DESIGN AND CONSTRUCTION OF A PC BASED APPLIANCES CONTROL SYSTEM

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Declaration

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Abstract

This project presents the Design and Construction of a PC based appliance control system. The method used to implement the switching system is the serial communication method, which uses the serial port of the PC to interface with a programmed chip (microcontroller). The microcontroller was programmed using C language so that it reads commands from the PC, decodes it and then relates to the relays which controls the corresponding appliances connected by switching them on or off. It takes advantage of the computer's communication abilities to implement a distributed control scheme. The system can be used to control appliance just at the type of the appropriate command, it can be used to control four appliances individually. This system makes both home and industrial automation relatively easy and affordable.

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CHAPTER ONE

GENERAL INTRODUCTION

1.1 Introduction

Science and technology is improving almost every day all around the world, most of the present day work activities are not manually operating again. They are automatically carried out by themselves with use of electronic components. This project, which is the Design and Construction of a Personal Computer (PC) based appliances control system. It is an electronic project that steps further in the improvement of man's standard of living at home and in industries where appliances control is a necessity. It uses the Personal computers interface with a microcontroller to control the appliances connected to the system. Personal computers are devices in the form of a desktop or laptop designed with a display monitor and a keypad for use by single persons. Since their introduction in the 1980's PCs have become powerful and extremely versatile tools that have revolutionized how people work, learn, communicate, find entertainment [1]. PC are also a crucial component of information technology (IT) and play a key role in modern economies worldwide. The telephone networks itself now relies extensive on computer-based switches and exchanges that have made all kinds of new telephone-related services possible, such as call waiting, call forwarding, call return, voice-mail services, and caller I.D. The relationship today between computers and the telephone system is inseparable.

The PC based appliances control system was primarily designed to make home and industrial automation relatively easy with little human intervention. It consists of a circuit connected to the printer serial port of a PC, for control application using software and some interface hardware. Serial port is a simple and inexpensive tool for building computer controlled devices and projects. The simplicity and ease of programming makes serial port popular [2]. This system can be used to control four appliances, but when an extension socket is used in place of any of the appliance, more appliances can be connected to the extension socket e.g. all the electronics, but the limitation of this extension is that all the electronics connected will be controlled together and the summation of all the current rating of each of the appliance must not be more than 10A, because a 12v,10A relay was used.

Devices can be controlled from the desktop while working on it. At home, one can be in the bedroom with your pc and switch on or off the security light, the electronics, fans, ACs, cooker e.t.c. while in industries, the computer operator can just be in the office and Probably during closing, he/she can use this system to switch, fans, ACs of offices because most employee forget or sometimes don't bother to switch off the appliances. The usefulness of the pc controlled appliance system has no limits. A setup facilitating such a thing would be to connect the appliances to the microcontroller interfaced with a pc that receives the controls from the user, the means of sending signals to the appliances being the PC.

1.1.1 Applications of PC based automation system;

1. Hotel power management
2. Street light management
3. Home automation
4. Load shedding
5. High voltage grid control
6. Industrial automation
7. Electro, hydraulic and pneumatic valve control
8. Robotic control and many more.

9. Packing machines

10. Automatic Assembly machines [3]

This system presents one of the emerging applications of the PC. It allows the user to monitor and control his appliances via his PC setup by sending commands in form of messages. It consists of two parts namely;

The hardware architecture consists of an embedded system that is based on an 8 bit microcontroller, an interface, a driver circuit to connect the microcontroller to the relays, and the HyperTerminal software.

1.2 Aims

- The aim of the proposed system is to investigate a cost effective and convenient solution to controlling appliances at home and industries with the use of a computer, interfaced with a switching circuit.

- To eliminate the stress of having to walk to each of the switching points especially in industries, the user can be at some distance away and control the appliance connected to the system one after the other. The computer operator can just be in the office and switch each appliance ON or OFF one after the other. E.g. fans, machineries, A.C's, lightings, security lights, e.t.c

1.3 Objectives

To achieve the construction of this project below are some of the activities carried out, they include using;

- A DB9 cord to interface the pc to the microcontroller via the voltage level converter(MAX232),
- An embedded chip to read command from the pc and then communicate it to the relays, as to which relay should be activated which in turn controls the corresponding Appliances.
- The PC communication ability to provide access to the system for automated appliance control.

1.4 Scope of Project

This project uses the PC to send signal, the microcontroller as the control circuit and then relay as the switching circuit to control any appliance connected to it. The appliances will be static loads, by static it is meant that they have only two states, on or off. The relay driver used is the ULN2803 which has 8 inputs and 8 outputs, but only 4 of those terminals were utilized to control 4 appliances, this is due to the available resources. Appliances connected to any of the output must not have current rating higher than 10A because a 12v, 10A relay was used.

1.5 Methodology

The method used in the achievement of this project is called the Serial communication method, which uses the serial port of the PC, serial port is a simple and inexpensive tool for building computer controlled devices and projects. The simplicity and ease of programming makes serial port widely used. C language was used to program the microcontroller. Using a PC, The development of the control signal is carried out using commands in form of message from the PC. This message is decoded by a programmed chip, which then sends a high or low signal to the relay which controls appliances via the relay driver IC. The driver IC used in this system is the ULN2803 because it is capable of handling high current and voltage applications especially in industries. An LCD is used to display what is being typed on the system's HyperTerminal due to the echo of typed characters.

CHAPTER TWO

LITERATURE REVIEW

A control system is one which performs some function, checks its success and takes further action until the objective is attained [4]. They are usually implemented using either hardware or software singularly, or as a hybrid of both. Control systems can be used to control various quantities which range from physical quantities, electrical appliances or even industrial machinery and processes.

Microcontrollers can be added to control system to extend the functionality of the system. This extension may include improvements in performance of system and increased flexibility, since microcontroller can be programmed to carry out different tasks such as data analysis and control of physical, electrical or mechanical quantities [5].

The control system implemented in this project uses the microcontroller to control the state of a set of electrical appliances. It also takes advantage of the computers communication abilities to implement a distributed control scheme. To investigate the workings of the system, a brief discussion of certain vital modules are carried out below.

2.1 Historical Background

Historical background of some control components and their developments over the years are highlighted below;

2.1.1 Solid state switches

Switches are commonly used to operate electrical lights, permanently connected equipments or electrical outlets. Although these switches are usually two states, to switch the device ON or OFF, there are switches that allow varying current levels to enter the device, these switches are called dimmer switches.

Although the transistor was sufficient for most switching tasks, it had limited power capabilities and low switching speeds. The need for higher power control and better switching speeds were needed, as such the thyristor family of switches was born. SCR (silicon controlled rectifiers) as there are commonly called are 4-layer solid state device that controls current flow.

SCR was developed by a team of power engineers led by Gordon Hall and commercialized by Frank W. "Bill" Gutzwiller in 1957 [6]. Since then, immense effort has been put into the research for development of better semiconductor switches. As such, electronic switches now provides immense flexibility in terms of different interfaces for its operation such as touch plates, soft-touch controls, pressure/ light sensor based control, interactive touch-screens(which are widely used in aircraft of lighting control) etc.

2.1.2 Embedded systems

An embedded system use a special purpose computer system designed to perform one or a few dedicated functions [7]. It is usually embedded as part of a complete device including hardware and mechanical parts. In contrast, a general-purpose computer, such as a personal computer, can do many different tasks depending on programming.

In the earliest years of computers, in the 1940's computers were sometimes dedicated to a single task, but were too large to be considered "embedded". Over time however, the concept of programmable controllers developed from a mix of computer technology, solid state devices, and traditional electromechanical sequences.

The first recognizable modern embedded system was the Apollo Guidance computer, developed by Charles Stark Draper at the MIT instrumentation laboratory. At the projects inception, the Apollo guidance computer was considered the riskiest item in the Apollo project. The use of the then new monolithic integrated circuits, to reduce the size and weight, increased the risk.

The first mass-produced embedded system was the autonetics D-17 guidance computer for the minuteman missile, released in 1961. It was built from transistor logic and had a hard disk for main memory. When the minuteman II went into production in 1966, the D-17 was replaced with a new computer that was the first high-volume use of integrated circuits. This program alone reduced prices on quad NAND gate ICs.

Since these early applications in the 1960's embedded system have come down in price. There has also been an enormous rise in processing power and functionality. For example the first microprocessor was the Intel 4004, which found its way into calculators and other small systems, but required external memory and support chips.

In 1978, National Engineering Manufacturers Association released the standard for a programmable microcontroller. The definition was an almost any computer-based controller. They included single board computers, numerical controllers, and sequential controllers in order to perform event-based instructions.

By the mid 1980's, many of the previously external system components had been integrated into the same chip as the processor, resulting in integrated circuits called microcontrollers[7], and widespread use of embedded system became feasible.

As the cost of a microcontroller fell, it became feasible to replace expensive knob-based analog components such as potentiometers and variable capacitors with digital electronics controlled by a small microcontroller with up/down buttons or knobs. By the end of the 80's embedded systems were the norm rather than the exception for almost all electronics devices, a trend which has continued since.

2.1.3 Computer based control

At the outset of the computer engineering development in the 1950s the main attention was concentrated on the creation of computers which could solve complex mathematical problems. Computers then were stationary and intended for successive or batch problem solution irrelatively to the real time and dynamic parameter changes. Later the machines formed the most widespread class of universal computers for various applications.

By the late 1950s the defense industry and Ministries of Defense took an interest in computers for data processing and control in military systems. The nature of such applications considerably differed from the computational problems which had become tradition by the time.

The military now use computer based systems for various applications including, manufacture processes where computer controlled robotic arm are used in the assembly of component part of a product, control of surveillance system to control the general military infrastructure, in unmanned aircraft control and missile guidance system.[10].

By 2007, Omale Sunday Abbah with matric no. 2001/12127EE, a former student of the electrical and computer engineering department designed and constructed a computer based load switching system using the parallel port for interfacing electrical appliances. The project comprises two major units; the hardware unit which comprises of the power supply unit, relay and driver unit. The software section comprises a program written in C++ and complied using Microsoft Visual C++6.0. Some of the limitations of this design are that it is not universal, that is, any computer cannot be used with the system unless the software program is first installed on the computer, therefore in a situation where the software is not available, the system cannot be used with another computer. Also, when the computer switches off perhaps due battery outage, the appliance connected automatically switch off. Parallel port was utilized in interfacing the computer to the system, this is slower in communication.[19]

The same year, ubah Thomas ubah with matric no. 2001/12131EE of the same department implemented a distributed computer controlled switching system. It uses the microcomputer and its abilities with external devices to implement the system. The completion of this project results in a switching system that can be controlled from any computer on the internet. Where there is no internet these system cannot be used therefore it is not universal. LCD was not used to monitor the status and output display.[20]

2.2 Theoretical background

Automation as an aspect of technological advancement has brought an ease in most of the activities we perform in our everyday lives. By the use of computer serial port and an interfacing circuit and a modular software package known as HyperTerminal which is found on most operating systems, one can remotely monitor and control house hold and industrial devices.

Previous works on the computer based appliance control utilized software based programs to implement, but this project uses a hardware program to achieve the project. So even if the computer eventually goes off, the already switch on appliances remains on. Serial port which is faster and efficient was used instead of the parallel port. The system is universal in the sense that it can be used with any PC without having to configure it or install any software. The HyperTerminal is makes it universal, since HyperTerminal is available on all operating systems except XP and window 7. To remedy this, the HyperTerminal can be downloaded from the internet and then installed on such computers.

LCD was used to monitor the output display because characters typed on the HyperTerminal are echoed, so one can use it the check what is actually typed rather than what is displayed on the HyperTerminal.

2.2.1 Working principle

The microcontroller decodes the command and takes the corresponding action by sending signal to the relay Driver IC telling it which relay should be activated. This command is in this format, For instance, if the user wants appliances 1 to switch ON, He will just type "ON 1 on the PCs HyperTerminal, and then press the ENTER key. This command goes to the microcontroller and the microcontroller sends signals via its pins to the relay driver IC telling it to switch on appliances 1, a HIGH signal will be sent to relay 1. As soon as the relay receives a HIGH it immediately triggers the appliance 1 on instantly. To switch off the appliance 1, OFF 1 is typed. The same applies to switching appliances 2, 3 and 4.

SYSTEM DESCRIPTION

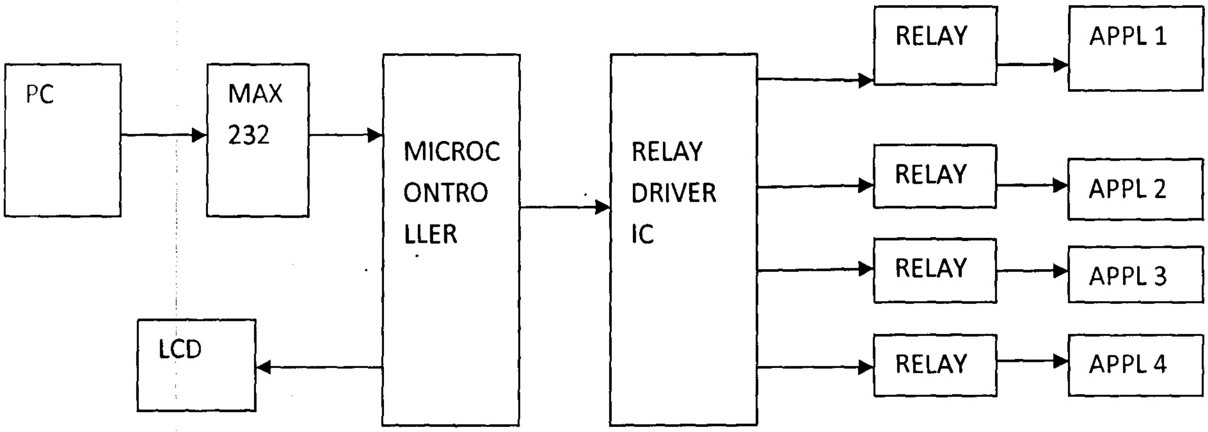


Fig.1. block diagram of the system.

CHAPTER THREE

DESIGN AND CONSTRUCTION

3.0 Overview

Some of the components used in the construction includes; A programmed chip (microcontroller unit), DB9 cord, max232, relays, uln2803, capacitors etc. As understood from the block diagram of the system in fig.2, chapter two. There is need to analyze each block of the project for proper design and implementation. Therefore, these blocks are as follows:

1. Power supply unit
2. PC interfacing unit
3. Programmable chip unit
4. Relay driver unit

3.1 Design of the Power Supply Unit

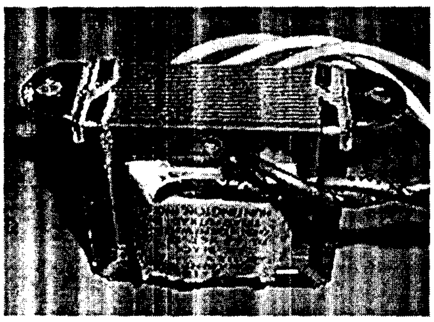
Most of the electronic devices and circuits require a dc source for their operation [9]. The dc power supply converts the standard 230V, 50Hz ac available all wall outlets into a constant dc voltage. It is one of the most common electronic circuits that you will find. The dc voltage produced by power supply is used to power all types of electronic circuits, such as television receivers, computers and laboratory equipment [8]. A typical dc power supply consists of five stages as shown in fig. 3.1 below. Thus, the ICs and other components used in this project run on a 5V and 12V dc power supply, hence the supply must be regulated to prevent fluctuation in voltage level. A 7805 voltage regulator is used to produce the +5v which powers the microcontroller, max232, LCD. While a 7812 to produce the +12v to power the relays and its driver.

Transformer → Rectifier → Filter → Voltage Regulator → Load

Fig. 3.0 A typical dc power supply block diagram [8, 9, 14]

These blocks can be briefly explained as follows:

(i.) **Transformer:** its job is either to step up or (mostly) step down the ac supply voltage to suit the requirement of the solid state electronic devices and circuits fed by the dc power supply [9]. In this system, a 220/24v transformer was used to step-down the voltage level to 24v AC before it is being fed to the rectifier circuit.



(ii.) **Rectifier:** it is a circuit which employs one or more diodes to convert ac voltage into pulsating dc voltage [8, 9, 10, 12, 13]. A rectifier can be either a half-wave rectifier or full-wave rectifier [8]. In this design a full-wave rectifier diode was employed.

(iii.) **Filter:** The function of filter of this circuit element is to remove the fluctuations or pulsations (called ripples) present in the output voltage supplied by the rectifier [9]. This is done by connecting a 1000uF capacitor to filter the rectified voltage.

(iv.) **Voltage Regulator:** Its main function is to keep the terminal voltage of the dc supply constant even when the ac input line voltage to the transformer, or the load varies [8, 9, 18]. Two voltage regulators were used, the 7805 and 7812 to produce 5v and 12v respectively. 470mF capacitors were used to further filter these outputs.

(v.) **Load:** the load block is usually a circuit for which the power supply is producing the dc voltage and load current [8]. In this case, the PC based system is the load.

Therefore, the circuit diagram of the power supply is as shown below.

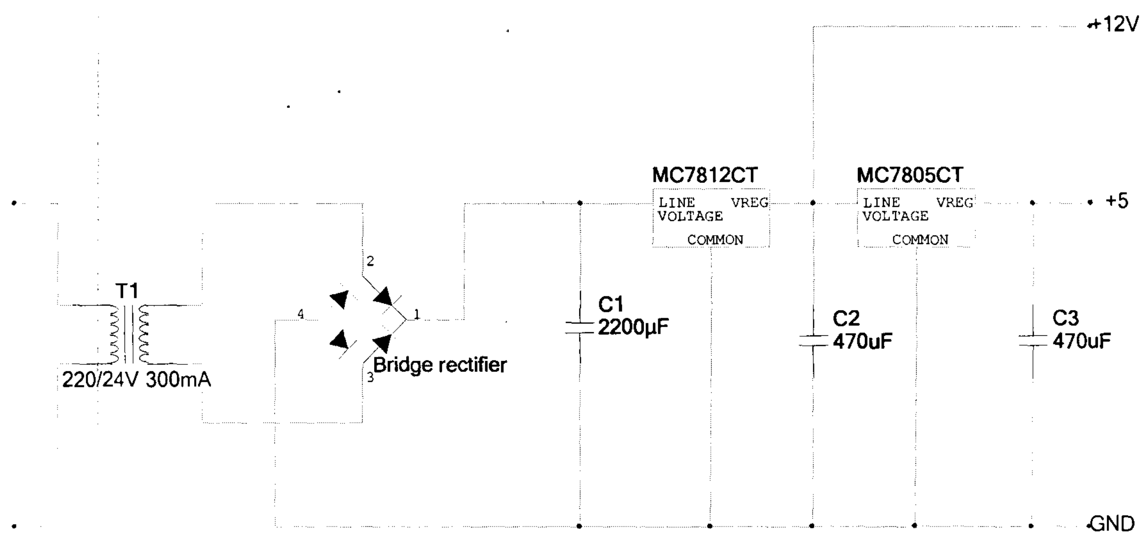


Fig. 3.1 Circuit diagram of the power supply

The main AC voltage of 220V is stepped down by a 220V/24V, 300mA transformer. It is then rectified by full wave bridge diode rectifier. The waveform at this stage has no negative component, but a lot of ripples. Smoothing capacitors are needed to reduce the ripple to an acceptable level.

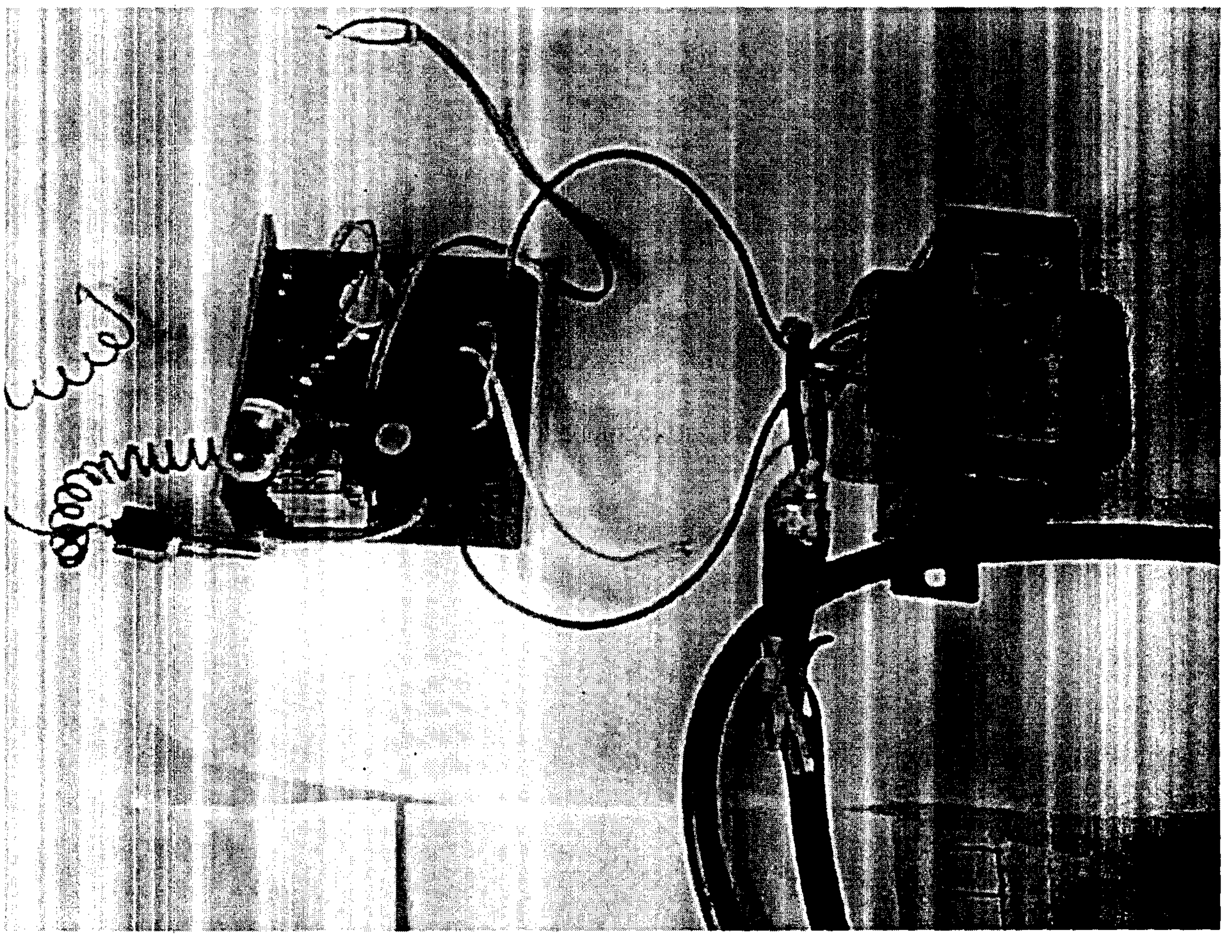


Fig. 3.2 pictorial diagram of the power supply unit

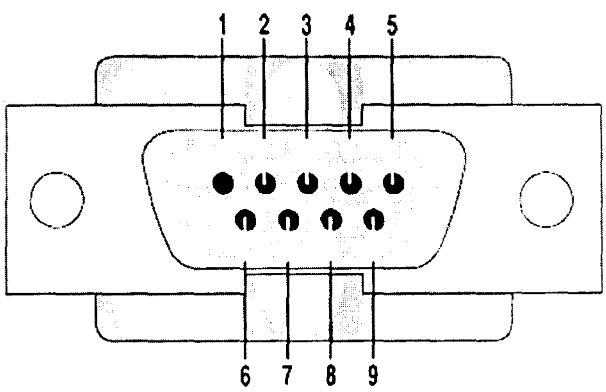
3.2 Pc to microcontroller interfacing unit

This section allows the PC to interface with the microcontroller unit via a driver IC known as MAX232. The microcontroller then sends a high or low signal to the relays telling it to

Switch on oroff any of the appliances connected to the relay. It uses HyperTerminal which is usually found on most operating systems, but when not present it can easily be installed on the pc, this software is a platform where the user types the message to be transmitted in the form of a command. This command first flows to the MAX232 through the DB9 cable.

The transmitter and the receiver of the computer serial cable (DB9) is connected to the receiver (pin13) and the transmitter (pin14) of the MAX232. Pin 15 and 16 are connected to ground and Vcc.respectively. The Vcc is powered by a 5v dc supply. Then pin11 and pin12 which are another transmitter and receiver of the MAX232 is being connected to the the receiver and transmitter of the microcontroller respectively which processes the data received and communicates it to the relay. The components used in this section includes the DB9 cable, MAX232, four 10uf capacitors.

- Ring indicator (RI) 9



- Clear to send (-CTS) 8
- Request to send (-RTS) 7
- Data set ready (-DSR) 6
- Signal ground (GND) 5
- Data terminal ready (DTR) 4

Fig.3.3 DB9 and its pin functions

► Transmitted data (TxD) 3

► Received data (RxD) 2

Data carrier detect (-DCD) 1

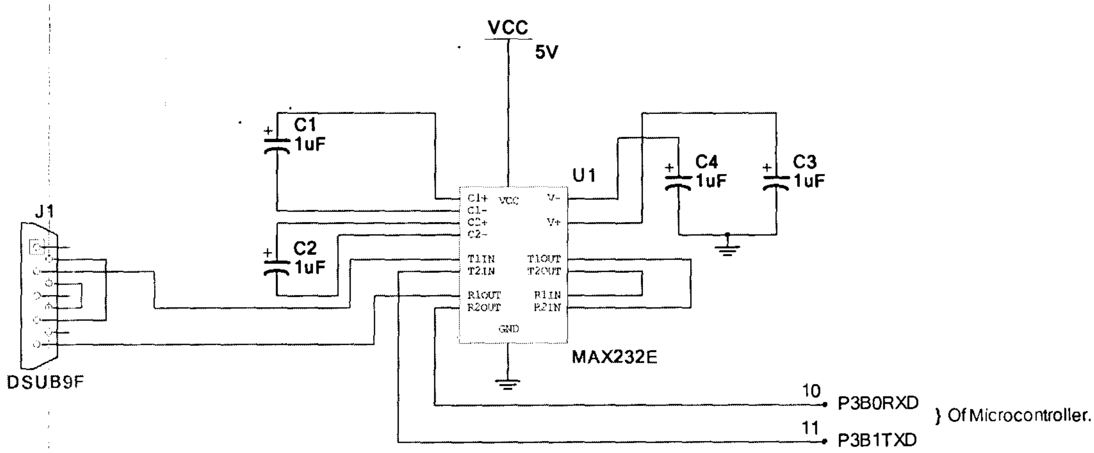


Fig 3.3.1 circuit diagram of the pc interfacing unit

For instance He wishes to switch ON appliances 1, the command is in the following format; on 1, then the ENTER key is pressed. On the push of the ENTER key, a signal is sent via a driver known as the RS232 to the microcontroller which processes the signal and tells the relays to carry out the instruction from the pc unit. The software that makes this command feasible is called "HYPERTERMINAL".

3.3 Microcontroller unit

A microcontroller (also microcontroller unit, MCU or µC) is a small computer on a single Integrated circuit consisting of a relatively simple CPU combined with support functions such as a crystal oscillator, timers, watchdog, serial and analog I/O etc. Program memory in the form of NOR flash or OTP ROM is also often included on chip, as well as a, typically small, read/write

Memory.[15].

The major component in this project design is AT89C52 microcontroller which controls, coordinates and directs all the activities and behaviors of this design. Most control application required extensive I/O and need to work with individual bits. The AT89C52 addresses both of these needs by having 32 I/O, bit manipulation and bit checking. A 11.092MHz crystal oscillator was used in conjunction. The AT89C52 provides the following standard features:

- 8 Kbytes of In-System Reprogrammable Flash Memory
- Endurance: 1,000 Write/Erase Cycles
- Fully Static Operation: 0 Hz to 24 MHz
- Three-Level Program Memory Lock
- 256 x 8-Bit Internal RAM
- 32 Programmable I/O Lines
- Three 16-Bit Timer/Counters
- Eight Interrupt Sources
- Programmable Serial Channel[17]

Microcontrollers are designed for small applications. Thus, in contrast to the microprocessors used in personal computers and other high-performance applications, simplicity is emphasized. Some microcontrollers may operate at clock frequencies as low as 32 kHz, as this is adequate for many typical applications, enabling low power consumption (mill watts or microwatts).

Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, 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. The microcontroller forms the heart of the system. Its responsibilities include reading the message from the pc unit and then communicate the command to the relay circuit which then triggers the appliances connected to it. Here an 8051 based AT89C52 microcontroller manufactured by Atmel. was used. The pin configuration includes; Pin 40 and 31 are connected to the Vcc while pin 20 to ground. Pins 1 2 3 and 4 of the microcontroller are connected to pins 1 2 3 4 of the relay driver IC, pin 21 to 28 are connected to the LCD.UNL2803 is used here because it is capable of withstanding high current and voltage. Pins 18 and 19 are connected to the crystal oscillator.

The machine cycle frequency of all 8051 based microprocessors is 11.0592MHz.

$$= \frac{11.0592}{12} = 921.61 \text{ kHz}$$

And $$\frac{921.61}{32} = 28{,}800\text{Hz}$$

Because most microcontrollers operate at clock frequencies as low as 32kHz as this is adequate for many application, enabling low power consumption. 32

28800Hz is frequency by UART to timer 1 to set the baud rate

$$\text{Baud rate} = \frac{28800}{3} = 9600\text{Hz}$$

where 3 is the baud rate constant

9600 is the equivalent of FD

FD will be loaded into timer high 1 (TH1).

Baud rate is the rate at which the PC communicates with the microcontroller.

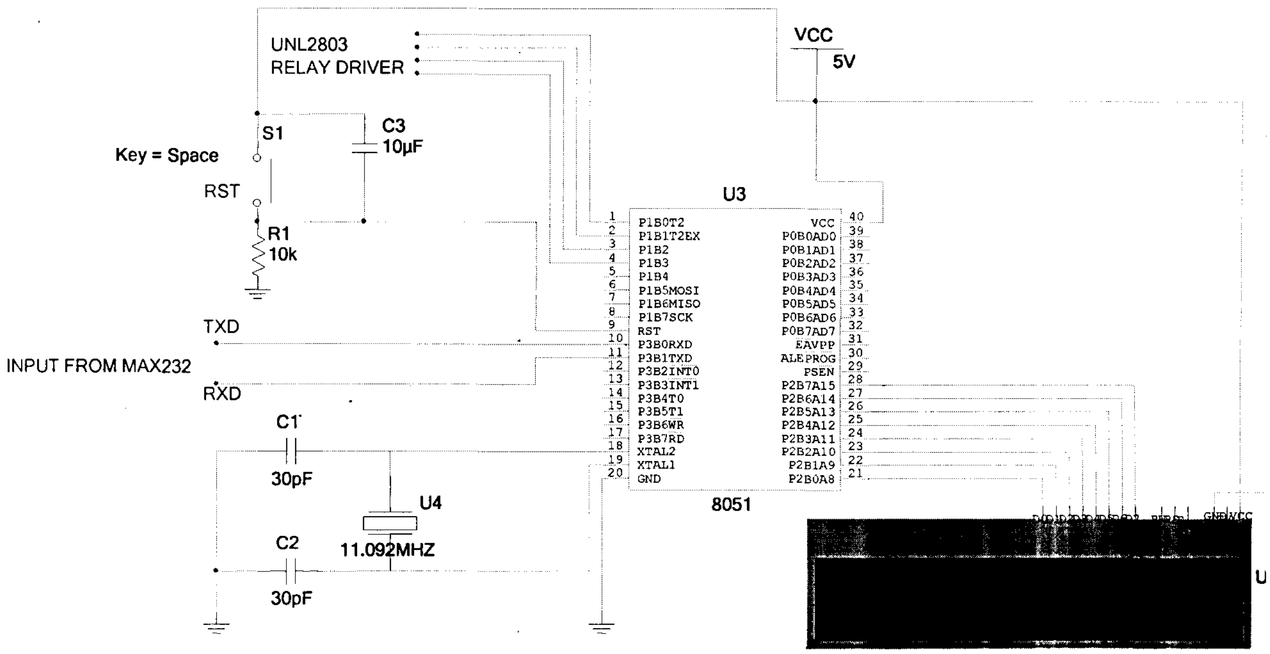


Fig 3.4 Circuit Diagram of the microcontroller unit

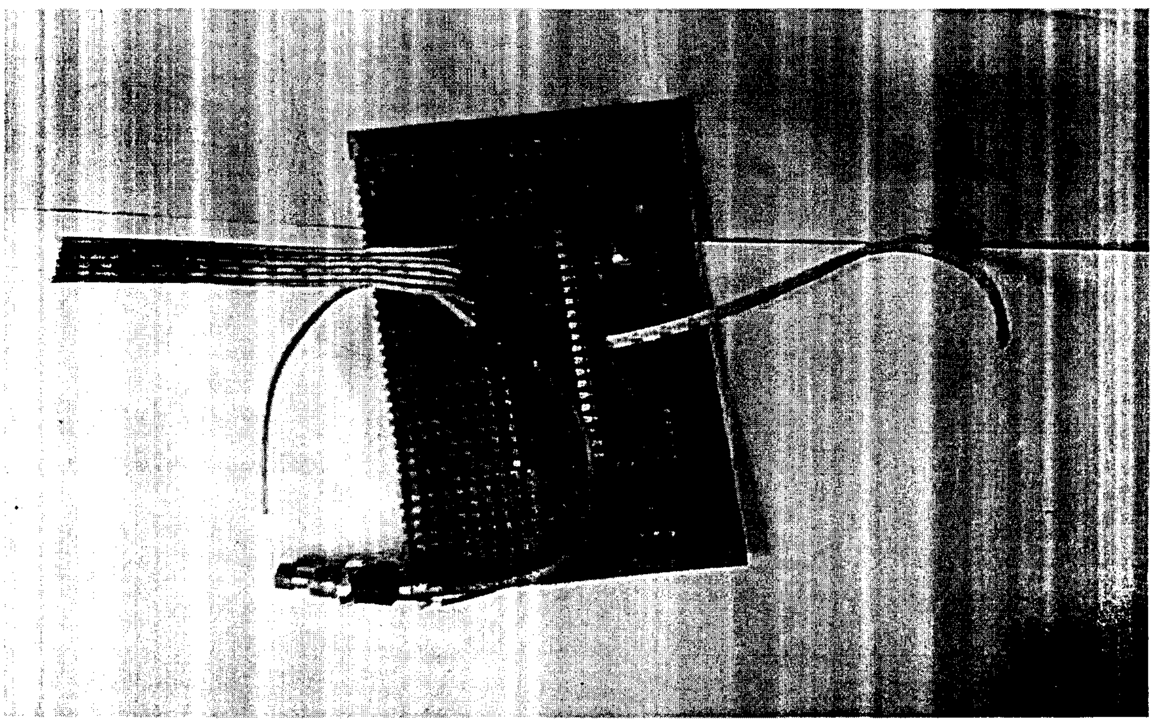


Fig. 3.5 pictorial view of the microcontroller unit

3.4 Relay driver unit

This unit explains how the signal from the microcontroller is being communicated to the relays with the help of relay driver IC.

3.4.1 Relay driver (ULN2803)

This system uses ULN2803 as the relay driver, it was chosen due to the high current and high voltage capabilities, and it was selected because of the industrial application of the system. The pins configuration is as follows; usually, the ULN2803 has eight inputs and outputs but for this project only four of these terminals was used. The output from the microcontroller is being inputted to pins 1,2,3,4 of the driver (ULN2803) then outputted at pins 15, 16, 17, 18 of the UNL2803. Each of the outputs are used to control each of the relays which in turn controls the respective appliances. Pins 9 and 10 are connected respectively to ground and Vcc.

3.4.2 Relay as a switch

A relay is an adaptation of an electromagnet. It consist of a coil of wire surrounding a soft iron core, an iron yoke, which provides a low reluctance path for magnetic flux, a movable iron armature and a set of contacts. The armature is hinged to the yoke and mechanically linked to a moving contact. It is held in place by a spring so that when the relay is de-energized there is an air gap in the magnetic circuit. In this condition one of the contact is closed and the other open. An electromechanical relay has contacts like a manual switch, but it is controlled by external voltage instead of being operated manually. They are of two modes of operation, Normally Closed (NC) and Normally Opened (NO) relays. When NC condition, the contacts are touching or closed at rest but opened by energizing the magnetic coil. While when in NO, the contacts are not touching, they are opened, but closed by energizing the magnetic coil [8, 13, 16].

A relay provides total isolation between the triggering source applied to the terminal and the output. This total isolation is important in many digital applications, and it is a feature that certain semiconductor switches (e.g. transistors, diodes and integrated circuits) cannot provides. Also, the contacts are normally rated for currents much higher than the current rating of semiconductor switches [13].

The 12v dc is permanently connected to the common terminals of the relays, the outputs from the uln2803 is then connected to the normally open terminal of the relay so that as a signal goes to the relay, it switches to the normally closed terminal which is the conduction mode.

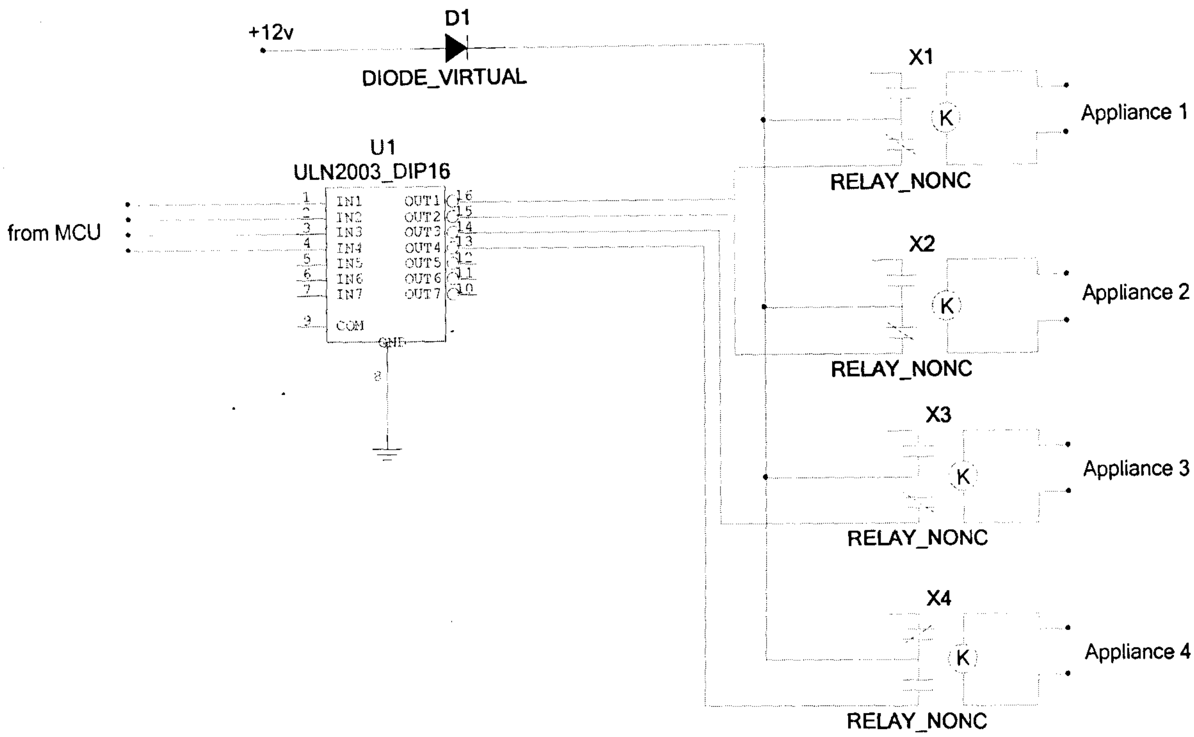


Fig 3.6 circuit diagram of the relay driver unit

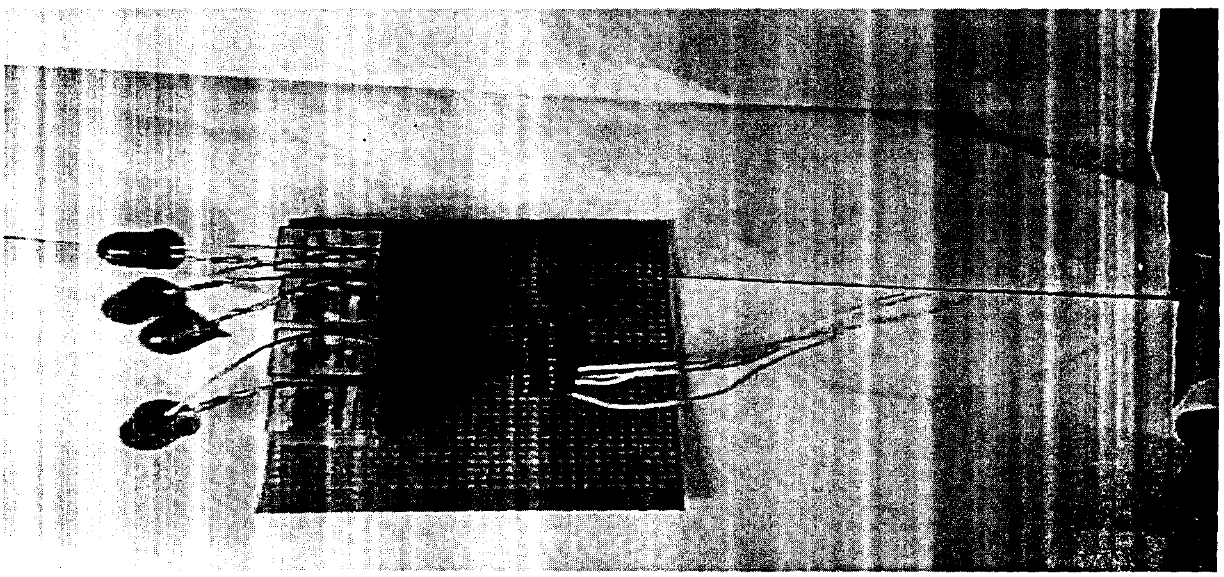


Fig 3.7 pictorial view of the relay driver unit

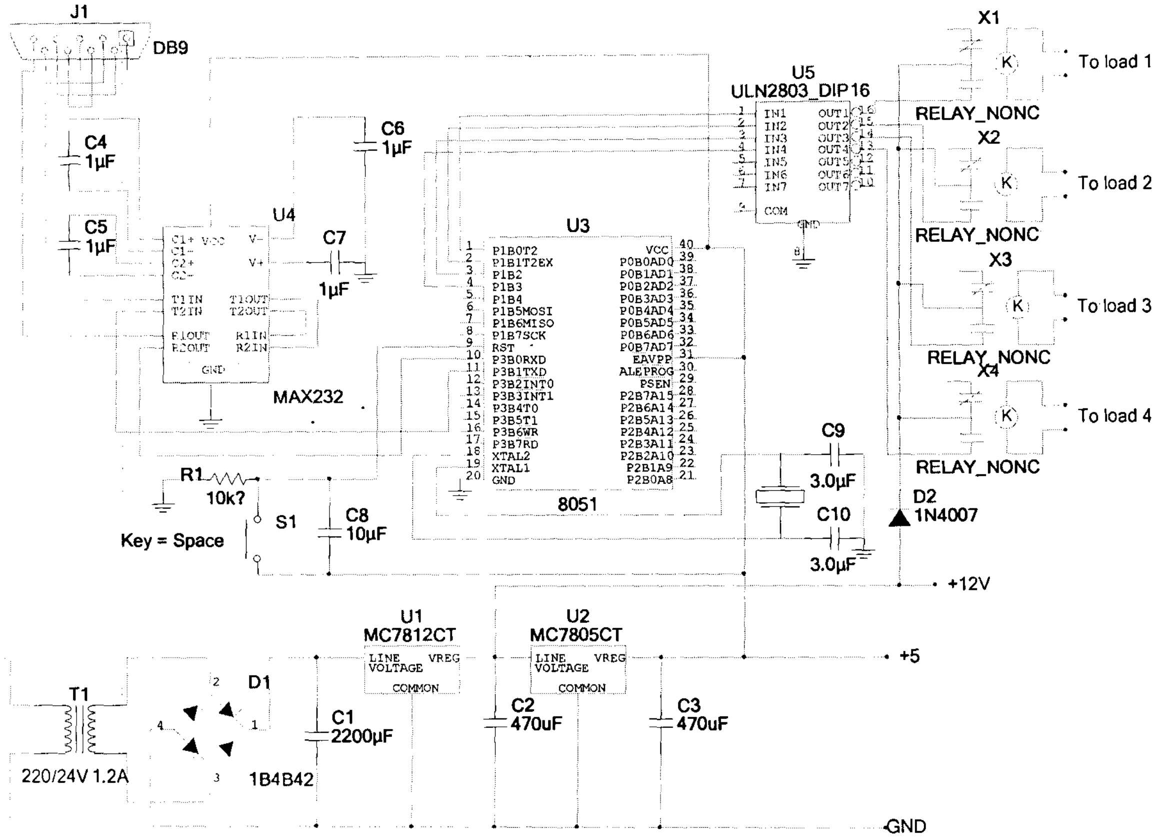


Fig 3.8 Complete circuit diagram

List of hardware used

1. 8051 Microcontroller
2. Max 232 IC.
3. Relays
4. Relay driver IC ULN 2803
5. Voltage regulator 7805, and 7812
6. Bridge rectifier diode
7. LCD

CHAPTER FOUR

TESTS, RESULTS AND DISCUSSION

4.0 Product characteristic focus

In designing and construction of the PC based appliance control system, the following factors were carefully put into consideration. They include;

- Reliability
- Durability
- Efficiency
- Affordability
- Effectiveness
- Low purchase cost

4.1 Testing

AT89S52 microcontroller is a programmable IC, which needs to be programmed to suit the design. The source code was first compiled on the notepad and then test ran on Multism Simulator. Proper concentration was given to the code during compilation in order to avoid any logic errors. The hex file was then generated and transferred to the chip with the aid of a programmer.

All the ICs were tested separately on a bread board to make sure they work properly. The whole circuit was also tested on the bread board to make sure it was design correctly. During construction, each section was tested as it was built to make sure the connections were done correctly before going onto the next section. This was done by applying the correct logic signals to the ICs and observing the output.

After construction, the system was tested as follows; To test each of the relay outputs, I typed ON1 on the PCs HyperTerminal, then pressed the Enter key. Almost immediately, appliance 1 switched ON. To test the second relay ON2 was typed and then ENTERED, the appliance 2 switched ON, the same procedure was repeated for output 3 and 4, and the corresponding appliance came ON. To test the reverse case, OFF1 was typed and then ENTERED, appliance 1 automatically switched OFF. The same applies to appliance 2, 3 and 4. Below is showing events leading to accessing the output port for "ON operation.

STATE OF DATA	PORT PIN LAYOUT								LOGIC EVENT	DEVICE STATE	DEVICE
	9	8	7	6	5	4	3	2			
INITIAL STATE	X	X	X	X	X	X	X	X			
REF BITS	0	0	0	0.	0	0	0	1			APPLIANCE
FINAL STATE	X	X	X	X	X	X	X	1	OR	ON	1
INITIAL STATE	X	X	X	X	X	X	X	X			
REF BITS	0	0	0	0	0	0	1	0			APPLIANCE

FINAL STATE	X	X	X	X	X	X	1	X	OR	ON	2

INITIAL STATE	X	X	X	X	X	X	X	X			
REF BITS	0	0	0	0	0	1	0	0			APPLIANCE
FINAL STATE	X	X	X	X	X	1	X	X	OR	ON	3
INITIAL STATE	X	X	X	X	X	X	X	X			
REF BITS	0	0	0	0	1	0	0	0			APPLIANCE
FINAL STATE	X	X	X	X	1	X	X	X	OR	ON	4

Table 1.Shows events leading to accessing the output port for "ON operation.

4.2 Precautions taken

1. Various component used were prevented from heat related damage by making sure that the solder was carefully applied.

2. Little but enough solder was applied to any joint to ensure proper contact of the components.

3. Heat sink was used to conduct heat away.

4. It was also ensured that the soldering iron temperature was not too high to avoid damage resulting from overheating.

5. Sensitive part of the circuit were properly insulated to prevent short circuit.

6. The circuit was firmly screwed to the casing for rigidity to prevent unexpected removal of wires.

7. Extreme care was taken to ensure that there were no conflicts with the use of identity names when entering the codes for the various controls.

8. Also the syntax for entering the codes was carefully followed to avoid errors.

9. I also made sure that I was careful enough not to delete any of the in-built resident code that enhances the operation of the program.

4.3 Difficulties encountered

The difficulty encountered in the design and construction of this system was the unreliability of the relays used. The relays I got from the market were bad in the sense that when a test is done on any of the relays for a couple of times, the relays eventually goes bad and had to be replaced with another.

4.4 Limitation

The load that must be connected to any of the output of the system must not have current rating higher than 10A, for example in a situation where an extension socket is connected to any of the output, the summation of the current ratings of each of the appliance connected must not be more than 10A because a 10A relay was utilized in this project. The remedy for this is to use a higher current rating relay.

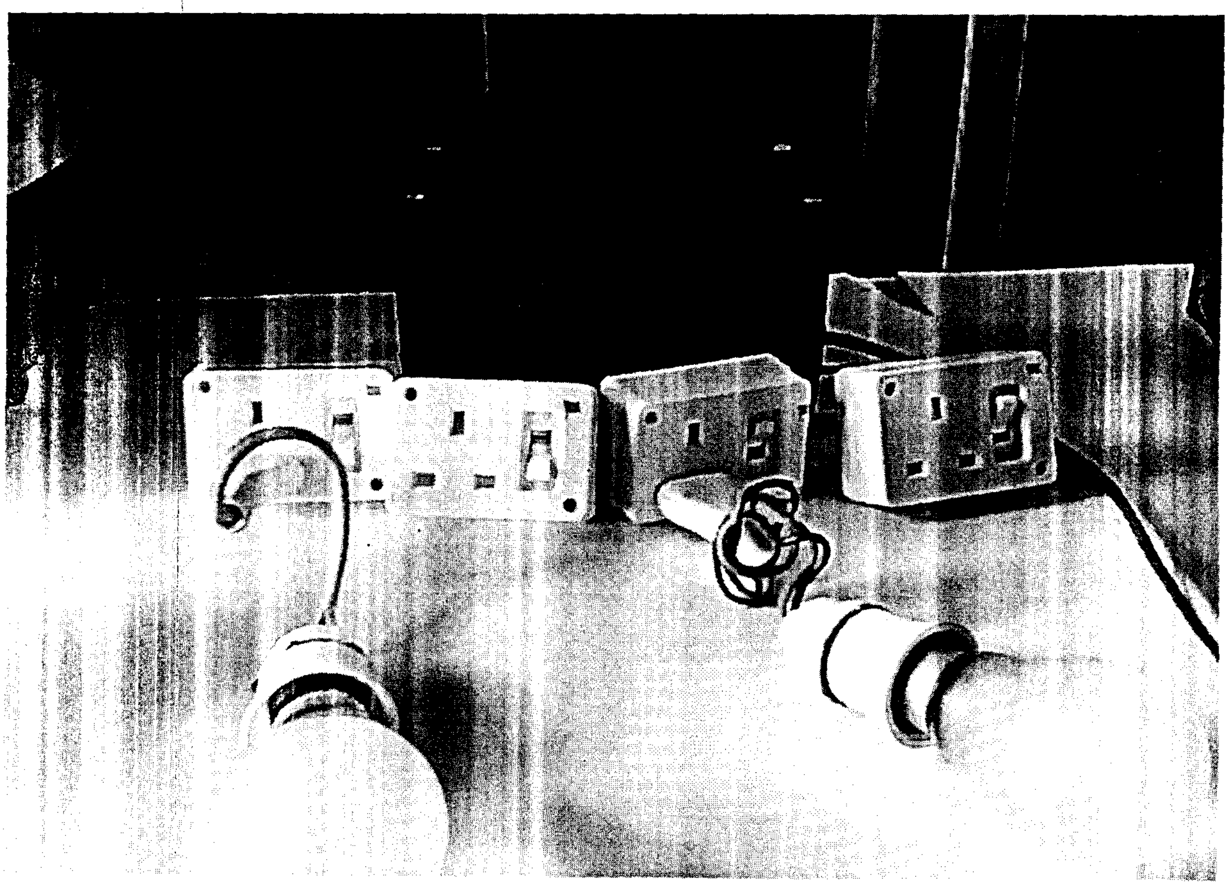


Fig 3.9 pictorial view of the complete project work

CHAPTER FIVE

CONCLUSION

5.1 Conclusion

The design and construction of this project was quite a challenging one although it was realized as proposed. The basic design of the PC based appliances control system is primarily to control appliances; this project remains the same though extra functions can be included. This system will control appliances on reception of a signal from the microcontroller unit. After typing the appropriate command on the PCs HyperTerminal, on the press of the Enter key, this signals the microcontroller which then relates it to the relays to carry out the specific task thereby switching ON or OFF any of the appliances. It has the advantage of high current and voltage capabilities, because of the relay driver used (ULN2803). Also, after switching the appliances, even if the PC is shutdown, the appliances remains ON, this is an improvement over other previous works in this field. The system can be used with any PC without having to configure the PC, provided the PC contains the HyperTerminal. HyperTerminal was chosen in this project because of its universality. Therefore, from the results obtained, it can be concluded that the aim of this project work has been practically and theoretically achieved.

5.2 Recommendation

Recommend that the system be put to better use because of its obvious advantages. Any individual or industry that require the service of this product should connect it to a voltage stabilizer before use, this is to avoid any fluctuation in the supply voltage which will alter the operation of the product, it will make the system to restart itself there by making the user to wait until the system initializes. All eight output data can be put to use, thereby enhancing greater control capabilities.

Finally, individuals, business and cooperate organizations should take advantage of this project offers to improve on the control of their electrical appliances with less human interference. The same applies to the industrial organizations. It will be fun to have their heavy machines and equipments switched ON and OFF by "themselves". There operations can even be regulated and feedback path could also be incorporated to allow the user observes the state of the control work been carried out at any particular time. This project gives necessary background information for such improvements.

5.3 Possible Improvement

There are a lot of other things that can be included in the project to increase its functionality, performance and dynamism. Some of these are given below:

1. Regulating the speed of the motor for various applications could also be in cooperated into the design.
2. More relays can be cascaded to increase the number of appliances that will be controlled, most especially in industrial applications.
3. The system can be modified such that the PC can be used to control the appliances wirelessly via LAN, etc.
4. It could be designed as a closed loop system to enable one observe the state of the control work been carried out at a particular time.

5. In a situation where heavy machinery with current rating higher than 10A is to controlled, then, a higher current relay should be used instead of the 10A relay used in this project. E.g 30A, 60A relays.

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APPENDIX A (user manual)

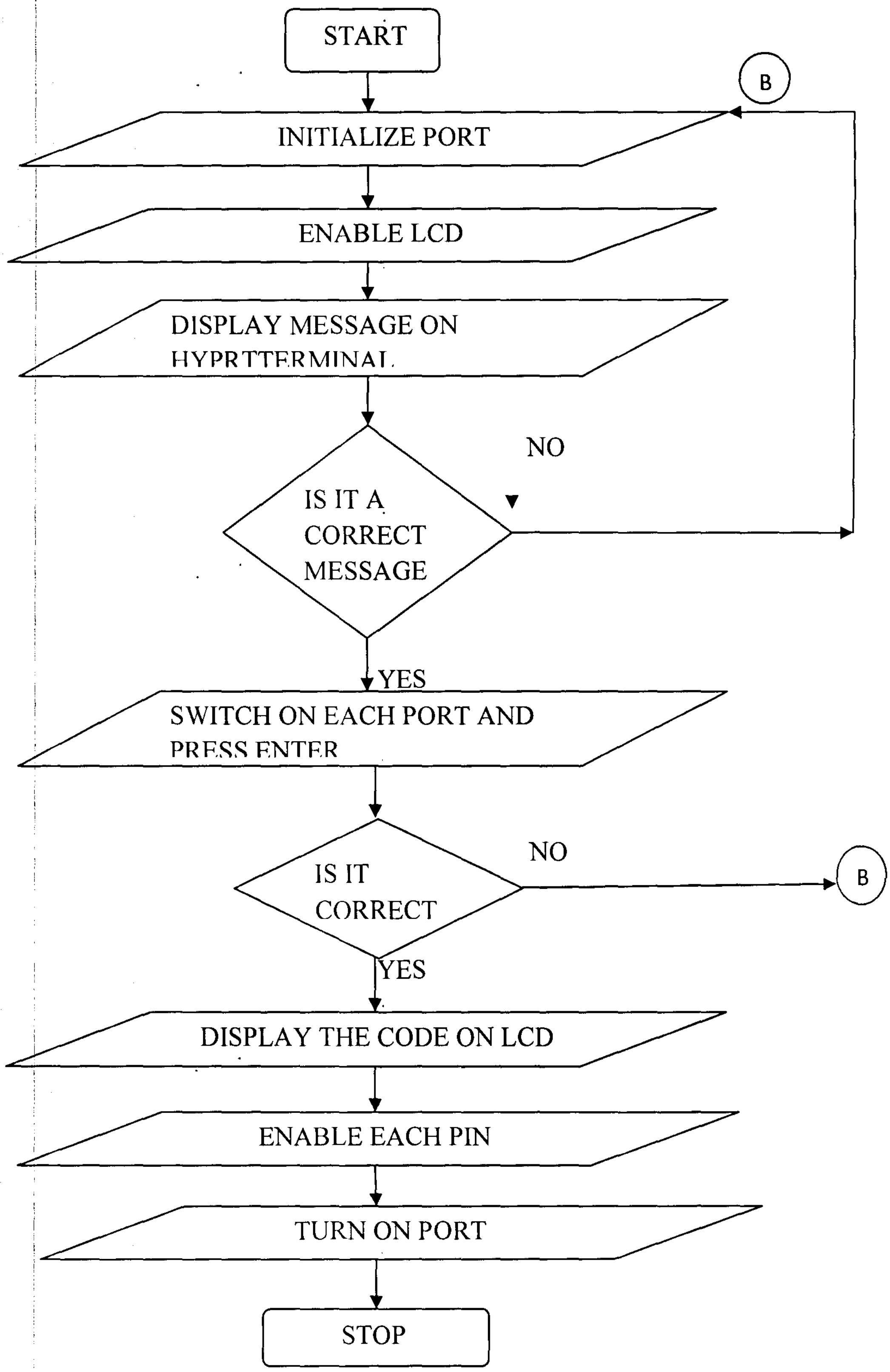
TROUBLESHOOTING MANUAL FOR PROGRAMMABLE BASED PC APPLIANCES CONTROL

1. **SYSTEM NOT POWER:** Check the power connection and make sure the output voltages from the power supply are 5volt and 12volt.
2. **NO OUTPUT ON THE LCD:** Adjust the variable resistor placed in front of the LCD to control the contrast. Make sure the LCD display reads "HOME APPLIANCES CONTROL SYSTEM" before connecting the serial cable to the personal computer
3. **NO WELCOME MESSAGE ON THE PC HYPERTERMINAL:** Check theconnection from the pc to the systems. And make sure you enable the "echo character" on the HyperTerminal.
4. **NO COMMUNICATION BETWEEN THE PC AND THE SYSTEM:** Make sure the baud rate settings on the HyperTerminal are set to 9600bps. The programmable device is set to 9600bps.
5. **NO OUTPUT FOR THE APPLIANCES:** Ensure that the relay connected to each appliance is working fine. You can change the relays and also check the output from the uln2803 which is a display driver. Check if every connection is working fine and there are no loose wires. Each appliance is independent of each other.

USER MANUAL FOR THE PC BASED APPLIANCES CONTROL

1. Power on the system from the power supply and ensure that the power indicator is on
2. Ensure there is a welcome message which reads "HOME APPLIANCE CONTROL SYSTEM" from the liquid crystal display
3. Make sure you open the HyperTerminal before connecting the serial cable to the serial port.
4. Ensure your computer is having db9 connector, if not get a computer with db9 connector
5. To switch on any appliances, type "ON1", "ON2" e.t.c and to switch the appliances off, type "OFF1", "OFF2" etc. The system can control any number of appliances connected to it.
6. The appliances that is connected and switch on will be indicated with a light emitting diode and any appliances you type on the HyperTerminal will be displayed on the LCD
7. If the system hanged, just pressed the reset button. It will reload the memory of the programmable chip

APPENDIX B (flow chart)



APPENDIX C (CODE)

```
#include<reg52.h>

sbit R1=P1^0;
sbit R2=P1^1;
sbit R3=P1^2;
sbit R4=P1^3;

sbit RS=P0^2;
sbit EN=P0^4;

voidRxmsg(void);
voidlcdinit(void);
voidlcdData(unsigned char l);
voidlcdcmd(unsigned char k);
voidDelayMs(unsigned int count);
void Welcome(void);
void ON(void);
void OFF(void);

void main()
{
unsigned char i=0;
unsignedint j=0;
unsigned char c[15];

TMOD=0x20;                    // Configure the serial port to 9600 baud
rate
TH1=0xFD;
SCON=0X50;
TR1=1;

R1=0;
R2=0;
R3=0;
R4=0;

lcdinit();
Welcome();
DelayMs(1000);

while(1)
{
back:

for(i=0;i<15;i++)             //command to recv data
{
c[i]=0xFF;
}

while(RI==0);
```

```
while(SBUF!=0x0d)                //command to recv data
{
j=0;
while(RI==0)
{
if(j>=1000)
goto timeout;
j++;
}
c[i]=SBUF;
RI=0;
}

timeout:
for(i=0;i<15;i++)
{
if(c[i]=='O' && c[i+1]=='N' && c[i+2]=='1' )
{
R1=1;
lcdcmd(0x01);
DelayMs(100);
ON();
DelayMs(100);
lcdcmd(0x84);
DelayMs(100);
lcdData('1');
DelayMs(100);
goto back;
}

if(c[i]=='O' && c[i+1]=='N' && c[i+2]=='2' )
{
R2=1;
lcdcmd(0x01);
DelayMs(100);
ON();
DelayMs(100);
lcdcmd(0x84);
DelayMs(100);
lcdData('2');
DelayMs(100);
goto back;
}

if(c[i]=='O' && c[i+1]=='N' && c[i+2]=='3' )
{
R3=1;
lcdcmd(0x01);
DelayMs(100);
ON();
DelayMs(100);
lcdcmd(0x84);
DelayMs(100);
lcdData('3');
```

```
DelayMs(100);
goto back;
}

if(c[i]=='O' && c[i+1]=='N' && c[i+2]=='4' )
{
R4=1;
lcdcmd(0x01);
DelayMs(100);
ON();
DelayMs(100);
lcdcmd(0x84);
DelayMs(100);
lcdData('4');
DelayMs(100);
goto back;
}

if(c[i]=='O' && c[i+1]=='O' && c[i+2]=='F' && c[i+2]=='1'  )
{
R1=0;
lcdcmd(0x01);
DelayMs(100);
OFF();
DelayMs(100);
lcdcmd(0x84);
DelayMs(100);
lcdData('1');
DelayMs(100);
goto back;
}

if(c[i]=='O' && c[i+1]=='O' && c[i+2]=='F' && c[i+2]=='2'  )
{
R2=0;
lcdcmd(0x01);
DelayMs(100);
OFF();
DelayMs(100);
lcdcmd(0x84);
DelayMs(100);
lcdData('2');
DelayMs(100);
goto back;
}

if(c[i]=='O' && c[i+1]=='O' && c[i+2]=='F' && c[i+2]=='3'  )
{
R3=0;
lcdcmd(0x01);
DelayMs(100);
OFF();
DelayMs(100);
lcdcmd(0x84);
```

```
DelayMs(100);
lcdData('3');
DelayMs(100);
goto back;
}

if(c[i]=='O' && c[i+1]=='O' && c[i+2]=='F' && c[i+2]=='4'  )
{
R4=0;
lcdcmd(0x01);
DelayMs(100);
OFF();
DelayMs(100);
lcdcmd(0x84);
DelayMs(100);
lcdData('4');
DelayMs(100);
goto back;
}

}
}
}

void Welcome(void)
{
unsignedint i=0;
unsigned char c[]="HOME APPLIANCES";
unsigned char d[]="CONTROL SYS.";

lcdcmd(0x01);
DelayMs(10);
lcdcmd(0x80);
DelayMs(10);

i=0;
while(c[i]!='\0')
{
lcdData(c[i]);
i++;
}

lcdcmd(0xc0);
DelayMs(10);

i=0;
while(d[i]!='\0')
{
lcdData(d[i]);
i++;
}
}

void ON()
```

```
{
unsignedint i=0;
unsigned char c[]="ON ";

lcdcmd(0x01);
DelayMs(10);
lcdcmd(0x80);
DelayMs(10);

while(c[i]!='\0')
{
lcdData(c[i]);
i++;
}
}

void OFF(void)
{
unsignedint i=0;
unsigned char c[]="OFF ";

lcdcmd(0x01);
DelayMs(10);
lcdcmd(0x80);
DelayMs(10);

while(c[i]!='\0')
{
lcdData(c[i]);
i++;
}
}



//---------------------------------------
// Lcd initialization subroutine
//---------------------------------------
voidlcdinit(void)
{
lcdcmd(0x38);
DelayMs(250);
lcdcmd(0x0E);
DelayMs(250);
lcdcmd(0x01);
DelayMs(250);
lcdcmd(0x06);
DelayMs(250);
lcdcmd(0x80);
DelayMs(250);
}

//---------------------------------------
```

```
// Lcd data display
//----------------------------------------
voidlcdData(unsigned char l)
{
P2=l;
RS=1;
EN=1;
DelayMs(1);
EN=0;
return;
}

//----------------------------------------
// Lcd command
//----------------------------------------
voidlcdcmd(unsigned char k)
{
P2=k;
RS=0;
EN=1;
DelayMs(1);
EN=0;
return;
}

//----------------------------------------
// Delay mS function
//----------------------------------------
voidDelayMs(unsigned int count)
{  // mSec Delay 11.0592 Mhz
unsignedint i;                  // Keil v7.5a
while(count) {
        i = 115;                // 115     exact value
            while(i>0)
            i--;
count--;
    }
}
```