It comes with nonvolatile memory for storage of configuration information, a real time clock and a raw measurement output data. This version compatible with USB1.1 full speed version hosts. The output data which is in the Garmin propriety format can be converted in to NMEA 0183 format with help of Franson GPS Gate software [AB].

2.8.2 Gramin Device Interface

The protocols which are used in the Garmin Device Interface are arranged in the following three layers:

1. Application layer(highest)
2. Link layer
3. Physical layer(lowest)

2.8.3 Physical Layer

The Physical layer is based on RS-232. Two types of protocols are used in Garmin USB 18 .One is serial protocol and other one is USB protocol [ggi06].

Serial Protocol details

The Serial Protocol is based on RS-232. The voltage characteristics are compatible with most hosts however, the device transmits positive voltages only, whereas the RS-232 standard requires both positive and negative voltages. The other electrical characteristics are full duplex, serial data, 9600 baud, 8 data bits, no parity bits, and 1 stop bit [ggi06].

Serial Packet Format

All data is transferred in byte-oriented packets. A packet contains a three-byte header (DLE, ID, and Size), followed by a variable number of data bytes, and followed by a three-byte trailer (Checksum, DLE, and ETX).

Handshaking

A device that receives a data packet must send an ACK or NAK packet to the transmitting device to indicate whether or not the data packet was successfully received. Normally, the transmitting device does not send any additional packets until an ACK or NAK is received (this is sometimes referred to as a stop and wait protocol) [ggi06].

USB Protocol

This protocol provides a mechanism for using the link and application layer protocols over USB [ggi06].

3. RELATED WORK DONE

We can extract data from GPS in many ways. For extracting data from Garmin GPS 18 we used software called Franson GPS Gate which also converts the data in the NMEA format and make it available in list of virtual ports and also can record the data in a file using NMEA file Recorder as the output. We can also extract data directly from the USB port.

3.1 Working of GPS receiver

Franson GpsGate

Franson GpsGate is compatible with all latest versions of windows. It supports NMEA and it takes the Garmin USB as the input and converts the output of the Garmin USB 18 GPS from the Garmin propriety format to the NMEA standard format. These out puts the available at the virtual serial ports created for GPS enabled application. And these virtual serial ports support NMEA. So, it enables to share a single GPS among several devices [AB].The Figure given below shows how the virtual ports are used for mapping and customizing and GIS(geographical information system).We used this Franson GpsGate for recoding the data. Franson GPS Gate takes Garmin USB as the input and the output is set as File Recorder/ NMEA filter. The data coming from the GPS receiver is recorded in a file. It contains 6 types of NMEA format sentences of data. From that we extracted a single type of sentence " \$GPGLL" using a C++ program. The output is shown in Figure 1. This data contains the latitude, longitude and altitude and some information about satellite. From this only the latitude and longitude data is extracted and kept the values in excelsheet.

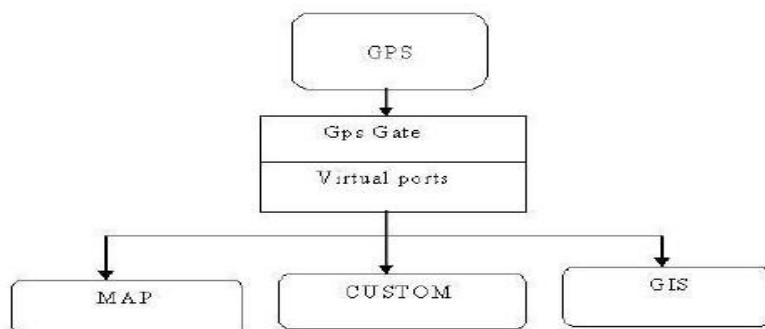


Figure 1: Franson GpsGate

That graph has shown the route or path in which we traveled as shown in Figure 2 and Figure 3.

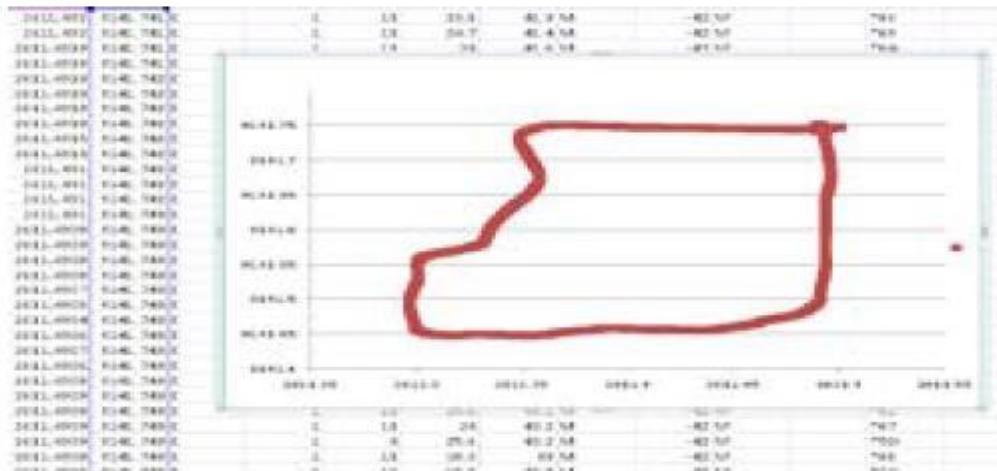


Figure 2: Excel graph

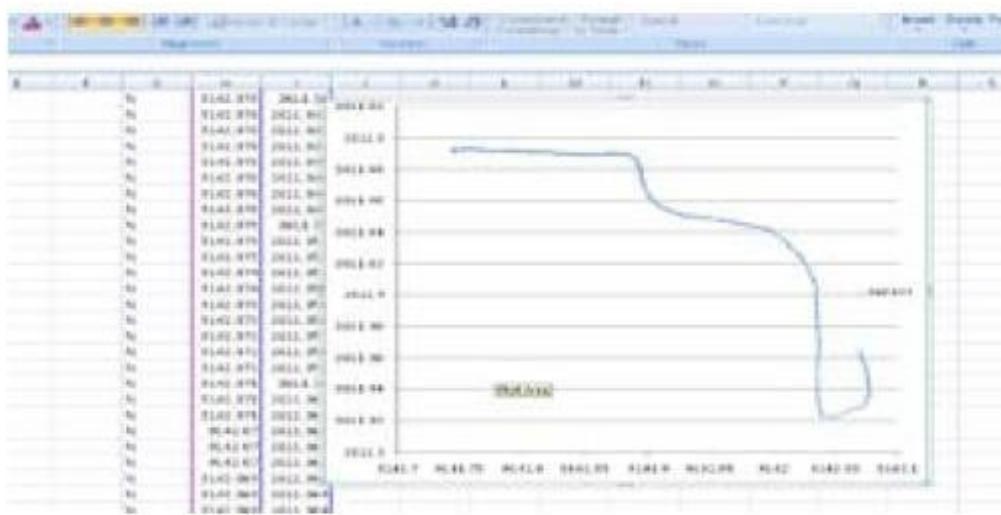


Figure 3: Excel Graph

This API listens to the virtual serial ports created by Franson GPS Gate and fetches the instructions. Then it reads the NMEA sentences and filters out the latitude and longitude in to a file.

3.2 Implementation of algorithm

In this project we have to implement software that will find the shortest path from a point (source) to the other point (destination) and to follow that shortest path from the point (source) to the destination. We are using Dijkstra's shortest path algorithm. Dijkstra's algorithm solves the single-source shortest-path problem when all edges have non-negative weights. Algorithm starts at the

source vertex, s , it grows a tree, T , that ultimately spans all vertices reachable from S . Vertices are added to T in order of distance i.e., first S , then the vertex closest to S , then the next closest, and so on. Following implementation assumes that graph G is represented by adjacency lists. Here we are considering the selected waypoints as the vertices of the graph. The waypoints are selected in such a way that where ever a comparable turn comes that point is taken as the waypoint as shown in the figures.

The algorithm follows Dijkstra's shortest path algorithm until it finds a vertex with destination vertex. Once it finds the destination vertex while executing the Dijkstra's algorithm then it will break from the loop. Then it saves the previous vertex list of the destination vertex. This previous vertex list shows the shortest path. This previous vertices list is saved in an array. From this array the first two vertices are taken out and initialized as the Start and End vertices. The line L is the line formed by these two vertices. Let us say S_1 is the point on the path. D_1 is the distance from the point S_1 to the line L . This D_1 is used to check whether the point S_1 is inside the road or outside the road. $D_{[k]}$ is the distance between S_1 and the End point. This is used to check whether we are moving in the right direction or not. And also used to check whether we reached the end point or not. If we reach the end point then $D_{[k]}$ must be less than M where M is some constant and radius of the circle near the End point. After we reached the end point then we have to change the End point as the Start point and incrementing the End point by one. It goes until we reached the destination.

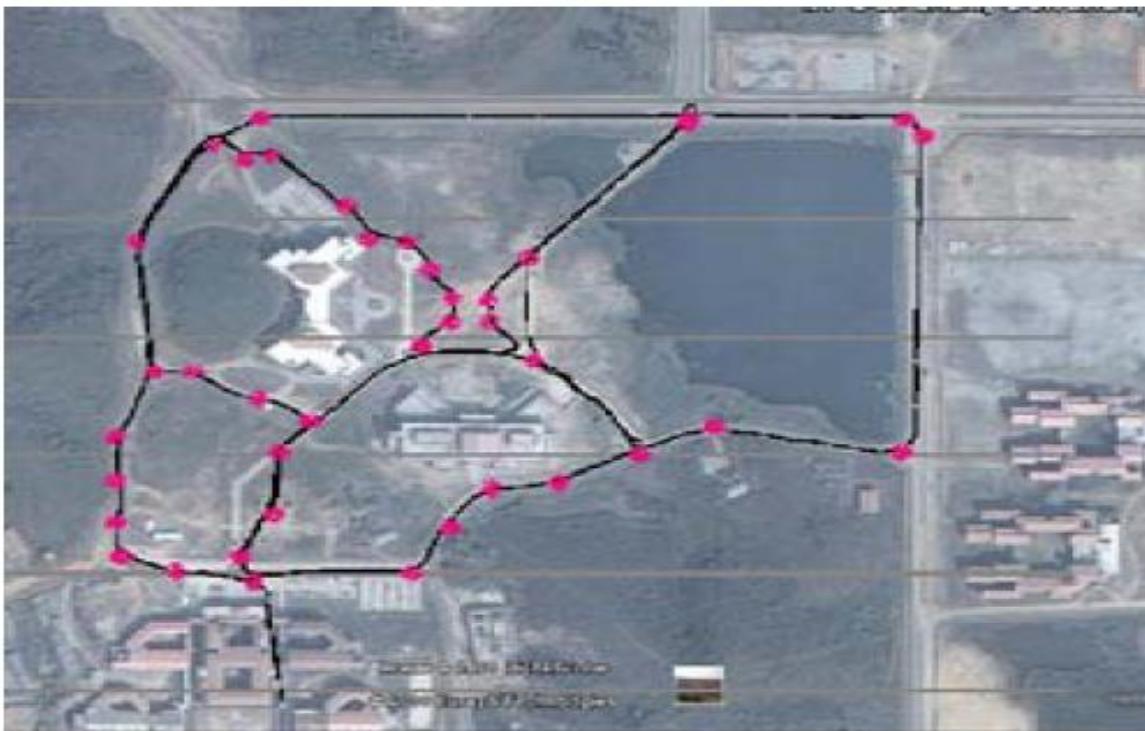


Figure 4: Selecting Way point

4. FUTURE WORK AND CONCLUSION

We have to implement software using the above proposed algorithm integrating the speech processing and synthesis to it. The software should guide a person in such a way that he should go in the shortest path among many paths in the map to reach the destination. It should tell messages if he is moving in the wrong path or outside the road. It should also show the direction in which he has to move to go in the correct path. For this we have to implement the above proposed algorithm taking some of the waypoints as the vertices in of the graph. And also we should include some recorded sounds to interact with the user or the person. We have to make the software such a way that it should work on anyplace if change the waypoints.

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