ARM7 *Based An Energy Efficient Lab Automation*

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Abstract –

In present scenario, it is more of a win-win than ever to save on energy. Every time we lower our utility bills, we put more money back in our bank account and lowers the energy bills also means low amount of energy consumed, which means less harmful emissions passed into our environment and provides safe eco. To make our Lab more energy efficient, one of the least expensive and most necessary changes that we can make is replacing the light bulbs. Hence this project proposed an intelligent LED lighting system to make the lab energy efficient and user satisfied. The proposed system wireless communication technology and this system also utilizes multi sensors in order to control a LED light according to user's motions and surroundings. An ARM 7 based embedded system design with day light and PIR sensors will be designed in order to control the lighting and its intensity in a household environment. The wireless communication technology uses RF module and RS-232 protocol for serial communication. After implementation the proposed system will be verified for its performance against a conventional system to make our system better and the percentage of energy saving will be calculated.

Keywords— *PIR-sensor-based Lighting Device, RF Module, GSM Module, Power Consumption, Energy Efficient, Presence Sensing.*

1.INTRODUCTION

Here we are designing a System which will automatically detect in many areas the power shortage is a major concern. In many big cities also there is always the question of power distribution. In this project we are prioritizing the power distribution to different area of city by means of load shading in which the load requirement is met by turning On/OFF the power distribution relay which provides the power to different parts of city. The input current is sensed using a current sensor and the load requirement is the monitored by the µC. If the input current goes below the load requirement then the µC will distribute the current by turning ON/OFF the corresponding relay.

Here we are designing a System which will automatically detect the human presence and turn On/OFF the lab appliances using relays. For this we are using PIR sensor which can detect the human presence in the room and give a pulse to µC. The µC will turn off all the appliances in the room if there is no human presence detected in this way we can achieve energy saving. If any human presence is detected then according to the lab temperature and ambient light the µC will turn on/off the fan and light relay.

2.RELATED WORK

In order to use efficient Electricity we propose an Intelligent LED Lighting System, which will automatically regulates the lighting system of house and timely displays the consumed Energy. [1]

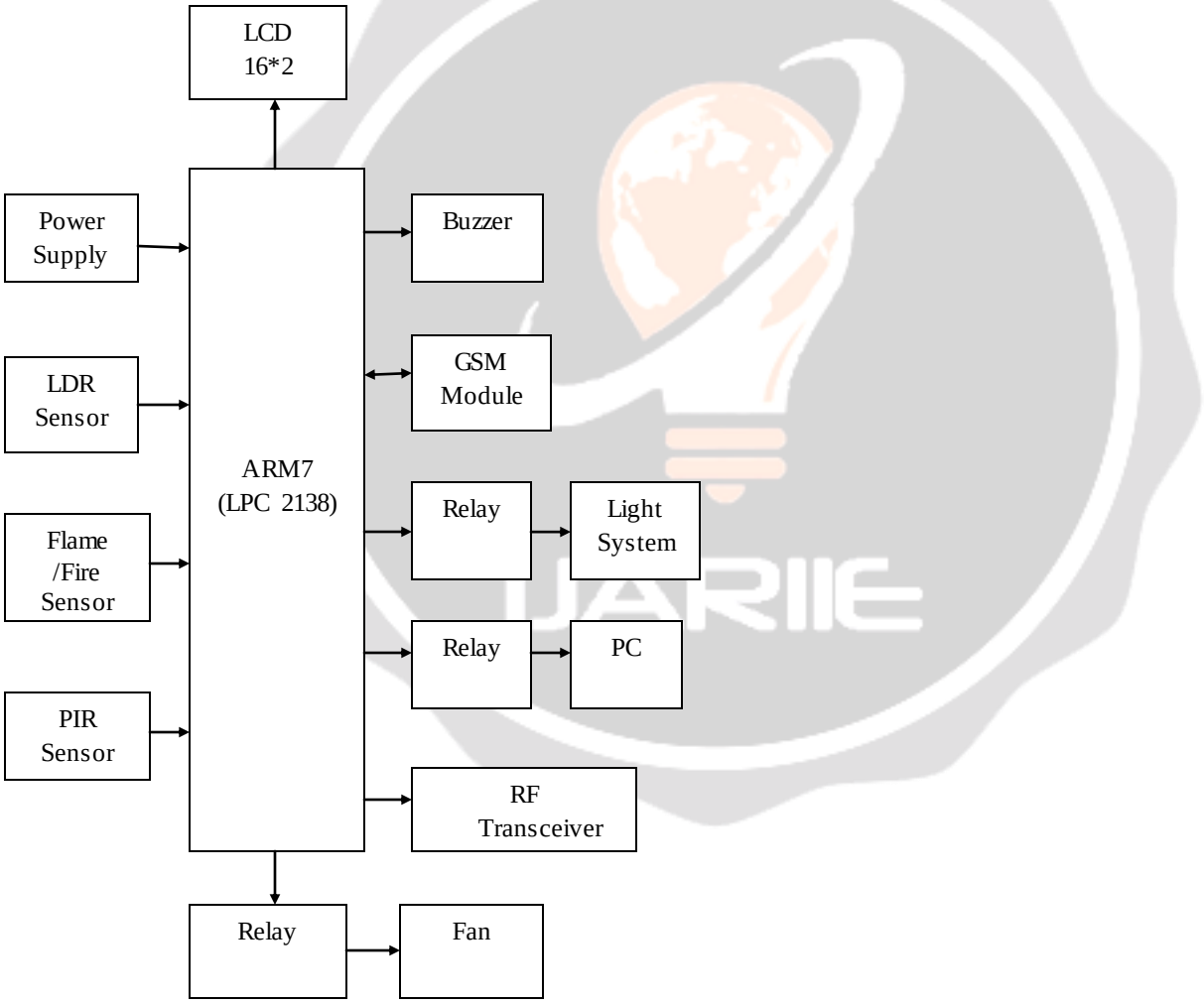
They propose a new design which, by using fewer circuit components, also reducing the standby power essentially. In addition, the power consumption will be reduced than that of other PIR sensor-based lighting devices. [2]

A GSM based smart notice board is developed. The module comprises of two major units. The first unit is a simple user's mobile handset. The second unit is the control unit. The control unit will be placed in remote places. Whenever any information or message have to be displayed the user can send the message as an SMS to the control unit. [3]

It consists of two microcontroller development boards such as ARM 7 and ARM 9 were used. ARM 9 (S3C2440A) is at transmitter side and ARM 7 (LPC2148) is at receiver side. OS Wince6.0 is used for designing the application on ARM9. [5]
They have introduced a new technology with FPGA controller, Bluetooth and Cellular Android phones. It is wireless technology. For a Xilinx Spartan-3E the VHDL language is used. V means VHSIC (Very High Speed Integrated Circuit). [4]

3.DESIGN AND IMPLEMENTATION

The block diagram for the designed system is shown which is basically consists of LED lighting system, outdoor light , person detection sensor, PIR sensor, Fire sensor and display units. This paper is implemented in an astute way in order to control the lighting system both indoor and outdoor. First of all we will be controlling the ON and OFF motion of light when person is detected then the PWM technique will be used to control the intensity of the light as explained in the fig.1 also in Design flow. When the power supply is ON the complete system will be activated. In the case of Indoor lighting system an IR sensor is used which detects an obstacle (person) and an LDR (lighting Detecting Resistor is used). Whenever there is less intensity in the room the LED will start blinking and when IR sensor detects a person coming into the room then it will ON the LEDs of the room completely.



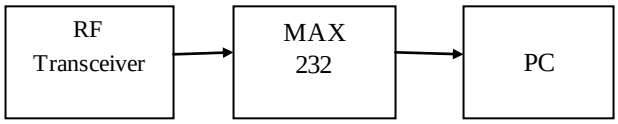


Fig. Block Diagram Of ARM7 Based An Energy Efficient Lab Automation

4.HARDWARE DESCRIPTION

i)ARM core:-

The ARM7 family includes the processors such as ARM7TDMI, ARM7TDMI-S, ARM720T, and ARM7EJ-S processors. The ARM7TDMI core is the industry's most widely used. The 32-bit embedded RISC microprocessor is the solution. They are optimized for cost and power-sensitive applications, the ARM7TDMI solution provides the low amount of power consumption, smaller size, and better performance needed in portable and embedded applications.

LPC2138 Processor: The ARM7TDMI-S is basically a general purpose 32-bit microprocessor, which offers better performance and very low amount of power consumption. The ARM architecture is based on such as RISC principles, and the instruction set and also related decode mechanism which are much simpler than the micro programmed CISC architecture. Typically, while one instruction is being executed, then its successor has been decoded, and a third instruction is being fetched from memory.

ii) LDR Light-Dependent Resistor :-

A Light-Dependent resistor is light controlled variable resistor. The resistance of the photo resistor decreases in accordance with increase in the light intensity in the room, it exhibits photo conductivity . It can be used in Light sensitive detection circuits and light and dark activated circuits.

A photo resistor is made of a high resistance semiconductor.

iii) PIR Sensor :-Passive Infrareds sensors (PIRs) are electronic component which is used in some security alarm systems which detects the motions of an infrared emitting source, usually a human body.

This unit can be easily incorporated into an alarm unit, to sound an alarm or visually indicates the LPG concentration. The sensor has excellent sensitivity along with a quick response time. The sensor can also sense iso butane, propane, LNG and cigarette smoke.

iv) Signal Conditioner :- A signal conditioner is a device which converts one type of electronic signal into another type of the signal. Its primary use is to convert a signal that may be difficult to read by conventional system into a more easily read and lowers the cost & the power because the system ARM7TDMI micro regulator which is a Flash based micro regulator can be programmed and erased several times.

v) RF Module :- nRF24L01 Single Chip 2.4GHz Transceiver.

RF stands for Radio Frequency. This module consists of both the Transmitter (TX) and Receiver (RX). It is available in different operating frequencies with different operating range. An Encoder and a Decoder circuit is used along with the Transmitter and Receiver respectively in order to transmit and receive message/signal.

vi) GSM (Global System for Mobile Communications):- Originally, GSM is an architecture which is developed by the European Telecommunications Standards Institute (ETSI), to describe protocols for second generation (i.e. 2G) digital cellular networks used by mobile phones. GSM provides an easy way of communication between two users at any part of the world. GSM system advantages: 1. Mobility 2. High Availability 3. Maturity SIM: A Subscriber Identity Module (SIM) is a portable memory chip. This is required to activate the GSM module.

vii) Flame Sensor:- (LM1117)

As the name suggests, is used as a simple and compact type of a device for protection against fire. The module makes use of heat sensor and comparator to detect fire . The device having the weight about 5 grams, can be easily mounted on the body of the device. It gives a high output on detecting fire. This output can then be used to take the appropriate action. An on-board is also provided for visual indication.

viii) Liquid Crystal Display(LCD-16*2):-

The 16*2 LCD is used in a project to visualize the output of the application. We have used 16*2 LCD which indicates 16 columns and 2 rows. So ,we can write 16 character in each line.
So, total 64 characters we can display on 16*2 LCD.
LCD can also used to visualise the output of different modules interfaced with the microcontroller. Thus

ix) Buzzer:-

Buzzers are used in a system to indicate or to grab the attention whenever any emergency situation has been occurred. Buzzer act as a panic horn which indicates the need of instant attention or help as the condition goes haywire.

x) Relay :- BC547 :Relays are basically switches that open and close circuits electromechanically or electronically. Relays control one electrical circuit by opening and closing the contacts in another circuit. When a relay contact is normally open (NO), that means there is a open contact when the relay is not energized. When a relay contact is normally closed (NC),that means there is a closed contact when the relay is not energized.

xi) MAX 232:- (+5V-Powered, Multichannel RS-232 Drivers/Receivers)

During serial type of communication between the microcontrollers with PC the MAX 232 IC is used which converts the TTL/CMOS logic levels to RS 232 logic levels. The microcontroller operates at TTL logic level (0-5v) whereas the serial communication in PC which is usually works on RS232 standards (-25v to +25v). This makes it difficult to establish a direct link between them to communicate with each other. The intermediate serial communication link is provided through MAX232. It is a dual driver/receiver that has a capacitive voltage generator to supply RS232 voltage levels from a single 5v supply.

5.SOFTWARE DESCRIPTION

a)Proteus Version6.1 Software:- Used for designing PCB, Circuit designing and Simulation purpose.
b) KEILµVISION 4: We are using Keil software (version 4) and doing programming in Embedded C language. Keil software is freely available and is easily downloadable. The Embedded C language is a high level language and it can be conveniently used for the development of complex systems.
c) Flash Magic:- Flash Magic is Windows software from the Embedded Systems Academy that allows easy access to all the ISP features of this software provided by the devices. Flash Magic provides a clear and simple user interface and can burn programs into the flash memories of NXP microcontrollers.
d) Virtual Basic v6.1
e) Operating system used is Windows 7

6.ALGORITHM

The Algorithm gives clear idea of the system, first the complete system will be activated and the kit will be synchronized with the PC. Now the operation begins for both indoor and outdoor lighting system; coming to the indoor lighting.

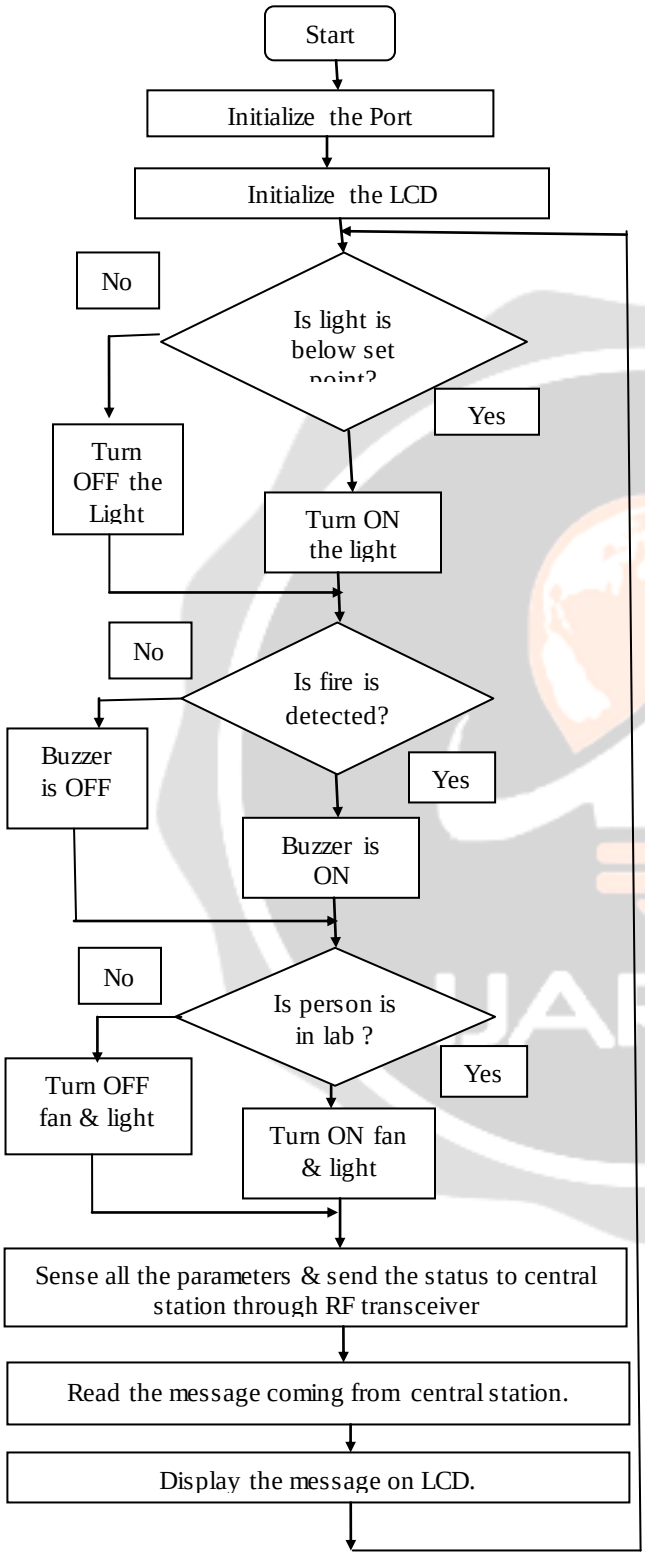
Lab Terminal

1. Start
2. Initialize the Port
3. Initialize the LCD.
4. Read light.
5. Covert the data into digital form.
6. If light is below set point turn ON light system, Otherwise turn OFF the light system.
7. If fire is detected turn ON the buzzer, Otherwise turn OFF the buzzer.
8. Read PIR Sensor reading i.e If person is in lab turn ON the light & fan, Otherwise turn OFF the light & Fan.
9. Sense all the parameters & send the status to central station through RF transceiver.
10. Read the message coming from central station
11. Display the message on LCD.
12. Go to step 4.

Central Terminal

1. Read the status of various sensors & display it.
2. Wait for message from keyboard(PC) .
3. If no message then go to first step.
4. If message is present then send it to lab terminal go to step 4., otherwise wait for message

7. FLOW CHART


Start
Initialize the Port
Initialize the LCD
No
Is light is below set point?
Yes
Turn OFF the Light
Turn ON the light
No
Is fire is detected?
Buzzer is OFF
Yes
Buzzer is ON
No
Is person is in lab ?
Yes
Turn OFF fan & light
Turn ON fan & light
Sense all the parameters & send the status to central station through RF transceiver
Read the message coming from central station.
Display the message on LCD.

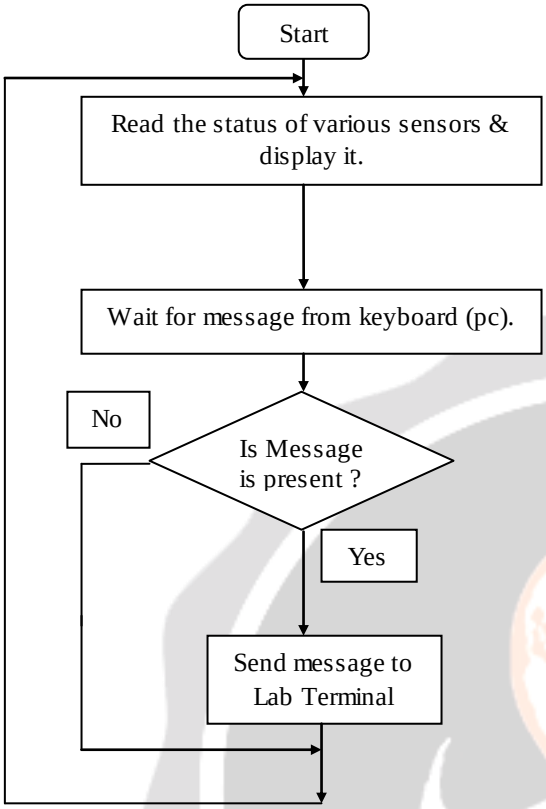


Fig. Flow Chart Of ARM7 based an energy efficient Lab Automation.

8.SYSTEM IMPLEMENTATION

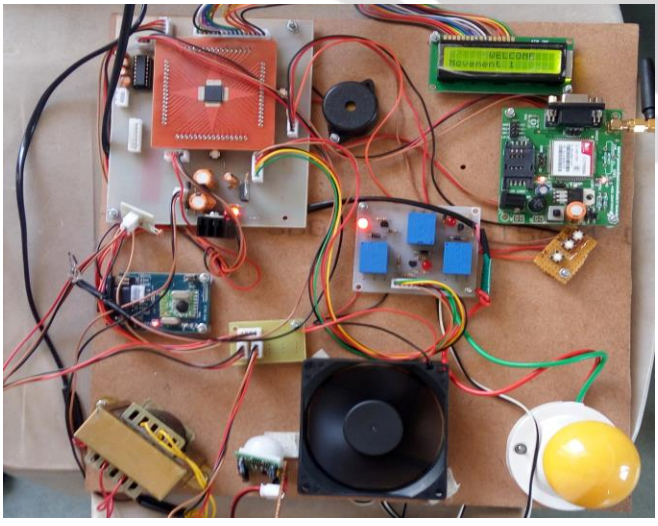


Fig. Main project implementation (project snap)

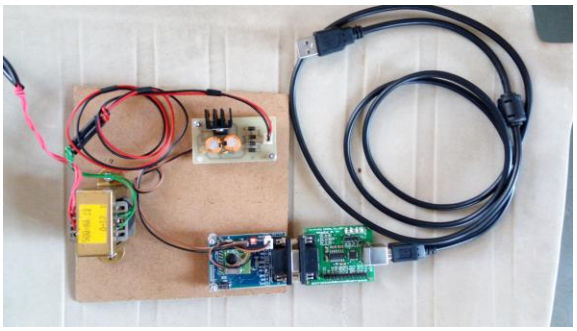


Fig. RF module snap

8. RESULTS:

Fig.(a)Continuously checking movement of person entering into the lab

Fig. (b)Person detected by PIR sensor

Fig. (c)LDR sensor output

Fig.(d)Fire detection alert message

10. ADVANTAGES:

- Highly flexible
- Energy Efficient
- Quick response time

- Fully automate system thus Reduces human efforts
- low power requirement
- Efficient way for wireless data logging of hazardous application
- Less time delays

11. DISADVANTAGE:

- LCD has limitations on number of characters to be displayed.
- RF transceiver has range up to 30 meters only.

12. APPLICATIONS:

- Used for security purposes.
- Energy conservation

13.FUTURE SCOPE:

The present system is used in labs for reducing human efforts operating various lab utilities automatically. By making use of different sensors different parameters like light, & fan can be controlled. The system can be further modified to which can be used in different offices and industries for making them more efficient by reducing human efforts.

13.CONCLUSIONS

In order to use efficient Electricity we propose an Intelligent Domiciliary LED Lighting System, which automatically regulates the lighting system outside & inside of Lab and timely displays the consumed Energy. This project is implemented on ARM, the sensor which detects the day light is used to switch outdoor lighting and the PIR sensor which detects the entering person into room are used here to regulate the indoor lighting intensity, which is done through PWM shifting technique. The power consumed by thes e lighting systems will be displayed on LCD for the monitoring purpose.

14.REFERENCES

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