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MOVABLE AUTOMATIC SOLAR LAMP POST

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Abstract: The system designed here is very useful for gardens, plantations where huge trees exist. In such places availability of solar energy may be difficult due to the shadow of trees, therefore solar lamp posts may not function properly. To overcome this problem, here in this project work, movable solar lamp post is designed, which moves towards sunlight. The main advantage of using this kind of technology is that the lamp post along with its accessories can be moved to a particular place where solar energy is available, this is essential in day time for charging the battery. The other advantage is that the panel can be positioned towards the Suns direction, there by maximum power can be utilized from the panel. The third & important feature is that the lamp post can be brought to a specific place where light is required in the nights. To perform all these activities, the system designed can be used. To prove the theme practically, a prototype module is constructed with lower rating electrical devices, which can be used for real applications. The lamp post arranged over a wooden chassis moves in singular direction freely. The chassis is equipped with 3 wheels and a DC motor connected to the front wheel. This DC motor drives the chassis. The solar lamp post contained with Solar panel, huge battery, lamp dome with high glow LED's, logic circuit, charging circuit, etc. is designed as totally automatic. The light will be activated automatically during the dark, & it will be switched off automatically in the morning. To achieve this, panel potential is monitored continuously. The battery is charged at constant voltage so that it is protected from over charging. Similarly, the battery voltage is also monitored & protected from deep discharging. When the battery voltage falls down by 9V, immediately load will be disconnected. The control circuit is designed with Atmel AT89C51.

Index Terms **– Solar Lamp, Microcontroller (89C51), Light Emitting Diode (LED), DC Motor.**

I. INTRODUCTION

As technology evolves solar powered outdoor lighting has become a more popular choice for lighting your gardens and outdoor property. There are many sources to purchase these different types of solar powered outdoor lighting products. Popular today are solar powered lamp posts, solar powered street lights, and more. The ability to position the solar lamps in non-traditional locations throughout the landscape is a very attractive option for homeowners.

Thus, this project enables a solar lamp post to be constructed as a movable one that can be moved to the open area where the light intensity of the sun is high and can be brought into the garden or where ever required during night time. The use of light dependent resistor (LDR) to determine whether it is daytime or nighttime, and also to drive the solar panel at the angle where maximum intensity of sunlight is hitting the solar panel is another important feature of this project.

Perhaps the best feature of this project is that the solar lamp post is virtually free to run. After all, they simply use the power of the sun; a power which is 100% free. It is very likely that a solar lamp post will pay for itself in just a year or two at most. Some accomplish this task within just a few months.

II. LITERATURE SURVEY

1) Power Saving Solar Street lights

AUTHORS: Badri Narayan Mohapatra, Aisharya Dash and Bipin Prasad Jarika

The gradually growing requirement of energy and the limited resource of traditional energy sources has become a challenge for both developed and developing countries. For this reason, in policy makers' agenda, energy efficiency and sustainability are given the first priority for any project to be installed. Solar street lighting system is an effective way to reduce power consumption and CO2 impact on the environment with the maintenance of the safety standards of the road. Electric street lighting consumes 114 TW h annually, leading to the emission of 69 million tons of CO2 [1]. By PV (Photovoltaic) effect the solar radiation can be directly converted into electrical energy. This energy is stored in a rechargeable battery and supplied to the luminary when it is required to glow.

2) Solar Cells in Research and Applications-A Review
AUTHORS: Shruti Sharma, Kamlesh Kumar Jain, Ashutosh Sharma
The light from the Sun is a non-vanishing renewable source of energy which is free from environmental pollution and noise. It can easily compensate the energy drawn from the non-renewable sources of energy such as fossil fuels and petroleum deposits inside the earth. The fabrication of solar cells has passed through a large number of improvement steps from one generation to another. Silicon based solar cells were the first-generation solar cells grown on Si wafers, mainly single crystals. Further development to thin films, dye sensitized solar cells and organic solar cells enhanced the cell efficiency. The development is basically hindered by the cost and efficiency. In order to choose the right solar cell for a specific geographic location, we are required to understand fundamental mechanisms and functions of several solar technologies that are widely studied. In this article, we have reviewed a progressive development in the solar cell research from one generation to other, and discussed about their future trends and aspects. The article also tries to emphasize the various practices and methods to promote the benefits of solar energy.

3) Solar lamp post lights come in many sizes, shapes and configurations but they all share some common attributes. All of them use a small solar panel located on the top to gather energy from the sun. That energy is then stored in a battery pack. LED (light emitting diode) lights provide the illumination and they in turn are powered by the battery pack. The battery pack is usually Lithium-Ion type and is easily replaced. The similarities of the solar lamp post lights seem to end there. No gas tubing or electrical cable is needed because they are powered by the sun. The battery pack is easily replaced and the lighting mechanism is easily replaced so maintenance is a snap. A solar lamp post is an excellent addition to any outdoor area. It is useful to know that the lantern of a solar lamp post can often simply replace an existing, non-solar lamp light. There is no necessary need to buy a lamp post specifically for housing a solar lamp. Of course, plenty of models integrate the light into the lamp post design for an overall uniform and put-together look. Most posts are relatively easy to install as they do not need to be connected to an electrical grid. A solar lamp post can easily be staked into the ground anywhere, so long as it will receive full sunlight. But considering that the sun's light intensity may not be constant throughout the day and the trees in the garden may obstruct the sunlight.

III. PROPOSED SYSTEM

In the proposed system, the ability to move freely is gained by the solar lamp post. The movement intern is guided by the microcontroller Atmel AT-89C51. The system consists of a wooden slab as the main chassis. The solar panel is mounted on top of another plank of wood which contains LDR sensors on either ends of the plank. The solar panel is raised by some height with the help of metal rods. Said metal rods are also used to move the plank of the solar panel in the direction of sunlight by the help of the DC motor. This DC motor is the middle piece in attaching the solar panel and the metal rods. Hence, the DC motor when actuated causes the movement of the solar panel. There is also another LDR present on the wooden chassis that determines the time of day. The main PCB along with an ADC and voltage regulators are placed firmly on the wooden chassis. A battery pack of 10000mah across 3 cells is taped and attached to the wooden chassis as well.

The system first determines the time of the day. If it is daytime, then the DC motor is actuated and the system moves forward till there is direct sunlight hitting the system. It then compares the values from the LDR's present in the edges of the solar panel. The values are compared in the microcontroller and the DC motor connected to the wooden plank of the solar panel is activates. The DC motor stops when both the values of the LDR's are same, ensuring the solar panel is facing the sun directly for maximum efficiency.

However, if the sunlight is not present, i.e., it is night time, then the LED representing the lamp is taken as load and it is activated for lighting the area.

IV. REQUIREMENT ANALYSIS

The project needed to be cost effective and sturdy enough to be deployed in a garden where for example the terrain is not necessarily flat. Hence the choice of materials was crucial. Also, the coding for the microcontroller had to be done on a personal computer which can run the required IDE. Hence, all the specifications of the requirements needed for the project are given below.
REQUIREMENT SPECIFICATION:

Software Requirements

For developing the system, the following Software Requirements had to be fullfilled:

1. A personal computer/desktop or laptop with Intel core i3 processor or higher, with 4GB of RAM.
2. Operating system : Windows xp or above
3. Coding Language : Assembly Language

Hardware Requirements

1) Atmel AT89C51 Microcontroller chip

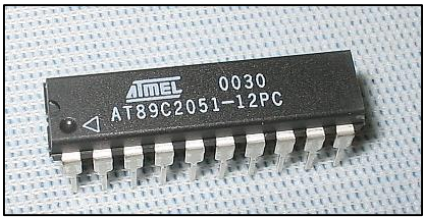


Fig 4.1: Atmel AT89C51 microcontroller

2) Solar Panel

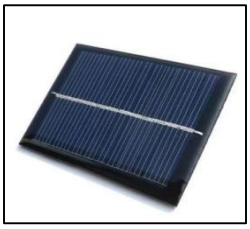


Fig 4.2: Solar panel

3) Battery

Fig 4.3: Battery pack

4) LM 324 IC

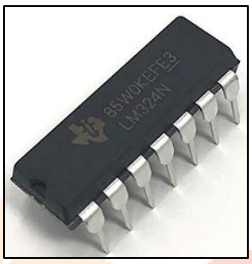


Fig 4.4: LM 324N IC

5) Resistors

Fig 4.5: Resistors

6) LDR sensor

Fig 4.6: LDR sensor

7) DC motor

Fig 4.7: DC motor

8) Relay

Fig 4.8: Relay

9) High Glowing LED's

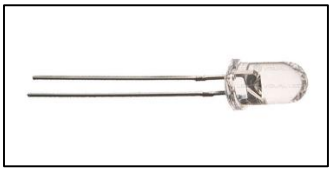


Fig 4.9: LED

10) 7805, 7815 Voltage Regulators

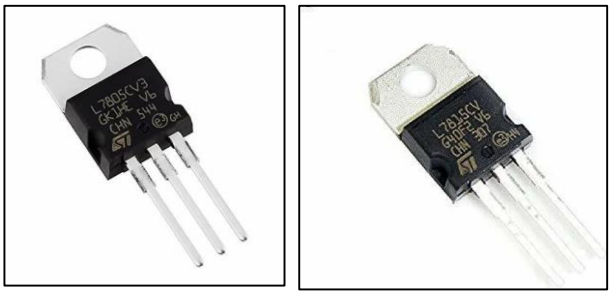


Fig 4.10: 7805, 7815 Voltage regulators

11) BC547 NPN Transistors

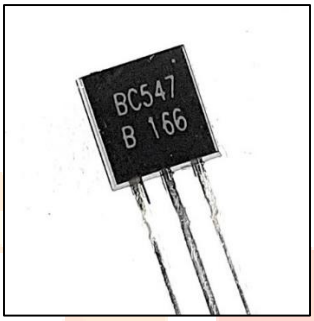
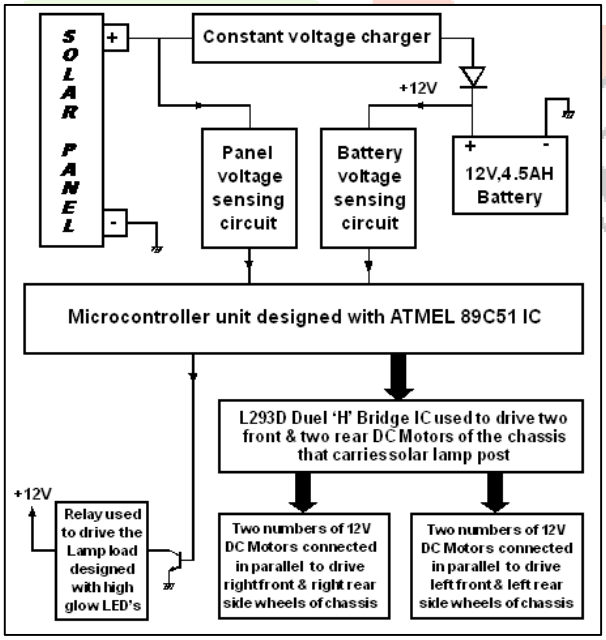


Fig 4.11: BC 547 NPN Transistor

V. **SYSTEM DESIGN**

5.1 Block Diagram



Solar panels can be used to exploit solar energy that, when absorbed, can be an efficient source of energy for electricity and heating. In addition, the power that is produced by solar panels can be used for many other things. Here in our project, we are using the solar panel to generate electricity to glow the outdoor lights. The panel used here is a 10W panel. For real applications this can be increased to generate more power depending on the number of lights used. The electrical energy generated by the solar panel is stored in the battery, which is used to drive the light system. Since the light system is to be operated during the dark, the energy produced by the solar panel will be stored in the battery, which in turn will provide the supply to the lamp when there is no light. Therefore, stored energy is used, for this purpose fully condition a lead acid rechargeable battery of 12v, 4.5Ah is used that will operate the high glowing LED's in the lamp-post.

And in the same way the battery voltage sensing circuit will give the information to the controller regarding the battery voltage. Depending on the voltage present in the battery only, the load i.e., the lights are operated. As we know that the battery is not deeply discharged, as it will be dead on doing so, a cut off value is defined by using this sensing circuit by which if the battery voltage drops less than it, the controller disconnects the load connected to the battery. As explained above, the Atmel AT89C51 microcontroller will be given inputs from the voltage sensing circuits of both the panel and the battery, by which the controller will

be understanding when the external lights should be operated and when they should be disabled, which will be defined in the controller programming.

5.2 Circuit Diagram

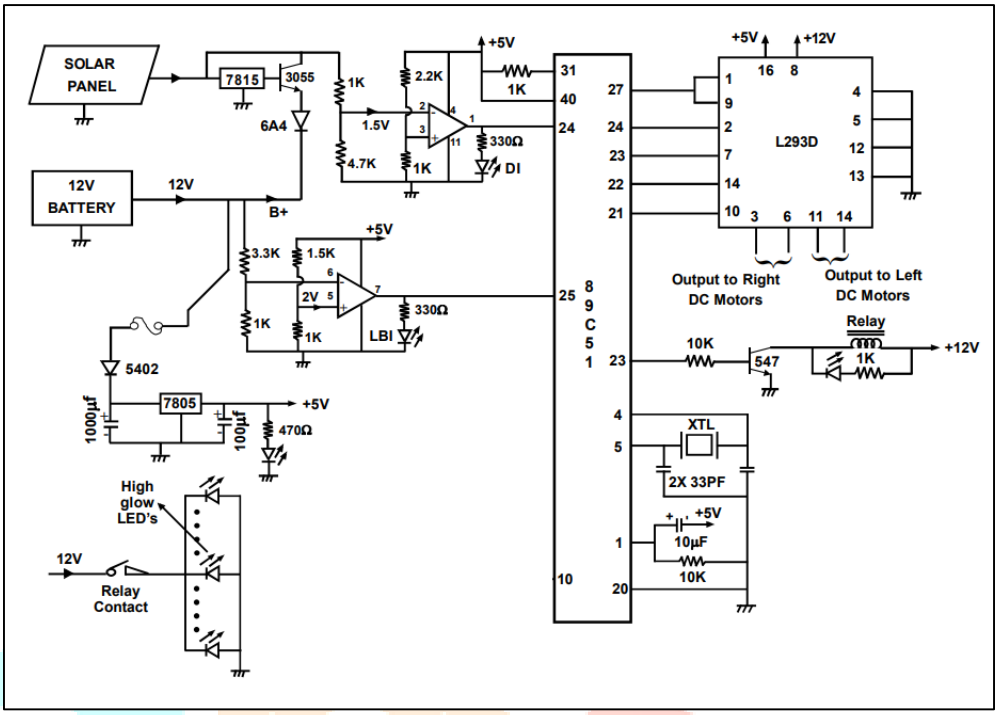


Fig 5.2: Detailed circuit diagram of the system.

The circuit description starts with a brief summary of sensing and controlling technologies as they pertain to autonomous machines. The system designed with micro-controller can move the solar lamp post. The microcontroller is programmed to control the movement of the lamp post. Here the controller is playing major role, it can be said as heart of the project work. Nowadays with the advancement of technology in the field of micro-controllers, all the activities in our day-to-day living have become part of information technology and we find micro-controllers in each and every application. Thus, the trend is directing towards controller-based project works.

Here for charging the battery from the voltage derived from the solar panel a charging circuit has been designed. In the charging circuit a 15V positive voltage regulator 7815, a silicon Epitaxial-Base Planar NPN transistor and a diode are used. The output voltage from the solar panel is connected to the input pin of the positive voltage regulator as well as the collector of the NPN transistor 2N3055. In the voltage regulator first pin is the input second is the ground pin and the third is the output pin that is connected to the base of the transistor 2N3055. The emitter of the transistor is connected to the battery positive terminal with a diode. So, when the transistor conducts, the solar panel voltage at the collector passes through the transistor and charges the battery. The output of the positive voltage regulator is used to drive the transistor by which the battery gets charged up.

In the module we are also measuring the solar panel voltage, which is an important aspect of this project work. By the voltage obtained from the panel only, the controller will be able to distinguish when the lamp post is to be operated for glowing i.e., the voltage from the solar panel determines whether there is light intensity or not. So here we constructed a panel voltage measuring circuit using an Op-Amp, as the voltage from the solar panel is high, which cannot be given to the controller directly. So by constructing potential divider or voltage divider network the reference voltage and the input voltages are given at non-inverting and inverting terminals of the operational amplifier respectively. The reference voltage is 1.5v, so when the panel voltage drops below it, the output of the op-amp becomes high which is fed to the controller. By this signal the controller understands the light intensity has been faded and operates the relay to activate the high glow LED's in the lamp post. And when the controller receives a low signal, which does happen when the light intensity is present, it de-activates the relay by which the lamp will be OFF.

5.3 Code for Microcontroller

```
TEMP_ADC  DATA  30H
LDR      BIT   P0.0
DC1      BIT   P2.4
DC2      BIT   P2.5
A0       BIT   P3.7
A1       BIT   P3.1
A2       BIT   P3.2
ALE      BIT   P3.3
SOC      BIT   P3.4
OE       BIT   P3.5
EOC      BIT   P3.6

KPK    BIT    01H
KPK1   BIT    02H
KPK2   BIT    03H
ORG    0000H
LJMP   RESET

RESET:
   MOV    P2, #00H
   MOV    TEMP_ADC, #00H
   CLR    KPK
   CLR    KPK1
   CLR    KPK2
   SETB   P2.0   ;LS1
   SETB   P2.1   ;LS2
   SETB   LDR
   CLR    DC1
   CLR    DC2

MAIN:
   JB    KPK2,DD1
   JB    KPK1,DD1
   JB    P2.0,CHK
   SETB  KPK
CHK:
   JB    P2.1,SCAN
   CLR   KPK

SCAN:
   JB    KPK,REV
   CLR   P2.3
   SETB  P2.2
   LCALL  DELAY1
   CLR   P2.3
   CLR   P2.2
   LJMP   DD1

REV:
   CLR   P2.2
   SETB  P2.3
   LCALL  DELAY1
   CLR   P2.3
   CLR   P2.2

DD1:
   CLR   A0
   CLR   A1
   SETB  A2
   LCALL  GET_ADC
   MOV   A,TEMP_ADC
   CJNE  A,#51D,NN    ;sun
```

```
NN:
   JNC    OK
   CLR    P2.2
   CLR    P2.3
   SETB   KPK2
   SJMP   main
OK:
   CLR    KPK2
   JB     LDR,GST
   SETB    DC1
   CLR     DC2
   SJMP    GH1
GST:
   CLR     DC1
   CLR     DC2

GH1:
   SETB   A0
   SETB   A1
   CLR    A2
   LCALL  GET_ADC
   MOV    A,TEMP_ADC
   CJNE   A,#240D,NNX    ;night
NNX:
   JC     OK1X
   SETB   KPK1
   CLR    P2.2
   CLR    P2.3
   CLR    DC1
   CLR    DC2
   WAIT:
      SETB   A0
      SETB   A1
      CLR    A2
      LCALL  GET_ADC
      MOV    A,TEMP_ADC
      CJNE   A,#240D,NV   ;night
      NV:
         JC     OK1X
         CLR    DC1
         CLR    DC2
      SJMP   WAIT

OK1X:
   CLR    KPK1
GB1:
   LJMP   MAIN


ddelay:
   MOV R4,#90
   Zz2X:  MOV R5,#90
   Zz1X:  MOV R6,#90
   DJNZ R6,$
   DJNZ R5,Zz1X
   DJNZ R4,Zz2X
   RET

GET_ADC:
   SETB        ALE
   NOP
   NOP
   SETB        SOC
   LCALL       D1
   CLR         ALE
   NOP
   NOP
   CLR         SOC
```

```
EOZ:
      JB        P3.6,EOZ
   EOCZ:
      JNB       P3.6,EOCZ
   SETB       OE
   MOV        A,P1
   MOV        TEMP_ADC,A
   NOP
   NOP
   CLR        OE
   RET

D1:
   MOV R3,#01H
   DJNZ R3,$
   RET


delay1:
   MOV R4,#30
   Zz2:  MOV R5,#30
   Zz1:  MOV R6,#30
   DJNZ R6,$
   DJNZ R5,Zz1
   DJNZ R4,Zz2
   RET

END
```

VI. RESULTS:

Case 1: When it is night time, the LED representing lamp is illuminated.

Case 2: When it is day time, the system moves forward till direct sunlight is falling on the system.

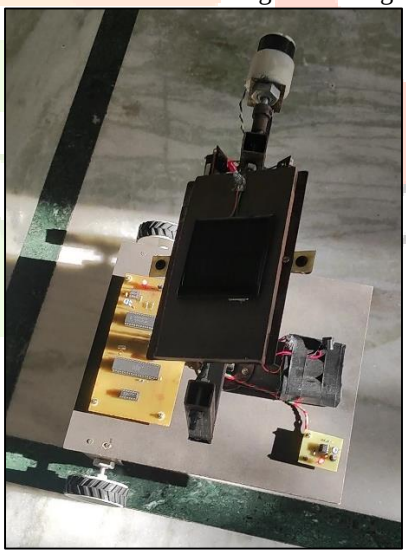


Fig 6.1: The system has moved to direct sunlight.

Case 3: The wooden plank holding the solar panel is rotated till it is directly facing the sun.

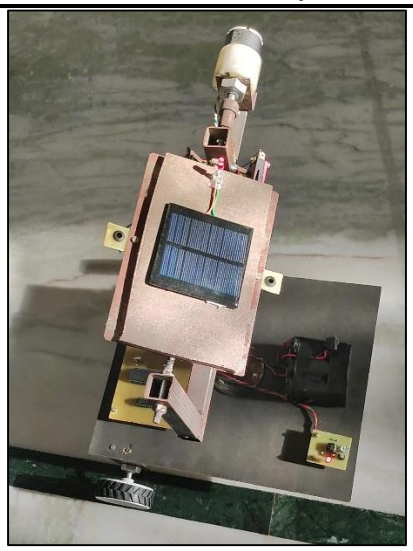


Fig 6.2: The solar panel is directly facing the sun.

VIII. CONCLUSION

With global warming and other such issues reaching the dinner tables of almost all families around the world, many of you must have decided to do your bit to save the environment. Countries around the world have realized that these issues are something that they will have to deal with proactively to reduce the over dependence on the natural resources. When conservation of energy is surely not possible as the entire world utilizes it, many scientists are of the opinion that the utilization of the non-conventional and renewable sources of energy will go a long way in helping nature by reducing the burden on it. One such source of energy which has unlimited potential but has not been well harvested is solar energy. It is believed that if we can harvest at least 10 % of the solar energy, we could save close to 100 billion dollars worldwide.

Even though the technology for things like Solar Outdoor Lighting and solar indoor electricity is pretty expensive and currently not feasible, with advent of technology in this sector, it has been estimated that it would be a practical option. There are already numerous companies which are producing Solar Outdoor Lighting equipments which harness the solar energy during the day and convert it in to electrical energy during the night. These kinds of Solar Outdoor Lighting will be very useful for you when you wish to reduce your dependence on conventional sources of energy. Even though solar lighting equipment is rather expensive when compared to the other normal lights, you will have to understand that this will be a one-time investment. You will not have to spend on the electricity bills if you manage to get these. You will also be able to save a lot of money. Every once in a year or so, the battery will have to be changed and apart from this, there will not be any other kinds of charges associated with the Solar Outdoor Lighting.

The project work “Movable Automatic Solar Lamp Post” is designed and developed successfully. For the demonstration purpose prototype module is constructed & results are found to be satisfactory. While designing and developing this proto type module, we have consulted few experts, these professionals working at different organizations belongs to Hyderabad helped us while building this module. Since it is a prototype module, much amount is not invested, the whole machine is constructed with locally available components, and they are not up to the requirement, some of the modifications must be carried out in design and is essential to make it as real working system.

This project revealed that building a relatively low cost, high precision movable solar lamp post is designed which is aimed control through a remote. Presently the system utilizes the RF remote technology with lesser transmitting power, there by the range is restricted to nearly less than 20 feet. Depending up on the equipment size, this range is enough. The range restriction is always essential for operating this kind of modules, as it cannot be operated from too long because good visibility is essential.

IX. REFERENCES

While designing and fabrication of this project work, we gathered information from websites & consulted experts in various fields. The information is gathered from yahoo.com search Engine. Regarding micro controllers plenty of books are available, the following are the references made during design, development and fabrication of the project work.

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