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SMART SOLAR EMERGENCY LAMP WITH MOTION DETECTOR

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Abstract—Comfort and safety is one of the biggest requirement in our life. But many real system fails to provide safety and comfort that we need. Making such a system is a big challenge because of need to make many controlling system which can run in same time. We create such a system which havemultipurpose lighting as well as security system. Our project capsuled three systems as – Solar powered lightning, motion based lightning, motion based security, which will give the idea of using renewable source of energy at large scale with minimum cost.

***Key Words*— Smart, Solar, Security, Burglary alarm, Light, Emergency, Energy efficient, Motion detection, automatic.**

1. INTRODUCTION

A smart solar emergency lamp is not a normal lamp which is used in our day to day life.This is efficiently utilising both the power sources A.C. and Solar energy on the basis of requirement. In which contains a photovoltaic solar panel, an A.C source, an LED lamp, a PIR motion detector and a rechargeable battery. Solar lamps are used for generally illumination where centrally generated power is not conveniently or economically available. The world cannot depend onlyon fossil fuels for the energy requirements for very long time. Fossil fuel is limited on our earth, in which speed it uses, one day come when it will end. When we burnt them, they produce air pollution which is biggest factor of global warming, acid rain, health issue and others.

Therefore, we must choose renewable source of energy such as solar energy, wind energy, tidal energy, geothermal heat and others. In this our research we choose solar energy which is photovoltaic system and ideal for providing electrical power. With the help of this power, we light the lamp and run our home appliances. One of the biggest advantages of solar energy is non-polluting. Other various advantages such as noise free and ecofriendly. It does not harm the natural resources and very cheap for long term usages. The main aim of this research is illustrate how we can get maximum usages and storage of this energy for further usages.

As the topic states that this solar lamp is a smart emergency lamp because If the weather is bad such as cloudy or winter season and electricity is unavailable for some consecutive days, due to which the battery will not proper charge. We use a transformer and full wave rectifier which have been charge the battery using microcontroller controlled relay switch. With the help of this technique we can be charged the battery whenever mains power is available.
This smart solar lamp also having a special function of "Motion Detecting". We used passive infrared (PIR) sensor, which automatically switch on the device when any living object comes closer to it. So whenever any stranger person will try to be closer to the solar lamp then the sensor starts making a noise through a speaker and we can get to know who is the person in the installed area of lamp.

The history of modern lamp was started through Thomas Edison which was invent electric light. We use LED lamp which is two-lead semiconductor light source. It is p-n junction diode, when a suitable voltage applied to the leads electrons are able to recombine with electron holes within the device, due to this energy release in the form of photons. This effect is called electroluminescence, and colour of the light is determined by the energy band gap of the semiconductor. LEDs have many advantages over incandescent light sources such as low power consumption, long life, smaller size, faster switching and others.

2. BLOCK DIAGRAM

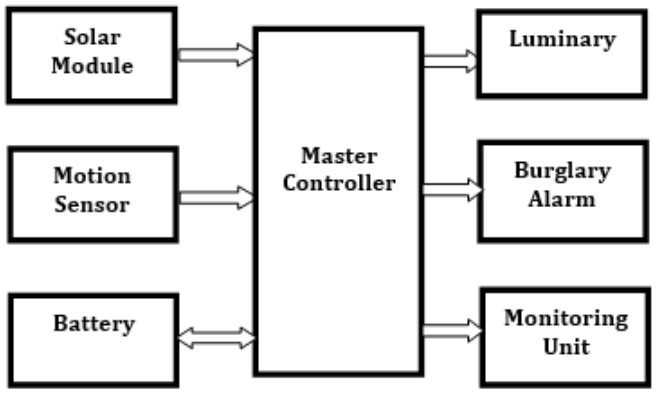

Fig-1: Block Diagram of solar lamp

Explanation of Block Diagram: -

In this project we use atmega16a microcontroller which have great interfacing with input and output module such as power sources, Motion sensor and load unit. Solar power unit converting the sun light into a direct D.C current and charge the battery with it. Monitoring unit is responsible for monitoring the battery life level. Microcontroller is enough smart it is wisely choosing input energy sources and process them for further usages. LED lamp use in this project because of its high efficiency and long life span.

The Block Diagram contains followingparts: -

1.1 ATMega16a Microcontroller

It is high performance, low power Atmel AVR 8-bit microcontroller. It has advanced RISC architecture, high endurance non-volatile memory segment with 16K Bytes of in system self programmable flash memory. It has JTAG interface and great peripheral features such as real time counter with separate oscillator, Four PWM channel, Programmable serial USART, Programmable watchdog timer with separate on chip oscillator. It's operating voltages ranges from 2.7V to 5.5V and speed grades is from 0 to 16 MHz. It's power consumption is 1 MHz, 3V and 25^0C.It executes instructions in a single cycle. ATmega16A achieves throughputs approaching 1MIPS per MHz allowing the system design to optimize power consumption versus processing system.XTAL1 gives Input to the inverting Oscillator amplifier and in internal clock operating circuit. XTAL2 pin is used for Output from the inverting Oscillator amplifier. Microcontroller is the heart of the circuit. It does the job of Master which control all the input and output module. µC continuously monitors the PIR receivers and executes the program stored in its ROM when it receives the signal from the sensors.

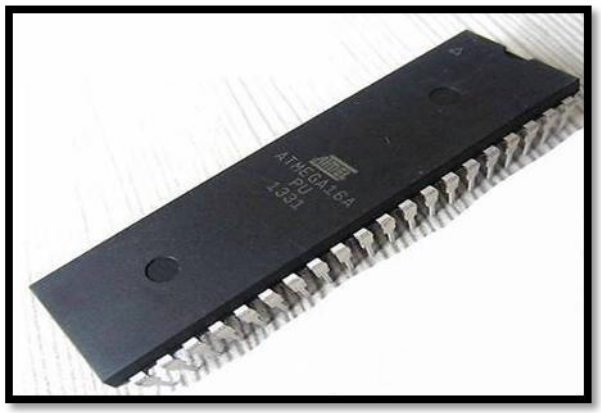

Fig-2:Microcontroller ATMEGA16A

1.2 PIR Motion Detector

This is a great invention known as pyroelectric or passive infrared (PIR) sensor. Every living object that has a temperature above perfect zero emits thermal energy in the form of radiation. Human radiate at wavelength of 9-10 micrometres all time of the day. The PIR sensor is turned to detect this wavelength when a human being arrives in their proximity. Behind the smart response to motion is gizmo that does not even reach the 2c.m. mark in size. The term pyro electricity means heat that generates electricity that means it generate electrical signal of low amplitude. In this sensor does not have an infrared source of its own, so it is also work as passive. It has range of 10 meter. It is widely used in automatic door lock system, elevator, burglar alarms at house and shops, automatic light system, electronic amenities in washrooms are just a few examples where human presence or absence puts the device into passive or active state.

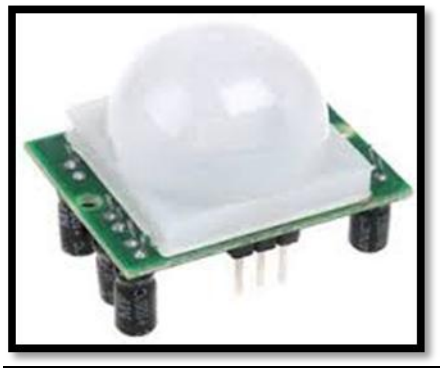

Fig-3: PIR Sensor

1.3 Solar Panel

The solar panel is primary source of energy in this project. It provides D.C current to the monitoring circuit where it is used to charge the battery. Basically three types of solar panel available they are single crystalline, polycrystalline and thin film. We used single crystalline in this project. It is the most efficient and its efficiency is approx. 15-18%. A large chunk of silicon crystal makes it different from others.

The solar panel work in three steps they are following:

a) Panel is made from semiconductor materials such as silicon, they observe photon when sunlight fallson the panel.
b) Photon raises an electron to a higher energy state and then flow of this high-energy electron to an external circuit. Due to the special composition of solar panel, the electrons are follow in a single direction.
c) Generation of current in a solar cell, known as the "light-generated current" or direct current (D.C) electricity.

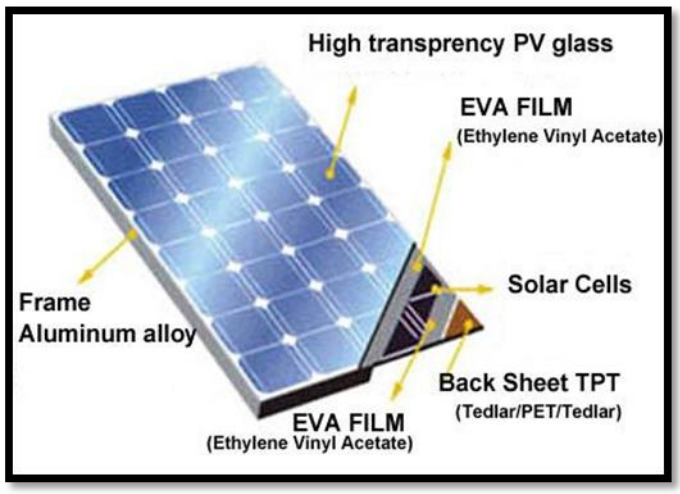

Fig-4: Solar Panel

1.4 Relay Driver Circuit

In relay driver circuit there are transistors, diodes and relays. Relay driver circuit is used to control the light. This block can drive the various controlled devices. We are using +12V dc relay. As µC cannot drive relay directly so output signal from microcontroller is passed to the base of the transistor, which activates the particular relay so that itcan select particular device to operate.Relays can control the charge flowing to the load. Load may be light, fan or other such types of devices.

1.5 Battery Monitoring

We use sealed maintenance free battery because it has long life span and requires low maintenance. Battery is connected to the monitoring circuit where it is efficiently charged and utilise. We have both power sources A.C. and Solar, battery will be charge through one source at a time depends on the avability of the power source. Every status of battery is display on the LCD.

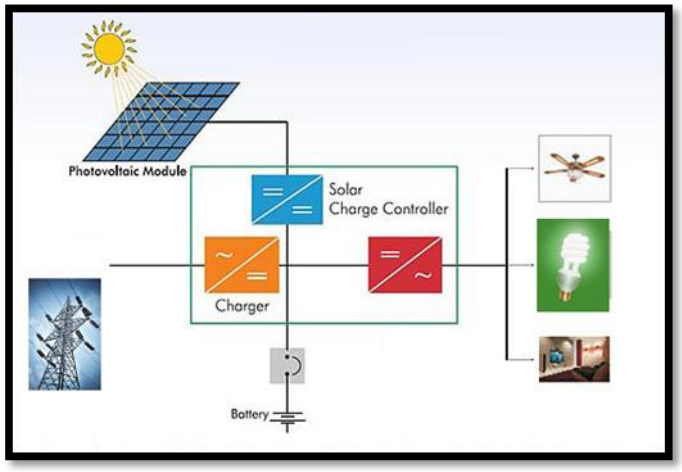

Fig-5: Battery Monitoring

1.6 LCD 2x16

LCD (Liquid Crystal Display) is used to display all the status of the circuit such as voltage of battery, motion detected notification and display which power source utilise. It is very thin technology based on the combination of liquid and crystal. Liquid state produces an image for display.

Fig-6: LCD Display

2. SYSTEM DESCRIPTION

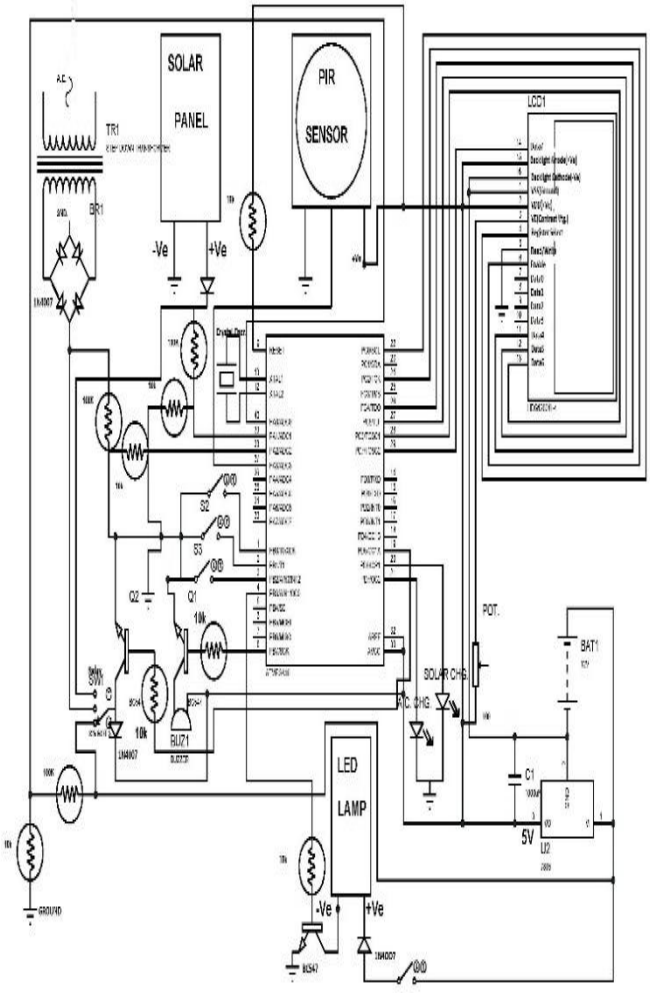

Fig-7: Circuit Diagram of Solar Emergency Lamp

Fig-8: Project image

2.1 Working:

The solar emergency lamp described here has 51 white LEDs.It is powered either by solar power or AC mains or 12V SMF battery, under normal operation the lamp is powered by the battery.Here the circuit is basically divided into two parts: A charging unit and Load unit.

The lamp will work with AC mains with battery voltage lower than 10.5V,230V AC is stepped down and rectified by a bridge rectifier DC voltage is around 15v. We used capacitor C1 because it increases the response time of relay, due to this switching occurs some time later when the voltage across it falls below 12V. When battery charges through A.C source then capacitor filters the rectified output. Switching time of relay is very important and delay in switching is depends on the value of capacitor.

When the battery voltage drops to 10.5V,the battery-charge-controller circuit goes into operation. Selection between a solar panel and AC mains for charging is done with the help of solid-state relays.If both sources are connected, the system selects solar power over AC mains for charging the battery.when batter voltage is lower than 10.5V,output of comparator circuit will be high, which is shown by the on state of green LED.

PIR sensor detects infrared radiation of the human body. It has a single output that goes high when motion is detected. In the case of security when someone come closer to PIR sensor its monitoring circuit turn on the light and burglar alarm.

2.2 Design Calculation:

Load calculation:

- Total 51 LED
- 3 LED in Series & 17 LED Lines in parallel.
- Watt = V x I
- Supply voltage =12V, 12V/3 LED= 4 Volt each LED consuming.
- With reference to data sheet of LED we know eachLED consumes 20 milliamp= 0.02 Amp. Of current.
- Hence each Line of LED consumes = 12V x 0.02 Amp=0.24 Watt.Thus 17 Lines of LED will consume = 0.24 x 17= 4.08 Watt.

  System Voltage = 12 Volt.

Battery Capacity:

- Taking battery's depth of discharge (DoD) = 70% (Deep discharge protection)
- Ah = Ampere Hour (Current per hour)
- Battery Ah = Total Watt/system voltage.

  = 4.08/12

  =0.340 Ah
- With DOD usable capacity = 0.340 X 0.7 =0.238 Ah,So 0.340 – 0.238= 0.102 Ah
- Total Ah required with DoD= 0.340+0.102=0.442Ah
- Total Ah required with DoD = 0.442 Ah
- Total Ah = Calculated Ah * Backup Hr. (e.g. 0.442 x 16.29 Hr. = 7.2 Ah)
- But as per market battery availability we have 7.2 Ah battery available which will give 16.29 Hrs. battery backup.

Daily energy generated by panels:

- The energy supplied by the panels will be higher because of efficiency of battery and Charger.
- An efficiency of 90% is taken for battery in this case.
- An efficiency of 90% is taken for charger in this case, now for battery = Energy supplied by thecharger / Battery's efficiency= 4.08 / 0.90= 4.533 Watt.
- For charger = 4.533 / 0.90 = 5.0366 Watt = 5.04 Watt.
- Thus 5.04 Watt. energy should be generated by SPV modules every day.
- Let Sun shines average of 4 hr. in a day (Reference MNRE).
- To get 5.04 Watt in a day we need = 5.04/4Hr.= 1.26 Watt
- Thus we need 1.26 Watt solar module. (1.26Watt = 12 V & 0.105 Amp. Current)

2.3 Software Requirements:

- Embedded C.
- Proteus:
  It is a Software used for simulation and designing of PCB layout. It was created by Simone Zanella in 1998. It is fully functional and procedural. It consists of many functions and languages.

- Flash Magic
- MikroC PRO:
  It is a powerful, feature-rich development tool for AVR microcontrollers. It is designed to provide the easiest possible solution to developing applications for embedded systems, without compromising performance or control.

2.4 Hardware Requirements:

- ATMEGA16A: 8-bit microcontroller
- PIR sensor
- LCD Display: 5V dc
- Step down Transformer: 12V,50Hz, 2AMP
- Relay Unit: +12V dc to 230V ac
- Power Supply: 230V,5Hz ac
- Solar Module: 12V, 15W
- S.M.F. Battery: 12V, 7.2 Ah
- Bridge Rectifier: 20V,2Amp
- Buzzer
- LED lamp
- Electrolytic Capacitor: (1000µf,35V) and (220µf,35V)
- LEDs
- Registers

- Transistor: BC547
- Diodes: 1N4007

3. CONCLUSION

This project is intended to design a simple and low cost multitasking hybrid solar emergency lamp with a motion detector.This is not only a simple solar emergency lamp,it is having an additional feature of charging better by mains supply if the weather is cloudy and having a motion detector sensor which ensure the safety.To design this system, we will use PIR sensor for motion detection and good materials at low cost. Our target is to design a system in such a way that its components will be able to provide better light in night and ensure the safety of nearby area.The whole system operates automatically. So it does not need any expert person to operate it. It is portable and not so expensive. This design has much more scope for future research and development. Though it is a project, we hope some modification in this project will lead to a reasonable diversity of usage.

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