Solar Powered LED Street Lighting with Auto Intensity Control

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Abstract— The project is designed for LED based street lights with an auto-intensity control that uses solar power from photovoltaic cells. A charge controller circuit is used to control the charging of the battery, and an LDR is used to sense the ambient light on day time.We have also attempted to measure the solar cell parameters through multiple sensor data acquisition. In this system, different parameters of the solar panel like light intensity, voltage, current and temperature are monitored using a microcontroller of the PIC16F8 family.The intensity of street lights is required to be kept high during the peak hours. The street lights are switched on at the dusk and then switched off at the dawn automatically by using a sensing device LDR LED lights are the future of lighting, because of their low energy consumption and long life they are fast replacing conventional lights world over. White light emitting diode (LED) replaces the HID lamps where intensity control is possible by pulse width modulation. A programmable microcontroller of the 8051 family is engaged to provide different intensities at different times of the night using PWM technique, for energy saving for solar based system, also using a charge controller for protecting the battery from over charging, overload and deep discharge protection. A light sensing device LDR (Light Dependent Resistance) is used , whose resistance reduces drastically in day light for sensing purposes.In the measuring circuit the light intensity is monitored using an LDR sensor, the voltage by voltage divider principle, the current by current sensor and the temperature by temperature sensor. All these data are displayed on a 16X2 LCD interfaced to thePIC microcontroller.

Index Terms— LED based solar street lighting using microcontroller 8051 ; charging of battery controlled by charge controller circuit; measurement circuit senses 4 parameters;

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1 Introduction

The main consideration in the present field technologies are Automation, Power consumption and cost effectiveness. Providing street lighting is one of the most important and expensive responsibilities of a city. Energy efficient technologies and design mechanism can reduce cost of the street lighting drastically. There are various numbers of control strategy and methods in controlling the street light system to ensure that it consumes less energy and is efficient in terms of money and usage.

Objective

The main objective of this paper is to provide a better solution to minimize the electrical wastage in operating street lights, in this electronic era human restless. Manual control is prone to errors and leads to energy wastages and manually dimming during mid night is impracticable. A rapid advancement in embedded systems had paved path for the virtual mechanisms based on micro-controllers.

This paper presents an automatic street light controller using light dependent resistor(LDR) which is also known as photo resistor made cadmium sulfide, a 8052 microcontroller which is programmed using C language to act as a pulse width modulator. The circuit also consists of a charging circuit and a measurement of the solar cell is done using a microcontroller of PIC16F8 family. The light intensity is monitored using an LDR sensor, the voltage by voltage divider principle, the current by current sensor and the temperature by temperature sensor. All these data are displayed on a 16X2 LCD interfaced to the PIC microcontroller.

Problem Definition

The idea of designing a new system for the streetlight that do not consume huge amount of electricity and illuminate large areas with the highest intensity of light is concerning each engineer working in this field. Inefficient lighting wastes significant financial resources every year, and poor lighting creates unsafe conditions. Energy efficient technologies and design mechanism can reduce cost of the street lighting drastically.

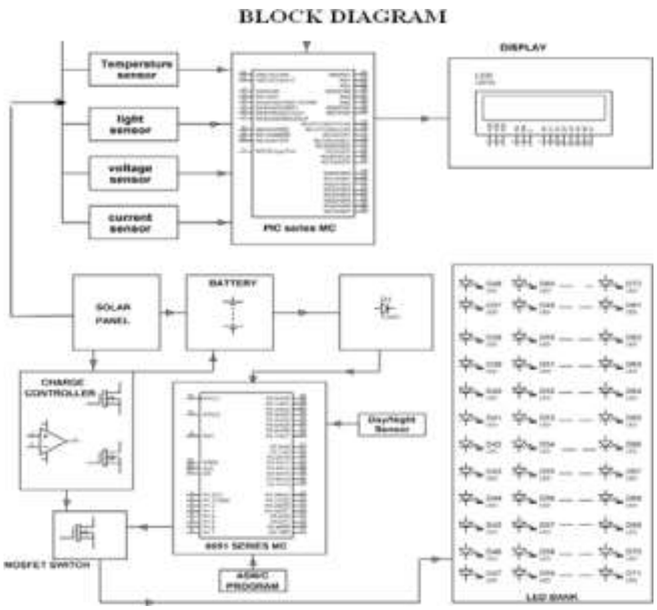
2 Implemented method for street lighting

This circuit consists of a battery charge controller circuit that is charged by the solar panel. The battery gives supply to the micro-controller which is programmed to work as a PWM connected to the LDR which gives high/low signal based on the light intensity. When the microcontroller gives a high signal to the mosfet the LED is OFF. Once the MOSFET gets a low signal it turns ON and the LED glows. The circuit also consists of measurement circuit for the measurement of photovoltaic power and the variation of light for the amount of sunlight obtained. The current is sensed by the current sensor, and temperature by the temperature sensor and voltage is noted by the potential divider circuit. The block diagram is shown below in fig. 2.1

3 WORKING

Solar Panel Section:

Battery B1 is charged via D10 and fuse. When battery gets fully charged Q1 conducts from output of comparator. This results Q2 to conduct and divert the solar power through D11 and Q2 such that battery is not over charged.



We use IC LM324 having 4 op-amps used as comparators that is U1:A,B,C,D. U1:A is used for sensing over charging of the battery to be indicated by action of U1:B output fed D1(red)and D12(green) for indicating battery status. Diodes D5 to D8 all connected in series are forward biased through R14 and D3 .This provides a fixed reference voltage of 0.65*4= 2.6v at anode point of D8 which is fed to pin 2 U1:A through R11, pin 13 of of U1:D, pin 6 of U1:B via R9 and pin 10 of U1:C via 5K variable resistor. While the battery is fully charged the voltage at cathode point of D10 goes up. This results in the set point voltage at pin 3 of U1:A to go up above the reference voltage. This will switch 'ON' the transistor Q1. MOSFET is triggered to drive a led D1 indicating battery is being fully charged. During overload U1:C going low to remove the drive to the gate of MOSFET Q2 that disconnects the load. The correct operation of the load in normal condition is indicated by D9 while the MOSFET Q2 conducts.

Control of Street Lighting Circuit

Here we use a LDR to sense the daylight, based on that we switch ON the LEDs. As we made a potential divider with 100K and LDR. While in the daylight light falls on LDR its resistance will go down, as resistance go down voltage drop across it will go down., voltage drop across 100K go increase. The voltage drop across LDR will go to 39th pin of MC as LOW logic. When night falls there will be no light on LDR so resistance of LDR go increase so voltage drop across will increase, this voltage drop goes to MC as HIGH logic sensing as Night. Based on light intensity falling on LDR decided the duty cycle of output LEDs . The MOSFET switches ON between its drain and source that completes its path of current flow through the LEDs. Therefore with varying duty cycle from 90% to 10% the current flowing through the LEDs reduces that result in lesser intensity as described earlier. The circuit is shown in fig 3.

3.3 Measurement of Solar Photovoltaic Power Circuit

In the measurement circuit the Voltage from the solar panel is fed to the MC pin no 4 through a potential divider comprising of R4 & R5. A resistance is used as load in series with another resistor R7 of 10ohm, 10W. The voltage drop across the resistor R7 is proportional to the load current which is fed to pin 5 of MC. Light input is sensed by LDR which is fed to MC pin 2. A temperature sensor LM35(U3) is connected to pin 3 of MC. Thus, four analog varying voltage parameters are fed to the internal ADC of the MC out of total availability of 8 channels. A LCD is used to display all the output parameters such as light intensity, temperature, voltage and current of solar panel.

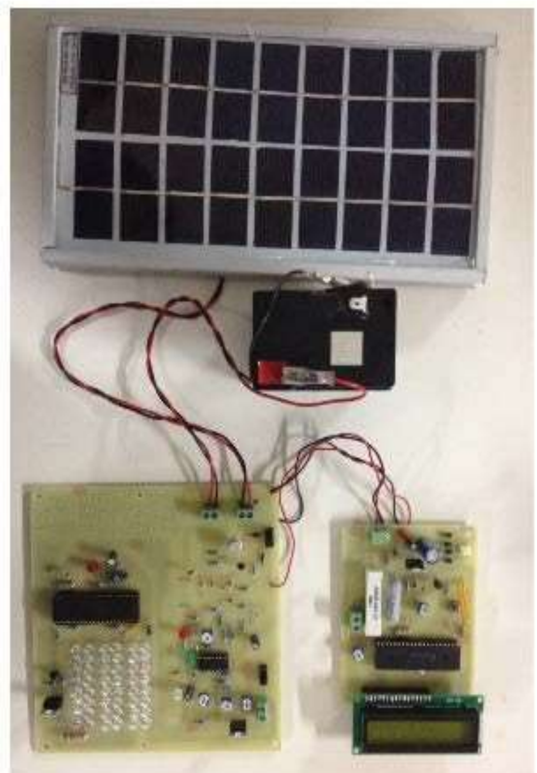


Fig 3. Designed circuit for street lighting

4 RESULT

The result comprises the successful operation of the **'SOLAR POWERED LED STREET LIGHT WITH AUTO INTENSITY CONTROL '.** The circuit is stationed in a suitable location that is exposed to sunlight so that immediately it is dark the system automatically switches "ON" the lamps and when the illumination is above 50 lux the lamps are automatically switched "OFF". The values of illumination, voltage, current and temperature is noted from the LCD.

OBSERVATION :

As observed on Friday, 20/ 05 / 2016 at 1 :22 pm in the AEC LAB of NEW HORIZION COLLEGE OF ENGINEERING :

Sl. no.	Curent (A)	Vol-tage (V)	Illumina-tion (lux)	Tempera-ture (°C)	Status of LED
1	0.012	0	69.2	22	OFF
2	0.011	0	53.5	22	ON but Dim
3	0.01	0	46.7	22	ON and Slightly bright
4	0.011	0	3	23	ON and glowing brightly

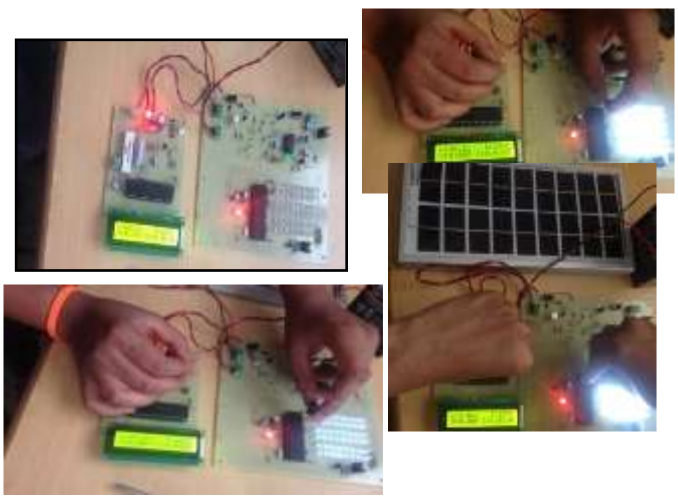


fig 4.1 Different illumination

5 Future Scenario

This design can be enhanced using the following:

1. Solar and Wind Powered Street Lights
2. Time Programmed Sun Tracking Solar Panel

6 Conclusion

This project **'SOLAR POWERED LED STREET LIGHT WITH AUTO INTENSITY CONTROL'** is a cost effective, practical, eco-friendly and the safest way to save energy. It clearly tackles the two problems that world is facing today, saving of energy and also disposal of incandescent lamps, very efficiently. According to statistical data we can save more that 40 % of electrical energy that is now consumed by the highways. Initial cost and maintenance can be the draw backs of this project. With the advances in technology and good resource planning the cost of the project can be cut down and also with the use of good equipment the maintenance can also be reduced in terms of periodic checks.

The LEDs have long life, emit cool light, donor have any toxic material and can be used for fast switching. For these reasons our project presents far more advantages which can over shadow the present limitations. Keeping in view the long term benefits and the initial cost would never be a problem as the investment return time is very less.

The project has scope in various other applications like for providing lighting in industries, campuses and parking lots of huge shopping malls. This can also be used for surveillance in corporate campuses and industries.

This paper elucidates the design and implementation of an automatic street light control system. The design works efficiently to turn street lamps ON/OFF. The LDR sensor is the only sensor used in this circuit. The lamps will come "ON" immediately darkness falls and go "OFF" once the illumination exceed 50 lux. With this design, the drawback of the street light system using timer controller is overcome and human intervention is completely eliminated. By this energy consumption and cost are drastically reduced.

The Automatic Street Light Control System based on Light intensity & traffic density, in the todays up growing countries will be more effective in case of cost, manpower and security as compare with today's running complicated and complex light controlling systems.

Appendices

- ATMEL 89S52 Data Sheets.
- PIC16F877A Data Sheets.
- VOLTAGE REGULATOR 7805
- ZENER DIODE
- LM35
- LED
- LDR
- DIODE IN4007

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