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Microcontroller Based Automatic Street Light Control by Using LDR & IR Sensors

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Abstract - This project aims at designing and executing the advanced development in embedded systems for energy saving of street lights. Nowadays, human has become too busy, and is unable to find time even to switch the lights wherever not necessary. The present system is like, the street lights which will be switched on in the evening before the sun sets and they are switched off the next day morning after there is sufficient light on the roads. This paper gives the best solution for electrical power wastage. Also the manual operation of the lighting system is completely eliminated. In this the two sensors are used which are **Light Dependent Resistor**(LDR) sensor to indicate a day/night time and the**IRsensors** to detect the movement on the street. The microcontroller PIC16F877A is used as brain to control the street light system, where the programming language used for developing the software to the microcontroller is C-language. Finally, the system has been successfully designed and implemented as prototype system.

Key Words: Embeded systems, Microcontroller, LDR ,IR, Lighting

1.INTRODUCTION

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. Providing street lighting is one of the most important and expensive responsibilities of a city. Lighting can account for 10–38% of the total energy bill in typical cities worldwide .Street lighting is a particularly critical concern for public authorities in developing countries because of its strategic importance for economic and social stability. Inefficient lighting wastes significant financial resources every year, and poor lighting creates unsafe conditions.[1] Energy efficient technologies and design mechanism can reduce cost of the street lighting drastically. Manual control is prone to errors and leads to energy wastages and manually dimming during mid-night is impracticable. Also, dynamically tracking the light level is manually impracticable. The current trend is the introduction of automation and remote management solutions to control street lighting.[3]

1.1 Various types of control strategy and methods in controlling the street light system such as:

1. Design and implementation of CPLD based solar power saving system for street lights and automatic traffic controller.[2]
2. Design and fabrication of Automatic Street light control system.
3. Automatic street light intensity control and road safety module using embedded system
4. Automatic Street light control system.
5. Intelligent Street Lighting System Using Gsm.
6. Energy consumption saving solutions based on intelligent street lighting control system.

1.2 BLOCK DIAGRAM OF STREET LIGHT SYSTEM:

It consists of microcontroller, LDR, and IR sensor. By using the LDR we can operate the lights, i.e. when the light is available then it will be in the OFF state and when it is dark the light will be in ON state, it means LDR is inversely proportional to light. When the light falls on the LDR it sends the commands to the microcontroller that it should be in the OFF state then it switch OFF the light, the IR Sensor will be used to turn ON or OFF the light according to the presence or absent of the object. All these commands are sent to the controller then according to that the device operates. We use a relay to act as an ON/OFF switch.

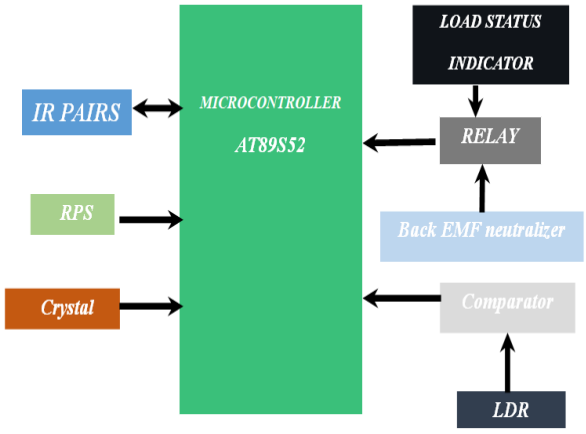

Fig.1 Block diagram of street light system

2. DESIGN AND METHODOLOGY

The inputs in the streets lighting system are LDR and IR sensors, after dusk the light sensor will activate the system, to be ready to detect any object by IR sensors, on the road to turn ON the streetlights.[5]

Each circuit which has been designed will be discussed. Firstly the LDR circuit as shown in Fig.2**,** the LDR and RV_1 form one arm of the bridge, and R_1-R_2 form the other arm. These arms can actually be regarded as potential dividers, with the R_1-R_2 arm applying a fixed half-supply voltage to the non-inverting input of the op-amp, and with the LDR-RV_1 divider applying a light dependent variable voltage to the inverting terminal of the op-amp. [4]

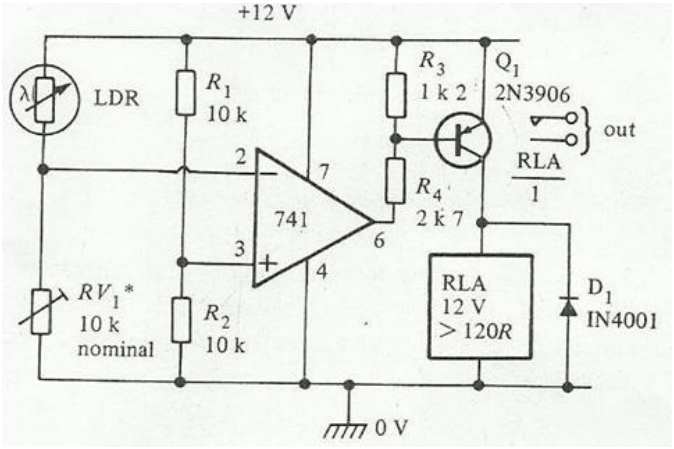

Fig.2 LDR CIRCUIT

In use, RV_1 is adjusted so that the LDR-RV_1 voltage rises fractionally above that of R_1-R_2 as the light intensity rises to the desired trigger lever, and under this condition the op-amp output switches to negative saturation and thus drives the relay on via Q_1 and biasing resistors R_3-R_4 when the light intensity falls below this level, the op-amp output switches to positive saturation.[5]

The circuit is very sensitive, being able to detect light-level changes too small to be seen by the human eye, the circuit can be modified to act as a precision dark-activated switch by either transposing the inverting and non-inverting input terminals of the op-amp, or by transposing RV_1 and the LDR. [7]

Their function to sense the objective that will pass through the street, at the same time give a signal to the IR to turn on the lamp.[8] The idea to save the energy, where the system have been designed to light ON the lamp in the night only and only if there is any object passes through the street. Except to that the light will be OFF. [6]First IR sensor is used to turn ON the first lighting column via microcontroller automatically when any object passes in front of it. Meanwhile the second IR sensor will turn ON the second lighting column and turn OFF the first one after few delay when the object passes in front of it as shown in the Fig.3.

The third sensor will activate the third lighting column when the object passes in front of it, and will turn OFF the second lighting column after few delays.[9]

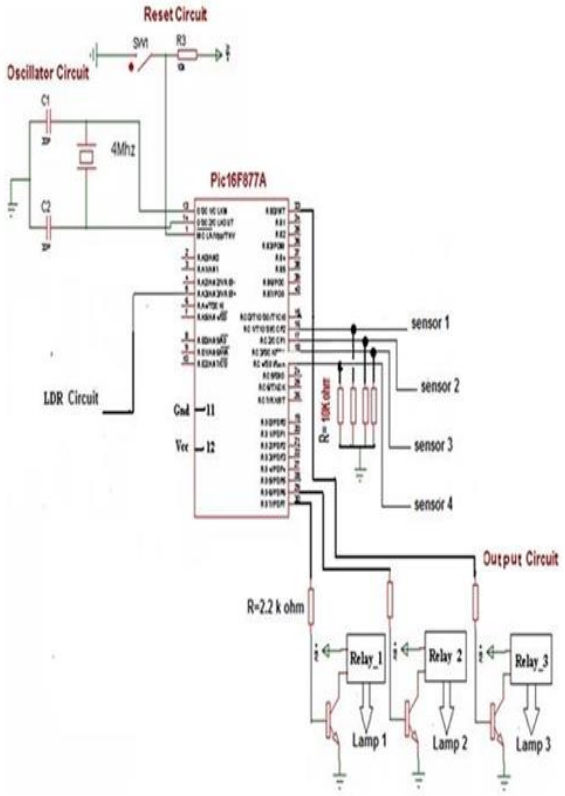

Fig.3 Schematic circuit of the street light system

Working:

1. When a person in the field of vision of the IR sensor, the sensor detects the presence and activates highway lighting system.
2. If it is day time the light gets OFF this operation can be performed by light sensor(LDR).
3. This project uses regulated 8051 microcontroller, 5V, 500mA power supply, 7805 three terminal voltage regulator is used for voltage regulation.
4. Bridge type full wave rectifier is used to rectify the ac output of secondary of 230/12V step down transformer.

3. MICROCONTROLLER & COMPONENTS

3.1 Power Supply Components List

1.Power supply : 12V-0-12V (750mA).

2.Regulated IC's : 7805

3. Diodes :D1, D2= IN4001.

4.Capacitors: C1=1000uf, C2, C3, C4=0.1uf

3.2 Microcontroller Circuit Components

1. IC1=8051 ,Transistor Q1=SL100

2. IC2=ULN 2803 ,Diode D1=IN4001

3. C1=10uf, C2, C3 = 33pf

,Crystal oscillator 11.0592 MHz

4. R1=10k ohms R2=1k ohms ,Connectors

5. IR sensor pairs 2 No's

3.3 Dawn & Dusk Circuit Components

1. Active components Passive components

2. LM-324 COMPARATOR IC R1-220k

3. D1-1N4001 R2, R3-4.7k

4. LDR -1 Relay-9V

3.4 Microcontroller

A microcontroller is a computer control system on a single chip. It has many electronic circuits built into it, which can decode written instructions and convert them to electrical signals. The microcontroller will then step through these instructions and execute them one by one. Microcontroller can be used to controller the lighting of a street by using the exact procedures.

Microcontrollers are now changing electronic designs. Instead of hard wiring a number oflogic gates together to perform some function we now use instructions to wire the gates electronically.[10] The list of these instructions given to the microcontroller is called a program. There are different types of microcontroller, this project focus only on the AT89S52Microcontroller whereit'spins as shown in Fig.4.

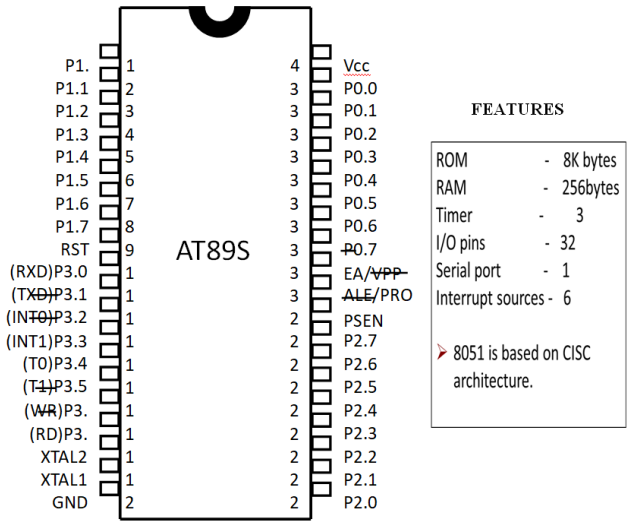

Fig 4: Pin Diagram of Microcontroller

3.5 crystal oscillator

1. One of the most important oscillator is its Frequency stability.
2. For very high stability a **quartz crystal** isgenerally used as the frequency determiningdevice to produce another types of oscillatorcircuit known generally as **Crystal Oscillators**.

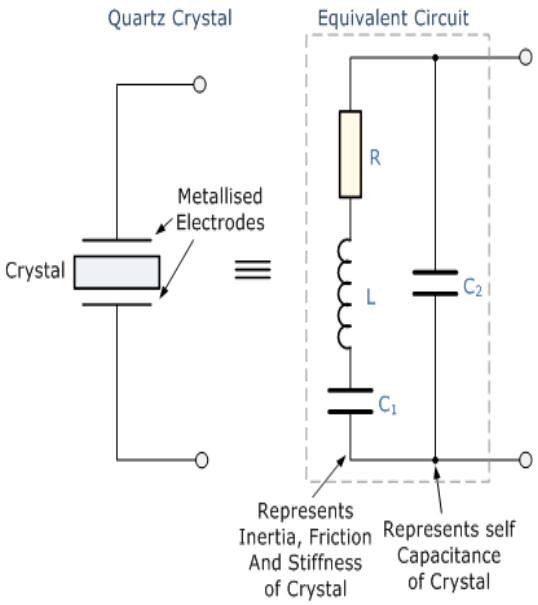

Fig 5: Quartz crystal oscillator

3.6 Back EMF Neutralizer

Diodes allow electricity to flow in only one direction. Fig 6

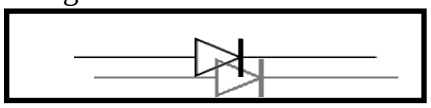

Fig 6; Neutralizer

3.7 relays

Relays are remote control electrical switches that are controlled by another switch, such as a horn switch or a computer as in a power train control module. Relays allow a small current flow circuit to control a higher current circuit. Several designs of relays are in use today, 3-pin, 4-pin, 5-pin, and 6pin, single switch or dual switches. Relays which come in various sizes, ratings, and applications, are used as remote control switches.

Fig: 7 Different types of relays

The relay's switch connections are usually labeled COM, NC and NO:

1. **COM** = Common, always connect to this, it is the moving part of the switch.
2. **NC** = Normally Closed, COM is connected to this when the relay coil is **off**.
3. **NO** = Normally Open, COM is connected to this when the relay coil is **on**.
4. Connect to COM and NO if you want the switched circuit to be **on when the relay coil is on**.
5. Connect to COM and NC if you want the switched circuit to be **on when the relay coil is off**.

3.8 LDR working

The theoretical concept of the light sensor lies behind, which is used in this circuit as a darkness detector. The LDR is a resistor as shown in Fig.8, and its resistance varies according to the amount of light falling on its surface. When the LDR detect light its resistance will get decreased, thus if it detects darkness its resistance will increase. LDR is an **input transducer** (sensor) which converts brightness (light) to resistance. It is made from cadmium sulphide (CdS).

Very bright light: minimum resistance, about 100Ω

Darkness: maximum resistance, about 1MΩ

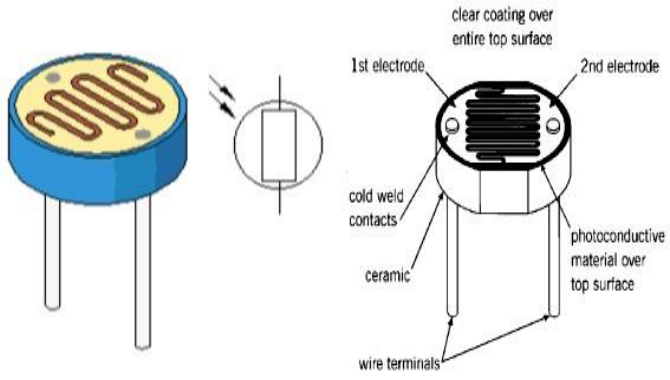

Fig 8 LDR

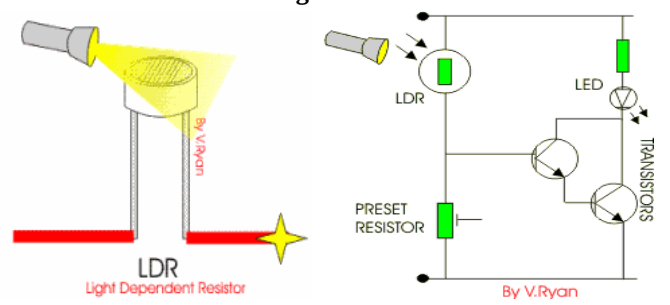

Fig.9 LDR CIRCUIT

4. Results and Discussions

The project aims were to reduce the side effects of the current street lighting system, and find a solution to save power. In this project the firstthing to do, is to prepare the inputs and outputs of the system to control the lights of the street. The prototype as shown in Fig.10 has been implemented and works as expected and will prove to be very useful and will fulfill all the present constraints if implemented on a large scale.

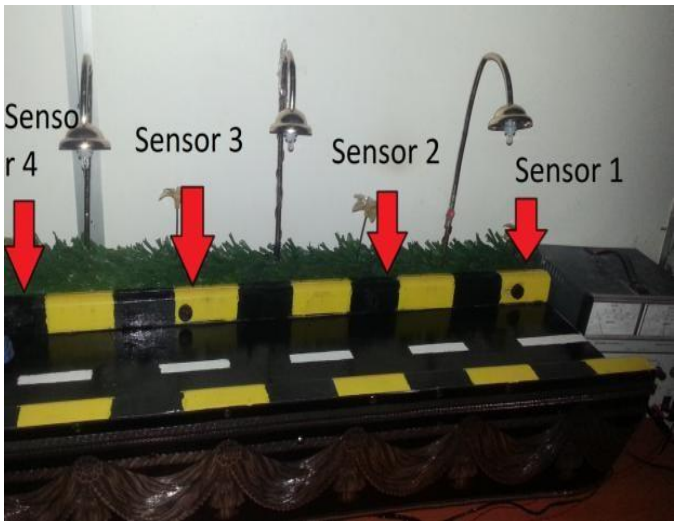

Fig: 10 Prototype of street light system

Fig.10 shows the street light system, from the figure it can be seen that, all lighting column are OFF, because there is no any object passes through the street, even though the weather is night. This is the idea of using the microcontroller to control each lighting column alone. When any object passes in front specific IR sensor the lighting column which connected to it will be turn ON automatically.

Scope

1. Nowadays, it became essential for people work during nights and returning back to homes late nights, so safety parameter to be implemented to a great extent on highways.
2. This can be best achieved by implementing proper lighting system on highways. The efficient monitoring of this lighting system must be taken into account.
3. The existing system is like, the high way lights will be monitored manually which in turns is a waste of huge human power as well as precious time in addition with power wastage at the instant when proper monitoring is failed.

5. CONCLUSION

The paper "Microcontroller Based Automatic Street Light Control by Using LDR&IR Sensors"is implemented by the design and construction of automatic street control system circuit. Circuit works properly to turn street lamp ON/OFF. After designing the circuit which controls the light of the street as illustrated in the previous sections. LDR sensor and the IR sensors are the two main conditions in working the circuit. If the two conditions have been satisfied the circuit will do the desired work according to specific program. Each sensor controls the turning ON or OFF the lighting column.

The street lights has been successfully controlled by microcontroller. With commands from the controller the lights will be ON in the places of the movement when it's dark. Furthermore the drawback of the street light system using timer controller has been overcome, where the system depends on IR sensor. Finally this control circuit can be used in a long roadways between the cities.

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