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Global Positioning System Using Mobile Phones: Three-Dimensional Positioning

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ABSTRACT

Mobile devices such as cell phones are one of the most used technology nowadays. It can perform any feature that can be useful in everyday life. This paper showsdevices. Digital communication is one of the concepts that is applied in this research such as database monitoring and data transfer.

Key words : global positioning system, digital communication, database monitoring, data transfer.

1. INTRODUCTION

One of the most advanced technology today is the Global Positioning System or GPS. Global Positioning System is a satellite-based radio system. Satellite operation is managed by the government which makes it free for anyone to use its GPS satellites. It is used primarily to navigate, and provide accurate location, position, and velocity to any GPS-equipped user around the world [1]. Various fields and professions use technologies that features global positioning systems. Agriculture technology, environmental science, marine technology, and surveying technology are examples of fields that use global positioning systems for their respective purposes [2]. Global Positioning System technology has been developed to be used in different applications. Applications include Telecommunications, Aviation, Robotics, and more. Today, Global Positioning System is available to civilians in various technologies. GPS are available in car navigation systems, mobile GPS handsets, and the most common application for GPS in today's advanced technology, mobile phones. The number of GPS users has increased because of its wide applications such as mobile GPS systems [3].

Modern mobile phones are mobile devices designed to operate faster and have more storage. Modern phones are also built to have wider screens with high quality resolution and functions as a touch screen. These phones are also capable of connecting to networks such as WiFi and Bluetooth connections. Another advancement in modern mobile phones is its ability to operate navigation systems such as the Global Positioning System, or GPS. It is common among modern mobile phones to feature a navigation system for applications such as phone-tracking, pathfinders, and positional location [4].

Three-dimensional simulation of satellite navigation is a whole different system of engineering of its own. It is necessary to analyze the space circular formation dynamics model to perform the three dimensional of satellite formation. This type of navigation is a simpler process but is relatively less accurate. The simulation is capable of providing reliable technical basis and test test data for spacecraft information technology and spacecraft rendezvous technology. The three dimensional simulation can be used for orbit monitoring and control [5].

2. BACKGROUND OF THE STUDY

Telecommunication systems have emerged throughout the world and it is considered as the most widely used technology which is why is necessary to learn digital communications. Signal generated by the source is in analog form which then converted to digital form before being transmitted. Digital communication systems is technology used to transmit data from sampled signals [6]. The data from sampling is converted to binary signals. Afterwhich, the binary signal is modulated and transmitted. The bit stream algorithm is usually based on chaotic number generation. Digital communication systems are represented in mathematical models. Physical transmission models have their respective mathematical models [7].

WiFi is a wireless technology which stands for IEEE 802.11x. Typically, WiFi for short range communication. It is used for environments such as offices and houses which are ideal for the short-range connectivity of Wi-Fi. It functions as a network to interconnect computers, mobile devices and other devices that is capable of connecting to the Wi-Fi network. Devices connected to the wireless network through an access point or wireless adaptors. Through this wireless medium, users can access the network to share network sources [8].

3. STATEMENT OF THE PROBLEM

Various applications of global positioning systems require different parameters or methods in order to perform proper navigation or positioning. for example, in urban areas, it is required to have at least four satellites in order to determine the positional state of the GPS receiver [9]. This is because the signals from the satellites are interfered by infrastructures from reaching the GPS receiver. This research aims to provide a three-dimensional position navigator that overcomes the problem of a four-satellite minimum [10].

4. SIGNIFICANCE OF THE STUDY

Internet is one of the technologies that is easily accessible today. People can use internet on many things. It can be for leisure or technical purposes. This paper focuses on the technical purpose of using internet. GPS is beneficial to the user and to the provider in many ways. Economically, this technology is cheap as it only requires one mobile device and software tools in order to develop. It does not require external or internal hardware for this technology [11]. The operation of this technology is feasible as it only requires an internet connection which it is easily accessible. Operational and maintenance cost is also low for this technology [12].

With these features for this technology, users can use this with ease. It can be downloadable in their specific application stores or it can be a built-in application [13]. They can use this for numerous purposes such as location detection. As for the provider, the cost of this system is low and expenses are not heavy as it only focuses on improving or maintaining the application.

5. DESCRIPTION OF THE SYSTEM

The GPS navigation system consists of a receiver and at least 3 GPS satellites. Each GPS satellite emits 2 bitstreams modulated at 1.57542 GHz and 1.2276 GHz for L1 and L2 respectively [14]. These bit streams are encoded in a direct sequence spread spectrum scheme by a pseudo-random chipping code at 1.023 million chips per second. Each satellites bit streams are demodulated and decoded to form the inputs for the trilateration function in the GPS receiver module [16]. Here the location of the 3 satellites are taken along with their respective distance from the receiver, and via trilateration the location of the receiver can be deduced.

6. METHODOLOGY

The implementation of the GPS receiver is fairly simple. The receiver module is composed of an antenna for receiving GPS satellite transmissions, a despreader circuit for retrieving the DSSS spread original signal, and a demodulator for retrieving binary data from the transmitted signal [15]. The trilateration algorithm can be handled by the mobile device itself using simple geometry based calculations. The trilateration algorithm works by getting the intersection point of 3 spheres centered satellites location, and its instantaneous distance with respect to the receiver. With this information and geometric solution, the location of the GPS device can be taken [17].

7. REVIEW OF RELATED LITERATURE

GPS-based Location Tracking System via Android Device is a journal article conducted by Palash Uddin, Zahidul Islam, and Nadim. The objective of this paper is to apply location detection using global positioning system on android device. Calculating from one location to another is the goal of the paper. The paper used the implementation of several programming languages such as Java, HTML, and Javascript. They used CSS, XML, and PHP as supporting tools. The goal of this paper is the create a design that is feasible economically and operationally. Since internet is easily accessible nowadays, the researchers took an advantage to design a program with the implementation of internet [18].

Development of navigation system for the blind using GPS and mobile phone combination is a journal article conducted by H. Makino, I. Ishii, & M. Nakashizuka. This paper focuses on creating a GPS based application on mobile devices that is beneficial to people with visual disability. This system involves a combination of microcomputer and speech synthesizer in order to create a communication between the device and its user. The system is using Differential global positioning system with FM correction data in order to detect the user's location. With this feature, DGPS is the solution of this study. This study is beneficial to the user as it does not require other people's assistance [19].

GPS mobile phone-based activity diary survey is a research article developed by N. Ohmori, M. Nakazato, & N. Harata. The paper mainly focuses on applying GPS on mobile device for activity diary survey. This paper applied data collection which is applicable in this research article and requires programming. The programming language that the researchers used is Java which is common of all programming languages. This paper was developed as an intelligent survey method for harnessing activity diary data which it became efficient. Data handling time was reduced in this study and frequency of data is large which it can be an advantage for flexibility in space for recording data [20].

Designing a positioning system for finding things and people indoors is a journal article that is conducted by J. Werb and C. Lanzl. The paper focuses mainly on tracking small physical objects or people in a small area specifically inside a building using global positioning system. This system implemented a concept of filtering of signals which is applicable in this technology as it requires wireless communication [21].

Airborne imaging system using global positioning system and inertial measurement unit data is a patent article conducted by J. E. Kain, & C. Yates. This paper focuses on implementation of data utilization that can access high speed data using wireless links on wireless access unit (WAU). This paper applied digital communications concepts and it is one of the foundations of numerous digital communications principles and application [22].

E. Almanza, M. Jerrett, G. Dunton, E. Seto, and M. A. Pentz conducted a research article titled "A study of community design, greenness, and physical activity in children using satellite, GPS and accelerometer data". This paper focuses on the relationship between greenness and physical activity of

children using satellite applications. One of the key methods of conducting this research is to gather data using image processing in satellite by using global positioning system. They used the concept of geocoding in order to process the terrain of the place. The researchers gather participants to provide data to themselves. They used data processing and merging. With this feature, digital communications system were used. This paper is beneficial as it can increase the awareness of safety for children [23].

M. A. Sturza. conducted a research article titled "GPS navigation using three satellites and a precise clock". The objective of this article is to require the user to navigate three satellites to resolve the 3 dimensional spatial position and time bias. The researcher conducted this article in order to improve its efficiency and time. This paper presents the formula of PDOP that consists of its components such as Horizontal DOP and Vertical DOP [24].

A. J. Van Dierendonck, P. Fenton, and T. Ford conducted a research titled "Theory and performance of narrow correlator spacing in a GPS receiver". The study focuses on performing narrow correlation spacing in global positioning system. The research article implemented a digital communication system concept such as delay locked loops (DLL) to satisfy the result of the output. With this feature, it can reduce errors of the output with the presence of noise and multipath. The advantage of this study is that the performance of the GPS receiver improved dramatically. This is because of the implementation of the correlator [25].

8. THEORETICAL CONSIDERATIONS

One-dimensional positioning is a type of global positioning system wherein there are one orbit satellite used. A clock is necessary for both the satellite and the receiving GPS for synchronization. The satellite transmits its current position and the current time as it orbits the Earth. The position sent by the satellite is a form of ''ephemeris constants'. Ephemeris constants indicate its specific equation of motion. It also allows its current time to be deduced to its current position. The satellite simply transmits its current time (t) and current position (x, y, z) to a stationary GPS receiver at a position X, Y, Z at the time $t + \Delta t$ [26].

Navigation include localization and tracking of mobile nodes, where mobile nodes deduce its positions from measurements and prior knowledge. Each mobile node determines its positional state from measurements with respect to fixed infrastructures or using inertial sensors for self-measurements. Mobile nodes for global positioning systems obtains its position from pseudorange measurements with respect to the position of multiple satellites. In the case of self-tracking GPS, each mobile node determines its position from its movement with respect to its inertial measurements [27].

9. DATA AND RESULTS

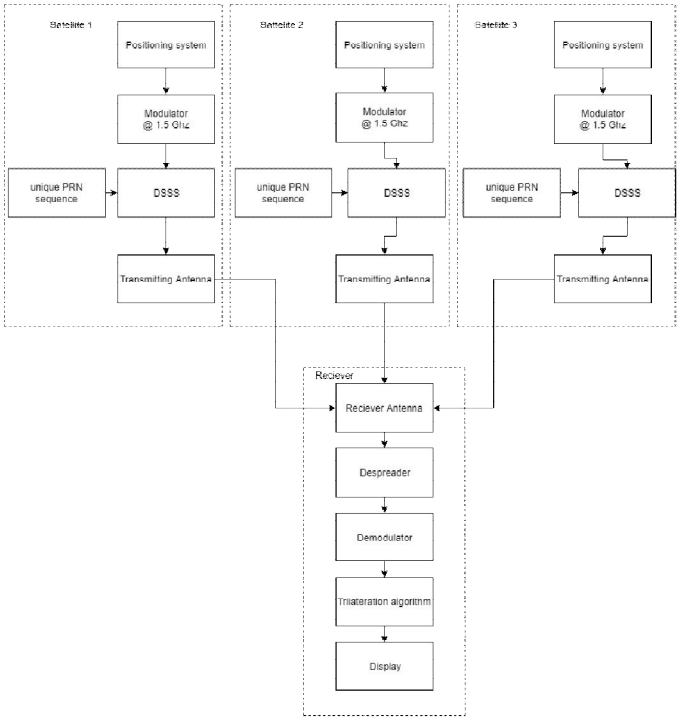

Figure 1: Satellite-Receiver Communication

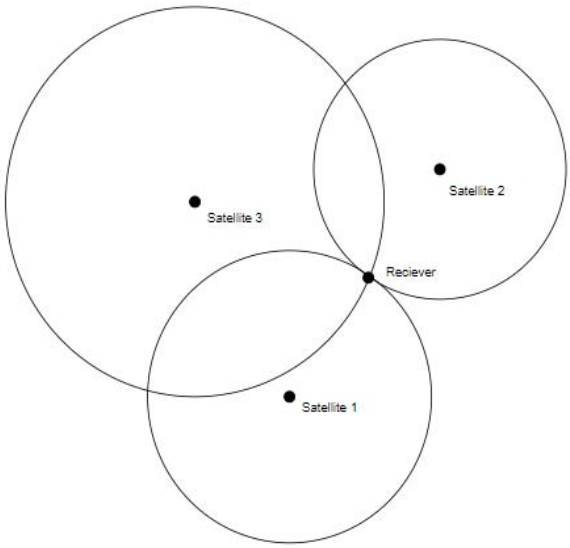

Figure 2: 2-Dimensional Trilateration

10. ANALYSIS OF DATA

The diagram shown above models the actual communication system used in the GPS satellite communications. Each satellite produces a unique positional vector along with its velocity and transmits this in a bit stream. the stream is then modulate by a 1.2 GHz carrier and spread with a Gold sequence PRN stream at 1.023 Gchips per second. The data is then taken by the receiver antenna, despread into each

corresponding satellite signal, and demodulated and decoded to take the actual positional data of each satellite [28]. Trilateration is then used to determine the position of the GPS receiver. The Diagram shown above shows a 2D top view of the trilateration theory wherein the intersection of 3 circles is the location of the GPS receiver, and the circle points are the absolute locations of the satellite at any given point in time. 3-Dimensional trilateration is similar but instead of circles, spheres are use. The radius of the sphere is the distance of the receiver from the satellite which can be obtained from the satellites clock and the receiver's clock [29,30,31].

11. CONCLUSION

Global positioning system is a system that involves mapping or detecting of locations. This system involves the concept of communication and signal processing. This research can follow the program code of [32,33,34,35]. This study mostly used the concept of digital communication as it was required for the course. These concepts such as database monitoring and data transfer. The simulation of this study was implemented in MATLAB to provide detailed results. The results of the study were considered as success as the result satisfied the condition of the given problem.

Global positioning system is beneficial to the society. It has many applications such as location mapping. It can be used in military or for aerospace purposes.

12. RECOMMENDATION

The researchers designed a system that involves global positioning system that has three-dimensional positioning using mobile phones. This study was done by simulation in MATLAB only. The researchers would like to recommend that the design must be implemented in real life situations. The researchers would also like to recommend extending the factors of detecting locations from the global positioning system.

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