DESIGN AND CONSTRUCTION OF A MICROCONTROLLER BASED ACOUSTIC AND INFRA-RED SWTICH.

BY

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DEDICATION

This project is dedicated to God, my destiny maker, my way maker, my hope giver and future builder, and my beloved parents, **Mr. and Mrs J.F Adeniyi**, who has always wanted the best for me in life.

DECLARATION.

I *Adeniyi Olorunfemi Babatunde*, declare that this work was done by me and has never been presented elsewhere for the award of a degree. I also hereby relinquish the copyright to the Federal University of Technology, Minna.

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ABSTRACT

The project designed and constructed is a microcontroller based acoustic and infra red switch. The circuit offer a way to control up to three appliances with just a clap of hand, or press of a remote control button which activates the 3 relay outlet individually or simultaneously.The above is achieved by embedded systems technology, thus aiding simplicity, efficiency, effectiveness, and robustness.

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CHAPTER ONE

1.0 INTRODUCTION

The most basic principle of the microcontroller based acoustic and infrared remote control is that it is a circuit that uses sound or infrared signal in general as the main source of signal that triggers an electronic relay switch via the microcontroller and transistor. If sound was selected as the means to switch on the ciruit then the input sound will come from a small transducer or a microphone that transmits the sound to the whole circuit by converting sound energy into some signal that can generate enough power to make the relay switch contact. So, basically thinking in terms of electronics, the microcontroller based acoustic and infrared remote control is a special electronic gadget that may be used as a switch to operate small to bigger appliances and even the simplest bulbs by the use of a clap that is fed to the circuit to enable the contact points of an electronic relay switch come together.

Alternatively if an infrared remote was used, then the relay switch is closed by pressing the button, and the information is translated to light signal that is received by the receiver side of the device. The transmitter part is constructed so that the oscillator which is driving the transmitter LED can be turn ON/OFF by applying a voltage on the input control. On the receiver, a photodiode takes up the signal then an amplifier increases the gain, it then triggers the microcontroller connected to it.

Basically a remote control operates in the following manner;

A button is pressed, this complete a specific connection which produces a Morse code line signal specific to the button. The transistor amplifies the signal into infra-red light and sends to the sensor on the appliances and responds appropriately to the received signal or command

1.1 AIMS AND OBJECTIVES

The primary reason this project was designed and constructed is to help relief the burden of stress the elderly or mobility-impaired person goes through.The device is intended to help those who have challenge moving from one point to another so as to turn off or on an appliance.With this device the person could seat, and just clap for the device to come on or off in any sequence he/ she wants.Since the device also as an option of remote control then the operator of the device could use a remote control to put his/her appliance on/off.

The microcontroller based acoustic switch with infra red remote is generally used to put on/off lighting appliances, television, radio, or similar electronic device that the person will want to turn on/off from the wheel chair ,bed,or when lying on the couch.

Another aim of this work is to facilitate the protection of electrical and electronic devices from electrical faults in the home, and also to facilitate the control of mains supply to a room from a distance easily.

1.2 METHODOLOGY

The microphone, mounted at the front of the device which is set into active mode by the switch that controls both the clap mode and the infrared mode, is always tuned in to the surrounding environment. Every sound that hits the clap activated switch is "heard" by the microphone, converted into an electrical signal.

Every time the device registers a "clap," it sends a signal to one of three electrical switches -- each of which activate a separate electrical outlets on the exterior of the device, which is where you've plugged in your TV radio or lamp. The sequence to which the on and off occurs is gotten from the binary arrangement of the outlets .Meaning for instancce a 001 represents switch 'C' being active alone and 010 for switch B till all the possible output arrangements are gotten via the clap or the remote.One perculiar thing is that any house hold remote control can be used to activate the device .

1.3 SCOPE OF THE PROJECT

The clap activated switch can even be used as a rudimentary burglar alarm. By simply adjusting the sensitivty through the variable resistor of the amplification side of the clapper circuit, the device becomes ultra sensitive which would go off at even the slightest noise. The idea is that if a burglar breaks in, and makes the slightest noise the circuit would pick it up and process it, which would result in the activation of the outlet and that which might be connected to it say a loud electrical bell or a bright light,or basically any thing that would startle the thief out of the house.

1.4 LIMITATIONS

The Clapper with option of a remote can sometimes be triggered by coughing, a dog's bark or clapping that emanates from televisions and stereo speakers set at high volume, making it somewhat inconvenient for households with dogs and loud appliances. Also the infrared remote part suffers some draw back, in that obstacle(s) must not be present between transmitter and receiver side of the microcontroller switch in the remote control mode.

CHAPTER 2

LITERATURE REVIEW

2.0 HISTORICAL BACKGROUND

Since the infrared and the sound mode of triggering the microcontroller switch are different in operation and history,then its worth talking on them briefly.

Clapper Origins:

In New York, eighty-year-old Edna Hubbs sued the makers of the Clap activated switch (also know in usa as the clapper), claiming that she had injured her wrists while clapping. The judge threw the case out and advised Hubbs to adjust the Clapper's sensitivity control.

Originally dubbed "The Great American Turn-on," the predecessor to the Clapper was first conceived in a Toronto workshop by two Canadian inventors. The pair brought a prototype to advertising mogul Joseph Pedott.Pedott was a tough customer. Founder of Joseph Enterprises Inc., he was a career marketing and advertising man. Whatever might be said about his grating and repetitive TV commercials, they sold products. "If you do something repetitive, you're doing a little brainwashing," Pedott once said in an interview

In the early 1980s, Pedott already had the Chia Pet under his belt, and he was on the lookout for his next big money maker. Only one out of every thousand products Pedott saw ever made it into distribution, but the Clapper was special; it was convenient, simple and, above all, patentable. Pedott sealed an agreement with the two inventors, and a Clapper ad campaign and assembly line was soon underway.

Infrared control origin:

One of the earliest examples of remote control was developed in 1898 by Nikola Tesla, and described in his patent, U.S. Patent 613,809, named Method of an Apparatus for Controlling Mechanism of Moving Vehicle or Vehicles. In 1898, he demonstrated a radio-controlled boat to the public during an electrical exhibition at Madison Square Garden. Tesla called his boat a "teleautomaton".

In 1903, Leonardo Torres Quevedo presented the Telekino at the Paris Academy of Science, accompanied by a brief, and making an experimental demonstration. In the same time he obtained a patent in France, Spain, Great Britain, and the United States. The Telekino consisted of a robot that executed commands transmitted by electromagnetic waves. It constituted the world's first apparatus for radio control and was a pioneer in the field of remote control.

The first remote-controlled model aero plane flew in 1932, and the use of remote control technology for military purposes was worked intensively during the Second World War, one result of this being the German Wasserfall missile. By the late 1930s, several radio manufacturers offered remote controls for some of their higher-end models. Most of these were connected to the set being controlled by wires, but the Philco Mystery Control (1939) was a battery-operated low-frequency radio transmitter, thus making it the first wireless remote control for a consumer electronics device.

Its worth noting that in this project both types of switching mode(sound and infrared remote) was incoporated into one circuit so as to complement each other in disadvantages they might posses.

2.1 THEORETICAL BACKGROUND

The idea behind the microcontroller based acoustic switch with option of a remote is that on emission of a sound wave (hint: talking only on the sound aspect) the sound is converted to an analog electical signal.

A clap activated switch provides a signal indicative of the presence of human clap in an audio signal. That signal can be used to activate a tape recorder, a transmitter, or a variety of other audio devices that process human clap.

One way to detect the predominance of particular frequency components in a signal is by the well known technique of auto-correlation where the signal is multiplied by a time-delayed version of itself. The delay amount is the period corresponding to the frequency of interest. U.S. Pat. No. 4,959,865 to Stettiner et al. discloses using thirty-six separate autocorrelation lags to detect voiced speech and non-speech tones. Stettiner teaches examining the periodicity of the peaks of the thirty-six autocorrelation bins to detect the presence of predominant frequency components at frequencies between fifty and five-hundred Hz. However, providing thirty-six autocorrelations requires a relatively large amount of processing bandwidth and therefore may not be desirable for applications where a relatively large amount of processing bandwidth is not available

According to the present invention, human speech is detected in an audio signal by providing a single autocorrelated signal indicative of the audio signal multiplied by a time-delayed portion of the audio signal, the delay being an amount of time indicative of a period corresponding to a first formant frequency, detecting when a portion of the autocorrelated signal exceeds a scaled noise value, and determining when a portion of the audio signal contains human speech according to whether a plurality of portions of the audio signal exceed or do not exceed the scaled noise value.

According further to the present invention, the scaled noise value equals the minimum of forty-eight portions of the audio signal multiplied by a constant value which can be selected by a user.

The infrared remote control part of the device is made up of a transmitter and a receiver (Photo detector). The transmitter transmits light with a particular color within the frequencies of 30 KHz and 60 KHz having a wave length of about 950nm. This is just below the red part of the visible light spectrum, and cannot be seen by the human eye. The control works by pressing a button on the transmitter, which sends signals by a binary code, a series of logical zeros and ones having different combinations to tell the receiver what to do. These codes hold information, like the address to the receiver i.e. the particular receiver the information was meant for and also to the appropriate location, with commands to be executed. The first thing the transmitter sends to the receiver is called the header. The header is a burst of high that alerts all the infrared receivers in an area.

After the header comes, then the code which includes the address to the specific receiver that is to be operated arrives. Then comes the command that tells the receiver what to do, this command will continue as long as a button on the transmitter is held or pressed down when the button is released a string of code as sent to the receiver telling it to stop.

2.2 LIMITS OF PERFORMANCE

The major disadvantage is that it's generally cumbersome to have to clap one's hands once twice or eight times as the case may be to turn an appliance on or off and it's generally seen as simpler for most house hold cases to use a traditional light switch

The modern world is a noisy place and not always the best environment for clap-activated appliances. Any loud, rhythmic noise can set off the device. Loud music or barking dogs have been known to set off the Clapper. Even if there are no burglars at hand, common household sounds can quickly turn a Clapper-wired living room into a confusing mess of on-and-off appliances. That's why it is recommended you don't plug any heat generating appliances into the device. An accidentally switched-on light is annoying, but an accidentally switched-on hair dryer is a fire hazard. The above disadvantage stated of the switch in the sound/acoustic mode is overcomed by the introduced infrared circuit

The Clapper is a notoriously finicky device. Clap too softly or clap too rapidly, and you might find yourself suddenly plunged into darkness when you meant to turn off the TV. It takes a while to get used to it, but after a brief meeting with your new Clapper, you can easily master the art of clapping.

Of course, not everybody can clap, and this can present a problem -- especially given that elderly and disabled people compose a significant segment of the community.

In those cases, the Clapper recommends using a "cricket" -- a handheld metal device that, when squeezed, emits loud clicking sounds. In a pinch, the Clapper can also be activated by yelling words in a Clapper-friendly cadence.

In the case where the infrared remote control is used, the notable limitations are that the remote might be misplaced, or there might be an obstruction between the receiving and sending part of the device.Also since the remote uses battery instead of ac source then there is need to occasionally replace the 9volts batery when it runs down.

2.3 MAIN COMPONENTS DESCRIPTION

2.3.0 TRANSFORMER

A transformer is a device that transfers electrical energy from one circuit to another through inductively coupled conductors—the transformer's coils. A varying current in the first or primary winding creates a varying magnetic flux in the transformer's core, and thus a varying magnetic field through the secondary winding. This varying magnetic field induces a varying electromotive force (EMF) or "voltage" in the secondary winding. This effect is called mutual induction.

If a load is connected to the secondary, an electric current will flow in the secondary winding and electrical energy will be transferred from the primary circuit through the transformer to the load. In an ideal transformer, the induced voltage in the secondary winding (VS) is in proportion to the primary voltage (VP), and is given by the ratio of the number of turns in the secondary (NS) to the number of turns in the primary (NP) as follows:

$$\frac{V_S}{V_P} = \frac{N_S}{N_P}$$

By appropriate selection of the ratio of turns, a transformer thus allows an alternating current (AC) voltage to be "stepped up" by making NS greater than NP, or "stepped down" by making NS less than NP. In the vast majority of transformers, the windings are coils wound around a ferromagnetic core, air-core transformers being a notable exception.

2.3.1 DIODE BRIDGE

A diode bridge is an arrangement of four diodes in a bridge configuration that provides the same polarity of output for either polarity of input. When used in its most common application, for conversion of an alternating current (AC) input into direct current a (DC) output, it is known as a bridge rectifier. A bridge rectifier provides full-wave rectification from a two-wire AC input, resulting in lower cost and weight as compared to a rectifier with a 3-wire input from a transformer with a centre-tapped secondary winding.

The essential feature of a diode bridge is that the polarity of the output is the same regardless of the polarity at the input

2.3.2 CAPACITOR

A capacitor (formerly known as condenser) is a passive electronic component consisting of a pair of conductors separated by a dielectric (insulator). When there is a potential difference (voltage) across the conductors a static electric field develops in the dielectric that stores energy and produces a mechanical force between the conductors. An ideal capacitor is characterized by a single constant value, capacitance, measured in farads. This is the ratio of the electric charge on each conductor to the potential difference between them.

Capacitors are widely used in electronic circuits for blocking direct current while allowing alternating current to pass, in filter networks, for smoothing the output of power supplies, in the resonant circuits that tune radios to particular frequencies and for many other purposes.

2.3.3 REGULATOR

The Regulator is used as one half of a potential divider to control the output voltage, and a feedback circuit compares the output voltage to a reference voltage in order to adjust the input to the transistor, thus keeping the output voltage reasonably constant. This is inefficient: since the transistor is acting like a resistor, it will waste electrical energy by converting it to heat. In fact, the power loss due to heating in the transistor is the current times the voltage dropped across the transistor. The same function can be performed more efficiently by a switched-mode power supply (SMPS), but it is more complex and the switching currents in it tend to produce electromagnetic interference. A SMPS can easily provide more than 30A of current at voltages as low as 3V, while for the same voltage and current, a linear regulator would be very bulky and heavy.

All linear regulators require an input voltage at least some minimum amount higher than the desired output voltage. That minimum amount is called the dropout voltage. For example, a common regulator such as the 7805 has an output voltage of 5V, but can only maintain this if the input voltage remains above about 7V, before the output voltage begins sagging below the rated output. Its dropout voltage is therefore 7V - 5V = 2V. When the supply voltage is less than about 2V above the desired output voltage, as is the case in low-voltage microprocessor power supplies, so-called low dropout regulators (LDOs) must be used.

When one wants a voltage higher than the available input voltage, no linear regulator will work (not even an LDO). In this situation, a switching regulator must be used.

2.3.4 MICRO CONTROLLER

A microcontroller (sometimes abbreviated µC or uC) is a small computer on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals. Program memory in the form of NOR flash or OTP ROM is also often included on chip, as well as a typically small amount of RAM. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general purpose applications.

Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, implantable medical devices, remote controls, office machines, appliances, power tools, and toys. By reducing the size and cost compared to a design that uses a separate microprocessor, memory, and input/output devices, microcontrollers make it economical to digitally control even more devices and processes. Mixed signal microcontrollers are common, integrating analog components needed to control non-digital electronic systems.

Some microcontrollers may use four-bit words and operate at clock rate frequencies as low as 4 kHz, for low power consumption (milliwatts or microwatts). They will generally have the ability to retain functionality while waiting for an event such as a button press or other interrupt; power consumption while sleeping (CPU clock and most peripherals off) may be just nanowatts, making many of them well suited for long lasting battery applications. Other microcontrollers may serve performance-critical roles, where they may need to act more like a digital signal processor (DSP), with higher clock speeds and power consumption.

2.3.5 PIEZO ELECTRIC QUARTZ CRYSTAL

A crystal oscillator is an electronic circuit that uses the mechanical resonance of a vibrating crystal of piezoelectric material to create an electrical signal with a very precise frequency. This frequency is commonly used to keep track of time (as in quartz wristwatches), to provide a stable clock signal for digital integrated circuits, and to stabilize frequencies for radio transmitters and receivers. The most common type of piezoelectric resonator used is the quartz crystal, so oscillator circuits designed around them were called "crystal oscillators".

Quartz crystals are manufactured for frequencies from a few tens of kilohertz to tens of megahertz. More than two billion (2×109) crystals are manufactured annually. Most are small devices for consumer devices such as wristwatches, clocks, radios, computers, and cellphones. Quartz crystals are also found inside test and measurement equipment, such as counters, signal generators, and oscilloscopes.

2.3.6 RESISTOR

A resistor is a two-terminal electronic component that produces a voltage across its terminals that is proportional to the electric current passing through it in accordance with Ohm's law:

$V = IR$

Resistors are elements of electrical networks and electronic circuits and are ubiquitous in most electronic equipment. Practical resistors can be made of various compounds and films, as well as resistance wire (wire made of a high-resistivity alloy, such as nickel/chrome).

The primary characteristics of a resistor are the resistance, the tolerance, maximum working voltage and the power rating. Other characteristics include temperature coefficient, noise, and inductance. Less well-known is critical resistance, the value below which power dissipation limits the maximum permitted current flow, and above which the limit is applied voltage. Critical resistance is determined by the design, materials and dimensions of the resistor.

Variable resistors consist of a resistance track with connections at both ends and a wiper which moves along the track as you turn the spindle. The track may be made from carbon, cermet (ceramic and metal mixture) or a coil of wire (for low resistances). The track is usually rotary but straight track versions, usually called sliders, are also available.

2.3.7 TRANSISTOR

A transistor is a semiconductor device used to amplify and switch electronic signals. It is made of a solid piece of semiconductor material, with at least three terminals for connection to an external circuit. A voltage or current applied to one pair of the transistor's terminals changes the current flowing through another pair of terminals. Because the controlled (output) power can be much more than the controlling (input) power, the transistor provides amplification of a signal. Today, some transistors are packaged individually, but many more are found embedded in integrated circuits.

The transistor is the fundamental building block of modern electronic devices, and its presence is ubiquitous in modern electronic systems. Following its release in the early 1950s the transistor revolutionised the field of electronics, and paved the way for smaller and cheaper radios, calculators, and computers, amongst other things

2.3.8 LM 358 OPERATIONAL AMPLIFIERS

The LM358 consists of two independent high gains, internally frequency compensated operational amplifier.

It can be operated from a single power supply and also split power supplies. It has a internally frequency compensated for unity gain, wide power supply range 3V - 32V,

Input common-mode voltage range includes ground, Large DC voltage gain.

Some Unique Characteristics of the operational amplifier is that in the linear mode the input common-mode voltage range includes ground and the output voltage can also swing to ground, even though operated from only a single power supply voltage.

Also the unity gain cross frequency is temperature compensated. Lastly the input bias current is also temperature compensated. LM358 can be used to construct a stable amplifier, an inverting amplifier and a non-inverting one since there are two op amps on each LM358 chip

2.3.9 RELAY

A relay is an electrically operated switch. Many relays use an electromagnet to operate a switching mechanism, but other operating principles are also used. Relays find applications where it is necessary to control a circuit by a low-power signal, or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits, repeating the signal coming in from one circuit and re-transmitting it to another. Relays found extensive use in telephone exchanges and early computers to perform logical operations. A type of relay that can handle the high power required to directly drive an electric motor is called a contactor. Solid-state relays control power circuits with no moving parts, instead using a semiconductor device to perform switching. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults; in modern electric power systems these functions are performed by digital instruments still called "protection relays".

2.3.11 ELECTRET MICROPHONE

An electret microphone is a type of condenser microphone, which eliminates the need for a polarizing power supply by using a permanently-charged material.

An electret is a stable dielectric material with a permanently-embedded static electric charge (which, due to the high resistance and chemical stability of the material, will not decay for hundreds of years). The name comes from electrostatic and magnet; drawing analogy to the formation of a magnet by alignment of magnetic domains in a piece of iron

2.3.10 555 TIMER IC

The 555 Timer IC is an integrated circuit (chip) implementing a variety of timer and multivibrator applications. The IC was designed by Hans R. Camenzind in 1970 and brought to market in 1971 by Signetics (later acquired by Philips). The original name was the SE555 (metal can)/NE555 (plastic DIP) and the part was described as "The IC Time MachineDepending on the manufacturer, the standard 555 package includes over 20 transistors, 2 diodes and 15 resistors on a silicon chip installed in an 8-pin mini dual-in-line package (DIP-8). Variants available include the 556 (a 14-pin DIP combining two 555s on one chip), and the 558 (a 16-pin DIP combining four slightly modified 555s with DIS & THR connected internally, and TR falling edge sensitive instead of level sensitive).

Ultra-low power versions of the 555 are also available, such as the 7555 and TLC555. The 7555 requires slightly different wiring using fewer external components and less power.

CHAPTER THREE

3.0 DESIGN AND IMPLEMENTATION

The General layout of the microcontroller based aucostic and infrared remote switch are

- ❖ Power supply unit
- ❖ Infrared receiver unit and transmitter unit
- ❖ Clap sensor unit
- ❖ Control unit
- ❖ Output unit

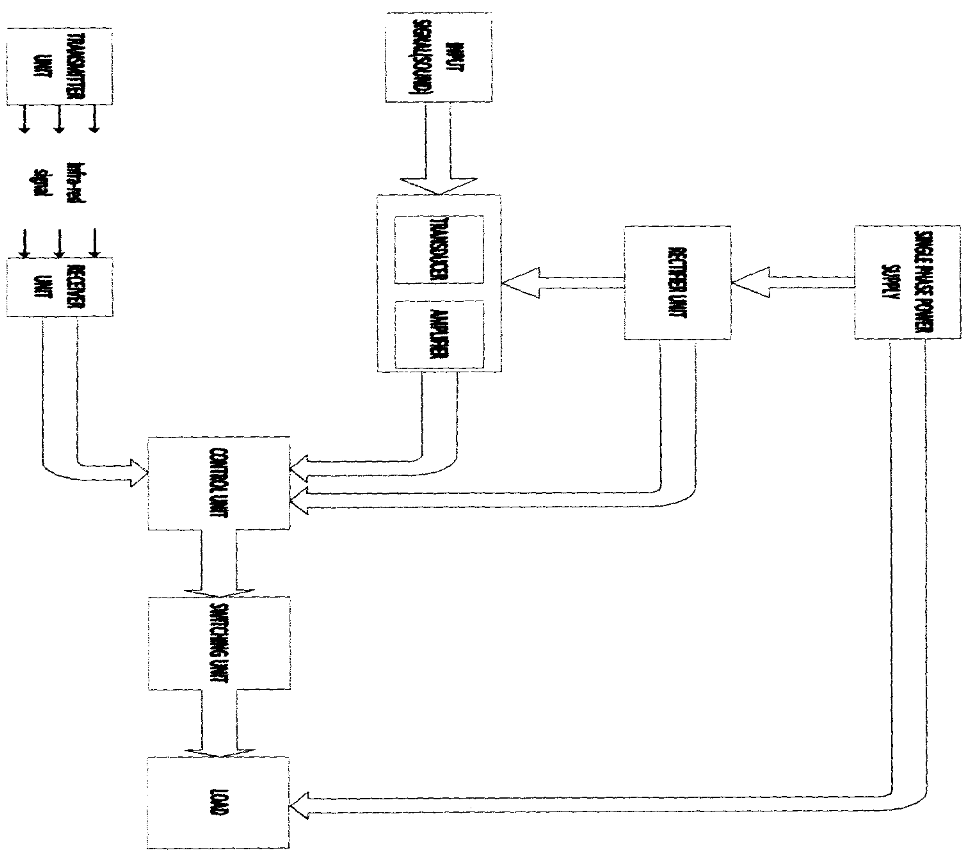

FIG 3.1: DEVICE BLOCK DIAGRAM

3.0.0 POWER SUPPLY UNIT :

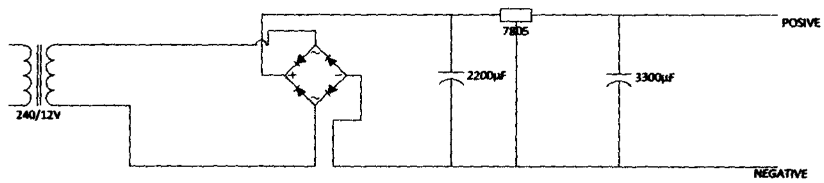

FIG 3.2: POWER SUPPLY UNIT

Considering the power supply unit shown above

A voltage of approximately 240volts is applied at the primary side of the transformer and its stepped down to a voltage value of 12volts. A bridge rectifier was connected to the output of the transformer. During the postive input half cycle,two diodes are forward biased and the other two are reversed biased making them inactive.while in the negative input half cycle, the former diodes become reversed biased(inactive) and the later would be forward biased(active conducting mode). The frequency of the rectified output consists of a D.C component and many A.C components of diminishing amplitude.

By the analysis of Fourier series, we know that a rectified sine wave consists of a D.C components and harmonics of the supply frequency. These harmonics are responsible for the ripples and this is undesirable for smooth operation of the microcontroller based acoustic and infrared remote control device. The process of removing these ripples is known as filtering. The type of filtering process employed was the capacitor type.

The capacitor filter circuit similar to the one used in this project for filtering the rectified A.C supply from the transformer is described as follows

The action of this system depends on the fact that the capacitor stores energy during the conduction period and delivers this energy to the load during the non-conductive period. In this way, the time during which the current passes through the load is prolonged and the ripple is considered decreased. Ripples are the A.C components of a supposed D.C output from the rectifier.the ripple voltage, V_r is given by the equation:

$$Vr = \frac{2.4 \times Vdc}{C \times Rl}$$

Its worth noting that the pulsating DC voltage was filtered free of AC content by a 2200Uf 25V capacitance evaluated from the expression.

Q = CV = It. If V is the ripple voltage which is the output of the rectifier, then $V = \delta V =$ Peak Voltage$-$Vmin……………………………………………3.1

Peak Voltage= $\sqrt{2} \times$Vrms……………………………………………………………...3.2

Vrms = 12V $\therefore$Peak Voltage= $12\sqrt{2} \cong 16.9V$

Since a silicon rectifier is used, 1.4V is subtracted from the peak voltage

$\Rightarrow$Peak Voltage$\approx$ 15.5V.

But Vmin =Vreg + head……………………………………………………………...3.3

For this system to work well even when PHCN supply is low (at about 180V), the peak voltage at 180V is calculated from 3.2. However, Vrms at 180V is calculated as

220V (A. C) would yeild 12V(D. C)

$180V(A.C)$would yeild $\frac{(180\times12)}{220} \cong 9.8V$(from simple cross multiplication)

$\Rightarrow Vpeak = 9.8\sqrt{2} \approx 13.85V$ but because a silicon rectifier was used,

$Vpeak \cong 13.85 - 1.4 = 12.3V$ which is the minimum voltage for the system to operate.

$\therefore \delta V = 15.5 - 12.3 = 3.2V$

From above values we have

$C\delta V = It$, $I = 0.5A$(transformer rating), $C = C_1$ while

$t = \frac{1}{2f}$ where $f = 50Hz$ $\therefore t = \frac{1}{2\times50} = 0.01s$

$\therefore C_1 = \frac{0.01\times0.5}{3.2} \cong 1563\mu F$(from $C\delta V = It$, the c was made subject of formula)

A 2200μF was chosen for C_1 since it fell within range.

C_2 is taken to be 3300 μF to maintain system intergrity and to prevent unwanted ripples The above capacitance yields the minimum capacitance required for worst-case system operation. A value of 3300 UF was thus selected at a 25 V DC voltage.

3.0.1 REMOTE CONTROL TRANSMITTER AND RECEIVER SIDE

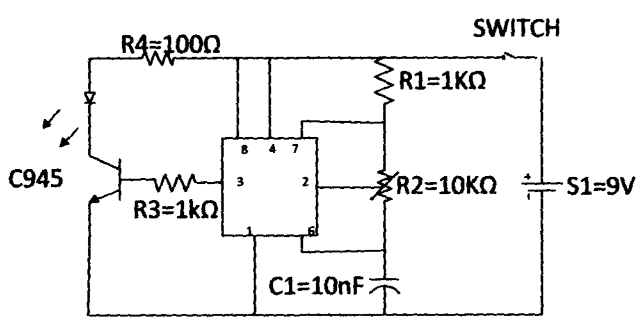

FIG3.3: TRANSMITTER CIRCUIT DIAGRAM

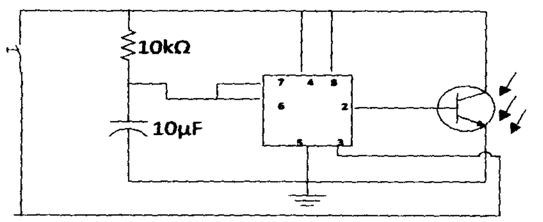

FIG3.4: RECEIVER CIRCUIT DIAGRAM

The basic principle of operation of above infrared transmitter and receiver is stated below

A 9 volts battery powers the transmitter. It consumes little power. A 555 timer shown in Figure3.3 was used to generate the signal and it was configured in unstable mode . The threshold input pin (6) six was connected to the trigger input pin (2) two. The external components R1, R2, and C1 form the timing network that sets the frequency of oscillation.

When the switch S1 is closed, power is turned ON, and the capacitor "C1" uncharged, thus the trigger voltage (pin 2) is at 0 volt. This causes the output of the comparator "B" to be HIGH and output of comparator "A" to be LOW, Forcing the output of the latch, and thus the base of the transistor LOW and keeping the transistor OFF. Now, C1 begins charging through R1 and R2 as seen in Figure 3.3 when the capacitor voltage reaches 1/3 Vcc, comparator B switch to its LOW output state, and when the capacitor voltage reaches 2/3Vcc, comparator A switches to it's HIGH output state. This RESETS the latch, causing the base of Q1 to HIGH, and turns ON the transistor. This sequence creates a discharge path for the capacitor through R2 and the transistor. The capacitor now begins to discharge, causing comparator A to go LOW.

At the point where the capacitor discharges down to 1/3 Vcc, comparator B switches HIGH; this SETS the latch, which makes the base of the transistor LOW and turns OFF the transistor. Another charging cycle begins and the entire process repeats. The result is a rectangular wave output whose duty cycle depends on the values of R1 and R2..

The resistor R2 was chosen to be one with very high resistance, because a duty cycle approaching a minimum of 50% can only be achieved if R2 >> R1 so that the charging and discharging times are approximately equal.

The capacitor alternately charges towards Vo and discharges towards zero according to the input voltage . Here, the frequency (and therefore period) of the input square wave voltage is exactly such that the capacitor is allowed to fully charge and discharge. The time constant "t," is equivalent to KRC.

t = KRC

Frequency circuit calculation

Considering equation, the time constant t = KRC , it can be deduced that for 1 (one) period of oscillation of the RC circuit the capacitor charges for say;

T charge seconds and discharges for T discharge seconds. Where R is a resistor, C is a capacitor, and K is a constant (0.693).

From the transmitter circuit in figure 1: R1 = 1kΩ, R2 = 10kΩ C = 10nF:

T charge = 0.693RTC

where RT is R1 + R2

Therefore:

T charge = 0.693(R1 + R2) C

T charge = 0.693(1k + 10k) 10x10-9 = 0.00007623= 76.23μs

T discharge = 0.693R2C

T discharge = 10k × 0.693 (10 × 10-9) = 69.3μs

Therefore, period of oscillation:

T = t charge + t discharge = 76.23 + 69.3 = 145.53μs Frequency of oscillation:

F = 1.44/ (R1+2R2) C = 1.44/ (1k+2*10k) × 10 × 10-9

F = 6857.142857Hz ≈ = 6.9 kHz

THE RECEIVER

It consists of a photodiode pre-amplifier and a signal processor, which operates at a turned frequency of about 37.9KHZ. When the pin 3 of the receiver is powered, R1 limits the current into the photodiode. The output of the Receiver at pin one (1) as shown in Figure 3.4 is the voltage drop across the photodiode under normal light. When the photodiode, receivers any signal from the transmitter, the resistance of the photodiode will drop and consequently drop the voltage across it. With a considerable signal received by the receiver of about 30KHz to 40KHz, the resistance may fall to a negligible value and thus the drop across the photodiode is approximately zero volts, thus making the output of the receiver low. But when no signal is received, the resistance increases and thus the voltage drop across the photodiodes increases.

3.0.2 THE DESIGN OF THE CLAP SENSOR UNIT

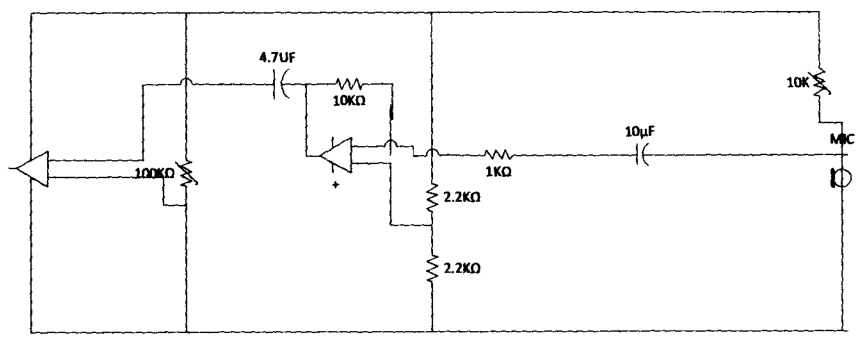

FIG 3.5: CLAP SENSOR CIRCUIT DIAGRAM

The clap sensor unit comprises of a condenser microphone, a preset resistor, low pass filter, an inverting amplifier, a variable resistance, coupling capacitor and a comparator. The condenser microphone serves as transducer converting sound energy to electrical energy. A preset resistor was used to preset the voltage required for the microphone to work effectively which is also used to adjust the sensitivity

An RC filter is connected to the output of the microphone thereby removing noise and adjusting level of response. An ideal low pass filter provides a constant output from a dc up to a cutoff freq and passes no signal above that frequency.

A 10μf coupling capacitor was used to at the output of the microphone to couple from the microphone to the amplifier circuit.

The gain of the amplifier was determined by the 1kΩ and 10kΩ resistor.

A brief mathematical explanation of the gain of the amplifier circuit of the LM358 chip is show below

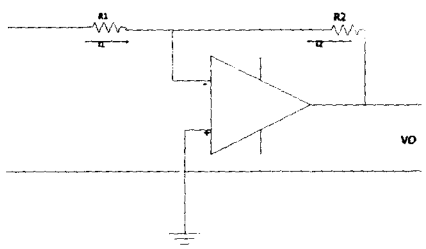

FIG 3.6: OP AMP

CALCULATIONS

Gain of the amplifier

Applying KCL

$.i_{1+}(i_2) = 0$

$V_1/R_1 + V_0/R_2 = 0$

Or $V_0/R_2 - V_1/R_1 = 0$

$- V_0/V_1 = - R_2/R_1$

$A_V = - R_2/R_1$ where $A_v = - K$

The gain (A_v) of the amplifier is therefore

= -10K/1K

= -10v/v

The filtered signal is passed through an operational amplifier. An operational amplifier is made up of two input terminal, the inverting and the non inverting terminals. In the inverting terminal (-) the signal applied to the input will be amplified and inverted between the input and output (output is 180^0 out of phase with input). On the other hand, the non-inverting input (+) the signal applied will be amplified but not inverted between input and output (output is in phase with input). In this design signal is applied the inverting input while the non- inverting input is used to control the operational amplifier operating characteristics.

An RC coupling is then introduced between the amplifier and the comparator.

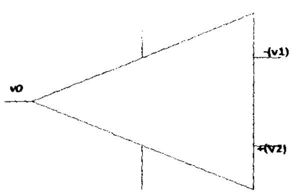

FIG 3.7: COMPARATOR

As shown above a comparator compares two signals or voltage levels. If V_1 and V_2 are equal then V_0 should ideally be zero. Even if V_1 differs from V_2 by a very small amount, V_0 is high because of amplifiers high gain. Hence a comparator can detect very small level changes which is another way of saying it compares two signals.

The comparator would help to know the amount sound to trigger the microcontroller .if u don't use a comparator , random noise would be trigger the microcontroller

The 10kΩ also determines the sensitivity of the comparator. The 10kΩ at the microphone also aids its sensitivity.

Its when you set it to 5volts that the comparator will give a output.its usually manually adjusted by the variable resistor

The output is connected to the interrupt input of the microcontroller which receives signal at falling edge at the comparator.

3.0.4 DESIGN OF THE CONTROL UNIT

The major component of this unit is AT89S51 microcontroller which can be regarded as the major component of the design.

Pin 12 (P 3.2) is an 8-bit bidirectional pin as well as an interrupt pin. It is used as the input of the microcontroller receiving signal from the input unit of the circuit and relating with the output pins. Pin 35, 34, and 33 (P0.4, P0.5, and P0.6) which are 8-bit open drain bidirectional input/output pins serve as the output to which the load receives signals. Resistances are connected to the each terminal of the microcontrollers' output pins to limit the flow of current to the microcontroller.

Pin 40 which is the VCC (power supply voltage) is powered with 5V rectified voltage thereby supplying 5v to the microcontroller and pin 31 EA/VPP is strapped to VCC for internal programme executions.

Pin 18 and 19 are input and output pins respectively for an inverting amplifier which can be configured for use as an on-chip oscillator. A crystal oscillator is connected across this pin while a capacitor of 1µF is connected across pins 9 and 31, while pin 20 is connected to ground.

3.0.5 DESIGN OF THE OUTPUT UNIT

This unit responds to control signals received from the control unit. It comprises of PNP transistors and 10amps relays. Each transistor here serves as a switch to a particular relay just as the relay is there to switch the load. The transistors switched ON the relay when voltage is applied and a high is achieved by the control unit and in the same vain switches OFF the relay when the transistor receives a low from the control unit. A diode IN 4001 was connected across the relay to prevent inductance kick back which is usually caused by the applied load.The diode also servers to protect the relay contacts from arcing and also protects the transistor from damage.Three led's and three resistors were connected each across the three relays.the resistor is there to limit the amount of current flow throught the led .

3.1 CIRCUIT OPERATION

From above it could be summarized that the power supply of 220V/12V AC is step down and rectified with bridge rectifier to get a dc supply and further filtered with capacitor of large value 2200µf. The filtered 12V dc is regulated with 7805 5V regulator to get a 5V dc and a capacitor connected across the regulator to stabilize the voltage and improve system performance.

The clap sensor unit receives a clap, performaces various amplification and comparator operations as explained above and then feeds the signal to the interrupt pin 12 of the microcontroller chip. The transmitter and receiver units can also accomplish the same thing the clap sensor unit gets.The only difference is that in the case of the clap sensor, sound is the source of input while the infrared transmitter and receiver deals with infrared light.

Whichever one is selected or chosen through the switch provided, the pin 12 is triggered. When a single clap is heard or the button of the remote is pressed once, the microcontroller recevies the signal and with the program embedded in the chip, the signal is routed to the P0.4 of the chip.

As the microcontroller receives the signal through the interrupt pin. This serve as the clock input to the microcontroller. The output of the microcontroller (port 0) drives the switching transistor as the microcontroller is clocked the output goes low 1 at a time which energizes the first PNP transistor which then makes the relay connected to it active.

If the above process is repeated again , but with another single clap or a press of the remote control button , then the following can be achieved

Switch Outlet A	Switch Outlet B	Switch Outlet C
0	0	1
0	1	0
0	1	1
1	0	0
1	0	1
1	1	0
1	1	1
0	0	0

TABLE 3.1: SWITCH OUTPUT IN BINARY DIGITS

the table simply depicts the states each switch would be after a clap or a press of the remote.

FLOW CHART

Below represents the flow chart of the device.The flow chart is in two parts,the first part represents the operation the device implements from start to sending a high to port 0.4 while the second part represents a continuation of the operation from implementing a 3sec delay to the clearing of ports 0.4,0.5,0.6.

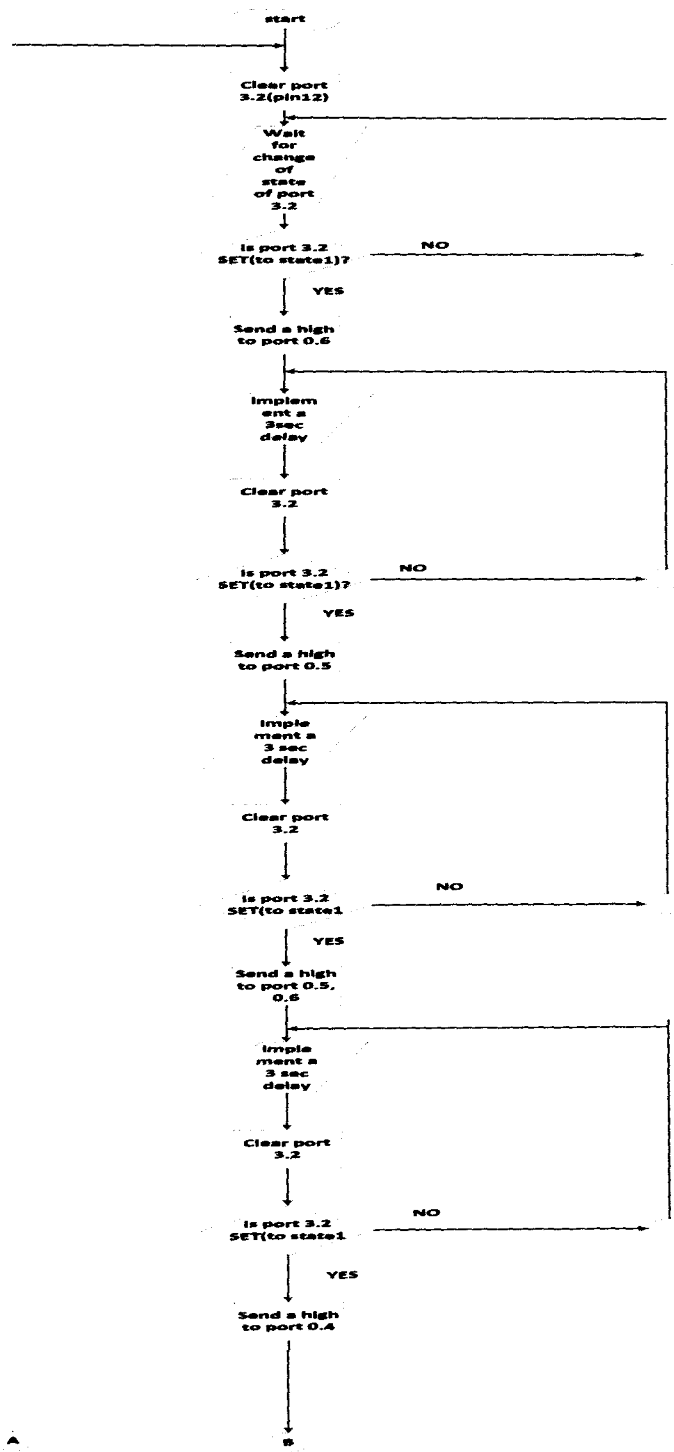

FIG 3.8a: FLOW CHART OF THE MICRO CONTROLLER SWITCH

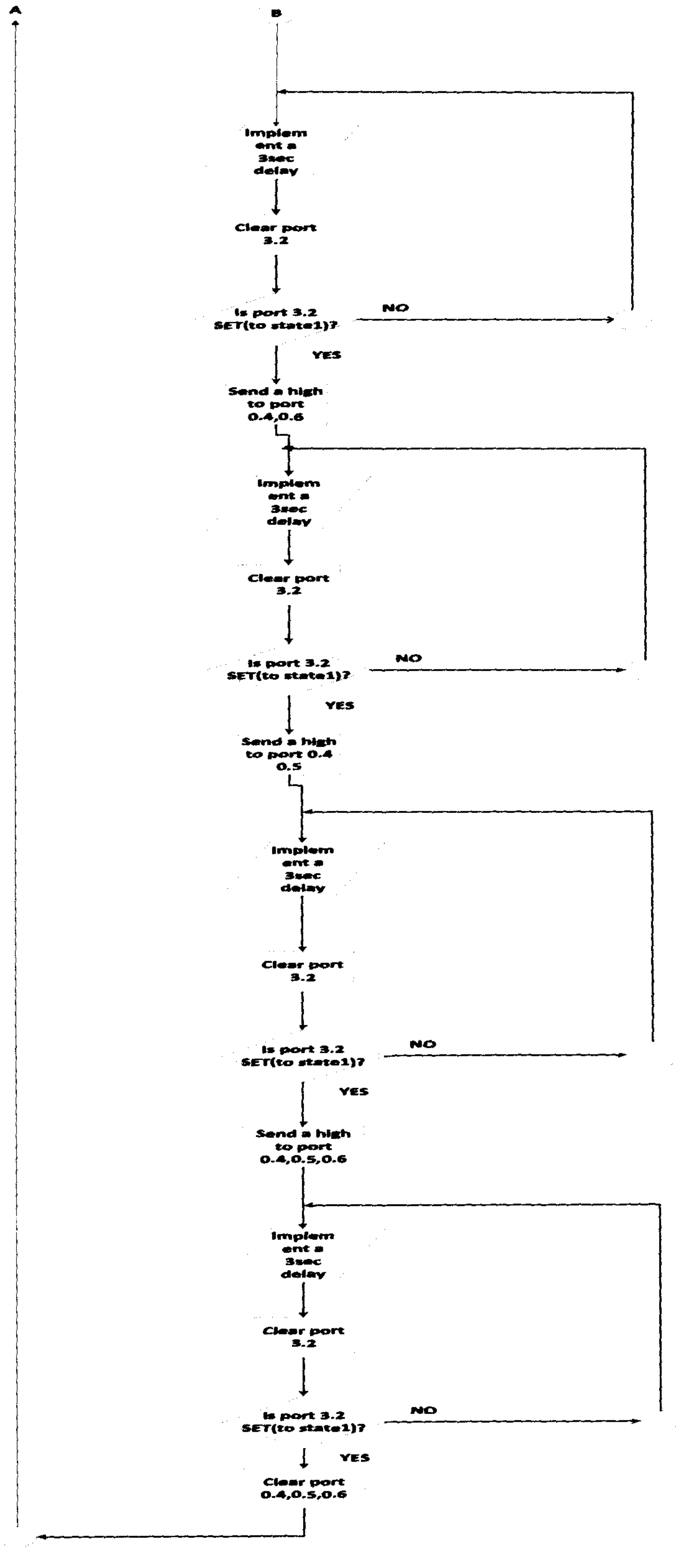

FIG 3.8b: FLOW CHART CONTINUED

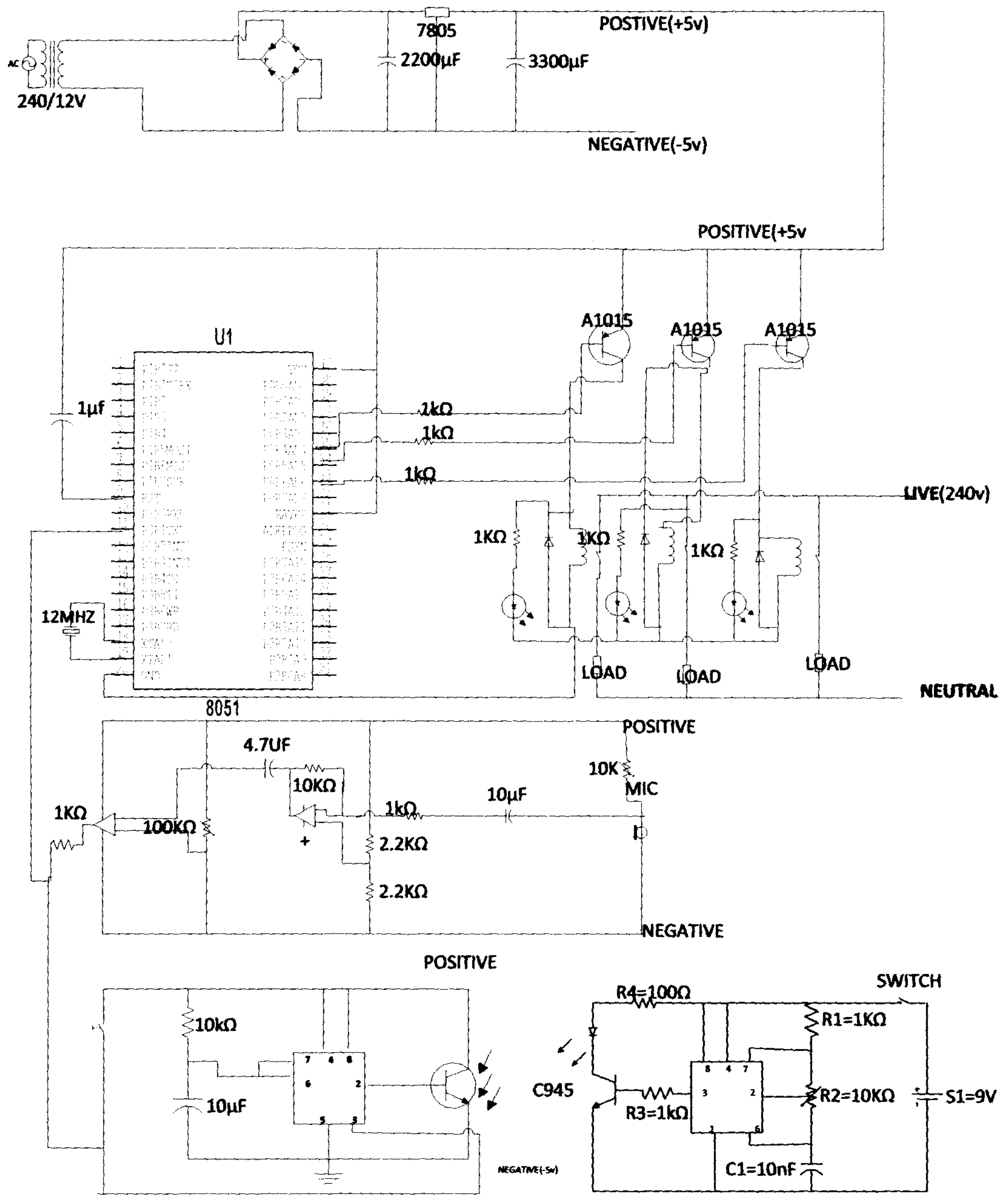

FIG 3.9: CIRCUIT DIAGRAM OF THE MICRO-CONTROLLER BASED ACOUSTIC AND INFRARED REMOTE CONTROL SWITCH

CHAPTER FOUR

4.0 TEST, RESULT AND DISCUSSION

This chapter will encompass practical actualization of the project specification. The packaging, testing and construction are also discussed. It also deals with the various critical indepth analysis carried out on the constructed circuit test its performance and correlate the results obtained with the design specification in order to evaluate the overall design performance.

4.1 CONSTRUCTION

The circuit was first simulated, then assembled temporarily on a breadboard /prototype board and tested before soldering the components on the Vero board. IC sockets were used for the microcontroller chip to avoid damage due to over heating.

During and after the construction of the work was completed, a continuity test was performed so as to prevent bridging of the pins of the components ,which might result in the malfunctioning of the entire device

4.2 CASING

The casing was constructed with a ply wood material, which is due to the ease of it to be cut into various sizes easily.provision was made for ventilation and were the switches, socket outlet,microphone, leds etc would be located.

4.3 INDIVIDUAL COMPONENT TEST

All the components were tested through the use of a multimeter so as to be sure they are properly working. Components like the resistor, transistor, capacitor, diode,relays were tested before making use of the component, they were subjected to various tests to confirm their workability.

The polarities of the LED, microphone were confirmed through the use of the multimetre.

4.4 WIRING TEST

The wiring of the circuit was done on a Vero board short circuited and open circuit tests were done using a digital multi-meter. To check if there is any short or open circuit at any point in the circuit.connecting wires were also tested to guide against open circuit.

4.5 COMPLETE SYSTEM TEST

Repeated test were performed on the microcontroller based acoustic and infra red remote so as to determine is reliability. At different occassions a clap and remote was used to activate the device and appliances like television, standing fan, and table lamp were used to confirm that the device actually switches between appliances when its triggered by the remote control or the clap.

The issue of sensitivity is a very important factor that determines the quality of an electronic device. The sensitivity is simply understood as the minimum amount of input signal needed for a reasonable output to be produced. The circuit is tested with different input signals and the lowest input that produces a meaningful output couldn't be determined. This is because the sensitivity of the circuit can be adjusted using the variable resistor VRI.

4.6 SHORT COMING OF THE PROJECT

The microcontoller based acoustic switch and infrared remote can at times be triggered into its active state by a very loud noice. At times its tedious to clap for the appliances to come On.(that's why the remote control was introduced)

4.7 SUGGESTED REMEDY

In order to overcome the constant sound finickering of the device it is recommended that a voice synthezizer be incoporated with the device so that isnt of sound activation, it would be human voice activation

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 CONCLUSION

The essence of carrying out this project work is to design and construct a microcontroller based acoustic and infrared remote switch that could be used in various areas of life.The device can be triggered by any domestic infra red remote which gives it a distinct advantage.

The project simply demonstrates the significance of modern integrated circuits or generally electronic remote control applications.

Despite the fact that the project is a bit less important to the non handicap society, its serves as a very important house hold device for the physically challenge people in the society at large. With the device, a person who has a leg injury can make maximum use of the device, since he could stay in one place and activate the clapper via sound or through a remote control.

5.2 RECOMMENDATION

1) The project could be designed to control more loads.

2) A human voice synthesizer circuit could be included which would reduce random noise

3) Instead of using a microcontoller chip a pre- programmmed micro processor chip could be used.

4) A better intelligent circuit could be developed to remove switching error resulting from unwanted noise

5) An LCD could be introduced to indicate which device is ON

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APPENDIX

```
; FUNCTION delay_long (BEGIN)

MOV    x+03H,#018H

MOV    x+03H,#03H

MOV    x+03H,#C0H

MOV    x+03H,#07H

MOV    x+03H,#080H

MOV    x+02H,#038H

MOV    x+01H,#01H

MOV    x,#00H

?C0001:

MOV    R0,#LOW x

MOV    A,#0FFH

ACALL  ?C?LILDIDATA8

MOV    A,R4

ORL    A,R5

ORL    A,R6
```

```
ORL    A,R7

JNZ    ?C0001

RET

; FUNCTION delay_long (END)

; FUNCTION ex0_isr (BEGIN)

PUSH   ACC

PUSH   PSW

MOV    PSW,#00H

PUSH   AR0

PUSH   AR4

PUSH   AR5

PUSH   AR6

PUSH   AR7


MOV    A,select

XRL    mask,A

MOV    A,mask

CPL    A

MOV    P0,A
```

```
MOV    A,select
ADD    A,ACC
MOV    select,A
SETB   C
SUBB   A,#08H
JC     ?C0004
MOV    select,#01H
ACALL  delay_long
POP    AR7
POP    AR6
POP    AR5
POP    AR4
POP    AR0
POP    PSW
POP    ACC
RETI
; FUNCTION ex0_isr (END)
; FUNCTION init (BEGIN)
MOV    select,#01H
```

```
CLR    A
MOV    mask,A
MOV    P0,#0FFH
SETB   IT0
SETB   EX0
SETB   EA
RET
; FUNCTION init (END)
; FUNCTION main (BEGIN)
ACALL  init
SJMP   ?C0007
; FUNCTION main (END)
```