DESIGN OF AN AUTOMATIC SATELLITE TRACKING SYSTEM

N. A. R. Priyanka*[*], L. S. K. Udugama and C.J. Basnayakage

Department of Electrical & Computer Engineering, The Open University of Sri Lanka

This research proposes an automatic satellite tracking system that tracks the target satellites by automatically positioning the satellite dish. A major aspect of the research is to develop a low cost and highly effective product for automatically positioning the satellite dish to the target satellite to receive the peak satellite signal as receiving the maximum signal strength from the satellite is useful. This research is mainly focused on digital television transmission and very small aperture terminals (VSAT). The proposed system will track geographically synchronized satellites.

The system is designed with a Satellite Dish Control Unit (SDCU), a Signal Detection Tuner Unit (SDTU), Raspberry Pi (RPI), DC motors, motor control circuits and display units. The SDCU unit consists of a Satellite Position Finder Unit (SPFU) and a Motor Control Unit (MCU). The dish antenna attached to the motors rotates either in the clockwise or counter-clockwise direction. Tracking is carried out according to the satellite signal reception. Angle and azimuth is calculated based on the location (longitude and latitude). To satisfy these parameters, the system will drive the actuators. Once the above parameters are satisfied, the system will be able to track a verified satellite searching known frequencies.

In order to track the satellite of interest, the mechanical and electrical sub systems provide the physical capability while the software provides easy and accurate pointing as well as safe operation. In the basic method of satellite finding, the satellite receiver should know the required satellite signal information. Satellite signal information consists of transponder frequency, symbol rate, forward error correction (FEC) ratio and polarity of the signal. Selected satellite search parameters should be fed to the receiver. The system will calculate the approximate azimuth angle and elevation to the respective satellite from the current position. The RPI will enable the general purpose input and output (GPIO) pins according to the calculated data. Motors drive the satellite dish to point to the respective satellite.

When the tuner receives the correct signal, automatic gain control (AGC) voltage will be increased proportionate to the reception signal. Thus, we need to measure the peak AGC voltage location of the signal. This measured voltage will be converted into a digital value and the digital value will be an input to the RPI. The display unit provides information regarding satellite signals (strength, quality), motor position, and LNBF skew position and detects satellite information. The information which was provided by the sensors and tuner are captured in the RPI as the main control mechanism.

We have designed a prototype system and tested it successfully by tracking two satellites (ABS2, and NSS6/ 95E). We were able to successfully find and tune the satellite dish based on received signal strength using a specific servo motor mechanism and an actuator system. The system successfully found the geographically synchronized satellites by receiving maximum signals from the target satellite. The proposed system finds known satellites easily by capturing peak signals (signal strength 85-95%). The system carries out automated calibration. Therefore, no calibration after maintenance and human intervention are necessary for satellite finding. The system also satisfies the requirements of simplicity and low cost.

Keywords: Satellite tracking, AGC Voltage, Raspberry Pi (RPI), GPIO, Servomechanism

[*]Corresponding author: email- rajith.nap@gmail.com