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Intelligence Satellite Tracking System

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Abstract - *The main aim of our project is to develop satellite tracking systole that rotates on a fixed path using m microcontroller. A satellite programmed to rotate on a fixed path called orbit, but due to various reasons the satellite does not do so, it drifts. The proposed project is modeled to track the satellite path &get drift metric in terms orbit and position, the microcontroller compares this data with the database and gives out the corrected value and brings the satellite to the orbit. A satellite usually transmits orbital information to the earth station at certain intervals. The earth station has a tracking system which uses this information to find the current position of the satellite. In this project we plan to develop a prototype model of satellite tracking system based on personal computer using visual basics. We plan to develop a satellite object and make it rotate in a fixed orbit, providing the user to control the drift of satellite.*

Key Words: **Orbital correction Engine**, **Tracking processor, RS-232 interface**, **Transmitter**, **Receiver, ATMEL 89C51, LCD unit. Light emitting diode.**

1. INTRODUCTION

A Satellite programmed to rotate on a fixed path called its orbit, but due to various reasons the satellite does not do so, it drifts. The proposed project is model to track the Satellites path and get the drift metric and use algorithms to find the real-time correction to feed the same to satellite to bring it back to its own orbit. A satellite usually transmits orbital information in terms of longitude and latitude to earth station at certain intervals, the earth station has a tracking system which uses this information to find the current position of the satellite, speed and direction of the movement and compares with the static orbital database and works out the correction.

In this project we planned to develop a prototype model of satellite tracking system based on Pc, using Visual Basics we plan to develop a satellite object and make it rotate in fixed orbit, provided user control to drift the satellite, and design the backend software to work out the correction and feed the same to front end to visually bring the satellite object to its original orbit. Satellite communication is the most important mode of communication which covers the large area of earth's surface. For satellite communication we use geostationary satellite (GEO) which covers 1/3 area of earth's surface.

1.1 GEOSTATIONARY SATELLITES

GEOs satellites provide the kind of continuous monitoring necessary for intensive data analysis. They circle the earth in a geosynchronous orbit, which means they orbit the equatorial plane of the earth at a speed matching the earth's rotation. This allows them to hover continuously over one position on the surface. The geosynchronous plane is about 35800km (22300 miles) above the earth, high enough to allow the satellites a full-disc view of the earth. Because they stay above a fixed spot on the surface, they provide a constant vigil for the atmospheric "triggers" for severe weather conditions such as tornadoes, flash floods, hail storms, and hurricanes.

1.2 PROJECT APPROACH:

Once the satellite is launched in the orbit various forces act on the satellite which diverts the satellite away from its orbit. The forces include centripetal force, centrifugal force, and gravitational forces of sun, moon and Earth. In our project, we track the satellite which is out of the orbit due to the above said forces and bring it back to the original position. We use microcontroller to keep the track of satellite by sending the information of its latitude and longitude to the earth station at certain intervals of Frequency. The block diagram description is given in the chapter 3 which tells about the major components used in the project. The circuit implementation is also given in the Same chapter.

2. OVERVIEW

The basic design of a satellite communications system depends to great degree upon the characteristics of the orbit of the satellite. In general terms, an orbit is either elliptical or circular in shape. An antenna is adapted to receive radio frequency signals from a moving satellite and an antenna pointing mechanism is adapted to point the antenna beam in the direction of maximum received signal strength in response to command signals.

LITERATURE SURVEY

According to Birn J et al (1997) , particle injections associated with sub storms were usually studied based on observations at the geosynchronous orbit (GEO). According to Birn J et al (2004), electron acceleration and energetic electron flux increases in the inner tail are investigated on the basis of test-particle orbits in the dynamic fields of a three-dimensional magneto hydro dynamic simulation of neutral line formation

and depolarization in the magneto tail. Christon SP et al (1991) said that, spectral characteristics of central plasma sheet ions and electrons observed during 71 hours when geomagnetic activity was at moderate to high levels.

PROBLEM IDENTIFICATION

From literature survey, we came to know that Satellite is used for various application such as communication, space and earth exploration etc. The satellite is launched in space with the help of launch vehicle. It is used so that satellite will cross the earth's atmosphere as well as gravitational pull. Once the satellite is placed in designated orbit, following activities need to be performed as part of maintenance.

- Orbit maintenance
- Battery maintenance
- Thermal management
- Power management etc.

But the particles present in space and forces like centripetal force, centrifugal force, and gravitational forces of sun, moon and Earth affect on satellite and the satellite will be drifted from its original orbit. So to overcome this disadvantage we originated a project. In this project we track the satellite which is out of the orbit due to the above said forces and bring it back to the original position. We use microcontroller to keep the track of satellite by sending the information of its latitude and longitude to the earth station at certain intervals of frequency.

BLOCK DIAGRAM DESCRIPTION

We use an 89C52 ATMEL MICROCONTROLLER. This is a single chip, 8-bit, low power high performance device in advanced technology. The microcontroller belongs to the 8051 family and contains 8kb of flash memory. Its uses a serial communication mode. This is the heart of the system which controls the entire operation. In satellite tracking system orbital database is used to store the orbital parameter of a satellite such as eccentricity, apogee point, perigee point, inclination, latitude, longitude, elevation etc.

RS232 is a standard which is used for serial binary data interconnection between a DTE (data terminal equipment) and a DCE (data circuit termination equipment). It is commonly used in computer serial ports. Here we use this to exchange location of satellite between satellite-and microcontroller.

When the error occurs the satellite drifts from the orbit. The tracking processor keeps track of present position of a satellite. It detects the deviation of satellite from actual orbit due to external forces acting on satellite. The orbital correction engine corrects the error in orbit of satellite by bringing back the satellite to its original orbit. In satellite tracking system orbital database is used to store the orbital parameter of a satellite such as eccentricity, apogee point, perigee point, inclination, latitude, longitude, elevation etc.

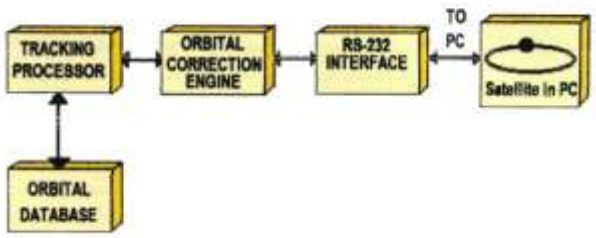

Fig -1: Block diagram of satellite tracking system

ORBITAL CORRECTION ENGINE:

Low altitude Earth satellites are subjected to aerodynamic forces that can vary considerably in a short time, making precise prediction of orbital parameters difficult. It is possible to correct low elliptical orbits so as to compensate for these forces using low thrust engines such as iron reaction motors. The unpredictability of atmospheric density Nevertheless necessitates the use of ongoing measurements of actual orbital parameters and the utilization of this data in a computer flight control system. Control algorithms are Developed based on analytical and semi analytical models of the controlled motion, which allow the updating of the control parameters with each orbit. The proposed correction algorithms provided for the step-by-step compensation of the perturbing forces via direct measurements and the calculation of the controlling data from approximate equations. The technique is illustrated with a comparative analysis of the approximate and precise determination of control parameters for the case when the orbital period and perigee are corrected, for the cases of both high and low solar activity levels, for an orbit having an apogee of 350km and a perigee of-l-6mcm.

TRACKING PROCESSOR

A precision satellite tracking system incorporating a novel smoothing processor. The satellite tracking system estimates an angle between antennas bore sight and a desired line of sight to a moving satellite. The processor then executes a sequential, discounted least mean square algorithm to estimate the satellite's angular position, velocity, and acceleration as a function of time. Based on these estimates, the processor determines incremental adjustments to azimuth and elevation pointing angles of the antenna to maintain the center of an antenna beam on the moving satellite.

The information is used in a program track mode to continually update the pointing of the antenna beam during the measurement process. The satellite tracking system provides continuous tracking of the antenna, which minimizes the instantaneous error between the reported direction of the line of sight and the actual direction to the Satellite.

RS-232 INTERFACE

The serial port is harder to interface than the parallel port. In most cases, any device you connect to the serial port will need the serial transmission converted back to parallel so that it can be used. This can be done using a DART. On the software side of things, there are many more registers that you have to attend to than on a standard parallel port. (SPP) Devices which use serial cables for their communication are split into two categories. These are DCE (Data Communication Equipment) and DTE (Data Terminal Equipment.) Data communications equipment are devices such as your modem, TA adapter, plotter etc while Data Terminal Equipment is computer or terminal. A null modem is used to connect two DTE's together. This is commonly used as a cheap way to network games or to transfer files between computers using ZModem protocol, Xmodem protocol etc. This can also be used with many Microprocessor Development systems. Null modem. It only requires 3 wires (TD, RD & SG) to be wired straight through thus is more cost effective to use with long cable runs. The theory of operation is reasonably easy. The data terminal ready is looped back to data set ready and carrier Detect on both computers. When the data terminal ready is asserted active, then the data set ready and carrier detect immediately become active. At this point the computer thinks the virtual modem to which it is connected is ready and has detected the carrier of the other modem.

All left to worry about now is the request to send and clear to send. As both computers communicate together at the same speed, flow control is not needed thus these two lines are also linked together on each computer. When the computer wishes to send data, it asserts the Request to send high and as it's hooked together with the Clear to send, it immediately gets a reply that it is ok to send.

ORBITAL DATABASE

It is a database which maintains ALMANOC database i.e. satellite position with respect to time. This data base is backbone of the tracking system to maintain the satellite in the track this data base is used by the tracking processor to generate the correction messages using least match path find algorithm.

PROGRAMMING THE FLASH

The AT89C51 is normally shipped with the on-chip Flash memory array in the erased state (that is, contents = FFH) and ready to be programmed. The programming interface accepts either a high-voltage (12-volt) or a low-voltage (VCC) program enable signal. The low voltage programming mode provides a convenient way to program the AT89C51 inside the user's system, while the high-voltage programming mode is compatible with conventional third party Flash or EPROM programmers. Once the write cycle has been completed, true data are valid on all outputs, and the next cycle may begin. Data polling may begin any time after a write cycle has been initiated.

SOFTWARE DESCRIPTION

VISUAL BASICS

VISUAL BASICS is a high level programming language evolved from the earlier DOS version called BASIC. BASIC means Beginners All-purpose Symbolic Instruction Code. It is fairly easy programming language to learn. The codes look a bit like English Language. Different software companies produced different version of BASICS, such as Microsoft QBASIC, QUICKBASIC, GWBASIC, IBM BASICA and so on. VISUAL BASIC is VISUAL events driven Programming Language. These are the main divergence from the old BASIC. In BASIC, programming is done in a graphical environment. Because users may click on a certain object randomly, so each object has to be programmed independently to be able to response to those actions (events). Therefore, a VISUAL BASIC program is made up of many subprograms; each has its own program
Codes and each can be executed independently and at the same time each can be linked together in one way or another.

3. CONCLUSION

By the usage of embedded system the task of tracking the satellite is easier as it is a dedicated system. Hence the communication speed as well as fading can be minimized. Thus we can track the satellite in precise resolution of microsecond.

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