INTELLIGENT SYSTEM FOR CONTROLLING LIGHTS AND FANS POWERED BY SOLAR PV

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***Abstract*— The model is developed for reducing the wastage of electricity due to careless and improper switching in households, schools, colleges and offices etc. It saves energy by maximizing the use of daylight. This is an automatic system which employs solar energy through PV. The system is capable of controlling lights, fans and air conditioners in a room depending upon various parameters such as LUX level, room temperature and motion. All these parameters are measured through various sensors and the controlling is done by microcontroller. PIR sensor detects the occupancy in the room. The microcontroller reads the LUX level of the room from the ambient light sensor. If the daylight value is below the preset threshold value, then the lights are turned on and vice versa. LM 35 sensor reads the room temperature and is compared with preset value and accordingly the ON and OFF of the fan is controlled. The model has been developed and tested in Department of Energy, MANIT Bhopal. This model itself consumes very low power and helps in saving a significant amount of energy. The model can be applied to government offices, private firms, residential buildings, schools, colleges etc. so as to avoid the wastage of electricity and maximum use of day lighting, also reduces our dependence on conventional energy and will help in conserving energy.**

***IndexTerms*—Microcontroller, LUX, Temperature, PIR sensor, Solar PV.**

I. INTRODUCTION

India is a slumbering giant, is waking up, with a growing thirst for energy especially electricity. Electricity has direct relation to economic development. Electricity consumption in India has been increasing rapidly due to growing industrialization, modernization of agriculture, urbanization and the rise in household incomes. India, having priority of economic development, poverty reduction, accessing of energy to all, improvements in standard of living and social welfarebycontrolling and mitigating GHG emission without hindering economic development is a daunting challenge[1].

As per Census 2011, 31.16% of the country's people live in urban areas and the rest were still in rural [2]. Expansion in urban area leads to use modern fuel like electricity. One of the basic uses of electricity is for lighting households, schools, offices, commercial and private institutes, etc. Apart from this, electricity is also used for running many electrical appliances / equipment's. Lighting has become a basic requirement now a day for standard of living, studies, entertainment, and for various appliances, and electricity have become an important source for lighting in urban India.

As the population of India increases, demand for electricity increases. In recent years, a noticeable growth is observed in the electricity generation from 420.6 Billion Units (BU) in 1997-98 to 580.5 BU in 2011-12 [3]. But still there is a shortage of electricity since the demand for it is much higher than its generation. There is a shortage of 10.6% of peak power in India [4]. There are many rural areas in India where electricity has not reached so far. In 2009-10 about 33% of rural household and 5% of urban households are still relying on kerosene for lighting [5]. Electricity is desecrated due to careless and improper use in households, schools, government offices and many other places. This leads to frequent power cut off in many of the urban and rural areas in India. The conscience is from increasing demand, supply of electricity and efficient use. In recent years the electricity crises have become one problem which India is facing in its development path. Household power consumption makes up the largest part of the energy consumption in the world. Various studies based on microcontroller home lighting automation system is designed and developed worldwide[6].

In this paper, we have developed a solar energy based hardware model which automatically switches the lighting and cooling appliances to reduce the wastage of electricity accordingly to certain sensor output. Thus the problem such as demand and supply gap of electricity is minimized, maximum use of day-lighting and saving conventional sources of energy. The developed system is such that it can easily be applied to government offices, private firms, residential buildings, schools, colleges etc. so as to avoid the wastage of electricity.

II. HARDWARE DESCRIPTION

The system comprises of software and hardware. In software programming is done to control electrical appliances like tube-light, fan or air-conditioners. This programming is machine level programming and compiled using inbuilt C cross-compiler. The program is then fed into the microcontroller which is the hardware system. This hardware system is incorporated with microcontroller as a heart of the system, PIR sensor, ambient light sensor and temperature sensor. All the devices mentioned are using very low power and operated on DC supply. The power consumed by the components is mentioned in **Error! Reference source not found.**.The system has taken care to separate DC supply from an AC supply. Solar PV panels are used as a source of electricity for the appliances (AC Loads). Liquid Crystal Display (LCD) is incorporated to enhance the system quality by the displaying temperature, LUX level etc.

TABLEI: POWER CONSUMPTION OF DEVICES

Components	Average Current (mA)	Operation Voltage (V)	Average power Consumption
Microcontroller	123	5	0.615
PIR Sensor	35	5	0.175
Ambient Light Sensor	0.5	3.6	0.002
Temperature Sensor	10	5	0.05
LCD Display	0.6	5	0.003
Opto-isolator	20	3	0.06
Power Consumption by the model			0.905

III. MICROCONTROLLER BASED AUTOMATIC CONTROL FOR LIGHT AND FAN

The complete setup is designed and implemented on Printed Circuit Board (PCB). The block diagram shown in the

Figure *1* is the complete set up of hardware having solar panels, charge-controller, battery bank, inverter, including the PCB board designed and developed.

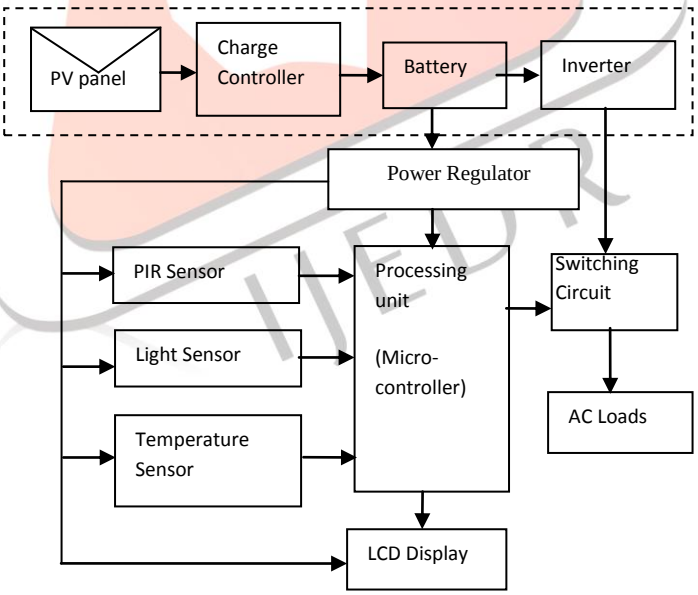

Figure 1: Block diagram of the system

The hardware is designed using Transistor-Transistor Logic (TTL),thus devices consume less DC Power. A 5V DC source is required to supply power to the circuit. The switching circuit is controlled with the signaling from microcontroller. These signals are generated on the basis of the sensors input to the microcontroller. The complete system is self-controlled, reduces human efforts and efficient in terms of power savings.

Proper functioning of the system is described in the flow charts shown in the Figure 2 and utomatic controlling for Fans Figure 3. The motion sensor first detects the presence of human and sends signal to the microcontroller. Then it senses the light intensity and room temperature using ambient light sensor and temperature sensor respectively. Microcontroller is

programmed to control the lights and fans in a room such that whenever LUX level and temperature in a room varies with reference to the threshold value. An LCD display unit is also provided to display the Lux level and the room temperature.

Microcontroller based automatic control system for light and fan is a demo system. It is designed to control two tube-light and two fans, and this can be expanded to a number of lights and fans of a room or offices. The complete developed hardware is shown in the Figure 4 with, microcontroller, sensors, LCD and other controlling TTL devices mounted on the PCB.

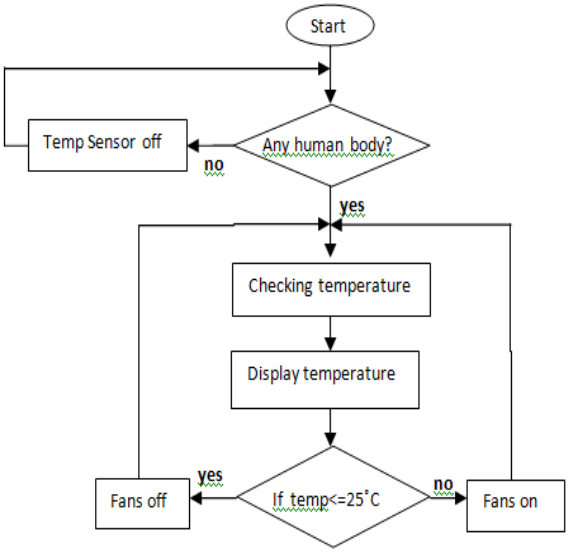

Figure 2: Automatic controlling for Fans

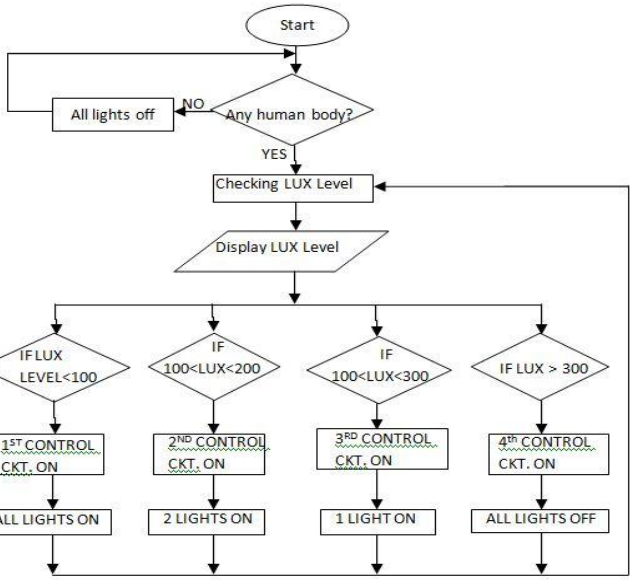

Figure 3: Automatic controlling for Tube-light/CFL

Error! Reference source not found. shows the complete setup for testing where tube-light and fans are controlled via the designed hardware. The system has a provision to set the temperature above which the fan/air-conditioner is ON. Similarly LUX level can be set for reading to put ON the tube-light.

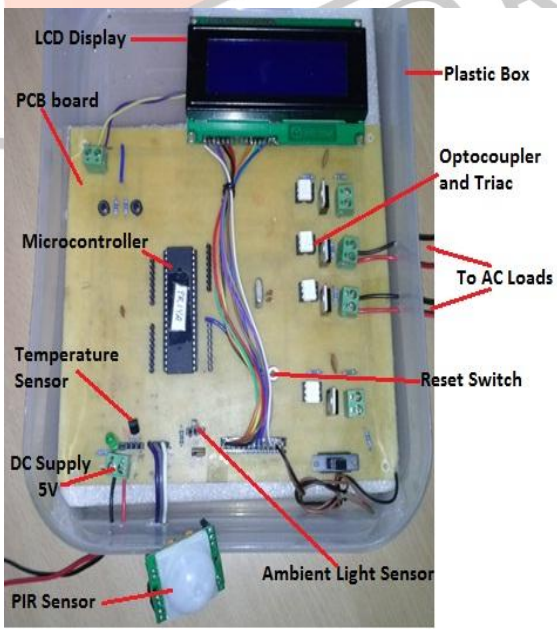

Figure 4: Developed hardware

IV. RESULT

Developed system can easily be implemented with the existing setup. The complete hardware system consumes very less amount of power. The technology adopted in this project is quite simple, very logical and economical too. Making it more compact and producing it on a large scale, can make this device even more durable and help reduction in the cost. This system is simple and easy to use. It can be installed by anyone for saving energy in home, schools, offices etc.

The designed demo hardware has been installed in a room where daylight was not sufficient. The circuit is examining with connected load of 120W (one tube light and one fan each 60W) in the month of June when the temperature is more than 25^0C. The test result with the hardware and without the hardware is shown in the Table 1. With the help of the developed system using one tube light and one fan approximately 133 units (kWh) of electricity can be saved in a year. Developed system is focused on curtailing wastage of energy which happens due to improper switching and careless use. System itself consumes very low amount of power which is 0.905 W. A comparison is also done to show the importance and the electricity saved by the developed hardware as shown in the Figure 6.

Figure 5: Complete testing circuit

Table 1: Energy consumption

Days	With Developed hardware (ON time of appliances)	Energy Consumption with developed hardware	WithoutDeveloped hardware (ON time of appliances)	Energy Consumption without hardware	Total Energy saved
	Hours	Watt hours	Hours	Watt hours	Watt hours
Monday (10/6/2013)	7.92	950.4	11.00	1320.0	369.6
Tuesday (11/6/2013)	6.55	786.0	10.00	1200.0	414.0
Wednesday (12/6/2013)	7.15	858.0	10.25	1230.0	372.0
Thursday (13/6/2013)	7.40	888.0	9.22	1106.4	218.4
Friday (14/6/2013)	6.33	759.6	9.70	1164.0	404.4
Saturday (15/6 2013)	12.40	1488.0	16.62	1994.4	506.4
Sunday (16/6/2013)	10.15	1218.0	12.38	1485.6	267.6

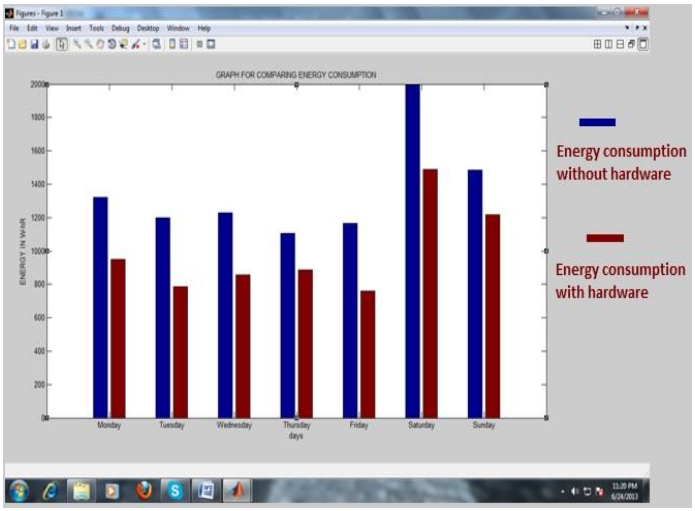

Figure 6:Eenrgy consumption comparison with developed hardware and without hardware.

V. CONCLUSION

In this paper, a design of microcontroller automatic control of light and fan is fabricated and tested at the Department of Energy, MANIT, Bhopal. The system is focused on hold back the electricity wastage and the use of solar energy for lighting and cooling. The hardware system can be used to control lights in houses, residential buildings, offices etc. It can also be used to control the lights in offices, conference halls, libraries, schools, colleges, industries, hospitals, theatres, etc. It can also be implemented at railway stations, bus stands, airports, etc. as we all know lights are turned ON throughout the day.With the increasing cost of conventional energy, this system is an efficient means of saving energy. The power supply used, is from renewable source which helps in reducing dependence on conventional electricity.

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