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A GUI For Transformation Of Coordinate System

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Abstract

The Global Positioning System (GPS) is a satellite based navigation system that can be used to locate positions anywhere on earth. It consists of satellites, control and monitor stations, and receivers. GPS receivers take information transmitted from the satellites and use triangulation to calculate a user's exact location.
This proposed work is developed for the use of GPS system. A Graphic User Interface (GUI) is developed in Matlab 2012 for conversion of latitude and longitude data to northing and easting in real time. This is one of important technology used in determination of position of self station as well as target position. This simulation helps in determining state real time, range real time, change in altitude real time. Developed results are shown in tables.

Keywords - GUI(Graphical User Interface);GPS(Global Positioning System); Lat(latitude);Long(Longitude).

I. INTRODUCTION

The basis of the GPS[1] is a constellation of satellites that are continuously orbiting the earth. These satellites, which are equipped with atomic clocks, transmit radio signals that contain their exact location, time, and other information. The radio signals from the satellites, which are monitored and corrected by control stations, are picked up by the GPS receiver. A GPS receiver needs only three satellites to plot a rough, 2D position, which will not be very accurate. Ideally, four or more satellites are needed to plot a 3D position as shown in fig1, which is much more accurate. GPS receivers take information transmitted from the satellites and use triangulation to calculate a user's exact location in terms of Lat & Long. After getting this lat & long data , which describe the position in globe. While for target firing in particular country this data is converted to Northing & Easting[2].For this purpose GUI is developed used on incidents in a variety of ways, such as:

- To determine position locations. for example, you need to radio a helicopter pilot the coordinates of your position location so the pilot can pick you up.
- To navigate from one location to another. for example, you need to travel from a lookout to the fire perimeter.
- To create digitized maps. for example, you are assigned to plot the fire perimeter and hot spots.
- To determine distance between two points or how far you are from another location.

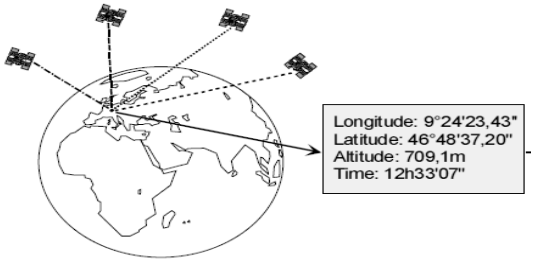

fig1: GPS working

II. REQUIRMENT OF GUI

A. Provide a simple and easy to use interface

Interface can be used without learning new skills of computers , result obtained just by giving input data in term of Lat and Long. The developed operation is simple and easy.

B. Avoid technical details

A user need not know the technical details of algorithm involved in the calculation of conversion.

III. MATHEMATICAL MODELING

Converting Latitude and Longitude to UTM (Universal Transverse Mercator)

$y = \text{northing} = K1 + K2p^2 + K3p^4$, where

$K1 = Sk_0$,

$K2 = k_0 \, nu \, \sin(lat)\cos(lat)/2 = k_0 \, nu \, \sin(2\,lat)/4$

$K3 = [k_0 \, nu \, \sin(lat)\cos^3(lat)/24][(5 - \tan^2(lat) + 9e'^2\cos^2(lat) + 4e'^4\cos^4(lat)]$

$x = \text{easting} = K4p + K5p^3$, where

$K4 = k_0 \, nu \cos(lat)$

$K5 = (k_0 \, nu \cos^3(lat)/6)[1 - \tan^2(lat) + e'^2\cos^2(lat)]$

Easting x is relative to the central meridian.

K1 is simply the arc length along the central meridian of the zone corrected by the scale factor. All the higher K terms involve nu, the local radius of curvature (roughly

equal to the radius of the earth or roughly 6,400,000 m), trig functions, and powers of e'^2 (= .007). So basically they are never much larger than nu. Actually the maximum value of K2 is about nu/4 (1,600,000), K3 is about nu/24 (267,000) and K5 is about nu/6 (1,070,000). If just to stop with the K2 term in the northing, got a quadratic term of p. In other words approximate the parallel of latitude as a parabola. Since the projection cylinder has a curvature, the exact curve is not a conic but the difference across a six-degree UTM zone is small. Hence the need for higher order terms. Now p will never be more than +/-3 degrees = .05 radians, so p^2 is always less than .0025 (1/400) and p^4 is always less than .00000625 (1/160000). Using a spreadsheet, it's easy to see how the individual terms vary with latitude. $K2p^2$ never exceeds 4400 and $K3p^4$ is at most a bit over 3. That is, the curvature of a parallel of latitude across a UTM zone is at most a little less than 4.5 km and the maximum departure from a parabola is at most a few meters.

K4 is what calculated for easting in a simple-minded way, just by calculating arc distance along the parallel of latitude.As we get farther from the central meridian, the meridians curve inward, so our actual easting will be less than K4. That's what K5 does. Since p is never more than +/-3 degrees = .05 radians, p^3 is always less than .000125 (1/8000). The maximum value of $K5p^3$ is about 150 meters.

IV. DESCRIPTION OF GUI

An algorithm of calculation was developed for the GUI based simulation on MATLAB2012 which is a powerful tool. THE GUI was developed using GUIDE (Graphical User Interface Development). The program utilizes a graphical user interface (GUI) to change the object parameters. The latitude and longitude are input parameters. As part of the program, these sets of parameters are included as packaged model. The Push Button is used for calculation of result. The Additional feature is that user can change the initial parameters by pressing the reset button GUI. The working of the GUI has been well-defined by its particular code functions explaining the various tasks performed by it.

V. DESIGN DESCRIPTION

The main designed window of the GUI, shown in fig.2 is divided into three zones:

- The first zone includes the panel containing the textboxes for entering data on the both side of the GUI.
- The second zone includes the panel containing the buttons for performing the required action on the middle portion of the GUI.
- The third zone includes the boxes for result.

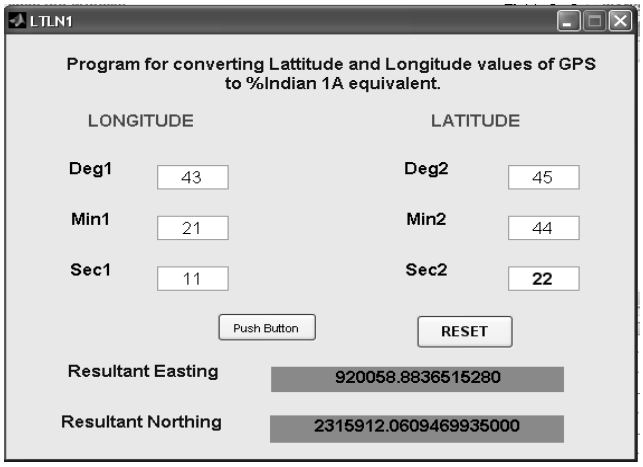

Fig2: Design Description Of Developed GUI

VI. RESULTS

The degrees, minutes and seconds (DD, MM, SS) is the conventional method [3] of presentation. In the case of degrees of latitude or longitude the format be negative or positive.There is usually a quadrasphere designation as well, such as N, S, E or W, based on the equator and the prime meridian. For the hemisphere, either north or south, the designation is N or S for latitude. East of the prime meridian is E (positive) and west of the prime meridian is W (negative). negative numbers (in certain situations, southern latitude is displayed as negative. If negative latitude, it is south while a negative longitude is west can also be used to express a quadra sphere designation. In this converter, it does not matter. Only converting numbers. All numbers are assumed to be positive.

The decimal degrees is displayed as the degrees in normal value, with both minutes and seconds. This is the most known GPS format though some GPS units, is displayed as (DD,MM.MMMM) in which seconds are converted to decimal minutes, as a minute value. Seconds have the value of 0 to 60, with 0 and 60 (usually designated as 0 to 59 and then restarting at 0) being the same value, minutes have the same characteristics and degrees are valid from 0 to 180 and 180 to 0, (0 and 180 do not have the same value) both north and south of the equator, and east and west of the prime meridian.

If not familiar with latitude and longitude, Lines of latitude and longitude are hypothetical lines on the surface of the earth. On the Earth, lines of latitude are circles of different size. The longest (largest in diameter) is the equator, whose latitude is zero, while at the poles, at latitudes 90° north and 90° south (or -90°), the circles shrink to a point. On the earth, lines of constant longitude (meridians) extend from pole to pole, and cross the lines of latitude. Every point on the surface of the Earth has coordinates where a given line of latitude and a give line of longitude intersect (cross). To sum it up, latitude is measured from the equator, with positive values going north (0 to 90) and negative values going south (0 to -90). Longitude is measured from the Prime Meridian (which is the longitude that runs through Greenwich, England), with positive

values going east (0 to 180) and negative values going west (0 to -180). for example, 65 degrees west longitude, 45 degrees north latitude is -65 degrees longitude, +45 degrees latitude. The simulated experimental results are shown in form of table(TableI).

TABLE I.

S.No	Latitude	Longitude	Easting	Northing
1.	43°17′ 12′′	22 ° 46′2′′	196032.048	128822.447
2.	55 °17′8′′	33°21′45′′	1564138.4055	1080304.934
3.	47 °47′47′′	45°40′40′′	1136127.4247	2541681.441
4.	60 °21′10′′	55°23′11′′	2213526.9360	3548908.218
5.	62 °44′11′′	78°44′11′′	2546517.5644	6940892.103

VII. CONCLUSION

This GUI based algorithm helps in designing software for GPS, which computes the position of fire to be imparted to the weapon. Based on target calculated data, direction & time of the launched weapon is to decided. The problem of tracking target may be solved by the proposed technique. However, it seems that a single algorithm is not suitable for all positions in globe. This paper enhances current report about these techniques & gives proper algorithm. The implementation to GPS is yet to be explored.

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