DESIGN AND CONSTRUCTION OF A FAN AND LIGHT AUTOMATION SYSTEM

BY

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DEDICATION

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DESIGN AND CONSTRUCTION OF A FAN AND LIGHT AUTOMATION SYSTEM

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ABSTRACT

Electricity is one of the foremost necessary resources during this century which needs to be conserved otherwise the next generations might be deprived of the opportunity. However there is tendency we leave our various rooms and offices and forget to switch off the lights and fan, so electricity is wasted. Additionally in most cases, switches of lights and fan are situated in places where we might need to search for them in the dark and just in case of guests, it becomes tougher. This project has two elements, the first which is the Passive Infrared sensor (PIR) and also the alternative one which is the Light Dependent Resistor (LDR) and LM35 Temperature sensor. The first part actually senses the presence of human in the room or office while the second part switches on the light and fan respectively based on the state of the Passive Infrared sensor (PIR) and also the condition of the room or office where it is installed at. Once variety of persons within the space is zero, power provided within the space are cut off and at such, the lights and fan goes off but when somebody enters the room, the system automatically measures the temperature and light intensity inside the room and accordingly controls the light and fan. During daytime lights will not be operated and during cold season fan may not be operated. This helps to avoid wasting electricity and reduces human efforts.

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CHAPTER ONE

INTRODUCTION

1.0 GENERAL BACKGROUND

Energy crisis being one of the major problems we are facing these days makes the conservation of energy so relevant in this occasion. Electricity which is one of the most important resources in this century has really being one of the most difficult forms of energy to conserve. Many times we leave our homes and offices, we often forget to turn off the lights and fans and as a result electrical energy (electricity) is wasted. Similarly, there are cases in which switches to light and fan are located inside our rooms and offices and so we may have to search for them in darkness and in case of guest, it becomes very difficult and if care is not taken it might lead into an accident. Technology advancement in recent years has played significant roles in reducing energy and power consumed and wasted due to the use of illuminations or lightning in household, industrial or commercial buildings. Various measures have been implemented to ensure this which includes the use of energy saving bulbs, the use of timer incorporated switch and the use of PIR sensor, but none of these methods saves energy 100% efficiently

This project proposes a system of automatic lightening system by sensing any body movement near the door. This is achieved with help of a PIR (Passive Infrared) sensor. A live body generally emits infrared energy which is sensed by the PIR sensor from a considerable distance. This sensing signal is fed to an integrated circuit to operate and switch on the light. The controlling of home ac lights is usually maintained by the occupant of the house on several occasions. This is not only precarious but also sometimes results in wastage of power because of the negligence or unusual circumstances on part of the occupant of the house in operating the lights on and off. Not only in case of lights, even for controlling the home appliances like garden or outdoor lights, we can utilize the LDR (Light Dependent Resistor) sensor for the automatic switching on and off the lights based on daylight's intensity.

LM35 is the temperature sensor the senses the temperature of a room then controls the speed of a fan. Since our weather conditions are widely varied, temperature up and downs are common in our country. When the temperature is less than 20 ^{0}C definitely the fan is not required, there by a facility is provided in the system to ensure the fan will be switched off automatically at less than

20 ^{0}C. The system is programmed to run the fan at its maximum speed at 40 ^{0}C. Therefore, the fan speed varies linearly between 20 ^{0}C to 40 ^{0}C. This device facilitates the operation of fan speed around the home or office automatically. It adds more comfort to everyday living by removing the inconvenience of having to move around to operate a fan regulator reducing or increasing it. The system seeks to develop a system that is cost effective while not under mining the need for efficiency.

1.1 PROBLEM STATEMENT

This project is modeled to make amendment to lapses of previous systems by overcoming the drawbacks of existing system such as the lack of efficient conservation of electrical energy and also ease human stress of controlling switches to fans and lights.

1.2 SIGNIFICANCE OF STUDY

Electrical energy is always wasted when our fans and lights are left on when there is little or no use of them in our homes. This design presents an economical and effective way of conserving and saving electricity as a form of energy.

1.3 AIMS AND OBJECTIVES

The aim of this project is to design and construct a room's light and fan automation system that will switch on or off the fan and lights of a room connected to it when the temperature increases and also when the illumination level of the room drops. The objectives are

- To reduce cost incurred from the wastage of energy.
- To reduce human interaction, efforts and intervention.
- To make efficient use of electrical energy.

1.4 SCOPE OF THE PROJECT

This project will provide more convenience and comfort for the user as well as saving appreciable amount of energy. This project can be implemented in malls, offices, schools and hotel rooms. This project work is complete on its own in automatically switching on and off

of the lights and fans connected to it. It does not implement the automatic detection of faults in the controlled appliances. This project has three (3) basic modules that perform three different functions. The first module detects if anybody enters into the house. The second module triggers the AC light during dark hours while the third module controls the speed of the fan according to the temperature of the room.

1.5 SIGNIFICANCE OF THE PROJECT.

- Automatic switching OFF the lights based on daylight's intensity by using the LDR sensor. It relieves the user from the stress of moving from one place in attempt of switching of ac lamps.
- This system also protects the energy waste in an ac fan by switching it ON or OFF heat time and cold time.
- This system is fully automated. So once this system is installed inside home or industry, then it does not require any human interaction to operate. With the use of this system we can save the life of person inside home / industry.
- This system is cost effective and also fast and efficient.

1.6 LIMITATION OF THE PROJECT

The limitations of this project are;

- The PIR sensor cannot actually differentiate between human beings and animals; it is therefore possible for the presence of an animal anywhere close to the sensor to trigger it.
- The LDR sensor can also cause false triggering if external light (such as thunder lightening or motor flash) falls on the sensor.

CHAPTER TWO

LITERATURE REVIEW

2.1 HISTORICAL BACKGROUND OF THE STUDY

Automation is the technology by which a process or procedure is performed with minimum human assistance. (Groover & Mikell, 2014). Automation or automatic control is the use of various control systems for operating equipment such as machinery, processes in factories, boilers and heat treating ovens, switching on telephone networks, steering and stabilization of ships, aircraft and other applications and vehicles with minimal or reduced human intervention. (Rifkin & Jeremy, 1995). Automation covers applications ranging from a household thermostat controlling a boiler, to a large industrial control system with tens of thousands of input measurements and output control signals. In control complexity it can range from simple on-off control to multi-variable high level algorithms.

Automation plays an important role in the global economy and in daily expense. Engineers strive to combine automated devices with mathematical and organizational tools to create complex systems for a rapidly expanding range of application and human activities. Tasks requiring subjective assessments of synthesis of complex sensory data such as scents, sounds, temperature and nature as well as high level tasks such as strategic planning currently require human expertise which is being taken over by automation systems. Automation has as a notable impact in a wide range of highly visible industries beyond manufacturing. Telephone operators have been replaced largely by automated telephones, switchboards and answering machines. Also automated teller machines have reduced the need for bank visitations to obtain cash and perform transactions. Generally, automation has really been responsible for the shift in the world's economy from agrarian to industrial in the 19^{th} century and from industrial to services in the 20^{th} century.

In the simplest type of an automatic control loop, a controller compares a measured value of a process with a desired set value, and processes the resulting error signal to change some input to the process, in such a way that the process stays at its set point despite disturbances. This closed-loop control is an application of negative feedback to a system. The mathematical basis of control theory was begun in the 18th century, and advanced rapidly in the 20th.Automation has been achieved by various means including mechanical, hydraulic,

pneumatic, electrical, electronic devices and computers, usually in combination. Complicated systems, such as modern factories, airplanes and ships typically use all these combined techniques. The benefit of automation includes labor savings, savings in electricity costs, savings in material costs, and improvements to quality, accuracy and precision. (Bennett,1993).

2.1 REVIEW OF RELATED WORKS

Home automation or domotics is building automation for a home, called a smart home. A home automation system will control lighting, climate, entertainment systems, and appliances. It may also include home security such as access control and alarm systems. When connected with the Internet, home devices are an important constituent of the Internet of Things. A home automation system typically connects controlled devices to a central hub or gateway (Hill & Jim, 2015). The user interface for control of the system uses wall-mounted terminals, tablet or desktop computers, a mobile phone application, or a web interface, that may also be accessible off-site through the Internet. While there are many competing vendors, there are very few worldwide accepted industry standards and the smart home space is heavily fragmented. Manufacturers often prevent independent implementations by withholding documentation and by litigation. (Hill & Jim, 2015).

When an object (defined by a difference in luminance from its surroundings) moves, the motion can be detected by a relatively simple motion sensor designed to detect a change in luminance at one point on the retina and correlate it with a delayed change in luminance at a neighboring point on the retina. Sensors that work this way have been referred to as Reichardt detectors. (Reichardt, 1961)

Rahul et al., 2013 used the LM35 temperature sensors, 16F887A microcontroller, optocoupler and an infra-red sensor (IR) to develop an automatic person detection system which controls electrical fan and lights in a museum. When somebody enters into the Museum then the light in the museum will be switched ON and count also incremented by one when any one leaves the room then count will be decremented by one. If the total count will be zero, the light will be automatically switched OFF. The microcontroller does the above job. It receives the signals from the sensors, and this signal is operated under the control of software which is stored in ROM. Pic

Microcontroller 16F887A continuously monitor the sensors, A IR Sensor is which controls the switching on/off of the light when it detects the any person entered into the museum. The implementation is made simpler by using sensor to detect person. The system includes IR sensor, microcontroller, LCD display and a 5v power is supplied to run the system. The system uses a compact circuitry built around pic microcontroller programs are developed in Embedded C. Flash magic is used for loading programs into Microcontroller.

Arun et al., 2017. during their design of an automatic room's fan, light and air conditional control with visitor counter using the AT89C51 microcontroller explained that When an individual enters into a room then one counter is incremented by one and one light and fan in a room will be switched ON and when the individuals leaves a room then the counter is decremented by one. When the number of individuals in a room is greater than 6 then 2 lights and one fan will be switched ON. When the individuals in a room are more than 11 then 3 lights two fan will be switched ON and when the temperature is more than 27°C, one A.C. will be switched ON. Similarly, on the increase of every 5 individuals one more light will switched ON. Lights, fan and A.C. will be turned OFF when all the individuals go out of a room. The total number of individuals present inside a room is also displayed on the LCD display.

Shobug et al., 2016 designed and implemented a microcontroller based fan speed regulator with continuous monitoring using LCD display. Most of the available fans today are controlled manually by voltage regulators which have different stages of speed. During summer nights, especially the room temperature is initially quite high, as time passes, the temperature starts dropping. Also, after a person falls asleep, the metabolic rate of one's body decreases, and one is expected to wake up from time to time to adjust the speed of the Fan. Many people who are disabled / physically challenged persons are affected the most because of the inconveniences associated in changing the Fan speed level manually when the room temperature changes. So, an efficient automatic Fan speed control system that automatically changes the speed level according to the change in environment / room temperature which is more comfortable than manual system. This project has been designed in such a way that the required components are available in local market. Therefore, an indigenous low cost control scheme has been developed which can be used in real life application.

Zungeru & Obafemi, 2017 modelled and designed a digital automatic sliding door with a room light control system by considering some factors such as economy, availability of components

and research materials, efficiency, compatibility and portability and also durability in the design process. The performance of the system after test met design specifications. This system works on the principle of breaking an infrared beam of light, sensed by a photodiode. It consists of two transmitting infrared diodes and two receiving photodiodes. The first one is for someone coming in and the second one is for someone going out of the room. The photodiodes are connected to comparators, which give a lower output when the beam is broken and high output when transmitting normally. The general operation of the work and performance is dependent on the presence of an intruder entering through the door and how close he/she is in closer to the door. The door is meant to open automatically but in a case where there is no power supply trying to force the door open would damage the mechanical control system of the unit. The overall work was implemented with a constructed work, tested working and perfectly functional.

Murmu & Sonkar, 2004. explained an approach to control the household electrical devices like room light or fan in a room environment using whistle and clap. There are many alternative techniques to remotely control electrical devices in room environment such as using a TV remote control or speech recognition techniques etc. But our approach is the most cost effective. Though this product is aimed at physically challenged user, it has universal appeal as a comfortable way to control the room environment. We have designed microcontroller based circuits to detect clap and whistle against other sounds and are controlling the intensity of the load using a microcontroller based triac drive and a specific code.

Arun et al., 2013 proposed a room light control system which is named as light control system (LCS). This proposed system will able to provide the needed light which provides the satisfaction of users and will provide energy saving and management. Lighting Control System and the decision making algorithm, are discussed. As per the algorithm the system will first check any occupant is there in the room. If so then the system will check the intensity of light in the room and if it is low, then it will switch on the light.

This system takes two things into account before taking any action, namely

- human presence
- intensity of light

The system consists of a PIR sensor (Parallax 555- 28027) and an LDR (NORP 12). The PIR sensor is used to detect whether any occupants are there in that room and LDR is used to detect the intensity of light in that room. Apart from this an algorithm can be implemented in our system which uses both the LDR and PIR sensor to decide whether to switch on the light The required intensity of light for various environments were discussed which are;

Types of place and work	Intensity required
Filing – Office work	300 lux
General office (typing and writing)	500 lux
Painting	750 lux
Classrooms	300 lux
Classrooms for evening classes	500 lux
Auditorium	500 lux
Assembly (industry)	1000 lux

Table 1 light intensity for various environments

Oyebamiji, 2010 explained the design and construction of an automatic room light control using light sensitive switch so as to use energy much more efficiently. It helps to switch on the lighting in a room when it is occupied and switches off when the room is not occupied. Testing was carried out to ascertain the efficiency of the design. The result of this testing shows that more than one person can occupy a room at a time with the light staying on until the fifth person who resets the counters. Also when a person leaves the room, the system will retain the on state of the light if there is still someone in the room or switch off the light if there is no one in the room.

Adeloye et al., 2017 explained the construction of a circuit using a temperature sensor and a microcontroller that will automatically control the speed of the fan whenever there is a change in ambient temperature. An Arduino program is used to program the microcontroller based on the desired function. The Arduino language is an open source project that creates microcontroller based kit for building digital device and interactive objects that can sense physical quantities and control devices. The original control unit of the fan is disabled and replaced with the constructed circuit. The fan is given 3 different speed levels, with each

speed level being activated by a certain degree of temperature change. This will eventually reduce human stress as well as reduce energy wastage.

Widyaningrum & Pramudita, 2018 designed an automatic lamp and fan control based on microcontroller. Both of these systems will be processed using an Arduino Mega 2560 microcontroller. A microcontroller is used to obtain values of physical conditions through sensors connected to it. In the automatic lamp system required sensors to detect the light of the LDR (Light Dependent Resistor) sensor. While the automatic fan system required sensors to detect the temperature of the DHT11 sensor. In tests that have been done lamps and fans can work properly. The lamp can turn on automatically when the light begins to darken, and the lamp can also turn off automatically when the light begins to bright again. In addition, it can be concluded also that the readings of LDR sensors are placed outside the room is different from the readings of LDR sensors placed in the room. This is because the light intensity received by the existing LDR sensor in the room is blocked by the wall of the house or by other objects. Then for the fan, it can also turn on automatically when the temperature is greater than 25°C, and the fan speed can also be adjusted. The fan may also turn off automatically when the temperature is less than equal to 25°C.

Pratik et al., 2009 designed an automatic room light controller with bidirectional visitor counter using the AT89S52 microcontroller which is activated whenever an intruder enters into an unauthorized no entry area. It automatically activates the landline number and redial the last dialed number from the conventional telephone, all we need is to do minor changes to activate this telephone as it works as to become auto dialer circuit. Thus whenever the intruder enters to the area, it activates the sensor circuit of either sound activation or infrared light beam obstruction circuit, the redial circuit become active and give a ring tone to the receiving end. it may be a mobile phone or any landline phone or even police control room.

Bagali & Navalyal, 2016 designed a sensor-based automatic fan controlling system and power consumption analysis system to analyse the power usage in a Gathering Hall/Auditorium by deploying a visitor counter and automatic fan control system using the raspberry Pi, internet of things (IOT), infrared sensor and a counter. The main goal of this project is to save the electricity from being wasted when not necessary by automatically switching ON of the appliances that are required based on the number of people present in the

hall, instead of blindly switching on all the appliances and also switching them off as and when the people move out of the hall, again based on the count of people leaving the hall.

Devi et al., 2014 designed an intelligent system for controlling lights and fans powered by solar photo voltaic cell. 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. This model itself consumes very low power and helps in saving a significant amount of energy, it also helps 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.

Reddy et al., 2017 designed a light and fan automation system using infrared (IR) and light dependent resistor (LDR) sensor for the automation of lights and fans using Arduino with Internet of Things for smart homes. The suggested framework may be a greater amount efficient, settled Also expense compelling. This is intended as it were that it is not that muddled will associate those gadgets for the client as it will be client cordial. Arduino is utilized likewise a web server and associations. Every one there may be to do will be on join the prompted Arduino What's more control it utilizing a standout amongst Arduino yield. That Arduino customer in the app sends an http appeal on Arduino that runs the web server. The thought will be that those smartphone sends an http of the Arduino. A little Furthermore straightforward web server runs for Arduino tolerating the http appeal. Those infrared sensor (IR) will be a low expense analyst sensor that camwood a chance to be connected toward homes utilizing LED's. Those PIR sensors will be utilized to identification of human body vicinity.

The work by Prakash et al., 2016 aimed at designing and executing the advanced development in embedded systems for energy saving of street lights. Currently we have a manual system where the street lights will be switched ON in the evening before the sunsets and they are switched OFF in the next day morning after there is sufficient light on the outside (Archana. G et al.,2015). But the actual timing for these lights to be switched ON is when there is absolute darkness. With this,

the power will be wasted up to some extent. This project gives solution for electrical power wastage (Akshay et al., 2015). Also the manual operation of the lighting system is completely eliminated. The proposed system provides a solution for energy saving. This is achieved by sensing and approaching a vehicle using an IR transmitter and IR Receiver couple. Upon sensing the movement, the sensor transmits the data to the microcontroller which furthermore the Light to switch ON (Isah et al., 2015). Similarly, as soon as the vehicle or an obstacle goes away the Light gets switched OFF as the sensor sense any object at the same time the status(ON/OFF) of the street light can be accessed from anywhere and anytime through internet. This project is implemented with smart embedded system which controls the street lights based on detection of vehicles or any other obstacles on the street. Whenever the obstacle is detected on the street within the specified time the light will get automatically ON/OFF according to the obstacle detection and the same information can be accessed through internet. The real time information of the street light (ON/OFF Status) can be accessed from anytime, anywhere through internet.

Nwankwo et al., 2014 presents the design and implementation of Microcontroller based automatic fan speed regulator using temperature sensor, the system made use of; AT89C51 Microcontroller, temperature sensor (LM 35), Analog to Digital Converter (ADC) and the Liquid Crystal Display (LCD) as its main components to achieve a new technology in "control system" that monitors and regulates the speed of a Ceiling Fan depending on the room temperature at any point in time. The temperature sensor (LM 35) which is directly connected to the Analogue to Digital converter (ADC) is used to sense any slight change in room temperature. The output of the temperature sensor which is in Analogue form is fed to the input of the Analogue to Digital Converter (ADC) whose main task is to convert the analogue signal (change in room temperature) from the temperature sensor to its digital equivalent. The output of the (ADC) is directly coupled to the Microcontroller for further processing and control to achieve the desired system. The sensed and the set values of the temperature, including the Fan speed are displayed on the (16 x 2) Liquid Crystal Display (LCD). The designed system has been proven to be a reasonable advancement in control system technology.

Islam et al., 2013 proposed and designed an intelligent lighting control strategy aided with maintenance of external factors by humidity and temperature and PIR motion sensors and Graphical User Interface (GUI) all of which help significantly reducing energy usage and operational cost, whereas maximizing daylight harvest and user comfort and also exploring the possibilities of enhancing the user comfort and operational cost of smart departmental store

providing range of methods for maximum utilization of resources. Moreover, the wide array of products and services of departmental store require greater emphasis on maintenance of temperature and humidity and confirming the protection and contamination of the products. Thus, the features of stabilizing temperature with the aid of varied sensors helps to monitor the betterment of the entire environment. The buildings which are designed currently do not use building control strategy that may incorporate occupant level comfort as well as meeting operation goals in an efficient manner.

Bharmal et al., 2017 designed an automatic home lighting system using human detection, sunlight intensity and room temperature. The design basically is divided into three blocks human detection circuit, LDR based light detection circuit and temperature sensor based fan of off controller circuit. The first circuit will control the main switch which will be turned on only if a person is detected; it is based on IR sensor and microcontroller. The second circuit is based on LDR, it is used to detect the intensity of the sunlight and depending on the intensity of sunlight number of led glowing will be controlled. The third circuit uses LM35 as a temperature sensor to control the switching of the fan. The human detection circuit can also be used to count the number of person present in the room. The basic idea behind this paper is to save the amount power wasted when the home lighting system is on even in the absence of human being. The system will restrict the turning on the lights with enough amount of sunlight entering the room and turning on the fan with the room temperature below the par temperature.

Alex et al., 2015 explained electricity as one of the most important resources in this century that should be conserved effectively otherwise generations to come may have to live without it. But many times we come outside the room or hall and forget to turn off the lights and fan, thus electricity is wasted. Also in most cases switches of lights and fan are located inside the room and so we may have to search them in darkness and in case of guests, it becomes more difficult. To overcome these problems, a microcontroller based room automation system was designed which has two parts. First is "Person counter" and the other one is "Automatic room light and temperature controller with a temperature and light intensity display". The first part is to count and display the number of persons entering in any room which can be used in large rooms like seminar halls, conference rooms, theatres etc. to decide the number of seats remaining. When number of persons inside the room is zero, power supply inside the room can be cut using a

TRIAC and when somebody enters the room, the system automatically measures the temperature and light intensity inside the room and accordingly controls the light and fan. During daytime lights will not be operated and during cold season fan may not be operated. This helps to save electricity and reduces our effort. LCD display placed outside the room displays number of person inside the room, temperature and light intensity.

2.2 THEORY OF COMPONENTS

2.2.1 Light Dependent Resistor (LDR) Sensor

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. The LDR sensor has some special features as it changes its resistance with the change in the daylight intensity. LDR is rugged in nature, hence can be used even in dirty and rough external environments like outdoor lighting of homes and in automatic street lights as well.

Light Dependent Resistor or photocell is a variable resistor controlled by light intensity. It is made of high resistance semiconductor material like cadmium sulphide that exhibits photoconductivity. There are many different symbols used to indicate a Light Dependent Resistor (LDR), one of the most commonly used symbol is shown in the figure below. The arrow indicates light falling on it.

2.2.1.1 Working Principle of LDR

A light dependent resistor works on the principle of photo conductivity. Photo conductivity is an optical phenomenon in which the material's conductivity is increased when light is absorbed by the material. When light falls i.e. when the photons fall on the device, the electrons in the valence band of the semiconductor material are excited to the conduction band. These photons in the incident light should have energy greater than the band gap of the semiconductor material to make the electrons jump from the valence band to the conduction band. Hence when light having enough energy strikes on the device, more and more electrons are excited to the conduction band which results in large number of charge carriers. The result of this process is that more and more current starts flowing through the

device when the circuit is closed and hence it is said that the resistance of the device has been decreased.

The basic structure of an LDR is shown below.

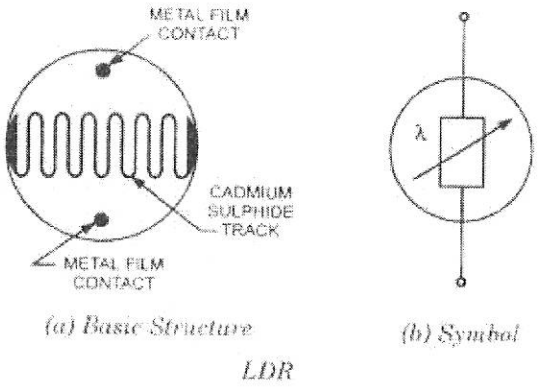

Figure 2.1 Symbol of LDR

The snake like track shown below is the Cadmium Sulphide (CdS) film which also passes through the sides. On the top and bottom are metal films which are connected to the terminal leads. It is designed in such a way as to provide maximum possible contact area with the two metal films. The structure is housed in a clear plastic or resin case, to provide free access to external light. As explained above, the main component for the construction of LDR is cadmium sulphide (CdS), which is used as the photoconductor and contains no or very few electrons when not illuminated. In the absence of light, it is designed to have a high resistance in the range of mega ohms. As soon as light falls on the sensor, the electrons are liberated and the conductivity of the material increases. When the light intensity exceeds a certain frequency, the photons absorbed by the semiconductor give band electrons the energy required to jump into the conduction band. This causes the free electrons or holes to conduct electricity and thus dropping the resistance dramatically ($< 1k\Omega$).

The equation to show the relation between resistance and illumination can be written as

$R = A \times E^{a}$

Where,

E is the Illumination in lux

R is the Resistance in Ω

A is a constants

The value of 'a' depends on the CdS used and on the manufacturing process. Values usually range between 0.7 and 0.9.

2.2.1.2 Light Intensity Vs LDR Resistance

In dark, the LDR has very high resistance of around a few MΩ (Mega Ohms) and in the light, its resistance decreases to around a few 100Ω (hundred Ohms). Hence, its resistance is inversely proportional to the light intensity. The light sensor is a passive device that convert this "light energy" whether visible or in the infra-red parts of the spectrum into an electrical signal output. Light sensors are more commonly known as "Photoelectric Devices" or "Photo Sensors" because the convert light energy (photons) into electricity (electrons).

Photoelectric devices can be grouped into two main categories, those which generate electricity when illuminated, such as photo-voltaic or photo-emissive etc., and those which change their electrical properties in some way such as Photo-resistors or Photo-conductors. This leads to the following classification of devices.

- Photo-emissive Cells – These are photo devices which release free electrons from a light sensitive material such as cesium when struck by a photon of sufficient energy. The amount of energy the photons have depends on the frequency of the light and the higher the frequency, the more energy the photons have converting light energy into electrical energy.
- Photo-conductive Cells – These photo devices vary their electrical resistance when subjected to light. Photoconductivity results from light hitting a semiconductor material which controls the current flow through it. Thus, more light increase the current for a given applied voltage. The most common photoconductive material is Cadmium Sulphide used in LDR photocells.
- Photo-voltaic Cells – These photo devices generate an emf in proportion to the radiant light energy received and is similar in effect to photoconductivity. Light energy falls on to two semiconductor materials sandwiched together creating a voltage of approximately 0.5V. The most common photovoltaic material is Selenium used in solar cells.

- Photo-junction Devices – These photo devices are mainly true semiconductor devices such as the photodiode or phototransistor which use light to control the flow of electrons and holes across their PN-junction. photo junction devices are specifically designed for detector application and light penetration with their spectral response tuned to the wavelength of incident light.

2.2.1.3 Characteristics of LDR

Light Dependent Resistors (LDR) are light dependent devices whose resistance is decreased when light falls on them. When a light dependent resistor is kept in a dark place, its resistance is very high. This resistance is called as dark resistance. It can be as high as $10^{12}\Omega$ and if the device is allowed to absorb light its resistance will be decreased drastically. If a constant voltage is applied to it and intensity of light is increased the current starts increasing. Their sensitivity varies with the wavelength of light incident on them. Some photocells might not at all respond to a certain range of wavelengths. Based on the material used different cells have different spectral response curves.

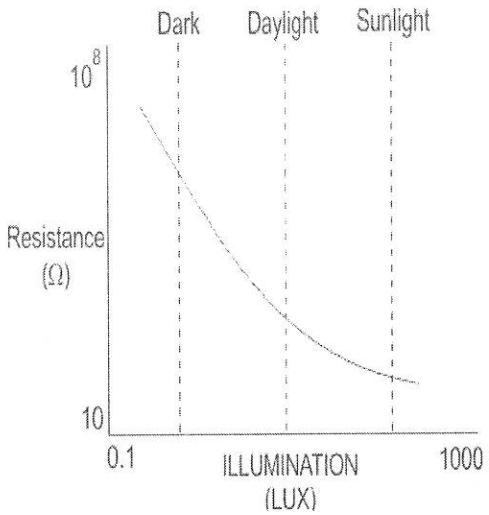

Figure 2.2 LDR working flow chart

2.2.2 Temperature Sensor

A temperature sensor is a device that collects the data about temperature from a particular source and converts the data into understandable form for a device or an observer. Temperature sensors are used in many applications like HV and AC system environmental controls, food processing

units, medical devices, chemical handling and automotive under the hood monitoring and controlling systems, etc. The most common type of temperature sensor is a thermometer, which is used to measure temperature of solids, liquids and gases. It is also a common type of temperature sensor mostly used for non-scientific purposes because it is not so accurate.

2.2.2.1 Types of Temperature Sensors

There are different types of temperature sensors_that have sensing capacity depending upon their range of application. Different types of temperature sensors are as follows:

- Thermocouples
- Resistor temperature detectors
- Thermistors
- Infrared sensors
- Semiconductors
- Thermometers

The semiconductor temperature sensor used here. Semiconductor sensors are the devices that come in the form of ICs. Popularly, these sensors are known as an IC temperature sensor. They are classified into different types: Current output temperature sensor, Voltage output temperature sensor, Resistance output silicon temperature sensor, Diode temperature sensors and Digital output temperature sensor. Present semiconductor temperature sensors offer high linearity and high accuracy over an operating range of about 55°C to +150°C. However, AD590 and LM35 temperature sensors are the most popular temperature sensors.

The LM35 temperature sensor series, which is a high precision integrated-circuit temperature sensor, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. Low cost is assured by trimming and calibration at the water level. The LM35's low output impedance, linear output, and precise inherent calibration makes interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 μA from its supply, it has very low self- heating, less than 0.1°C in still air. The LM35 is rated to operate over a −55° to +150°C temperature range, while the LM35C is rated for a −40° to +110°C range (−10° with improved accuracy). The LM35 series is available packaged in hermetic

TO-46 transistor packages, while the LM 35C, LM 35CA, and LM 35D are also available in the plastic TO-92 transistor package.

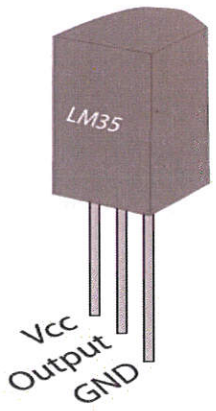

Figure 2.3. Temperature sensor (LM35)

2.2.2.2 Working Principle of the LM35 Temperature Sensor

The LM35 temperature sensor is used to detect precise centigrade temperature. The output of this sensor changes describes the linearity. The o/p voltage of this IC sensor is linearly comparative to the Celsius temperature. The operating voltage range of this LM35 ranges from-55° to +150°C and it has low-self heating. This is operated under 4 to 30 volts. The most extensively used electronic devices are operational amplifiers, which are certain kind of differential amplifiers. Temperature sensor circuit has terminals such as two inputs like non-inverting (+) and inverting (-) and only one output pin. Operational amplifier IC741 is used as a non-inverting amplifier. The variation between the i/p terminals amplifies the circuit.

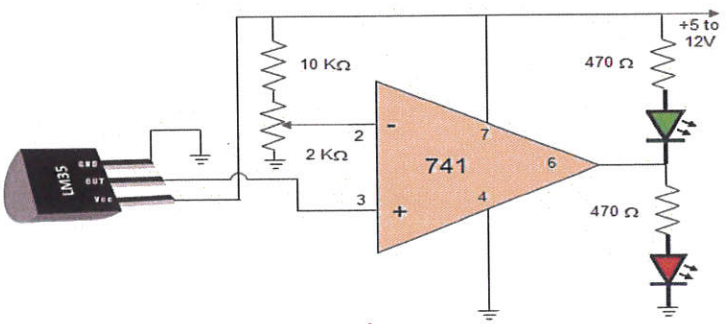

Fig 2.4. LM35 Circuit Diagram

The amount produced by IC2 amplifies in an amount to the temperature by 10 mV per degree. This unstable voltage is supply to a comparator IC 741. OP Amplifier is the most generally used electronic devices today. The IC 741 op-amp is one sort of differential amplifier. We have used IC741 as a non-inverting amplifier which means pin-3 is the input and the output is not inverted. This LM35 temperature sensor circuit amplifies the difference between its input terminals. The advantages of temperature sensor include It has no effect on the medium, more accurate, It has an easily conditioned output and It responds instantly.

2.2.3 Passive Infrared (PIR) SENSOR

The first motion detector was invented in the early 1950s by Samuel Bango, which was also used as a burglar alarm. He applied the fundamentals of a radar to ultrasonic waves, a frequency to detect fire or thief and that which human beings cannot hear. Samuel motion detector is based on the principle of Doppler Effect. Nowadays, most of the motion detectors work on the principle of Samuel Bango's detector. Infrared(IR) sensors and microwave sensors can detect motion by the alterations in the frequencies they emit. Motion detectors are used as security systems in banks, offices and shopping malls, and also as intruder alarm in home. The prevailing motion detectors can stop serious accidents by sensing the persons who are in close proximity to the detector.

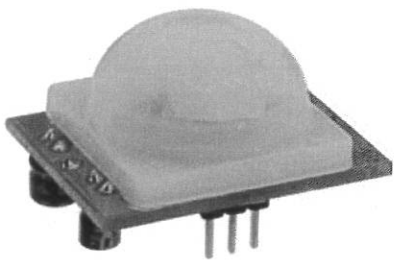

Figure 2.5. PIR sensor

We can observe motion detectors in shopping malls or stores with automatic doors. The main element in the motion detector circuit is the dual infrared reflective sensor or any other detecting sensor. Passive Infrared (PIR) sensors detect a person's body heat when the person comes in close proximity. These sensors are small, low power, inexpensive and

easy to use. Due to these reasons, PIR sensors are generally used in gadgets, home appliances, business enterprises, industries, etc. PIR gives digital output when it detects motion. It consists of pyro-electric sensor that detects the infrared radiation emitted from humans.

The Passive Infrared sensor consists of three pins, ground, signal, and power at the side or bottom. Generally, the PIR sensor power is up to 5V, but, the large size PIR modules operate a relay instead of direct output. It is very simple and easy to interface the sensor with a microcontroller. The output of the PIR is (usually digital output) either low or high.

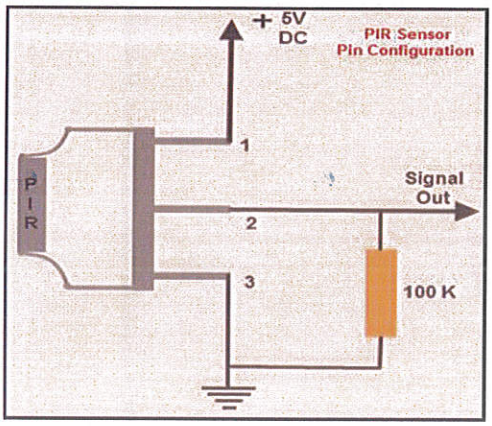

Fig 2.6. Pin Configuration of PIR Sensor

2.2.3.1 PIR Sensor Working Principle

The PIR sensor internally is split into two halves, one half is positive and the other is considered as negative. Thus, one half generates one signal by detecting the motion of a hot body and other half generates another signal. The difference between these two signals is generated as output signal. Primarily, this sensor consists of Fresnel lens which are bifurcated to detect the infrared radiation produced by the motion of hot body over a wide range or specific area.

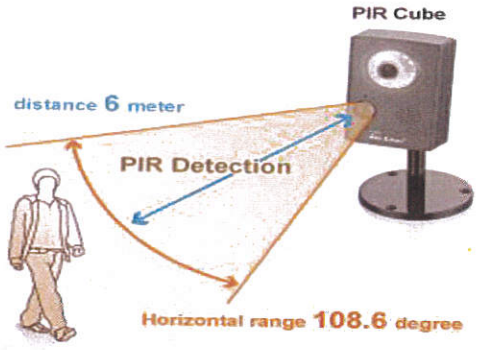

Fig 2.7. PIR Sensor Detection Area

Once the sensor gets warmed up, then the output remains low until it detects motion. If once it detects the motion, then the output goes high for a couple of seconds and then returns to a normal state or low. This sensor requires settling time, which is characteristically in the range of 10 to 60 seconds.

CHAPTER THREE

METHODOLOGY

3.1 System Block Diagram

Automation system can be achieved by adopting central controllers to control home devices or appliances that sense different variables using appropriate sensors. The main aspect of such a system is a sensory system that collects the parameter information like temperature, human presence, light and darkness detection, and sends the corresponding data to the controller. This controller is programmed such that when these parameters cross their prescribed limits, it sends the command signals to various final controlling devices like relays, motors and buzzer devices. The system was first design by understanding the block diagram, followed by the circuit diagram and lastly the system block description which is as below.

This work started with the studying of the block diagram, followed by the the studying of the circuit diagram and gathering of the parts used in the construction. Block diagram gives a pictorial understanding of any work. The block diagram of the system is as below:

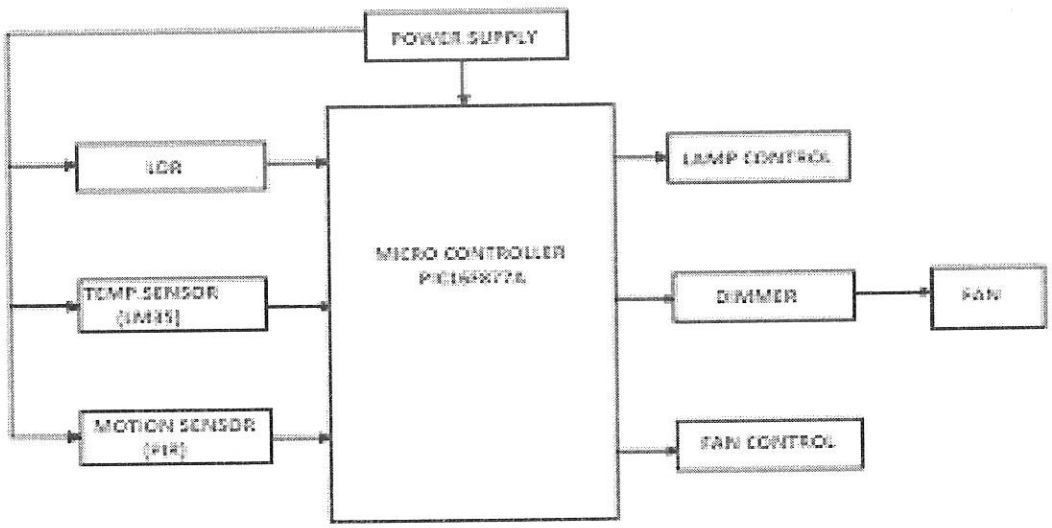

Figure 3.1. Block Diagram of the System

3.2 System Operation

The design demonstrates here, has 2 modules. The first module is the temperature control, while the second module is the automatic light and fan controller. The automatic light and fan controller is used to turn ON/OFF the electrical appliance. Where the LDR is used to differentiate between day and night to control the light. During daytime the light will be switched OFF while at night the light will be switched ON automatically. In this design microcontroller ATMEGA8 is used to control the sensor. Three (3) sensors are used, which are the temperature sensor, LDR (Light Dependent Resistor) sensor and the Passive Infrared (PIR) sensor which is otherwise known as the motion sensor. Here the motion sensor is used to detect the person to switch ON the fan and light automatically. It identifies the human and other living things by using body temperature. It will deduce the person who is present under the fan and rotates automatically. The temperature sensor is then used to sense the temperature of the room and initiates the fan to rotate according to the room's temperature. The speed of the fan can vary according to the atmosphere temperature. Here we draw on three circuits as input of a microcontroller (MCU) and two circuits as output. The input circuits are the Light Dependent Resistor (LDR), Temperature sensor (LM 35), and the Passive Infrared (PIR) sensor while the output circuits are the Lamp and Fan. If a person enters in the monitored area, the PIR sensor will activate and sense the person. By sensing the person, the sensor sends a signal to the micro controller. After that the LDR checks the light intensity of the monitored area, whether it is bright or dark. The output of the Light Dependent Resistor (LDR) sensor will settle on the ON or OFF status of the lamp. We can also regulate light intensity depending on the brightness of the monitored area. By using this system, we can change the speed of Fan according to the atmospheric temperature calculated by the temperature sensor LM35, which is connected to the microcontroller. This system will save power and it is very comfortable for human use.

3.3 Circuit Description

The ATMEGA8 microcontroller is used for this work which is manufactured by Microchip Technology Inc. The microcontroller is powered with +5V through a battery (for the convenience of the work). For efficient functioning of the microcontroller a crystal oscillator is used. The microcontroller gets input signals, LDR, temperature sensor LM 35 and sends output signals to the light and fan. Light dependent resistor as the name suggests depends on light for the variation of resistance. When light falls on the narrow piece, the

resistance decreases. In the absence of light, the resistance can be to 10kΩ to 15kΩ. Hence voltage drop across LDR also changes with the intensity of light. The variable voltage of LDR is applied to the input of the microcontroller (pin 3, RA1), is compared with threshold voltage applied to the microcontroller (pin 5, RA 3). When the voltage is less than the threshold voltage, the microcontroller provides 1 (high voltage) to the dimmer circuit which switches the light, through the output pin 13 (RC2). Light intensity can be controlled by the variable voltage drops of LDR. Here we make use of LM 35 temperature sensor whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM 35 is rated to operate over −55°C to +150°C temperature range. The variable voltage of the LM35 is applied to the input of the microcontroller (pin 2, RA0), which is compared with the threshold voltage applied to the microcontroller (pin 4, RA2). When the voltage is greater than the threshold voltage, the microcontroller provides 1 (high voltage) to the dimmer2 circuit which switches the fan, through the output pin 12 (RC1). The speed of the fan can be controlled by the variable voltage drop of the LM35 temperature sensor. With the increase of output voltage of LM35 temperature sensor, the speed of the fan is also increased.

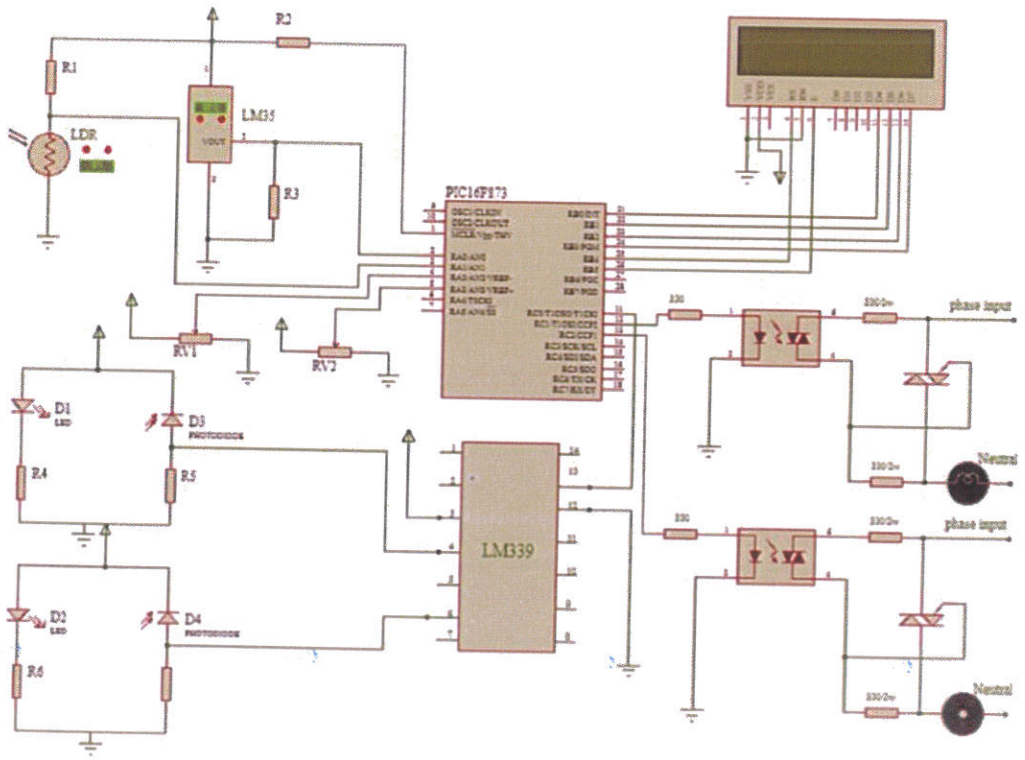

Fig 3.2 Circuit Diagram of the System

3.3.1 Control of Lighting System

In this aspect we have two different sensors, the Light Dependent Resistor (LDR) and the Passive Infrared (PIR) sensor. Here LDR is used to determine the light intensity and PIR sensor is used detect human body. Here one part of the LDR is connected to the 5v and another point is connected to the resistor R_1 in series. The voltage across R_1 is the output voltage and this is the analog input to the microcontroller unit (MCU) . For different light intensity the output voltage will be different. If light intensity rises, then voltage across LDR will decrease and voltage across R_1 will rise. Also if light intensity decreases then voltage across R_1 will decrease. For different output voltage the microcontroller unit (MCU) will turn on and turn off the switches of light to control the light intensity in a specific area. In lighting control system, we have three different conditions for light intensity per square meter which are given below:

If Light intensity > 1000 Lux, then it will be considered as high light intensity.

If Light intensity = 600to1000 Lux, then it will be considered as medium light intensity.

If Light intensity < 600 Lux, then it will be considered as low light intensity.

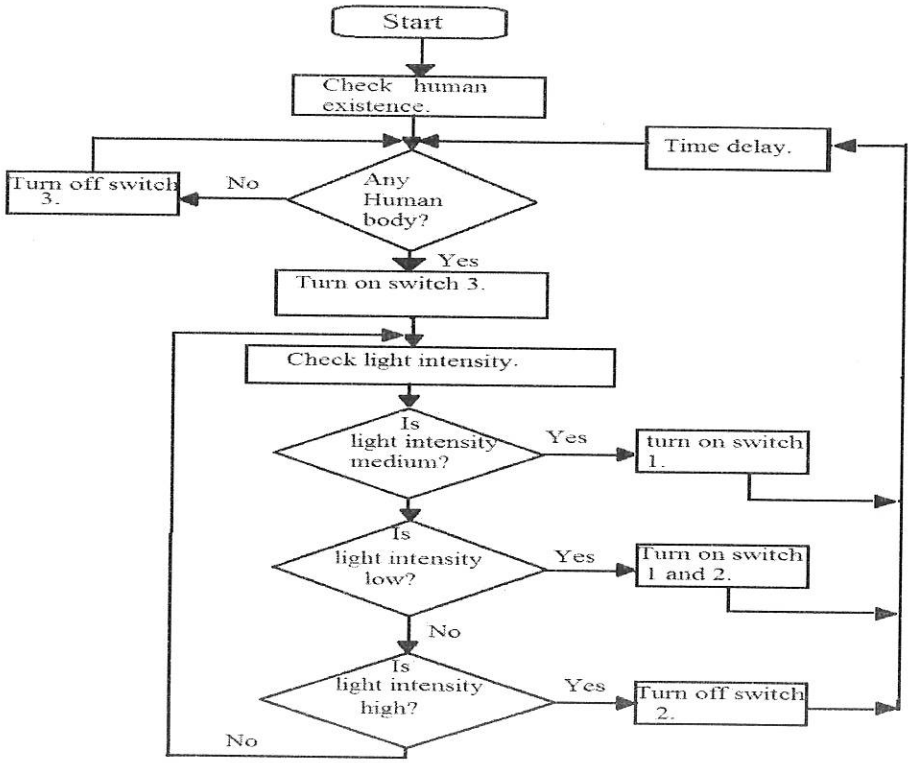

Figure 3.3 Control Flowchart of Lighting System.

At the same time light will not turn on in a specific area if no human exists in that area. If any human is detected by sensor in that area, then PIR sensor will send 3.3v as analog signal to the Microcontroller Unit (MCU). When the Microcontroller Unit (MCU) get signal from the PIR sensor then it will turn on switch 3(Relay 3). At that time the lights will actually turn on. Here resistor across LDR, R_1=1KΩ and resistor across PIR, R=10KΩ.

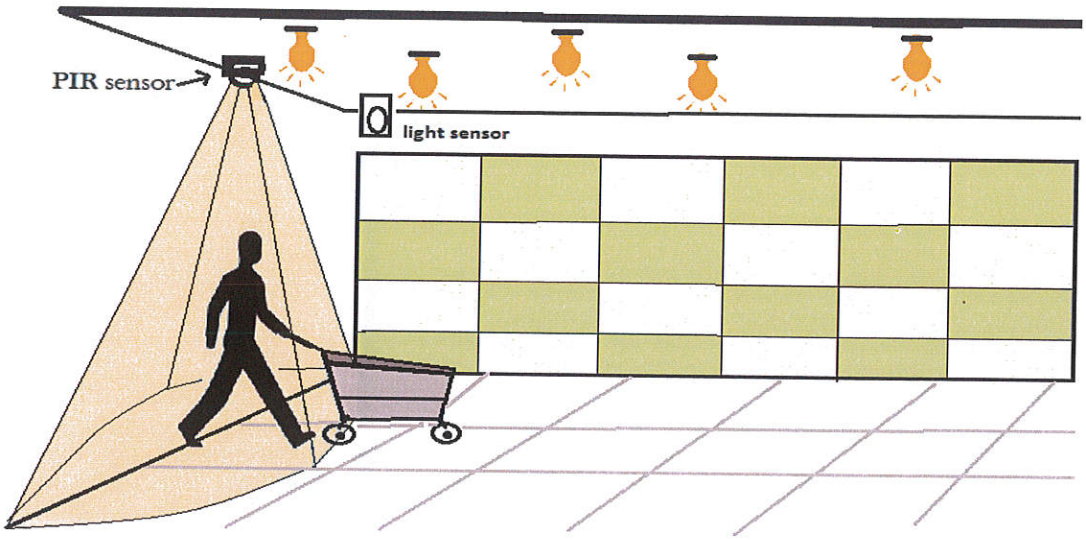

Figure: 3.4 Lights Turns On When Human Body is Detected.

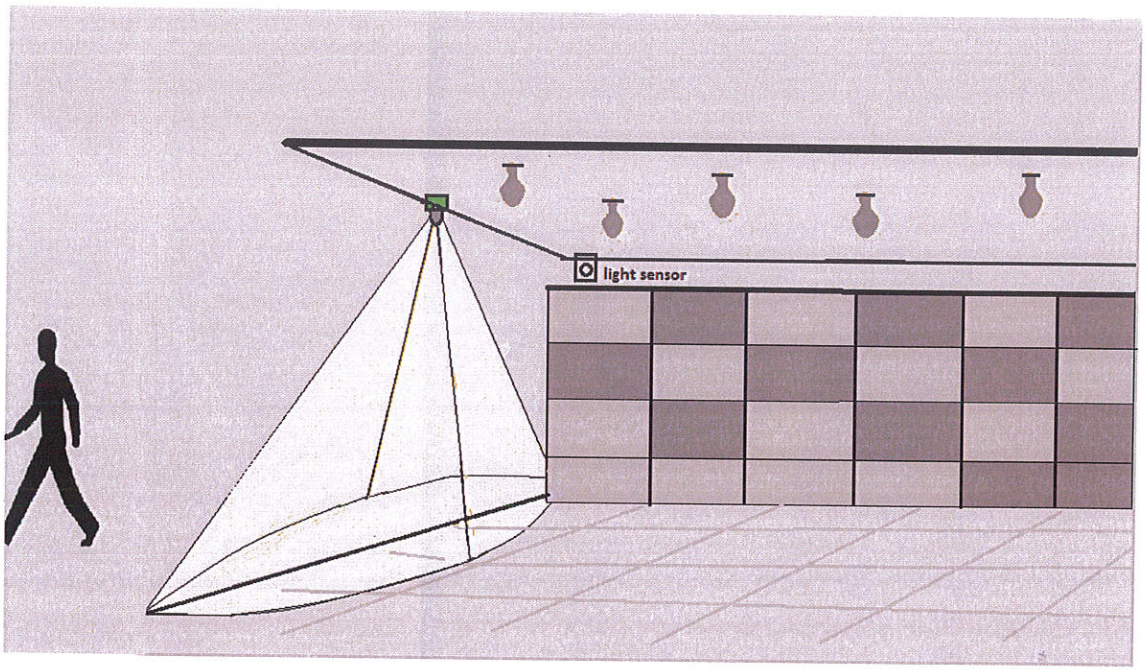

Figure 3.5 Lights Turn Off When No Human Body Is Detected.

3.3.2 Temperature Control System

In the temperature control system, we make use of the LM35 temperature sensor. There are three different pin in LM35 temperature sensor. The first pin is connected the +5vdc source from the microcontroller. The middle pin is connected to the 10KΩ resistor in series. The last pin is connected to the ground. The voltage across 10KΩ resistor is the output voltage. This output

voltage is the input signal or analog signal for the microcontroller. At different temperature the LM35 temperature sensor provides different output voltage but it changes linearly according to temperature changes. When the microcontroller unit get signal from the sensor it will convert the signal and count it as in °C. For example, if temperature is 25°C in a specific area then sensor will provide 0.25v across the resistor. Then microcontroller unit will convert it to actual temperature and write that value.

3.5 POWER SUPPLY UNIT

The basic step in the designing of any system is to design the power supply required for that system. The power supply unit consists of a 12V/500mA step down transformer, a bridge rectifier, 1000µf/35V capacitor, 7805 voltage regulator, status indicator; a 1KΩ resistor limits the voltage entering the LED. The 7805 regulates the voltage to give a voltage of 5Vdc required as VCC. This voltage is delivered to various loads that needs the supply. The characteristics of the power supply unit and distribution of the dc voltage to various parts of the system have some effects on the performance of the circuit. D.C. voltage is isolated from the mains by the transformer. From the rating, it steps down 240v input to 12v before delivering to the output of the bridge rectifier. The rectifier circuit consists of four diodes configured into a full-wave bridge rectifier mode. The regulator used in this design provides regulated and stable dc. voltage (5v+/_0.1%) And these outputs drive all chips use d for this design. The capacitor is designed to filter and remove surges that appear on either the input or output of the supply.

CHAPTER FOUR

CONSTRUCTION, RESULTS AND DISCUSSION

4.1 CONSTRUCTION PROCEDURE AND TESTING ANALYSIS

This project is designed to automatically switch on and off the light and fan of a room based on the presence of human in the room as well as the physical and climatic condition of that room. A prefabricated approach was employed in the design of this project, by simulating and creating the design on the proteus software, in order to ensure that the hardware is working well before permanently executed on a Printed Circuit Board (PCB). The microcontroller used in the project is theATMEGA8, which is especially suitable for such applications.

4.2 PROCEDURE

In building this project, the following procedures were properly considered,

4.2.1 Procurement and Testing of Components needed

After studying related fields to generate ideas collect data needed. Circuit diagram of the proposed system was drafted to know the type of components needed to be procured. Each of the components was then tested using a multimeter in order to check for their state of performance and accurate values.

4.2.2 Simulation of the Proposed System

The simulation of the proposed system was done using the proteus software. Proteus is a software where you can design circuit, see the result, design the PCB layout of the circuit, see the 3d visualization of the circuit and even print the PCB layout. The component needed was selected using the icon on the left side. One of the important feature of the proteus software is that it has a wide range of components ranging from different kinds of microcontroller and sensors and ability to design and print the Printed Circuit Board layout which makes the simulation of the proposed system easier. After connecting the components together on the lower part of the software click on the play icon to run, the pause icon pauses your simulation, the stop icon stops the simulation.

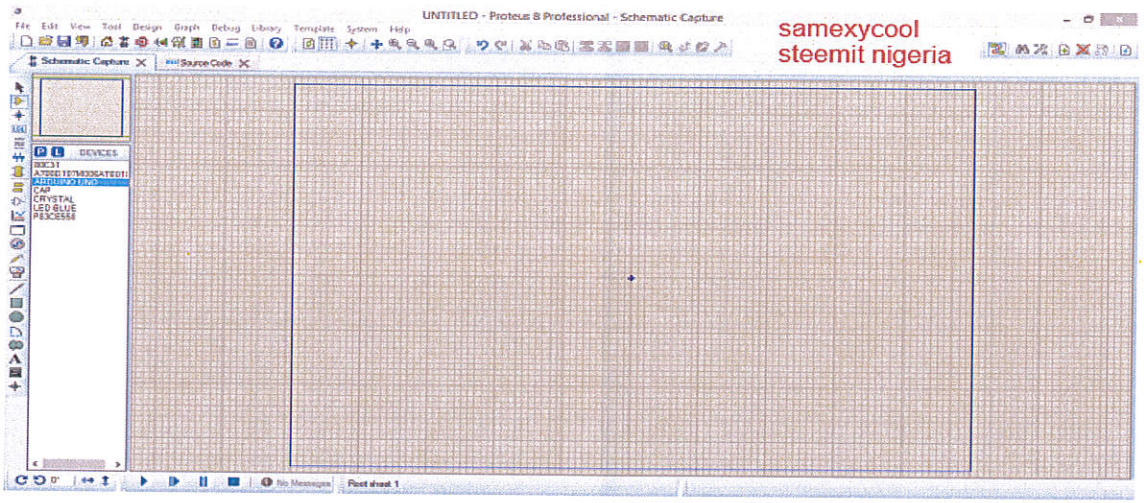

Figure 4.1 Proteus interface

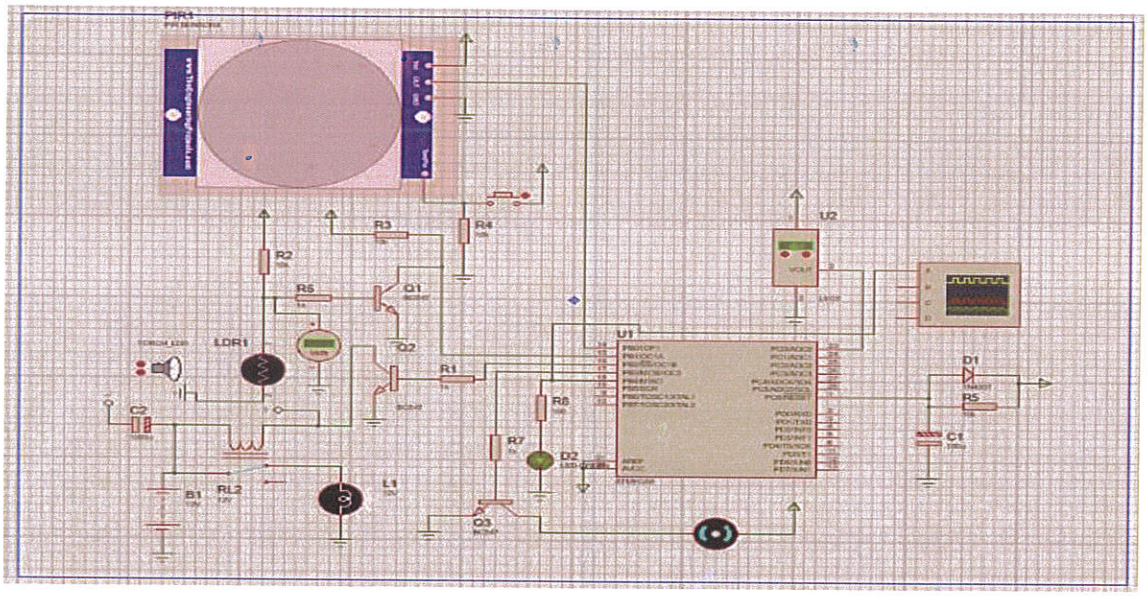

Figure 4.2 Simulation Diagram

4.2.3 Hardware Design of the Project

The printed circuit board is used for this project because the circuit circuit will look neat without any wires popped up and will not fall apart and also there is precise control over the circuit component you are using, and one can comfortably fit in odd shaped components that are difficult to fix on other types of boards. Having simulated the system on the proteus software, the

design for the printed circuit board is made using the EAGLE CAD software. the other steps involved in the printed circuit board fabrication are;

- Etching
- Drilling
- Conductor plating
- Solder resist
- Assembling

4.2.4 Casing and Packaging

A case was gotten where the entire circuit was mounted follow by other external components such as the bulb, fan, switch, and sensors were mounted.

4.2.5 Assembling of Sections

Having provided the casing and having finished the construction of the sections of this system, the assembling into the casing followed. The sections were properly laid out and assembled into the casing where the general coupling and linkages into the peripheral devices took place.

Finally, the switch and sensor were carefully brought out from the internal part of the casing through the holes made on the body of the casing.

4.2.6 Testing of System Operation

In this stage, the system was due for testing and operation. The system operation was tested where all its required performance was maintained.

4.2.7 Results and Observation

The interior part of the design consists of the ATMEGA8 microcontroller, resistor, capacitor, transistor and series of jumping wires. The exterior part consists of the Passive Infrared sensor, Light Dependent sensor the temperature sensor, the fan, bulb and the push buttons or switch. It is made up of three switches or push buttons which are used to control the light manually, control the light manually and also control both the light and fan automatically. Once the automatic switch is pressed, the system switches on the room's fan and light automatically based on the level of illumination, temperature and presence of human in the room. The temperature of the LM35 sensor can be adjusted as well as the light intensity of the Light Dependent Resistor.

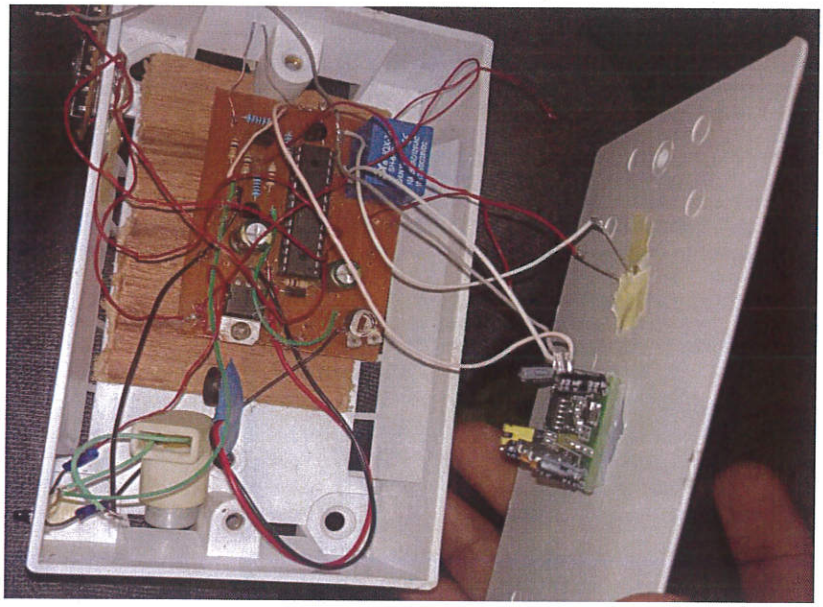

Figure 4.3 Interior view of the system

4.3 PROBLEMS ENCOUNTERED

- In-depth Practical Knowledge: Due to insufficient knowledge of the components, their properties and the connections to be carried, there was difficulty in carrying out the connections effectively and accurately and thus, there was delay in the construction of the project. This was eventually solved by the means of seeking the required knowledge and resources from individuals with the practical know-how, video tutorials and online discussions necessary for the successful construction and implementation of the project.
- Programming the Micro-controller: The micro-controller was programmed via the Arduino programming language platform after which the programmed is compiled into the microcontroller. Understanding this programming language and know-hows proved tricky but after consultations and studying, the desired results were achieved.
- Design of the Circuit: During the design phase of the project, there were hiccups in design because some the software platforms used did not have all of the components needed to implement the design such as multisim. The circuit diagram was eventually

CHAPTER FIVE

CONCLUSION AND RECOMENDATION

5.1 Conclusion

The automatic light and fan system with considering energy saving system can be used anywhere be it in rooms, offices or industry with little modifications in software coding according to the necessities. This concept can be used in many developing countries in order to save their limited power. It ensures that our work will not only be usable in the future but also provides the flexibility to adapt and extend, as needs change. In our scheme we associated all the sensors to micro controller with the wires. This can be originated with wireless such that we can put different sensors in different places. This sensor will turn on the micro controller with the signals instead of using wires. The automatic light and temperature control system is an energy efficient system in different ways such as the use of Light Dependent Resistor, Passive Infrared and the LM35 temperature sensor which save a vast amount of power every year. Unlike typical lighting system which consumes large amount of power this system is able to minimize the power consumption as well as the yearly cost.

5.2 Limitations

The following limitations was observed in the system

- Inability of the passive infrared sensor to differentiate between human beings and animals.
- The adjustment to the room temperature and illumination level can only be made by adjusting the microcontrollers code which can only be done by a skilled personnel.

5.2 Recommendation and Future Implementation

The following are the recommendations based on findings from this project;

- A more efficient motion sensor should be used which would be able to differentiate between animals and human.
- A physical control should be incorporated to adjust the temperature range of the LM35 temperature sensor as well as the illumination level of the Light Dependent sensor.

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