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SOLARIUM: HOME AUTOMATION SYSTEM USING BLUETOOTH

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Abstract: In this paper, we aim at designing a home automation system using automatic sun tracking system. Also operating the home appliances using Bluetooth, thus resulting in the intelligent homes by avoiding the wastage of energy i.e. low energy consumption. Automatic sun tracking system is a hybrid hardware and software prototype which automatically provides best alignment of solar panel with the sun to get maximum output. The system is implemented for operating home appliances (home automation) which will be operated by using Bluetooth technology.

Keywords: solar panel, Bluetooth, Microcontroller.

I.Introduction

Now days the development of the electricity industry is facing major changes. The progressive development of technology pushes the energy industry to a new level of energy development. The technology which is environment friendly natural and clean. Therefore renewable energy sources are the best proven sources of energy, among which solar energy is one of the choices of this category. Energy from sun is obviously environmentally advantageous from all aspects. Though number of maximum power point tracking algorithms have been developed and employed around the world. [1]

The photo voltaic (PV) module is one of the efficient sources of harnessing solar energy in the form of electricity. The output of PV module varies with the solar insolation, the cell temperature and output voltage of PV module. The PV panel ensures the conversion of light radiation into electricity and it is characterized by a strong dependence of the output power on the incident light radiation. [2]

Here in our project, we describe a home automated system where decision making part is carried out by microcontroller (Arduino Uno). The solar tracking system is harnessing maximum energy from sunlight which will be stored in the DC battery. This stored energy will further be used for operating home appliances like fan, LEBs bulbs etc.

II. Block Diagram

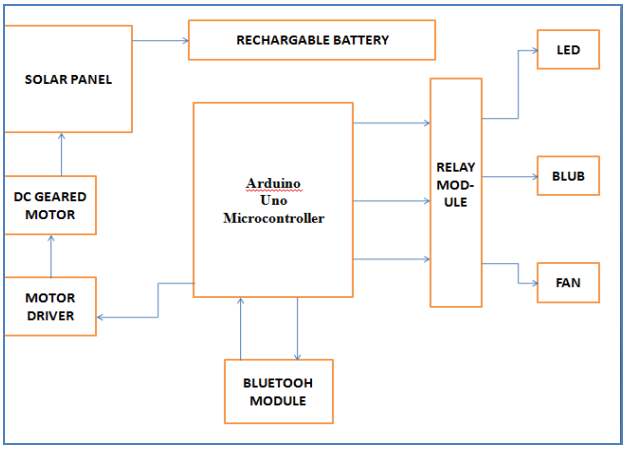


Fig: 1 Block Diagram of Solarium: A Home Automation System

III. System Architecture and Implementation

Arduino Uno: it is the heart of the project. It is used as it is open source hardware. Current models feature a USB interface together with six analog input pins and 14 digital I/O pins.

Solar cell panel: it is a set of solar photovoltaic (PV) modules electrically connected and mounted on a supporting structure. A PV module is a packaged, connected assembly of solar cells

LDR: LDRs or Light Dependent Resistors are very useful especially in light/dark sensor circuits. Normally the resistance of an LDR is very high, sometimes as high as 1000 000 ohms, but when they are illuminated with light resistance drops dramatically. In this project four LDRs are fixed on the solar panel at four distinct points. LDR (Light Dependent Resistor) varies the resistance depending upon the light fall. The varied resistance is converted into an analog voltage signal. The analog voltage signal is then fed to an A/D which convert analog voltage signal to corresponding digital signal. Microcontroller receives the four digital signals from the A/D and compares them. The LDR signals are not equal except for normal incidence of sunlight. When there is a difference between LDR voltage levels the

microcontroller program drives the stepper motor towards normal incidence of sunlight.

DC Gear Motor: A DC motor is designed to run on DC electric power. The Most Common DC Motors are the brushed and brushless types which use internal and externally. Brushless DC motors are commonly used where precise speed control is necessary. DC brushless motors range in power from a fraction of a watt to many kilowatts. Larger brushless motors up to about 100 kw rating are used in electric machines. They also find significant use in high performance servo controlled systems in Industrial automation. In this project we have used DC geared motor with 1.8 rpm, 85mA input current, because start and stop of motor is easy and due to low current it can be interfaced by microcontroller directly without the usage of any driver IC.
Battery: A 12 V DC battery is used to store the charge or power that is generated by the Solar Cell Panel. This stored energy will be further used to power the automation system. The same stored energy is also used to control the entire system implemented in this project. That means the same stored energy will be used to power up the Microcontroller unit that is used to control the entire system. Also the same energy is used to move the Solar Cell Panel according to the position of the sun.

Home Automation Using Bluetooth: the Bluetooth wireless technology is set to revolutionize the way people perceive digital devices in our homes and office environment. Now they are no longer just the individual devices; instead with the embedded Bluetooth technology, they form a network in which appliances can communicate with each other. The Bluetooth module is connected to the Arduino Uno board. The DC geared motor is interfaced with microcontroller via an interfacing block which contains an IC called L293D. Two Light Dependent Resistors (LDR) are attached on either surface of the solar module. The programming of this system is so done as when the difference between the two sensors is less than (<) 10, the motor will rotate. When the difference of the two sensors is between 0-10, then the panel will hold its position and both the pins of motor will become low. Its position and both the pins of motor will become low.

The output of the panel is a DC current so that's why we have used a rechargeable battery so that it will get charged from the output coming from the solar panel. The charged DC battery than can be used with an inverter to convert it into AC to provide AC voltages in household. Here we have used Bluetooth SPP Pro Application; it is a serial port Bluetooth module that works efficiently with Arduino Microcontroller board. It establishes a serial communication with the Microcontroller and can search for low energy Bluetooth devices. The software feature of Bluetooth SPP pro is that it searches for the low energy Bluetooth devices and displays the class and received Signal Strength Indication respectively. Serial communication is used for sending and receiving of data bits.

Relay Module A 12V relay is being used in this project for switching purposes. The relay is also connected to the Bluetooth module via the microcontroller and it is the Bluetooth that is responsible for switching ON and OFF.

IV. Working Principle

For Home automation a Bluetooth module HC-05 is interfaced with the microcontroller board. The Vcc pin of the module is connected to the 5V pin of arduino board. The Transmitting(Tx) pin of the module is connected to the Rx of the board and the Tx of the board is connected to the Rx of the Bluetooth module.

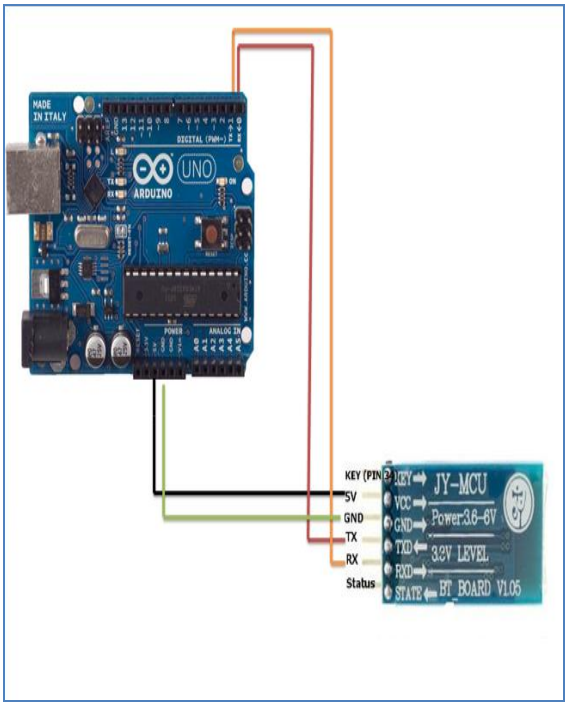


Fig.2(a) circuit diagram of arduino with Bluetooth

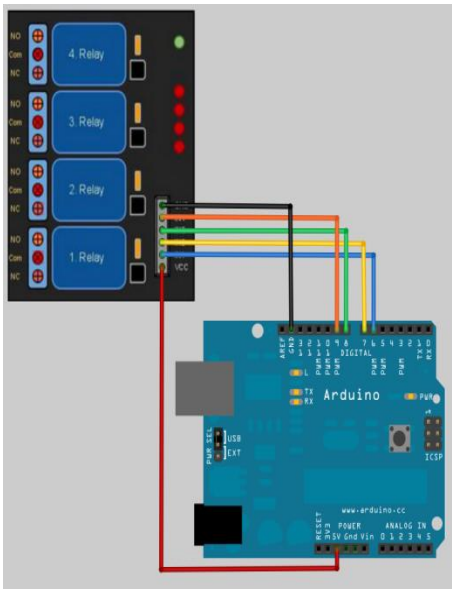


Fig. 2(b) circuit diagram of arduino with relay module

The microcontroller board is operated at DC voltage from a battery. Now, as the light falls on the sensors there resistance changes leading to rise in current. The movement of the panel will depend upon where the max. light is falling and on which sensor. correspondingly the panel will rotate in that particular direction.

The movement of the panel is guided by the movement of the DC motor used.

DC geared motor cannot be interfaced with the microcontroller directly. The reason being is that motor, relays, solenoids are heavy loads and we require large current to drive these kind of loads. The current at the pins of arduino microcontroller board is generally around 40mA which is not enough to drive a DC motor.

So, an interfacing circuit is used that will connect the DC motor and the arduino microcontroller board. That circuit comes in an IC called L293D. L293D is responsible for interfacing loads such as motor, relay, solenoids with the microcontroller.Now, according to the logic implemented, at night i.e. when there will be no light falling on the sensors, the panel will automatically adjust itself in the east direction and then again in the morning it will continue the tracking of the sun.

For this to happen, the motor needs to be rotated in the opposite direction.

That's where L293D comes in. This IC consist of a circuit know as H-bridge that is responsible for the bidirectional movement of the motor. L293D consist two H-bridge that means two motors can be interfaced with the microcontroller with bidirectional movements.

Now, for home automation we need to interface relay with the microcontroller board. For this to achieve we need a driver circuit as we have done for the interfacing of DC motor. But since we are using relay module, than there is no necessary for the driving circuit since it will automatically adjust the current required to drive the relay.

Four relay are being used out of which only three are working and are connected to port 3, 4, and 5 respectively. For the bulb to glow using the Bluetooth module, the necessary connection has to be done with the relay terminals and the battery. The positive terminal of the LED is connected to the positive terminal of the battery.

The negative terminal of the LED is connected to the common port of relay and the normally-close (NC) of the relay is connected to the negative of the battery.

Application: The application that we are trying to show here is the home automation. Home automation is the residential extension of building automation. It is automation of the home, housework or household activity

V. Bluetooth SPP Pro Application

The software for the Bluetooth client communication tools (ie: Bluetooth slave mode), Bluetooth serial communication can be tested .It can connect a Bluetooth MCU and PC serial port.

Fig. 3(a) Bluetooth SPP Pro

Support android 4.0+ version of the system. The hardware description of Bluetooth SPP pro is that it's a serial port Bluetooth module that works efficiently with Arduino Microcontroller board. It establishes a serial communication with the MCU and can search for low energy Bluetooth devices.

The software feature of Bluetooth SPP pro are that it search for the low energy Bluetooth devices and display the class and the Received Signal Strength Indication(RSSI) respectively. Serial communication is used for sending and receiving of data bits.

Bluetooth SPP Pro can be set to American Standard Code for Information Interchange(ASCII) and HEX input/output mode. Also, the data results can be saved to your Phone SD card memory (/sdcard/Bluetooth spp pro/...).

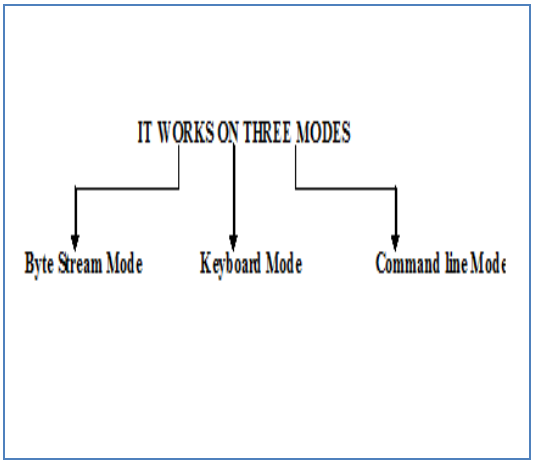
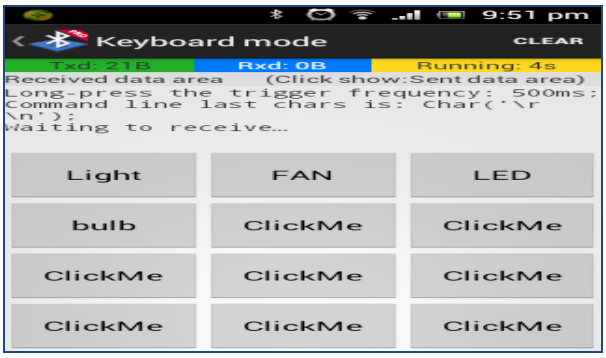


Fig. 3(b) Modes of SPP-PRO

If the connected Bluetooth device is not paired, the system will automatically prompt the user for pairing. Bluetooth pairing is successful, try to connect again.

This can only connect Bluetooth serial module devices, Bluetooth devices are generally used for MCU serial communication.



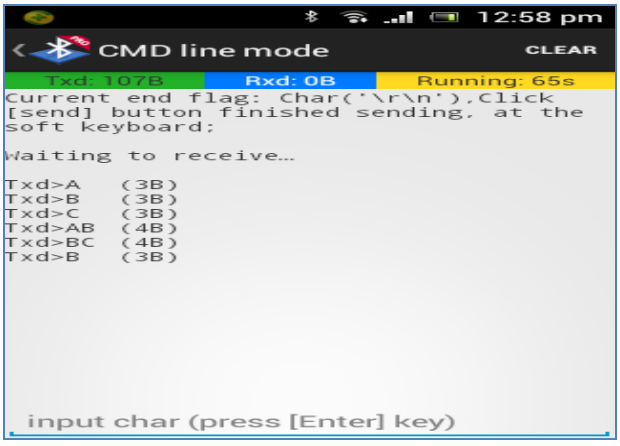


Fig:3(c) Keyboard Mode
Fig: 3(d) Command Line Mode

System using the Bluetooth pairing means: [menu-> Settings -> Wireless and Network -> Bluetooth Settings], open the Bluetooth feature, and to search for Bluetooth devices to pair, paired with a device only once.

System Configuration (includes keyboard mode button settings) file can be found in the SD card Bluetooth spp pro directory. You can back up the configuration file, or copy the configuration file to terminal equipment, covering his profile to complete recovery.

Special cases:
Non-normal end of the Bluetooth function, may lead to not be able to connect Bluetooth devices such as this is the case, please restart the phone can often return to normal.

Conclusion: The proposed sun tracker automatically tracks the sun capturing maximum solar power with help of microcontroller. The system tracks the sun both in normal and bad weather Condition. The tracker can initialize the starting position itself which reduce the need of any more photo resistor. Summer

solstice and winter solstice problem is solved manually by tilting the panel with the help of fine screw arrangement.

The overall cost of the system is kept as low as possible. The components used are easily available in the market and are user friendly. The position of the LDR plays a crucial role in the tracking of the sun and hence the positions where they are placed in this project justify their operation fully and efficiently. Also, the programming is done in basic C language. Hence, anyone with a basic command in C can write its code.

Future Development: One of the future enhancements that can be done is the Enhancement of solar Distillation using image processing and Neural Network Sun tracking system.

In the last decades, many researchers have studied Sun tracking systems for wide range of applications to improve the efficiency of solar systems by adding the tracking equipment to these systems. A comparison study is made in
Jordan based on fuzzy decision founds that solar distillation utilizing solar energy was most preferable, then came electricity production, solar water pumping and space heating and ventilation, respectively .

Tracking mechanism must be reliable and able to follow the Sun with a certain degree of accuracy, return the collector to its original position at the end of the day or during the night, and also track during periods of cloud cover. Fixed collectors producing heat or electricity throughout the year are usually installed and tilted at an angle equal to the latitude of the installation site facing directly to the Sun.

In this case, the energy collected by the solar collector during both winter and summer is less due to Sun's changing altitude. The use of a tracking mechanism increases the amount of solar energy received by the solar collectors resulting to a higher output power. Commercially, one axis and two -axis tracking mechanisms are available. Usually, the single axis tracker follows the Sun's East-West movement, while the two axis tracker follows also the Sun's changing altitude angle.

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