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Verification of GPS data using REB-4216 card During Satellite Communication System

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***Abstract*— Since ancient times was used GPS system is essential for marine navigation, where it depends on the magnetic needle to determine the North Pole and the South , depending on the form of the stars at night to determine the desired direction, the development of science and in particular the communications sciences development GPS system positioning using telecommunications allocated for this purpose satellite and some companies manufacture electronic equipment for this purpose, in particular where he became benefit from system determine the reality in the maritime, air and land. In this paper is verifying and synchronization the data received from the satellite using the card REB-4216 Technical to determine how many satellites could contact them, determine the location for the latitude and longitude, determine the UTC time, date, and the Speed Over the Ground (SOG) if the speed of a moving, knowledge of the protocols used where it is necessary to have contact with three satellites at least to get the clear data, some industrial device need to synchronization the time without internet connection ,to prevent unauthorized person from injection the information in the device, by using GPS time for each device.**

***Keywords*— GPS, REB-4216, UTC time, SOG, protocols, latitude and longitude.**

Introduction

At the present time cannot be ignored for the purpose of satellite positioning in the presence or absence of an Internet connection , and also can take advantage of GPS system without any Internet connection that without the use of special protocols for Internet related. This can be determined authority by contacting the reliability of satellite where it sets the site depending on the latitude and longitude then select the area code (pin code) depending on the database linked to satellite, so that system using in Vehicle Tracking, Anti-Theft, Tracking System and Locking System.

The GPS/GSM Based System is one of the most important systems, which integrate both GSM and GPS technologies. It is necessary due to the many of applications of both GSM and GPS systems and the wide usage of them by millions of people throughout the world. This system designed for users in land construction and transport business, provides real-time information such as location, speed and expected arrival time of the user is moving vehicles in a concise and easy-to-read format. This system may also useful for communication process. The block diagram shown below illustrates the idea of the project.

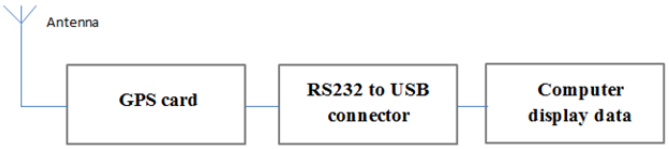

Fig.1 block diagram of the proposed model

Architecture Design

This program is designed by Microsoft Visual Basic 6.0 language, It includes Interface port Rs-232with REB-4216 card where this card consists of microprocessor SIM28M and it processes the data received via antenna, which is characterized bandwidth : 1575.42 MHz and voltage : 3V – 5V and coaxial cable with length about 5m that connect between the antenna and card , The antenna receipt the signal from the satellites , the connection may be one or several satellites of up to 12 satellite and sometimes more depending on the signal strength .

The data are processed in the CARD After that is sent to the computer via serial cable using Rs-232protocolto be processed and extract data from them, And the type of contact is a synchronies so must specify each of the [BIT PER SECOND 9600 , DATA BIT 8 , PARITY NONE , STOP BIT 1 , FLOW CONTROL NONE] .

There are correction for some data where they are sent because they have variable packet , this consider problem but solved by program , the correction based on type of the information. Finally, the data is extracted from each protocol and is displayed in the specified text On the front of the main program, There are two types of data may have been imitation values graphically, They signal strength and availability of data, The strength of the signal depends on the number of satellites that connected, It was simulated with four levels , if N represent the number of satellites that connected then showmen in table below.

Table.1: Network Level

N of level	Condition
Level- 1	if 0 < N < 3
Level- 2	if 3 =<N < 6
Level -3	if 6 =< N < 9
Level- 4	if N >= 9

The availability of data, there are a graphical representation also. It indicates whether there is data or not.

2.1 Software:

Visual Basic was initially introduced in 1991 as the first programming language that directly supported programmable graphical user interfaces using language-supplied objects. From that time until 2002, there were five other versions released, each version having features that increased the power of the language. In 2001, Microsoft released the .NET (pronounced "dot net") platform. Visual Basic .NET, or VB.NET, is an upgrade to the last version of VB (version 6.0) that conforms to the .NET platform. As you will see in subsequent chapters, the changes in VB.NET allow programmers to write Web or desk-top applications within the same language. In addition, VB.NET is fully object-oriented as opposed to prior versions that had many, but not all, of the elements of an object-oriented language. This book is based on VB.NET. In the balance of the book we will sometimes refer to Visual Basic as VB, omitting .NET.

From a programming viewpoint, Visual Basic is an object-oriented language that consists of two fundamental parts: a visual part and a language part. The visual part of the language consists of a set of objects, while the language part consists of a high-level procedural programming language. These two elements of the language are used together to create applications. An application is simply a Visual Basic program that can be run under the Windows operating system.

2.2 Flow Chart:

A Flowchart is a diagram that uses graphic symbols to depict the nature and flow of the steps in a process . Another name for this tool is "flow diagram."

At the beginning process improvement efforts, an as-is Flowchart helping team and others involved in the process to understand how it currently works. The team may find it helpful to compare this as-is Flowchart with a diagram of the way the process is supposed to work. Later, the team will develop a Flowchart of the modified process—again, to record how it actually functions. At some point, the team may want to create an ideal Flowchart to show how would ultimately liking the process to be performed. In this paper the flowchart explaining in fig.2 below.

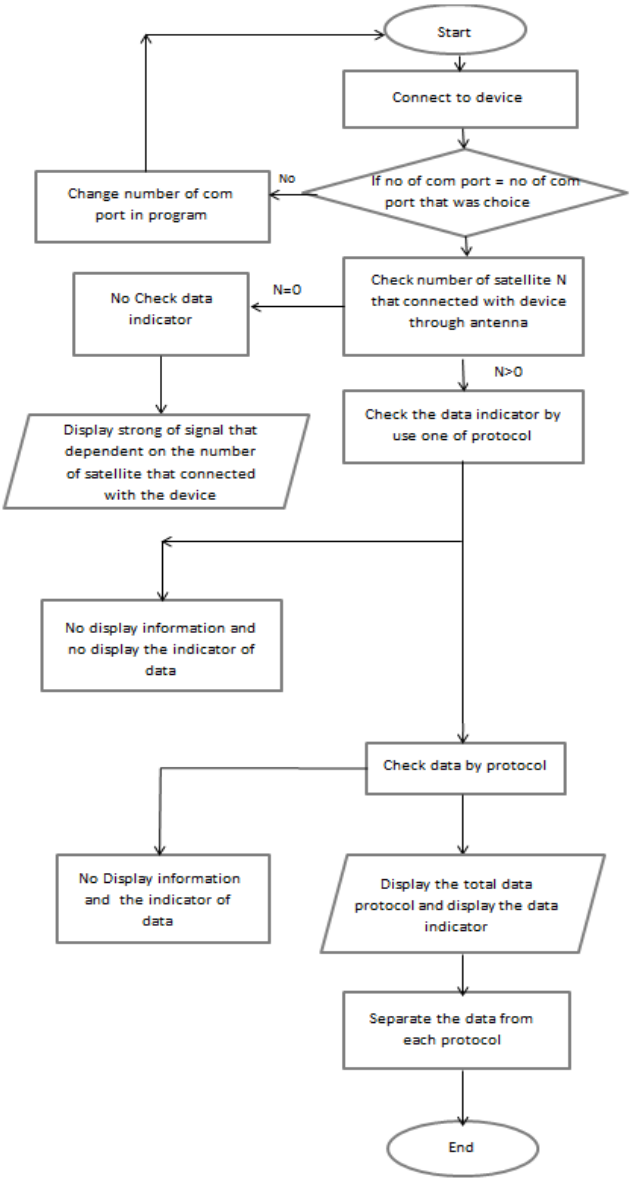

Fig.2 project flowchart

2.3 Hardware:

Designs and positioning accuracy depending on the company designed and differ as shown in Figure used in this project.

2.3.1Hardware content

1. GPS Antenna :that tool which received the data from the satellite as shown fig below.

Fig.3 Backside of antenna

Fig.4 Front side of antenna

2. Wire: the connection between the antenna to the card it long 5-7 meter.
3. Card that using type REB-4216as shown below

Fig.5 card REB-4216 type

4. RS232 wire : that tool using to connecting the card to the USB connection.
5. RS232 to USB convertor : that card not supported the USB connection so that using convertor as shown below.

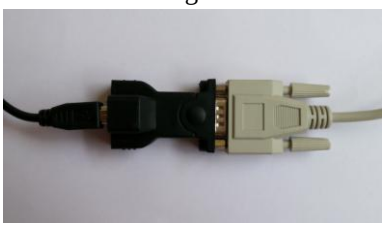

Fig 6 RS232 to USB convertor

6. Personal computer that has the software recommended as shown fig below. (see maximized window in last page)

Fig.7 software application

2.3.2 Description of GPS Units

The GPS units used for this paper, which isspecified to have a steady-state (with differential) position accuracy of 2-5 meters and a steady state velocity accuracy of 0.1 meters per second. Latitude, longitude, day of the week, UTC time (Universal Coordinate Time, formerly known as Greenwich Mean Time), speed (mph) and direction are logged to a file each second by the GPS unit.

Results

In this program it was obtained three protocols as shown in the table.2 below. Each protocol is entitled Message ID.

Table.2: Protocol Type

No	Output Messages	Description
1	GGA	Global positioning system fixed data
2	RMC	Recommended minimum specific GNSSdata
3	GSA	GNSS DOP and active satellites

The first message GPGGA Gotten the following results:

Table.3: Protocol Results

No	Name	Value	Description
1	UTC Position	165411.000	hhmmss.sss
2	Latitude	1622.6312	ddmm.mmmm
3	N/S Indicator	N	N=north or S=south
4	Longitude	08030.9895	dddmm.mmmm
5	E/W Indicator	E	E=east or W=west
6	Position Fix Indicator	2	
7	Satellites Used	9	
8	HDOP	0.81	Horizontal Dilution of Precision
9	MSL Altitude	5.3	mean sea level

Fig.8 protocol massage details

The second message GPRMC Gotten the following results:

Table.4: Protocol Results

No	Name	Value	Description
1	UTC Time	165410.000	
2	Status	A	A=data valid or V=data not valid
3	Latitude	1622.6312	dddmm.mmmm
4	N/S Indicator	N	N=north or S=south
5	Longitude	08030.9895	dddmm.mmmm
6	E/W Indicator	E	E=east or W=west
7	Speed Over Ground	0.00	
8	Course Over Ground	202.33	
9	Date	020815	ddmmyy

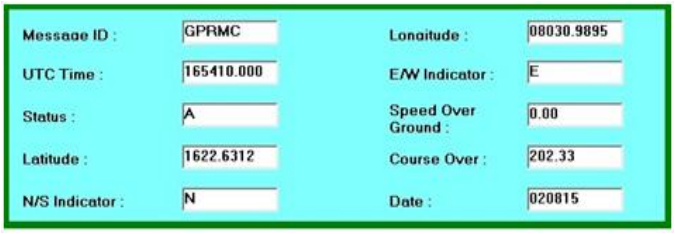

Fig.9 protocol massage details

The third message GPGSA Gotten the following results:

Table.5: Protocol Results

No	Name	Value	Description
1	Mode 1	A	M=Manual-forced to operate in 2D or 3D mode A= Automatic-allowed to automatically switch 2D/3D
2	Mode 2	3	1= Fix not available 2= 2D 3=3D
3	ID of Satellite Used	20	Sv on Channel 1
4	Time	16:54:10	hh:mm:ss
5	Date	02/08/15	dd/mm/yy

Fig.10 protocol massage details

It is noted for positioning, we need at least three satellites and the greater the number of satellites it runs on correct value and by following an increase in the proportion of precision positioning , GPS system consists of 24 satellites orbiting the earth And cover the entire it, And be at a height 20200 km , Each satellite transmits signal carrying its position and Timing of the broadcast signal And the reference atomic clock high precision , The REB-4216 CARD receive signals coming from satellites and determine Signal transmission time by calculating the difference timing for each signal And thus calculate the distance between each satellite and the receiver card, And three receiving signals from three different satellites determine the point of intersection of the receiver position. When increase the number of satellites can be observed for the receiver, can be corrected errors and then increasing accuracy.

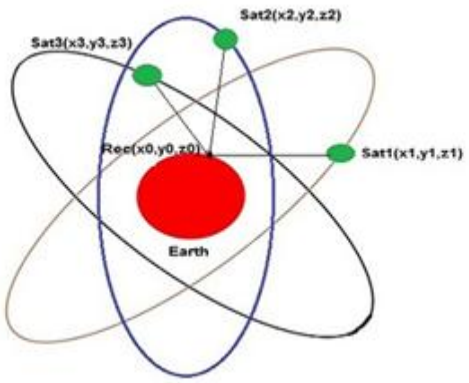

Fig.11 illustrate the specific correct location

If the coordinates of the receiver Rec(x0,y0,z0) , t0 represents the time of arrival of the signal to the receiver card , The coordinates of the three satellites are Sat1(x1,y1,z1) , Sat2(x2,y2,z2) and Sat3(x3,y3,z3) And the time broadcast of each satellite are t1,t2 and t3 respectively ,c represent speed of light, Assuming that there are no atomic clock , then we need to fourth satellite with coordinates Sat(x4,y4,z4)) And it time broadcast is t4 , By solving the four following equations:

$$(x1 - x0)^2 + (y1 - y0)^2 + (z1 - z0)^2 = [\, c\,(t1 - t0)\,]^2 \text{ ------1}$$

$$(x2 - x0)^2 + (y2 - y0)^2 + (z2 - z0)^2 = [\, c\,(t2 - t0)\,]^2 \text{ ------2}$$

$$(x3 - x0)^2 + (y3 - y0)^2 + (z3 - z0)^2 = [\, c\,(t3 - t0)\,]^2 \text{ ------3}$$

$$(x4 - x0)^2 + (y4 - y0)^2 + (z4 - z0)^2 = [\, c\,(t4 - t0)\,]^2 \text{ ------4}$$

we can get the variables x0,y0, z0 and t0 Which represent the coordinates of the receiver card and receive time of the card respectively.

The results Obtained on the value of longitude and latitude when the number of satellites 4 and this value is corrected by increasing the number of satellites and by drawing shown below, each point represents the intersection of latitude and longitude and distance from the site the most correct red depends on the number of satellites moving them.

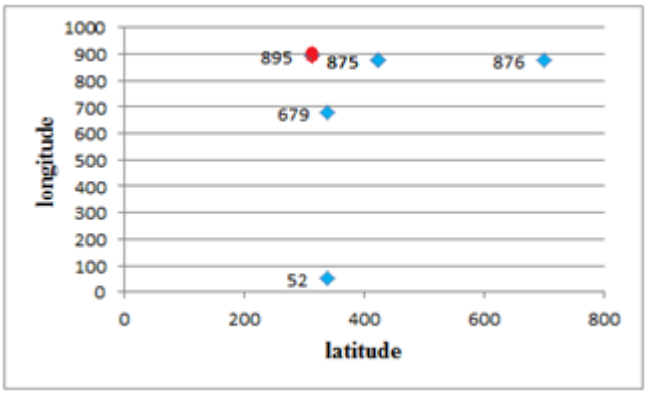

Fig.12 result of the location depend on the Latitude and longitude

Conclusion

Became Undoubtedly and the evolution of the Internet Science evolution is linked to internet connection Sciences, a science (hacking) is designed to spy on communications systems and for several different purposes and multiple details, so there are applications require synchronization without connecting to the Internet and especially the GPS in the military field and applications Finance. Through this research paper can be obtained on the precise synchronization of the personal computer and the rest of the associated applications and access to the site to detail without connecting to the Internet, but should be the availability of equipment (hardware) to connect to the satellite and is the card REB-4216which in turn secures communication satellite through the GPS technology and through communication and reliability associated equipment designer and through the program under Visual Basic environment was able to obtain the required synchronization.

Future Scope

This design can be made more enhanced in future to support camera, handset phone / hands free, mobile data LCD display, web based tracking software, also PC based standalone software if it using web applications. This paper could be made more convenient and secure with the use of satellite modems instead of cell phones as tracking device as the system may fail when there is no network coverage. This project could be made more convenient and secure with the use of satellite modems instead of cell phones as tracking device as the system may fail when there is no network coverage.

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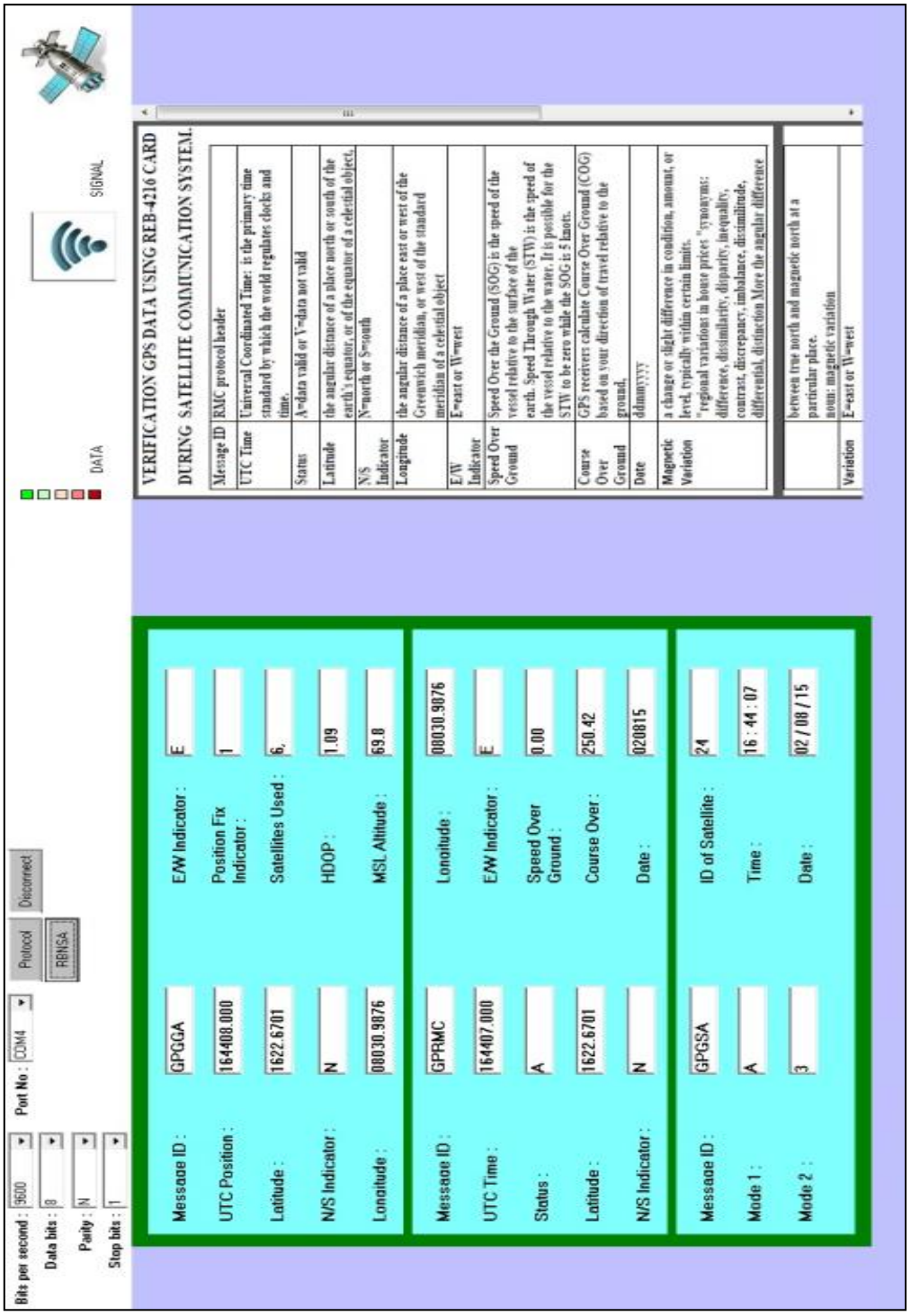

Fig.7 Verification of GPS data using REB-4216 card during satellite communication system (Software Application)