DESIGN AND CONSTRUCTION OF A REMOTE CONTROL FOR FAN REGULATOR

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This project work titled "**Remote Control For Fan Regulator**" by **Balogun Oluwatobi Isaac**, has been read and approved as meeting the requirements of the Department of Electrical and Electronics Engineering in the Faculty of Engineering, Federal University, Oye-Ekiti for the award of Bachelor of Engineering (B. Eng.) degree in Electrical and Electronics Engineering.

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DEDICATION

This report is dedicated to Almighty God, the ruler of the universe, the custodian of great wisdom and the giver of knowledge, to my dearest parent Chief & Mrs. J.K Balogun who made my academic succession a reality through their moral inspiration and financial support.

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ABSTRACT

This thesis is on the design and construction of a Remote control for fan speed regulation. It is a home device used to control the speed of household appliances (fan) from a distance. It serves to make the regulation of fan speed easy for the elderly, physically challenged, the young and anyone who, in any circumstance, needs comfort and security.

This paper develops a remote control system using the Infrared radiation (IR) technology utilizing microcontrollers, encoders, decoders, and Infrared Radiation module with the analysis of various technologies which can be used for the development of a remote control system. A security system is incorporated in this remote control to provide a secured usage of the system from a distance of about thirty meters away. To achieve the aim of this work: a transmitter system is design and constructed which processes and sends out signal when a button is pressed; the construction of a receiver system which receives and processes the signal from the transmitter system, then turn on/off or regulates the appliances; and incorporate a security system which allows transmission of signal only when certain condition is met. With the use of microcontroller, this paper developed an affordable, reliable and effective remote control system for regulating the fan speed.

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LIST OF ABBREVIATIONS

1. LED – Light emitting diode
2. IR- Infrared radiation
3. LDR- Light dependent resistor
4. SSL- Solid state lighting
5. PIC- Programmable integrated circuit
6. GPS- Global position system
7. WSN- Wireless sensor network
8. USART - Universal synchronous/asynchronous receiver/transmitter
9. EEPROM - Electrically erasable programmable read only memory
10. SRAM - Static read access memory
11. IC - Integrated circuit
12. PIR - Passive infrared
13. IoT - Internet of things
14. SCR - Silicon Controlled Rectifier

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CHAPTER ONE

1.0 INTRODUCTION

Remote control are devices that sends digitally-coded pulses to control functions like power, volume, tuning, temperature set point, fan speed, just to name a few, to control different equipment's. These devices are usually small wireless handheld objects with an array for various automation setting buttons for television channel, track number, and volume [1]. For many devices, the remote control contains all the function controls while the controlled device itself has only a handful of essential primary controls.

The advancement in electronics and communication technologies has made automation as an integral part of every process. From domestic to commercial and power and process industries to save energy, to increase work efficiency of human by reducing tiring moves, to improve productivity and to save time automation is recommended. With the advancement of technology, number of equipment's and modern household appliances increases to make life easier and comfort. Operating them manually is a tedious job and again hectic sometimes. If one can control devices like TV, fan, light or a music system with a remote from a distance place just by pressing the button, life will become simpler [3]. Home automation is becoming very common these days as technology advances to reduce manual work. To switch on or off the devices one has to move to the switch board which is inconvenient even for an able person. If all this manual work is replaced by a single remote control even the aged and disable person can do the task like a normal person.

Remote control facilitates the operation of fan regulators around the home or office from a distance. It provides a system that is simple to understand and also to operate, a system that would be cheap and affordable, a reliable and easy to maintain system of remote control and durable system irrespective of usage. It adds more comfort to everyday living by removing the inconvenience of having to move around to operate a fan regulator. The system seeks to develop a system that is cost effective while not under mining the need for efficiency.

1.1 BACKGROUND OF THE PROJECT

The earlier remote controls used ultrasonic tones. Remote control has continually evolved and advanced over recent years to include Infrared (IR), Radio frequency, Bluetooth connectivity, motion sensor-enabled capabilities, voice control. IR remote control has been proved to be the most popular equipment for office application, for example, control of air conditioner, turn on or switch off light as well as the normal use of satellite receivers and Televisions [1].

The first remote control, called "lazy bones" was developed in 1950 by Zenith Electronics Corporation (then known as Zenith Radio Corporation). The device was developed quickly, and it was called "Zenith space command", the remote went into production in the fall of 1956, becoming the first practical wireless remote control device.

Remote control helps the operation of fan regulators around the home or office from a distance. It provides a system that is simple to understand and also to operate, a system that would be cheap and affordable, a reliable and easy to maintain system of remote control and durable system irrespective of usage. It adds more comfort to everyday living by removing the inconvenience of having to move around to operate a fan regulator. The system seeks to develop a system that is cost effective while not under mining the need for efficiency.

Today, remote control is a standard on other consumer electronic products, including VCRs, cable and satellite boxes, digital video disc players and home audio players. And the most sophisticated TV sets have remote with as many as 50 buttons. In year 2000, more than 99 percent of all TV set and 100 percent of all VCR and DVD players sold are equipped with remote controls. The average individual these days probably picks up a remote control at least once or twice a day.

Basically, a remote control works in the following manner. A button is pressed. This completes a specific connection which produces a Morse code line signal specific to that button. The transistor amplifies the signal and sends it to the LED which translates the signal into infrared light. The sensor on the appliance detects the infrared light and reacts appropriately. [2]

The remote control's function is to wait for the user to press a key and then translate that into infrared light signals that are received by the receiving appliance. The carrier frequency of such infrared signals is typically around 36 kHz. Usually, the transmitter part is constructed so that the transmitter oscillator which drives the infrared transmitter LED can be turned on/off by applying a TTL (transistor-transistor logic) voltage on the modulation controlled input. On the receiver side, a photo transistor or photodiode takes up the signal which is then decoded to produce an output that controls the appliance connected to it.

1.2 STATEMENT OF THE PROBLEM

Fan is an unavoidable electrical appliance in which an average man in our country (Nigeria) can afford to purchase and use but then it is always been compared to an air condition that has a great feature of controlling it remotely. Going to the conventional switchboard to change the speed level of the fan has always been inconvenience and has posed an extra burden on its user.

Upon execution of this project, switching of household appliances is made easy for the elderly, physically challenged, the sick and anyone who, in any circumstance, needs comfort and security.

1.3 MOTIVATION

Home automation is becoming very common these days as technology advances to reduce manual work. Research shows that going to the conventional switchboard can be a difficult task for people suffering from arthritis, kids, handicaps and aged people, hence, the reasons for embarking on this project.

1.4 SIGNIFICANCE OF THE STUDY

This work provides a means of control fan speed from a distance using remote. The device would allow a person to control the speed of a fan by simply pointing the remote towards a sensor and then pressing any key. It adds more comfort to everyday living by removing the inconvenience of having to move around to operate a fan regulator. This project can be used in places where fans are installed such as homes, offices, schools, laboratories, factories, supermarkets, cinemas, boutiques, shops, hospitals, libraries, hotels e.t.c.

1.5 AIM AND OBJECTIVES

The aim of this work is to design and construct a remote control for a fan regulator that is portable in size and a receiver that responds only to the infra-red signal transmitted by the remote control. The objectives are:

(i) To control the speed of a fan remotely without the need of going to the conventional regulator.

(ii) To establish a wireless connection between the transmitter and the receiver circuit using the Infrared (IR) technology

(iii) To design a transmitter circuit that switches to send signal to the receiver circuit using the IR technology.

(iv) To design and construct a receiver circuit that receives signal from the transmitter circuit via IR technology then acts to switch on or off a Fan.

1.6 SCOPE OF PROJECT

The approach used in this work is the modular approach where the overall design was broken into functional block. The project is broken down into two modules (The Transmitter and the Receiver modules). The project uses microcontroller and IR LED which helps in establishing connection and sending of signal wirelessly between the transmitter and the receiver module. The remote control device sends an infra-red beam, which is received by the infra-red sensor on the regulator and the speed of the fan is increased or decreased.

CHAPTER TWO

LITERATURE REVIEW

2.0 INTRODUCTION

Years ago some remote control made use of wires, but modern remote control now works based on wireless communication. This allows information to be exchanged between two devices without the use of wire or cable [7]. There are various technologies that can be used for developing wireless remote control for household application. Each technology has its own merits and limitations. The literature related to the research topic has been reviewed for last twenty years in order to find out work carried out by various researchers.

There are many systems for remote control designed as commercial products or experimental research platforms. It is noticed that most of the research carried out belongs to the following categories

a. Monitoring using Wireless Sensor Networks (Bluetooth, Wi-Fi, Zigbee and Radio Frequency).

b. GSM-SMS protocols using GSM module individually or in combination with Internet Technologies. .

2.1 Remote Monitoring using Wireless Sensor Networks (WSN), Bluetooth, Wi-Fi, Zigbee Technologies

Many Wireless Technologies like Radio Frequency (RF), Wi-Fi, Bluetooth and Zigbee have been developed and remote monitoring systems using these technologies are popular due to flexibility, low operating charges, etc. Today Wireless Sensor Network are used into an increasing number of commercial solutions, aimed at implementing distributed monitoring and control system in a great number of different application areas.

The Author in [1] designed and constructed a remote control switching device for household appliances application using the Radio frequency module. This RF module comprises of an RF Transmitter and an RF Receiver. The transmitter/receiver (Tx/Rx) pair operates at a frequency of 434MHz [17]. An RF transmitter receives serial data and transmits it wirelessly through RF through its antenna connected at pin 4. The transmitted data is received by an RF receiver operating at the same frequency as that of the transmitter. In this RF system, the digital data is represented as variations in the amplitude of carrier wave. This type of

modulation is known as Amplitude Shift Keying (ASK). RF remotes tend to cost a bit more, have longer range, and is not affected by line of sight as is the case for Infrared. However, it cannot be used for very long range and any transmitter operating in the range can carry out the control.

In [2], the authors designed and constructed an infrared remote controlled for fan regulator. The remote transmits a tone using an infrared light-emitting diode. This tone is decoded by a receiver, since the receiver only switches when the tone is received. The system was broken down into simpler functional blocks namely; infra-red transmitter, infra-red sensor, signal amplifier, control logic, sampler, control stepper, output control logic, load and display unit. The communication between the transmitter and the receiver is done using an infrared sensor. The remote control device has the task of sending the infra-red signal, which is received by the infra-red sensor. The controller is based on 4060B oscillator IC which produces a pulses at a frequency determined by the RC configuration on pins 11, 12 13.

In [3], the authors designed a Remote Control for Home Appliances Using RF Sensors. This Rx/Tx module is used with two IC's i.e encoder and decoder each having four dedicated port which is configured as input channel and output channel. The encoder IC HT12E converts the parallel data from the four input switches into serial data and fed the data through pin 17 into the input data pin 2 of the transmitter module. The signals are transmitted serially through the antenna of RF transmitter. In order to enable the transmission, pin 14 should be connected to active low state. These set of transmitted data is received by the transmitter module and then fed in serially to the decoder IC HT12D through the data input pin 14. This decoder converts the serial data back into parallel data and outputted at the four output port through D0 to D3. Each of the input switches is configured to control a corresponding relay through which a load is connected. Similar connection is made for light, music system and fan through transistor which is acting as a switch and will activate the relay when it is turn on by the output bit of 1.8V from the decoder. HT 12E and HT 12D are encoder and decoder IC's which has a wide application in switching and operates at RF frequency wirelessly. These IC's can transmit and receive.

To control many electrical appliances using a circuit, the author in [4] implemented an infrared controlled switch that could control up to six electrical devices. Any RC5 remote control can be used to control this circuit. The remote we use sends a train of bits (0's and 1's) of some fixed length modulated with a 38 KHz infrared signal. The sequence of bits

which the remote sends is decided by a particular protocol known as RC-5 protocol. The IR receiver in the circuit is **TSOP 1736.** These are capable of receiving pulsed IR rays of 36 kHz only and can receive no other frequencies. It receives the signals from the transmitter and retrieves the original modulating signal from the 36 kHz carrier. The front end of this module has a PIN photodiode and the input signal from the remote is passed into an Automatic Gain Control (AGC) stage from which the signal passes into a Band pass filter and finally into a demodulator. The demodulated output drives an NPN transistor. The collector of this transistor forms the output of the module which is connected to the load.

The authors in [5] described details of the design and implementation of Android Controlled Air Conditioner Remote using an Arduino IDE. With the help of LIRC, you can decode any infrared remote control codes and any Android phone can be converted into a remote control, so totally removing the need of remote controls. The only limitation with this approach is that the android phone should have an infrared port with it. Firstly we required the IR remote control of AC (Hitachi AC here). Using the IR receiver we received the codes on the Arduino IDE which we installed on our hardware (i.e. laptop). After receiving the codes from the remote, we used the same codes as the output to be delivered on pressing the particular button on mobile application. When the button was pressed on the application it transfers the control via Bluetooth device to the Arduino board. Arduino board gives the command to IR LED to send that code to the AC, and thus the AC is controlled with Android phone. The main drawback of this project is the range of IR LED, because it needs to be kept near the AC set.

In [6], the authors discuss the application of Radio Frequency (RF) signal in controlling the electrical loads automatically through remote. With the objective to save energy, switch the loads ubiquitously, to avoid unnecessary human moves and to make electrical loads free from wired connection to respective switches, a low cost automation system is proposed. The proposed method uses PIC 16F877A microcontroller, Encoder, Decoder, RF module to control electrical loads. About 15 loads within a distance of 30m can be controlled reliably. The use of PIC 16F877A is used to control a maximum of 15 loads reliably. The remote for controlling uses radio frequency signals with which accurate control within a distance of 30m is possible and the frequency of operation is 433 MHz. Safe switching of electrical loads by old people, children, person with disabilities is assured.

The authors in [7] also designed and constructed an infrared remote controlled power supply-switching unit, which is a device that enables the user to operate or control the mains power supplied from approximately 5 to 10 meters away. The circuit comprises of a transmitter

designed to generate an average frequency from 30 KHz to 60 KHz. The frequency rate of the output pulse is determined by the values of two resistors "R1 and R2" and the timing capacitor "C of the 555 timer.

The signal generated by the timer is picked up by the infrared detector unit, which goes low on receiving the signal.

Using the Bluetooth, the authors in [8] proposed a home appliance control system over Bluetooth with a cellular phone, which enables remote-control, fault-diagnosis and software-update for home appliances through Java applications on a cellular phone. The system consists of home appliances, a cellular phone and Bluetooth communication adapters for the appliances. The communication adapter hardware consists of a 20MHz 16bit CPU, SRAM and a Bluetooth module. The communication adapter board is connected to the home appliance and to the cellular phone through serial ports. The appliances can communicate with the cellular phone control terminal via Bluetooth SPP.

Authors in [9] developed a Home Automation using Remote Control System which evaluates the potential of Zig-Bee for addressing these problems through the design and implementation of flexible home automation architecture. The scope of this research work will include the control and monitoring system for home appliances from Graphical User Interface (GUI) using Microsoft Visual Basic software that use Microsoft Speech Recognition engine as an input source and being control wirelessly. The research methodology involved is application of knowledge in the field of radio frequency communication, microcontroller and computer programming.

In [10], the authors designed a Remote Controlled Home Automation Using Android Application via Wi-Fi Connectivity. In this project we have integrated technologies like Android with Wi-Fi to execute Home Automation System. The user Interfaces is designed using Android because Android operating systems are capturing most of the mobile market. Wi-Fi technology is selected to be used in this project because it will keep Home Automation System active and user can interact with server even if user is not present at home. The Entire project consists of two main phases i.e. Hardware and Software. User has the central control over home appliances by using Android phone application. User commands through Android application whose signal is given to PC via Wi-Fi. PC has the sever program deployed on it. Server is configured to handle both hardware and software modules. Microcontroller using serial communication port interacts with server.

In [11], the authors designed a device for Controlling Home Appliances by Using Universal Remote Control System (IoT and Bluetooth). The device design System consists of three main components; web server, which presents system core that controls, and monitors users' home and hardware interface module, which provides appropriate interface to sensors and actuator of home automation system. Communication interfaces are used between the Universal Remote controller (Android Mobile Phone) and the target devices, including Bluetooth, Wi-Fi, ZigBee and IR. Setback with the methodology used is that an android app must be developed which will create a link between the mobile Bluetooth and the receiver circuit Bluetooth.

The authors in [12] designed and constructed a remote control for fan regulator which can be used to adjust the speed of the fan by using any kind of remote, most commonly, a TV remote. The receiver is made from a commonly available TSOP1738 IR receiver. It converts the IR signal into an electrical signal and is fed in the monostable multivibrator module. Both the monostable multivibrators consist of the popular NE555 timer IC. They are wired in the monostable mode. Their function is to fire a single pulse, of known width, from their output when there is a trigger signal from the preceding blocks. While, for the first multivibrator, trigger is sent from the IR receiver, for the second multivibrator, trigger is sent from the Opto-coupler. The Opto-coupler MCT2E serves as a zero crossing detector and fires pulses whenever the input 12V AC supply crosses zero. Thus it fires pulses at a rate of 50Hz and triggers the timer block. This setup is used to get a continuous pulse train from the monostable multivibrator, whose pulse width is determined by R5 - R9 & C5 network. The pulse train is supplied to an Opto-isolator, MOC3021 (IC4). The MOC3021 drives the triac BT136. Resistor R13 and capacitor C7 combination is used as snubber network for the triac. The triac network ultimately drives the fan. The major setback of this circuit is that the IR radiation from remotes is designed to spread to large area. If the regulator sensor is placed near the television/AC, then the fan speed can be changed whenever the remote is pressed for controlling the other device.

In using the wireless fidelity technology to control appliances remotely, authors in [13] proposes a design and implementation of a remote controlled car by wi-fi technology via computer or mobile devices. In completing this research work, wireless software and hardware technologies have been used, such as wireless module of ESP8266 for transceiver (transmitter and receiver), Arduino Uno as microcontroller, an H-bridge L293D IC for motor

controller, and two electric DC motors are used to move the automobile. Two objectives of this project are to expand the limitation range of a normal radio frequency car using wi-fi technology and also to create a ubiquitous technology for automobile that operates in daily life with a control system. The test result shows that the controlled car can move in any direction. However, the performance depends on the device signal strength where the maximum testing range is only about 20 meters' distance from the user's location.

In [14], Chintha et al., described details of Electrical appliances in home control through IR Remote. The author based is design around the ATMEL 89C52 microcontroller which consists of the arithmetic and the logic unit, I/O Unit, control unit and other various components. The AT89C52 provides the following standard features timer/counter, five vector interrupt architecture with two levels, full duplex serial port, on-chip oscillator and clock circuitry, In addition, the AT89C52 is designed with static logic for operation down to zero frequency and supports two software selectable power saving modes. TSOP-1738 receiver module is used to receive the IR signal from transmitter. The drawback of this work lies in the fact that it covers only small range of distance and as well does not pass through a wall which makes it limited to be used within a very short range of distance.

Authors in [15] designed a Remote Controlled Switching System with a Sequential Power 'ON' Attribute. It comprises opto-coupler (4N33) [4], IR receiver module (TSOP1738), decade counter (CD4017), divide-by-12 counter (CD4040) [5], [6], divide-by-16 counter (74LS93), 1-of-16 decoder (74LS154) [5], [6], set-reset flip-flop (74LS74) [5]-[7], NAND gate (74LS00) [5]-[7], regulator (7805) [4], Relay switches and a few discrete components. AC mains operating frequency is 50Hz, which is isolated through opto-coupler (4N33).

In [16], the authors designed a general purpose controlling module designed with the capability of controlling and sensing up to five devices simultaneously. The communication between the controlling module and the remote server is done using Bluetooth technology. The server can communicate with many such modules simultaneously. The controller is based on ATMega64 microcontroller and Bluetooth communication TDK Blu2i (Class 1) module which provides a serial interface for data communication. The designed controller was deployed in a home automation application for a selected set of electrical appliances.

To utilize the usefulness of Bluetooth, the authors in [17] presented an Analysis of a Bluetooth Based Home Automation System. This paper describes an application of Bluetooth

technology in home automation environment. It proposes a network, which contains a remote, mobile host controller and several client modules (home appliances). The client modules communicate with the host controller through Bluetooth devices. The design is based on stand-alone Arduino UNO board and the home appliances are connected to the input/output ports of this board via relays. The communication between cell phone and Arduino UNO board is wireless. This system is designed to be low cost and scalable allowing variety of devices to be controlled with minimum changes to its core.

Authors in [18] implemented a wireless medical interface based on ZigBee and Bluetooth technology. The purpose is to acquire, process, and transfer raw data from medical devices to Bluetooth network. The Bluetooth network can be connected to PC or PDA for further processing. The interface comprises two types of device: MDIZ and MDIZB. MDIZ acquires data from medical device, processes them using microcontroller, and transmit the data through ZigBee network through UART. MDIZB receives data from several MDIZs and transmit them out to PC through Bluetooth network. MDIZB comprises of ZigBee module, two processors, RAM, and Bluetooth module. It receives data from ZigBee network through its ZigBee module. The data are then sent to processor 1. Processor 1 decides priority of MDIZs. In processor 1, the data frame is added with Start byte and End byte to mark the beginning and the end of data frame. After being processed in processor 1, the data are then sent to processor 2 through SPI (Serial Peripheral Interface). Processor 2 transmits data to PC through Bluetooth network. Processor 2 controls Bluetooth module. It also receives commands given by PC through Bluetooth network. The interface is connected with four different medical devices through UART and analog port at 42 kbps of data rate.

In [19], the authors propose a Development and Implementation of a Microcontroller based Remote Control of a Single Phase Induction Motor Using Radio Frequency. The authors concentrated on controlling the speed of a single phase induction motor using remote by the help of the radio frequency interfaced with the microcontroller. The Microcontroller decodes the signal and sends it to the relays. Then, the respective relays operate to change the speed of Induction motor from zero percent to 100 percent. This device does not only control the speed of an Induction motor, but it also uses feedback network to detect the over temperature, high voltage, low voltage, miniature circuit breaker (MCB) tripping on account of any faults and also monitors the phase lines of the motors. Because these types of uncertainties are likely to happen in Industries, this design will be very helpful in industries, households, shopping malls etc.

In [20], the authors implement a Dish Positioning by Using IR Remote. Using the fundamental knowledge of IR receiver circuit, the circuit is connected to a motor. Microcontroller is used to drive the motor to the clockwise direction when the command degree is greater than the last degree and counterclockwise direction when the command degree is less than the last degrees. Like other devices with infrared, the line of site is a major setback to this project as the receiver circuit must be position in such a way to ensure line of site communication from the transmitter.

In [21], Joydeep Roy et al. did a project on Design of Smart Universal Remote using Mobile for Home Automation. The whole system is divided into the two functional parts. First is the teaching module which required by the URC to learn new devices and their new IR bit patterns. Second part of the system is the operational module. This part comes to play whenever the URC is operated and whenever a user wants to control IR devices or lights and fans from his Mobile phone. The main feature of the work is the unique way in which the URC learns new devices and functions irrespective of make and manufactures and their underlying IR Protocols.

The authors in [22] designed a Remote Controlled Security Door which has a transmitter and a receiver circuit just like every other remote controlled appliances. It features the use of a microcontroller (PIC16F877A) which serves as the control unit and an infrared Led for the transmission and reception of signals. The designed was improved by including and LCD for displaying the command prompt send by the transmitted but it is also limited by line of site like every other infrared circuit.

For easy configuration of Integrated circuits, authors in [23] implemented a design which controls a wall lamp using arduino. Arduino Nano is used here and it is a small circuit based on ATmega 328.To power this project safely arduino PSU is used and power is given by USB. An IR sensor is used as the receiver. Controlling the light emission of LEDs may be done most effectively by using the principles of non-imaging optics.

In [24], the authors designed and implemented a Microcontroller Based Home Automation System Using Aiwa Remote. The receiver circuit is constructed using an infrared receiver which is able to detect infrared signals and decode the signal using the microprocessor (AT89051). AIWA TV remotes use a space-coding method in which the length of the spaces between pulses of light represents a one or a zero. When the infrared receiver on the circuit

picks up the signal from the remote and verifies from the address code that it's supposed to carry out this command, it converts the light pulses back into the electrical signal for 001 0010. It then passes this signal to the microcontroller, which will use the information to switch the required device. The receiver circuit is capable of controlling home automation such as fan, lamp e. t. c

Authors in [25] present an approach in remote controlling of appliances by proposing an Android and Bluetooth Technology Enabled Remote Control Using Smart Phone. This paper discusses how to build user friendly user interfaces to the smart world. The research architecture was present for controlling Internet services through physical user interfaces, using a mobile terminal and icons placed in the environment. An icon advertises a service that can be started by touching the icon with a mobile terminal. This service activation configures the mobile terminal as a remote control for the service. We have implemented this architecture and designed an icon set. The physical user interface is based on RFID technology: the terminals are equipped with RFID readers and RFID tags are placed under the icons. We present the first prototype applications and the first usability tests that we have carried out.

Integration of two wireless technologies came in existence when the authors in [26] proposed a wireless patient monitoring and Control System which integrates Bluetooth and Wi-Fi wireless technologies. The system consists of the mobile unit, which is set up on the patient's side to acquire the patient's physiological signals, and the monitor units, which enable the medical personnel to monitor the patient's status remotely. The mobile unit is based on AT89C51 microprocessor. The digitized vital-sign signals are transmitted to the local monitor unit using a Bluetooth dongle. Four kinds of monitor units, namely, local monitor unit, a control center, mobile devices (personal digital assistant; PDA), and a web page were designed to communicate via the Wi-Fi wireless technology.

In [27], the authors implemented a Bluetooth based remote monitoring & control system which is designed using the microcontroller(ATmega16) as an embedded target and Bluetooth device which is connected to the controller along with different sensors to measure different real time parameters such as temperature, pressure & humidity, it also controls the temperature of a process. During implementation, the Microcontroller which acts as the Central Controlling System controls the Bluetooth module connected to it and acquires the data from the different subsystems and transmits it to the control station.

Authors in [28] present a different study, also based on home automation by designing a remote control for smart classroom with Bluetooth networks. A Smart classroom system is use wirelessly to connect between smartphone and devices and classroom facilities. The designed system is a set of control through wireless system. It contained with an Apps, Bluetooth, Arduino and PLC. The first part is use smartphone platform, the second is signal transfer through Bluetooth transmit to Arduino. And the last is hard model with PLC control. It use an Android platform to control all electrical devices in the classroom

In [29], the authors proposed a design of the universal remote control for next generation. The Universal Remote proposed in this paper suggests a non-conventional solution to the conventional problem of non-standardization of codes in remotes. Its strength lies in its method of operation. It features a power button and series of buttons to select which device the remote is controlling at the moment. The design incorporates Infrared learning or head-to-head learning which enables a user to program certain buttons to perform specific actions. To set up new command, One can activate infrared learning, hold the remotes head-to head, and press the button on the old remote to 'teach' the command. User definable (Programmable) buttons are simply blank buttons that can be programmed to control any aspect of the device.

2.2 GSM-SMS Based Monitoring

With the wide spread use of cellular networks, this approach is also popular when small amount of data is to be transferred through the network. Extensive work has been carried out by researchers using this approach especially in medical field.

In [30], the author implemented a mobile remote control for home automation based on Main controller/actuator, Server, internet and mobile devices. The main controller/actuator is necessary to meet the basic needs of home automation systems and connects to the server via Xbee S1 radius using the IEEE 802.15.4 protocol. This controller acts as an actuator to connect directly to the lamps and water pumps to turn them on or off, depending on the instructions received by the server. The Server is essential to provide connectivity between the radios and the Internet. It consists of a Raspberry PI that has a Web server, PHP and MySQL. The server has an Xbee radio that is wirelessly connected with the Main Controller / Actuator. It connects to the Internet via the local network (Ethernet) or can function as access point using a wireless card. This computer was chosen because of its low power (5V, 700mA) and small size. The Internet ensure that the server and the mobile device are connected to the Internet so that they can remotely control the functions of turning the lights,

air conditioning and water pumps on and off. Importantly, if an Internet connection is not available, persons can still control the automation system within the physical confines of the home. The Mobile device serves as communications to the home automation network remotely using 802.11/3G/LTE. The device should function regardless of the operating system used, although the Apple IOS operating system for the i-phone and i-Pad was used in this work.

The authors in [31] described details of the design and instrumentation of variable rate irrigation remote control, a wireless sensor network, and software for real-time in-field sensing and control of a site-specific precision linear-move irrigation system. Field conditions were site-specifically monitored by six in-field sensor stations distributed across the field based on a soil property map, and periodically sampled and wirelessly transmitted to a base station. An irrigation machine was converted to be electronically and remotely controlled by a programming logic controller (Siemens S7-226 with three relay expansion modules activated electric over air solenoids to control 30 banks of sprinklers) that updates geo-referenced location of sprinklers from a differential Global Positioning System (GPS) (17HVS, Garmin) and wirelessly communicates with a computer at the base station. Communication signals from the sensor network and irrigation controller to the base station were successfully interfaced using low-cost Bluetooth wireless radio communication through Bluetooth RS-232 serial adaptor (SD202, Initium Company).

In [32], the author implemented the Remote Control and Management System in the Windows O.S. The implemented remote management system is divided into a server functions and client functions. The server function enables you to manage the client system remotely by specifying a controlling system. Server function has remote management capabilities for managing the target (client) system. The server machine's (remote controlled system) IP address is entered on program. If the system is encountered, initializing configuration for setting up the connection. If the remote controlled system is not found, the system cannot connect two systems. When the system is initialized by the connection settings, the server system will connect using network protocol.

The author in [33] implemented home security system by means of GSM cellular communication network using microcontroller 89X52 and Sony Ericsson GM-47 GSM module. This system enables far end user through SMS facility to monitor the state of home door, provide password facility for key based door lock and control home lighting system.

In [34], the authors proposed a mobile-based home automation system that consists of a mobile phone with Java capabilities, a cellular modem, and a home server. The home appliances are controlled by the home server, which operates according to the user commands received from the mobile phone via the cellular modem. In the proposed system the home server is built upon an SMS/GPRS (Short Message Service/General Packet Radio Service) mobile cell module Sony Ericsson GT48 and a microcontroller Atmel AVR 169, allowing a user to control and monitor any variables related to the home by using any java capable cell phone.

In [35], the authors proposed SMS based system for controlling of home appliances remotely and providing security when the user is away from the place. Home appliance control system (HACS) consists of PC which contains the software components through which the appliances are controlled and home security is monitored and GSM Modem that allow the capability to send and receive SMS to and from the system. The communication with the system takes place via RS232 serial port.

Authors in [36] developed a system for controlling home electrical appliances over the Internet by using Bluetooth wireless technology to provide a link from the appliance to the Internet and Wireless Application Protocol (WAP) to provide a data link between the Internet and a mobile phone. However, technical details relating controller are not revealed.

The authors in [37] demonstrated that the control of home appliances can be extended beyond the home network to wireless mobile networks without any modification in the network specifications. This was accomplished by developing and implementing a HAVi (Home Audio Video Interoperability) - WAP UI gateway that intermediates between a wired home network and a wireless communication network using HAVi and WAP specifications, respectively. The gateway use both pull and push technologies, improves the network integration and provides opportunities for developing applications that combine mobile devices with home network devices.

Authors in [38] developed an Internet-based monitoring and control of fuzzy controlled inverter for air conditioning system. The system consists of client/server, programmable logic controller, D/A modules, inverters, induction motors and the temperature sensing modules. The client accepts the command from the user and can also access the database created in server, using Internet Explorer (IE) Browser. The server performs function of fuzzy logic control, communication interface between server and PLC, and receiving command from client. Furthermore, the server also creates a database of the sensed temperature, speed of inverter-controlled motor drives, and reference command.

In [39], the authors improved on the design of embedded web server-based home appliance networks. The design uses an embedded controller based on C8051F005 microcontroller which is connected to a PC-based home Web server via RS232 serial port. The home appliances are connected to the input/output ports and the sensors are connected to the analog/digital converter channels of the embedded controller. The software of the system is based on the combination of Keil C, Java Server Pages, and JavaBeans, and dynamic DNS service (DDNS) client. Password protection is used to block the unauthorized user from accessing to the server.

Authors in [40] developed an Internet Controlled Heating Ventilation Air Conditioning (HVAC) system. The system can be controlled by three different units (web based remote control, remote control by hand-held device and keypad control mounted on AC). The hardware system of AC is controlled by PIC16F877 microcontroller. A DAQ board inserted into PCI bus of web server is used to control system over web. User is able to access system parameters over web by logging and setting parameters on forms available on main control page. User submits forms to web server having CGI program which performs requested tasks and reports status of system operation. The current operational parameters of the system are measured by microcontroller and displayed on LCD. Using web camera focused on LCD, these parameters are monitored online by client PC.

Authors in [41] developed the Design of Remote Intelligent Smart Home System Based on Zigbee and GSM Technology. Based on ZIGBEE and GPRS technology a wireless remote and smart home security system has developed. Wireless remote systems for smart home application are developed to analysis and detect the status of home equipment based on GPRS and ZIGBEE technology. It consists of host control system and several sub function module and software. The host control system has GPRS module, a controller, ZIGBEE module and PIR sensor. The several sub function modules consists of the data acquisition module, centralized switch and ZIGBEE module.

In [42], the authors developed wireless home automation system by merging communication technologies of GSM, Internet and speech recognition. GSM and Internet methods were used for remote access of devices of house whereas speech recognition was designed for users inside the house. The communication between the user and the home is established by the SMS (Short Message Service) protocol. A GSM modem is connected to the home automation server. The communication between the home automation server and the GSM modem is

carried out by the AT (Attention) commands. To accomplish Internet connectivity, a web server is built to take requests from remote clients. The clients can send requests to the home appliances. The home appliances can send their statuses to be displayed for the remote client through the server. A web page is constructed as an interactive interface where commands can be submitted by the client to change and also monitor the status of the devices. A speech recognition program is written to control the house by means of human voice. Dynamic Time Warping (DTW) algorithm is used for speech recognition.

CHAPTER 3

HARDWARE DESIGN AND METHODOLOGY

3.0 INTRODUCTION

The hardware of this circuit explains the remote control for fan regulator. The heart of the project is the microcontroller (PIC 16F628A) which gives control to all other functions in the project. The system is low cost & low power consuming so that anybody can afford it. The transmitter circuit serves as the remote which send out encoded signals via the Infrared (IR) LED while the Receiver serves as the regulator which decodes the signal transmitted and pass it to the output transducer before it finally gets to the load. The system is designed in such a way that even illiterate can operate it.

The hardware of this project is divided into two modules which are further divided into many units. These are:

The Transmitter Module (The Remote)

a. **The Power Supply**: The input power required to power the microcontroller is 5v and therefore the lm7905 is used to regulate the input power from 9v to 5v.
b. **The Remote Buttons:** The microcontroller (PIC 16F628A) is the heartbeat of the project and the buttons are on pin Rb3, Rb4, Rb5 and Rb7 (pin 9, 10, 11, 13). The Diode (1N4007) is there to serve as gate protection.
c. **Infrared Sensor Section:** An IR LED (infrared light emitting diode) is a solid state lighting (SSL) device that emits light in the infrared range of the electromagnetic radiation spectrum. Pin RB2/Tx and RA1 are used for these connections, pin RB2/Tx represents the transmitter pin on the PIC 16F628A, on which the frequency ranges from 30-38 kHz is generated internally.

The Receiver Module

a. **The Power Supply:** The power supply to the receiver circuit consist of a transformer (12v-0v-12v), the diodes arrangement connected to the transformer is to rectify the output voltage which is AC to DC
b. **IR Photo Sensor**: An hardware that detect information from an infrared remote control to another device by receiving and decoding signals.
c. **The Triac Unit:** The triac circuit is used or functions as the circuit to control the fan.

d. **The Dimmer Unit:** The Light Dependent resistor (LDR) section connected to the gate of the triac enables manual variations of the control as the amount of light determines the resistances of the triac.

3.1 REVIEW OF SOME FUNDAMENTAL CONCEPTS

The design and construction of a remote control for fan regulator can be implemented using so many techniques, based on so many related designs that have been carried out on this project. It was deduced that techniques such as Infrared, Radio Frequency, GSM module , ZigBee, Bluetooth module, Arduino system and different kind of sensors was used to achieve related goals.

3.1.1 POWER SUPPLY UNIT

Components in this unit with their specifications are:

(i) A 9VDC battery which supplies voltage to the circuit components.

(ii) A 240/12v AC/DC transformer which supplies voltage to the circuit components and to the load.

(iii) An LM7805 voltage regulator which provides a 5V regulated supply which is the required voltage to power the PIC in order not to damage it.

The power supply used in this design is a linear power supply type, which comprises of a step down transformer, filter capacitors, rectifier and voltage regulators. The two regulators were used to give the various voltage levels. The power supply circuit diagram is shown in Figure 3.2 below.

For the transmitter circuit (Remote Control), the supply is a direct current source, rectification and transformation are being ignored here, and therefore two stages are involved in the power supply units which include the regulation and filtering stage.

For the receiver circuit (Regulator), the supply is an alternating current source, rectification and transformation are being needed here, and therefore three stages are involved in the power supply units which include transforming, regulation and filtering stage.

The turn's ratio of a transformer in a D.C power supply can be selected to either increase or decrease the 240V AC input. With most electronic equipment, a supply voltage of less than 240V is required, and therefore, a step down transformer is used. The rated turn's ratio of the transformer can be calculated as thus: $\frac{Vp}{Vs} = \frac{Np}{Ns}$

$\frac{240}{12} = \frac{NP}{NS} Therefore \frac{NP}{NS} = \frac{20}{1}$

Where:

Vp = voltage induced at the primary winding

Vs= Voltage induced at the secondary winding

Ns= Number of turn induced in the secondary winding

Np= Number of turn induced in the primary winding

Therefore the transformer has rated turn ratio of 20:1

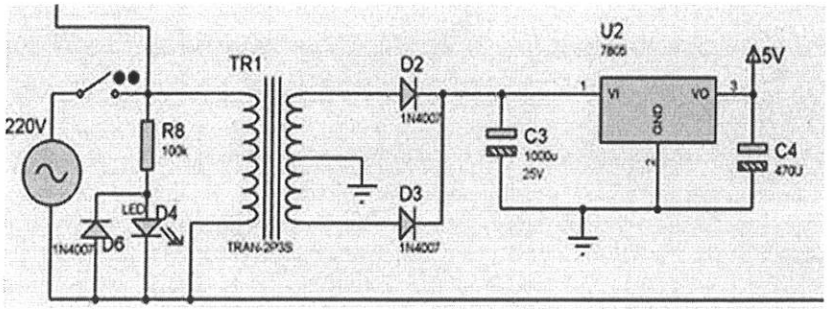


Figure 3.1: Circuit Diagram of the power supply unit.

3.1.1.1 FILTERING STAGE

A filter is used to smoothen the pulsating DC output after rectification so that a nearly constant DC voltage is supplied to the load. In both circuit, a 470µF is connected in parallel with the LM7805IC voltage regulator output. This is known as a filtering capacitor which is employed in the circuit to steady the slow alterations in the output voltage

3.1.1.2 VOLTAGE REGULATION

We need a low voltage for power supply to entire low voltage control circuit. We step down the 240V AC to 12V-0-12V using a Centre tapped transformer. This voltage is rectified to DC and using a LM7805 IC, regulated to 5V DC which is used to power the control circuitry. For the transmitter circuit, the voltage regulator LM7805 is connected to the battery as the 9v battery voltage is too high to power on the PIC 16F628A, LM7805 IC regulates and gives an output of +5V which is the required voltage for the PIC as specified in the datasheet. The voltage regulator has three pins; the input, ground and output pins. Fig. 2 illustrates the pin layout of the voltage regulator.

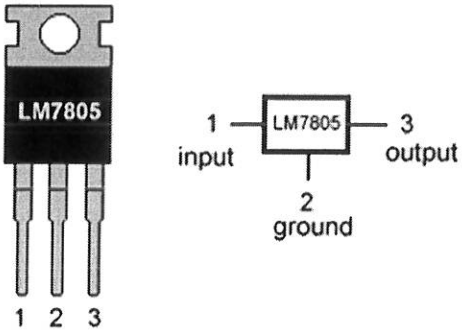


Figure 3.2: LM7805 IC and its Pin Layout

3.1.2 MICROCONTROLLERS

A microcontroller is a compact integrated circuit designed to govern a specific operation in an embedded system. A typical microcontroller includes a processor, memory and input/output (I/O) peripherals on a single chip.

In modern terminology, it is a system on a chip. A microcontroller contains one or more CPUs (processor cores) along with memory and programmable input/output peripherals. Program memory in the form of Ferroelectric Random Access Memory (RAM), non-volatile NOR flash or One Time Programmable Read Only Memory (OTP ROM) is also often included on chip, as well as a small amount of RAM. A microcontroller is a component that has its core building block the same as a microprocessor but is optimized to interact with the outside world through on board interfaces.

The microcontroller used for the purpose of this project is the PIC 16F628A. The high performance Microchip pico-Power is an 18-pin flash based, 8-bit AVR RISC-based microcontroller combines 32kB In-System Programmable flash memory with read-while-write capabilities,1024BEEPROM, 2kB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, a 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 3-5.5 volts. Fig. 3 shows the pin configuration of the PIC 16F628A.

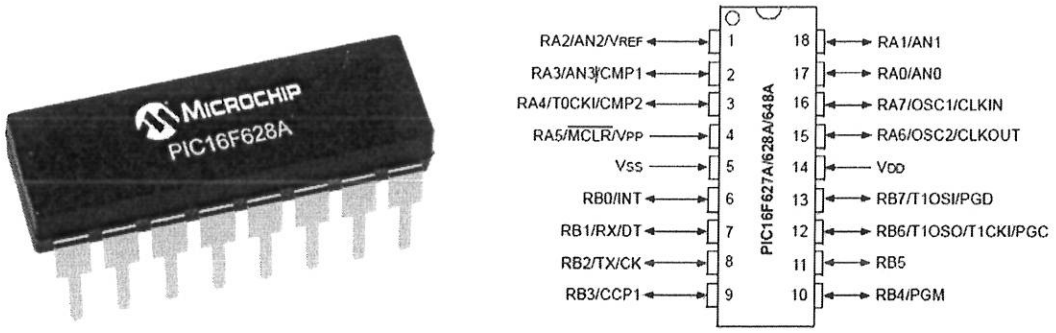


Figure 3.3: Microcontroller and its pin configuration

3.1.3 INFRARED DETECTOR SENSOR

Infrared radiation is an electromagnetic wave with wavelength of 700nm to 1mm. It is emitted by objects with temperature above 0 kelvins. Furthermore, intensity and wavelength of infrared radiation depends on the temperature of the object. Infrared or IR communication is a common, inexpensive, and easy to use wireless communication technology.

The infrared sensors are the sensors that detect/measure infrared radiation or change in the radiation from outer source or inbuilt source. Also a sensor that uses the property of infrared radiations to detect the changes in surrounding are termed as infrared sensors. Infrared sensors are widely known in the arts of transmitting and reception of signals. These are the types of infrared sensors based on the working mechanism:

a. **Passive Infrared Sensor:** Passive infrared sensors detect the infrared radiations from outer source. When an object is in a field of view of a sensor, it provides a reading based on a thermal input. It does not generate any infrared. It generally uses an optical collection system and multiple sensing elements of alternating polarity to create a detection pattern in the volume of interest.

b. **Active Infrared Sensors:** Active infrared sensors are the types of infrared sensor that emit infrared radiation which is later received by the receiver. The IR is emitted by an IR Light Emitting Diode (LED) and received by photodiode, phototransistor or photoelectric cells. During the process of detection, the radiation is altered, between process of emission and receiving, by object of interest. The alteration of radiation causes change in received radiation in the receiver. This property is used to generate desired output with help of associated electronic circuit.

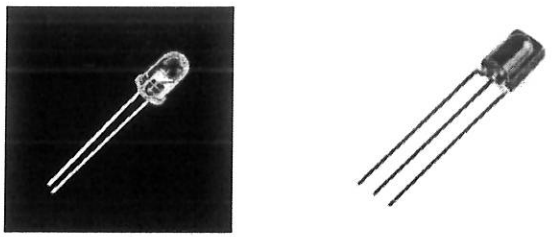
For the sake of this project, we will be using the Active Infrared sensor that has the following components

Infrared Light Emitting Diode (LED)

An IR LED (infrared light emitting diode) is a solid state lighting (SSL) device that emits light in the infrared range of the electromagnetic radiation spectrum. IR LEDs allow for cheap, efficient production of infrared light, which is electromagnetic radiation in the 700 nm to 1mm range. Because IR LEDs can be used in conjunction with a number of different types of sensors, they are becoming common in machine-to-machine (M2M) environments and Internet of Things (IoT) applications.

Infrared Photo Sensor/Receiver

An infrared receiver, or IR receiver, is hardware that detects information from an infrared remote control to another device by receiving and decoding signals. In general, the receiver outputs a code to uniquely identify the infrared signal that it receives. This code is then used in order to convert signals from the remote control into a format that can be understood by the other device. It is the part of a device that receives infrared commands from a remote control (IR LED). Because infrared is light, it requires line-of-sight visibility for the best possible operation, but can however still be reflected by items such as glass and walls. Poorly placed IR receivers can result in what is called "tunnel vision", where the operational range of a remote control is reduced because they are set so far back into the chassis of a device.



IR LED **IR PHOTOSENSOR**

Figure 3.4: Infrared Sensor

3.1.4 LIGHT DEPENDENT RESISTOR (LDR)

A light dependent resistor is a component that is sensitive to light. When light falls upon it then the resistance changes. Values of the resistance of the LDR may change over many orders of magnitude the value of the resistance falling as the level of light increases.

It is not uncommon for the values of resistance of an LDR or photo resistor to be several meg-ohms in darkness and then to fall to a few hundred ohms in bright light. With such a wide variation in resistance, LDRs are easy to use and there are many LDR circuits available.

The sensitivity of light dependent resistors or photo resistors also varies with the wavelength of the incident light.

The Light Dependent resistor (LDR) section is connected to the gate of the triac which enables manual variations of the control as the amount of light determines the resistances of the triac.

Figure 3.5: Light Dependent Resistor

3.1.5 TRIAC CIRCUIT UNIT

The term TRIAC stands for Triode for Alternating Current. It is a three terminal switching device similar to SCR (Thyristor) but it can conduct in both the directional since it construct by combining two SCR in anti-parallel state. The symbol and pin out of TRIAC is shown below.

Since the TRIAC is a bi-directional device the current can either flow from Terminal 1 to Terminal 2 or from Terminal 2 to Terminal 1 when the gate terminal is triggered. For a TRIAC this trigger voltage that is to be applied to the gate terminal can either be positive or negative with respect to terminal 2. Thus this puts the TRIAC into four operating modes.

TRIACs is used in this circuit for Phase control application, the gate pulse that is supplied to the gate pin has to be controlled using a microcontroller (PIC 16F628A). In that case the gate pin will also be isolated using an opto-coupler. This TRIAC can be triggered through the Light Emitting Diode when it received a signal. The output of the TRIAC is then connected to the load.

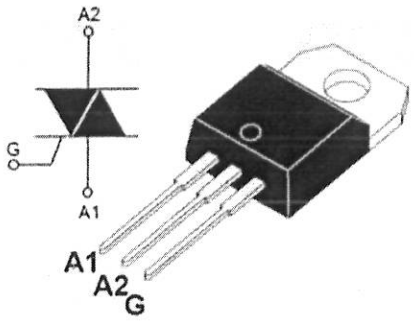


Figure 3.6: Triac BT136 and its Pin Layout

3.2 SPECIFICATIONS

The system and its components have specifications at which they can operate and have maximum efficiency. The specification of each component is analyzed below.

POWER SUPPLY UNIT

Transformer

Operating Frequency	50Hz
Input Voltage	220/240v AC,
Output Voltage	12V DC
Power ratings	500mA.
Turns ratio	20:1

7805 Voltage Regulator IC Ratings

Input Voltage	7V – 25V
Supply Current	1.5A (maximum)
Output Voltage	5V (fixed)
Operating Virtual Junction Temperature	0^0C – 125^0C

MICROCONTROLLER RATINGS

Input Voltage Range (Volts)	3.0-5.5V
Operating speed	20 MHz
Standby Current	100 nA @ 2.0V, typical
Operating Current	12μA @ 32 kHz, 2.0V, typical
Timer 1 Oscillator Current	1.2μA @ 32 kHz, 2.0V, typical
Dual-speed Internal Oscillator:	Selectable between 4 MHz and 48 kHz

INFRARED SENSOR RATINGS

Peak Forward Current	1.0 A
Voltage	5 V
Operating Temperature	-40 ~ +85 °C
Storage Temperature	-40 ~ +85 °C
Soldering Temperature	260 °C
Power Dissipation at (or below)	
25°CFree Air Temperature	150 mW

TRIAC (BT136) RATINGS

Maximum Gate Trigger Voltage	1.5v
Surge Current Ratings	27A
Pin count	3
Repetitive Peak Forward Blocking Voltage	600v
Average Power dissipation	0.5W

LDR RATINGS

Voltage rating	100v
Resistance	100kohm
Power ratings	50mW
Operating Temp Minimum	-30^0c

3.3 DESIGN

In order to design this system, there are basic structures and patterns followed and this includes

i. The block diagram

ii. The flow chart

iii. The circuit diagram.

3.3.1 FUNDAMENTAL BLOCK DIAGRAM

The approach used in this work is the modular approach where the overall design was broken into functional block diagrams, where each block in the diagram represents a section of the circuit that carries out a specific function. The block diagram includes blocks of components used in making the circuit functional, the block diagram is sub divided into two modules which is the transmitter and the receiver module. It also encompasses the channel of transmitting which is the free space.

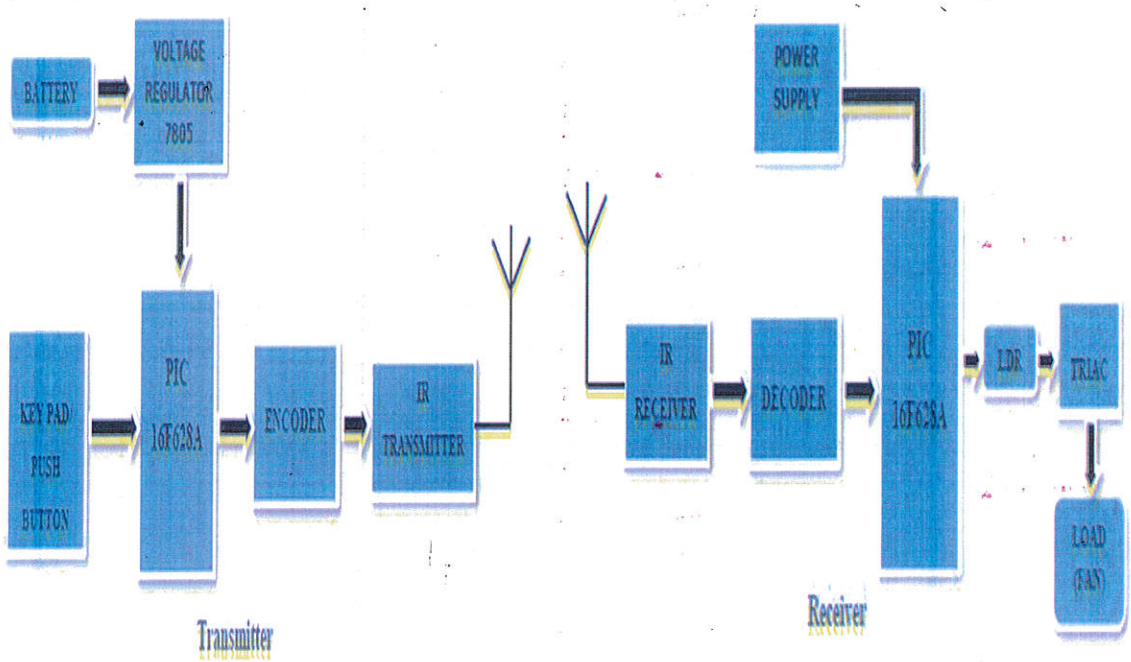


Figure 3.7: Block Diagram of the design

3.3.2 FUNDAMENTAL FLOW CHART

The operation of the detector system is shown in the next figure which is called the *flow chart* in the following algorithm.

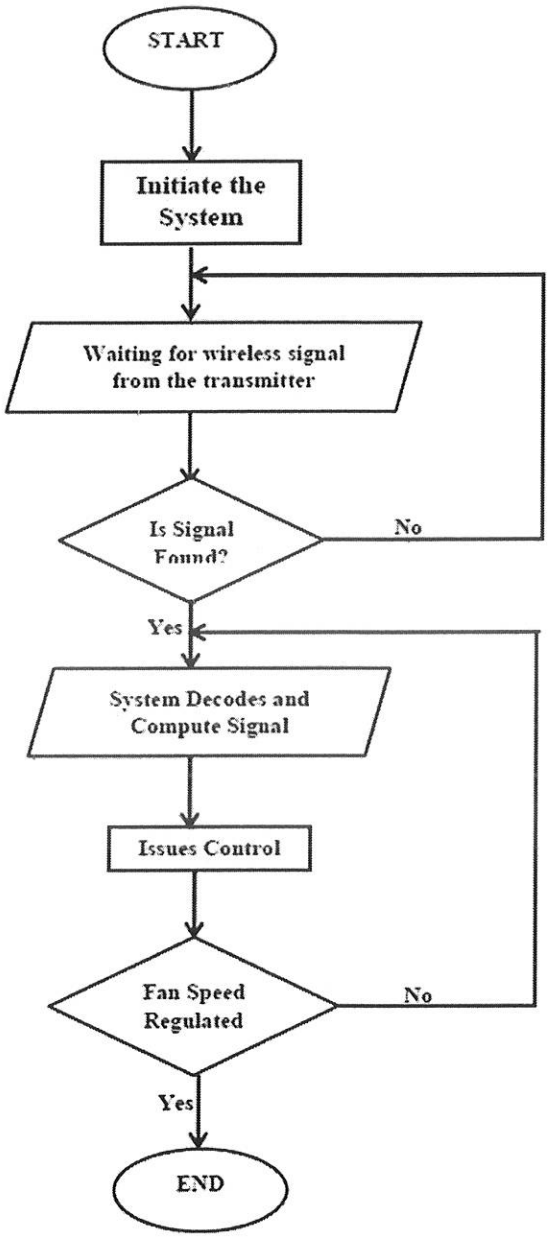


Figure 3.8: Schematic Flow Chart

3.3.3 FUNDAMENTAL CIRCUIT DIAGRAM

This project required an interconnection of sensors, the power supply unit, the microcontroller board, the switch and some other components as illustrated below.

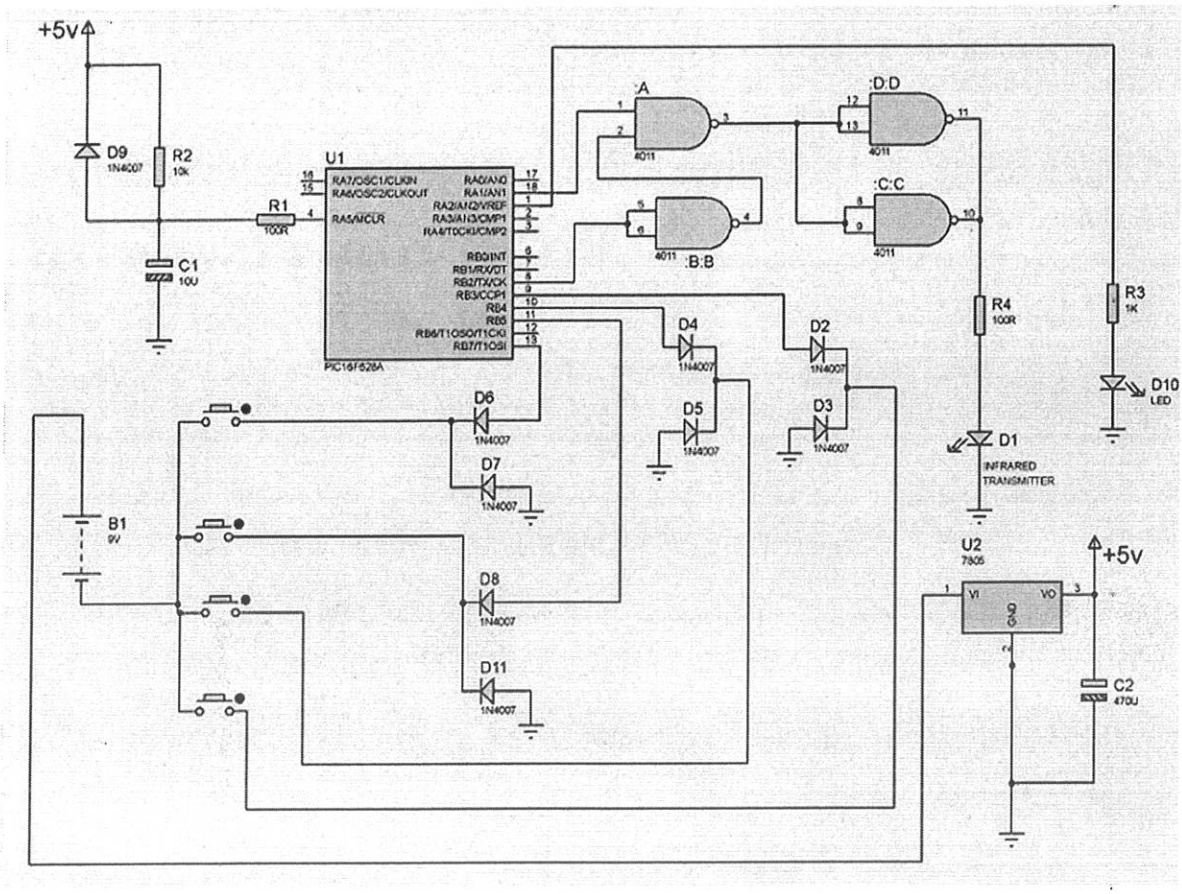


Figure 3.9: Circuit diagram of the transmitter

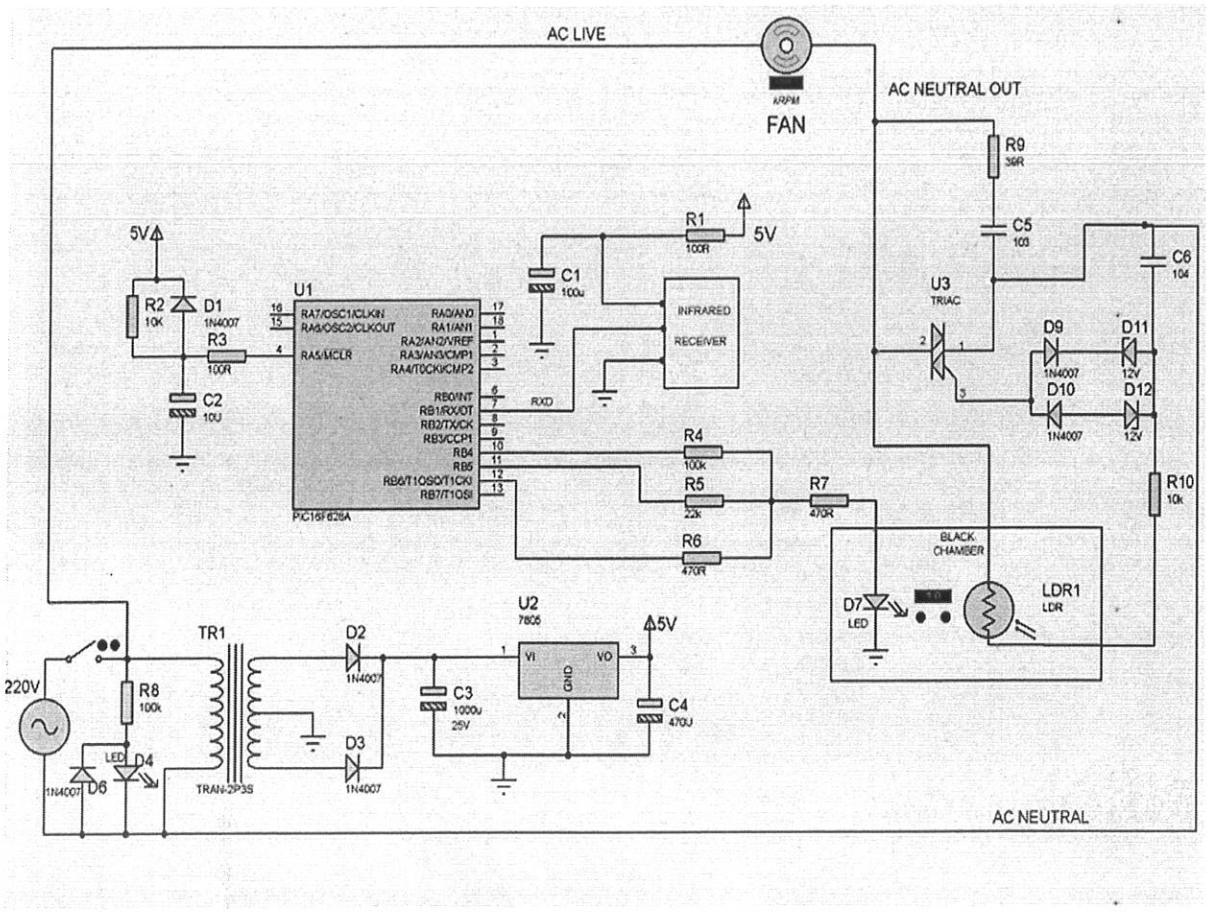


Figure 3.10: Receiver Circuit Diagram

CHAPTER 4

4.0 RESULT, ANALYSIS AND DISCUSSION

The processes and steps taken during the implementation of this project are explicitly analyzed in the following subsections.

4.0.1 TOOLS USED DURING IMPLEMENTATION

i. MULTIMETER: For taking measurements of voltage, current continuity etc.

ii. LAPTOP COMPUTER: For programming microcontroller, designing and simulation of the circuit.

iii. PRECISION SCREWDRIVER SET: For driving in and out of screws, bolts and nuts.

iv. SOLDERING STATION: This consists of temperature controlled soldering iron, heater etc. for the purpose of fusing and joining of wires of the hardware.

v. BENCH POWER SUPPLY: This supply the work station with the required voltage for the purpose of soldering.

4.1 IMPLEMENTATION OF THE SYSTEM

In implementing any electronic circuit, there are some step to step procedures which are needed to be put into consideration before achieving the desired result. Steps taken during the design of the project includes:

1. Circuit design and Simulation
2. Pre Implementation Testing of Components Part
3. Programming of the PIC
4. Hardware implementation of circuit design
5. Casing
6. Coupling of the circuit

4.1.1 CIRCUIT DESIGN AND SIMULATION

The circuit was designed on Proteus by picking the required and necessary components from its database; they are then interconnected and form the basis of our circuit diagram as shown in the Figure below. Afterwards, the design code was uploaded, and the design runs. Below is the detailed Proteus design.

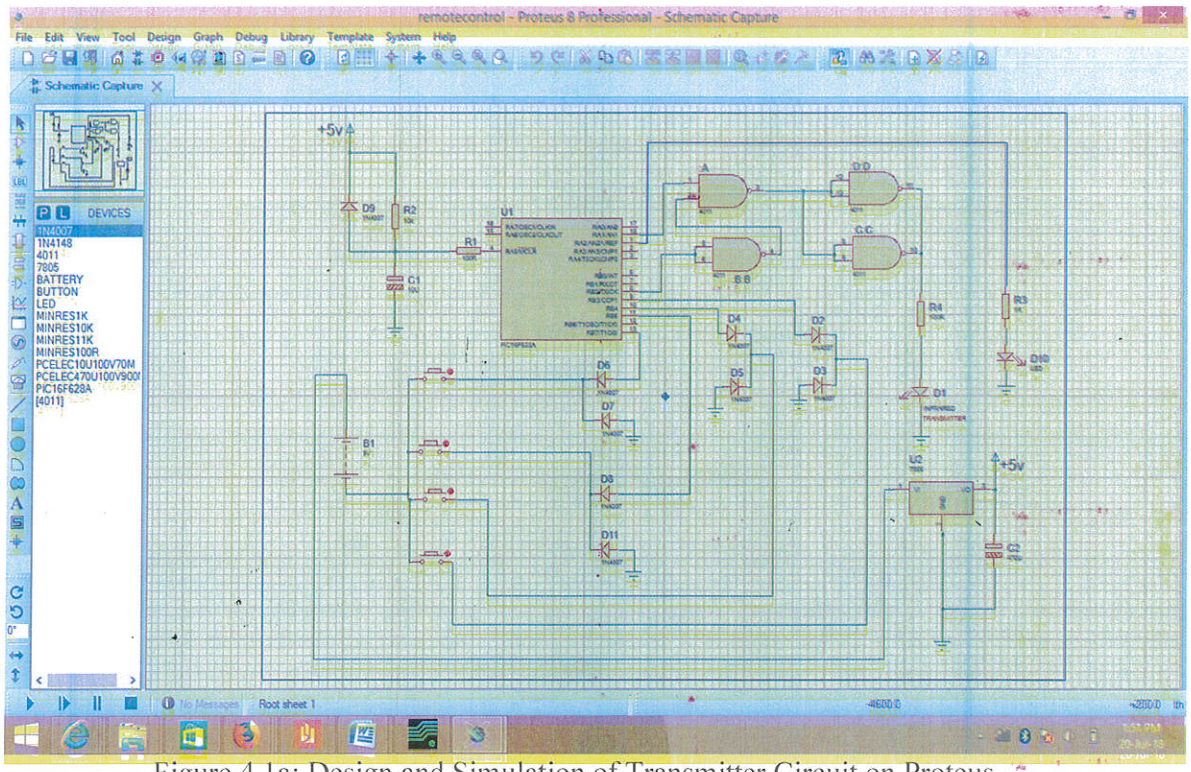


Figure 4.1a: Design and Simulation of Transmitter Circuit on Proteus

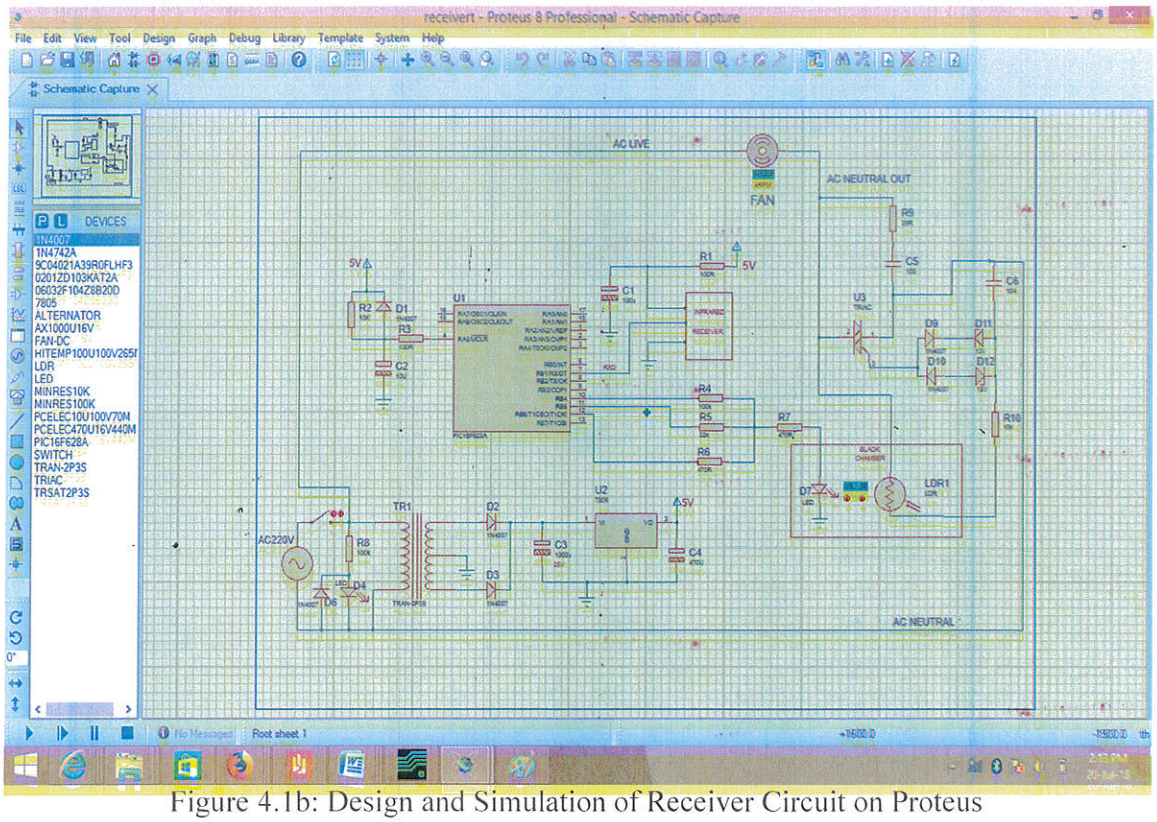


Figure 4.1b: Design and Simulation of Receiver Circuit on Proteus

4.1.2 PRE-IMPLEMENTATION TESTING

The components were bought and tested to ensure that none was faulty before and was in a good condition before soldering them on the Printed Circuit board.

4.1.2.1 TESTING OF POWER SUPPLY UNIT

The components in this unit consist of a 12V DC battery, a transformer and a LM7805IC which provides a 5V regulated DC supply. The components were individually tested and their component values were verified. After the construction of this unit, a test was properly carried out to ensure that the voltage delivered by the power supply unit was within the specified range of values needed for the project. The voltmeter section of a digital multimeter was used to read out and confirm the various stages.

4.1.2.2 TESTING OF THE MICROCONTROLLER UNIT

To test the proper operation of the microcontroller, a simple program code was written and uploaded unto the chip. The pin of the microcontroller was trigger high for a second and then switch to low, after cycling through all of the pins individually, simultaneously trigger all the pins high for a second and then low.

It is also tested by connecting each digital pin of the microcontroller to a channel of logic analyser and a check is made to see that each pin is functioning as intended.

4.1.2.3 TESTING OF THE IR LED

The IR LED was tested to be in a perfect working condition after it was correctly connected to the circuit of an already constructed remote. A video cell phone camera is turned on and point at the infrared LED, a button is then pressed on the remote. If the infrared LED is working, it will appear on the digital camera viewfinder as a purple glow.

4.1.3 PROGRAMMING OF THE MICROCONTROLLER UNIT

The microcontroller requires a program to be written on it by the use of an Arduino IDE to perform the desired operation it is required to execute. A source code was used to instruct the microcontroller to send signals through the IR LED to the receiving end, and another source code written to decode signal being received by the receiving IR LED. The source code was written with the C-programming language as provided by the Arduino library.

Programming the chip was done with an Arduino IDE, which is free-licensed software available for Windows Operating System. The source code is then uploaded unto the chip before the microcontroller can finally make use of it.

4.1.4 HARDWARE IMPLEMENTATION

In this project work, before components were finally soldered on the Printed Circuit board, they were first arranged on a breadboard. This stage of the project work is the prototype stage. The essence of this was to certify that the circuit was working desirably. The designed Remote Controlled for fan regulator was first of all divided into two functional blocks and each block was then simulated on electronics workbench. Each block worked to specification. Thereafter, the construction was done on Printed Circuit board in accordance with the designed circuits as illustrated Figure 1, Figure 4 above.

4.1.4.1 PRINTED CIRCUIT BOARD CONSTRUCTION

The board, which was used for construction of this project work, is the Printed circuit board. It is the most common kind of board used for construction of this kind of project so as to reduce project size. A printed circuit board mechanically supports and electrically connects electronics component using conductive tracks, pads and other features etched from copper sheet laminated onto a non-conductive substrate. It has a pre designed copper tracks according to the circuit diagram on a conducting sheet. The pre-defined tracks reduced the wiring, thereby reducing the faults arising due to loose connections.

It is been constructed by converting the circuit schematic diagram into a PCB layout using a PCB layout software, then a copper plate is cut for the circuit board. The copper plate cut is being rubbed using a steel wool or abrasive sponge so as to remove the top oxide layer of cooper as well as the photoresist layer. The schematic layout of the circuit is then transfer onto the copper plate using a laser cutting edge etching.

Figure 4.2: Construction of PCB

4.1.4.2 SOLDERING

After the positioning of the components on the Printed circuit board as provided on the circuit diagram of the project, the joining of components to one another was done using a soldering

iron with rating of 60W/220V and soldering lead. Most components are very sensitive to heat, so extra care was taken in handling and soldering to avoid burning of the components.

Also, each joint was ensured to be electrically sound to allow conduction of electricity and mechanically sound to avoid getting disjointed on receiving considerable mechanical stress.

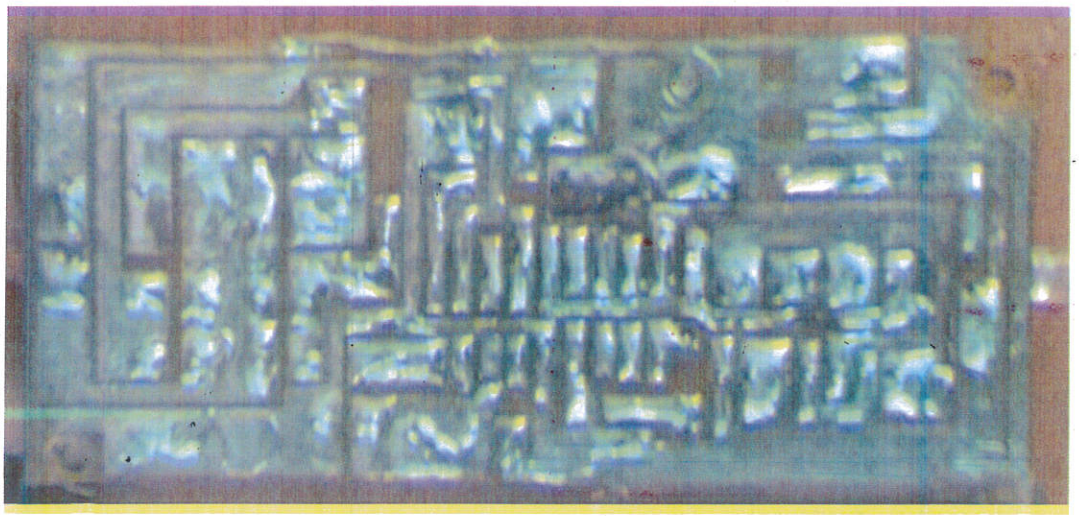


Figure 4.3: Soldering of Component on PCB

4.1.5 CASING

The casing was constructed putting the size of the circuit board, power supply and ventilation for the circuit into consideration. The Figure below shows the typical casing used.

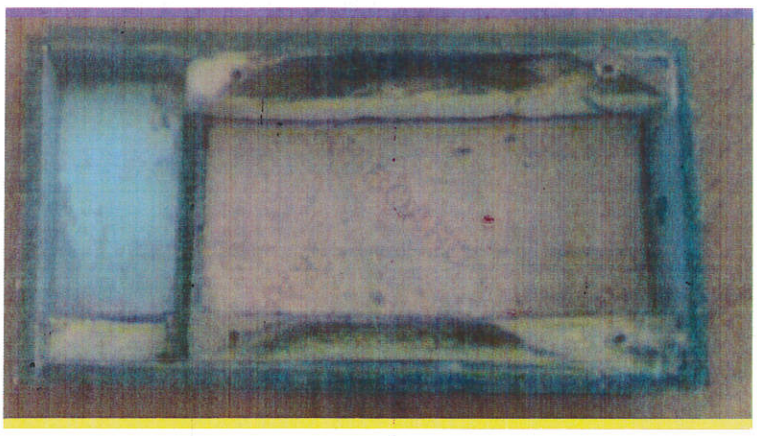


Figure 4.4: Typical Casing Used for the project

4.1.6 COUPLING

The circuit was attached to the base of the casing by screwing it tightly to it. This is to makes it more user friendly. The detectors were attached to the respective openings on the cover of the casing.

In the process of doing this, the individual circuits were observed for burning, excessive generation of heat and failure.

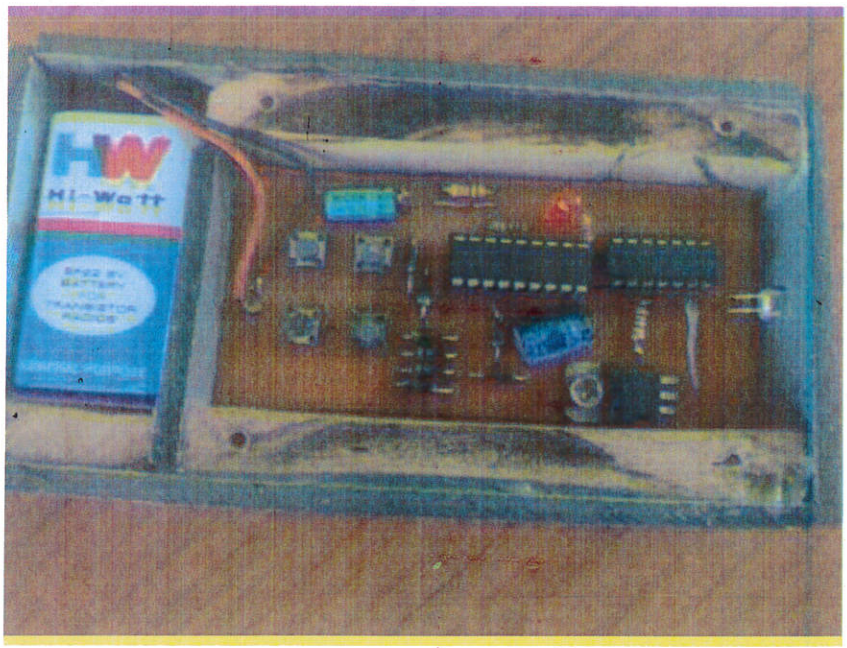


Figure 4.5: Coupling of the Circuit and the Casing

4.2 TESTING

At various stages of the project, it was tested using multimeter to ensure its working ability. The multimeter was used to measure continuity, resistance, voltage, current and the working condition of transistors and diodes, during the project construction. The multimeter was also used to measure the different voltage levels of the power supply unit. The charging time (T_{on}) was calculated to be a little higher than the discharging (T off), because from the design the RC network was adjusted so that a minimum duty cycle of 50% could be achieved, so that the charge and discharge time will be approximately equal. During the test, a percentage error of about 0.001 was recorded, which is still within experimental error.

In testing the transmitter, an AM radio receiver was brought near it. The reception of the radio receiver was interfered with by the transmitter, proving that the transmitter is working. The theory behind this is that infrared circuit's cause's interference noise whenever they are brought near radio receiver in AM band. It was also obvious that each time a button is pressed on the remote control; the supply was triggered either ON or OFF.

4.3 RESULT

A transmitter system (the handheld remote), which comprises of encoder, microcontroller, IR LED module, push buttons, etc. has been developed which when operated, sends a signal to

the receiver system. This receiver system receives and processes the signal from the transmitter, then turn ON or turns OFF an appliance. The receiver system which comprises of decoder, oscillator, microcontroller, LDR, Triac, etc. has also been developed which when receiving signal from the transmitter processes of the signal, switches ON or switches OFF a load.

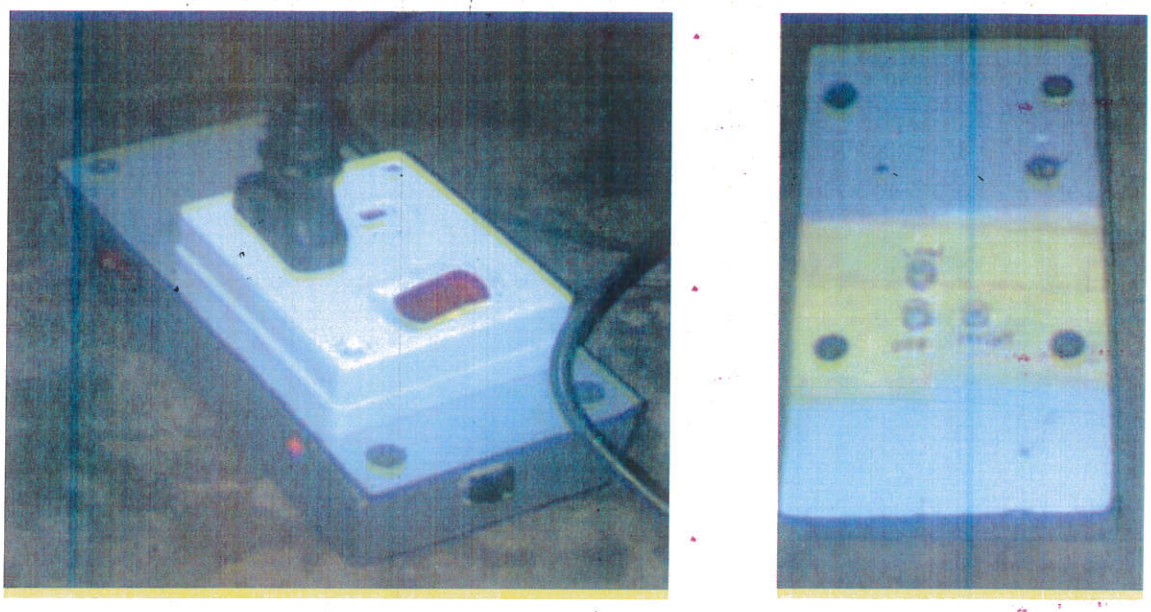


Figure 4.6: Project Result (Transmitter and Receiver Circuit)

4.3.1 PERFORMANCE EVALUATION

It is relevant to know the working principle of this electronic circuit before going to its actual testing. The operating sequence of this circuit includes the following:

1. A button is pressed on the transmitter circuit (Remote) and signal is being sent through the Infrared LED (IR LED) to the Receiver circuit.

2. Signal is been detected by the Active Infrared Detector (Photo-Sensor) which is then decoded by the microcontroller.

3. The microcontroller then triggers the Light Dependent Resistor, and controls the Triac circuit which is connected to the load (Fan). This in turns regulate the speed of the fan.

4.3.1.1 EXPECTED PERFORMANCE OF THE REGULATOR UNDER NO SIGNAL CONDITION

Having understood the above analysis, we can now analyse the operational principles of the circuit under no signal condition and then under the signal condition performance method.

Under no signal condition, the regulator/detectors tend to remain in their default state as programmed, since no signal is received by the infrared photo sensor. Once an infrared signal from other transmitter is detected, the microcontroller won't be able to decode it due to the program written, therefore, the regulator still remains in their default state as programmed. Once the required signal is detected, it is being decoded by the microcontroller which then sends a command to regulate the load (Fan) as specify by the transmitter.

4.3.1.1 EXPECTED PERFORMANCE UNDER REQUIRED SIGNAL CONDITION

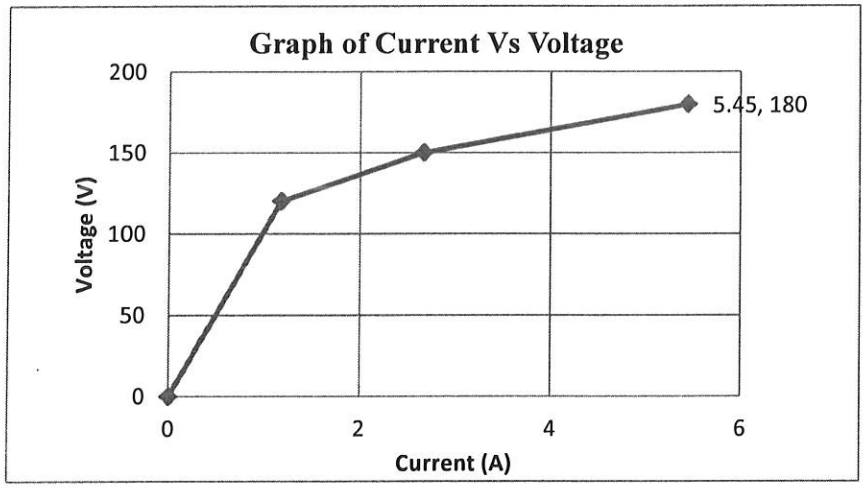
When a key is pressed on the remote(transmitter), an infrared pulse (typically in the range of 36 kHz) is emitted from the remote, the infrared photo sensor on the transmitter picks up the signal and sends the required signal to the microcontroller to decode the signal. The microcontroller will in turn send a command to the light dependent resistor, and the triac circuit. The triac circuit will then implement the command and regulates the load since the load is connected to the output of the triac circuit.

4.4 ANALYSIS

The work deals with assembling, soldering, casing etc. The circuit components used was locally sourced while the detectors were ordered from the foreign marketplace. Once they were gotten, the components were then assembled and soldered according to the specifications of the circuit diagram. After soldering, the testing of the circuit design took place across the nodes of the circuit. A side of the casing had to be drilled in order for the power jack to fit in and for ventilation. This system was tested using different models of load (i.e. the ceiling fan, wall fan and the standing fan). This system is easy to use and very simple. The model can be installed with a low economical cost.

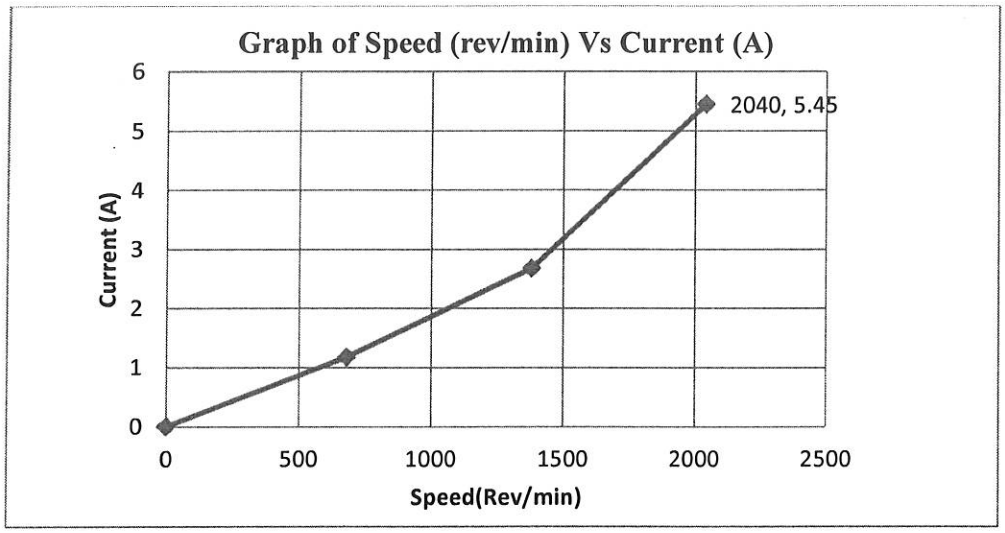
4.4.1 ANALYSIS OF THE OUTPUT VOLTAGE

The graph below shows the relationship between the current and the voltage at the output of the regulator. As seen in the graph, the voltage is directly proportional to the current i.e. as the output voltage increases; there is an increase in current which brings about an increase in the speed of the fan.



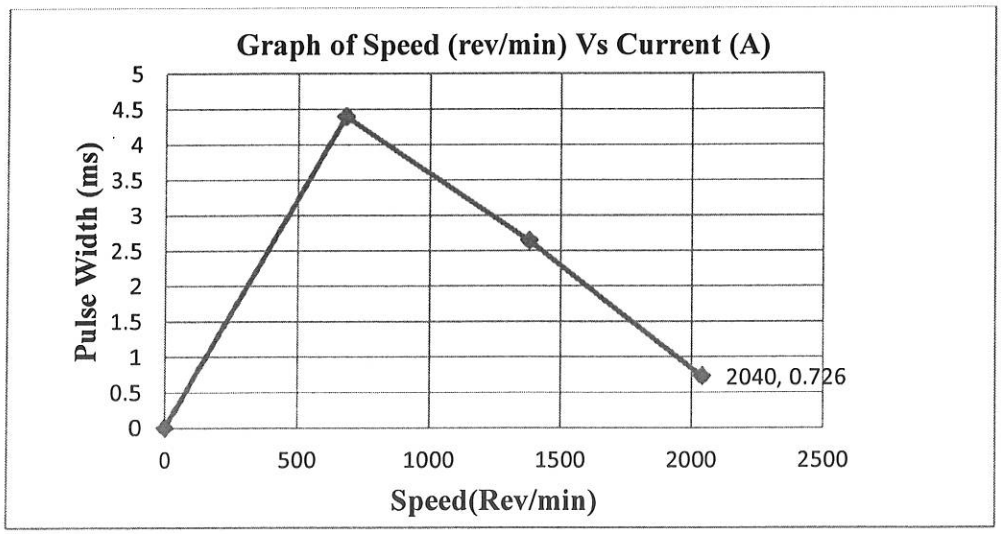
4.4.2 ANALYSIS OF THE SPEED

The graph below shows the relationship between the current and the speed of the fan. From the graph, as the detective current increases, the detective speed also increases. An increase in the current from 1.175 to 5.450 shows that there is a relative increase in the detective speed of the fan. The highest detective speed is 2040 rpm while the highest detective current is 5.450. The lowest detective speed is 680rpm and the lowest detective current is 1.175.



4.4.3 ANALYSIS OF THE TIMING PULSE WIDTH

The graph below shows the relationship between the Speed in Rev/min and the Pulse width of the timing oscillator. The microcontroller multivibrator stage produces an output pulse whose width is precise and equal to 1.1RC. This pulse is coupled to the Triac circuit that regulates the speed of the fan. An increase in the timing of the pulse width brings about a decrease in the detective speed of the fan.



4.5 PROJECT MANAGEMENT

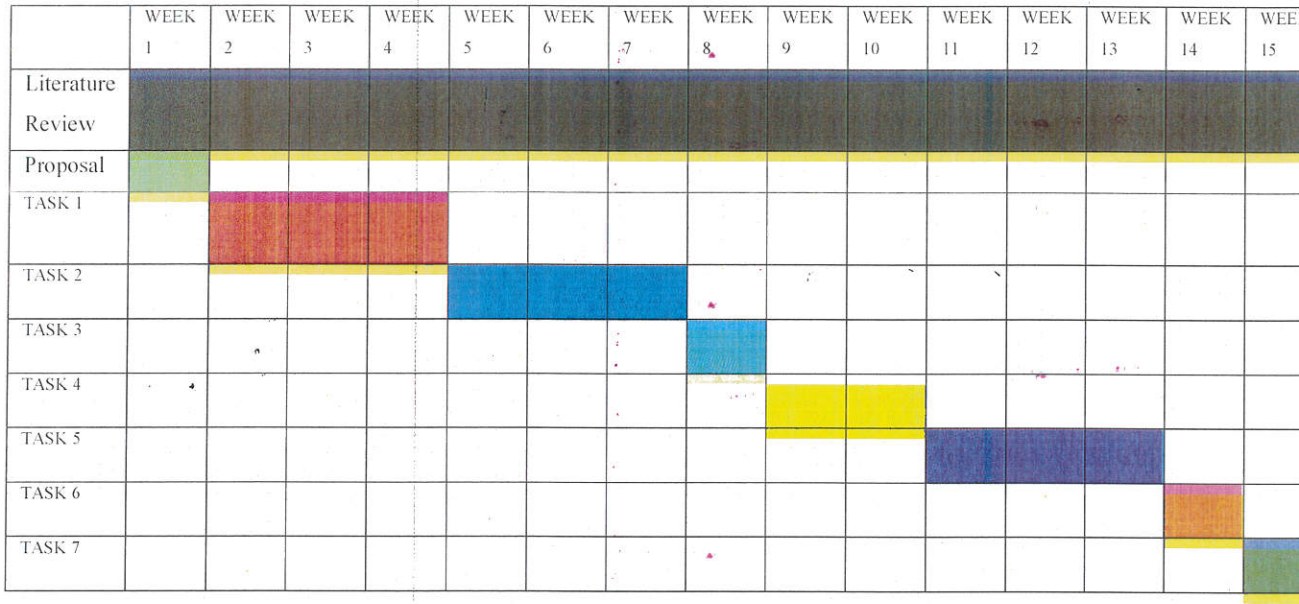
The following subsections show how the achievement of the aim of this project is managed.

4.5.1 PROJECT SCHEDULE

The chart below shows the tasks involved in this project and the time period to complete each of this task.

4.5.1.1 GANTT CHART

Gantt chart is a visual view of tasks scheduled over time. Gantt charts are used for planning projects of all sizes and they are a useful way of showing what work is scheduled to be done on a specific day. They also help you view the start and end dates of a project in one simple view. The fundamental Gantt chart of the project is shown below:



Task 1: Gathering of materials for project.

Task 2: Design of project circuit.

Task 3: Programming of code for the design.

Task 4: Acquisition of components.

Task 5: Hardware implementation.

Task 6: Soldering.

Task 7: Testing and casing of the project.

4.5.2 RISK MANAGEMENT

In the design and implementation of this project, the likely threats to encounter are:

i. Components failure

ii. System error

iii. Electric shock.

These threats are been mitigated by:

i. Using the right equipment in implementing the task

ii. Ensuring that the project is supervised by an expert.

iii. Provision of surplus components so as to serve as redundancy thereby improving the reliability of the system.

In the course of this project, no risk actually materializes simply because of the proper planning.

4.5.3 SOCIAL, LEGAL, ETHICAL AND PROFESSIONAL CONSIDERATIONS

This project was ensured to have been designed and implemented to meet and conform to the standards of Institute of Electrical and Electronics Engineers (IEEE). It was also ensured that all safety rules and regulations were duly observed during the course of the project.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

This chapter concludes the chapters in this thesis. It includes conclusion, recommendation of the project, its limitations, likely future works etc. This project has undergone the process of construction, implementation, testing, and analysis and has been completed. Therefore, the aim and the objectives of the project were achieved.

5.1 CONCLUSION

The objective of this project which is to regulate the speed of fan using a remote control at homes and offices has been successfully achieved. The remote/keypad was able to control the speed of fan. The transmitter was able to send a signal at a frequency of 30-60 kHz to the receiver and the receiver implemented the signal sent to it. The microcontroller was able to understand the command sent by the user through the transmitter and implement the command to either ON/OFF, increase or decrease the speed of the fan.

The transmitter transmits signals to the receiver from a distance of 30m and below when functioning at its best. It was observed that the transmitting distance depends on the strength of the battery because it was observed that when the battery went low, the transmitter had to be brought closer to the receiver before the receiver picks the signal, but reverse is the case with a stronger batteries. Another factor that determines the frequency of transmission was discovered to be the values of the resistor and capacitor used at the transmitter stage. The AC load (fan) was connected to the Triac output, and it performed its normal operation of switching either "on" or "off", whenever the transmitter button was pressed. The project was not only able to regulate the speed of a fan but, it could also be used to control (switch) the lighting unit of a room to dim or increase the brightness, and also serves as a home automation system to control any electronic or electrical device connected to its output.

5.2 RECOMMENDATIONS

It is encouraged that this remote control for fan regulators should be used by all in their homes, offices and everywhere there is a need for ease and convenience. The device should be installed, powered on and load connected to it. The transmitter is portable and thereby recommended to be a handheld device. The transmitter battery should be replaced occasionally once it's detected that it is no longer functioning as expected. Despite the advantages of this work, there are still things that can be done to increase the reliability and efficiency of this project work. These include:

i. The transmitter LED should be position directly proportional to the receiver circuit photo sensor to ensure there is ease reception of signal since infrared works with line of sight.

ii. The transmitter distances should not be too far from the receiver as the maximum distance of the infrared used is 30m.

5.3 CONTRIBUTION TO KNOWLEDGE

The development, design and implementation of this project have greatly improved my practical knowledge in relative to the theoretical knowledge gained in school. It sheds more knowledge on the word "Infrared" as I now have a bright exposition of the said component in terms of its frequency and wavelength. Secondly, the design and implementation of a remote control for fan regulator helped me to make researches in different aspects of power/electronics technology; this include; power electronics, physical electronics, analogue electronics, digital electronics, digital communication, Signal Processing, and software engineering.

5.4 LIMITATIONS

Upon the completion of this project I realized some limitations which are discussed below

1. The drawback of this work lies in the fact that Infrared radiation covers only small range of distance and as well does not pass through a wall which makes it limited to be used within a very short range of distance (Maximum of 30m)

2. The transmitters and receivers must be almost directly aligned (that is, able to see each other) to communicate.

5.5 FUTURE WORKS

Though the main objective of this project was achieved, the following can be made to improve on the performance and rating.

a. A digital display may be included so as to show the level of the fan speed.
b. An automatic regulator unit could be included so that it regulates the incoming voltage or switch off an abnormal voltage.
c. A solid-state relay (opto-coupler) and other digital integrated circuits could be used to increase the rate of switching.
d. Incorporating a unique sound alarm unit, that will come ON once there is an unusual voltage.
e. On a final note, to improve the performance of the device, the output of the device should be regulated to properly handle variations in the power supply line.

5.6 CRITICAL APPRAISAL

Remote control is very important in household application, it brings about comfort when controlling and operating household appliances. It makes life easy while trying to make switching operation of appliances. The remote control for fan regulator is developed to make the switching of household appliances easy for the elderly, physically challenged, the young and anyone who, in any circumstance, needs comfort and security. With the advancement in technology, it's now possible for users to control and operate electrical appliance with the use of a remote at low cost. The development also brings in other advantages like cost effectiveness, User friendly, Portability and much needed efficiency. The system consists of infrared Emitting Diode and Infrared photo sensor as transducers for transmitting and reception of signals. The signals are then processed by an embedded microcontroller unit which then implements the command signal sent by turn ON or OFF the fan connected to its output. Initial testing of this system shows that it worked as expected.

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APPENDIX A: BILL OF ENGINEERING MEASUREMENT AND EVALUATION

S/N	DESCRIPTION	UNIT PRICE (Naira)	QUANTITY	AMOUNT (Naira)
1	PIC 16F628A Microcontroller with Programmer	800	4	3200
2	Step down Transformer (230v AC to 12V)	1000	1	1000
3	IR LED	100	2	200
4	IR Receiver Sensor (TSOP1738)	400	2	800
5	NAND GATE (CD 4011BE)	200	2	400
6	Light Dependent Resistor	20	2	40
7	Triac (BT136)	150	2	300
8	Printed Circuit Board	1000	2	2000
9	9VDC Battery	80	2	160
10	Voltage regulator (LM7805)	400	4	1600
11	Capacitors	50	12	600
12	LED	20	3	60
13	Resistors	10	20	200
14	Diode (1N4007)	20	20	400
15	Push button	15	6	90
16	Connecting wires	-	-	600
17	Data wire lines	200	1	200
18	Breadboard	200	2	400
19	Casing	500	2	1000
20	Standing Fan	4000	1	4000
21	Miscellaneous	2000	1	2000
	Total			**19250**

APPENDIX B: CONFIGURATION SUMMARY FOR PIC 16F628A

FEATURES	PIC 16F628A
Pin Count	28/32
Flash (Words)	2048
SRAM (Bytes)	224
EEPROM (Bytes)	128
General Purpose I/O Lines	16
SPI	2
CCP (PWM)	1
USART	1
ADC 10-bit	15Ksps
ADC Channels	8
8-bit Timer/Counters	2
16-bit Timer/Counters	1

APPENDIX C: PROGRAMMING CODE

The following code was uploaded to the PIC 16F628A microcontroller chip.

FOR THE TRANSMITTER CIRCUIT PIC 16F628A

```
TMR0   EQU   01H
STATUS EQU   03H
PORTA  EQU   05H
PORTB  EQU   06H
TRISA  EQU   85H
TRISB  EQU   86H
INTCONEQU    0BH
COUNT  EQU   20H
COUNT2       EQU   21H
VALUE  EQU   22H
COUNT3       EQU   23H
VALUE2EQU    24H
OPT    EQU   81H
CMCOM        EQU   1FH
TXREG  EQU   19H
RCREG  EQU   1AH
SPBRG  EQU   99H
TXSTA  EQU   98H
RCSTA  EQU   18H
TXIF   EQU   4
RCIF   EQU   5
PIR1   EQU   0CH
STATE  EQU   70H
       LIST  P=16F628
       ORG   0
       NOP
       NOP
       NOP
       GOTO  ADC1
INT
       MOVLW       0XF6
       MOVWF       TMR0
       COMF  PORTA,F
       BCF   INTCON,2
       RETFIE
SERIAL2
       BTFSS PIR1,TXIF
       GOTO  SERIAL2
       BCF   INTCON,7
       MOVF  VALUE,W
       MOVWF       TXREG
       BSF   INTCON,7
       CLRF  COUNT3
```

```
SERIAL2A
        CLRF    COUNT
SERIAL2B
        CLRF    COUNT2
SERIAL2C
        INCF    COUNT2,F
        BTFSS   COUNT2,6
        GOTO    SERIAL2C
        INCF    COUNT,F
        BTFSS   COUNT,6
        GOTO    SERIAL2B
        INCF    COUNT3,F
        BTFSS   COUNT3,0
        GOTO    SERIAL2A


SERIAL2X
        BTFSS   PIR1,TXIF
        GOTO    SERIAL2X
        BCF     INTCON,7
        MOVF    VALUE2,W
        MOVWF           TXREG
        BSF     INTCON,7

        CLRF    COUNT3
SERIAL2AX
        CLRF    COUNT
SERIAL2BX
        CLRF    COUNT2
SERIAL2CX
        INCF    COUNT2,F
        BTFSS   COUNT2,7
        GOTO    SERIAL2CX
        INCF    COUNT,F
        BTFSS   COUNT,7
        GOTO    SERIAL2BX
        INCF    COUNT3,F
        BTFSS   COUNT3,0
        GOTO    SERIAL2AX

        RETURN
```

```
KEY1
        CLRF    VALUE
        CLRF    VALUE2
        BSF     VALUE,0
        BSF     VALUE,1
        BSF     VALUE,4
        BSF     VALUE,7
        BSF     VALUE2,2
        BSF     VALUE2,6
        GOTO    SERIAL2
KEY2
        CLRF    VALUE
        CLRF    VALUE2
        BSF     VALUE,0
        BSF     VALUE,2
        BSF     VALUE,4
        BSF     VALUE,5
        BSF     VALUE,7
        BSF     VALUE2,0
        BSF     VALUE2,2
        BSF     VALUE2,4
        BSF     VALUE2,5
        GOTO    SERIAL2
KEY3
        CLRF    VALUE
        CLRF    VALUE2
        BSF     VALUE,0
        BSF     VALUE,5
        BSF     VALUE,7
        BSF     VALUE2,0
        BSF     VALUE2,1
        BSF     VALUE2,4
        BSF     VALUE2,6
        GOTO    SERIAL2
KEY4
        CLRF    VALUE
        CLRF    VALUE2
        BSF     VALUE,1
        BSF     VALUE,2
        BSF     VALUE,3
        BSF     VALUE,4
        BSF     VALUE,6
        BSF     VALUE,7
        BSF     VALUE2,1
        BSF     VALUE2,2
        BSF     VALUE2,5
        GOTO    SERIAL2
```

```
KEY5
        CLRF    VALUE
        CLRF    VALUE2
        BSF     VALUE,2
        BSF     VALUE,7
        BSF     VALUE2,1
        BSF     VALUE2,5
        BSF     VALUE2,6
        GOTO    SERIAL2
KEY6
        CLRF    VALUE
        CLRF    VALUE2
        BSF     VALUE,0
        BSF     VALUE,1
        BSF     VALUE,2
        BSF     VALUE,3
        BSF     VALUE,5
        BSF     VALUE,6
        BSF     VALUE,7
        BSF     VALUE2,0
        BSF     VALUE2,1
        BSF     VALUE2,2
        BSF     VALUE2,4
        GOTO    SERIAL2
SERIAL1
        BANKSEL         SPBRG
        MOVLW           0X33
        MOVWF           SPBRG
        MOVLW           0X20
        MOVWF           TXSTA
        BANKSEL         RCSTA
        MOVLW           0X90
        MOVWF           RCSTA
        RETURN
ADC1
        BANKSEL         TRISB
        CLRF    TRISA
        BCF     OPT,7
        BCF     OPT,5
        BANKSEL         PORTB
        MOVLW           0X07
        MOVWF           CMCOM
        CLRF    PORTA
        MOVLW           0XFF
        MOVWF           PORTB
```

```
        CLRF    VALUE
        CLRF    VALUE2
        CALL    SERIAL1
        MOVLW           0XA0
        MOVWF           INTCON
REDO
        BTFSS   PORTB,3
        CALL    KEY1
        BTFSS   PORTB,4
        CALL    KEY2
        BTFSS   PORTB,5
        CALL    KEY3
        BTFSS   PORTB,7
        CALL    KEY4
        GOTO    REDO
        END
```