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DESIGN OF AN INTELLIGENT CLASSROOM WITH ENERGY SAVING SYSTEM USING TIVA C SERIES MICROCONTROLLER

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Abstract—**Thewastage of electricity is the major problem which is faced nowadays. In schools, colleges the fan / lights are switched ON even if there is nobody in the classrooms. This happens due to the negligence of the students to turn OFF the electrical appliances in the hurry. To implement this, a system is proposed based on the microcontroller TM4C123GH6PM, light dependent resistor, temperature sensor, RFID tag/reader. The system is designed in such a way thatthe working of the electrical appliances based on the number of students present in the class. The attendance is automatically recorded using the RFID tag/reader when the student enters the classroom. Based on the number of students in the class the necessary fan / light needed is automatically switched ON in a particular order. The light dependent resistor indicates the light intensity level of the classroom from that light brightness gets changed automatically. The speed control of fan is automatically done based on the temperature sensor. An alert will be sent to the concerned staff regarding his / her subject before 15 – 20 minutes the class commences using the GSM.**

Keywords— **Microcontroller, light dependent resistor, temperature sensor, RFID tag/reader, GSM**

I INTRODUCTION

In homes, schools, colleges or industry we see that fan and lights are kept ON even if there is nobody in the room or area. The power wastages most commonly occurred in organizations are considered so as to avoid the wastage of power in the class room where more electricity is wasted due to carelessness or the negligence of students. To overcome this wastage the automatic switching of electrical appliances is considered [1]. This is done based on the control of the electrical appliances during the class session timings where the switching ON of the electrical appliances is done automatically and in the remaining hours when the students move to other places like libraries, laboratories the switching OFF of the electrical appliances is done[2].The need of power consumers increasing rapidly meanwhile the renewable and non-renewable power generation are insufficient and the power wastage is also high due to the absence of people.

The following table discusses the major situation where power is wasted if students forget to switch OFF the electrical appliances.

TABLE ISummarization of Power loss in an institutions

Students moving from classroom for necessities	**Total time the electricity is wasted**
Laboratories	3 Hours
Break hours(Normally 3 Breaks per day)	1 ½ Hours
Moving to home at the end of day	15 Hours (till next day morning)

II METHODOLOGY

The main objective of this project is to develop an Automated Power Controlling System using embedded system for minimizing the wastage of power in the institutions. Due to this, the classrooms are controlled by the power controlling system as per the given necessary timings. The electrical appliances are controlled based on the given necessary timings and also the number of students present inside the classroom and also based on the

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atmospheric conditions.The following conditions are to be satisfied for controlling the electrical appliances

i. Working hours of a day
ii. Number of students present inside the classroom
iii. Atmospheric conditions
iv. Automatic Attendance using RFID
v. SMS alert

In this project the power wastage is controlled by the number of students entering the class which is observed using a RFID tag/reader. Attendance of the class is automatically recorded using this RFID tag [3]. Based on the number of students entering inside the particular class the switching ON of the electrical appliances will be incremented.The light dependent resistor (LDR sensor) is used to indicate the light intensity level from that light brightness of the room which is automatically changed and also the autonomous speed of the fan is controlled based on data from the temperature sensor [4].The GSM technology is used to send a SMS to the staff regarding his / her subject hour timings in the given time table scheduled for a class [5]. This alert will be send to the concerned staff before 15 – 20 minutes before the commencement of the class.

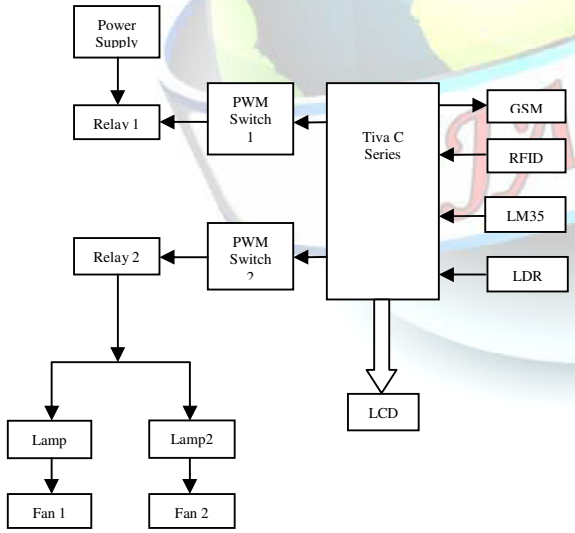

Fig.1.Functional Block Diagram

III HARDWARE DESCRIPTION

A. Tiva C Series TM4C123GH6PM Microcontroller

The TM4C123GH6PM microcontroller is targeted for industrial applications, including remote monitoring, electronic point-of-sale machines, test and measurement equipment, network appliances and switches, factory automation, gaming equipment, motion control, transportation, and fire and security.The Tiva™ C Series TM4C123G LaunchPad Evaluation Board (EK-TM4C123GXL) is a low-cost evaluation platform for ARM Cortex™-M4F-based microcontrollers. The Tiva C Series LaunchPad design highlights the TM4C123GH6PMI microcontroller USB 2.0 device interface, hibernation module, and motion control pulse-width modulator module. The Tiva C Series LaunchPadalso features programmable user buttons and an RGB LED for custom applications.

B. LDR

LDR's or light dependent resistors are very useful especially in light/dark sensor circuits which are used to automatically switch ON /OFF the lights. Normally the resistance of an LDR is very high, sometimes as very high as 1000000 ohms and is called the dark resistance but when they are illuminated with light, resistance drop dramatically to 50ohms.This resistance is called as dark resistance. It can be as high as 1012Ω. If a constant voltage is applied to it and intensity of light is increased the current starts increasing.

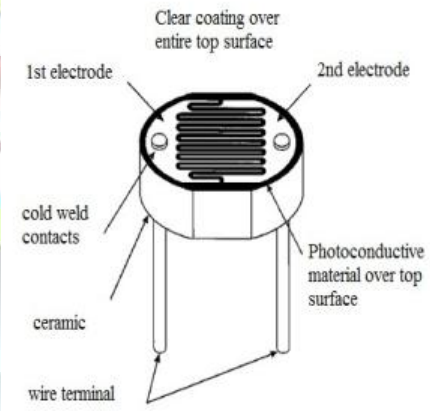

Fig.2.Structure of LDR

C. LM35 Temperature Sensor

Temperature sensor is a device which senses variations in temperature across it. LM35 is a basic temperature sensor that can be used for experimental purpose. It gives the readings in centigrade(degree Celsius)since its output voltage is linearly proportional to temperature. It uses the fact that as temperature increases, the voltage across diode increases at known rate. The LM35 is an integrated circuit sensor that can be used to measure temperature with an electrical output proportional to the temperature (^{o}C). It can

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measure temperature more accurately than using a thermistor. The LM35 generates a higher output voltage than thermocouples and may not require that the output voltage be amplified. The scale factor is .01V/^{o}C and LM35 does not require any external calibration or trimming and maintains an accuracy of +/-0.4 ^{o}C at room temperature and +/- 0.8 ^{o}C over a range of 0 ^{o}C to +100^{o}C.Another important characteristic of the LM35DZ is that it draws only 60 micro amperes from its supply and possesses a low self-heating capability.

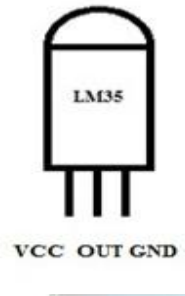

Fig.3. LM35 Temperature Sensor

D. LCD display

LCD is a type of display used in digital watches and many portable computers. LCD displays utilize to sheets of polarizing material with a liquid crystal solution between them. When an electric current passed through the liquid causes the crystals to align so that light cannot pass through them. LCD technology has advanced very rapidly since its initial inception over a decade ago for use in lap top computers. Technical achievements has resulted in brighter displays, higher resolutions, reduce response times and cheaper manufacturing process. LCD has two line displays each can represent 20 characters per line. The density of light passed through LCD which is also used to display images.

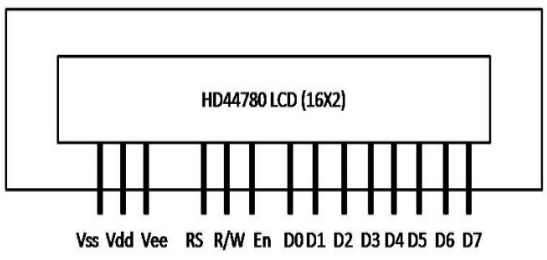

Fig.4. Pin Diagram of LCD

The liquid crystal display is a low power device. The power requirement is typically in the order of microwatts for the LCD. However, an LCD requires an external or internal light source. LCD is used to display the PIR mode and room temperature. A 14-pin access is provided having eight data lines, three control lines and three power lines.

There are four categories of instructions

- Designate LCD functions, such as display format, data length, etc.
- Set internal RAM addresses
- Perform data transfer with internal RAM
- Perform miscellaneous functions

E. RFID Tag / Reader

Radio-frequency identification is the wireless use of electromagnetic fields to transfer data, for the purposes of automatically identifying and tracking tags attached to objects. The tags contain electronically stored information. An RFID tag is a microchip combined with an antenna in a compact package; the packaging is structured to allow the RFID tag to be attached to an object to be tracked. "RFID" stands for Radio Frequency Identification. The tag's antenna picks up signals from an RFID reader or scanner and then returns the signal, usually with some additional data. An RFID reader is a device that is used to interrogate an RFID tag. The reader has an antenna that emits radio waves and the tag responds by sending back its data.

Fig.5. RFID Tag

F. GSM

The GSM standard has given birth to wireless services like general packet radio service (GPRS) and enhanced data rates for GSM evolution (EDGE). Its end users were the first to take advantage of an inexpensive implementation of SMS (short message system). Being a cellular network, GSM makes use of cells to provide wireless communication to subscribers who are in the

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vicinity of these cells. The four main cells that make up a GSM network are called macro, micro, pico and femto. Outdoor coverage is typically provided by macro and micro cells, while indoor coverage is usually provided by the pico and femto cells. GSM phones may be identified by the presence of a subscriber identity module (SIM). This tiny object, which is about as wide as a finger, is a removable smart card that contains a user's subscription information, as well as some contact entries. This SIM card allows a user to switch from one GSM phone to another. One of the main advantages of the GSM standard is the ability to roam and switch carriers by using individual mobile units.

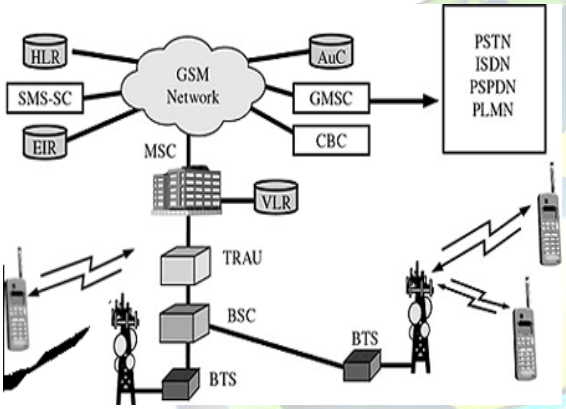

Fig.6. General Block Diagram of GSM

IV DESIGN FLOW

Initially the Time table of a class is fed to the microcontroller. When the class hours starts the whole design flow is taken into account based on the necessary conditions given. The number of students entering the classroom is considered initially and the attendance is recorded. With respect to the number of students present inside the classroom the necessary number of electrical appliances will be switched ON and OFF in a particular order. Based on the atmospheric conditions the electrical appliances are controlled based on the given necessary timings and also the number of students present inside the classroom.

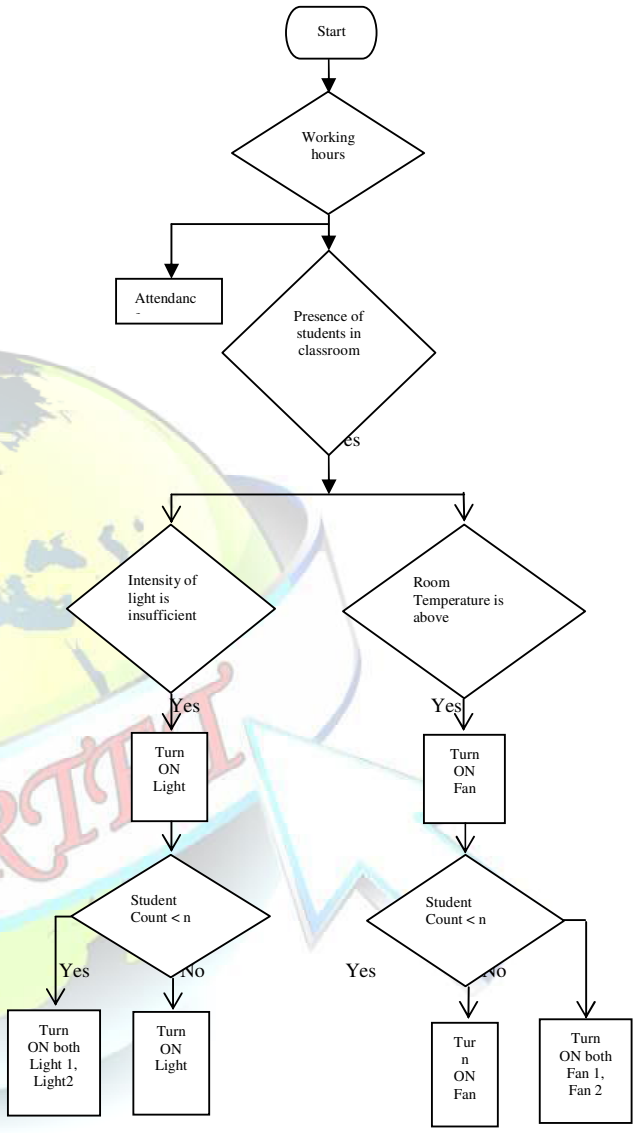

Fig.7. Flowchart for Proposed Model

V SIMULATION RESULTS

The LED turns ON when the respective class hours gets started.Similarly the LED turns OFF when the break time started.

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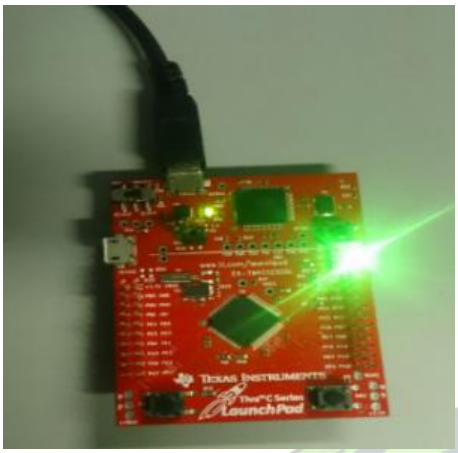

Fig.9. LED turns ON When Break Period 1 Starts

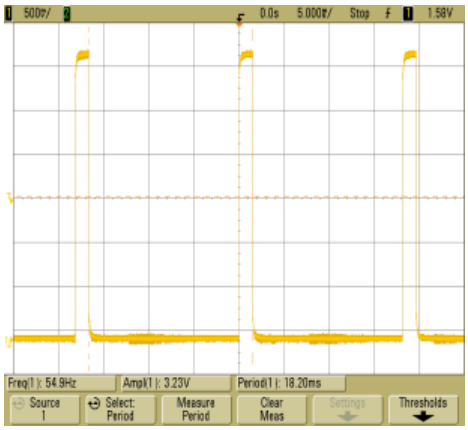

Fig.11. Frequency Measured in the Agilent MSO6012A Oscilloscope Autoscale

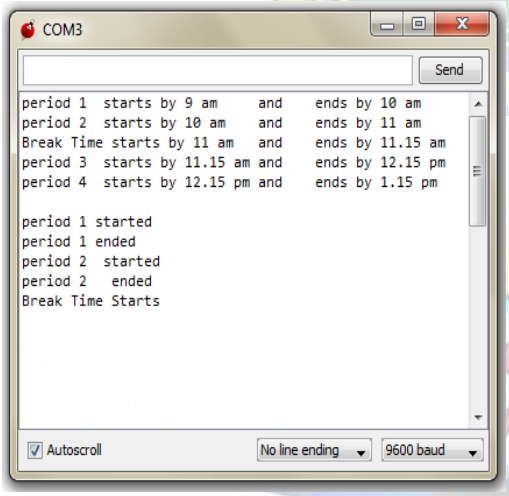

Fig.10. Serial Port Output With Break Time

The frequency measured in the mixed signal oscilloscope is found to be 54.9Hz for the PWM signal generation to control the servo motor which is interfaced with the TM4C123GH6PM. The testing is done with the given mixed signal oscilloscope.The Pulse width modulation signal on the Tiva C Series device is used to control the servo motor. The servo-motor requires a control signal of between 50 and 60Hz to control the position.

Interfacing the LED using relay and TM4C123GH6PM the necessary output is obtained. A relay is an electrically operated switch. Relays are used to control the necessary circuit by a low-power signal or where several circuits must be controlled by one signal.

- The output from the Launchpad produces a 3.3V which is interfaced with the relay circuit to turn ON and turn OFF the LED.
- When the switch is not pressed the LED willbe in OFF condition.
- When the switch is pressed the digital 1 is sent through the relay circuit and the LED turns ON.

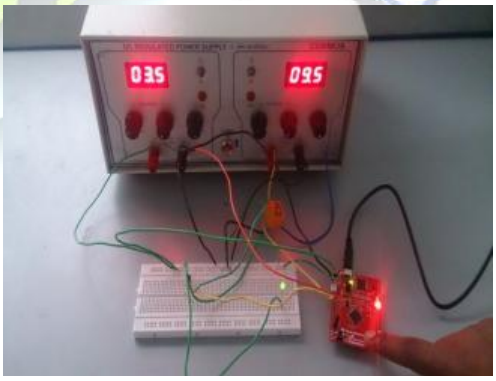

Fig.12. LED Turns ON When Switch is Pressed

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VI CONCLUSION AND FUTURE WORK

The electrical appliances can further be controlled by the entry of number of students inside the class in which the attendance is automatically recorded using the RFID Tag. Also by the number of students present inside the classroom the respective electrical appliances is to be controlled. The power consumption can also be reduced by the automatic change in the intensity of the light and also the control of speed in the fan which is given with respect to the atmospheric conditions. The automatic SMS alert system to the staffs can also be included before a certain time interval the respective period starts which is to be proposed by using the real time clock. From this a constrained amount of power wastage can be minimized with respect to the automatic control of the electrical appliances.

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