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IoT Based Energy Management System

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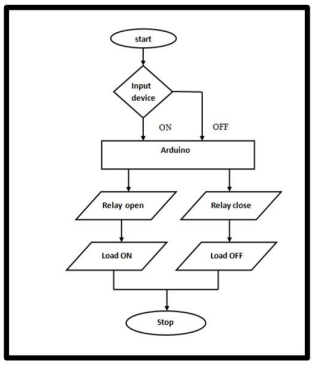
Abstract: *This paper is designed for optimum energy management based on counter, light intensity and temperature sensor. the system also counts the number of persons entering and leaving the room and displays that information on lcd display. Depending on person's entry as well as exiting condition the room appliances will play their role. the ultimate objective of this system is to save the energy as well as to design automatic room light controller by turning off all the appliances when nobody is there in the home. In this project we are using Arduino uno, LDR sensor, dht-11 sensor, IR sensors, lcd display, fan and lamp. there are two pair sensors, each kept at certain distance from the other. one pair of sensor consists of a transmitter and a receiver, kept exactly opposite to each other. The transmitting part emits modulated IR light which is received at the receiver end and fed to a microcontroller of Arduino uno family. when a person enters the room Arduino senses it (with the help of IR sensors) and increments the count and displays it on lcd. if LDR sensor is in dark condition then the lamps of room get on. This system possesses two sets of IR led and IR sensors to detect the persons entering and leaving the room. so, if the person goes outside of the room then the lamp will get off. Similarly, when temperature sensor sensed the temperature then the signal goes to the Arduino board and through Arduino board the fan gets on. if nobody is present in the room then it will sensed by Arduino and it will turn off the fans. This helps in saving lot of energy. Further the project can be enhanced by using timer arrangement in the project so that if the load switching doesn't take place for some reason as desired, then timer would complete the task after prefixed time.*

Keywords: Arduino UNO, Dht-11 Sensor, Energy Management, LDR, IR Sensor

I. INTRODUCTION

Increasing economic growth and consumption patterns are leading to ever growing demand for energy. Since most of the energy supply is from fossil fuels, the resource is depleting thus increasing cost of energy. Burning fossil fuels has also increased concentration of carbon-di-oxide in the environment leading to extreme weather patterns. Hence it is imperative that Industries and commercial enterprises take steps to reduce energy wastage, become energy efficient and reduce costs. A simple definition of an EMS is a system to control and monitor energy consuming devices, which may include heating and cooling equipment, fans, pumps, dampers, and lighting. Energy management systems can also be used to control refrigeration equipment, industrial processes, or other systems.

1.1 Flowchart



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1.2 Project Objectives

The LDR (light dependent resistor) is used in order to Control the number of lights to be switched ON in a room by constantly checking the amount of light. On a normal sunny day, the lights will be OFF even if the temperature sensor marks the presence of people inside the room. But on a cloudy day, once the illumination levels are going to be low, the controller determines the estimated lighting by checking the illumination level and initiates the lights.

1.3 Scope

This system can be used for hostels where the corridor and bathroom lights always remain ON. The lights remaining on costs a lot to the University and by the use of this system. The energy saved can be used in places which are deficient in power. In this way, we can contribute a little towards humanity and can take one step forward to save the nature andour planet Earth which has given you everything.

1.4 IoT (Internet of Things)

IOT as a term has evolved long way as a result of convergence of multiple technologies, machine learning, embedded systems and commodity sensors. IOT is a system of interconnected devices assigned a UIDS, enabling data transfer and control of devices over a network. It reduced the necessity of actual interaction in order to control a device. IOT is an advanced automation and analytics system which exploits networking, sensing, big data, and artificial intelligence technology to deliver complete systems for a product or service. These systems allow greater transparency, control, and performance when applied to any industry or system.

II. COMPONENTS REQUIRED

SL. NO	Component	Quantity
3.	Arduino Uno	1
4.	LCD Display	1
5.	DHT-11 Temperature Sensor	1
6.	LDR	1
7.	Relay Channel	2
8.	DC Fan	1
9.	Lamp	1
10.	IR Sensor Arduino Module	2
11.	USB Cable	1
12.	Jumper Wires	1

2.1 Arduino Uno

Arduino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. You can tinker with your Uno without worrying too much about doing something wrong, worst-case scenario you can replace the chip for a few dollars and start over again.

"Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards.

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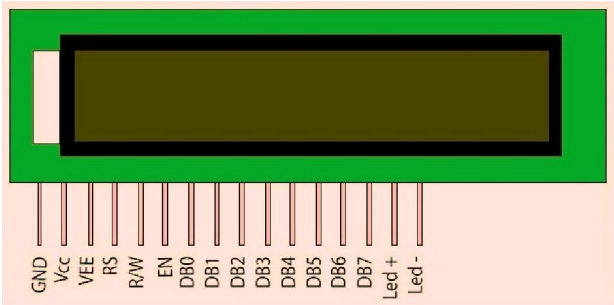
2.2 LCD Display

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

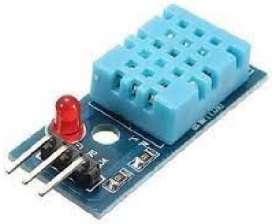
A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD. Click to learn more about internal structure of a LCD.



2.3 DHT 11 Humidity Sensor

DHT11 Temperature & Humidity Sensor features a temperature & humidity sensor complex with a calibrated digital signal output. By using the exclusive digital-signal acquisition technique and temperature & humidity sensing technology, it ensures high reliability and excellent long-term stability. This sensor includes a resistive-type humidity measurement component and an NTC temperature measurement component, and connects to a high performance 8-bit microcontroller, offering excellent quality, fast response, anti-interference ability and cost-effectiveness.



2.4 LDR

A Light Dependent Resistor (LDR) or a photo resistor is a device whose resistivity is a function of the incident electromagnetic radiation. Hence, they are light sensitive devices. They are also called as photo conductors, photo conductive cells or simply photocells.

They are made up of semiconductor materials having high resistance. There are many different symbols used to indicate a LDR, one of the most commonly used symbol is shown in the figure below. The arrow indicates light falling on it.

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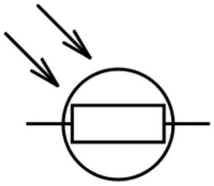


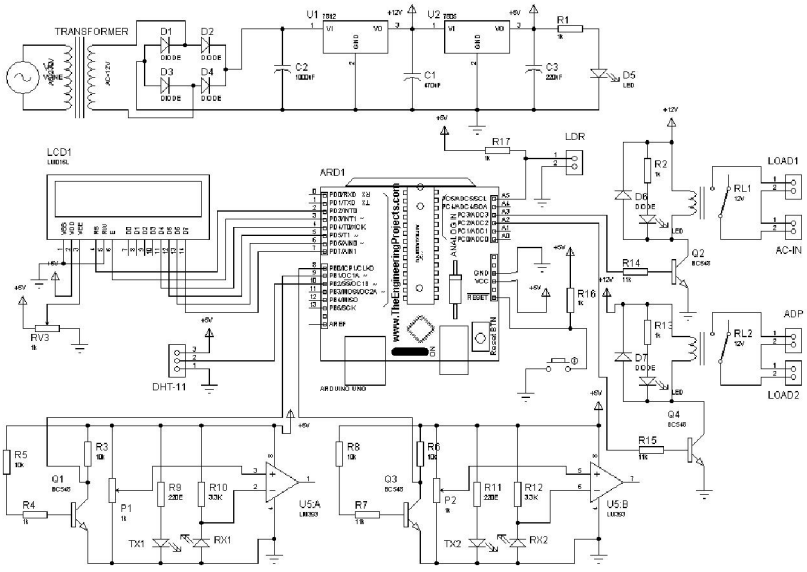
2.5 Relay Channel

A power relay module is an electrical switch that is operated by an electromagnet. The electromagnet is activated by a separate low-power0020signal from a micro controller. When activated, the electromagnet pulls to either open or close an electrical circuit.

2.6 IR Sensor

An infrared proximity sensor or IR Sensor is an electronic device that emits infrared lights to sense some aspect of the surroundings and can be employed to detect the motion of an object. As this is a passive sensor, it can only measure infrared radiation. This sensor is very common in the electronic industry and if you've ever tried to design an obstacle avoidance robot or any other proximity detection-based system, chances are you already know about this module, and if you don't, then follow this article as here we will discuss everything about it.

III. CIRCUIT DIAGRAM



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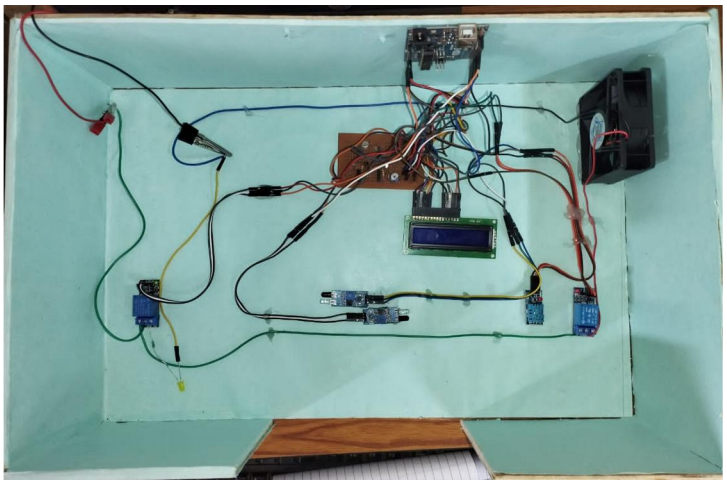
Actual Model Setup



IV. RESULT

The experimental model was made according to the circuit diagram and the results were as expected. When a person enters the room Arduino senses it (with the help of IR sensors) and increments the count and displays it on LCD. If LDR sensor is in dark condition then the lamps of room get ON. This system possesses two sets of IR LED and IR sensors to detect the persons entering and leaving the room. So, if the person goes outside of the room, then the lamp will get OFF. Similarly, when temperature sensor sensed the temperature then the signal goes to the Arduino board and through Arduino board the fan gets ON. If nobody is present in the room then it will be sensed by arduino and it will turn off the fans. This helps in saving lot of energy.

V. LIMITATIONS

Electricity is central to all the activities of the modern society. In the present-day situation, energy catastrophe is a huge challenge; a system that saves electricity is of great use. The existing system did not provide to incorporate the features like improvement of energy efficiency and surveillance at low cost.

VI. FURTHER ENHANCEMENT AND FUTURESCOPE

This system can be used for hostels where the corridor and bathroom lights always remain ON.
The lights remaining on costs a lot to the University and by the use of this system. The energy saved can be used in places which are deficient in power.
In this way, we can contribute a little towards humanity and can take one step forward to save the nature andour planet Earth which has given you everything.

VII. CONCLUSION

As the need for an active and systematic building energy management system a smart home energy management system model using IoT was constructed as a way to reduce energy consumption in houses. Nowadays in busy schedule this system can be used in home, hospitals and also in some public places like complex, showrooms etc., “IF WE IMPLEMENT THIS, WE CAN CREATE A SMART HOME”.

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