Energy conservation: Automatic Light Control System for Commercial Infrastructures

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Abstract - The huge amount of electrical power of many countries is consumed in lighting the buildings, shopping malls. However, there is no need in midnight. The system purposed throughout this paper, functions automatically and switches the light off for shopping malls and buildings when having nobody in it and turns on the light when someone going to enter the mall. Practically, this system saves considerable amount of the electricity. In addition to this, it also increases reliability of the light bulbs and reduction in the power expenses. This system automatically controls and monitors the light of the shopping mall. In this project, the prototype comprised primarily of infrared sensors, LDR sensor and automatic circuit switching. Results show that the saved energy may reach up to 45% and an increase of the lifetime of the lights of 53% [4].

Keywords - *Save Energy, Automatic control system, Luminous Efficacy, LDR, photoelectric sensor, microcontroller.*

I. INTRODUCTION

Energy is the ability to do work and work is the transfer of energy from one form to another form. Here, we are discussing about electric energy. Electricity was introduced in Greek. William Gibert, an English physician, physicist and natural philosopher was the first to coin the term "electricity" derived from the Greek word for *amber*. The combinations of qualities and quantities act of community or human group's use of resources for survival, needs, comfort and enjoyment is called consumption pattern. Consumption pattern is divided into three terms, broader terms include social process, and narrow terms include energy demand, energy demand, and energy utilization pattern [1]. Income raises agriculture sector and industrial sector get mechanized which lead to increase in population and consumption of electrification increases in both rural and urban areas. With the growing Indian economy power demand and its consumption increasing day by day. Some data which we have collected from survey represents shopping mall which has an area about 1.8 million square feet requires 52KW power consumption in a day only for lighting system.

II. ANALYSIS OF POWER CONSUMPTION

A. Monthly Power Consumption

The task starts form January 2015 to January 2015. The electricity consumption because of lighting system reaches the peak as shown in figure 1.

B. Analysis of Energy used Intensity (EUI)

Energy used Intensity (EUI, with unit of $kWh.m^{-2}year^{-1}$) is the average electricity consumption in unit area per year. Figure 2 shows the variation of EUI in each month for lighting. It can be seen from this figure that most of the electricity in shopping malls consumed by the lighting system. The monthly trend is similar to the total annual energy consumption with average EUI value of 359.45 $kWh.m^{-2}$ $year^{-1}$.the electricity consumption in shopping mall was monitored individually in a d day of January 2015. The result is shown in table 1, which reveals that the lights system of different areas in mall consumes 58.8kW of electricity, about 6.02% o f the total electricity consumption [3].

Finally, our research focus would be to design an automatic light control system device which will helpful in power consumption reduction as shown figure 3. Research focuses on save energy, automatic light control system and luminous efficacy. In this system, embedded system plays a major role. System will make with help of IR sensors, LDR sensor, and microcontroller and other components. We propose a system that automatically switches off the light for the shopping malls and buildings when having nobody in it and turns on the light when someone going to enter the mall with help of IR sensor and automatic turn on light in night and off in day with help of LDR sensor.

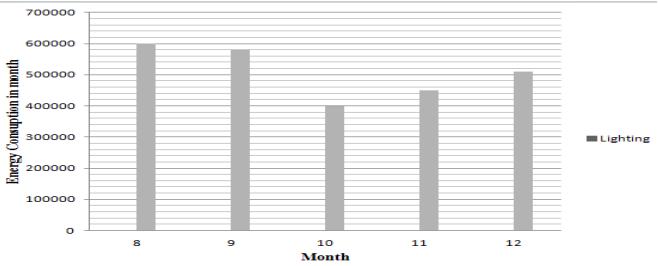

Fig.1: Monthly Electricity Consumption

TABLE1. ELECTRICITY CONSUMPTION AND THE EUI VALUE OF SHOPPING MALL.

Place	Area	Electricity consumption (kW)	EUI(kWh.m^{-2} month^{-1})
Shopping Mall	89695.00	2811.98	25.08
Lighting	69818.00	1481.75	16.97
Other	640.70	38.80	40.06

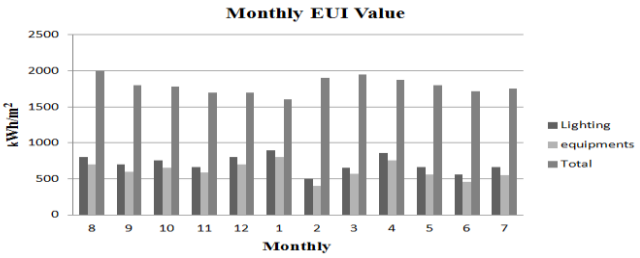

Fig.2: Monthly EUI Value

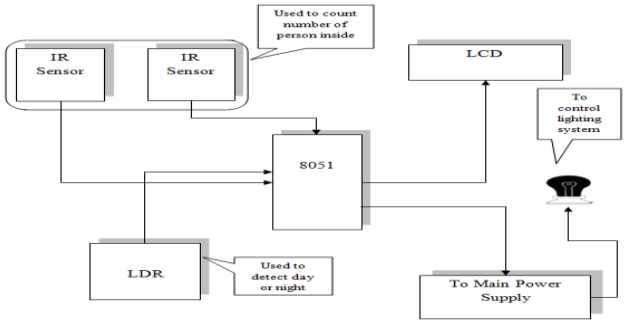

Fig.3: Block diagram of automatic light control system

III. LITERATURE STUDY

Indoor climate control is responsible for a large fraction of the world's energy consumption. In India, more than 60% of the energy consumption is used for indoor climate control with large potential of energy savings by energy efficiency [4]. A study for Saudi Arabia, a similar climate as presented here, showed that 15%, 19% and 40% annual energy can be saved in large, medium and small office buildings through envelope thermal optimization in the hot–humid climate of Riyadh, also for the city of Jeddah, annual energy savings of 8%, 12% and 24% can be obtained for large, medium, and small offices, respectively [5]. A series of studies targeting energy efficiency on commercial building is available as there are many untapped opportunities in this area [6, 7].

There are two methods for sensitivity analysis applied in the domain of building analysis based on input variation: local and global methods [10]. Local sensitivity analysis can be compared to the Monte Carlo Simulation, which focuses on the effects of uncertain inputs around a point (or base case), whereas global sensitivity analysis is more interested in the influences of uncertain inputs over the whole input space [9]. These methods are used to cover the input space and to analyze the variations to the inputs impacting the output. A comparison of both methods was done in [10].

Regression models utilize the strong correlation of load with relevant factors such as weather, hour-of-the-day and day-of-the-week. A comparison between six modelling techniques was done for short term urban level energy forecast [4], the regression model yielded the best results for up to one day ahead, being only outperformed by one of the methods (exponential smoothing filter with autoregressive 278 component) for one to two days ahead forecast. In [3], a linear regression model was used to estimate the elasticity of GDP, price and GDP per capita for the domestic and non-domestic Italy's energy consumption, and comparing it with available projections.

IV. SYSTEM DESIGN DESCRIPTION

A. *ATMEL (AT89S52)*

The AT89S52 belongs to 8051 family which has low power idle and power down mode, and high performance device and it works at crystal frequency from 0Hz to 33MHz and executes powerful instruction in single clock cycle. It has 8K Bytes of ISP Flash Memory. It has 256 bytes RAM and 32 I/O programmable I/O lines, Low power idle and power down modes, full duplex UART serial channel, it has also watchdog timer, power off flag, two 16 bit timer/counters [2].

B. *IR Technology (TSUS5400)*

Infrared light basically an electromagnetic radiation which has more wavelength than of visible light, it has frequency range from 1 to 400 THZ. Infrared used in this project is of 950nm emitting diode in GaAs technology melded in a blue gray tinted plastic package. It has peak wavelength of 950nm and high reliability. It also has good spectral matching with Si photo detectors.

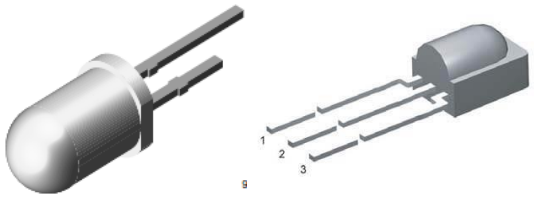

Fig.4: IR Technology

C. *Relay used as Switch (DS2Y)*

Relay is a simple switch which is operated both electrically and mechanically. It consists of an electromagnet along with a set of contacts. Electromagnet performs the switching mechanism in it [5]. Main function of relay is to control the circuit by using low power signals. It is also used in circuit where only single signal can be used. We are using DS2Y series relay in this project for automatic switching to control light system of shopping mall which has high sensitivity 200mW nominal operating power and high breakdown voltage 1500V FCC surge between open contacts.

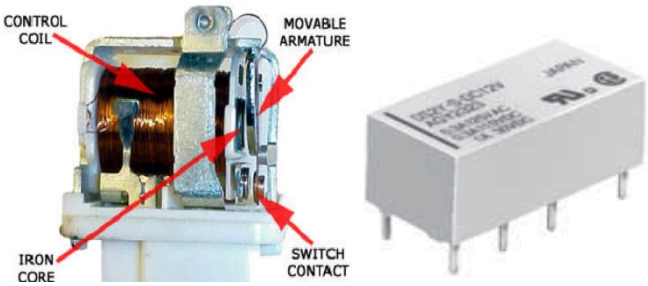

Fig.5: Relay

D. *Light Dependent Resistor (LDR)*

Light dependent resistor is very useful especially in light/ dark sensor circuit. Normally the resistance of an LDR is very high (1000000 ohms) but when they are under light its resistance drops significantly. We are using 10 X LDR sensors in this project. It principle behind its working is, when it's dark, the LDR has very high resistance. Due to high resistance the voltage across the base of the transistor is not sufficient enough to turn on the transistor so current path from collector to emitter is blocked. When LDR is illuminated, the transistor is turned on allowing the current path from collector to emitter.

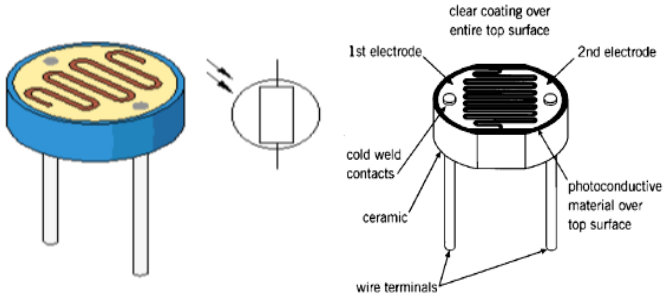

Fig.6: LDR

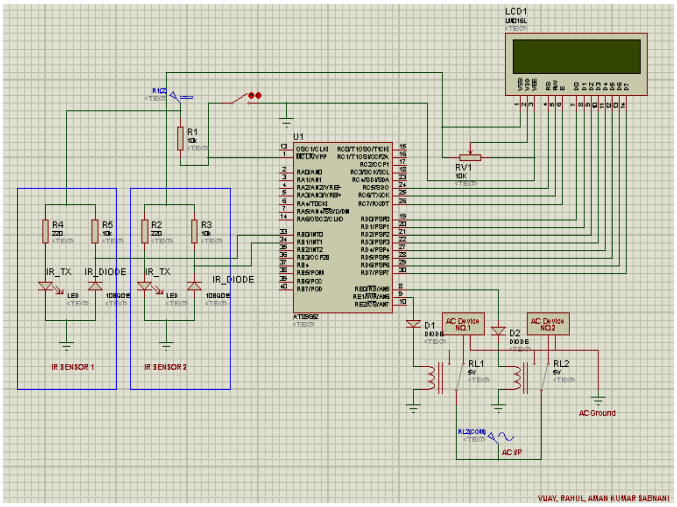

Fig.7: Proteus Design of automatic light control system

E. *Hardware Description*

The research is toward a development of an electronic product named automatic light control system for commercial infrastructure, in which IR sensor are used to detect or count the number of person inside shopping mall, and relay switch used to turn on all light automatically when detect people inside shopping mall and turn off the lights when no one inside it. LDR sensor is used to monitor day and night vision, used to automatic switching as shown in proteus design.

V. SOFTWARE DESCRIPTION

A. *µvision for AT89s52*

Kiel software is used for the software implementation of the developed system. With help of it, we can generate embedded applications for the multitude of 8051 and 251 derivatives**.** µvision4 Integrated Development Environment is an IDE that make facility, editor and powerful debugger. It is used for compile the programs [6]. In this project, coding is written for all modules, sensors, switching unit which are interfaced with AT89s52 microcontroller. As per the embedded in the

controller, the interfaced modules and sensors generate appropriate output at the receiving terminal.

B. *Proteus 7.0 for circuit simulation*

Proteus 7.0 is a virtual system modelling that combines circuit simulation, animation components and microcontroller model to co-simulate the complete microcontroller based designs. In this project, virtual simulation circuit is designed with help of proteus for testing.

VI. RESULT AND DISCUSSION

A. *Testing of Device on different subjects*

The complete prototype as shown in figure 6 developed was tested on different voltages and different areas. It provided the accurate result at voltage of 230v to440v.we have tested circuit in "Sheetal departmental store", phase 3b2, Mohali. Total power consumed by store before installation of device is 22KW in month. But after installation of automatic light control system it reduced to 18.26 KW (power reduction of 17%).flowchart of working shown in figure 9.

B. *Ergonomics design*

It is the function design of the equipment e.g. interface design i.e. display and controls , safety maintainability ,handling etc that helps in making the system user friendly. For the designing of the automatic light control system the following ergonomics design steps need to be followed.

1. The size of complete circuit is compact.
2. Response time of device is very fast.
3. Reliable and auto-cut when voltage transients.

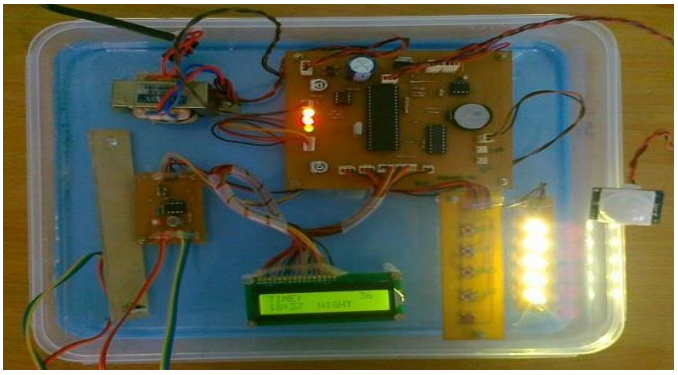

Fig.8: Picture of project

VII. CONCLUSION AND FUTURE SCOPE

In this paper, the automatic light control system for commercial infrastructures was presented. As a conclusion, around 37%-47% of power consumption can be reduced by using this system towards providing a solution for energy saving. Furthermore, the minimal components including the low cost controller and sensors produce the better saving in term of cost. On top of that, the lifetime, better illumination and use of light on requirement are the other criteria for reducing the operational and maintenance cost of lights. Hence, it helps in further improves the energy efficiency and quality of lighting level.

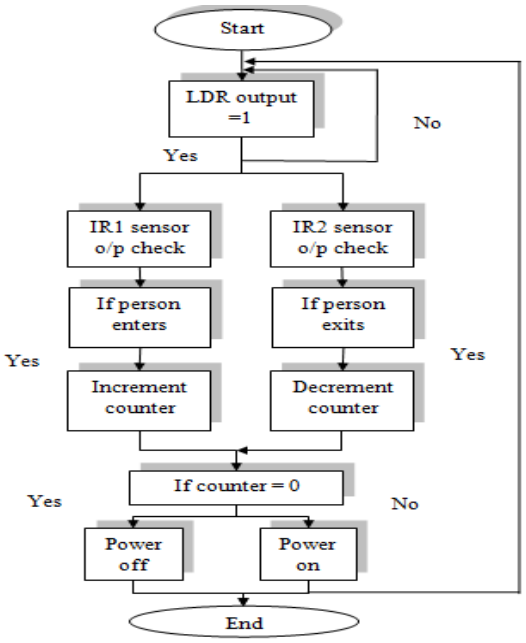

Fig.9: Flowchart of device

VIII. REFERENCES

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