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ADVANCED USER CONTROLLED ROOF TOP ANTENNA SIGNAL TRACKING SYSTEM WITH GEARED DC MOTOR

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Abstract:

Radar is an object-detection system which uses waves to determine the range, altitude, direction, or speed of objects. The object returns a tiny part of the wave's energy to a dish or antenna which is usually located at the same site as the transmitter. Here in this paper we present the antenna which is fitted with DC geared motor. The PIC microcontroller, DC Geared motors, H-Bridge is used to drive the geared DC motor, and IR sensors. We can place antenna at an altitude to track various frequencies emitted by radio stations. The system is provided with control switches. If user presses one switch, antenna tracks for corresponding IR signal. The rotation of antenna is based on the signal tracked by a pair of infrared sensor. Once the signal is matched antenna bowl will stop in that particular direction. In this way we can track the signal and can switch ON the particular desired frequency channel.

Keywords:
Power supply, PIC micro controller, LCD, DC motor, IR sensor

1. Introduction:

The Radar, which is used to track the path of one or more targets is known as **Tracking Radar**. In general, it performs the following functions before it starts the tracking activity.

- Target detection
- Range of the target
- Finding elevation and azimuth angles
- Finding Doppler frequency shift

So, Tracking Radar tracks the target by tracking one of the three parameters — range, angle, Doppler frequency shift. Most of the Tracking Radars use the **principle of tracking in angle**. Now, let us discuss what angular tracking is.

Angular Tracking

The pencil beams of Radar Antenna perform tracking in angle. The axis of Radar Antenna is considered as the reference direction. If the direction of the target and reference direction is not same, then there will be **angular error**, which is nothing but the difference between the two directions.

There exists a feedback mechanism in the Tracking Radar, which works until the angular error becomes zero.

Following are the **two techniques**, which are used in angular tracking.

- Sequential Lobing
- Conical Scanning

Sequential Lobing- If the Antenna beams are switched between two patterns alternately for tracking the

target, then it is called sequential lobing. It is also called sequential switching and lobe switching. This technique is used to find the angular error in one coordinate. It gives the details of both magnitude and direction of angular error.

Conical Scanning- If the Antenna beam continuously rotates for tracking a target, then it is called conical scanning. Conical scan modulation is used to find the position of the target. Following figure shows an example of conical scanning.
Squint angle is the angle between beam axis and rotation axis and it is shown in the above figure. The echo signal obtained from the target gets modulated at a frequency equal to the frequency at which the Antenna beam rotates.

The angle between the direction of the target and the rotation axis determines the **amplitude of the modulated signal**. So, the conical scan modulation has to be extracted from the echo signal and then it is to be applied to servo control system, which moves the Antenna beam axis towards the direction of the target.

The purpose of a tracking system is to determine the location or direction of a target on a near-continuous basis. An ideal tracking system would maintain contact and constantly update the target's bearing (azimuth), range and elevation. The antenna is rotated by a motor which provides a negative position feedback signal to a controller. This subsystem is known as a *servo-mechanism.*

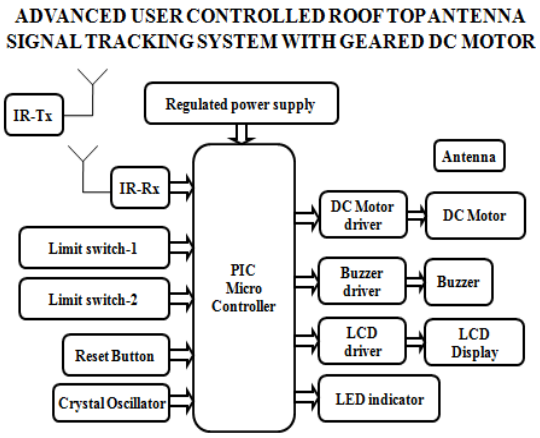
We present a User controlled roof top antenna tracking system, the antenna is fitted with DC geared motor interfaced with PIC microcontroller. H-Bridge is used to drive the geared DC motor and antenna is placed at an altitude to track various frequencies emitted by radio stations. The rotation of antenna is based on the signal tracked by a pair of infrared sensor. Once the signal is matched antenna bowl will stop in that particular direction, In this way we can track the signal and can switch ON the particular desired frequency channel.

2. LITERATURE SURVEY:

I. In the paper of "Advanced User Controlled Roof Top Antenna Signal Tracking System Using Arm11". A roof top antenna tracking system is designed to track the signal. Roof top antenna better suits in all the areas for tracking signals from a distant place .Here in this project the antenna is fitted with DC geared motor and to control its operation we are using BCM2835 as its controller. In this project we are using ARM11 Processor, DC Geared motors, IR sensors. In this project, L293D H-Bridge is used to drive the geared DC motor. In this project antenna is placed at an altitude to track various frequencies emitted by radio stations. The system is provided with control switches. If user presses one switch, antenna tracks for corresponding IR signal. The rotation of antenna is based on the signal tracked by a pair of infrared sensor. Once the signal is matched antenna bowl will stop in that particular direction it indirectly turns ON the relay to switch ON the particular Buzzer. In this way we can track the signal and can switch ON the particular desired frequency channel.

II. In this paper, "Automatic Satellite Tracking System on a Movable Platform". Satellite dish antennas have become popular in recent years primarily for use in vehicle communication systems. Accordingly, the satellite dish antenna further comprises a roof mount to install the dish on the roof of the vehicle, such as maritime vessel, truck, or caravan. However, such a mobile satellite dish has several drawbacks. As it is mentioned above, since the satellite dish antenna is a highly directional antenna, the dish must be manually adjusted its orientation when the vehicle travels from place to place. The tuning process requires the user to manually elevate, lower, and position the dish to the direction of the satellite, where the alignment of the dish is somewhat difficult to be fixed due to the manual adjustment and usually resulted in low-quality signal reception and possible satellite interference. Furthermore, the dish may be unintentionally shifted its orientation misalign with the direction satellite in a high wind operating environment. An automated satellite TV tracking system can rather be very expensive depending on system complexity. The mobile satellite dish antennas are costly to manufacture, install, and maintain in order to perform as the mentioned condition. Accordingly, the manufacture of the receiving dish itself is somewhat inexpensive. However, the installation of the satellite dish antenna is time consuming and requires an experienced technician to install and maintain the whole electrical wiring for the user's requirements and the system's safety. This project is aimed to produce a reliable and cheaper prototype of satellite TV tracker system. The output of this project is intended to be mounted on a maritime vessel.

3. HARDWARE IMPLEMENTATION:



3.1 Block diagram of ADVANCED USER CONTROLLED ROOF TOP ANTENNA SIGNAL TRACKING SYSTEM WITH GEARED DC MOTOR

The main blocks of this paper are: Regulated power supply, PIC Microcontroller, Reset, DC motor, IR sensor, LCD.

This paper idea makes use of a PIC micro controller, which is programmed, with the help of embedded C instructions. This PIC Microcontroller is capable of communicating with input and output modules. The main controlling device of the whole system is PIC microcontroller. The main aim of the project is to track the signal. A roof top antenna tracking system is designed to track the signal. Roof top antenna better suits in all the areas for tracking signals from a distant place. H-Bridge is used to drive the geared DC motor, antenna is placed at an altitude to track various frequencies emitted by radio stations. The system is provided with control switches. If user presses one switch, antenna tracks for corresponding IR signal. The rotation of antenna is based on the signal tracked by a pair of infrared sensor. Once the signal is matched antenna bowl will stop in that particular direction it indirectly turns ON the relay to switch ON the particular Buzzer. In this way we can track the signal and can switch ON the particular desired frequency channel.

4. Related Work:

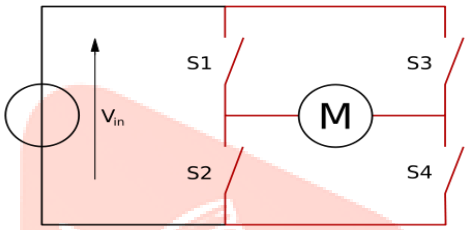
The brief introduction of different modules used in this project is discussed below:

4.1. DC Motor:

A dc motor uses electrical energy to produce mechanical energy, very generally through the interaction of magnetic fields and current-containing conductors. The reverse process, producing electrical energy from mechanical energy, is carried out by an alternator, source or dynamo. Many types of electric motors can be run as sources, and vice verse. The input of a DC motor is current/voltage and its output is torque (speed).

Fig: DC Motor

An H bridge is an electronic circuit that enables a voltage to be applied across a load in either direction. These circuits are often used in robotics and other applications to allow DC motors to run forwards and backwards.



When the switches S1 and S4 (according to the first figure) are closed (and S2 and S3 are open) a positive voltage will be applied across the motor. By opening S1 and S4 switches and closing S2 and S3 switches, this voltage is reversed, allowing reverse operation of the motor.

4.2. LCD Module:

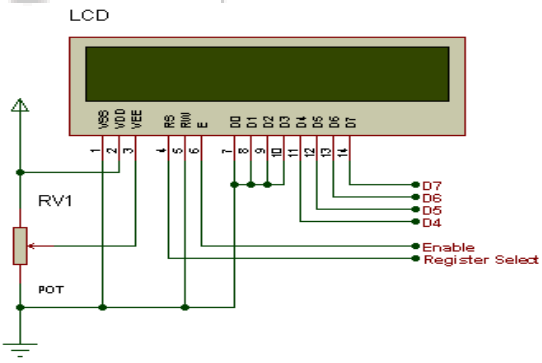


Fig: LCD

One of the most common devices attached to a micro controller is an LCD display. Some of the most common LCD's connected to the many microcontrollers are 16x2 display. This means 16 characters per line by 2 lines respectively. As previously mentioned, it takes a certain amount of time for each instruction to be executed by the LCD.

4.3. PIC micro controller:

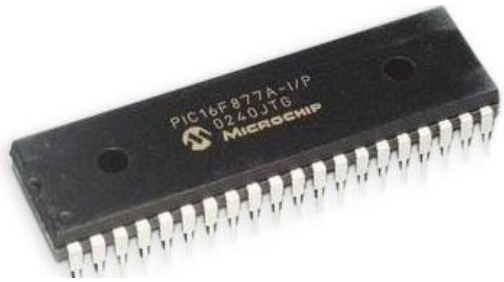


Fig: PIC micro controller

The PIC microcontroller features 5 channels of 8-bit Analog-to-Digital (A/D) converter with 2 additional timers, capture/compare/PWM function and the synchronous serial port can be configured as either 3-wire Serial Peripheral Interface (SPI™) or the 2-wire Inter-Integrated Circuit (I²C™) bus. All of these features make it ideal for more advanced level A/D applications in automotive, industrial, appliances and consumer applications. The hardware capabilities of PIC devices range from 6-pin SMD, 8-pin DIP chips up to 144-pin SMD chips, with discrete I/O pins, ADC and DAC modules, and communications ports such as UART, I2C, CAN, and even USB. PIC devices are popular with both industrial developers and hobbyists due to their low cost, wide availability, large user base, extensive collection of application notes, and availability of low cost or free development tools, serial programming, and re-programmable flash-memory capability. The Proteus Design Suite is able to simulate many of the popular 8 and 16-bit PIC devices along with other circuitry that is connected to the PIC on the schematic. The program to be simulated can be developed within Proteus itself, MPLAB or any other development tool.

Peripheral Features:-

- High Sink/Source Current: 25 mA
- Timer0: 8-bit timer/counter with 8-bit pre-scaler
- Timer1: 16-bit timer/counter with pre-scaler, can be incremented during SLEEP via external crystal/clock
- Timer2: 8-bit timer/counter with 8-bit period register, pre-scaler and post-scaler
- Capture, Compare, PWM (CCP) module- Capture is 16-bit, max. resolution is 12.5 ns- Compare is 16-bit, max. resolution is 200 ns- PWM max. resolution is 10-bit
- 8-bit, 5-channel analog-to-digital converter
- Synchronous Serial Port (SSP) with SPI™ (Master/Slave) and I2C™ (Slave)
- Brown-out detection circuitry forBrown-out Reset (BOR)

4.4. IR sensor:

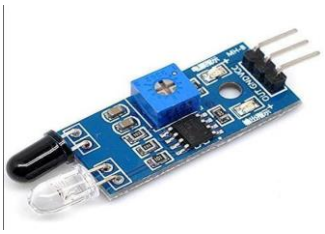


Fig: IR sensor

This sensor is a short range obstacle detector with no dead zone. It has a reasonably narrow detection area which can be increased using the dual version. Range can also be increased by increasing the power to the IR LEDs or adding more IR LEDs. The photo below shows my test setup with some IR LED's (dark blue) as a light source and two phototransistors in parallel for the receiver. You could use one of each but I wanted to spread them out to cover a wider area. This setup works like a FritsLDR but with IR. It has a range of about 10-15cm (4-6 inches) with my hand as the object being detected.

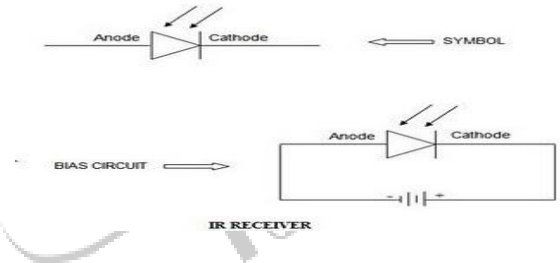


Fig: IR sensor module

IR transmitter and receiver

An electroluminescent IR LED is a product which requires care in use. IR LED's are fabricated from narrow band hetero structures with energy gap from 0.25 to 0.4 eV. Infra red transmitter emits IR rays in planar wave front manner. Even though infra red rays spread in all directions, it propagates along straight line in forward direction. IR rays have the characteristics of producing secondary wavelets when it collides with any obstacles in its path. This property of IR is used here. When IR rays gets emitted from LED, it moves in the direction it is angled. When any obstacle interferes in the path, the IR rays get cut and it produces secondary wavelets which propagates mostly in return direction or in a direction opposite to that of the primary waves, which produces the net result like reflection of IR rays.

Infrared photo receiver is a two terminal PN junction device, which operates in a reverse bias.

It has a small transparent window, which allows light to strike the PN junction. A photodiode is a type of photo detector capable of converting light into either current or voltage, depending upon the mode of operation. Most photodiodes will look similar to a light emitting diode. They will have two leads, or wires, coming from the bottom. The shorter end of the two is the cathode, while the longer end is the anode. A photodiode consists of PN junction or PIN structure. When a photon of sufficient energy strikes the diode, it excites an electron thereby creating a mobile electron and a positively charged electron hole. If the absorption occurs in the junction's depletion region, or one diffusion length away from it, these carriers are swept from the junction by the built-in field of the depletion region. Thus holes move toward the anode, and electrons toward the cathode, and a photocurrent is produced.

4.5 Buzzer:

Fig: Picture of buzzer

Basically, the sound source of a piezoelectric sound component is a piezoelectric diaphragm. A piezoelectric diaphragm consists of a piezoelectric ceramic plate which has electrodes on both sides and a metal plate (brass or stainless steel, etc.). A piezoelectric ceramic plate is attached to a metal plate with adhesives. Applying D.C. voltage between electrodes of a piezoelectric diaphragm causes mechanical distortion due to the piezoelectric effect. For a misshaped piezoelectric element, the distortion of the piezoelectric element expands in a radial direction. And the piezoelectric diaphragm bends toward the direction. The metal plate bonded to the piezoelectric element does not expand. Conversely, when the piezoelectric element shrinks, the piezoelectric diaphragm bends in the direction Thus, when AC voltage is applied across electrodes, the bending is repeated, producing sound waves in the air.

5. CONCLUSION and FUTURESCOPE:

Integrating features of all the hardware components used have been developed in it. Presence of every module has been reasoned out and placed carefully, thus contributing to the best working of the unit. Secondly, using highly advanced IC's with the help of growing technology, the project has been successfully implemented. Thus the idea of the paper has been successfully designed and tested. So the arrangement of this design with a core features such as to track the signal using roof top antenna mounted on the geared DC motor. The paper presented "Advanced User Controlled Roof Top Antenna Signal Tracking System With Geared Dc Motor" was designed to track the signal of Roof top antenna better suits in all the areas for tracking signals from a distant place.

In future we can use this project in order to control devices automatically in weather stations and intimation of environmental conditions. This kind of automation provides greater advantages like accuracy, climate conditions, and reliability and more over the automated systems do not require any human attention. As the energy conversation is very important in the current scenario and should be done to a maximum extent where ever it is possible we can implement even solar power for storing the energy in battery for back up.

6. ACKNOWLEDGEMENT

We would like to thank all the authors of different research papers referred during writing this paper. It was very knowledge gaining and helpful for the further research to be done in future.

7. RESULTS:

The paper presents the design of "Advanced User Controlled Roof Top Antenna Signal Tracking System with Geared Dc Motor" was designed to track the signal of Roof top antenna better suits in all the areas for tracking signals from a distant place. Where radar is used to follow the motion of a single object or target, it is advantageous to provide that the receiver be operated only during the periods in which energy from the selected target is being received. The rotation of antenna is based on the signal tracked by a pair of infrared sensor. Once the signal is matched antenna bowl will stop in that particular direction it indirectly turns ON the relay to switch ON the particular Buzzer. In this way we can track the signal and can switch ON the particular desired frequency channel.

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