CONTROL SYSTEM FOR THE ANTENNA POSITIONING

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Abstract: - The control system for the antenna positioning is showed in this paper. The system is based on GPS receiver, microcontroller and personal computer to select the geostationary satellite for the antenna positioning to communicate to the satellite selected.

Key-Words: - Antenna, GPS, Satellite, Geostationary.

1 Introduction

Directional antennas have several advantages for communication systems. Higher gain antenna improves the performance in the power consumption, coverage and sensitivity. However, this type of antennas is not suitable for mobile service. So, the control system for antennas positioning permits use directional antennas in mobile communication systems[1].

The control system for antenna positioning proposed in this paper can be use for geostationary satellite communications with mobile applications.

2 The Control System

The control system is conformed by several parts: Hardware and Software. The block diagram of the control system is showed in the next figure.

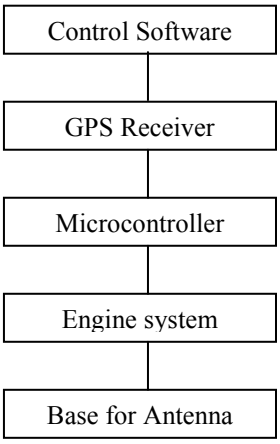

Fig. 1 Block Diagram

2.1 Control Software

Control software is basically in the PC. Ii is a software application using Visual Basic 6.0. The control software supports several functions for antenna positioning like:

- Data acquisition from the GPS receiver
- Monitoring the antenna position
- Show the graphical representation
- Show the data location
- Calculate the antenna position
- Control the motors
- Satellite data base

2.1.1 Data acquisition from the GPS

This function is used for the location of the antenna positioning. The data acquisition from the GPS is related only with the latitude, longitude and altitude. The GPS used is DELUO GPS RECEIVER with a USB interface at 4800 baud rate and 8 bits data. The latitude, latitude and altitude is loaded from the NMEA 0183: GGA, GSV, GSA and RMC data frame at the USB entrance. The accuracy in the position is about 5 meters and the navigation update rate is once per second. The frame structure of NMEA GSV includes the elevation angle and azimuth and the NMEA GGA the latitude, longitude and the altitude among others. The steps we follow to get the data before mentioned are:

- Find the port where the GPS receiver is connected
- Establish the communication parameters
- Get the GGA frame to extract the latitude, longitude and altitude

- Get the GSV frame to extract the azimuth and elevation angles
- Show the data coordinates in the graphic user interface

2.1.2 Monitoring the antenna position

The antenna position is obtained through a microcontroller AVR ATMEGA8535 at 16 MHz. The microcontroller makes a polling of a digital compass, which shows the orientation of the antenna positioning according the Hall-effect technology. This sensor indicates the horizontal component of the earth´s field. The computer sends a command to the microcontroller for data positioning monitoring in order to convert the data from the sensor with a maximum error up to 12 degrees [2].

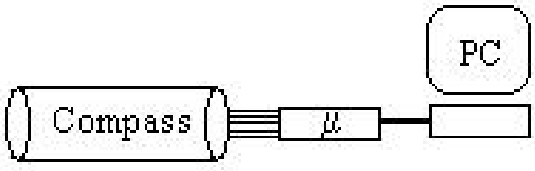

Fig. 2 Antenna Orientation Block

We can see in the picture that the data orientation is monitored by the PC getting the compass direction (N, S, W, E, NE, NW, SE or SW). Furthermore, the elevation angle of the antenna is always known by the microcontroller. In the figure 3 is showed the digital compass location and the elevation angle engine in the antenna positioning.

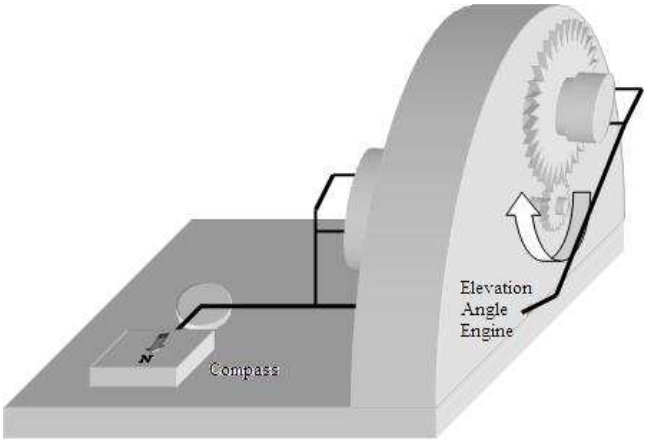

Fig. 3 Position Engine

The elevation angle of the antenna is controlled according the voltage read in the internal ADC of the microcontroller. Furthermore, the position of the digital compass connected to the port B, where the code received is send to the personal computer by serial port.

2.1.3 Graphical Representation

The graphical representation consists in positioning a mark in the global map of the system location in real time while the system is moving. Also the coordinates are shown in text boxes.

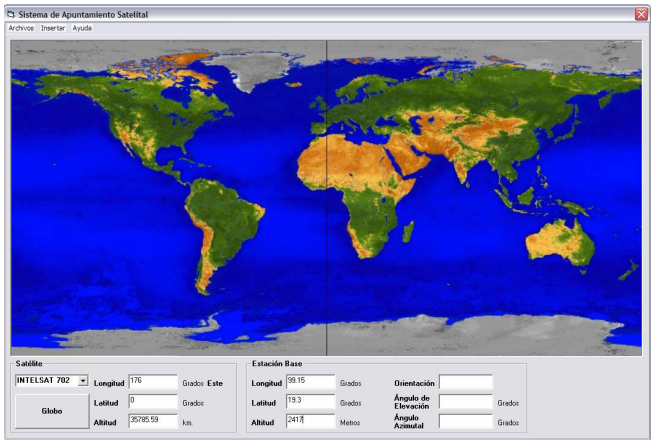

Fig. 4 Graphical Interface

2.1.4 Data Location

The data from the GPS receiver is update once per second and showed in the graphics user interface (longitude, latitude and altitude) as we can see in the figure 6.

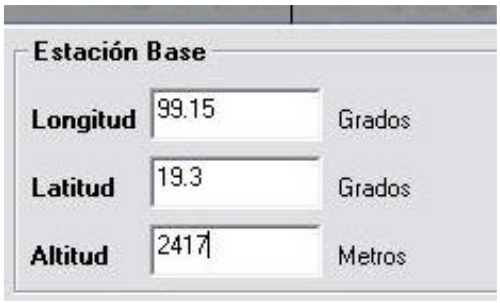

Fig. 6 Data from GPS

2.1.5 Antenna Position Calculation

The antenna position is calculated using the data location of the receiver and the data position of the satellite.

The calculation is based on vectors analysis getting the vector from the receiver point to the satellite point. First, it is necessary to determine if there is line of sight (LOS). Second, making algebraic calculations it can be possible to obtain the azimuth and elevation angle for the antenna positioning.

2.1.6 Control for the engines

This function is related for the positioning of the antenna sending commands to the microcontroller for the engines in order to manage the antenna position.

The figure 7 shows the circuit for each engine control [2].

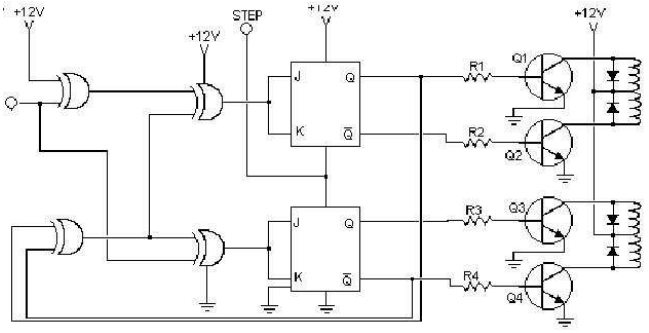

Fig. 7 Circuit for engine control

2.1.7 Satellite Data Base

The software has a satellite data base of 36 geostationary satellites like ACTS, EUTELSAT, INMARSAT, INTELSAT, etc. its longitude in order to select the satellite of interest as we can see in the figure 8. Also, the software has the option to add more satellite data.

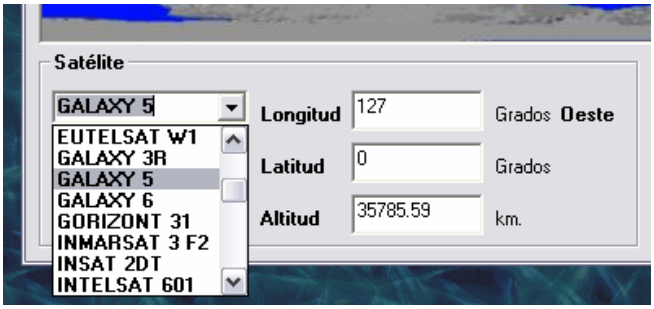

Fig. 8 Satellite Selection

3 Conclusion

The control system for the antenna positioning is useful for long distance communication systems due its improvement in sensitivity and low power consumption. This control tool represents a low cost application. Also, we are using this application at this moment for education in electronic engineering. This application can be use in several cases giving good performance.

References:

[1] H. Schulz, H. J. Golberg, "GPS Low noise Amplifier with High Immunity to Wireless Jamming Signals and Power Control Option", Advances in Radio Science, 2004, pp. 195-197

[2] H. Gil, "Sistema Programable de Posicionamiento de Antena hacia Satélites Geoestacionarios", 2004