Satellite Dish Positioning Using IR Remote Control

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ABSTRACT: The paper is designed to develop a platter positioning system that can be operated using a conventional television remote. The main application of using a dish is to receive signal from satellites and other broadcasting sources. It needs to be manually adjusted to position the dish to the exact angle to receive the maximum signal of a particular frequency. PIC microcontroller was developed in this paper to create a satellite dish positioning system which can be controlled with remote control. The key point of using a dish is transmitting signal from satellites and other sources of broadcast. To get the exact angle of the dish's location, it needs to be manually changed. To solve the difficulty of manually changing, this paper helps by remote control to adjust the location of the bowl. Remote control serves as a transmitter whose data is transmitted by an IR receiver that is interfaced with a PIC 16F877A microcontroller. Remote control sends coded data to the receiver whose output is then forwarded to the microcontroller. This framework is also used for the implementation of simple pro language. The microcontroller sends the control signals via an interface known as a relay driver to the motor.

KEYWORDS: PIC 16F877A, Infrared (IR), Television, Remote Control, DC Motor, Satellite Dish.

INTRODUCTION

Satellites are an important part of the worldwide communication systems since they carry vast quantities of data, telephone traffic and TV signals. The use of satellites in daily life is evident in the many homes and workplaces that are fitted with various types of antennas that are used for transmitting signals from satellites placed further away from the earth [1]. Satellites are positioned further from the Earth because the Earth's gravitational force is weaker at comparatively higher levels and stronger at lower levels, and communication satellites are typically built about 36,000 km away from the Planet. Because approximately 42 per cent of the Earth's area is visible from a satellite, satellite communication has an advantage over other communication methods. Some type of stabilization is required to prevent from satellites from swinging from their placed orbits. Attitude control combines this stabilization with a mechanism that keeps it going uniformly across its orbits by the satellite's orientation. With geostationary satellites, the satellite may receive or transmit messages to any transmitter or transceiver that is permanently visible to the satellite within a specified geographical area [2].

Communication between Earth Observers and space satellites is made possible through antennas. A satellite dish is a type of antenna designed to focus on a particular broadcast source that collects information by reflecting signal beams and concentrating them on a fairly narrow beam that reaches its parabolic surface and then transmits the signal to the receiving equipment. The art of remote communication between device users and their respective systems is becoming increasingly complex every day, with a variety of ways like electrical wires, component cables, storage media, computer buses, radio signals and infrared beams, and an even greater variety of connectors, plugs and protocols.

Wired communication is used to describe any form of communication mechanism that relies on cable direct use and wiring for data transmission [3]. Examples of wire based networking systems include mobile networks and networking with fiber-optics. Notwithstanding this, wireless technologies have changed how people and machines will communicate with each other anywhere in the world, where the position of users or machines is not required to be set for contact, with a great shift from wired to wireless technology in many lifetimes.

The geosynchronous orbit is home to several commercial communications satellites. Geostationary satellites are located in orbit directly above the equator, and stay in the same place in the sky as they rotate around the planet at the same angular velocity as that of the earth. Therefore satellite positions can only be identified by longitude. Geo orbit position is the position of longitude around the geostationary orbit. The satellites in the sky above the equator are all approximately defined. Negative orbit position numbers are degrees West of meridian Greenwich. Positive numbers are East Degrees. Eastern and western longitudes are common for public use, as the numbers are smaller [4]. However, using just degrees East (0 to + 360deg, heading east from Greenwich) is my choice because the satellites are traveling along this way and it makes sense for the numbers to start to rise as the satellite goes forward.

It is difficult enough to try to do orbit calculations without making numbers that keep moving forward and backward. Many satellite operators do use the method 0 to + 360 deg but may also have the notation "deg West" for certain production publications. Imaginary lines which run vertically around the globe, often called meridians. Lines are not parallel, unlike latitude axes. Meridians converge at the poles and the equator is most far apart. Prime meridian is called zero degrees longitude (0°). The degrees of longitude from the prime meridian run 180° East and 180° West. Microcontroller is used in this paper to power the satellite dish's DC motor (East and West) in directional terms. Microcontroller is extensively used where the exact positioning of the motor driving the system is required. Microcontroller, like computer control system, is as essential [5].

Using remote control, the user commands the signals to the microcontroller to drive the satellite positioning dish's DC motor. The microcontroller's key advantage is also in monitoring location feedback. Microcontroller can be a command for moving exactly to a specific location. Satellite dish requires precision. For this paper the microcontroller PIC 16F877A was selected to monitor the system's satellite dish. PIC 16F877A microcontroller has the advantages of low-cost high-performance RISC (Reduce Instruction Set Computer) with multiple I/O ports, timer, memory and communication ports [6]. This is thus ideal for monitoring the system's actual location. The system can place the receiver satellite dish in five different positions.

LITERATURE REVIEW

Microcontroller was developed in this paper to create a dish positioning system which can be controlled with remote control. The key point of using a dish is transmitting signal from satellites and other sources of broadcast. To get the exact angle of the dish's location, it needs to be manually changed. To solve the difficulty of manually changing, this paper helps by remote control to adjust the location of the bowl. Remote control serves as a transmitter whose data is provided by a microcontroller-interfaced IR-receiver. The remote control sends coded data to the receiver which is then sent to the microcontroller for output [1]. The key point of using a dish is transmitting signal from satellites and other sources of broadcast. To get the exact angle of the dish's location, it needs to be manually changed. To solve the difficulty of manually changing, this paper helps by remote control to adjust the location of the bowl. Remote control serves as a transmitter whose data is received by a microcontroller-interfaced IR-receiver. The remote control sends coded data to the receiver which is then sent to the microcontroller for output [2]. The goal of this study was to assess the effects of implementing the Proportional-Integral-Derivative (PID) controller in controlling the location of the dish antenna mounted on distributed mobile telemedicine nodes within Nigeria when the connection is through Nigcomsat-1R. The composite transfer function of the closed loop system was obtained and subjected to unit phase forcing function which then yielded parameters of the time domain. The value of system time domain parameters obtained for compensated PID controller system compared to uncompensated system was reduced.

The implementation of the PID controller into this framework has greatly improved the framework response based on the importance of the device time domain parameters obtained from the simulation. This paper presents the design and implementation of a wireless position control device for dc motors, using microcomputers to position a small dish antenna at the desired azimuth and elevation angle. The necessary angle of rotation is the system's input data. Two dc motors are used to position the dish antenna (one for the azimuth position while the other for the elevation position). Signals are sent through the computer's parallel port into the motor control circuit. Because of the remote position of the platter, an infrared transmitter-receiver system is developed to send and receive the required signals via the PC's parallel port to and from the interfacing circuit to control the speed of the motor. A flux mapping system was designed and worked at the Platform Solar de Almerı'a (PSA), capable of calculating the flux distribution of dish systems in planes perpendicular to the optical axis. It uses the indirect measurement method with a water-cooled Lambertian target positioned in the beam direction, and a CCD camera mounted on the focuser taking images of the focal spot's brightness distribution. The calibration is achieved by calculating the total power coming from the platter and connected to the integrated gray value in the entire measuring area. An infrarot radiometer (Infrared Radiometer for Millimeter Astronomy, IRMA) was developed to determine the amount of water vapor in the atmosphere by its 20 mm emission. Water vapor is the major contributor to signaling phase error in submillimeter interferometric arrays, and the primary cause of darkness for infrared wavelength working telescopes. Although earlier IRMA versions required hands-on operation, the ability to work on remote and frequently hostile sites demanded sophisticated and robust software creation. IRMA is a distributed, real-time control and data acquisition system spread over three separate computers, and can be remotely managed by command scripts or a graphical user interface software program over the network.

METHODOLOGY

A satellite dish's control system consists of the equipment used to move it inside the dish, and the software written to control this step. This system consisted of hardware components which mechanism was based on remote controller, PIC microcontroller, relay driver, and DC motor servo. A user enters a command such as satellite dish location; a location is created and then the control software is called. The controller program will calculate a desired dish location and send the command through the microcontroller to the motor. Remote control sends 12 bits of information to command.

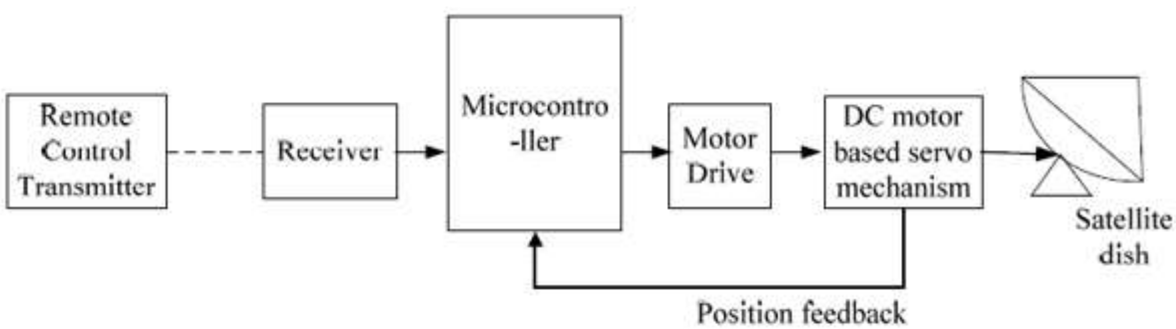

FIGURE 1: Block Diagram of the system

Firstly, when the power supply is on, the motor reaches in some degree. The latter is called this degree. If the setting switch is pressed to save degree and satellite dish motor count, the motor will go to the current degree maximum at the lowest. The motor will stop after it hits the lowest mark.

Then the engine can go to its full capacity. The motor must stop until it hits the maximum mark. And then at the microcontroller, the maximum degree is saved. And you are having the maximum degree and the maximum count. Microcontroller measured the resolution and stored EEPROM degrees and pulses. The motor is powered when command degree fed to the PIC microcontroller from remote control. The engine shifts with the counts. The reed sensor senses those counts. Feedback from the reed sensor to the microcontroller counts driving motor.

Microcontroller raises the counts if the degree of the order is greater than the last degree. Although through the counts, microcontroller can stop the motor when the degree of command is equal to the final degree. Similarity, if the degree of command is less than the last degree, microcontroller makes the counts decrease. The motor will be stopped by microcontroller while through the counts when the degree of command is equal to the last degree.

HARDWARE COMPONENT OF THE SYSTEM

Infrared Remote Control Device

The infrared remote controller consisted of an infrared remote control transmitter, and an infrared remote control receiver. Remote transmitter circuit structure consisted of unique integrated circuit IC1 as the core element; transmitter keyboard matrix circuits consisted of matrix switches that could constitute keyboard input circuit with pulse generator in the IC1 and signal encoder in the keyboard. Remote receiver was composed of photodiode-installed specific IC2 integrated circuit. When photosensitive receiver tube receives infrared light from remote control, the light signal will be converted by photosensitive tube as the electrical signal [3].

The IR sensor module receives remote type sent IR pulses and converts them to corresponding electrical pulses. These electrical pulses are provided to the microcontroller, which uses zero crossing detector and chip timer and interrupt to decode it to corresponding data byte. These bytes of data are used to take additional control decisions. The control output signals are passed to the driver circuit, which drives the satellite dish's DC motor. This paper employs a Sony Remote Control Transmitter. The Sony remote control is based on the signal coding scheme Pulse-Width. The code exists of 12 bits sent on a carrier wave of 40 kHz. The code begins with a 2.4milli second (ms) header or 4 times T, where T is 600 micro second (µs). Following the header are 7 command-bits and 5 address-bits as shown in Figure 4. Logical ones and zeros function as the address and commands. A logical one is generated by 600 µs or 1 T of space and 1200 µs or 2 T of pulse. A logical zero is formed by 600 µs of space and 600 µs of pulse. When pushing a button, the distance between 2 transmitted codes is 40 ms. At first, the bits are transmitted with the least important bits. A bit-stream's total lenght is always 45 ms.

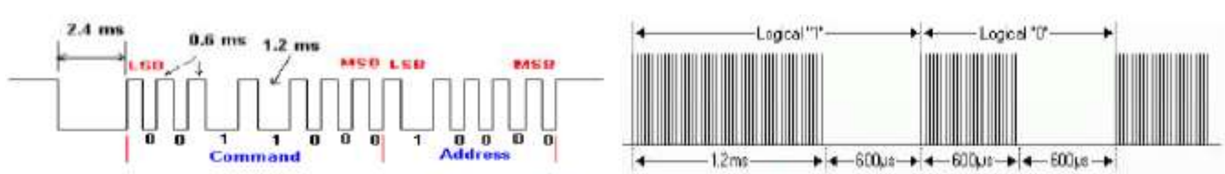

FIGURE 2: IR transmitter protocol

PIC Microcontroller

There are several types of PICs. Some are devices of the type OTP (One Time Programmable), and some are devices of the type Flash. OTP tools are not appropriate for hobbyists in the field of electronics, since their software code cannot be modified when programmed. Flash type devices are reprogrammed in-circuit over and over again. There are usually three types of microcontroller Flash type unit. These are PIC 16F84A, 18 pin microcontroller, PIC 16F628A, 18 pin microcontroller and PIC 16F877A, 40 pin microcontroller. The microcontroller PIC 16F877A has built-in ADC (analog to digital converter), USART (universal synchronous and asynchronous receiver transmitter), PWM (pulse width modulation), more I / O ports and more software memory room. It was chosen in this paper because of its capability [4].

DC Motor Based Servomechanism

Nowadays the most common motor is a servo motor that is used for heavy load application control and driving. At the other hand, the cost of servo motoring for this application is extensively high. So for this device, the YURI 518R servomechanism is chosen. The general view of servomechanism YURI 518R. Driving over 250 kg loads is assisted, when powered only by 36V DC motor. The process consists of the transfer upper and lower limits. This limit switch is shielded so as not to affect the mechanism on the main axis and the feedback reed switch for extremely drive and internal magnetic. The reed turn feedback is 7 pulses per rotation, and totally 873 pulses for the entire inner rod movement [5]. A reed sensor is a system designed using a reed switch with additional features such as higher shock resistance, easier mounting, additional intelligent circuitry etc. When a magnetic force is produced parallel to the reed switch, the reeds in the magnetic poles become flux carriers which attack each other. If the magnetic force between the poles is strong enough to overpower the reed restorative force, the reeds are drawn together. The reeds switch is typically in a sealed glass capsule with a special insert gas which prevents oxidation (rusting) of the switch contacts. The reed blades become opposite magnetic poles which attract when a magnet is brought within a specific distance. This closes the circuit and allows flowing of current. When the magnet is removed the reed blades lose their magnetic induced and thereby open the circuit separately. It can be used in harsh conditions, since the switch is sealed. On both magnetic poles reed switches react [6].

Software Implementation of the System

This system utilized input device remote control and user interfacing LCD module for output device. In addition, two other separate LEDs are used for motor path movement indications. With transistor amplification the DC motor is powered by two electromagnetic relays. The location feedback is obtained with the aid of the Opto coupler by using the reed switch interface.

Operation of the Motor

Microcontroller is used to drive the motor in the direction of the clockwise when the degree of command is greater than the last degree, and the direction of the counterclockwise when the degree of command is less than the last degree. And it is used to drive the motor with the desired degree by measuring the degree of command from the remote and the degree of input from the reed sensor Microcontroller is used to drive the motor in the direction of the clockwise when the degree of command is greater than the last degree and in the direction of the counterclockwise when the degree of command is less than the last degree. And it is used by measuring the command degree from the remote and feedback degree from the reed sensor to drive the motor with the desired grade.

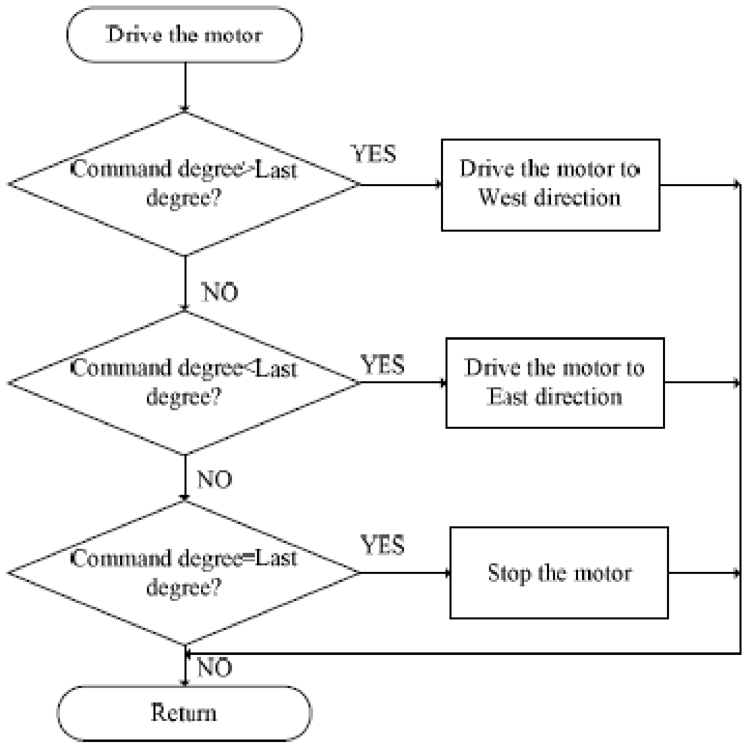

FIGURE.7. Flow chart for the motor operation

CONCLUSION

This paper is intended to push the satellite dish towards the location of the selected channel. The device shows the satellite dish positioning menu at first, and waits via remote control for the desired channel user input. When selecting the desired channel, the program initially calculated which direction to drive is needed. And the EEPROM load current shows up on the LCD. The dish is powered by subroutine search and feed backed and measured by subroutine test feedback signals. Two LEDs show the direction of motion of the pot. When the forward direction is taken the green LED is indicated and the red LED is indicated for the opposite direction. The software will stop the motor as soon as the powered location is reached and two LEDs will go off. In this paper the reed sensor is used to give the microcontroller the feedback signal that the satellite dish is in the desired location or not. If the sensor is not attached the device will hang and the device will have to be reset by the user. So microcontroller can't directly connect a motor because it can't provide enough current to drive the motor. Thus, in this system, the motor driver circuit is designed as switches with two relays that are used to drive the motor in clockwise and counterclockwise direction.

Satellite dish positioning device without microcontroller can be equipped with computer system. But a single chip microcontroller is low cost, small size and high performance. Microcontroller is thus ideally suited for auto positioning system. A Satellite Positioning System was developed in this system. Essential to its monitoring capability is a satellite dish control system. Satellites are operated on Earth by a ground station antenna transmitting commands and receiving information from the satellites. This system uses remote control to start pushing the motor in the direction you wish. PIC microcontrollers are commonly used worldwide and are based on cutting-edge technology. Using remote control improves the cutting-edge technology. And the motor is designed using the microcontroller to maintain the desired location. While this is the first approaching phase towards control system, automation system, and robotics systems, these will serve the industrial control to a great extent.

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