Lighting System Analysis

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***Abstract*- With ever increasing demand for Electric power, Energy conservation is becoming a paramount approach in the recent scenario. Energy conservation and energy savings is most essential for our country to lead existing resources for the upcoming generations. Lighting plays a vital role in consumption of electricity. Knowing or unknowingly we lose lot of power towards lighting. In our project, we would like to construct an electrical project, where we can connect different types of electrical lightings and analyze them towards electrical Vs light energy. We can prove, which one can be the perfect light source. So that we can able to set same amount of light with less infeed of electrical energy.**

***Index Terms*- Luminous intensity, CT, PT, LDR, Incandescent lamp, CFL lamp, LED lamp, Illuminance, Visual Basic6.0**

I. INTRODUCTION

Energy conservation and energy savings is most essential for our country to lead existing resources for the upcoming generations. The nature must be preserved for the next generations to improve and to keep the people safe from global warming. In the past twenty years, the attention paid to the lighting sector has increased and, in particular, the attitude towards lighting of outdoor spaces has changed during this time. More attention has been paid to improvement programs for cities and different ways to experience urban areas: the identity of cultural and architectural heritage sites has been promoted in order make cities more pleasant and livable during the night.

"Analysis of the performance of domestic lighting lamps" M.M. Aman[1], highlights the comparison on performances of domestic lighting lamps. Optimal Light Power Consumption Using LDR Sensor " Ghassan Maan Salim[2] describes a method to optimize the electrical power consumption using Light Dependent Resistor (LDR) sensor. " Automatic Street Light Control System Using Microcontroller " Mustafa Saad[3] paper deals with the designing and executing the advanced development in embedded systems for energy saving of street lights

The objective of this paper is, to analyse an optimal power usage of different lights and to set same amount of light with less infeed of electrical energy.

II SYSTEM METHODOLOGY

The electrical set up is designed using PT's, CT's, solid state relays and appropriate wiring. The output of the electrical circuit will be connected to a electronic circuit for signal conditioning. The voltage, current, power will be fed to an embedded micro controller to have real time values of the above simultaneously. Two sensors are used which are Light Dependent Resistor LDR[5] sensor to measure the Light intensity and the Temperature sensors to detect the temperature of the surrounding. The microcontroller PIC16F877A is used as brain to control the system analysis, where the programming language used for developing the software to the microcontroller is Visual Basic

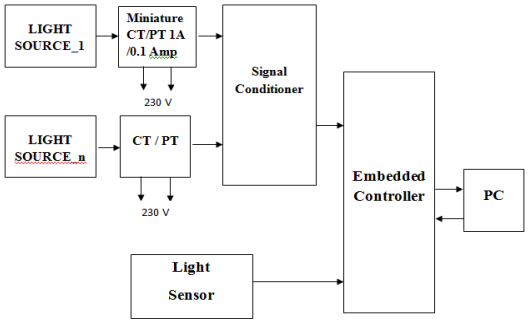

Figure 1: Block Diagram of Proposed System

III LIGHTING SYSTEM ANALYSIS DESIGN

1. Lamp Type Analysis : The selection of lamp for analysis purpose depends upon their use in the domestic lighting purposes. Many lighting sources are available like Incandescent lamps ,Compact

fluorescent lamps, Halogen lamps, Metal halide Lamps, Light Emitting Diode, Fluorescent tube, Neon lamps, High intensity discharge lamps, Low pressure sodium lamps, etc.

For our Analysis purpose we took three different lighting sources.

Device-1 : Incandescent Lamp

Device-2 : Compact Fluorescent Lamp

Device-3 : Light Emitting Diodes

These three type of lamp are highly used for domestic purposes and are very competitive in the market. Incandescent lamp produces and emits much heat as compared to the amount of light. In actual, only 8-10 percent of the energy is utilised in producing light. This bulb is often used, especially in a fixture that actually controls the light output rather than scattering it everywhere. Compact Fluorescent lamps are almost four to five times more efficient than incandescent lights. They are nowadays most widely used for indoor applications. Energy saving is achieved because they are lower wattage lamps and provide more lumens. They are more efficient than the older ones. The most efficient and most compact among these are T5 lamps. These are light and have less tube diameter. Hence we choose T5 type of CFL lamp as the second device for analyzing purpose. An LED lamp is a LED unit that is fitted into a lamp for lighting purpose. LED lamps have greater lifespan and much more efficiency than other lamps. LEDs have more efficacy than incandescent bulbs. Incandescent or fluorescent lamps often need an external reflector to collect light and direct it in a usable manner. LEDs are ideal for use where frequent on-off cycling is required. LEDs are very expensive which is the biggest disadvantage, but the payback period of installation is very less.

2. Pic Microcontroller : To perform the various operations and conversions required to switch, control and monitor the devices a processor is needed. The processor may be a microprocessor, micro controller or embedded controller. In this paper an embedded controller has been preferred because of its industrial advantages in power electronics like built in ADC, RAM, ROM, ports, USART, DAC. This leads to lesser space occupation by the circuit and also the speed of embedded controllers are more compared to other processors. The embedded controller selected for this project is PIC16F877A due to its various features :

- High-performance RISC CPU
- Only 35 single word instructions
- 256 x 8 bytes of Data Memory (RAM)
- All single cycle instructions except for program branches which are two cycle
- Operating speed: DC - 20 MHz clock input and DC - 200 ns instruction cycle
- 4K x 14 words of Program Memory (EPROM)
- Interrupt capability (up to 14 internal/external interrupt sources)
- Eight level deep hardware stack
- Direct, indirect, and relative addressing modes
- 12-bit multi-channel Analog-to-Digital converter On-chip absolute band gap voltage reference generator
- Universal Synchronous Asynchronous Receiver Transmitter, supports high/low speeds and 9-bit address mode (USART/SCI)

3. Light Dependant Resistors : LDRs or Light Dependent Resistors are very useful especially in light/dark sensor circuits. Normally the resistance of an LDR is very high, sometimes as high as 1000 000 ohms, but when they are illuminated with light resistance drops dramatically. When the light level is low the resistance of the LDR is high. This prevents current from flowing to the base of the transistors. Consequently the LED does not light. However, when light shines onto the LDR its resistance falls and current flows into the base of the first transistor and then the second transistor. The LED lights. LDRs are made of semiconductors as light sensitive materials, on an isolating base. The most common semiconductors used in this LDR structure are cadmium sulphide, lead sulphide, germanium, silicon and gallium arsenide [6]. The most common type of LDR has a resistance that falls with an increase in the light intensity falling upon the device

4. Visual Basic 6.0 : In Visual Basic 6.0, the " Visual " part refers to the method used to create the Graphical User Interface. Rather than writing numerous lines of code to describe the appearance and location of interface elements, we simply add Pre built Objects in the required place on the screen.

The "Basic "part refers to the BASIC (Beginners All-purpose Symbolic Instruction Code) language, a language used by more programmers than any other language in the History of Computing. Its features includes Improved performance,

It can be used as a data base creation tool, Visual data access with the data control so that it is possible to create data browsing application without writing code. A new OLE (object linking and embedding) control that allows in place editing. A collection of common dialog boxes that streamline common user interface tasks. The ability to create pop-up menus anywhere in the application

IV IMPLEMENTATION

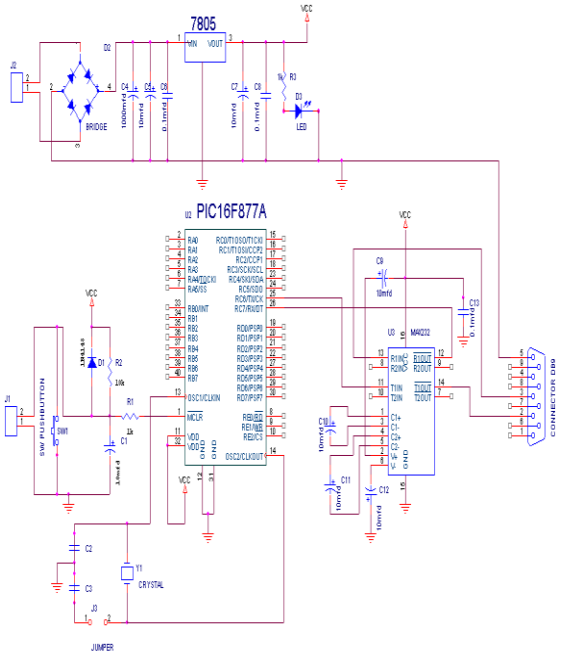

Figure 2: Embedded Circuit of Proposed System

From the circuit diagram shown in figure 2, it can be seen that the reference analog supply after being regulated by the 9v regulator enters the zener diode through the resistance R4 where it is again regulated to 5v since the zener diode used here has a cut off of 5v. R6 is a potential divider used for setting the dynamic response range of the reference supply. This means that the reference 5v can be used as it is or it can be made into a fraction of the 5v for example 1v so that readings in this range can be read with more precision. This is because the ADC has 10 bit resolution which can be totally used for representing the 1v rather than 5v. The voltage and the current is sensed by the Potential Transformer(PT) and Current Transformer (CT). Simultaneously the Luminous intensity is also measured by the photoconductivity principle of the LDRs.

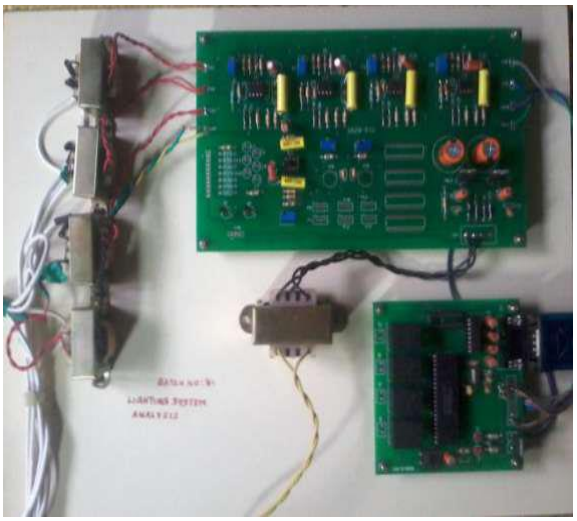

Figure 3: Hardware Implementation

The Figure 3 shows the hardware setup for Lighting system Analysis. In this circuit, the sensed voltage and current signals are conditioned to make suitable for the embedded controller. The embedded controller communicates with the personal through RS232. Other than this the hardware consists of three CT for sensing the input current to the lighting devices and one PT to sense the voltage across the lighting devices. The voltage across the three lighting devices remains the same and hence only one PT is used in this system. The overall hardware implementation of the proposed lighting system analysis sense the voltage and current sensing by the PT and the CT. This hardware setup is interfaced with the Personal Computer with the help of RS232. The result obtained by implementing our project is shown in the Figure 4. In this Figure the device-1 corresponds to the CFL lamp, device- 2 corresponds to the Incandescent lamp and the device-3 corresponds to LED lamp.

The PIC Controller is used to produce the Comparative analysis among the three devices. Now the light intensity which have been sensed by the LDR in terms of voltage is fed to the controller for the Analysis purposes. The Coding in the visual basic language enable the controller to provide the comparative analysis of the light intensity measured in all the three lighting devices. Initially the comparison is made with the electrical energy and the

light output of each devices separately. Then over all efficient light device is determined with the help of comparative analysis of luminous efficiency of all the three devices.

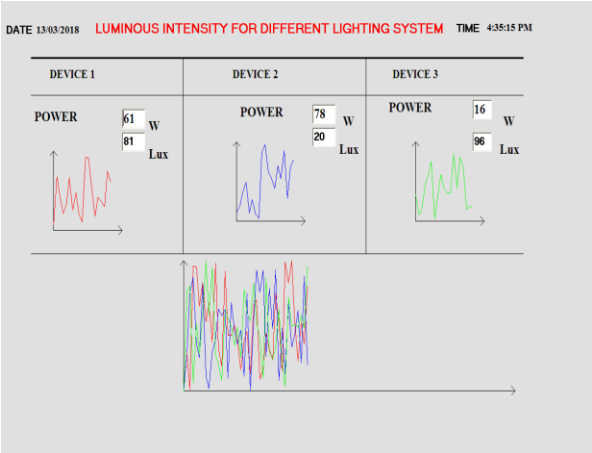

Figure 4 : Graphical Representation of Electrical energy Vs Light Energy

V DISCUSSION

The comparative study of luminous intensity of light sources explains that incandescent lamps are the most inefficient with maximum power consumption and maximum life cycle cost. CFLs are good alternative for incandescent lamps with somewhat lesser power consumption and very less life cycle cost. LED lamps have very low life cycle cost as compared to other lamps but somewhat higher than CFL lamps. This is because their lamp cost is far higher than other lamps. If this cost would be less, they would have least life cycle cost.

Table 1: Electrical output Vs Light Output

Lamp	Electrical Output(W)	Luminous Intensity(Lux)
Incandescent Lamp	78	20
CFL Lamp	61	81
LED Lamp	16	96

The performance rating for different lamps can be obtained using this setup. From this we can understand that only advantage with LEDs is that they have maximum burning hours. It means once the LED lamps are installed, they do not need to be replaced again and again for years. Only advantage with LEDs is that they have maximum burning hours. It means once the LED lamps are installed, they do not need to be replaced again and again for years. The life cycle assessment shows that replacing older lamps of high power consumption and high cost with new and innovative lamps of comparatively low power consumption and less cost could be beneficial for a particular application from the aspect of both energy and cost saving.

VI CONCLUSION

All the newly introduced lighting devices are designed with less consumption and more luminous efficiency. Proper lighting can have positive psychological effects on human occupants and increases one's ability to perform tasks. The result shows that with the current technology, the use of CFL and LED lamp is beneficial for utility as well as for consumer. However, with the current pace in the development of LED technology, it is possible LED lamps will lead the lighting market in the near future. This assessment shows that replacing older lamps of high power consumption and high cost with new and innovative lamps of comparatively low power consumption and less cost could be beneficial for a particular application from the aspect of both energy and cost saving.

VI FUTURE SCOPE

In a future work, this project can be done for analyzing the temperature with the help of temperature sensor so that the effect on global warming can also be studied. With the help of intelligent controlling system automatic switching on the efficient and energy saving lighting system can also be designed.

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