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PROJECT REPORT*

TOPIC :

SUN TRACKING SYSTEM to achieve maximum incident sunlight USING 8051 MICRO CONTROLLER.

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COURSE TITLE : MICRO CONTROLLER AND EMBEDDED SYSTEMS

COURSE CODE :ECE3031

FACULTY : PROF. SUMIT KUMAR JINDAL

ADVISIOR SLOT : A1

ACKNOWLEDGEMENTS

This is to acknowledge the immense support we got from the faculty and the institution while pursuing this project on "**Design a smart solar panel that absorbs the maximum sunlight according to the time of the day using 8051 microcontroller**". We would like to take this moment to thank VIT for giving me the opportunity to work on this project. We would additionally thank the dean of school SENSE (School of Electronics Engineering) for their unconditional support. We would also like to thank my faculty **Prof. Sumit Kumar Jindal** for his guidance and keen involvement in helping us to do this project

CERTIFICATE

This is to certify that the project work entitled “design a smart solar panel that absorbs the maximum sunlight according to the time of the day using 8051 microcontroller” that is being Submitted Vagisha sharma, Atanu, Saswaty Mohanty and Jasvinder is a record of bonafide work done under my supervision. The contents of this Project work, in full or in parts, have neither been taken from any other source nor have been submitted for any other CAL course.

Place : **Vellore**

Date: 22-10-2018.

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ABSTRACT :

Solar trackers are rising in popularity, but not everyone understands the complete benefits and potential drawbacks of the system. Solar panel tracking solutions are a more advanced technology for mounting photovoltaic panels. Stationary mounts, which hold panels in a fixed position, can have their productivity compromised when the sun passes to a less-than-optimal angle. Compensating for this, solar trackers automatically move to "track" the progress of the sun across the sky, thereby maximizing output.
It's a fantastic system for energy output, but there are a few considerations to bear in mind before pursuing one for a particular jobsite.

Solar panel has been used increasingly in recent years to convert solar energy to electrical energy. The solar panel can be used either as a stand-alone system or as a large solar system that is connected to the electricity grids. The earth receives 84 Terawatts of power and our world consumes about 12 Terawatts of power per day. We are trying to consume more energy from the sun using solar panel. In order to maximize the conversion from solar to electrical energy, the solar panels have to be positioned perpendicular to the sun. Thus the tracking of the sun's location and positioning of the solar panel are important. The goal of this project is to design an automatic tracking system, which can locate position of the sun. The tracking system will move the solar panel so that it is positioned perpendicular to the sun for maximum energy conversion at all time. Photoresistors will be used as sensors in this system. The system will consist of light sensing system, microcontroller, gear motor system, and a solar panel. Our system will output up to 40% more energy than solar panels without tracking systems.

In this project, we are going to develop a sun tracking **system** to track and achive maximum sunlight incident on the solar panel on anytime of the day. This project is developed using 8051 microcontroller. It can be used to detect any intensity of sunlight in houses and offices rooftop and change the position of the panel when the incident angle changes.

The following sequences could be observed in the system.

The user has to set this system on the area of the house where there is maximum sunlight access. Then the tracking system is set up. On the different times of the day we have to check whether the apparatus moves with the change in the intensity of incident sunlight.
An 8051 microcontroller is used for monitoring the ADC output to check where the maximum is and then accordingly move the DC motor to change the direction of receiving.

INTRODUCTION :

What is a Sun Tracking System?

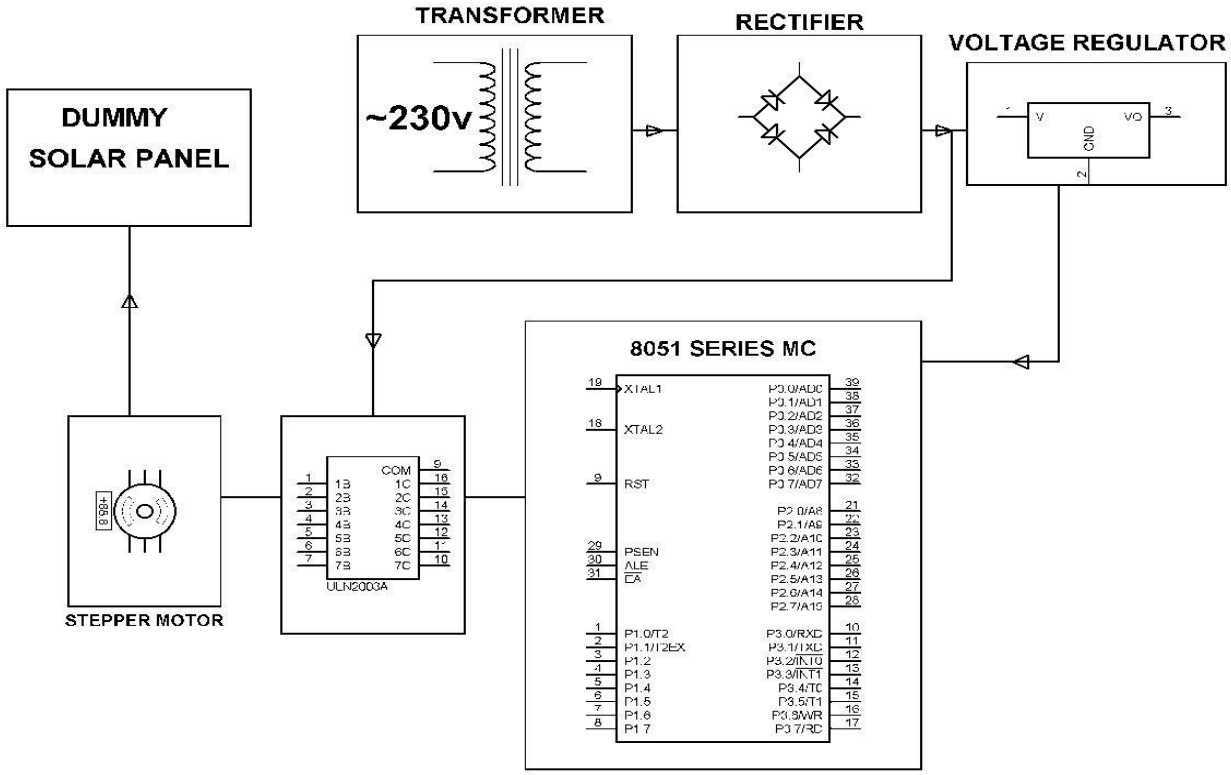
This solar tracking system is a power house. The heart of this circuitry is the generation method of solar energy. One of the microcontroller for the tracking and generating thermostpromising technology of power from sunlight and controls the converting solar energy to electrical energy and the direction of the motor to get maximum light is photovoltaic.

Solar tracking system is a method to withdraw maximum power from solar panels. As we know solar panels convert solar energy into electrical energy through photovoltaic phenomenon. Greater the intensity of solar light falls on solar panel, greater output observes at the output of solar panel. So we Need to develop a such method which rotate solar panel according to tracking of sun. So that we can withdraw maximum power from our installed solar panels.

- I have already explained that why we need of Solar tracking system. The objective is to expose solar panel to maximum time in front of solar light to get maximum power from solar panels. Many methods have been developed to for Solar tracking system. But in this article, I will discuss only two popular methods of Solar tracking system. Name of two methods are given below: Sun solar tracking system
- Time solar tracking system

Sun Solar tracking system :
In this method, we rotate the solar panel with the help of DC motor with the direction of sun light. The main purpose is to expose solar panel maximum to sun light. cease greater the sun light, greater will be the output of solar panel.A DC motor is used to rotate solar panels in the direction of sun light. In this method two lights sensors are used to measure sun light. Light dependent resistor (LDR) and photo diode both are use for this purpose.
Time solar tracking system :
This method is basically an enhancement of sun solar tracking system. In this advance method of Solar tracking system, time is also involved for the rotation of solar panels according to sun light direction. A real-time clock is used to keep information of real-time during the day. With the help of real-time clock and microcontroller, Solar tracking system turn off automatically in night-time. Real time clock use time information during the day and season. Season information is also used to keep idea about the rotation of sun. With the help of this information solar panels rotate according to rotation of sun.

The following block diagram shows the sun tracking system by using the 8051 Microcontroller :



AT89C51 Microcontroller

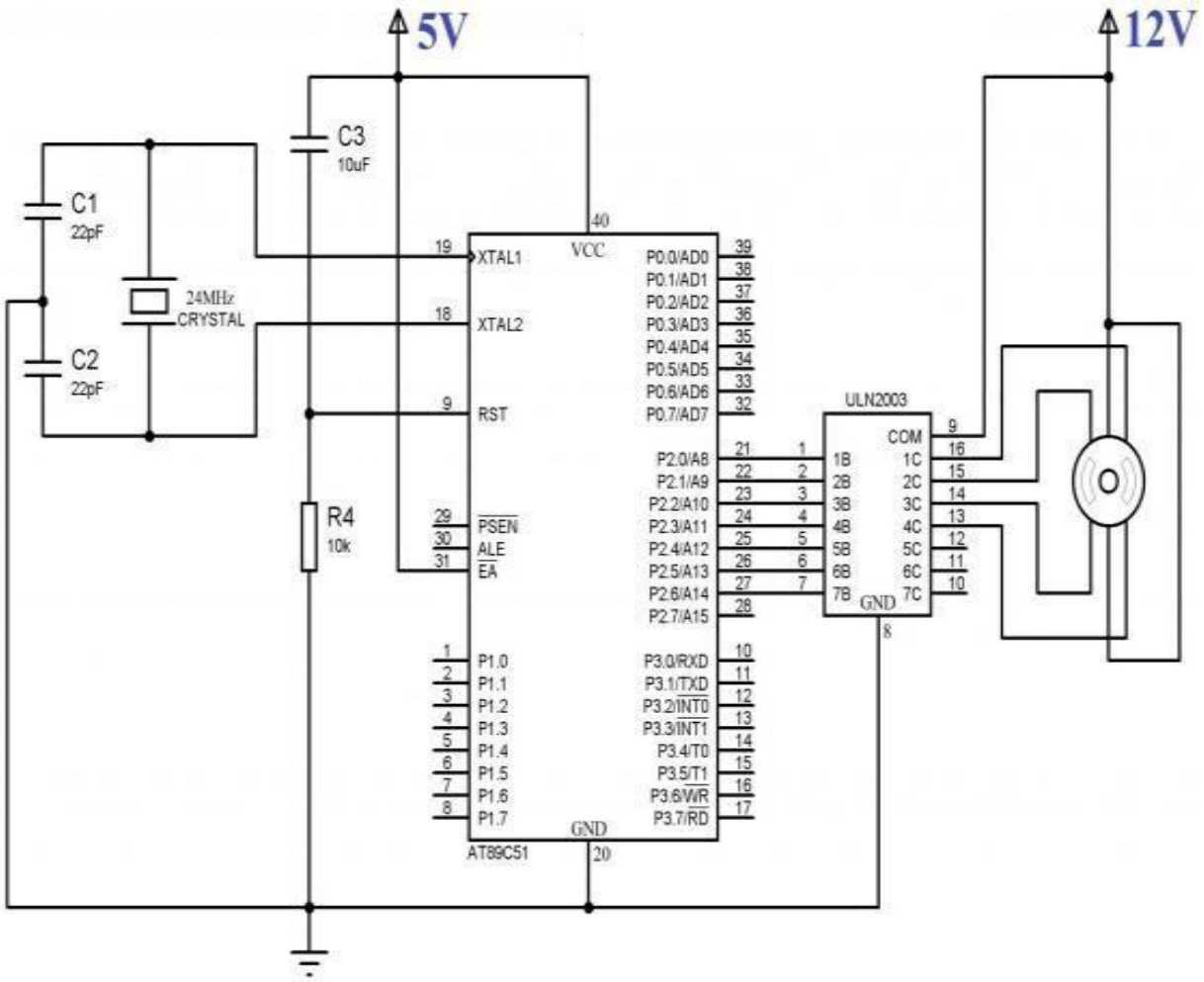
The Micro controller (AT89C51) is a low power; high performance CMOS 8-bit micro controller with 4K bytes of Flash programmable and erasable read only memory (PEROM). The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional non-volatile memory programmer. By combining a versatile 8-bit CPU with Flash on a monolithic chip, the Atmel AT89C51 is a powerful microcomputer, which provides a highly flexible and cost-effective solution to many embedded control applications. By using this controller the data inputs from the smart card is passed to the parallel port of the pc and accordingly the software responds. The IDE for writing the embedded program used is KEI L software

Keil Micro vision Integrated Development Environment.

Keil Software development tools for the 8051 micro controller family support every level of developer from the professional applications engineer to the student just learning about embedded software development. The industry-standard Keil C Compilers, Macro Assemblers, Debuggers, Real-time Kernels, and Single-board Computers support ALL 8051-compatible derivatives and help you get your projects completed on schedule.

The source code is written in assembly language. It is saved as ASM file with an extension. A51.the ASM file is converted into hex file using keil software. Hex file is dumped into micro controller using LABTOOL software. At once the file is dumped and the ROM is burnt then it becomes an embedded one.

CIRCUIT DIAGRAM :



COMPONENTS :

- 8051 MICROCONTROLLER (ATMEL89S52)
- L293D MOTOR DRIVER IC
- DC MOTOR
- ADC0804
- LIGHT DETECTING RESISTOR(LDR)
- Bread Board
- USB TTL
- 10K resistor (3)
- 150pf capacitor
- Power Supply

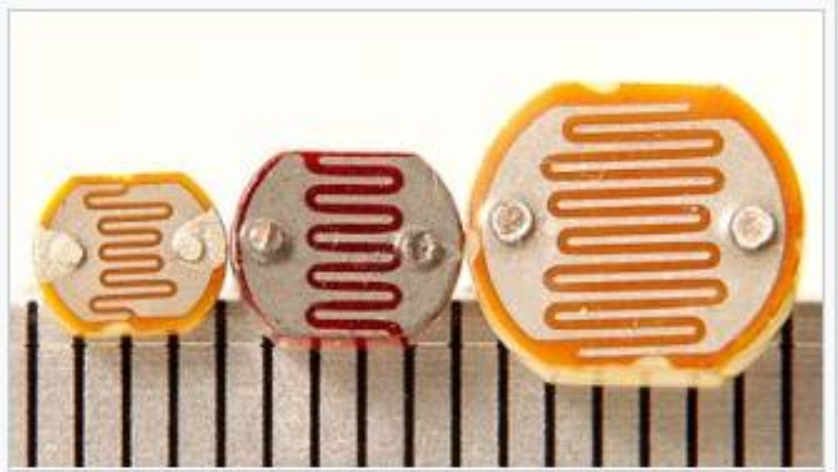
ADC 0804

The **ADC0804** is a commonly used ADC module, for projects were an external ADC is required. It is a 20-pin Single channel 8-bit ADC module. Meaning it can measure one ADC value from 0V to 5V and the precision when voltage reference (Vref –pin 9) is +5V is 19.53mV (**Step size**). That is for every increase of 19.53mV on input side there will be an increase of 1 bit at the output side.
This IC is very Ideal to use with Microprocessors like Raspberry Pi, Beagle bone etc.. Or even to use as a standalone ADC module. Every ADC module requires a clock to function; this IC comes with its own internal clock so you don't have to worry about it. Hence, if you are looking for a **compact ADC module** with a decent resolution of 8-bit then this IC is for you.

LDR

A **photoresistor** (or **light-dependent resistor**, **LDR**, or **photo-conductive cell**) is a light-controlled variable resistor. The resistance of a photoresistor decreases with increasing incident light intensity; in other words, it exhibits photoconductivity. A photoresistor can be applied in light-sensitive detector circuits, and light-activated and dark-activated switching circuits.

A photoresistor is made of a high resistance semiconductor. In the dark, a photoresistor can have a resistance as high as several megohms (MΩ), while in the light, a photoresistor can have a resistance as low as a few hundred ohms. If incident light on a photoresistor exceeds a certain frequency, photons absorbed by the semiconductor give bound electronsenough energy to jump into the conduction band. The resulting free electrons (and their holepartners) conduct electricity, thereby lowering resistance. The resistance range and sensitivity of a photoresistor can substantially differ among dissimilar devices. Moreover, unique photoresistors may react substantially differently to photons within certain wavelength bands.



Three photoresistors with scale in mm

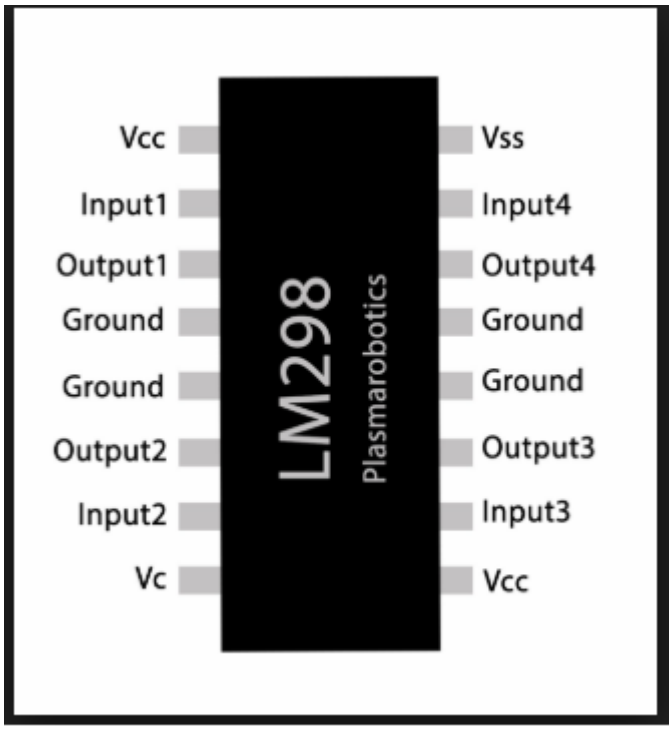
LM293D

L293D is a dual H-bridge motor driver integrated circuit (IC). Motor drivers act as current amplifiers since they take a low-current control signal and provide a higher-current signal. This higher current signal is used to drive the motors.

L293D contains two inbuilt H-bridge driver circuits. In its common mode of operation, two DC motors can be driven simultaneously, both in forward and reverse direction. The motor operations of two motors can be controlled by input logic at pins 2 & 7 and 10 & 15. Input logic 00 or 11 will stop the corresponding motor. Logic 01 and 10 will rotate it in clockwise and anticlockwise directions, respectively.

Enable pins 1 and 9 (corresponding to the two motors) must be high for motors to start operating. When an enable input is high, the associated driver gets enabled. As a result, the outputs become active and work in phase with their inputs. Similarly, when the enable

input is low, that driver is disabled, and their outputs are off and in the high-impedance state.



DC MOTOR:

A **DC motor** is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current flow in part of the motor.

DC motors were the first form of motor widely used, as they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings. Small DC motors are used in tools, toys, and appliances. The universal motor can operate on direct current but is a lightweight brushed motor used for portable power tools and appliances. Larger DC motors are currently used in propulsion of electric vehicles, elevator and hoists, and in drives for steel rolling mills. The advent of power electronics has made replacement of DC motors with AC motors possible in many applications.

THEORY :

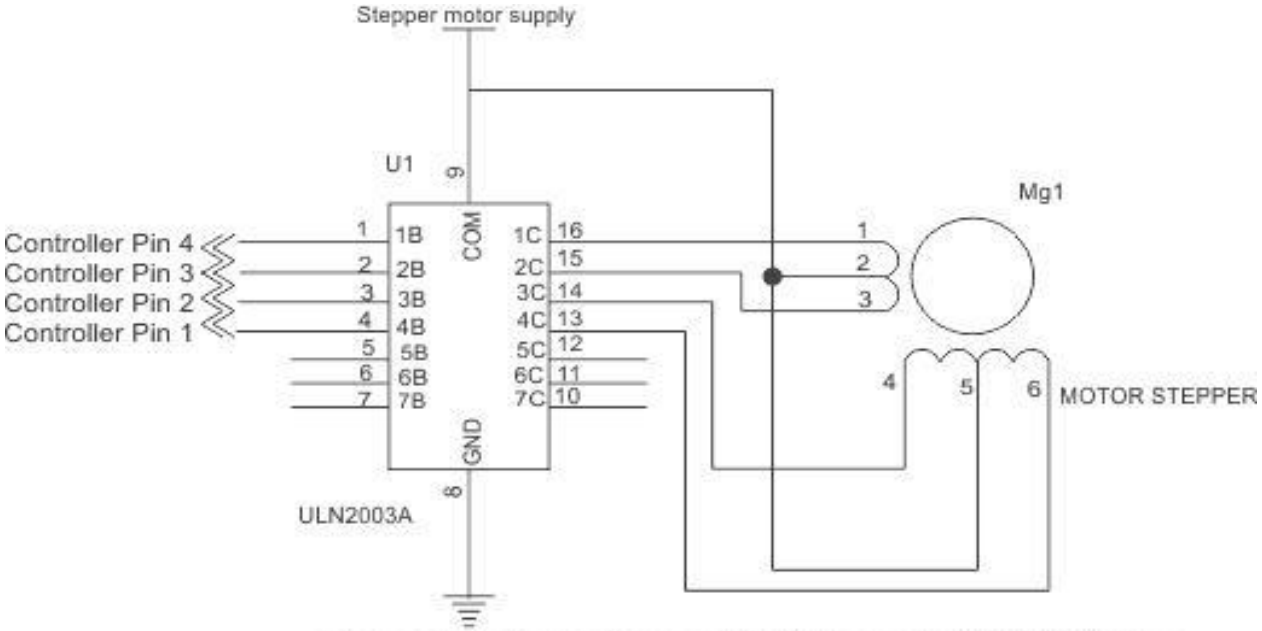
This tracking movement is achieved by coupling a dc motor to the solar panel such that the panel maintains its ace always perpendicular to the sun to generate maximum energy.This is achieved by using a programmed microcontroller to deliver stepped pulses in periodical time intervals for the dc motor to rotate the mounted panel as desired. The microcontroller used in this project is of the 8051 family.The dc motor driven is driven by interfacing IC as the controller is not capable of handling the power requirements of the dc motor. Therefore a motor driver is used to meet the requirements of the driver.

The project is provided with the dummy solar panel which can be used for demonstration purpose only.

Trackers are used to keep solar collectors/solar panels oriented directly towards the sun as it moves throught the sky everyday. Using solar trackers increases the aamount f solar energy which is received and then the solar collector improves its efficiency.

The energy output improves and thus the electricity produced also improves.Solar trackers can increase the output of solar panels by 20-30% which improves these economics of the solar panel project.

PIR BRIEFING :



General Interfacing diagram of a Stepper with ULN2003A driver

WORKING :

In this method two light dependent resistors are used. LDRs are separated with the help of sheet (Metallic sheet or wood shield) .One on the left hand side of sheet and other on the right hand side of shield. This is main part of this project. Two Light dependent resistors measure intensity of light with the help of microcontroller . Now the question come into mind, how these light dependent resistors rotate solar panels with the help of solar panel. I will explain it later. If you don't know how to measure intensity of light using pic16f877a microcontroller.

I hope after reading above article you know that how to measure intensity of light using Light dependent resistor and pic microcontroller. Now come to the question" How these LDRs will rotate solar panels with the help of DC motor. LDR is used to measure intensity of light with the help of microcontroller. Microcontroller reads values of both light dependent resistors. In other words, microcontroller reads intensity of light with the help of light sensors. If the intensity of light is same of both light sensors, solar panels don't rotate, and DC motor remain off. Solar panel also remain stable in night timing when there will be no light. In morning, left light sensor is turned on and start rotating solar panel with the help of DC motor. Rotation of motor depends on the intensity of light. Solar panel keep rotating until intensity of light on both sensors become equal. When both sensors have same intensity of light, solar panel become stable. This process repeats in opposite direction after 12:00 am or after afternoon. In evening when light intensity of both light sensors become equal, solar panel again become stable. This process remains continue during day timing.

ADVANTAGES AND DISADVANTAGES :

Advantages:

- Trackers generate more electricity than their stationary counterparts due to increased direct exposure to solar rays. This increase can be as much as 10 to 25% depending on the geographic location of the tracking system.
- There are many different kinds of solar trackers, such as single-axis and dual-axis trackers, all of which can be the perfect fit for a unique jobsite. Installation size, local weather, degree of latitude and electrical requirements are all important considerations that can influence the type of solar tracker best suited for a specific solar installation.
- Solar trackers generate more electricity in roughly the same amount of space needed for fixed-tilt systems, making them ideal for optimizing land usage.
- In certain states, some utilities offer Time of Use (TOU) rate plans for solar power, which means the utility will purchase the power generated during the peak time of the day at a higher rate. In this case, it is beneficial to generate a greater amount of electricity during these peak times of the day. Using a tracking system helps maximize the energy gains during these peak time periods.
- Advancements in technology and reliability in electronics and mechanics have drastically reduced long-term maintenance concerns for tracking systems.

Disadvantages:

- Solar trackers are slightly more expensive than their stationary counterparts, due to the more complex technology and moving parts necessary for their operation. This is usually around a $0.08 – $0.10/W increase depending on the size and location of the project.
- Even with the advancements in reliability, there is generally more maintenance required than a traditional fixed rack, though the quality of the solar tracker can play a role in how much and how often this maintenance is needed.
- Trackers are a more complex system than fixed racking. This means that typically more site preparation is needed, including additional trenching for wiring and some additional grading.
- Solar trackers are generally designed for climates with little to no snow making them a more viable solution in warmer climates. Fixed racking accommodates harsher environmental conditions more easily than tracking systems.
- Fixed tracking systems offer more field adjustability than single-axis tracking systems. Fixed systems can generally accommodate up to 20% slopes in the E/W direction while tracking systems typically offer less of a slope accommodation usually around 10% in the N/S direction.

FUTURE SCOPE :

Technology has advanced so much in the last decade or two that it has made life moreefficient and comfortable. The comfort of being able to take control of devices from one particular location has become imperative as it saves a lot of time and effort. Thereforethere arises a need to do so in a systematic manner which we have tried to implementwith our system. The system we have proposed is an extended approach to automating acontrol system.With the advancement and breakthroughs in technology over the years, the lives of people have become more complicated and thus they have become busier than before.With the adoption of our system, we can gain control over certain things that requiredconstant attention. The application of our system comes in handy when people get toknow about the advantages and the efficient use of solar power is possible and can be made automated to achieve drastic results.

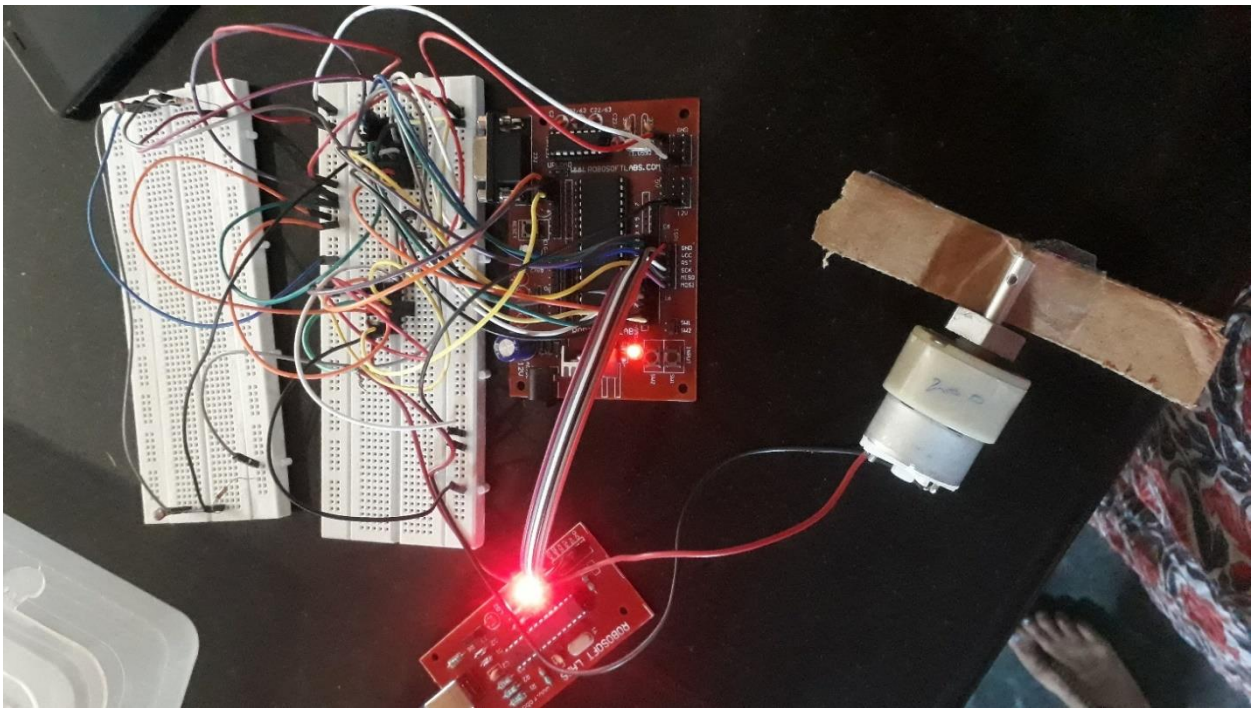
It could be implemented on larger scale.

It could be made a start up.

CONCLUSION :

The project was successfully executed and we are able to design a home automation system.
We hereby conclude that the smart solar panel can be very easy group of controls. The costs mainly include equipment, components, furniture, and custom installation and the ongoing costs include electricity to run the control systems, maintenance costs mainly for the control and networking systems, including troubleshooting, and eventual cost of upgrading as standards change. The Sun tracking solar panel consists of two LDRs, solar panel a DC motor and 8051 Micro controller
Two light dependent resistors are arranged on the edges of the solar panel. Light dependent resistors produce low resistance when light falls on them. The microcontroller takes the decision according to the fed algorithm and instructs the DC motor connected to the panel to rotate the panel in the direction of Sun. Panel is arranged in such a way that light on two LDRs is compared and panel is rotated towards LDR which has high intensity i.e. low resistance compared to other.

CITCUIT:



WORKING CODE :

```
ORG 0000H
        RED BIT P3.0
        WRT BIT P3.1
        INTR BIT P3.2
        MYDATA EQU P1
        MOV P1,#0FFH
        SETB INTR
        BACK: CLR WRT
        SETB WRT
        HERE:JB INTR,HERE
        CLR RED
        MOV A,MYDATA
        ACALL ROTATE
        SETB RED
        SJMP BACK

        ROTATE:RLC A
        MONITOR:SETB P2.0
        JNC JUMP1
        SETB P2.1
        CLR P2.2
        ACALL DELAY
        CLR P2.1
        CLR P2.2
        SJMP MONITOR
        JUMP1:CLR P2.1
        SETB P2.2
        ACALL DELAY
        CLR P2.1
        CLR P2.2
        SJMP MONITOR

        DELAY: MOV R2,#255
        H1: MOV R3,#255
        H2: DJNZ R3,H2
        DJNZ R2,H1
        RET
        END
```

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- https://en.wikibooks.org/wiki/Embedded_Systems/8051_Microcontroller
- http://www.circuitstoday.com/8051-microcontroller

Books:

- 8051 Microcontroller-Internals, Instructions, Programming & Interfacing by Subrata Ghoshal
- The 8051 Microcontroller and Embedded Systems using Assembly and C -by Muhammad Ali Mazidi
- The 8051 Microcontroller (with CD) by Kenneth Ayala