A PROJECT ON THE

DESIGN AND CONSTRUCTION OF AN INFRARED ACTIVATED SWITCH.

By

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NOVEMBER, 2005

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A THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF BACHELOR OF ENGINEERING DEGREE B. ENG IN THE DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING OF ELECTRICAL AND COMPUTER ENGINEERING, SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOGY, FEDERAL UNIVERSITY OF TECHNOLOGY MINNA NIGER STATE

NOVEMBER 2005

CERTIFICATION

This is certify that the project work titled design and construction of an infrared activated switch by Mohammed Ndaliman under the supervision of Mr. O.D. Ahmed and the submitted to the department of electrical and computer engineering of Federal University of Technology Minna.

Mr. O.D. Ahmed 03/12/05

Project supervisor date and signature

Dr. M.D. Abdullahi ....

Head of Department date and signature

EXTERNAL SUPERVISOR Date and signature

DECLARATION.

I hereby declare that this is my original work and has not been presented in any form for the awards of degree or diploma at any University.

All information derived from published or unpublished work of others have been acknowledged in the text.

Mohammed Ndaliman ....NOV 2005..........

Date and signature

DEDICATION.

To my sister **Fatima Zahara Ndaliman** who has been destined to live an extraordinary life beyond our comprehension. You are my motivation for most of the past years and I pray for better days to come for all of us. Secondly to my mother **Hajiya Fatima Ndaliman** who has been everything to me. Love you always.

ACKNOWLEDGEMENT

Praise be to **Allah** (SWT) for the gift of life because being able to go through this unique experience is indeed a learning process that takes the non conspicuous blessings of Allah to complete.

To my parents and my siblings for their love and support .This experience would never be regarded as a complete one without expressing my gratitude to the **Abubakar family**, the **Techno family**, all my people and those who made my experience something to learn from. For all those that might think I should have mentioned them, never doubt where you stand in my life because you know who you are to me

ABSTRACT

The remote control has been the one device that has aided the process of **automation** over the years of technological advancement. The ease of use of the remote control is one of the motivational points of this project.

This project uses an ordinary remote control to operate a switch in order to facilitate automation of devices and to overcome proximity obstacles. The circuit design uses an infrared module, a monostable multivibrator circuit, a bistable multivibrator circuit to switch on a relay on or off. The infrared module triggers the monostable circuit once it receives a signal from the remote control involved. The output signal of the monostable circuit provides a clock signal that triggers the bistable multivibrator circuit that switches the relay on or off through a series transistor connected to the relay. Automation of locally made machines using such a method would boost the small scale industries of Nigeria as a positive change in the small scale sector of the economy would give rise to a revolutionary change in the financial status of Nigeria and its masses.

Even thought the project provides room for improvement, the concept is simple enough so that the production is cheap enough for the small scale businesses can afford them since alternative methods using microcontrollers can alter the expenses involved in production.

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CHAPTER ONE

INTRODUCTION.

1.0 RELEVANCE OF STUDY.

Remote controls have brought about so much ease to most things activities we perform especially in the operation of simple electronics in our homes to elementary automation of processes that involve security, proximity and other associated obstacles. The principle of infrared technology which the remote control works on has been utilized over the years to facilitate electric gadgets with some form of automation to enhance easier use of these gadgets. The advantages associated with the simple automation the remote control brings to our lives cannot be overlooked even though our perception of the remote control and infrared technology as to be restricted to certain applications like microwave ovens and operation of electric hinders our ability to further explore its non-conspicuous uses. Automation as an aspect of technological advancement deals with the simplification of task we perform for convenient execution and this can be done through the process of interfacing. Interfacing in this case means using an existing remote control or constructing one that is compatible with some form of circuitry connected to the device to be operated to enable control of the device with the remote control. Depending on what aim is to be achieved, the use of the circuit to interface with the device is very important because it must fit the operation guidelines of the device to be operated. Certain conditions or points must be taken into consideration because the ease of use of the device to be operated is given priority. Some may want a special remote control to be design for the circuit while others would make a circuit that will work with any remote control type whether that for the television or that for the CD player thereby bringing out the multitasking ability of the remote control. This project aims at using an ordinary remote to control a designed infrared activated switch that could used in the automation of certain devices. Machines that have mechanical switches that need to be turned on and off manually can be automated so that they can be operated without proximity limitations and this kind of interfacing can be utilized in the electrical structure of buildings to enable wireless operation of light switches and other points that have switching points of such nature. This could be used as a replacement for the mechanical switch or as an alternative switching device by using both in the same device because the infrared activated switch prolongs the mechanical switch`s life span. The circuit basically contains an infrared receiver and some supporting circuitry that ensures proper channeling of the signals involved. Infrared receiver modules that are universal in nature, that is they receive infrared signals form any devices as long as the frequencies of both the sending and receiving devices are the same. Some infrared receivers are in the form of phototransistors that are accompanied with their matching transmitters. If this type of infrared receiver is used for the interfacing circuit then a remote control circuit must be designed using its matching transmitter for proper operation while interface circuits that contain the modules can work with any remote or infrared transmitting device of its frequency range. The circuit works by activating a relay that could perform the function of a switch and the signal received by the module is conveyed all the way to the relay to switch on or off by simply pressing a button on the remote control. The interface circuit could also be used as an infrared receiver for a computer once the proper pin connections are made to the serial port.

The relationship between the remote control and some other manually operated devices in our homes is what this project aims at establishing with the aid of interfacing. Most electronics in our houses are controlled by a remote control which is possible through infrared technology. Even though there are devices that operate based on infrared technology most of them do not perform universal functions that may be utilized in so many ways. This projects shows how a constructed infrared receiver would be used for various purposes as it relates to simple automation of switches and products at local scale level for convenient use.

1.1 OBJECTIVES.

1. To use an ordinary remote to control a switch.
2. To extend the life span of mechanical switches by activating the switch with less manual effort.
3. To achieve a simple means of automation of devices already existing that do not have that facility or automation the newly created devices especially those of local origin without the use of programming and microcontrollers.
4. To promote easier use of devices and switches by overcoming proximity obstacles for example switching on a lamp without actually being near it.

1.2 SCOPE OF STUDY.

This project aims at using an ordinary remote control to operate or activate a switch via an infrared receiver circuit that is interfaced to a relay. This project plays an important role of bringing out the diverse and multitasking nature of the remote control as an automation tool because it can be used to operate electronic devices, industry machines as long as the proper regulations are taken care of and even service design by incorporating the circuit in some specific points in the design like lighting points and switching points provided the power specifics are taken into consideration. How all this is intended to be achieved is as follows;

The infrared module receives the signal from the source and this signal is used to trigger the preceding segments of the circuit which consist of a monostable multivibrator as well as a bistable multivibrator . The multivibrators have different properties as far as triggering signals are concerned and a good knowledge of this was utilized in the execution of the project. This creates a switch that is activated with the remote control pressed for a period of two seconds (incase you would use the same remote for watching television so as not to cause accidental change of channels).

1.3 LIMITATIONS.

The aspect of this circuit that has not been explored is the ability for the circuit to have the same component values for different applications. In using it for lighting points of a house, the power connection could be critically looked or a battery could used instead.

CHAPTER TWO

LITERATURE REVIEW

2.0 INFRARED RADIATION AND THE REMOTE CONTROL.

2.0.1 INFRARED WAVES.

Infrared (IR) radiation is electromagnetic radiation of a wavelength longer than visible light, but shorter than microwave radiation. The name means "below red" (from the Latin *infra*, "below"), red being the color of visible light of longest wavelength. Infrared radiation spans three orders of magnitude and has wavelengths between 700 nm and 1 mm. Infrared light lies between the visible and microwave portions of the electromagnetic spectrum. Infrared light has a range of wavelengths, just like visible light has wavelengths that range from red light to violet. "Near infrared" light is closest in wavelength to visible light and "far infrared" is closer to the microwave region of the electromagnetic spectrum. The longer, far infrared wavelengths are about the size of a pin head and the shorter, near infrared ones are the size of cells, or are microscopic.

Far infrared waves are thermal. In other words, we experience this type of infrared radiation everyday in the form of heat. The heat that we feel from sunlight, a fire, a radiator or a warm sidewalk is infrared. The temperature sensitive nerve endings in our skin can detect the difference between inside body temperature and outside skin temperature. Infrared light is even used to heat food sometimes - special lamps that emit thermal infrared waves are often used in fast food restaurants. They can be used in medical appliances utilized in hospitals such as those used to flex the patients muscles in the psiotherapy unit. Short near infrared waves are not hot at all in fact you cannot even feel them. These shorter wavelengths are the ones used in remote controls that can be used to operate devices like televisions, CD players and other interfacial devices like computers that can be operated with a remote one interfaced in the proper. Since the primary source of infrared radiation is heat or thermal radiation, any object which has a temperature radiates in the infrared. Even objects that we think of as being very cold, such as an ice cube, emit infrared. When an object is not quite hot enough to radiate visible light, it will emit most of its energy in the infrared. For example, hot charcoal may not give off light but it does emit infrared radiation which we feel as heat. The warmer the object, the more infrared radiation it emits. Humans at normal body temperature radiate most strongly in the infrared at very short wavelengths (microns that is a micrometer or one millionth of a meter).

2.1 THE REMOTE CONTROL AS AN APPLICATION OF INFRARED TECHNOLOGY.

A **remote control** is an electronic device used for the remote operation of a machine. The term according to the wikipedia online encyclopedia (**www.wikipedia.com**), sometimes abbreviated to "the remote", is most commonly used to refer to a remote control for televisions or other consumer electronics such as stereo systems and DVD players, and to turn-on and off a mains plug as this project has been designed to achieve. Remote controls for these devices are usually small handheld objects with an array of buttons for adjusting various settings such as television channel, track number, and volume. In fact, for the majority of modern devices with this kind of control, the remote contains all the function controls while the controlled device itself only has a handful of essential primary controls. Most of these remotes communicate to their respective devices via infrared signals and a few via radio signals and are usually powered by small sized batteries with small direct current ratings.

2.2 EVOLUTION.

One of the earliest according to the encyclopedia (**www.wikipedia.com**) examples of remote control was developed in **1898** by **Nikola Tesla**. The first remote controlled model airplane flew 1936. The use of remote control technology for military purposes was worked intensively during the Second World War, one result of this was the German Wasserfall missile. The first remote intended to control a television was developed by Zenith Radio Corporation in the early 1950s. The remote unofficially called "Lazy Bones" used a wire to connect to the television set. To improve the cumbersome setup, a **wireless remote control** was created in **1955**. The remote called "Flashmatic" worked by shining a beam of light onto a photoelectric cell. Unfortunately, the cells did not distinguish between light from the remote and light from other sources. The Flashmatic also required that the remote control be pointed accurately at the receiver.

In **1956 Robert Adler** developed "Zenith Space Command", the **first modern wireless remote**. It was mechanical and used ultrasound to change the channel and volume. When the user pushed a button on the remote control it clicked and struck a bar, hence the term "clicker" was another reference to such a remote. Each bar emitted a different frequency and circuits in the television detected this sound. The invention of the transistor made possible cheaper electronic remotes that contained a piezoelectric crystal that was fed by an oscillating electric current at a frequency near or above the upper limit of human hearing, though still audible to dogs. The receiver contained a microphone attached to a circuit that was tuned to the same frequency. Some problems with this method were that the receiver could be triggered accidentally by naturally occurring noises, and some people, especially young women, could hear the piercing ultrasonic signals. There was even a noted incident in which a toy xylophone changed the channels on these types of TVs since some of the tones from the xylophone matched the remote`s ultrasonic frequency.

In the 1990s, when semiconductors for emitting and receiving infrared radiation were developed, remote controls gradually switched to that technology which, as of 2005, is still widely used. Remotes using radio technologies, such as Bose Audio Systems and those based on Bluetooth also exist.

The remote has gone through various changes over the years to become the device it is today. By average we pick up our domestic remotes at least once or twice a day. Since this is a device we are all used to operating on a daily basis then it is only logical to extend the usage horizon of the device by addition devices it operates or areas of application.

2.3 HOW THE REMOTE CONTROL WORKS.

The remote control operates by wait for you to press a key, and then to translate that key-press into infrared light signals that are received by the device to be operated. With a single channel remote control the presence of a carrier signal can be used to trigger a function. For multi-channel remote controls more sophisticated procedures are necessary: one consists of modulating the carrier with signals of different frequency. After the demodulation of the received signal, the appropriate frequency filters are applied to separate the respective signals. Nowadays digital procedures are more commonly used. When you take off the back cover of the control you can see that there is really just a few parts that are visible: a printed circuit board that contains the electronics and the battery contacts.

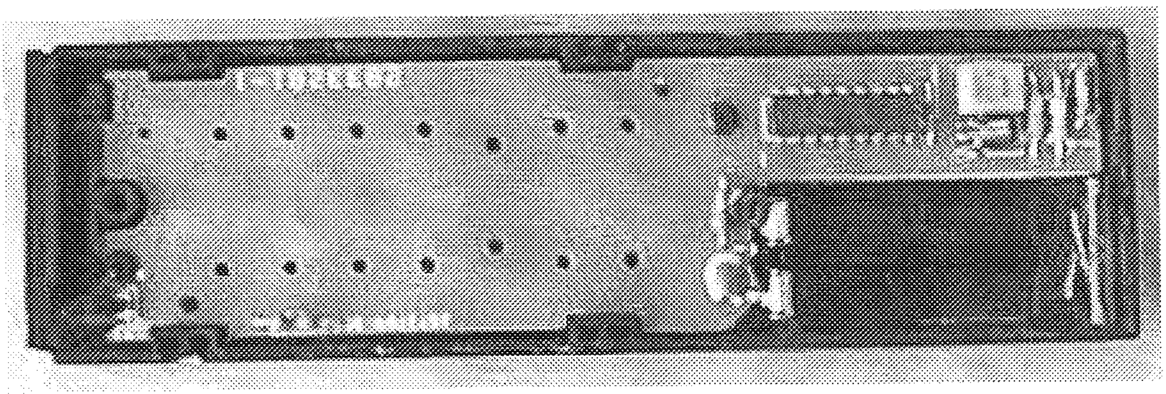


FIG. 2.0 INFRARED REMOTE CONTROL

The components that you see here are typical for most remotes. You can see an integrated circuit (also known as a chip). The chip is packaged in what is known as an 18 pin Dual Inline Package, or a DIP. To the right of the chip you can see a diode, a transistor, a resonator, two resistors and a capacitor. Next to the battery contacts there is a resistor and a capacitor. In this circuit, the chip can detect when a key is pressed. It then translates the key into a sequence something like morse code, with a different sequence for each different key. The chip sends that signal out to the transistor to amplify the signal and make it stronger for proper reception for the receiver. **(www.howstuffworks.com)**

2.4 TYPES OF REMOTE CONTROLS

Alternatively, **universal remote controls** combine multiple remotes into one, usually with some sort of switch or button indicating which device the remote is currently controlling. Universal remotes run from inexpensive basic models to a Linux-powered model from Sony. The first Universal Remote Control was developed by William Russell McIntyre in the mid 1980s, while employed at North American Philips Consumer Electronics Corporation. McIntyre's software design was awarded patents, since it was the first remote which could be pointed at an electronic device and learn its operational controls.

Remote or **radio control** exist for many other devices as well: model airplanes, helicopters and other radio controlled models are popular children`s toys: many robots are remotely controlled, especially those which are designed for doing perilous tasks; and some state of the art military fighter jets are operated by remote control. Remote controlled firearms are sometimes used to hunt birds and other animals.

2.4.1 TECHINIQUE

With a single channel remote control the presence of a carrier signal can be used to trigger a function. For multi-channel remote controls more sophisticated procedures are necessary: one consists of modulating the carrier with signals of different frequency. After the demodulation of the received signal, the appropriate frequency filters are applied to separate the respective signals. Nowadays digital procedures are more commonly used.

2.4.2 USAGE

Household: the operation of electronics and other devices for the ease of use.

Industry: Remote control is used for controlling substations, pump storage power stations and HVDC-plants. For these systems often PLC-systems working in the longwave range are used.

Weapons: Remote controlled weapons have been used since World War II.

Space: Remote control technology is also used in space travel, for instance the Russian Lunokhod vehicles were remote-controlled from the ground. Direct remote control of space vehicles at greater distances from the earth is not practical due to increasing signal delay times.

Bells : Remote control bell can be used to signal a receptionist from the manager office

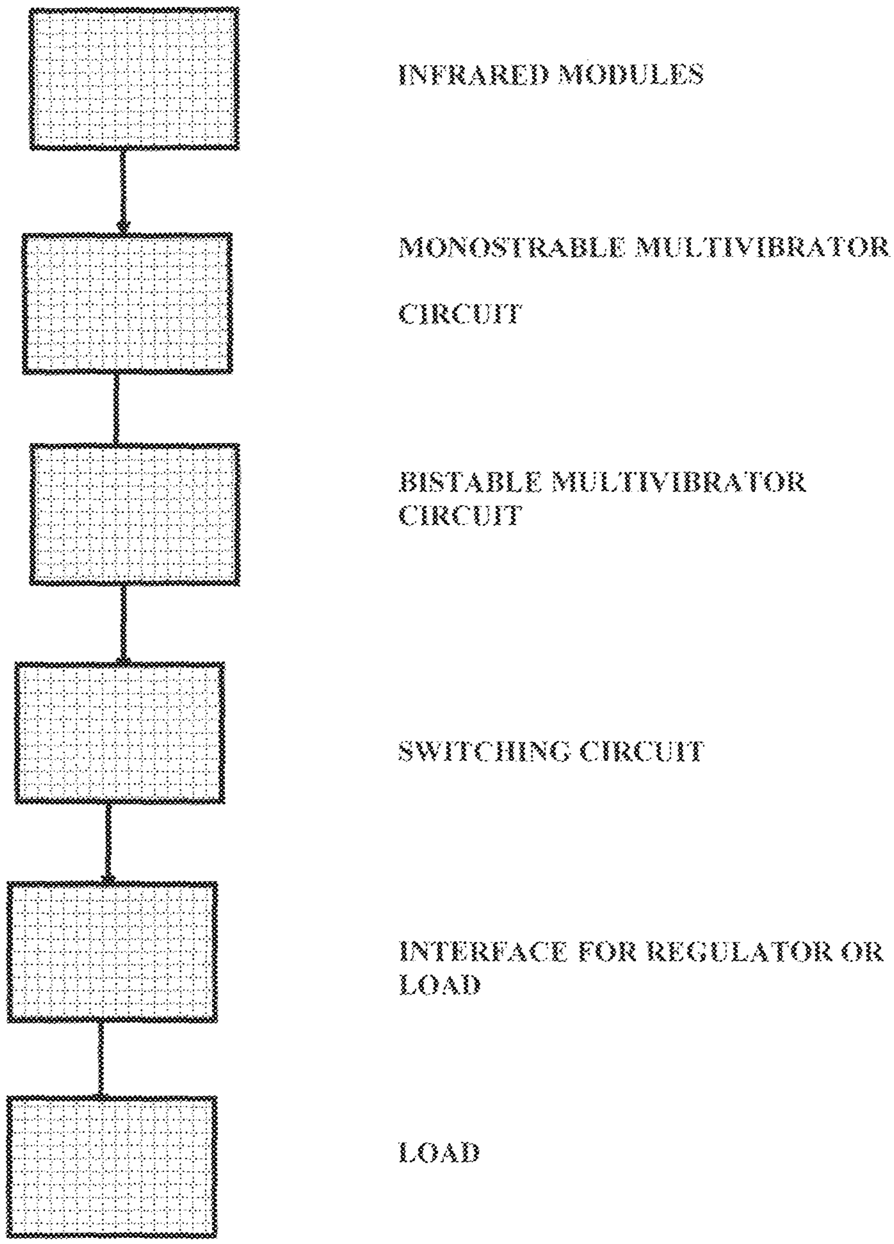
CHAPTER 3

CONSTRUCTION, TESTING AND RESULTS.

3.0 DESIGN ANALYSIS

The infrared activated switch circuit would be broken down into various segment blocks in order to properly understand the relationship between the components and to analyze the individual blocks involved in achieving the objective of the project. With reference to the block diagram below, the infrared switch circuit has an infrared module, monostable multivibrator ciruit and a bistable multivibrator circuit which play vital roles in the switching of relays intended for automated operation of devices to overcome proximity disadvantages involved in manual switching.

FIG. 3.0 THE CONCEPTUAL BLOCK DIAGRAM FOR THE INFRARED ACTIVATED SWITCH.



3.0.1 INFRARED MODULE: The infrared module is a three terminal infrared receiver integrated circuit that receives the infrared signals from the transmitting device (remote control) being used. The module used in this case is the TK1838 (or the Siemens SFH-506-38 as an alternative) which has a detection range of about ten metres and can detect a frequency of about 38kHz which is mostly generated by television remotes. The three pins represent the power pin, the common ground pin and the output pin of the receiver which is normally activated when it receives a signal on its sensors. The output of this integrated circuit is carried along to operate the other segments of the overall circuit. The TK1838 is shown below.

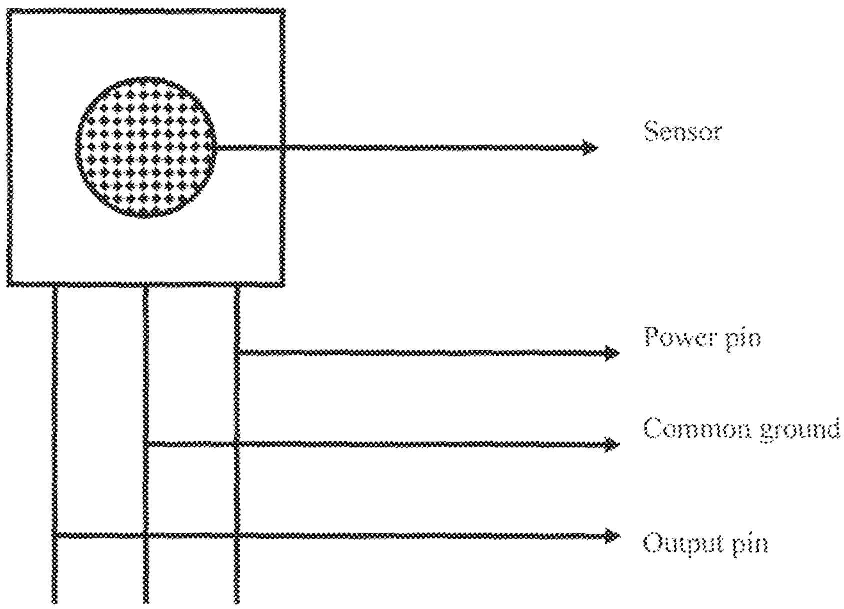


FIG. 3.1 INFRARED MODULE

3.0.2 MONOSTABLE MULTIVIBRATOR CIRCUIT: The signal from the infrared module is used to trigger a monostable circuit which is a member of the multivibrator family. The monostable circuit consist mainly a 555 timer eight pin integrated circuit (IC) that can be configured in monostable mode by a specific pin connection arrangement to give the required output which is always a one stable state signal. The auxiliary components of the monostable are the resistors and capacitors that form an RC circuit that provides the time delay that enables the circuit to remain in its unstable state for some time depending on the values of the resistors and capacitors used. The main function of this circuit is to flip from the stable state (which might be OFF state) to its unstable state (ON state) for some amount of time so that the output signal provides a clock pulse that would be able to trigger the preceeding bistable multivibrator circuit. The longer the remote control button is held, the longer the time delay for the monostable multivibrator circuit because it remains in the unstable state longer due to the resistor capacitor circuit capacity.

3.0.3 BISTABLE MULTIVIBRATOR CIRCUIT: This member of the multivibrator is the one in which the circuit will remain in either state (stable or unstable) indefinitely. The circuit can be flipped from one state (may be ON state) to the other (OFF state) by an external event or trigger and the trigger in this case is the output signal from the monostable multivibrator circuit. Such a circuit is important as the fundamental building block of a register or memory devices. This circuit is also known as a **flip-flop**. The bistable circuit in this application consists mainly of the CD4027 integrated circuit which is a CMOS J-K flip-flop that is used for its ability to withstand certain voltage levels unlike the transistor-transistor logic (TTL) counter parts that require some form of precision for their operation. The bistable circuit can be considered as the stabilizing circuit of the entire circuit set up because it keeps the load in its ON state or OFF state for as long as the bistable circuit remains in the required state. The output of the bistable set up is used as the switching signal for the switching aspect of the circuit.

3.0.4 SWITCHING CIRCUIT: The switching circuit consists of a transistor that is used as a switching aid in the operating of a relay that is connected to the transistor which is opened or closed by the signal from the bistable multivibrator circuit. The signal from the multivibrator is carefully monitored so as the current is enough to open the base terminal of the transistor when it is ON while the signal closes the base of the transistor to turn it to the OFF state. When the base of the transistor is open then the relay is switched on through the collector terminal signal but when the base is closed the collector signal is cut off therefore switching off the relay. For this circuit the transistor must be carefully chosen so that the output of the bistable circuit is enough to switch it on or off.

3.0.5 INTERFACE CIRCUIT FOR DEVICES: The interface is optional depending on the application of the circuit. The application of the circuit for switching on a lighting point in a house may differ from how it would be used in computer aided application. For the computer related use of this circuit, an interface circuit must be constructed in order to make the signals compatible with the external peripheral ports of the computer. The parallel port has certain current and voltage specifications and these must be considered in order to connect the circuit to a computer. The same applies to the serial port, universal serial bus and other peripheral ports that could be used to access the computer. For modification of the circuit, the interface circuit could be used with microcontrollers and auxiliary components like resistors and capacitors for improving how the circuit works or even what it

3.1 THE CIRCUIT CONSTRUCTION AND OPERATION.

With reference to the diagram on the circuit diagram page, the detailed operation of the circuit can be described by looking at the role of each component as they are related to each other and how they are made to achieve their intended purposes.

The circuit is built around a three terminal infrared receiver integrated circuit (IC) with model number TK1838. The infrared receiver (sensor) can detect a 38kHz signal from any infrared transmitting device within a range of ten metres as long the transmitter can transmit a signal to match the frequency required by the receiver. The three terminals of the infrared integrated circuit all have their respective places in the circuit. The power terminal of the infrared receiver is connected to the power source of circuit which is regulated through a five volt regulator (7805) because of the power specifications of the IC. The ground terminal is connected to the negative terminal of the power source while the output terminal provides the output signal of the infrared IC once a signal is detected by the receiver. The output of the infrared receiver is at an active low meaning that it is normally high when there is no signal detected by the sensor. Once the signal from a remote control activates the infrared receiver, the output terminal goes low to activate the monostable circuit next to it. To overcome the problem of visually knowing whether the detector has received the signal from the remote device or not, a signal reception light emitting diode (LED) was incorporated on the circuit to provide visual affirmation of the signal received. The light emitting diode was fixed to the output pin of the infrared receiver IC so that when an output is gotten at the terminal of the IC then the light emitting diode blinks or turns on to show that the signal was successfully received at the circuit. The method of fixing the diode depends on how the construction of the circuit is made but in the case of this particular circuit, the light emitting diode was fixed in such a manner so that it remains on as long as the relay is on and goes off when the relay turns off.

The output terminal provides a trigger signal for the monostable circuit that is built around a 555 timer IC. The specifications for the voltage and current values for the input and output signals for the 555 timer IC were considered in the construction of the monostable multivibrator circuit. The pin arrangements for the 555 timer IC in the monostable mode are connected as seen in the diagram with the reset and power pins (4 and 8) connected to the positive terminal of the power supply. The other pins are connected as the diagram depicts so that the output pin (pin 3) gives a signal that has one stable state and returns to that stable state after being flipped to the unstable state for some amount of time which is determined by the resistor capacitor network connected at the input pin (pin 2) of the 555 timer IC. The value of the resistor and capacitor chosen in the case of this project were chosen to give a delay for a couple seconds depending on how long the remote control button is pressed. With respect to this fact, the longer the button is held the more the capacitor stores energy from the input signal to keep the output signal in the unstable state. This time delay has the very advantage of preventing the monostable 555 timer circuit from being accidentally triggered incase the user of this circuit uses the same remote control he uses for the operation other household appliances.

The output signal of the 555 timer IC provides a clock signal that would trigger the bistable multivibrator circuit by going from the low state to the high state and back to the low state again. The output signal from the 555 timer is carefully monitored so that it provides the proper clock signal that would trigger the bistable circuit. The bistable circuit is built around a CD4027 J-K flip-flop IC that has reset and set pins to give a CMOS bistable multivibrator that is easier to operate on the basis of the input and output voltages. The bistable circuit has two stable states that is to say that no matter the state it is switch to, it can indefinitely stay in that state without flipping back to the other state unless a trigger has been applied to the input of the circuit. The output drives the relay through an npn transistor which is used as a switch for the relay.

The light emitting diodes on the diagram are used to display the status of the each stage of the operation of the circuit. The relay has the back EMF (electromotive force) diode for protection purposes while the transistor is configured as an open collector output device to drive the relay at 12V (Volts) direct current. As stated before, the circuit draws power from the voltage regulator 7805 while the capacitor on the power terminal of the infrared receiver IC is there to prevent noise and accidental triggering of the IC just as the capacitor on the output pin of the module prevents false triggering of the monostable NE555. The monostable acts as a one second hysterisis unit to restrict the flip-flop from getting retriggered within one second. To activate any 12V logic device, use the output across the relay coil terminals.

3.2 MULTIVIBRATOR CIRCUITS.

A **multivibrator** is an electronic circuit used to implement a variety of simple two-state systems such as oscillators, timers and flip-flops. The most common form is the astable or oscillating type, which generates a square wave - the high level of harmonics in its output is what gives the multivibrator its common name.

The types multivibrator circuits used in this project are:

- monostable, in which one of the states is stable, but the other is not - the circuit will flip into the unstable state for a determined period, but will eventually return to the stable state. Such a circuit is useful for creating a timing period of fixed duration in response to some external event. This circuit is also known as a **one shot**.

- bistable, in which the circuit will remain in either state indefinitely. The circuit can be flipped from one state to the other by an external event or trigger. Such a circuit is important as the fundamental building block of a register or memory device. This circuit is also known as a flip-flop. A similar circuit is a Schmitt trigger.

In its simplest form the multivibrator circuit consists of two cross-coupled transistors. Using resistor-capacitor networks within the circuit to define the time periods of the unstable states, the various types may be implemented. Multivibrators find applications in a variety of systems where square waves or timed intervals are required, but the simple circuits tend to be fairly inaccurate, so are rarely used where precision is required. An integrated circuit multivibrator, the 555, is very common in electronics. It uses a more sophisticated design to overcome some of the precision issues with the simpler circuits.

3.2.1 THE MONOSTABLE MULTIVIBRATOR.

The monostable circuit that is used in this project involved the use of a 555 timer IC. A popular version is the NE555 and this is suitable in most cases where a '555 timer' is specified. The 556 is a dual version of the 555 housed in a 14-pin package, the two timers (A and B) share the same power supply pins. The circuit diagrams on this page show a 555, but they could all be adapted to use one half of a 556.

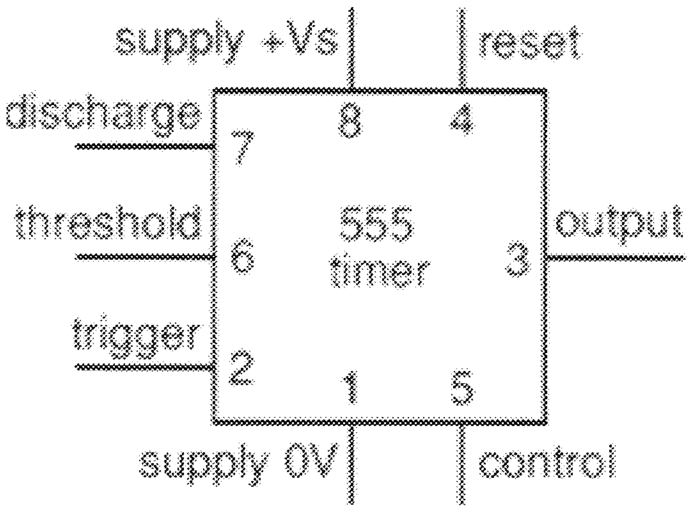


FIG. 3.3 Circuit symbol for the 555 timer IC.

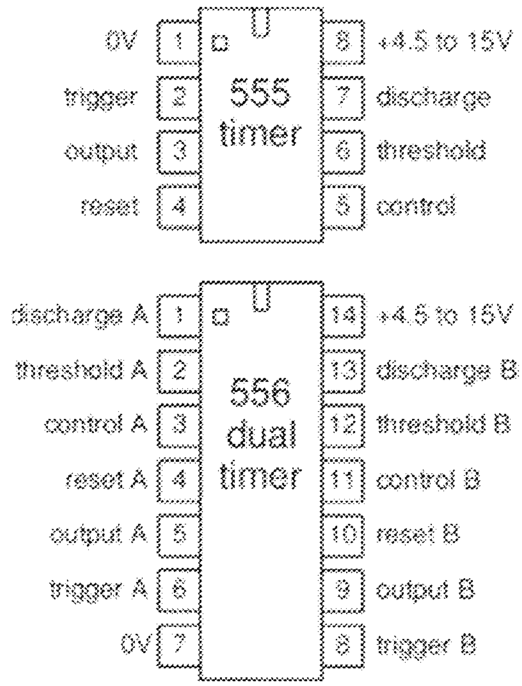


FIG. 3.4 Actual pin assignments for the 555 and 556 timer ICs

Low power versions of the 555 are made, such as the ICM7555, but these should only be used when specified (to increase battery life) because their maximum output current of about 20mA (with a 9V supply) is too low for many standard 555 circuits. The ICM7555 has the same pin arrangement as a standard 555.

The circuit symbol for a 555 (and 556) is a box with the pins arranged to suit the circuit diagram: for example 555 pin 8 at the top for the +Vs supply, 555 pin 3 output on the right. Usually just the pin numbers are used and they are not labelled with their function.

The 555 and 556 can be used with a supply voltage (Vs) in the range 4.5 to 15V (18V absolute maximum).

Standard 555 and 556 chips create a significant 'glitch' on the supply when their output changes state. This is rarely a problem in simple circuits with no other ICs, but in more complex circuits a **smoothing capacitor** (eg 100µF) should be connected across the +Vs and 0V supply near the 555 or 556.

INPUTS OF THE 555 TIMER.

Trigger input: when < $^1/_3$ Vs ('active low') this makes the output high (+Vs). It monitors the discharging of the timing capacitor in an astable circuit. It has a high input impedance > 2MΩ.

Threshold input: when > $^2/_3$ Vs ('active high') this makes the output low (0V)*. It monitors the charging of the timing capacitor in astable and monostable circuits. It has a high input impedance > 10MΩ.

* providing the trigger input is < $^1/_3$ Vs (the trigger input overrides the threshold input).

Reset input: when less than about 0.7V ('active low') this makes the output low (0V), overriding other inputs. When not required it should be connected to +Vs. It has an input impedance of about 10kΩ.

Control input: this can be used to adjust the threshold voltage which is set internally to be $^2/_3$ Vs. Usually this function is not required and the control input is connected to 0V with a 0.01µF capacitor to eliminate electrical noise. It can be left unconnected if noise is not a problem.

The **discharge pin** is not an input, but it is listed here for convenience. It is connected to 0V when the timer output is low and is used to discharge the timing capacitor in astable and monostable circuits.

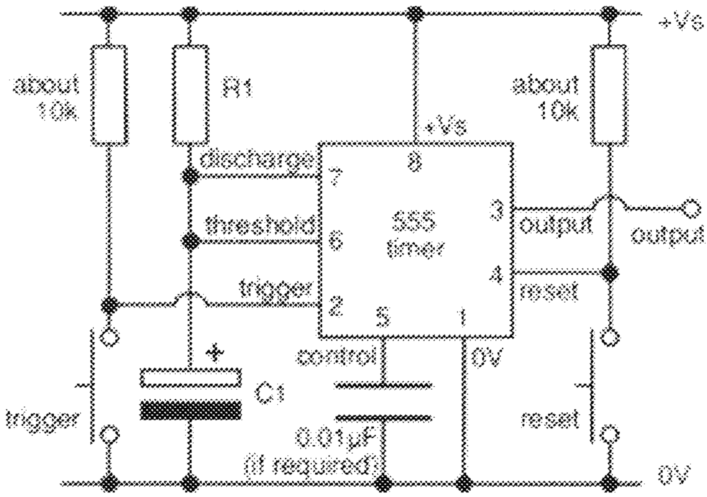
OUTPUTS OF THE 555 TIMER IC.

The output of a standard 555 or 556 can sink and source up to 200mA. This is more than most chips and it is sufficient to supply many output transducers directly, including LEDs (with a resistor in series), low current lamps, piezo transducers, loudspeakers (with a capacitor in series), relay coils (with diode protection) and some motors (with diode protection). The output voltage does not quite reach 0V and +Vs, especially if a large current is flowing.

To switch larger currents you can connect a transistor.

The ability to both sink and source current means that two devices can be connected to the output so that one is on when the output is low and the other is on when the output is high. The top diagram shows two LEDs connected in this way. This arrangement is used in the Level Crossing project to make the red LEDs flash alternately.

FIG 3.5   555 TIMER IN MONOSTABLE MODE.



A monostable circuit produces a single output pulse when triggered. It is called a monostable because it is stable in just **one** state: 'output low'. The 'output high' state is temporary.

The duration of the pulse is called the **time period** (T) and this is determined by resistor R1 and capacitor C1:

Time period, **T = 1.1 × R1 × C1**

T = time period in seconds (s)

R1 = resistance in ohms (Ω)

C1 = capacitance in farads (F)

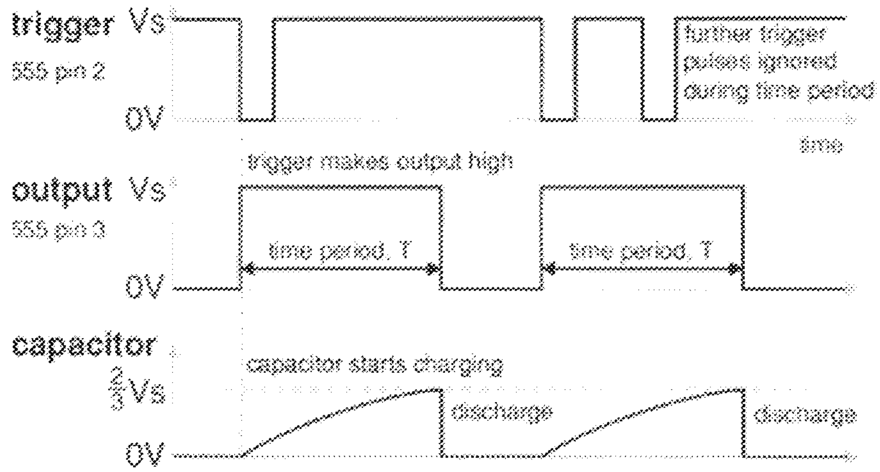


FIG. 3.6 THE EDGE TRIGGERING BEHAVIOUR OF MONOSTABLE CIRCUITS

The timing period is triggered (started) when the **trigger** input (555 pin 2) is less than $^{1}/_{3}$ Vs, this makes the **output** high (+Vs) and the capacitor C1 starts to charge through resistor R1. Once the time period has started further trigger pulses are ignored.

The **threshold** input (555 pin 6) monitors the voltage across C1 and when this reaches $^{2}/_{3}$ Vs the time period is over and the **output** becomes low. At the same time **discharge** (555 pin 7) is connected to 0V, discharging the capacitor ready for the next trigger.

The **reset** input (555 pin 4) overrides all other inputs and the timing may be cancelled at any time by connecting reset to 0V, this instantly makes the output low and discharges the capacitor. If the reset function is not required the reset pin should be connected to +Vs.

Power-on reset or trigger

It may be useful to ensure that a monostable circuit is reset or triggered automatically when the power supply is connected or switched on. This is achieved by using a capacitor instead of (or in addition to) a push switch as shown in the diagram.

The capacitor takes a short time to charge, briefly holding the input close to 0V when the circuit is switched on. A switch may be connected in parallel with the capacitor if manual operation is also required.

Edge-triggering

If the trigger input is still less than $^1/_3$ Vs at the end of the time period the output will remain high until the trigger is greater than $^1/_3$ Vs. This situation can occur if the input signal is from an on-off switch or sensor.

The monostable can be made **edge triggered**, responding only to **changes** of an input signal, by connecting the trigger signal through a capacitor to the trigger input. The capacitor passes sudden changes (AC) but blocks a constant (DC) signal. For further information please see the page on capacitance. The circuit is 'negative edge triggered' because it responds to a sudden fall in the input signal.

The resistor between the trigger (555 pin 2) and +Vs ensures that the trigger is normally high (+Vs).

3.2.2 THE BISTABLE MULTIVIBRATOR.

The bistable multivibrator circuit was made using a 16 pin 4027 dual J-K flip-flop which is monolithic complementary MOS (CMOS) integrated circuits constructed with N- and Pchannel enhancement mode transistors. Each flip-flop has independent J, K, set, reset, and clock inputs and buffered Q and Q outputs. These flip-flops are edge sensitive to the clock input and change state on the positive-going transition of the clock pulses. Set or reset is independent of the clock and is accomplished by a high level on the respective input. All inputs are protected against damage due to static discharge by diode clamps to VDD and VSS which are the power pins of the IC.

Features

1. Supply voltage range 3.0V to 15V
2. High noise immunity 0.45 VDD (typ.)
3. Low power TTL Fan out of 2 driving 74L compatibility or 1 driving 74LS
4. Low power 50 nW (typ.)
5. Medium speed operation 12 MHz (typ.) with 10V supply

3.3 RESULTS.

To calculate the trigger input.

For the trigger input, the voltage should be less than one third of the power (+Vcc) supply to the circuit therefore,

Trigger input < 1/3 (Vcc)

Where Vcc = 12Volts then the trigger input is lees than 1/3(12)

The trigger input should be less than 4Volts and also note that the trigger works at an active low (0).

To calculate the threshold pin input signal.

The threshold input should be greater the two-third of the power supplied to the circuit by formula.

Threshold input > 2/3 (Vcc) where the Vcc (power supply) is 12Volts

Therefore the threshold input signal should be greater than 8Volts and the input signal works at an active high.

For the reset input signal.

Since it not used for some special purpose the it is connect to Vcc but when it has a purpose incase of modification it should be less than 0.7 of Vcc. The control pin can be used to adjust the threshold pin while the discharge pin is not an input pin but used to discharge the timing capacitor

3.4 DIFFICULTIES ENCOUNTERED.

The main obstacle encountered in the construction of this project is the proper assertion of the input and output voltage values for the monostable multivibrator circuit consisting of the 555 timer IC based on the values mathematically calculated. The calculated values turned out to gave an idea of the range of values that could be practically used but not the exact value to be used. This point should be noted for those students that engage themselves in practical work for the time so as not to discourage them from practical work.

3.5 POSSIBLE MODIFICATION METHODS.

There are some possible ways of improving on the circuit depending on the application that it would be used for. My main aim was to provide automation without the use of microcontrollers so as to provide those without the knowledge of programming with a sense of belonging to the production field even though the knowledge of programming helps in production. The modification of this circuit could be done by incorporating a microcontroller on the circuit so that multiple loads could be controlled by a single remote control. With this method, a whole household could be controlled from a single remote. I tried using a tone decoder to attain the following objective but due to time constraint, I could not modify the circuit further. Modification could be in the form of operating multiple loads from a single remote control.

CHAPTER FOUR

CONCLUSIONS AND RECOMMENDATIONS

4.0 CONCLUSION

The project was carried on the basis of automation of devices that satisfy purposes of both household and industrial magnitudes with a reasonable financial backing. The circuit was constructed with materials that were available in the market to buy so gaining access to the integrated circuits (ICs), infrared modules and supporting components like resistors and capacitors was not much of a task. The most prominent objectives of the project were achieved with a few minor setbacks due to the fact that not all problems with the intention to be solved can actually be overcome with this circuit. This gives room for improvement on the problems this project can overcome with the aid of analyzing the loopholes on the circuit.

4.1 RECOMMENDATIONS

The difficulties encountered during the execution of this project cannot only be as a result of inexperience on my part as a student but the some difficulties can be attached to some areas I strongly recommend the school should work on. The sensitive areas that can bring about improvement in the execution of projects are the inclusion of more practically interactive courses that relate mainly to the specialization field of the students and provision of adequate materials in the labatory so that most students can have access to them at much ease as an encouragement factor.

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APPENDIX: CIRCUIT DIAGRAM