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Simple Implementaion of GPS in tracker location history recorder for moving vechiles

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Abstract— Normally the output data from GPS can be displayed instantaneously, the only equipment which can record these data and give a history track for location is Voyage Data Recorder (VDR). The VDR is interfaced with the GPS through National Maritime Electronic Association (NMEA) interface. In this research we will record the track position for moving object like ship, car or train, then after certain period of time we retrieve these data and use it for different purposes as data analysis for the path of the journey .Electronic circuit is designed to record GPS position coordinates, this enable marine officers to analyze and track their voyage at any time, and these data can be use as track history for the journey. The designed system simply use microcontroller PIC 16f877A with simple multimedia card that can save coordinates and extract information directly without need to external complex programs.

Index Terms— Microcontroller**, GPS, MMC, Circuit design, tracking, VDR, Data recording**

1 Introduction

The GPS system is officially known as the NAVSTAR System (Navigation Satellite Timing and Ranging). Its primary mission is to determine the position with certain accurately at any point on the earth's surface, at any time or weather condition [1][2]. As originally envisioned, a minimum constellation of 24 satellites in the US system would be required to meet the objectives of the GPS program,. GPS receiver calculates its position by precisely timing the signals sent by at least four GPS satellites high above the Earth. Each satellite continually transmits messages that include: The time of the message transmitted, and satellite position at that time of message transmission. The receiver uses these received messages to determine and computes the distance to each satellite using the speed of light. Each of these distances and satellites' locations defines a sphere [3]

In the 1960s, the Global Positioning System emerged as a radical new way to provide precise navigation for U.S. armed forces across the globe. Early work at The Aerospace Corporation helped get the program off the ground [5].

The International Civil Aviation Organization (ICAO) defines the Global Navigation Satellite System (GNSS) as a worldwide position and time determination system that includes one or more satellite constellations, aircraft receivers and system integrity monitoring, augmented as necessary to support the required navigation performance for the intended operation [6]. Triple deference observable bias parameters which are constant with time may be eliminated by forming the between-epoch difference. The operator represents this difference, and is applied to double-difference observables to obtain the triple-difference observables [7].

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Other studies using GPS data have placed far more stringent limits than we use here. But our goal here is not to set the most stringent limit on possible variations in the speed of light, but rather to determine what the maximum possible variation that can remain consistent with the data. The GPS operates by sending atomic clock signals from orbital altitudes to the ground. This takes a mere 0.08 seconds from our human perspective, but a very long (although equivalent) 80,000,000 ns from the perspective of an atomic clock. Because of this precision, the system has shown that the speed of radio signals is the same from all satellites to all ground stations at all times of day and in all directions to within ±12 meters per second (m/s). The same numerical value for the speed of light works equally well at any season of the year [8].

Date and time, are obtained from an external GPS navigator referenced to UTC. Time information is recorded at intervals of 1s. Latitude, longitude and datum are obtained from a GPS navigator, Loran-C receiver or other inertial navigation system or other available on standard digital interface. The source of data is identifiable on playback. As shown in equation 1

$$P_{ji}= [(xi-xj)^{2}+ (yi-yj)^{2}+(zi-zj)^{2}]^{1/2} \quad (1)$$

Where P: geometric range xi, yi, zi are coordinates of satellite I, xj, yj, zj are coordinates of site J. Speed, whether through the water (STW) or speed over the ground (SOG) is recorded at intervals of 1 s, with resolution 0.1 knot.

Common view GPS time transfer is an approach that builds and improves on the one-way technique. This technique allows the direct comparison of two clocks at remote locations. In this technique, two stations, A and B, receive a one-way signal simultaneously from a single transmitter and measure the time difference between this received signal and their own local clock. The data are then exchanged between stations A and B using any convenient method (email, FTP, etc.).

The time difference between clocks A and B is calculated by

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taking the difference between simultaneous R - A and R - B clock difference measurements. If the travel times to the receivers are exactly equal, then the two receivers can synchronize their clocks with an accuracy that does not depend on the characteristics of the transmitter or the transmission medium. Fluctuations in the delays between the single transmitter and the two receivers also cancel exactly if they are completely correlated. This ideal situation cannot be realized in practice, but the method works well even if the two paths are not exactly equal, provided that they are nearly equal and that fluctuations in the two delays are highly correlated. Since the path delay is usually affected by various environmental parameters (such as ambient temperature), the common-view method generally works best if the distance between the receiver stations (the baseline) is small relative to the distance between either receiver and the transmitter. This geometry tends to ensure that the delay fluctuations caused by the atmosphere for example in the two paths will be highly correlated. One disadvantage of the common-view technique is that a means of exchanging data between the two stations must be available [10].

The Commission tentatively concludes to add primary Fixed and Mobile allocations to the 2000-2020 MHz and 2180-2200 MHz bands. This allocation will be co-primary with the existing mobile-satellite allocation for these bands. Currently, the 1980-2010 MHz band is allocated to Fixed, Mobile, and Mobile-Satellite (Earth-to-space) on a primary basis while the 2170-2200 MHz band is allocated to the Fixed, Mobile, and Mobile-Satellite (space-to-Earth) on a primary basis in the international table for all regions. The 2010-2025 MHz band is allocated to Fixed, Mobile, and Mobile-Satellite (Earth-to-space) on a primary basis in Region 2 (North and South America) and to Fixed and Mobile on a primary basis in other regions [9].

2. DATA ACQUSISITION SYSTEM

National Marine Electronics Association (NMEA) has developed a specification that defines the interface between various pieces of marine electronic equipment [4]. The standard permits marine electronics to send information to computers and to other marine equipment. The hardware interface for GPS units is designed to meet the NMEA requirements. They are also compatible with most computer serial ports using RS232 protocols, however strictly speaking the NMEA standard is not RS232. They recommend conformance to EIA-422 as shown in figure 1

Figure 1 Serial RS232

Electronic circuits are designed to integrate NMEA 0183 that include latitude and longitude with multimedia card (MMC) in one system used to extract data. The system consists of two parts:

Part I: power supply design system for microcontroller system.

Part II: microcontroller pic 16f877A that take the data from real time GPS system and extract the latitude and latitude from GPS's output NMEA 0183 data stream and save it to MMC card that attached directly to microcontroller system

3. SYSTEM DESIGN

-SD card module that enable the user to save data in selective two formats (.txt or .log) and analysis the output data by any data representation like excel. The SD card is shown in figure 2. Total electronic circuit is designed by using Proteus software and arranged power supply and microcontroller circuit with MMC as shown in figure 5.

Fig.2 SD card

Fig.3 GPS Furno GP33 with NMEA 0183 output connector

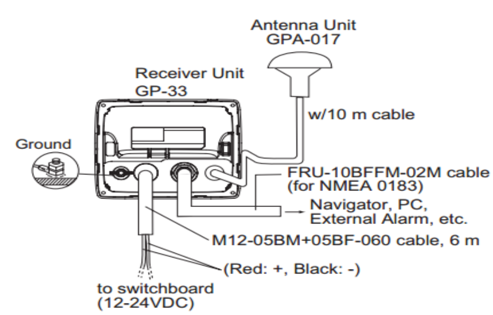

Fig. 4 GPS Connection

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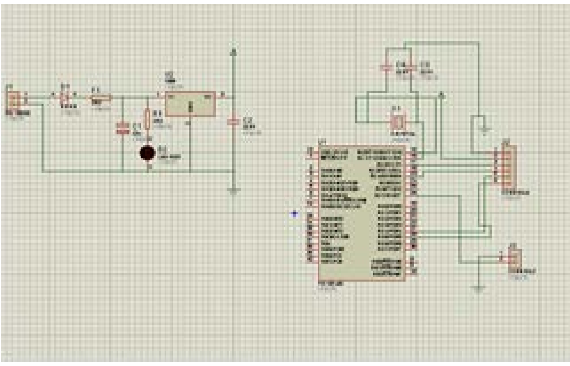


Fig 5 Circuit Schematic

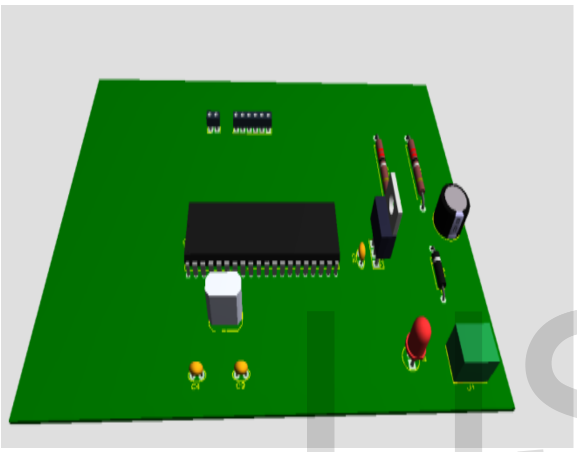


Fig 6 Circuit Layout

The electronic circuit board is shown in figure 6, 3D visualization to present the board is shown in figs. 7 (a) and (b)

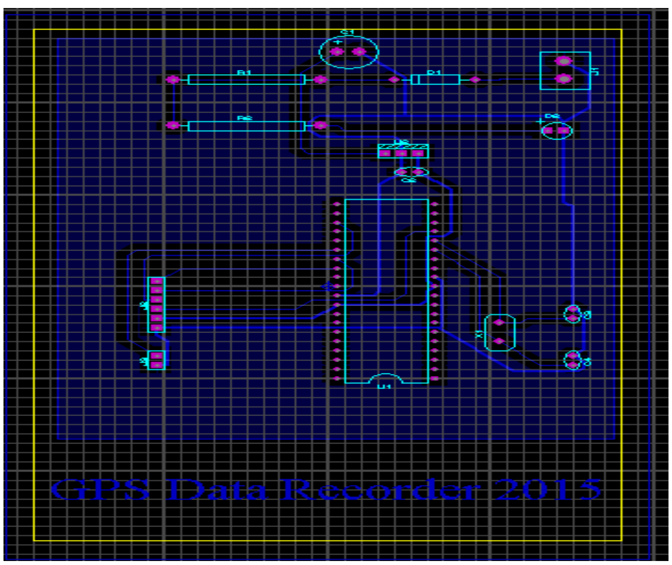
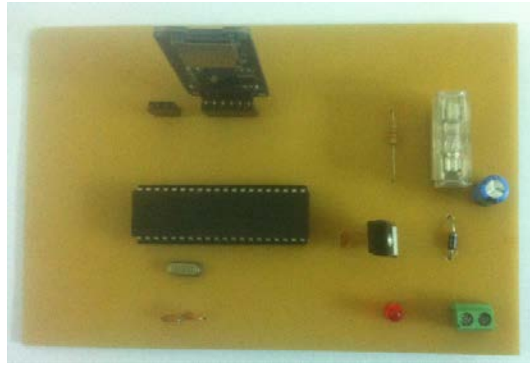


Fig .7 3D visualization upper and lower view



4. The output of GPS and MMC card

By using investigation area for tracking as shown in figure 8 we will apply the experimental trial.

Fig.8 Investigation Area

By using GPS Data with portable SD card we can obtain analysis data as shown in figure 9.

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31.205139,29.914591
31.205534,29.914398
31.205965,29.914184
31.206332,29.914023
31.206855,29.913765
31.207489,29.913497
31.20814,29.913186
31.208837,29.912864
31.209553,29.912542
31.210306,29.91222
31.210553,29.912574
31.210709,29.912843
31.210875,29.913218
31.210985,29.913443
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Figure 9 Serial GPS Data

From above serial data it is easy to analysis this data and make a relationship curve between LAT and LONG as shown in figure 10.

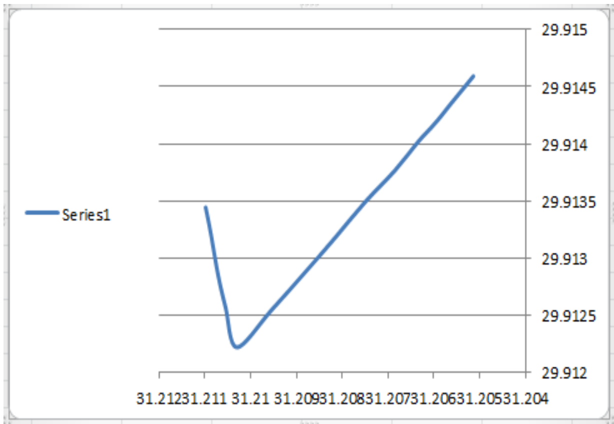

Fig.10. GPS data

5. Conclusion

GPS data recorder circuit has been built for data acquisition from GPS devices. The designed system based on microcontrollers (PIC 16F877), multimedia card MMC. All experimental data and control by software are tested in real environment, performed in a fully automated computer display and analysis of each sensor has been done. The real obtained data has been displayed on a computer station and verified. The system allows retrieving the history data stamped by time. The cost is relatively cheap compared to similar systems.

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