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# Energy Efficient Smart Street Lighting System

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**Abstract:- The paper aim is to modeling "Energy Efficient Smart Street Lighting System". This system reduces the issues arises in the contemporary avenue lighting system, and finds a way to keep energy greater than 15% of energy consumption in India and 19-38% global. In doing so the first step is LED lights instead of conventional lamps, secondly light by demand, not by the clock, thirdly solar street light. Maximum road safety with minimum operational costs, this is the guiding idea behind "Intelligent street lighting". Intelligent street lighting systems can think for themselves and reduce energy costs. LDR, IR and Microcontroller are the essential components of the system. The light dependent resistor (LDR) varies its resistance according to the light falls on it. When an obstacle is coming nearer to the highway lighting system, it will be detected by IR sensor and certain light will be in ON condition.**

**The AT89S52 microcontroller enables more dynamic and faster control. A solar panel made of crystals is used to charge a 6V rechargeable battery. Additional battery charger circuit is provided for emergency applications. The paper is designed for LED based Street Lights with an auto-vehicle detection that uses solar power. This prototype can be installed on toll roads at toll collection stations and on roads with sharp curves.**

***Keywords:-*** *LED, LDR, IR sensor, Microcontroller, Relays, Solar Panel, Etc.*

## I. INTRODUCTION

In the cutting-edge street lighting fixtures device lights are ON when not wanted and they may be manually operated. Mistakes and power wastages because of manage manually and also decreasing light intensity in the course of midnight isn't attainable. Additionally, dynamically monitoring the mild level is manually impracticable. Additionally conventional lamps are used, upkeep is high, lot of wiring required, and strength is wasted. Therefore there is a need to design a clever road lights machine.

The concept of creating a modern streetlight system that doesn't use a lot of energy and has a low intensity that covers a large area with bright light. One of a city's most significant obligations is to provide street lighting. In normal cities around the world, lights will account for 10–38 percent of the overall power bill. Because of their strategic importance for economic and social stability, street lights are a particularly pressing issue for public authorities in developing countries. Every year, inefficient lighting fixtures waste a large amount of money, and poor lighting creates hazardous conditions. Green energy technologies and format mechanisms have the potential to significantly reduce the cost of road lighting.. The contemporary fashion is the advent of automation and some distance flung control solutions to govern street lighting. As power consumption is a problem of growing hobby, feasible power financial savings in public street lighting fixtures tool is presently stated in distinct viewpoints.

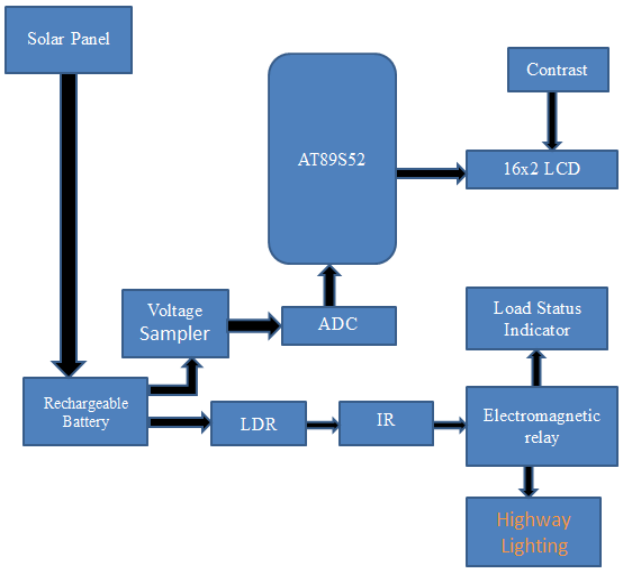
There are numerous manipulate strategies and strategies in controlling the road mild implement at the side of layout and implementation of CPLD predicated consummately solar energy preserving contrivance for avenue lighting and automatic site visitors controller [1], layout and fabrication of automatic road moderate manage implement, automatic street mild depth manage and avenue aegis module the utilization of embedded contrivance, automatic avenue marginal control contrivance, sapient road lights contrivance utilizing GSM, vigor consumption preserving answers predicated plenarily on perspicacious street lights control contrivance and a unique layout of an automatic lighting fixtures manage machine for a Wi-Fi sensor community with incremented sensor lifetime and decremented sensor numbers [6]. On this venture types of sensors can be utilized which is probably mild sensor and photoelectric sensor. The moderate sensor will discover tenebrosity to set off the ON/OFF switch, so the streetlights may be yare to reveal on and the photoelectric sensor will come upon kineticism to spark off the streetlights. LDR, which varies in line with the magnitude of mild falling on its floor, this offers an inductions for whether or not it's miles an afternoon-night time, the photoelectric sensors are located on the aspect of the road, which can be controlled via microcontroller AT89S52 [4]. The photoelectric may be activated simplest at the night time. If any object crosses the photoelectric beam, a particular mild may be mechanically ON.

Using this as a basic principle, a realistic device can be designed for the proper use of streetlights in any location. Over the current avenue lighting system this challenge is electricity green, dependable and secure, technically advanced, value effective in renovation, greater citizen satisfaction, and decreased greenhouse gases. The energy saving is around 30-40% with high traffic and more than 60% for low traffic (approximate values). Also maximum road safety with minimum operational costs, this is the guiding idea behind "Smart Street Lighting System".

## II. METHODOLGY

The aim of this paper is modeling "Energy Efficient Smart Street Lighting System". The system includes microcontroller, LDR, and photoelectric sensor. via the use of the LDR we are able to carry out the lighting fixtures, i.e. even as the mild is available then it is going to be in the OFF country and whilst it's miles dark the moderate might be in ON united states, it way LDR is inversely proportional to slight. When light falls on the LDR, it sends commands to the microcontroller that it should be in the OFF kingdom, at which point it switches off the moderate [3], the photoelectric sensor can be used to turn ON or OFF the moderate based on the presence or absence of an object. These types of commands are sent to the controller AT89S52 then consistent with that the device operates. We use a relay to behave as an ON/OFF switch.

### *2.1 BLOCK DIAGRAM*




### *2.2 SPECIFICATIONS*

Domain : Embedded System
Software: Embedded C, Keil, Proload
Power Supply : 5V, 750mA Regulated Power Supply
Microcontroller : AT89S52
Display : LCD
Solar Panel : 1
LDR : 1
IR : 3
Crystal : 11.0592MHz

### *2.3 COMPONENTS*

1. Microcontroller (AT89S52)
2. LED (Light Emitting Diode)
3. Battery
4. Solar Panel
5. LDR (Light Dependent Resistor)
6. IR sensor
7. Relays

#### *3.3.1 MICROCONTROLLER (AT89S52)*

The AT89S52 is a low-voltage, excessive-typical performance CMOS 8-bit microcomputer with 4K bytes of Flash programmable reminiscence. The device is synthetic the use of Atmel's excessive-density nonvolatile reminiscence era and is properly matched with the industry-standard MCS-51 training set.

#### *3.3.1.1 DESCRIPTION OF AT89S52*

The Atmel AT89S52 is an efficacious microcomputer, which gives a extensively flexible and value-efficacious technique to many embedded manage software program via coalescing a bendy eight-bit CPU with Flash on a monolithic chip ions [2]. Similarly, the AT89S52 shown in figure 3.3.1 is designed with static good judgment for operation right down to zero frequency and enables software program selectable energy preserving modes. The Idle Mode ceases the CPU on the identical time as sanctioning the RAM, timer/counters, serial port and interrupt contrivance to maintain functioning. The puissance-down mode preserves the RAM contents but freezes the oscillator incapacitating all concrete chip competencies until the following hardware reset.

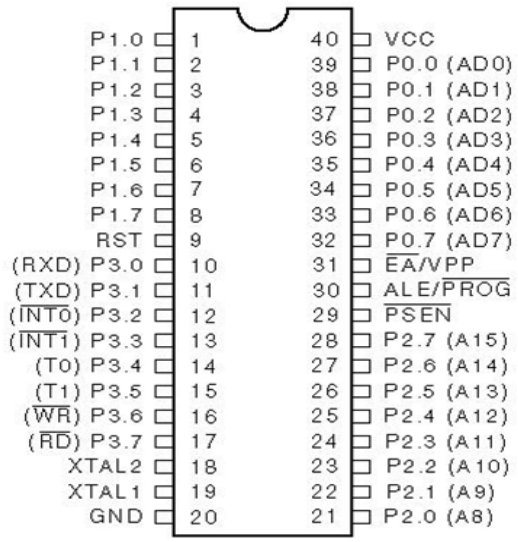



Fig: 3.3.1 Pin diagram

#### *3.3.1.2 PIN DESCRIPTION*

VCC (IC energy supply pin) - Pin 40 affords deliver voltage to the chip. The voltage source is +5V. GND- Pin 20 is the ground. XTAL1 and XTAL2- XTAL1 and XTAL2 are the input and output, respectively, of an inverting amplifier that can be configured for use as an on-chip oscillator used either a quartz crystal or ceramic resonator as proven in figure 3.3.2. To electricity the device from an external clock supply, XTAL2 should be left unconnected whilst XTAL1 is pushed, as shown inside the underneath figure. There are not any necessities on the responsibility cycle of the outside clock sign, for the cause that enter to the inner clocking circuitry is through a divide-by way of using- turn-flop, but minimum and maximum voltage excessive and occasional time specifications have to be discovered.

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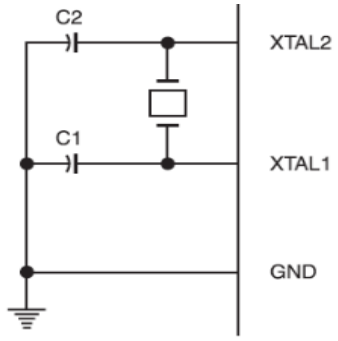


Fig: 3.3.2 Oscillator Connections

C1, C2 = 30 pF ± 10 pF for Crystals
= 40 pF ± 10 pF for Ceramic Resonators

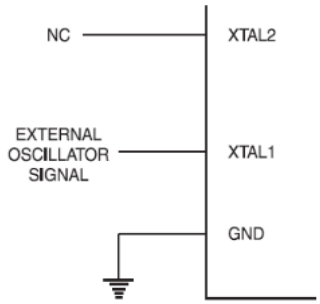


Fig3.3.4: External Clock Drive Configuration

The reset pin is located on Pin 9. It's a lot of information and has a lot of movement. When a high heartbeat is applied to this pin, the microcontroller will reset and the exercises will be terminated. That is frequently referred to as a force on reset. Pin 31 is EA (outside get passage to). It's a working low sign. It's an information pin and should be labelled with either VCC or GND; otherwise, it can't be left disconnected. A yield pin is PSEN (programming keep permit). Beer (address hook empower) is a vivacious high and a yield pin. P0, P1, P2, and P3 each have eight pins, making them eight-cycle ports. Every one of the ports upon RESET is intended to be an enter, despite the fact that P0-P3 have the expense FFH on them.

Port 0 is in like manner point by point as AD0-AD7, allowing it for use for both adapt to and insights. Brew shows if P0 has adapted to or data. When ALE=0, it displays realities D0-D7; when ALE=1, it displays addresses A0-A7. As a result, ALE is used to demultiplex adapt to and information using an inner hook. While there may be no external memory association, the P0 pins should be connected to a 10K-ohm pull-up resistor. That is a direct result of P0 being an open channel. With external pull-up resistors connected to P0, it can be used as a simple I/O, similar to P1 and P2. In any case, the ports P1, P2, and P3 no longer require any draw up resistors due to the fact that they are effectively equipped with pull-up resistors. Ports P1, P2, and P3 are configured as info ports after a reset.

P1 and P 2 are used as simple I/O without the use of an external memory association. With external memory connections, port 2 should be used in conjunction with P0 to provide the 16-cycle address to the external memory. Port 2 is unique in that it displays the A8-A15 double trademark. While P0 presents the first eight pieces through A0-A7, it is P2's responsibility to present pieces A8-A15 of the location. Port 3 is made up of eight pins, numbered 10 through 17. It could be used as an enter or a yield. P3, unlike ports 1 and 2, does not require any draw up resistors. Port 3 has the additional capability of providing some unusually critical signs incorporating hindrances, which are demonstrated in work area three. 3.1.1

| Port Pin | Alternate Functions |
|---|---|
| P3.0 | RXD (serial input port) |
| P3.1 | TXD (serial output port) |
| P3.2 | $\overline{\text{INT0}}$ (external interrupt 0) |
| P3.3 | $\overline{\text{INT1}}$ (external interrupt 1) |
| P3.4 | T0 (timer 0 external input) |
| P3.5 | T1 (timer 1 external input) |
| P3.6 | $\overline{\text{WR}}$ (external data memory write strobe) |
| P3.7 | $\overline{\text{RD}}$ (external data memory read strobe) |

Table: 3.3.1 Port 3 Alternate Functions

To allow the device to bring code from outer programming memory locations beginning at 0000H and ending at FFFFH, EA/VPP (outside get section to allow) should be connected to GND. It should be noted that if lock digit 1 is changed, EA may be inside hooked on reset. For inner programme executions, EA should be linked to VCC. When 12-volt writing computer programmes are selected, this pin also receives the 12-volt programming permit voltage (VPP) during Flash programming.

A couple of Port1 pins offer extra abilities are demonstrated in table 3.3.2. P1.0 and P1.1 might be designed to be the clock/counter 2 outer is checked information (P1.zero/T2) and the clock/counter 2 reason enter (P1.1/T2EX), separately. Besides, P1.4, P1.5, P1.6, and P1.7 might be designed on the grounds that the SPI slave port pick, data input/yield and move clock input/yield pins. Port1 furthermore gets the low-request adapt to bytes all through Flash programming and confirmation.

| Port Pin | Alternate Functions |
|---|---|
| P1.0 | T2 (external count input to Timer/Counter 2), clock-out |
| P1.1 | T2EX (Timer/Counter 2 capture/reload trigger and direction control) |
| P1.4 | $\overline{\text{SS}}$ (Slave port select input) |
| P1.5 | MOSI (Master data output, slave data input pin for SPI channel) |
| P1.6 | MISO (Master data input, slave data output pin for SPI channel) |
| P1.7 | SCK (Master clock output, slave clock input pin for SPI channel) |

Table: 3.3.2 Port1 Alternate functions

In Programmable Clock Out, the half-obligation cycle clock can be changed to output on P1.0. This pin, in addition to being an I/0 pin, has change capabilities. It can be modified

to serve as the external clock for Timer/Counter 2 or to produce a half-duty cycle clock ranging from 61 Hz to four MHz (for a sixteen-MHz working recurrence).

*3.3.2 LIGHT EMITTING DIODE (LED)*

The anode (+) has a longer lead and the cathode has a shorter lead (&minus). The anode is on the left in the schematic image of an LED (base), and the cathode is on the right. Light-emitting diodes (LEDs) are components used in electronic devices to signalise light.

*3.3.3 BATTERY*

Battery (power), a collection of electrochemical cells for energy storage, both as I believe connected or separately connected and housed in a single unit. An electrical battery is made up of one or more electrochemical cells that are used to convert stored substance strength into electrical strength.

*3.3.4 SOLAR PANEL*

These panels are stable-nation semi-conductor gadgets that convert the sun's strength immediately into energy.

*3.3.5 LIGHT DEPENDENT RESISTOR (LDR)*

LDRs, or light settled resistors, are particularly useful in light/dark sensor circuits. The opposition of an LDR is frequently extremely unreasonable, occasionally as unnecessary as 1,000,000 ohms; however, when they are enlightened with light, the opposition drops dramatically. This LDR performs a fundamental feature in controlling the electrical domestic system primarily based on the force of gentle, i.e., if the pressure of mild is greater (earlier or later of daytime), the hundreds can be in off circumstance. Supplementally, if the intensity of light is substantially less (over a duration of evenings), the heaps can be brief. Whilst the moderate degree is low the obstruction of the LDR is excessive. This maintains contemporary-day from streaming to the lower part of the semiconductors. Alongside those traces the LED would now not slight. But, when mild sparkles onto the LDR its obstruction falls and present day streams into the bottom of the essential semiconductor and then the second semiconductor. Right here in our dare to avoid the light from brought on fall straightforwardly to LDR, we place a compartment in which we are able to keep up our hoops. on the off threat that everyone eliminates the sphere the moderate from drove falls proper now directly to the LDR and in a while the semiconductor can be on this is checked via the microcontroller.

*3.3.6 INFRARED (IR) SENSOR*

An Infrared (IR) sensor is carried out to run over limits inside the front of the robotic or to split amongst colorations counting on the layout of the sensor [5]. An IR sensor includes of a manufacturer, indicator and related hardware. The circuit needed to make an IR sensor includes sections; the producer circuit and the collector circuit. The producer is truly an IR LED (slight Emitting Diode) and the identifier is largely an IR photodiode this is sensitive to IR moderate of the indistinguishable frequency as that radiated via the IR LED. Even as IR moderate falls at the photodiode, its opposition and correspondingly, its yield voltage, change with reference to the estimation of the IR mild got. this is the hidden rule of strolling of the IR sensor.

*3.3.7 RELAYS*

A relay is a type of electrical switch that opens and closes in response to the operation of another electric circuit. The switch inside the intriguing structure is operated by an electromagnet to open or approach one or more units of contacts.

*3.4 CODING*

```
#include<reg51.h>
#define lcd_data  P1
sbit rs   = P3^3;
sbit rw   = P3^4;                    // LCD CONTROL -PINS
sbit en   = P3^5;

sbit ir_rx = P2^0;
sbit ldr  = P2^1;
sbit led  = P2^2;

void delay(unsigned int);
void lcdcmd(unsigned char);
void lcddata(unsigned char);
void displaymsg(unsigned char *p);
unsigned char cmdarr[ ]={0x38,0x06,0x0e,0x01,0x80,0x0c};

void main()
{
 unsigned char i, ldr=0,  ir_rx, led = 0;;
 for(i=0;cmdarr[i]!='\0';i++)
 {
  lcdcmd(cmdarr[i]);
 }

 lcdcmd(0x01);
 lcdcmd(0x80);
 displaymsg(" SOLAR HIGHWAY");
 lcdcmd(0xC0);
 displaymsg("  LIGHTENING SYSTEM   ");
 delayadc(100);

 while(1)
 {
              if (ir_rx == 1 && ldr == 1)
              {
               lcdcmd(0x80);
              displaymsg("DAY MODE: LDR OFF");
               lcdcmd(0xC0);
              displaymsg("VEHICLE DETECTED");
               led = 0;
              }

              if (ir_rx == 1 && ldr == 0)
              {
              lcdcmd(0x80);
              displaymsg("NIGHT MODE: LDR ON");
              lcdcmd(0xC0);
             displaymsg("VEHICLE DETECTED");
              led = 1;
              }
```

```
            if (ir_rx == 0 && ldr == 1)
            {
            lcdcmd(0x80);
           displaymsg("DAY MODE: LDR OFF");
            lcdcmd(0xC0);
           displaymsg("VEHICLE NOT DETECTED");
           led = 0;
            }

            if (ir_rx == 0 && ldr == 0)
            {
            lcdcmd(0x80);
            displaymsg("NIGHT MODE: LDR OFF");
            lcdcmd(0xC0);
            displaymsg("VEHICLE DETECTED");
            led = 1;
            }
}
}
void lcddata(unsigned char x)
{
 P2=x;
 rs=1;
 rw=0;
 en=1;
 delay(3);
 en=0;
}
 void lcdcmd(unsigned char cmd)
{
 P2=cmd;
 rs=0;
 rw=0;
 en=1;
 delay(3);
 en=0;
}
void displaymsg(unsigned char *p)
{
 for(i=0;p[i]!='\0';i++)
 {
 lcddata(p[i]);
 delay(1);
 }
}

void delay(unsigned int itime)
{
 unsigned int k,l;
 for(k=0;k<itime;k++)
 for(l=0;l<900;l++);
}
```

## III. RESULT AND DISCUSSIONS

The smart lightening system provides better energy saving approach. The tested code is dumped into the microcontroller, the Lighting System and LDR, IR Sensors are found to be working properly under ordinary condition. For this system the energy saving is around 30-40% with high traffic and more than 60% for low traffic (approximate values). If compare with the present day road lighting fixtures system, this sytem is energy green, dependable and secure, technically superior, cost powerful in maintenance, greater citizen pride, and decreased greenhouse gases, match and overlook device.

## IV. CONCLUSION

The paper “Energy Efficient Smart Street Lighting System” is designed, examined and applied successfully. Circuit works appropriately to turn streetlight ON/OFF. Intelligent Street Lighting System can think for them and reduce energy costs which is the best solution for power saving and eco-friendly environment. The drawback of current Street Lighting System using LED, LDR, IR and Solar Power has been overcome. Finally this system can be installed on toll roads at toll collection stations and on roads with sharp curves.

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