

# Auto Intensity Control of Street Light with Solar Tracker using Microcontroller

Chitize Thapa<sup>1</sup>, Deepak Rasaily<sup>2</sup>, Tashi Rapden Wangchuk<sup>3</sup>, Ajay Pradhan<sup>4</sup>, Aarfin Ashraf<sup>5</sup>

<sup>1,3,4</sup> Diploma of Final Year Student in Dept. of Electrical & Electronics Engineering, Ccct Polytechnic

<sup>2</sup> sr. Lecturer in Dept. of Electrical & Electronics Engineering, Ccct Polytechnic  
Chisopani, P.O. Nandugaon, South Sikkim, India

**Abstract** — Energy has become the important factor in our day to day life, in order to save energy and use it wisely and in an efficient way we have come up with this project. In normal case turning on and off the street light would require manual operation which is time consuming, since time is a very important factor. On completion of this project manpower as well as time can be saved and it provides more accurate results than ordinary Street light. A solar tracker system provides solar charging to the battery which can be used when there is shortage of electric energy.

**Keywords:-** Microcontroller, LCD, Gear Motor, RTC, Photovoltaic cell, Battery, Bulb.

## I. INTRODUCTION

Atmega8 is an Atmel AVR microcontroller family this has many features similar to atmega32. Since it has reduced features and capabilities as compare to atmeg32 but has an enough functions to work with it. The function which is not available in atmega8 is the JTAG (Joint Test Action Group) interface but rest functions are the same as atmega32. From the name itself it can be guessed that the atmega8 line has 8kb of flash memory. All the programming codes are stored in on- chip flash and have no off- chip program memory [1]. This memory is non-volatile flash memory the address data location contains input output registers, file registers and SRAM (Static Random Access Memory). The single chip consists of flash, EEPROM and SRAM, so we don't require an external memory in various applications. Atmega8 has 8 Kb of flash memory, 1 Kbyte of internal SRAM and EEPROM of 512 bytes with write or erase cycle with the power un interruption.

The operating voltage of atmega8 is 4.5v to 5.5v the speed grade is 0 to 16MHz, power consumption at 4MHz, 3v, 25°C in active mode is 3.6mA, in idle mode is 1.0mA and in power down mode is 0.5µA. the peripheral features include two 8 bit timer /counter with separate pre scalar, one compare mode, 3PWM channels, on-chip analog comparator, programmable

Watchdog timer with separate on-chip oscillator. The special feature include power on reset, external an internal interrupt sources, five sleep modes: idle, power save, standby, ADC noise reduction and

power down. The atmega8 is a low power CMOS 8 bit microcontroller based on the AVR RISC architecture, it consist of 23 programmable input/output lines. The advance RISC architecture includes 130 powerful instructions, 32 × 8 general purpose working registers, on-chip two cycle multiplier.

Some microcontrollers may use four-bit words and operate at clock rate frequencies as low as 4 kHz, for low power consumption (single-digit mill watts or microwatts)[2,3]. They will generally have the ability to retain functionality while waiting for an event such as a button press or other interrupt; power consumption while sleeping (CPU clock and most peripherals off) may be just Nano watts, making many of them well suited for long lasting battery applications. Other microcontrollers may serve performance-critical roles, where they may need to act more like a digital signal processor (DSP), with higher clock speeds and power consumption.

## II. OUR WORK

The important factor of this project is to make an automatic, reliable and efficient (lesser energy utilization) control of street light using various electrical as well as electronic components. The circuit named auto intensity control of street light with solar tracker is designed using microcontroller along with real time clock (RTC) and Light Dependent Resistance (LDR)[4].

The atmega8 microcontroller is used for automatic operation, it adjust the intensity of light with respect to time. The solar tracker circuit is also used to control the gear motor so that the motor clamped with photovoltaic cell tracks the exact position of sunlight so that the continuous light energy is provided to the solar cell which converts the light energy into electrical energy so as to charge the battery. This stored charge in battery bank can be used in a period when there is no ac supply. When the battery is fully charged, to prevent the battery from further charging or over charging an automatic cut off comparator circuit is also provided using IC 741 (operational amplifier), Zener diode, transistor (BC547)[5].

The inverter circuit designed using IC CD4047, MOSFET and transformer provides automatic supply of power to street light when there is no ac supply.

### III. BLOCK DIAGRAM AND DESCRIPTION

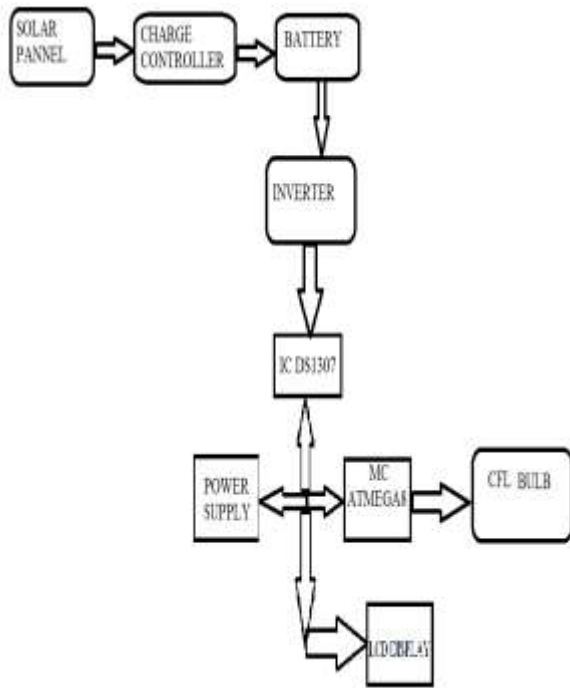


Fig.1 shows the block diagram.

#### A. Microcontroller:

This is the CPU (central processing unit) of our project. We are going to use a Microcontroller of Atmel atmega8 family[6]. The various functions of microcontroller are like:

- I. Sensing the LDR input signal
- II. Sending this signal to RTC which starts and provides the clock signal to microcontroller.
- III. Input to microcontroller is provided by RTC and it works and controls the intensity of LED bulb with respect to change in time.

#### B. Gear motor

The working of this gear motor depends on the operation of solar tracker circuit which indicate the position of sun and the output is obtained with rotation of this motor and the position of solar cell clamped to this motor.

#### C. Photovoltaic cell

It provides external supply of power from solar energy and converts it into electrical energy in order to charge the battery. It is made up of crystalline silicon.

#### D. LCD (16 × 2)

It is used to display the time and date. It supports 16 characters by 2 line display [7]. The contrast can be adjusted according to the users' desire



#### E. RTC

(Real Time Clock). It is a computer clock in the form of integrated circuit that keeps the track of current time and gives the signal to microcontroller in order to increase or decrease the intensity of light, according to change in time.

### IV. CIRCUIT DIAGRAM AND DESCRIPTION

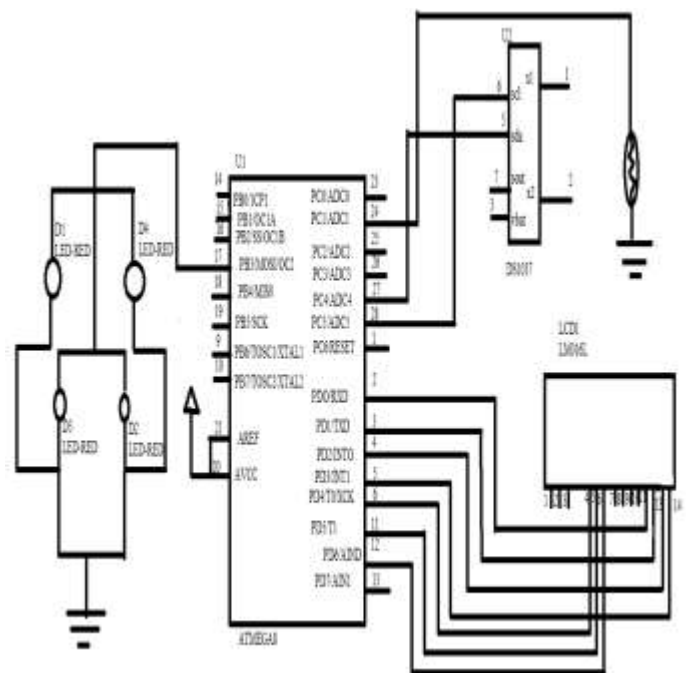


Fig.2 shows the Circuit diagram.

The circuit consists of ATmega8 controller, Real time clock and LDR. Depending on the time and LDR value, micro controller automatically adjusts the intensity of the street lights using pulse width modulation. In this project, Pulse width modulation signal is generated in ATmega8 micro controller using timer/counter-2 at OCR2 i.e. PB3 pin. Real time clock IC used is DS1307. It is compatible to I2C protocol. RTC acts as a slave. Time is read from RTC IC and micro controller automatically adjusts the intensity of light by generating PWM signal.

Light Dependent Resistor (LDR) is used in this project to check the intensity of light. Depending on the intensity, lights can be switched ON or OFF. Both light dependent resistor and real time clock are required for this project. Because, using Light dependent resistor alone may lead to wastage of

energy. Using RTC alone may cause the lights to be switched on even when there is light.

**Principle behind the Circuit:**

The main component in the circuit is atmega8 microcontroller. Here, solar tracker circuit driving gear motor with solar charging circuit cum automatic cut off circuit and inverter circuit. Each circuit needs to be design individually and it is than assembled as one circuit to provide intelligent street lighting[9]. The circuit is easier to design and its working is simple and efficient. The main work is done by microcontroller and with the help of RTC. The clock is set in such a way that when dusk occur the RTC sends pulse to microcontroller which converts the signal into electrical pulse and feeds it to LED bulb and the bulb glows. After one or two hour of interval, gradually the intensity of light increases and during the period of dawn the light intensity decreases and bulb switches to off position. This main work in this circuit is done by the microcontroller[10].

**V. COMPONENT DETAILS**

Sl/No	Items	Range/specification	Quantity
1	DC Battery	12V	1
2	Crystal oscillator	12MHZ	1
3	Microcontroller	At mega 8	1
4	Regulator IC	7805	1
5	Lcd	-	1
6	Capacitor	10uF , 0.1Uf , 33uF	5
7	Resistor	1k , 5k , 2k	7
8	Relay	12v DC	1
9	Transistor	BC547	2
10	Preset	10K(1/4 watt)	1
11	Reset switch	-	1
12	LED	-	2
13	Diodes	IN4007	2
14	Connecting wires	-	1set

**VI. RESULT AND ANALYSIS**

- In evening , when the intensity of sunlight falls the LDR triggers RTC which in turn give signal to microcontroller thus when time increases the intensity is increased.
- It adjusts the intensity of light in a given period of time.
- No manual operation is required in order to turn on and off the street light.
- The inverter provides continuous power to operate the street light.
- The solar tracker tracks the sun and controls the gear motor attached to solar cell which provides continuous supply to charge the battery bank.
- To prevent the battery from over charging an operational amplifier with comparator and zener diode cut off circuit is used.
- It is used to control 3 to 4 LED bulbs.

**VII. CONCLUSION**

This project deals with the functioning and extension of the natural source of sun and the automatic functioning of the highly required outdoor existence of light as streetlight. This project is user friendly and is efficient enough to work out. We get to know the various applications of microcontroller and the capability of the solar tracker circuit. Nevertheless this project also is of great use to the day to day life and is brilliant. Even in the worse climate condition we have a secondary way that is a battery backup to operate the circuit. Moreover the weather should not be a problem to handle this project and we are confident in making this project a success.

**VIII. REFERENCE**

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**Authors:**

[1]



**Chitizethapa** is a final year Diploma student, Dept.Of Electrical and Electronics Engineering from Centre for Computer and Communication Technology, Chisopani, South Sikkim. His main areas of interests are generation of electrical power, Renewable Energy Sources and Digital Electronics.

[2]



**Deepak Rasailyis** presently associated with the Department of Electronics and Communication Engineering at Centre for Computer and Communication Technology (CCCT-Govt.Polytechnic) Chisopani, South Sikkim, India as a Senior Lecturer since 2003 to till date.

[3]



**Tashi Rapden Wangchuk** is presently associated with the Department of Electrical and Electronics Engineering at “Centre for Computer and Communication Technology” (CCCT-Govt.Polytechnic),Chisopani, South Sikkim, India; as a Senior Lecturer since 2003 to till date.

[4]



**Ajay Pradhan** is a final year Diploma student, Dept. Of Electrical And Electronics Engineering from Centre for Computer and Communication Technology, Chisopani, South Sikkim. His main areas of interest are in transmission and distribution system, Analog electrical circuit

[5]



**Aarfin Ashraf** is a final year Diploma student, Dept. Of Electronics and Communication Engineering from Centre for Computer and Communication Technology, Chisopani, South Sikkim. His main areas of interest are Antenna Design, Radar Signal Processing and Microwave Theory and Techniques.