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A design of Software Driver for A satellite Dish Antenna Positioning System

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Abstract: This paper deals with designing a Satellite Dish Antenna Positioning System using stepper motors. The system's software use longitude, latitude of the dish position (antenna site) and the satellite longitude as an input data. The software makes different calculations to transform this data to digits. The digits are then transformed to signals and fed to the stepper motors drivers to move the antenna adjusting azimuth, elevation and polarization angles to the intended satellite. The paper aims to describe the algorism and flow-chart of the system's software which allows users controlling and adjusting the antenna remotely. Also it aims to show the outputs of the software that will be transformed to signals to control the system's hardware drivers.

Keywords: *Azimuth, Elevation, Look angle and Polarization*

I. INTRODUCTION

The aim of designing a digital control system is to allow the user of satellite receiver to switch between satellites without directing the dish antenna manually or using many dishes. Simply, the user can enter the antenna latitude, longitude and the intended satellite longitude. The system uses these inputs and processes it, and then adjusts the antenna to the correct position automatically.

Before we go through, it is best first define some terms as applicable to the world of satellite TV reception:

Geostationary satellite: Is the satellite remains a fixed (stationary) in an apparent position relative to the earth; about 35784 km away from the earth if its elevation angle is orthogonal (90°) to the equator. Its period of revolution is synchronized with that of the earth in inertial space [1].

Azimuth: The azimuth angle is the angle at which the earth station's disk is pointing at the horizon [1]. Defining north is 0 deg or 360 deg, east is 90 deg, south is 180 deg, and west is 270 deg [3].

Elevation: The elevation angle is the angle by which the antenna bore sight must be rotated to lock on to the satellite [1].

Look Angle: the look angle for the ground station antenna is the azimuth and elevation angles required at the antenna so that it point directly at the satellite [2].

Skew: refers to the polarization angle of the electric field. The term 'Dish Skew' refers to the dish tilt necessary to get the satellite dish position such that the LNB will be in exact alignment with the electric field of the incoming satellite signals. Setting the dish skew is necessary only when pointing to more than a single satellite [3].

II. SYSTEMS BLOCK DIAGRAM

Digital dish positioning system is a system allows the user to adjust the satellite dish to the accurate satellite position using full remote control system. The system use the dish site and the satellite position as an input data to the control system which will be transformed to a signal and fed to the stepper motors to moves the dish antenna to point to the intended satellite. The below figure, figure (1) shows the block diagram of the system.

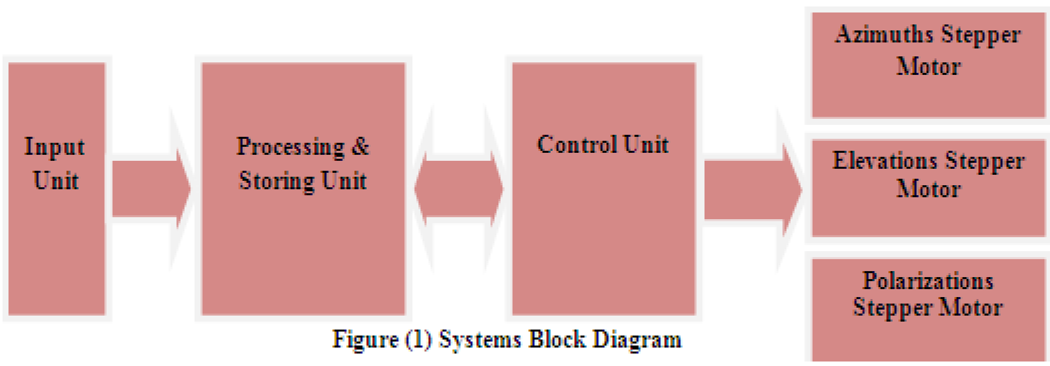


Figure (1) Systems Block Diagram

III. SOFTWARE ALGORISM

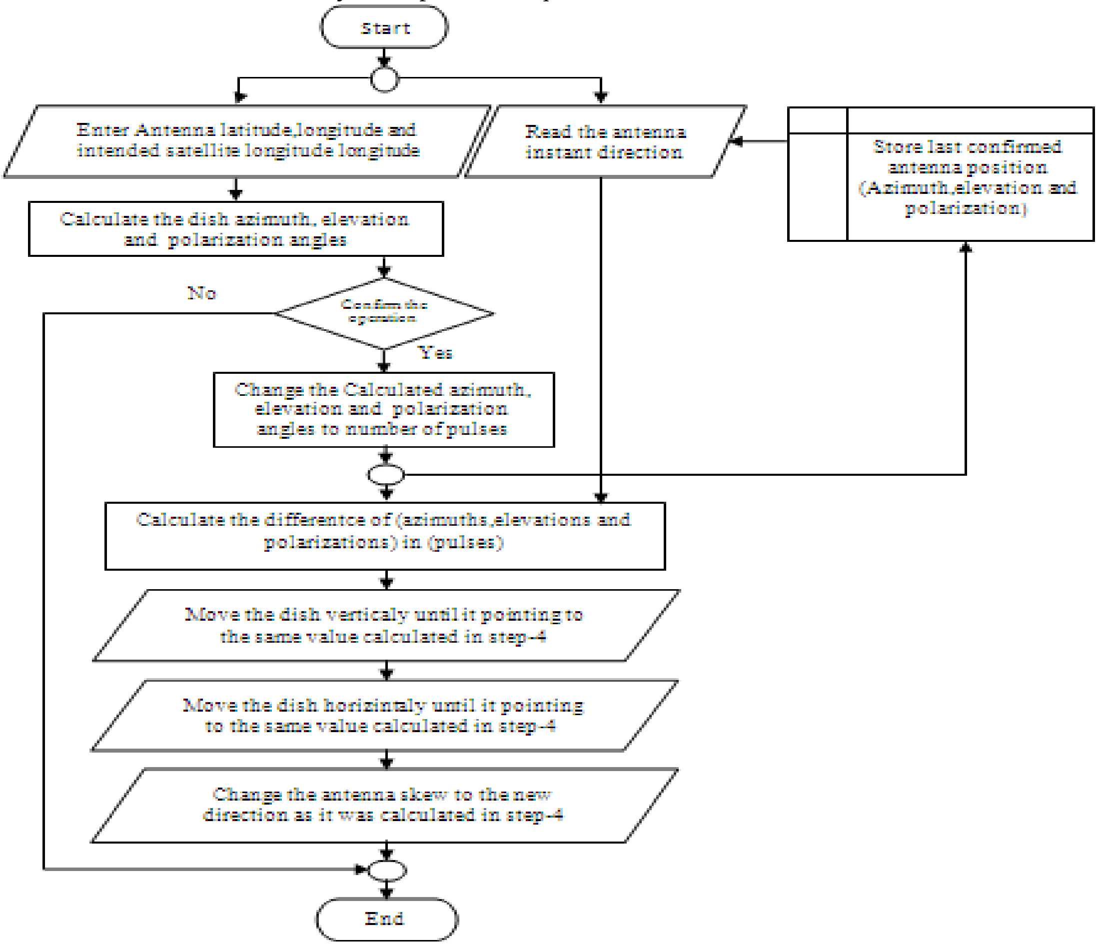
The system proceedes through the following steps in the algorism:

1- Start.
2- Read the antenna instant direction (azimuth, elevation and polarization) which was saved as a number of pulses or (digits) based on stepper motors step angles.
3- Enter Antenna latitude,longitude and intend satellite longitude (degree).
4- Calculate the intend satellite azimuth,elevation and polarization (degree).
5- Confirm the operation. If the decision is (Yes), continue step 6,7 and so on. Else (No), stop the procedures and go to the End.
6- Change the (azimuth,elevation and polarization) which were calculated in step-4 from degrees to number of pulses (digits) based on stepper motors step angles.
7- Store the values of the last confirmed antenna (azimuth elevation and polarization) in the antenna data file (which was calculated in step-6).
8- Calculate the differences of (azimuths,elevations and polarizations) in step-2 and step-6 (differences in pulses).
9- Move the dish horizintaly (azimuths pulses difference which was obtained in step-8) until it pointing to the intend azimuth which was calculated in step-4.
10- Move the dish verticaly (elevations pulses difference which was obtained in step-8) until it pointing to the elevation which was calculated in step-4.
11- Change the antenna skew to the new direction (polarizations pulses difference which was obtained in step-8).
12- End.

Note: We must take into acount the antenna offset (elevation) and the variation between magnatic and true north (azimuth).

IV. SYSTEM OPERATION FLOW CHART

The flow chart below illustrates the system operation sequence:



V. RESULTS

The system operation directs the antenna to the correct azimuth and elevation angles, and adjusts the polarization. The operation is performed remotely. The system hardware is not complicated and its cost is reasonable. The input data plays the main role to adjust and direct the antenna towards the wanted satellite. The system design makes a substitution for a multi dish installation. The below table, table (1) shows the results of operation of this system in a site with latitude 14°N and longitude 34°E to be directed to different satellites. The azimuth, elevation and polarization degrees transferred to integer numbers of pulses based on the step angles of the used stepper motors (in this application the steps angle equal to 0.9°).

Table (1): The results of the operating system.

Note: Selected Satellites are represented by their longitudes not names.

SELECTED SATELLITE	***AZIMUTH***		***ELEVATION***		***POLARIZATION***	
Degree	***Degree***	***Step***	***Degree***	***Step***	***Degree***	***Step***
7° W	***254.44°***	***282***	***40.47°***	***44***	***69.19°***	***76***
26°E	***210.15°***	***233***	***71.10°***	***79***	***29.16°***	***32***
20°E	***225.86°***	***250***	***66.89°***	***74***	***44.13°***	***49***
30.5°E	***194.18°***	***215***	***73.05°***	***81***	***13.75°***	***15***
42°E	***149.84°***	***166***	***71.10°***	***79***	***-29.16°***	***-32***

VI. CONCLUSION

Controlling a single antenna by stepper motors remotely is a challenging issue. The design adapted in this paper makes the remote control of the antenna easy. This procedure results in positioning the antenna to the desired satellite precisely. Also it reduces the dish antenna alignment-time.

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