SURVELLIANCE ROBOT USING DTMF AS A MODULE

Project Report submitted in partial fulfillment of the requirement for the degree of

Bachelor of Technology

in

Electronics and Communication Engineering

By

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CERTIFICATE

This is to certify that the project report entitled **"SURVELLIANCE ROBOT USING DTMF AS A MODULE"**, submitted by **Prashant Malik, Prashant Singh and Rahul Lavania** in partial fulfillment for the award of degree of Bachelor of Technology in Electronics and Communication Engineering to Jaypee University of Information Technology, Waknaghat, Solan has been carried out under my supervision.

Date : 18 May 2010

DR. VIVEK KUMAR SEHGAL

(Sr. Lecturer)

Certified that this work has not been submitted partially or fully to any other University or Institute for the award of this or any other degree or diploma.

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ACKNOWLEDGMENT

It has been a wonderful and intellectually stimulating experience working on the "SURVELLIANCE ROBOT USING DTMF AS A MODULE". As we all know in today's world every one wants to live a safe and peaceful life, different countries are showing more interest towards their security, so that their countries can counteract terrorist activities.

Terrorism is a serious issue worldwide and this project can be of great use to the defence of our country, which will enable us to keep a check on terrorist's activities.

We wish to express our earnest gratitude to **Mr.Vivek Kumar Sehgal** for providing us invaluable guidance , suggestions and providing us with the finest details of the subjects, which allowed us to present our project in its final form.

We gratefully acknowledge all the staff members of Electronics and Communication Engineering Department of Jaypee University of Information Technology, Waknaghat, for providing us with all the facilities required for the completion of our project.

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Date: 18 MAY 2010

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ABSTRACT

Defence security and surveillance robots are much more robust then their hobby grades and educational counterparts. They are built to save lives and take abuse by placing themselves in harsh conditions or dangerous environments where human would rather not find themselves in. They allow the operator to safely monitor the situation remotely while increasing awareness.

Working on a project that will be of great help to the security and surveillance department of our country has been interestingly challenging and a thrilling experience.

This project proposes an 8-bit embedded controller interfaced with vehicular robot whose movement are controlled with GSM/CDMA based mobile phone. The 8-bit microcontroller is interfaced with mobile phone which receives the command signal from other GSM/CDMA mobile. The controller is programmed to control the movement of two dc motor used in the robot through hands free port of mobile phone using signal from available network. The control mechanism is based on DTMF tones generated by mobile phone when the number keys are pressed. To keep the track of the movements of robot, a wireless video link is set.

The RF transmitter from the camera transmits the signal to the receiver, and RF converter gives us the video on the computer, which gives us detailed information in and around the area where our robot is placed.

LIST OF FIGURES

LIST OF ABBREVIATIONS

DTMF	- Dual tone multiple frequency
LED	- Light Emitting Diode
TV	- Television
IC	- Integrated Circuit
PSWR	- Program Status Word Register
ROM	- Read Only Memory
HBL	- H Bridge Logic
BCD	- Binary Coded Decimal

INTRODUCTION

For the aging population, surveillance in household environment and outside has become more and more important. In this project we present a robot that can detect abnormal events by utilizing video and audio information.

The proposed embedded platform can control and monitor the robotic car connected to it from any distance by just making phone call. It has ability to move forward, backward and turn right or left according to the command given by the user from his mobile phone. This system is designed to overcome the limitation of range offered by infrared or wireless technology in case of surveillance, by making use of available GSM/CDMA all over the world.

The proposed idea can be extended in following applications:

1) Generating of actuating signals in real time control applications
2) Smart sensor network
3) Wireless data acquisition system

The heart of system lies in DTMF (dual tone multi frequency) decoder. It is a tone consisting of two Frequency. Various innovations have been made in this field. A system could be designed based on the DTMF signals that could be sent through a loop of wire to switch on/off various appliances via a personal computer. The signals from DTMF go to the microcontroller input port. These decoded signals executed the different subroutines in the microcontroller program and send the control or switching signals to the devices.

NEED OF THE PROJECT

We came upon this concept after the 26/11 attack in Mumbai, where not only the Indian public lost their loved ones but foreign countries had to suffer as well, as their bureaucrats and entrepreneurs had to face difficulties. It was a check on the security system of our country which was not up to the expectations, and was embarrassing on the world stage, as the terrorists very easily got through the sea route.

All these events inspired us into making this project which will give us every detail of what's happening around with audio effects as well. This surveillance device could have been used in the Taj and trident Oberoi to keep a track of every move these terrorists would have made, as it would have made the job of our NSG commandos much easier and simple. and many such attacks that have taken place in the recent times like bank robberies, Jewellery theft in Ludhiana last summer where the shopkeeper was able to track down the robbery by looking at the recorded CCTV footage, making the job for the local police so much more easier.

This project finds its main application in the defence of our country. Contributing in such a manner to our country has motivated and inspired us to passionately complete our work.

Chapter 1

VIDEO CAPTURE

1.1 Wireless Camera

Wireless cameras are basically described as a wireless transmitter carrying a camera signal. The Camera is wireless and the signal travels between the camera and the receiver. This works much like radio. The sound you hear on a radio is wireless and you tune to a certain frequency and hear the sound. Wireless cameras have a channel also. The receiver has channels to tune in and then you get the picture. The wireless camera picture is sent by the transmitter the receiver collects this signal and out puts it to your TV and / or VCR.

1.2 Working

Wireless video transition is made possible with use of video transmitters and receivers. Most wireless cameras come with a built in video transmitter and a separate video receiver. Once installed the video signal is sent wirelessly thru a specific frequency to the receiver which is connected directly to a security monitor, time lapse recorder or the other components of the security camera system in more complex systems. Should we use wireless cameras? This is one of the most frequently asked questions that come up while designing a security camera system. The answer to this question is not as simple as it may seem. After all wireless cameras seem like the easiest solution, no cables to run means less labor involved. Not so fast, before you make that decision there are a few things you need to know about wireless systems. A wireless security camera is not totally wireless. That's right; their name is slightly deceiving because it only refers to the video signal. Even though no video cable is needed for the wireless camera, it still requires power, which means another cable from the camera to the closest outlet. And if there are no power outlets located nearby than a power cable will have to be installed all the way back to the nearest outlet. The limited number of frequencies available is another disadvantage when designing a system using wireless cameras. Most wireless camera are limited to 4 different frequencies. This means that you are limited to using four cameras at one location per frequencies range. Thankfully there are a couple of frequency ranges, 900MHz and 2.4 Ghz. A combination of cameras from both frequency ranges could expand the number of cameras per location to eight. Just like with many other wireless equipment that you might be familiar with, various objects located between the transmitter and receiver could pose reception problems. One of the worse material to go thru would be metal and clear line of sight is preferred for optimum range and reception. So while designing a wireless system, please keep in mind to keep the number of walls or objects between the wireless security camera and its receiver to a minimum for best reception. Now that you have a better understanding of wireless security cameras you should be able to decide whether wireless camera are the right choice for you. If they are, than there are numerous application where you can use them. They can be used almost anywhere but the most common ones are; covert video surveillance, baby sitter camera, lobby camera, museum or monitoring of high value objects because it makes it hard for intruders to destroy the recording media by locating the recording device.

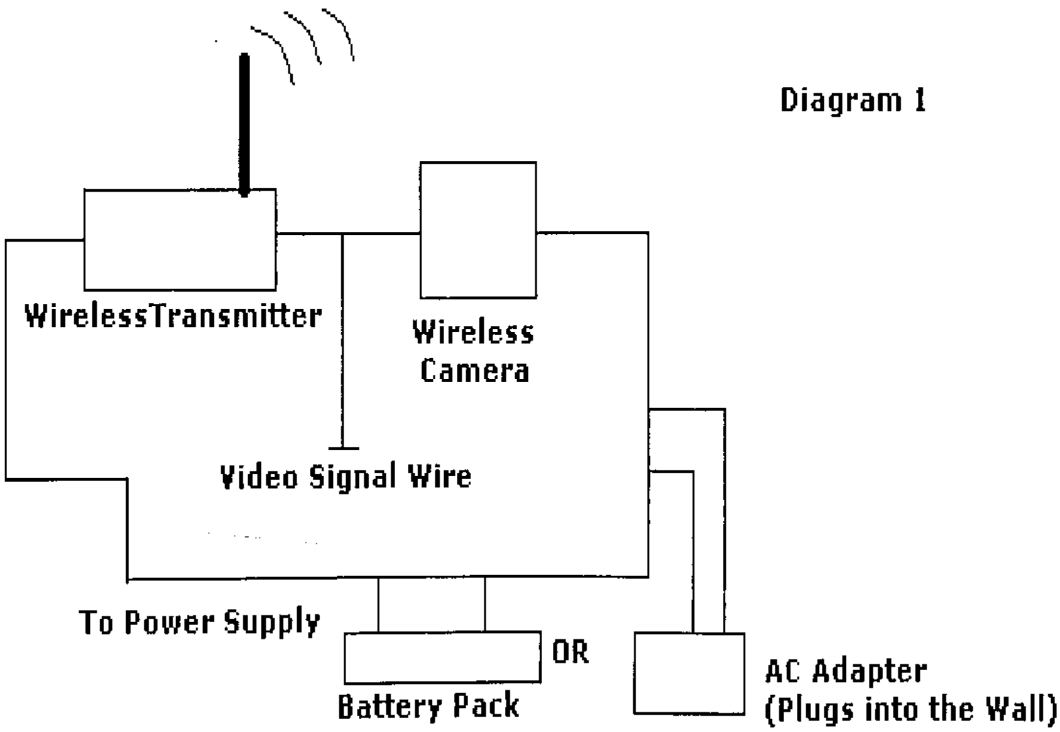
Covert camera otherwise known as spy or hidden cameras have become more and more popular in recent years. Some of this sudden popularity is due as a result of some highly publicized cases of children abuse by baby sitters that were uncovered by the use of hidden camera. Other reasons might be related to the lowering cost of manufacturing such cameras, which has made them more affordable in the market. In most application covert cameras are used as standalone units connected directly to a security time lapse recorder or digital video recorder (DVR). But they can also be very effective in enhancing a video security system. If most cameras within a video security system are in plain view, they are more susceptible to vandalism or avoidance by the subject being monitored. It is in these areas where a hidden camera could be helpful to monitor a high value item such as a safe, cash register etc. In such high security areas where currency exchanges hands or is temporally being stored employees are aware that they might be monitored. Therefore hidden spy cameras may be used and their location or the fact that they are installed may not be disclosed. However it is recommended that you consult with a local attorney before installing any covert video equipment.

1.3 Transmitter

The Camera sees the image, the camera then provides the video to the transmitter, then the transmitter sends the wireless signal to the receiver. There are many types of wireless cameras. You can make any camera wireless by adding a wireless transmitter and receiver. The camera and transmitter require power. The power is provided by battery and/ or transformer / adapter. The complete (Diagram 1) wiring for the wireless camera and transmitter end follows.

As you can see by (Diagram 1) The camera and transmitter both need power. The camera sees an image, sends it to the transmitter, and the transmitter sends the signal out to the air. The receiver picks up the signal and outputs it to a TV / Monitor / Digital Video recorder This is a basic diagram many wireless cameras and transmitters are very small and the power is provided to both from one source. A good example of this is an Hidden wireless camera. IE: A clock radio wireless camera is powered by plugging in the clock. The camera and wireless transmitter are provided power by the clock radio internally.

Diagram 1



1.4 Receiver

The wireless receiver has only one function. After the wireless camera and transmitters have provided the wireless video signal the receiver collects this signal and routes it the Monitor, TV, VCR or alternative recording or viewing device. See diagram 2 below.

As you can see in Diagram 2 The receiver accepts the wireless transmitters signal and then outputs it to your TV, VCR, Monitor or Other Recording Device. The receiver needs only power and a Device to view and or record the Signal /Video.

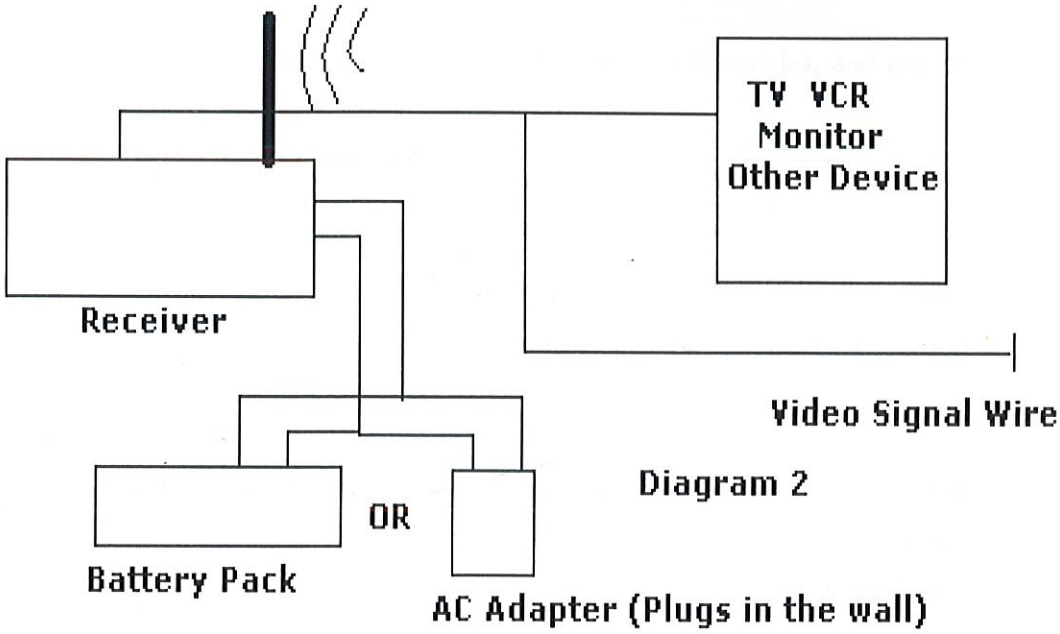


Diagram 2

1.5 Video Transmitters / Receivers

Video Transmitters can be obtained separate from cameras. If you have a wired camera now you can turn it into wireless by adding a transmitter and receiver. Instead of the wire from the camera to the recording device or monitor the wireless signal will send the video. Again you will need to provide power to the camera and the transmitter. Most transmitters and receivers are sold as a package but some are not. Be sure to check with the supplier.

Chapter 2

DUAL TONE MULTI FREQUENCY

2.1 Introduction

When you press a button in the mobile phone set keypad, a connection is made that generates a resultant signal of two tones at the same time. These two tones are taken from a row frequency and a column frequency. The resultant frequency signal is called "*Dual Tone Multiple Frequency*". These tones are identical and unique.

A *DTMF* signal is the algebraic sum of two different audio frequencies, and can be expressed as follows:

$$f(t) = A_0\sin(2*\Pi*f_a*t) + B_0\sin(2*\Pi*f_b*t) + ... \quad ------->(1)$$

Where f_a and f_b are two different audio frequencies with A and B as their peak amplitudes and f as the resultant DTMF signal. f_a belongs to the low frequency group and f_b belongs to the high frequency group.

Each of the low and high frequency groups comprise four frequencies from the various keys present on the telephone keypad; two different frequencies, one from the high frequency group and another from the low frequency group are used to produce a DTMF signal to represent the pressed key.

The amplitudes of the two sine waves should be such that

$$(0.7 < (A/B) < 0.9)V \quad -------->(2)$$

The frequencies are chosen such that they are not the harmonics of each other. The frequencies associated with various keys on the keypad are shown in figure (A).

The row and column frequencies are given below:

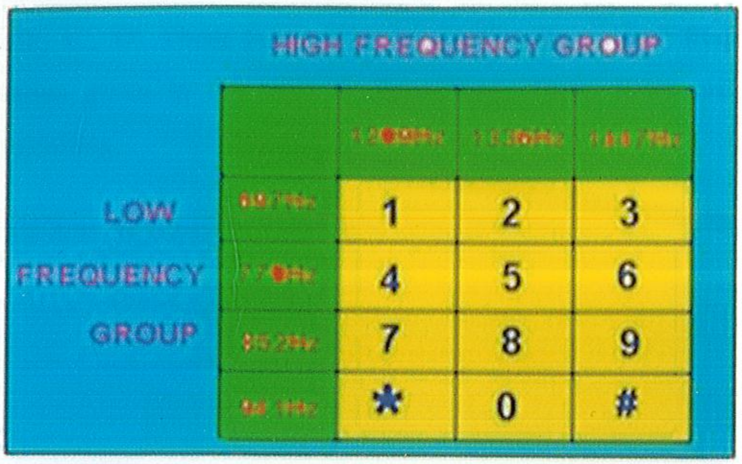


Fig (A)

When you press the digit 5 in the keypad it generates a resultant tone signal which is made up of frequencies 770Hz and 1336Hz. Pressing digit 8 will produce the tone taken from tones 852Hz and 1336Hz. In both the cases, the column frequency 1336 Hz is the same. These signals are digital signals which are symmetrical with the sinusoidal wave.

A Typical frequency is shown in the figure below:

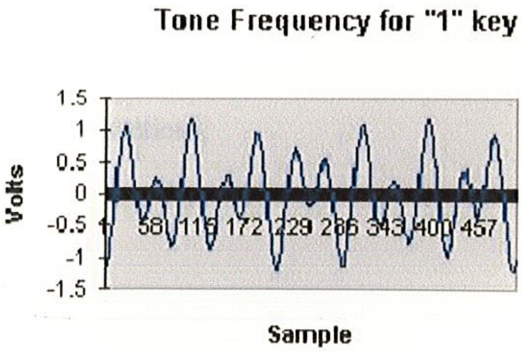


Figure (B)

Along with these DTMF generator in our mobile phone set provides a set of special purpose groups of tones, which is normally not used in our keypad. These tones are identified as 'A', 'B', 'C', 'D'. These frequencies have the same column frequency but uses row frequencies given in the table in figure (A). These tones are used for communication signalling.

The frequency table is as follows:

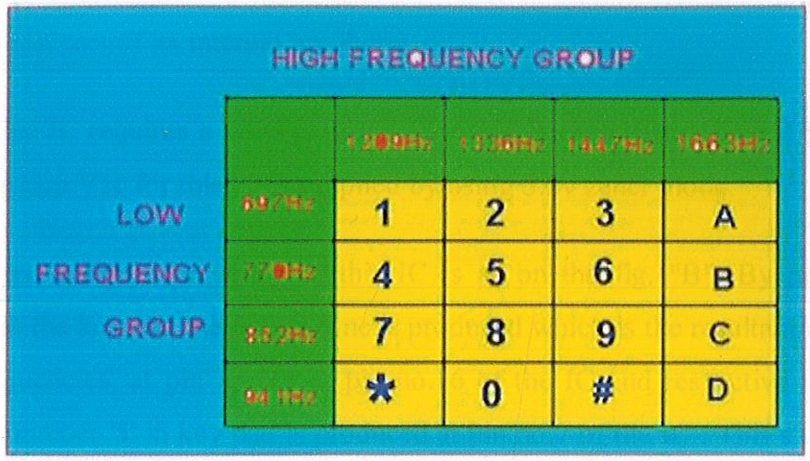


Figure (C)

Due to its accuracy and uniqueness, these DTMF signals are used in controlling systems using mobile phone. By using some DTMF generating IC's (UM91214, UM91214, etc) we can generate DTMF tones without depending on the telephone or mobile phone set.

2.2 Types of System

This system is divided into two sections,

1: Remote Section

2: Local Control Section.

2.2.1 Remote Section

This unit consists of telephone set or mobile phone which is present in the remote place. This may be your workspace (office / school) mobile phone or a phone in PCO. Signals are sent through this phone. The figure (E) shows the circuit diagram of the

DTMF encoder, which resembles the telephone set. It uses DTMF encoder integrated circuit, Chip UM 91214B. This IC produces DTMF signals. It contains four row frequencies & three column frequencies. The pins of IC 91214 B from 12 to 14 produces high frequency column group and pins from 15 to 18 produces the low frequency row group. By pressing any key in the keyboard corresponding DTMF signal is available in its output pin at pin no.7. For producing the appropriate signals it is necessary that a crystal oscillator of 3.58MHz is connected across its pins 3 & 4 so that it makes a part of its internal oscillator.

This encoder IC requires a voltage of 3V. For that IC is wired around 4.5V battery. And 3V backup Vcc for this IC is supplied by using 3.2v zener diode.

The row and column frequency of this IC is as on the fig. "B". By pressing the number 5 in the key pad the output tone is produced which is the resultant of addition of two frequencies, at pin no. 13 & pin no.16 of the IC and respective tone which represents number '5' in key pad is produced at pin no.7 of the IC . This signal is sent to the local control system through telephone line via exchange.

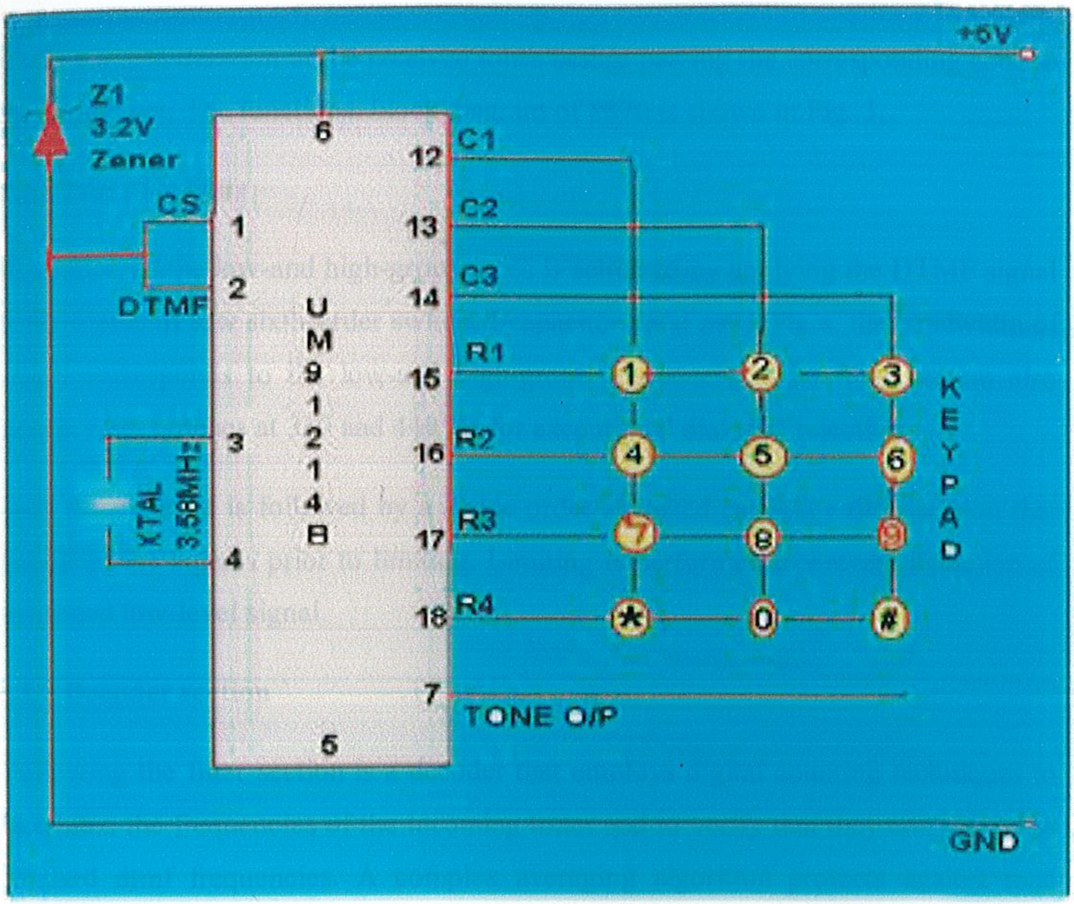


Figure (E). Circuit diagram of the DTMF encoder

2.2.2 Local Control Section

This is a control unit through which you can control your robot car. This contains one cell phone and a Local Control Section. The robot car to be controlled must be connected to cell phone through control unit. Control unit is kept with a sufficient backup.

Local Control Section consists of a DTMF decoder, microcontroller, and relay driver circuits. Before going into detail of the circuit, we will take a brief description about integrated circuits used in local control section.

2.3 MT 8870 DTMF decoder

The MT8870D/MT8870D-1 monolithic DTMF decoder offers the advantages of small size, low power consumption and high performance. It consists of a band-split filter section that separates lowed by a digital counting section that verifies the frequency and duration of the received tones before passing the corresponding code to the output bus. The functional block diagram of 8870 is shown in Fig. 3.

2.3.1 Filter section

Separation of the low-and high-group tones is achieved by applying the DTMF signal to the inputs of tow sixth-order switched-capacitor band pass filters, the bandwidth of which corresponds to the low-and high-group frequencies. The filter section also incorporates notches at 350 and 440 Hz for exceptional dial tone rejection.

Each filter output is followed by a single-order switched-capacitor filter section that smoothen the signals prior to limiting. Limiting is performed to prevent detection of unwanted low-level signal.

2.3.2 Decoder section

Following the filter section is a decoder that employs digital counting techniques to determine the frequencies of the incoming tones and to verify that they correspond to standard dtmf frequencies. A complex averaging algorithm protects against tone simulation by extraneous signals such as voice while providing tolerance to small frequency deviations and variations. This averaging algorithm has been developed to ensure and optimal combination of immunity to talk-off and tolerance to the presence of interfering frequencies (third tones) and noise.

When the detector recognizes the presence of two valid tones (signal condition), the early steering (ESt) output will go to an active state. Any subsequent loss of signal condition will make ESt inactive.

Steering circuit- Before registration of a decoded tone pair. The receiver checks for a valid signal duration (character-recognition condition). This check is performed by an external RC time constant driven by ESt.

Crystal oscillator- The internal clock circuit is completed with the addition of an external 3.579545MHz crystal.

IC MT8870/KT3170 serves as DTMF. This IC takes DTMF signal coming via telephone line and converts that signal into respective BCD number. It uses same oscillator frequency used in the remote section so same crystal oscillator with frequency of 3.85M Hz is used in this IC.

2.4 Working of IC MT8870

The MT-8870 is a full DTMF Receiver that integrates both band split filter and decoder functions into a single 18-pin DIP. Its filter section uses switched capacitor technology for both the high and low group filters and for dial tone rejection. Its decoder uses digital counting techniques to detect and decode all 16 DTMF tone pairs into a 4-bit code. External component count is minimized by provision of an on-chip differential input amplifier, clock generator, and latched tri-state interface bus. Minimal external components required include a low-cost 3.579545 MHz crystal, a timing resistor, and a timing capacitor. The MT-8870-02 can also inhibit the decoding of fourth column digits.

MT-8870 operating functions include a band split filter that separates the high and low tones of the received pair, and a digital decoder that verifies both the frequency and duration of the received tones before passing the resulting 4-bit code to the output bus.

The low and high group tones are separated by applying the dual-tone signal to the inputs of two 6^{th} order switched capacitor band pass filters with bandwidths that correspond to the bands enclosing the low and high group tones.

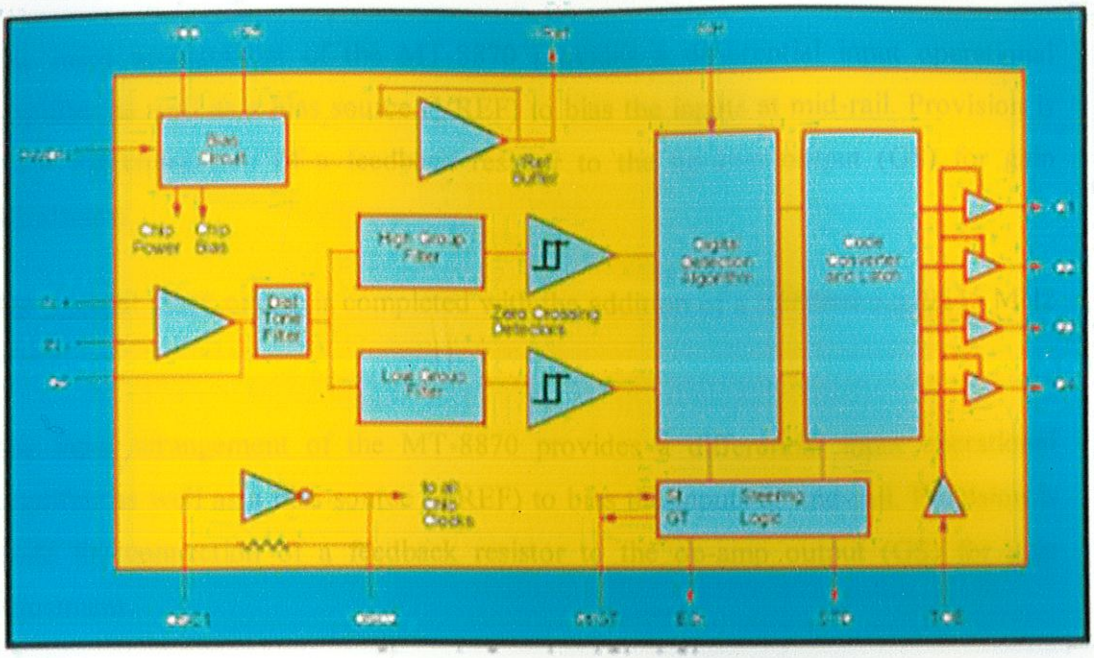


Figure (F).Block diagram of IC MT8870

The filter also incorporates notches at 350 and 440 Hz, providing excellent dial tone rejection. Each filter output is followed by a single-order switched capacitor section that smoothes the signals prior to limiting. Signal limiting is performed by high gain comparators provided with hysteresis to prevent detection of unwanted low-level signals and noise. The MT-8870 decoder uses a digital counting technique to determine the frequencies of the limited tones and to verify that they correspond to standard DTMF frequencies. When the detector recognizes the simultaneous presence of two valid tones (known as signal condition), it raises the Early Steering flag (ESt). Any subsequent loss of signal condition will cause ESt to fall. Before a decoded tone pair is registered, the receiver checks for valid signal duration (referred to as character- recognition-condition). This check is performed by an external RC time constant driven by ESt. A short delay to allow the output latch to settle, the delayed steering output flag (StD) goes high, signalling that a received tone pair has been registered. The contents of the output latch are made available on the 4-bit output bus by raising the three state control input (OE) to logic high. Inhibit mode is enabled by a logic high input to pin 5 (INH). It inhibits the detection of 1633 Hz.

The output code will remain the same as the previous detected code. On the M- 8870 models, this pin is tied to ground (logic low).

The input arrangement of the MT-8870 provides a differential input operational amplifier as well as a bias source (VREF) to bias the inputs at mid-rail. Provision is made for connection of a feedback resistor to the op-amp output (GS) for gain adjustment.

The internal clock circuit is completed with the addition of a standard 3.579545 MHz crystal.

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On the next page one can see how all the devices which are been used in this project are linked together. The transmitter section consists of matrix keypad, DTMF encoder and a mobile set which through GSM transmits the signals to the telephone exchange and then is been received by the receiver section which consists of 8870 DECODER IC, 89C51 Microcontroller, switching device and relay drivers.

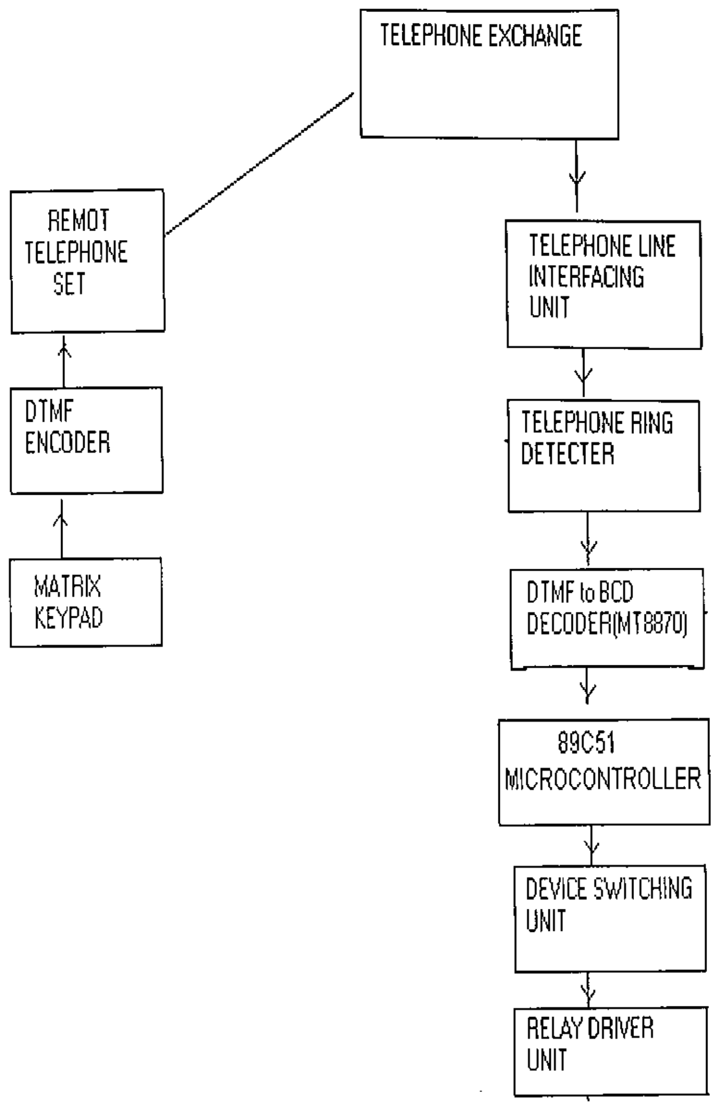


Figure (D) BLOCK DIAGRAM OF THE SYSTEM

Chapter 3

THE MICROCONTROLLER

In our day to day life the role of micro-controllers has been immense. They are used in a variety of applications ranging from home appliances, FAX machines, Video games, Camera, Exercise equipment, Cellular phones musical Instruments to Computers, engine control, aeronautics, security systems and the list goes on.

3.1 Microcontrollers and Microprocessors

The microprocessors (such as 8086, 80286, 68000 etc.) contain no RAM, no ROM and no I/O ports on the chip itself. For this reason they are referred as general-purpose microprocessors. A system designer using general- purpose microprocessor must add external RAM, ROM, I/O ports and timers to make them functional. Although the addition of external RAM, ROM, and I/O ports make the system bulkier and much more expensive, they have the advantage of versatility such that the designer can decide on the amount of RAM, ROM and I/o ports needed to fit the task at hand. This is the not the case with microcontrollers. A microcontroller has a CPU (a microprocessor) in addition to the fixed amount of RAM, ROM, I/O ports, and timer are all embedded together on the chip: therefore, the designer cannot add any external memory, I/O, or timer to it. The fixed amount of on chip RAM, ROM, and number of I/O ports in microcontrollers make them ideal for many applications in which cost and space are critical. In many applications, for example a TV remote control, there is no need for the computing power of a 486 or even a 8086 microprocessor. In many applications, the space it takes, the power it consumes, and the price per unit are much more critical considerations than the computing power. These applications most often require some I/O operations to read signals and turn on and off certain bits. It is interesting to know that some microcontrollers manufactures have gone as far as integrating an ADC and other peripherals into the microcontrollers.

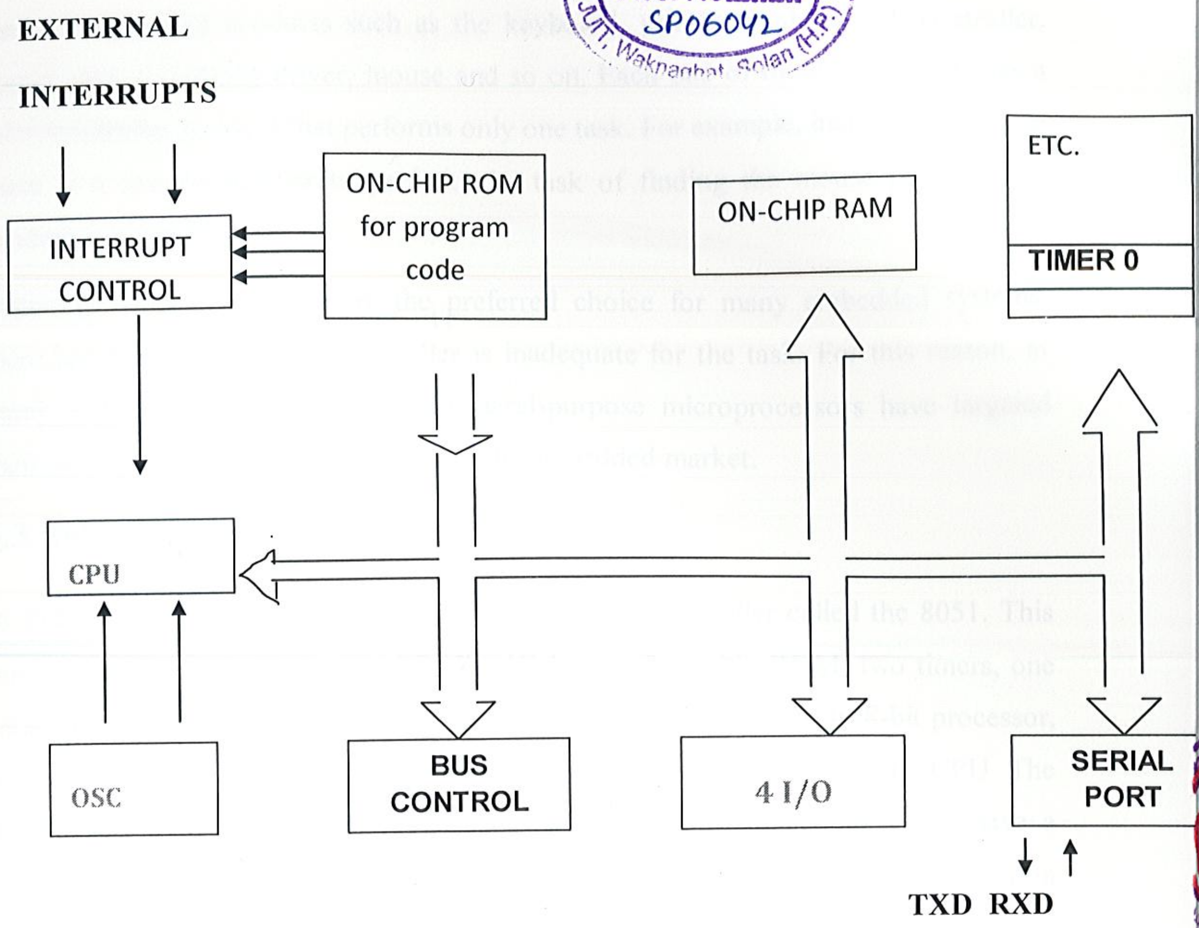


Fig-3.1 MICROCONTROLLER BLOCK DIAGRAM

3.2 Microcontrollers for Embedded Systems

In the literature discussing microprocessors, we often see a term embedded system. Microprocessors and microcontrollers are widely used in embedded system products. An embedded product uses a microprocessor (or microcontroller) to do one task and one task only. A printer is an example of embedded system since the processor inside it performs one task only: namely, get data and print it. Contrasting this with a IBM PC which can be used for a number of applications such as word processor, print server, network server, video game player, or internet terminal. Software for a variety of applications can be loaded and run. Of course the reason a PC can perform myriad tasks is that it has RAM memory and an operating system that loads the application software into RAM and lets the CPU run it. In an embedded system, there is only one application software that is burned into ROM. An PC contains or is connected to various embedded products such as the keyboard, printer, modem, disk controller, sound card, CD-ROM driver, mouse and so on. Each one of these peripherals has a microcontroller inside it that performs only one task. For example, inside every mouse there is a microcontroller to perform the task of finding the mouse position and sending it to the PC.

Although microcontrollers are the preferred choice for many embedded systems, there are times that a microcontroller is inadequate for the task. For this reason, in many years the manufacturers for general-purpose microprocessors have targeted their microprocessor for the high end of the embedded market.

3.3. Introduction to 8051

In 1981, Intel Corporation introduced an 8-bit microcontroller called the 8051. This microcontroller had 128 bytes of RAM, 4K bytes of on-chip ROM, two timers, one serial port, and four ports (8-bit) all on a single chip. The 8051 is an 8-bit processor, meaning the CPU can work on only 8- bit pieces to be processed by the CPU. The 8051 has a total of four I/O ports, each 8- bit wide. Although 8051 can have a maximum of 64K bytes of on-chip ROM, many manufacturers put only 4K bytes on the chip.

The 8051 became widely popular after Intel allowed other manufacturers to make any flavour of the 8051 they please with the condition that they remain code compatible with the 8051. This has led to many versions of the 8051 with different speeds and amount of on-chip ROM marketed by more than half a dozen manufacturers. It is important to know that although there are different flavours of the 8051, they are all compatible with the original 8051 as far as the instructions are concerned. This means that if you write your program for one, it will run on any one of them regardless of the manufacturer. The major 8051 manufacturers are Intel, Atmel, Dallas Semiconductors, Philips Corporation, Infineon.

3.3.1 AT89c51

This popular 8051 chip has on-chip ROM in the form of flash memory. This is ideal for fast development since flash memory can be erased in seconds compared to twenty minutes or more needed for the earlier versions of the 8051. To use the AT89C51 to develop a microcontroller-based system requires a ROM burner that supports flash memory: However, a ROM eraser is not needed. Notice that in flash memory you must erase the entire contents of ROM in order to program it again. The PROM burner does this erasing of flash itself and this is why a separate burner is not needed. To eliminate the need for a PROM burner Atmel is working on a version of the AT89C51 that can be programmed by the serial COM port of the PC.

FEATURES OF AT89C51

- 4K on-chip ROM
- 128 bytes internal RAM (8-bit)
- 32 I/O pins
- Two 16-bit timers
- Six Interrupts
- Serial programming facility
- 40 pin Dual-in-line Package

3.3.2 Pin Description

The 89C51 have a total of 40 pins that are dedicated for various functions such as I/O, RD, WR, address and interrupts. Out of 40 pins, a total of 32 pins are set aside for the four ports P0, P1, P2, and P3, where each port takes 8 pins. The rest of the pins are designated as Vcc, GND, XTAL1, XTAL, RST, EA, and PSEN. All these pins except PSEN and ALE are used by all members of the 8051 and 8031 families. In other words, they must be connected in order for the system to work, regardless of whether the microcontroller is of the 8051 or the 8031 family. The other two pins, PSEN and ALE are used mainly in 8031 based systems.

Vcc

Pin 40 provides supply voltage to the chip. The voltage source is +5 V.

GND

Pin 20 is the ground.

XTAL1 and XTAL2

The 8051 have an on-chip oscillator but requires external clock to run it. Most often a quartz crystal oscillator is connected to input XTAL1 (pin 19) and XTAL2 (pin 18). The quartz crystal oscillator connected to XTAL1 and XTAL2 also needs two capacitors of 30 pF value. One side of each capacitor is connected to the ground.

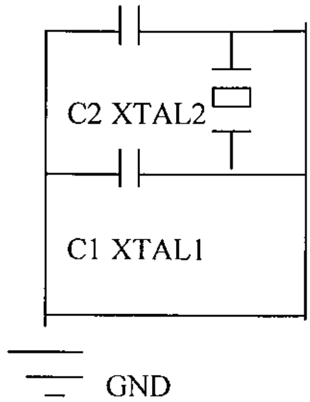


Fig:

It must be noted that there are various speeds of the 8051 family. Speed refers to the maximum oscillator frequency connected to the XTAL. For example, a 12 MHz chip must be connected to a crystal with 12 MHz frequency or less. Likewise, a 20 MHz microcontroller requires a crystal frequency of no more than 20 MHz. When the 8051 is connected to a crystal oscillator and is powered up, we can observe the frequency on the XTAL2 pin using oscilloscope.

RST

Pin 9 is the reset pin. It is an input and is active high (normally low). Upon applying a high pulse to this pin, the microcontroller will reset and terminate all activities. This is often referred to as a power –on reset. Activating a power-on reset will cause all values in the registers to be lost. Notice that the value of Program Counter is 0000 upon reset, forcing the CPU to fetch the first code from ROM memory location 0000. This means that we must place the first line of source code in ROM location 0000 that is where the CPU wakes up and expects to find the first instruction. In order to RESET input to be effective, it must have a minimum duration of 2 machine cycles. In other words, the high pulse must be high for a minimum of 2 machine cycles before it is allowed to go low.

EA

All the 8051 family members come with on-chip ROM to store programs. In such cases, the EA pin is connected to the Vcc. For family members such as 8031 and 8032 in which there is no on-chip ROM, code is stored on an external ROM and is fetched by the 8031/32. Therefore for the 8031 the EA pin must be connected to ground to indicate that the code is stored externally. EA, which stands for "external access," is pin number 31 in the DIP packages. It is input pin and must be connected to either Vcc or GND. In other words, it cannot be left unconnected.

PSEN

This is an output pin. PSEN stands for "program store enable." It is the read strobe to external program memory. When the microcontroller is executing from external memory, PSEN is activated twice each machine cycle.

ALE

ALE (Address latch enable) is an output pin and is active high. When connecting a microcontroller to external memory, port 0 provides both address and data. In other words the microcontroller multiplexes address and data through port 0 to save pins. The ALE pin is used for de-multiplexing the address and data by connecting to the G pin of the 74LS373 chip.

I/O port pins and their functions

The four ports P0, P1, P2, and P3 each use 8 pins, making them 8-bit ports. All the ports upon RESET are configured as output, ready to be used as output ports. To use any of these as input port, it must be programmed.

Port 0

Port 0 occupies a total of 8 pins (pins 32 to 39). It can be used for input or output. To use the pins of port 0 as both input and output ports, each pin must be connected externally to a 10K-ohm pull-up resistor. This is due to fact that port 0 is an open drain, unlike P1, P2 and P3. With external pull-up resistors connected upon reset, port 0 is configured as output port. In order to make port 0 an input, the port must be programmed by writing 1 to all the bits of it. Port 0 is also designated as AD0-AD7, allowing it to be used for both data and address. When connecting a microcontroller to an external memory, port 0 provides both address and data. The microcontroller multiplexes address and data through port 0 to save pins. ALE indicates if P0 has address or data. When ALE=0, it provides data D0-D7, but when ALE=1 it has address A0-A7. Therefore, ALE is used for de-multiplexing address and data with the help of latch 74LS373.

Port 1

Port 1 occupies a total of 8 pins (pins 1 to 8). It can be used as input or output. In contrast to port 0, this port does not require pull-up resistors since it has already pull-up resistors internally. Upon reset, port 1 is configures as an output port. Similar to port 0, port 1 can be used as an input port by writing 1 to all its bits.

Port 2

Port 2 occupies a total of 8 pins (pins 21 to 28). It can be used as input or output. Just like P1, port 2 does not need any pull-up resistors since it has pull-up resistors internally. Upon reset port 2 is configured as output port. To make port 2 input, it must be programmed as such by writing 1s to it.

Port 3

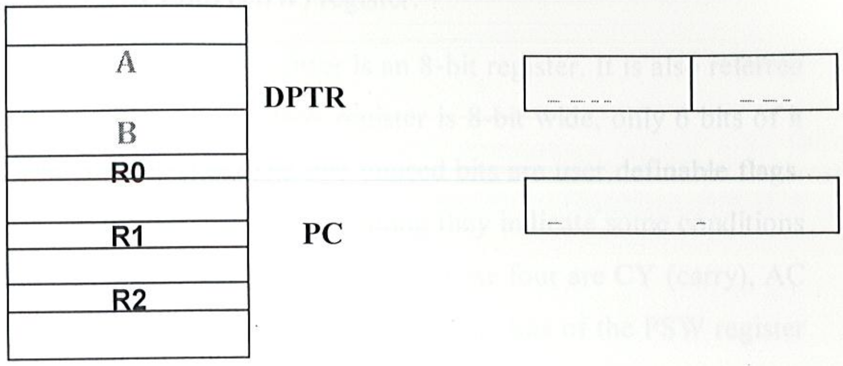
Port 3 occupies a total of 8 pins (pins 10 to 17). It can be used as input or output. P3 does not need any pull-up resistors, the same as P1 and P2 did not. Although port 3 is configured as output port upon reset, this is not the way it is most commonly used. Port 3 has an additional function of providing some extremely important signals such as interrupts. Some of the alternate functions of P3 are listed below:

P3.0	RXD (Serial input)
P3.1	TXD (Serial output)
P3.2	INT0 (External interrupt 0)
P3.3	INT1 (External interrupt 1)
P3.4	T0 (Timer 0 external input)
P3.5	T1 (Timer 1 external input)
P3.6	WR (External memory write strobe)
P3.7	RD (External memory read strobe)

3.3.3 Inside 89c51

Registers

In the CPU, registers are used to store information temporarily. That information could be a byte of data to be processed, or an address pointing to the data to be fetched. In the 8051 there us only one data type: 8 bits. With an 8- bit data type, any data larger than 8 bits has to be broken into 8-bit chunks before it is processed.



(b) Some 8051 16-bit register

(a) Some 8051 8-bit registers

The most commonly used registers of the 8051 are A(accumulator), B, R0, R1, R2, R3, R4, R5, R6, R7, DPTR (data pointer) and PC (program counter). All the above registers are 8-bit registers except DPTR and the program counter. The accumulator A is used for all arithmetic and logic instructions.

Program Counter and Data Pointer

The program counter is a 16- bit register and it points to the address of the next instruction to be executed. As the CPU fetches op-code from the program ROM, the program counter is incremented to point to the next instruction. Since the PC is 16 bit wide, it can access program addresses 0000 to FFFFH, a total of 64K bytes of code. However, not all the members of the 8051 have the entire 64K bytes of on-chip ROM installed.

The DPTR register is made up of two 8-bit registers, DPH and DPL, which are used to furnish memory addresses for internal and external data access. The DPTR is under the control of program instructions and can be specified by its name, DPTR. DPTR does not have a single internal address, DPH and DPL are assigned an address each.

Flag bits and the PSW Register

Like any other microprocessor, the 8051 have a flag register to indicate arithmetic conditions such as the carry bit. The flag register in the 8051 is called the program status word (PSW) register.

The program status word (PSW) register is an 8-bit register. It is also referred as the flag register. Although the PSW register is 8-bit wide, only 6 bits of it are used by the microcontroller. The two unused bits are user definable flags. Four of the flags are conditional flags, meaning they indicate some conditions that resulted after an instruction was executed. These four are CY (carry), AC (auxiliary carry), P (parity), and OV (overflow). The bits of the PSW register are shown below:

CY	AC	F0	RS1	RS0	OV	--	P

CY	PSW.7	Carry flag
AC	PSW.6	Auxiliary carry flag
--	PSW.5	Available to the user for general purpose
RS1	PSW.6	Register bank selector bit 1
RS0	PSW.3	Register bank selector bit 0
OV	PSW.2	Overflow flag
F0	PSW.1	User definable bit
P	PSW.0	Parity flag

CY, the carry flag

This flag is set whenever there is a carry out from the d7 bit. This flag bit is affected after an 8-bit addition or subtraction. It can also be set to 1 or 0 directly by an instruction such as "SETB C" and "CLR C" where "SETB C" stands for set bit carry and "CLR C" for clear carry.

AC, the auxiliary carry flag

If there is carry from D3 to D4 during an ADD or SUB operation, this bit is set: otherwise cleared. This flag is used by instructions that perform BCD arithmetic.

P, the parity flag

The parity flag reflects the number of 1s in the accumulator register only. If the register A contains an odd number of 1s, then P=1. Therefore, P=0 if A has an even number of 1s.

OV, the overflow flag

This flag is set whenever the result of a signed number operation is too large, causing the high order bit to overflow into the sign bit. In general the carry flag is used to detect errors in unsigned arithmetic operations.

3.3.4 Memory space

1. **Internal ROM**

The 89C51 has a 4K bytes of on-chip ROM. This 4K bytes ROM memory has memory addresses of 0000 to 0FFFh. Program addresses higher than 0FFFh, which exceed the internal ROM capacity will cause the microcontroller to automatically fetch code bytes from external memory. Code bytes can also be fetched exclusively from an external memory, addresses 0000h to FFFFh, by connecting the external access pin to ground. The program counter doesn't care where the code is: the circuit designer decides whether the code is found totally in internal ROM, totally in external ROM or in a combination of internal and external ROM.

2. Internal RAM

The 1289 bytes of RAM inside the 8051 are assigned addresses 00 to 7Fh. These 128 bytes can be divided into three different groups as follows:

1. A total of 32 bytes from locations 00 to 1Fh are set aside for register banks and the stack.
2. A total of 16 bytes from locations 20h to 2Fh are set aside for bit addressable read/write memory and instructions.
3. A total of 80 bytes from locations 30h to 7Fh are used for read and write storage, or what is normally called a scratch pad. These 80 locations of RAM are widely used for the purpose of storing data and parameters by 8051 programmers.

Countdown timers can be con strutted using discrete digital Ics deluding up/down counters and /or 555 timers. If you wish to incorporate various facilities like setting the count, start, stop, reset and display facilities, these circuits would require too many ICs.

Here is a simple design based on 40- Atmel AT89C51 microcontroller that performs countdown operation for up to LCD displays showing the actual time left. During the activity period, a relay is latched and a flashing led indicates countdown timing's progress. Four tactile, push-to-on switches are used to start /stop and to set the initial value for countdown operation. The timing value can also be changed while the counting is still in progress. Auto-repeat key logic also works, i.e., if you hold up or down key continuously, the timing as shown on L displays changes at a faster rate. The program code in hex is only 800 bytes long, while AT89C2051 microcontroller can take up to 2kb of code. This program can be 'burnt' into the chip using any universal programmer, suitable for Atmel AT 89C2051 chip.

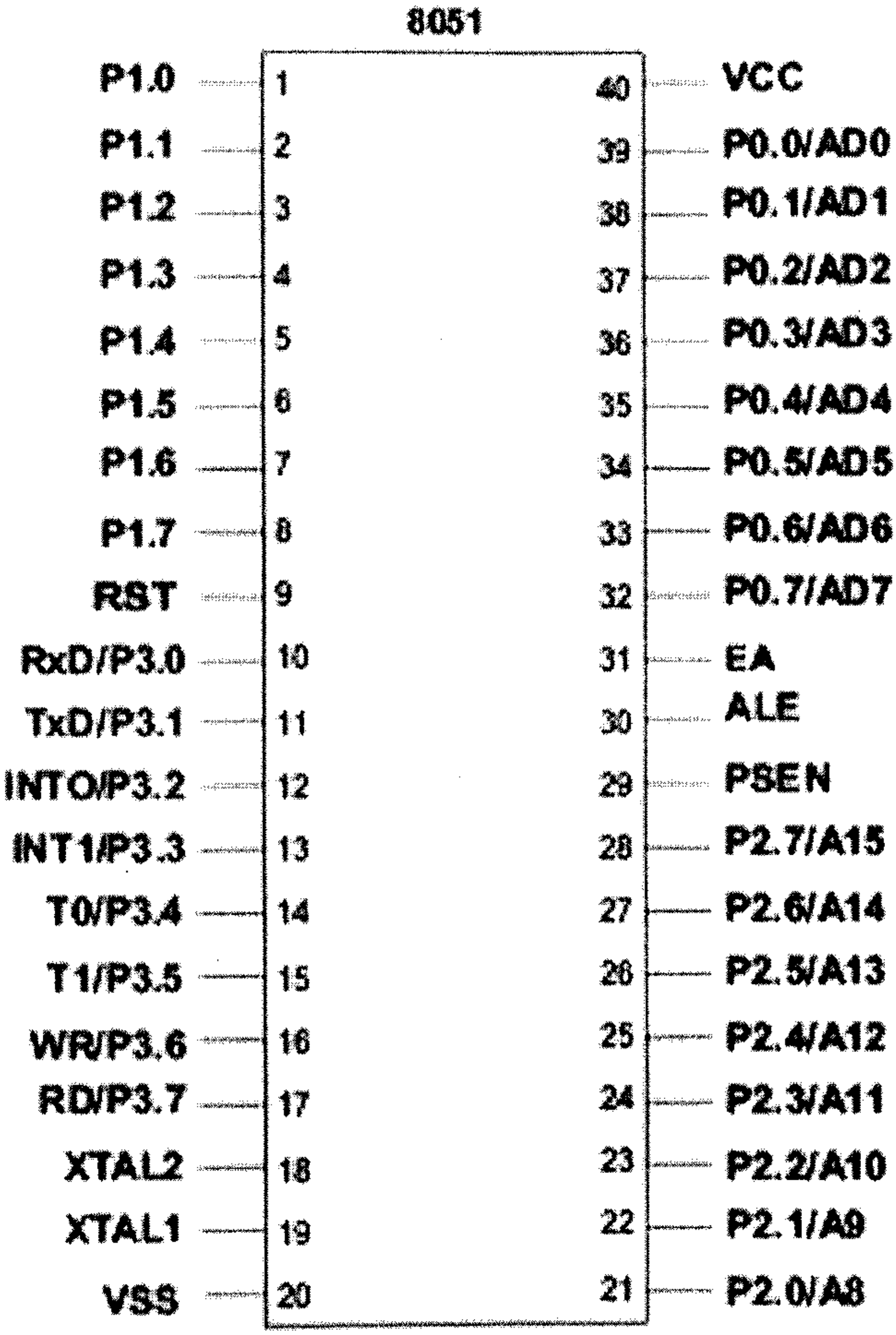


Fig 3.2-Pin diagram of 80c51

3.4 EXPLANATION OF PROJECT

The finalized project illustrated in the pictures shown below. The figures show the side and front views of the project.

A wireless video camera is connected to the robot head to keep track of its movements. A video link is thus established and a live view is generated on a computer screen with which camera receiver is connected. The camera is run by a 9v battery. The microcontroller and the two other ICs are powered by the same 9v battery. The overall operation is implemented as follows:

1. The user dials the number of the receiving mobile phone that is connected to the robot through its hands-free port.
2. The receiver phone is set on auto-answer. So after a few seconds of dialling, the connection is established.
3. The user now gives instructions through his mobile phone by presenting certain number keys on the keypad.
4. The corresponding DTMF tone is sent through the phone network.
5. The receiver phone receives the DTMF tone and it is sent to the DTMF to BCD converter through the hands-free port.a
6. The DTMF to BCD convertor decodes the frequency and gives the corresponding BCD code as output which goes to output ports of the de-multiplexer.
7. The de-multiplexer uses the 4 bit BCD code as its select lines. Thus, if the BCD code is 0010, the output of the DEMUX is low on the output pin 2(active low). Similarly, for BCD codes 0100, 0101, 0110 will result in ACTIVE LOW output at pins 4, 5, 6 respectively.
8. The microcontroller is programmed to perform specific operations with respect to these inputs: Forward, Backward, Left and Right through the H-Bridge.

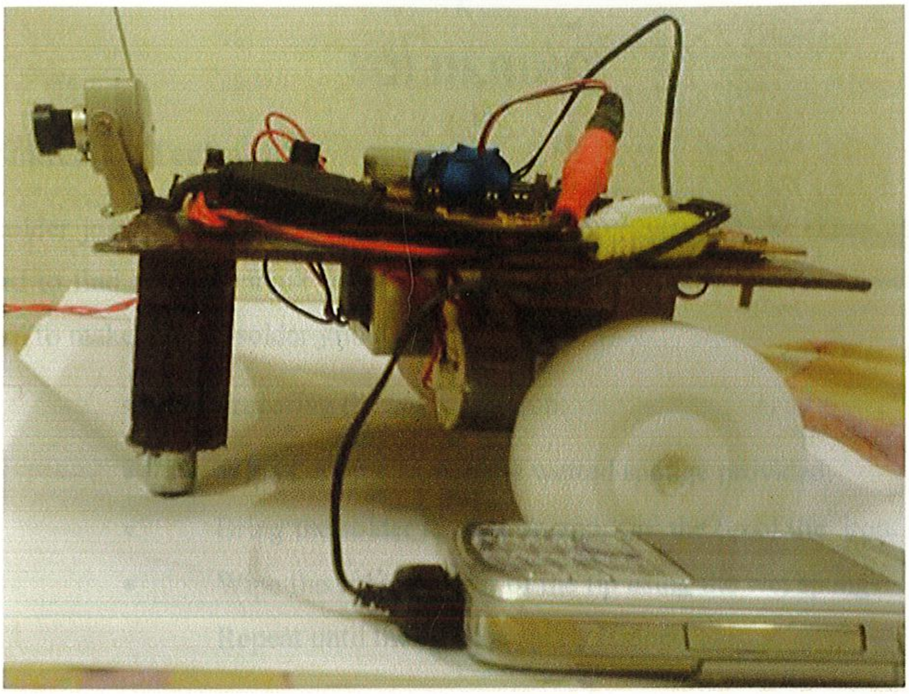


Fig: Side View of Robot

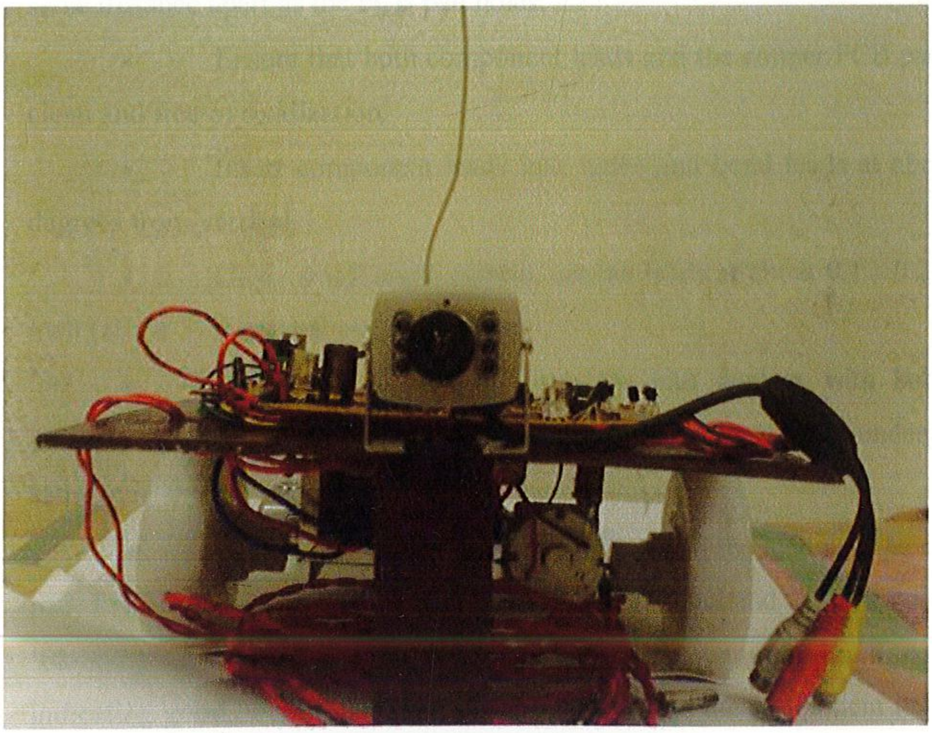


Fig: Front View of Robot

Chapter 4

SOLDERING

4.1 Soldering Techniques

Bad solder joints are often the cause of annoying intermittent faults. They can often be hard to find a cause circuit failure at the most inappropriate time. It's much better to learn to make a good solder joints from day one.

- Preparing the soldering iron:
- Wipe the tip clean on the wetted sponge provided.
- Bring the solder to the iron and 'tin' the tip of the iron.
- Wipe the excess solder of the tip using the wet sponge.

  Repeat until the tip is properly 'tinned'.

4.2 Soldering components into PCB

- Bend the component leads at right angles with both bends at the same distance apart as the PCB pad holes.
- Ensure that both component leads and the copper PCB pads are clean and free of oxidization.
- Insert component leads into holes and bend leads at about 30 degrees from vertical.
- Using small angle cutters, cut the leads at about 0.1 - 0.2 of an inch (about 2 - 4 mm) above copper pad.
- Bring tinned soldering iron tip into contact with both the component lead and the PCB pad. This ensures that both surfaces undergo the same temperature rise.
- Bring resin cored solder in contact with the lead and the copper pad. Feed just enough solder to flow freely over the pad and the lead without a 'blobbing' effect. The final solder joint should be shiny and concave indicating good 'wetting' of both the copper pad and the component lead. If a crack appears at the solder to metal interface then the potential for forming a dry joint exists. If an unsatisfactory joint is formed, suck all the solder off the joint using a solder sucker or solder wick (braid) and start again.

4.3 Precautions

1. Mount the components at the apron places before soldering. Follow the circuit description and components details, leads identification etc. Do not start soldering before making it confirm that all the components are mounted at the right place.

2. Do not use a spread solder on the board, it may cause short circuit.

3. Do not sit under the fan while soldering.

4. Position the board so that gravity tends to keep the solder where you want it.

5. Do not over heat the components at the board. Excess heat may damage the components or board.

6. The board should not vibrate while soldering otherwise you have a dry or a cold joint.

7. Do not put the kit under or over voltage source. Be sire about the voltage either is D.C. or A.C. while operating the gadget.

8. Do spare the bare ends of the components leads otherwise it may short circuit with the other components. To prevent this use sleeves at the component leads or use sleeved wire for connections.

9. Do not use old dark colour solder. It may give dry joint. Be sure that all the joints are clean and well shiny.

10. Do make loose wire connections especially with cell holder, speaker, probes etc. Put knots while connections to the circuit board, otherwise it may get loose.

Chapter 5

RELAY DRIVER CIRCUIT AND OTHER CIRCUIT DIAGRAMS

To carry out the switching of any motion of robotic car we commonly use the relays. Since the output of the microcontroller is normally 0 or it is the voltage of logic low state. So we cannot use this output to run the device or appliances. Therefore here we use relays, which can handle a high voltage of 230V or more, and a high current in the rate of 10Amps to energize the electromagnetic coil of the relays +5V is sufficient. Here we use the transistors to energize the relay coil. The output of the 89c51 microcontroller is applied to the base of the transistor T1 – T4 via a resister. When the base voltage of the transistor is below 0.7V the emitter-base (EB) junction of the transistor reverse biased as a result transistor goes to saturation region it is nothing but the switching ON the transistor. This intern switches on the relay. By this the device is switches ON. When the output of microcontroller goes high the base voltage drops above 0.7V as a result the device also switches OFF.

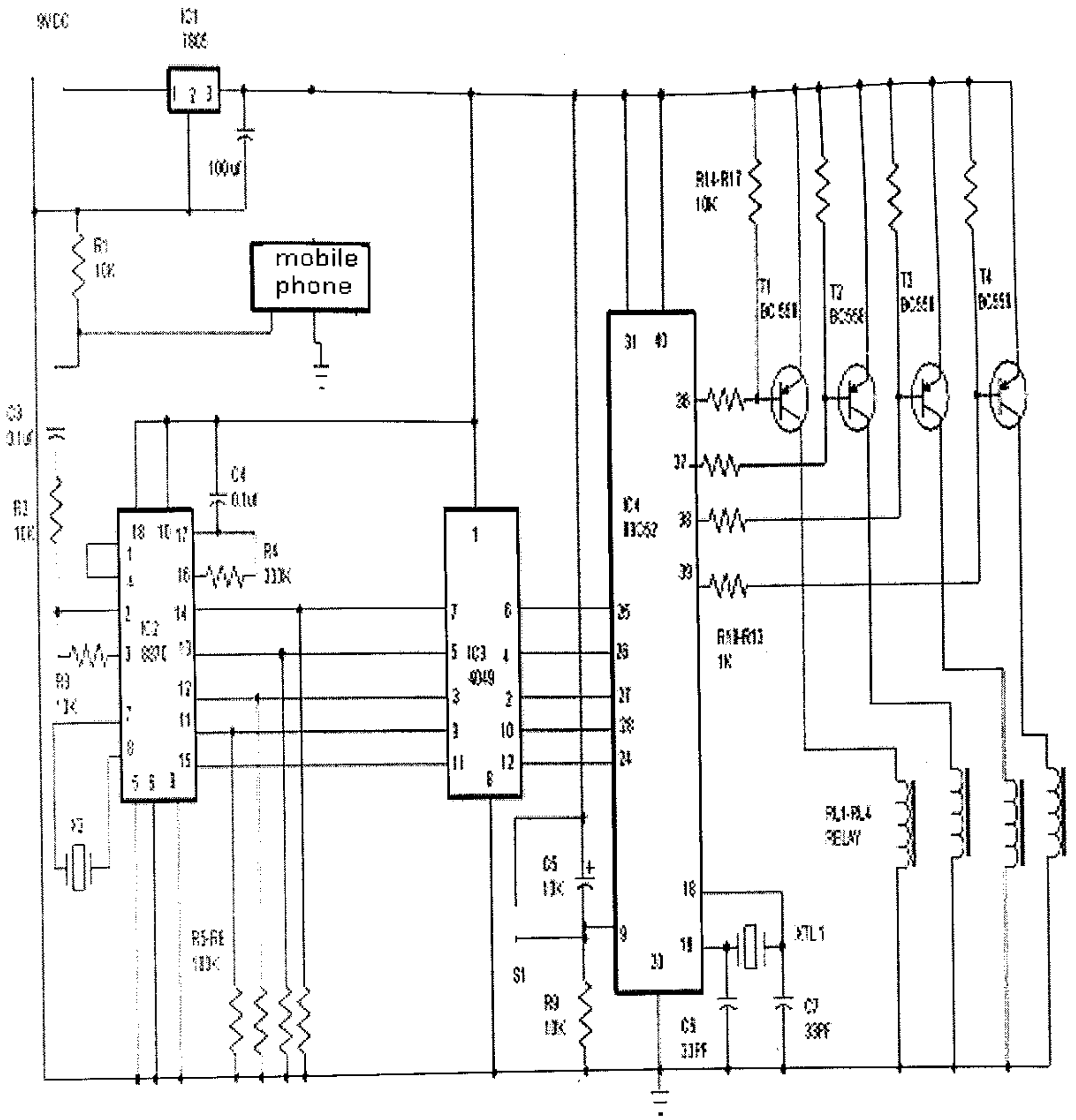


Fig: Finalized Circuit Diagram for the project

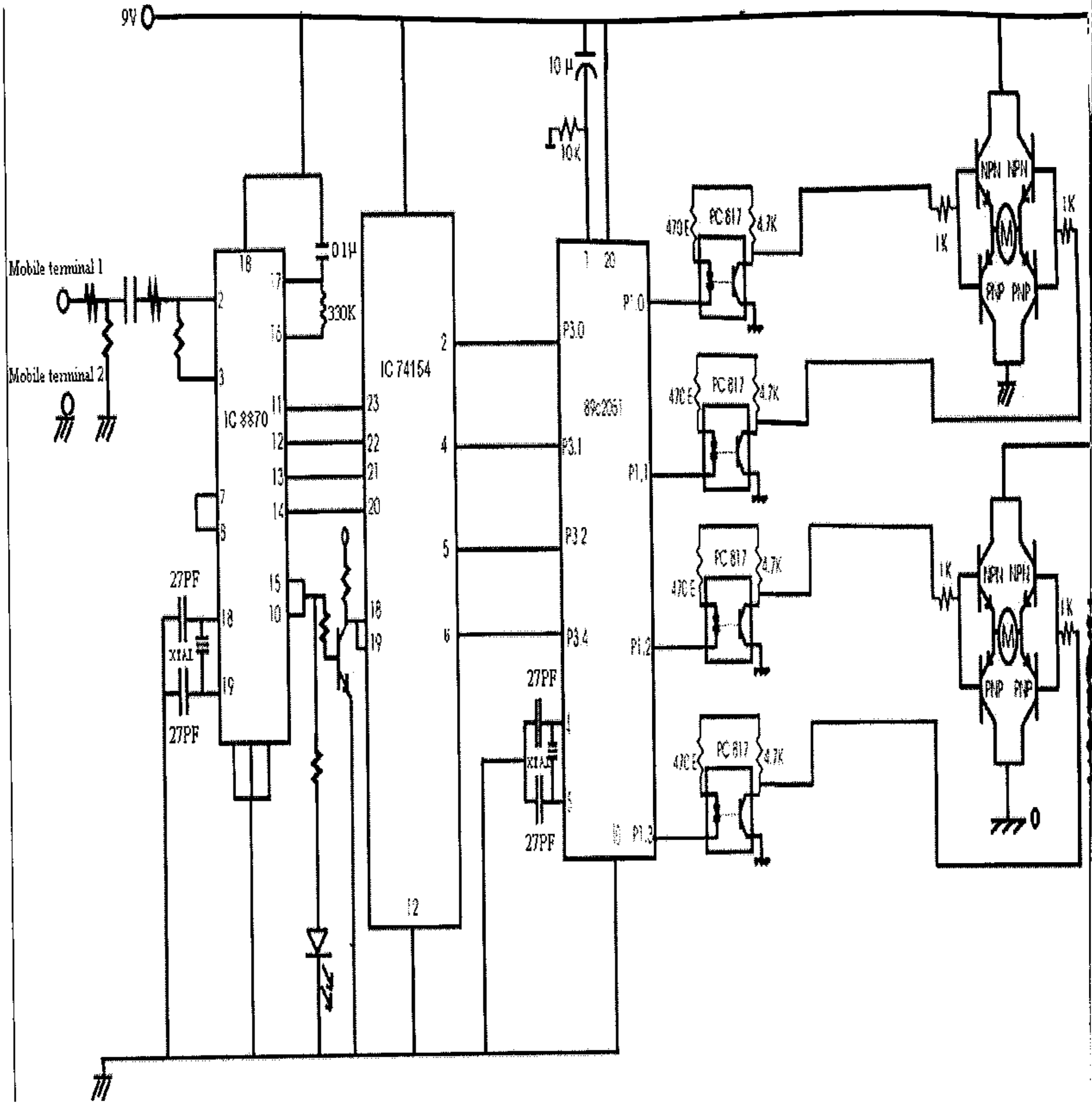


Fig-The schematic diagram of hardware implemented

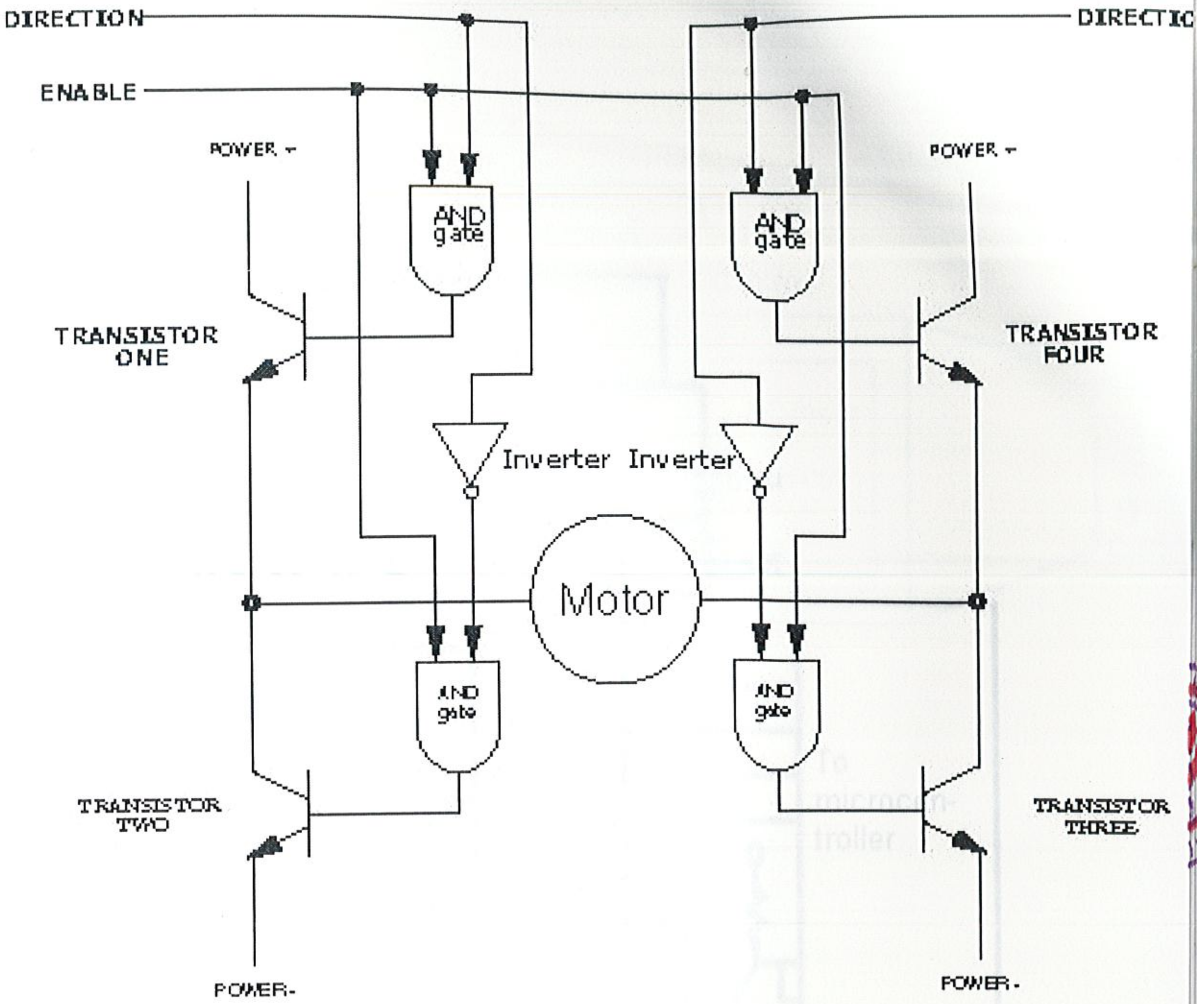


Fig- H Bridge Circuit which provides a forward and reverse mechanism to the motor

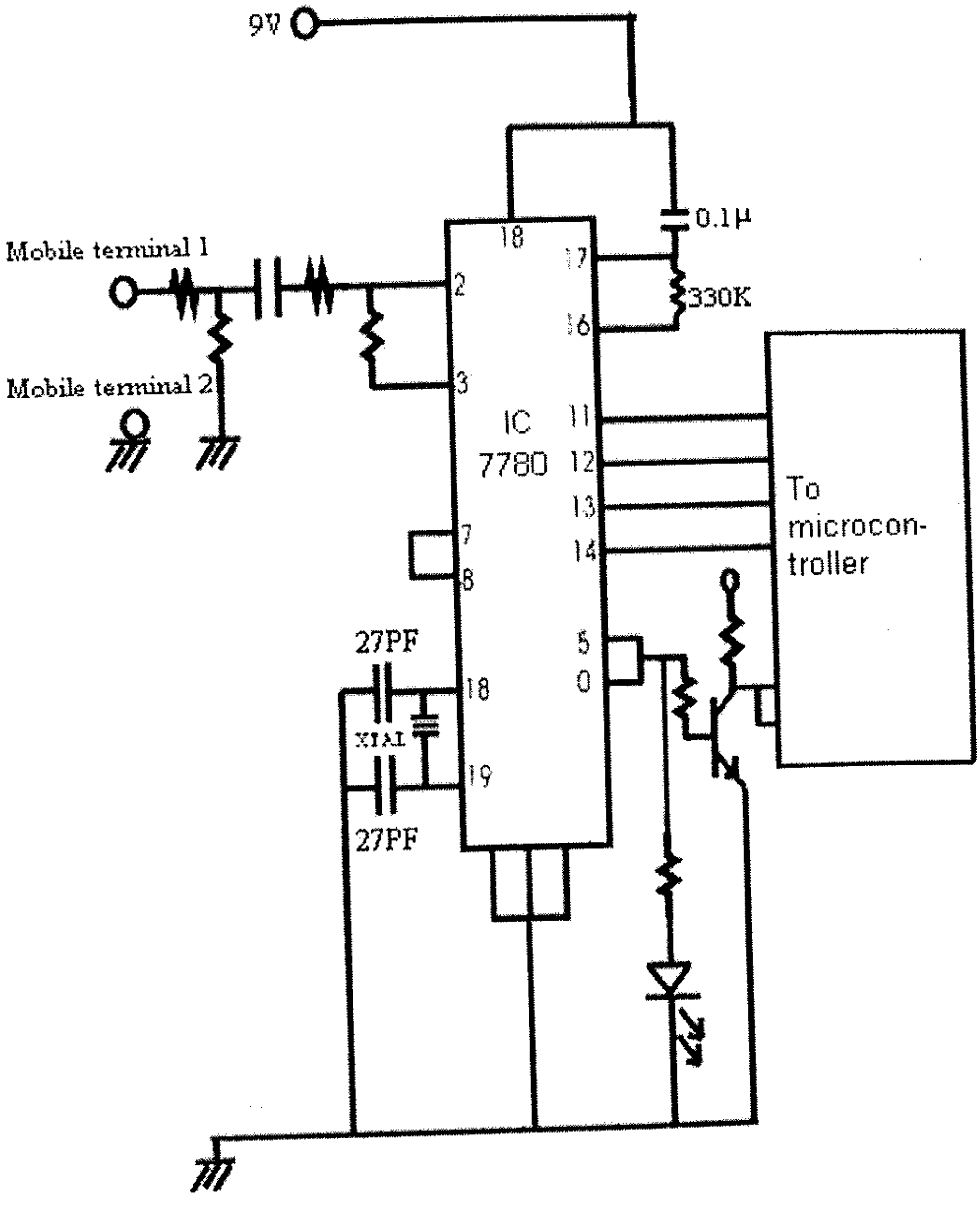


Fig-DTMF Decoder Circuit which converts the user given anolog commands to digital signal

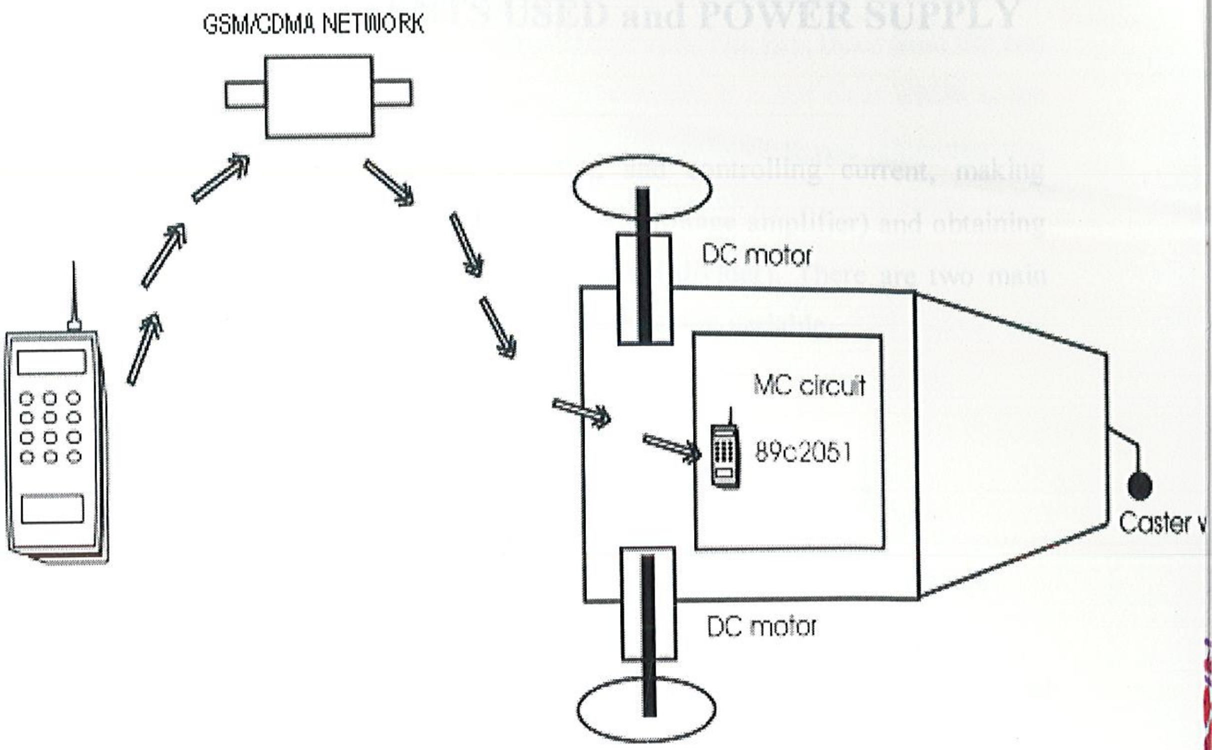


Fig-Block Diagram of Surveillance Robot

In this diagram, receiving end GSM/CDMA phone is connected with the programmable embedded microcontroller through a DTMF to BCD convertor IC as shown in the block diagram.

Chapter 6

OTHER COMPONENTS USED and POWER SUPPLY

6.1 Resistors

The jobs done by resistors include directing and controlling current, making changing current produce changing voltage (as in a voltage amplifier) and obtaining variable voltages from fixed ones (as in a potential divider). There are two main types of resistor-those with fixed values and those that are variable.

Fixed Resistance

Variable Resistance

When choosing a
resistor there are three factors which have to be considered, apart from the stated value.

(i) **THE TOLERANCE.** Exact values cannot be guaranteed by mass-production methods but this is snot a great disadvantage because in most electronic circuits the values of resistors are not critical. The tolerance tells us the minimum and maximum values a resistor might have, e.g. one with a stated (called nominal) value of 100□ and a tolerance of +-10% could have any value between 90□ and 110□

(ii) **THE POWER RATING.** If the rate which a resistor changes electrical energy into heat exceeds its power rating, it will overheat and be damaged or destroyed. For most electronic circuit 0.25 Watt or 0.5 Watt power ratings are adequate. The greater the physical size of a resistor the greater is its rating.

(iii) **THE STABILITY.** This is the ability of a component to keep the same value as it 'ages' despite changes of temperature and other physical conditions. In some circuits this is an important factor.

6.1.1 Resistor Markings

The value and tolerance of a fixed resistor is marked on it using codes. The resistor has four coloured bands painted on it towards one end. The first three from the end give the value and the fourth the tolerance. Sometimes it is not clear which is the first band but deciding where to start should not be difficult if you remember that the fourth band (which is not always present) will be either gold or silver, these being colours not used for the first band.

The first band gives the first number, the second band gives the second number and the third band tells how many noughts (0) come after the first two numbers.

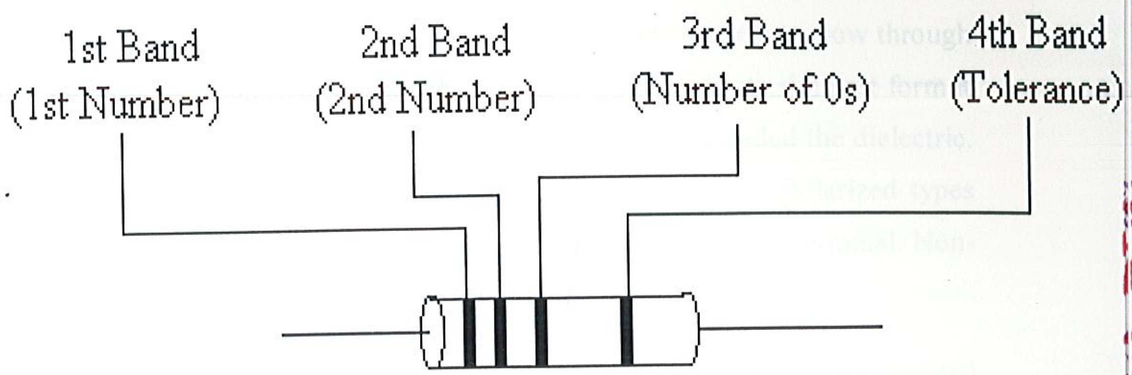
VALUE CODE

NUMBER	COLOUR
0	Black
1	Brown
2	Red
3	Orange
4	Yellow
5	Green
6	Blue
7	Violet
8	Gray
9	White

TOLERANCE CODE

PERCENTAGE	COLOUR
+-5%	Gold
+-10%	Silver
+-20%	no 4th band

6.1.2 Variable Resistors



RESISTANCE

Variable resistors used as volume and other controls in radio and TV set are usually called 'bots' (short for potential divider- see below). They consist of an incomplete circular track of either a fixed carbon resistor for high values and low power (up to 2W) or of a fixed wire-wound resistor for high powers. Connections to each end of the track are bought out to two terminal tags. A wiper makes contact with the track and is connected to a third terminal tag, between the other two. Rotation of the spindle moves the wiper over the track and changes the resistance between the centre tag and the ones. 'Slide' type variable resistors have a straight track.

In a linear track equal changes of resistance occur when the spindle is rotated through equal angles. In a log track, the change of resistance at one end of the track is less than at the other for equal angular rotations.

Maximum values range from a few ohms to several mega ohms, common values are 10k Ohm, 50k Ohm., 100k Ohm., 500k ohm. and 1M Ohm.

Some circuits use small preset types, the symbol and form of which are shown in figs. These are adjusted with a screwdriver when necessary and have tracks of carbon or cermets (ceramic and metal oxide).

6.2 Capacitor

A capacitor stores electric charge. It does not allow direct current to flow through it and it behaves as if alternating current does flow through. In its simplest form it consists of two parallel metal plates separated by an insulator called the dielectric. The symbols for fixed and variable capacitors are given in fig. Polarized types must be connected so that conventional current enters their positive terminal. Non-polarized types can be connected either way round.

The capacitance (C) of a capacitor measures its ability to store charge and is stated in farads (f). The farad is sub-divided into smaller, more convenient units.

1 microfarad (1uF) = 1 millionth of a farad = 10^{-6} F

1 nanofarad (1 nF) = 1 thousand- millionth of a farad = 10^{-9} F

1 picofarad (1pF) = 1 million-millionth of a farad = 10^{-12} F

In practice, capacitances range from 1 pF to about 150 000 uF: they depend on the area A of the plates (large A gives large C), the separation d of the plates (small d gives large C) and the material of the dielectric (e.g. certain plastics give large C).

When selecting a particular job, the factors to be considered are the value (again this is not critical in many electronic circuits), the tolerance and the stability. There are two additional factors.

(i) **The working voltage.** The is the largest voltage (d.c.or peak a.c.) which can be applied across the capacitor and is often marked on it, e.g. 30V wkg. It is exceeded, the dielectric breaks down and permanent damage may result.

(ii) **The leakage current.** No dielectric is a perfect insulator but the loss of charge through it as leakage current' should be small.

6.2.1 Fixed Capacitors

Fixed capacitors can be classified according to the dielectric used; their properties depend on this. The types described below in (i), (ii) and (iii) are non-polarized, those in (iv) are polarized.

(i) **Polyester.** Two strips of polyester film (the plastic dielectric) are wound between two strips of aluminium foil (the plates). Two connections, one to each strip of foil, form the capacitor leads. In the metallised version, films of metal are deposited on the plastic and act as the plates. Their good all-round properties and small size make them suitable for many applications in electronics. Values range from 0.01uF to 10uF or so and are usually marked (in pF) using the resistor colour code. Polycarbonate capacitors are similar to the polyester type; they have smaller leakage currents and better stability but cost more.

(ii) **Mica.** Mica is naturally occurring mineral, which splits into very thin sheets of uniform thickness. Plates are formed by depositing a silver film on the mica or by using interleaving sheets of aluminium foil. Their tolerance is low (± 1%), stability and working voltage high, leakage current low but they are used in radio frequency tuned circuits where low loss is important and are pictured in figs. Polystyrene capacitors have similar though not quite so good properties as mica types but are cheaper.

(iii) **Ceramic.** There are several types depending on the ceramic used. One type has similar properties to mica and is used in radio frequency circuits. In another type, high capacitance values are obtained with small size, but stability and tolerance are poor; they are useful where exact values are not too important. They may be disc, rod- or plate-shaped. A disc-shaped capacitor is shown in fig. Values range form 10pF to 1uF.

(iv) Electrolytic. In the aluminium type the dielectric is an extremely thin layer of aluminium oxide, which is formed electrolytically. Their advantages are high values (up to 150 000uF) in a small volume and cheapness. Their disadvantages are wide tolerance (-20 to + 100% of the value printed on them), high leakage current and poor stability but they are used where these factors do not matter and high values are required, e.g. in power supplies. Examples are shown in Fig.

Electrolytic are polarized. Usually their positive terminal is marked with a + or by a groove; often the aluminium can is the negative terminal. The D.C. leakage current maintains the oxide layer, otherwise reversed polarity (or disuse) will cause the layer to deteriorate.

Tantalum electrolytic capacitors can be used instead of aluminium in low voltage circuits where values do not exceed about 100 uF. They have lower leakage currents.

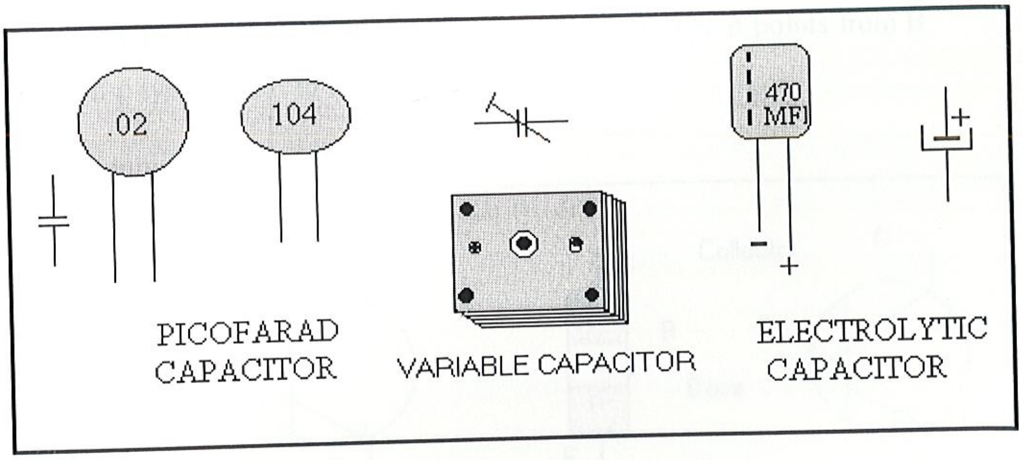


Fig 6.2-Types of Capacitor

6.3 Transistors

Transistors are the most important devices in electronics today. Not only are they made as discrete (separate) components but integrated circuits (Ics) may contain several thousand on a tiny slice of silicon. They are three-terminal devices, used as amplifiers and as switches. Non-amplifying components such as resistors, capacitors, inductors and diodes are said to be 'passive'; transistors are 'active' capacitors, inductors and diodes are said to be 'passive'; transistors are 'active' components.

The two basic types of transistor are:

(a) The bipolar or junction transistor (usually called the transistor) ; its operation depends on the flow of both majority and minority carriers;

(b) The unipolar or field effect transistor (called the FET) in which the current is due to majority carriers only (either electrons or holes).

JUNCTION TRANSISTOR

(i) CONSTRUCTION. The bipolar or junction transistor consists of two p-n junctions in the same crystal. A very thin slice of lightly doped p-or n-type semiconductor (the base B) is sandwiched between two thicker, heavily doped materials of the opposite type (the collector C and emitter E).

The two possible arrangements are shown diagrammatically in fig with their symbols. The arrow gives the direction in which conventional (positive) current flows; in the n-p-n type it points from B to E and in the p-n-p type it points from B to E and in the p-n-p type from E to B.

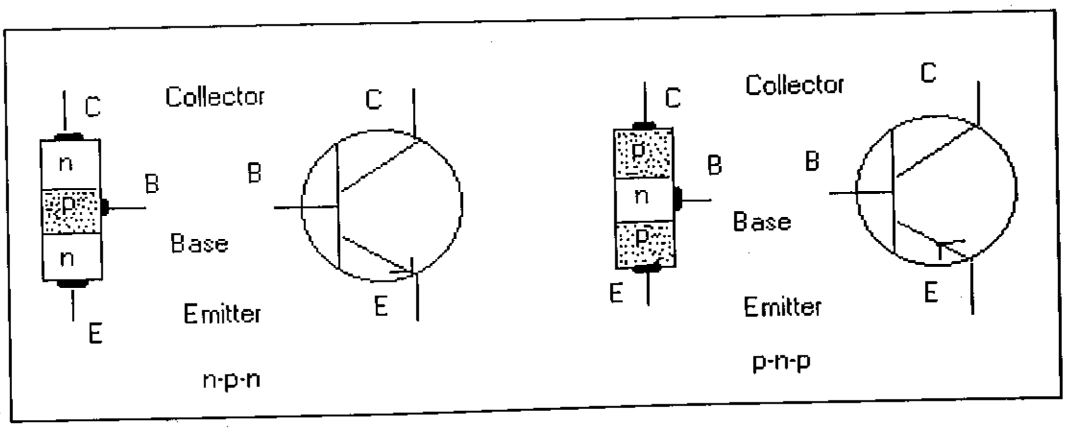


Fig 6.3-npn and pnp type transistor

As with diodes, silicon transistors are in general preferred to germanium ones because they withstand higher temperatures(up to about 175 ^{0}C compared with 75 ^{0}C) and higher voltages, have lower leakage currents and are better suited to high frequency circuits. silicon n-p-n types, are more easily mass-produced than p-n-p type, the opposite is true of germanium.

A simplified section of an n-p-n silicon transistor made by the planar process in which the transistor is in effect created on one face (plane) of a piece of semiconducting material; fig. shows a transistor complete with case (called the 'encapsulation') and three wire leads.

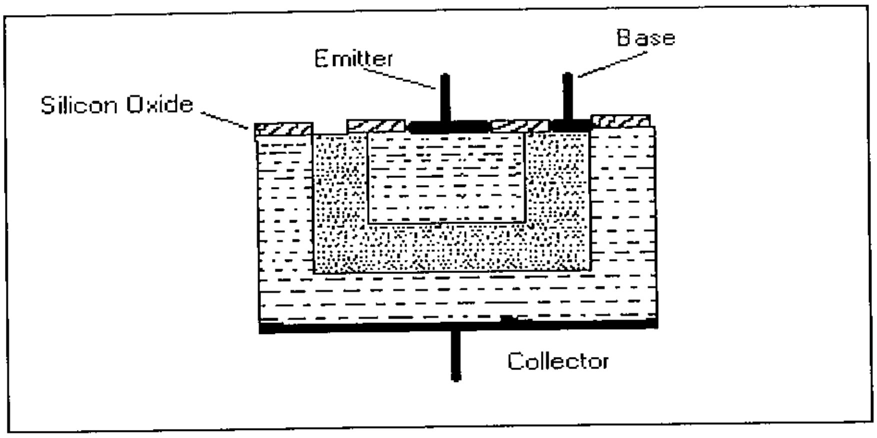


Fig 6.4-Construction of the transistor

(ii) ACTION. An n-p-n silicon transistor is represented and is connected in a common emitter circuit ; the emitter is joined (via batteries B1 and B2) to both the base and the collector . For transistor action to occur the base emitter junction must be forward biased, i.e. positive terminal of B1 to p- type base, and the collector base junction reverse biased, i.e. positive terminal of B2 to n- type collector .

When the base emitter bias is about +0.6 V, electrons (the majority carriers in the heavily doped n –type emitter) cross the junction (as they would in any junction diode) into the base. Their loss is made good by electrons entering the emitter from the external circuit to form the emitter current. At the same time holes from the base to the emitter but, since the p- type base is lightly doped, this is small compared with the electron flow in the opposite direction, i.e. electrons are the majority carriers in an n-p-n transistor.

In the base, only a small proportion (about 1%) of the electrons from the emitter combine with the holes in the base because the base is very thin (less than millionth of a meter) and is lightly doped. Most of the electrons are swept through the base, because they are attracted by the positive voltage on the collector, and the cross base – collector junction to become the collector current in the circuit .

The small amount of electron – hole recombination which occurs in the base gives it a momentary negative charge which is immediately compensated by battery B1 supplying it with (positive) holes . The flow of holes to the base from the external circuit creates a small base current . This keeps the base emitter junction forward biased and so maintains the larger collector current .

Transistor action is turning on (and controlling) of a large current through the high resistance (reverse biased) collector – base junction by a small current through the low – resistance (forward biased) base – emitter junction . the term transistor refers to this effect and comes from the two words ' transfer resistor ' . Physically the collector is larger than the emitter and if one is used in place of the other the action is inefficient.

The behaviour of a p-n-p transistor is similar to that of the n-p-n type but it is holes that are the majority carriers which flow from the emitter to the collector and electrons are injected into the base to compensate for recombination. To obtain correct biasing the polarities of both batteries must be reversed.

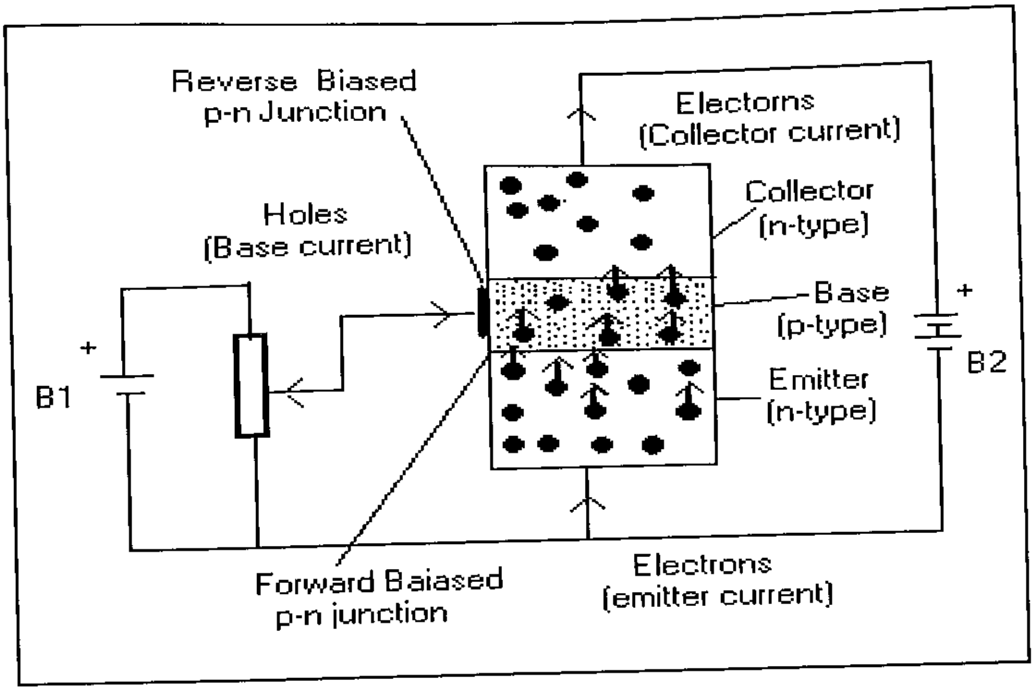


Fig 6.5-Baising of transistor

6.4 Light Emitting Diode

Light emitting diode (LED) is basically a P-N junction semiconductor diode particularly designed to emit visible light. There are infra-red emitting LEDs which emit invisible light. The LEDs are now available in many colour red, green and yellow,. A normal LED emit at 2.4V and consumes MA of current. The LEDs are made in the form of flat tiny P-N junction enclosed enclosed in a semi-spherical dome made up of clear coloured epoxy resin. The dome of a LED acts as a lens and diffuser of light. The diameter of the base is less than a quarter of an inch. The actual diameter varies somewhat with different makes. The common circuit symbols for the LED are shown in fig. 1. It is similar to the conventional rectifier diode symbol with two arrows pointing out. There are two leads- one for anode and the other for cathode.

LEDs often have leads of dissimilar length and the shorter one is the cathode. This is not strictly adhered to by all manufacturers. Sometimes the cathode side has a flat base. If there is doubt, the polarity of the diode should be identified. A simple bench method is to use the ohmmeter incorporating 3-volt cells for ohmmeter function. When connected with the ohmmeter: one way there will be no deflection and when connected the other way round there will be a large deflection of a pointer. When this occurs the anode lead is connected to the negative of test lead and cathode to the positive test lead of the ohmmeter.

Action- An LED consists of a junction diode made form the semiconducting compound gallium arsenide phosphate. It emits light when forward biased, the colour depending on the composition and impurity content of the compound. At present red, yellow and green LEDs are available. When a p-n junction diode is forward biased, electrons move across the junction from the n-type side to the p-type side where they recombine with holes near the junction. The same occurs with holes going across the junction from the p-type side. Every recombination results in the release of a certain amount of energy, causing, in most semiconductors, a temperature rise. In gallium arsenide phosphide some of the energy is emitted as light which gets out of the LED because the junction is formed very close to the

surface of the material. An LED does not light when reverse biased and if the bias is 5 V or more it may be damaged.

Fig 6.6-Light Emitting Diode

External resistor- Unless an LED is of the 'constant-current type' (incorporating an integrated circuit regulator—see Unit 20.4—for use on a 2 to 18 V d.c. or a. c. supply), it must have an external resistor R connected in series to limit the forward current which, typically, may be 10 mA (0.01 A). Taking the voltage drop (Vf) across a conducting LED to be about 107 V, R can be calculated approximately from:

$$R = \frac{(\text{supply voltage} - 1.7)\ V}{0.01A}$$

For example, on a 5 V supply, R = 3.3/0.01 = 330 Ohm.

Decimal display- Many electronic calculators, clocks, cash registers and measuring instruments have seven-segment red or green LED displays as numerical indicators (Fig. 9.18(a)). Each segment is an LED and depending on which segments are energized, the display lights up the numbers 0 to 9 as in Fig. 9.18(b). Such displays are usually designed to work on a 5 V supply. Each segment needs a separate current-limiting resistor and all the cathodes (or anodes) are joined together to form a common connection.

The advantages of LEDs are small size, reliability, long life, small current requirement and high operating speed.

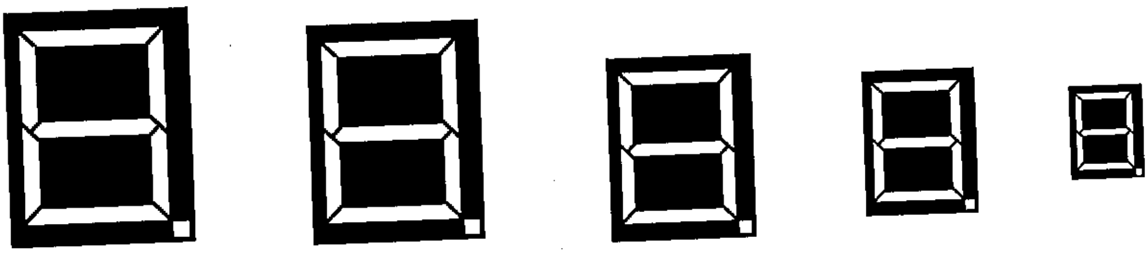


Fig 6.7-Seven Segment Display

6.5 Power Supply

6.5.1 Need for Power Supply

Perhaps all of you are aware that a power supply is a primary requirement for the test bench of a home experimenter's mini lab. A battery eliminator can eliminate or replace the batteries of solid-state electronic equipment and 220V A.C. mains instead of the batteries or dry cells thus can operate the equipment. Nowadays, the sued of commercial battery eliminator or power supply unit have become increasingly popular as power source for household appliances like transceiver, record player, clock etc.

Summary of power supply circuit features:-

- **Brief description of operation:** gives out well regulated +5V output, output current capability of 500mA.
- **Circuit protection:** Built –in overheating protection shuts down output when regulator IC gets too hot.
- **Circuit complexity:** simple and easy to build.
- **Circuit performance:** Stable +5V output voltage, reliable Operation.
- **Availability of components:** Easy to get, uses only common basic components.
- **Design testing:** Based on datasheet example circuit, I have used this circuit successfully as part of other electronics projects.
- **Applications:** part of electronics devices, small laboratory power supply.
- **Power supply voltage:** unregulated 8-18V-power supply.
- **Power supply current:** needed output current 500 mA.
- **Components cost:** Few rupees for the electronic components plus the cost of input transformer.

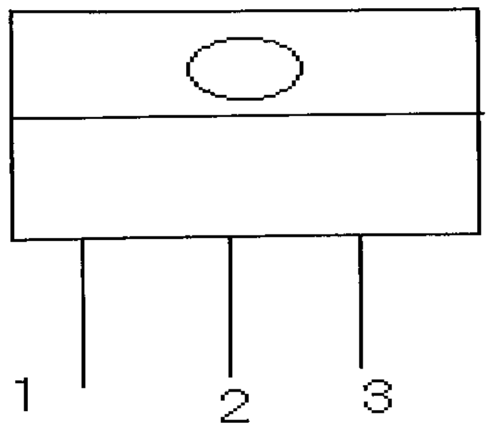


Fig 6.8-Pin Diagram of 7805 Regulator IC

Pin 1: Unregulated voltage input

Pin 2: Ground

Pin3: Regulated voltage output

Component list

1.7805 regulator IC.

2. 9V DC Battery.

3. 1000uf., 10uf. Capacitor, at least 25V voltage rating.

4. 0-9 Step down transformer

6.5.2 Description of Power Supply

This circuit is a small + 5 volts power supply Which is useful when experimenting with digital electronics. Small inexpensive battery with variable output voltage are available, but usually their voltage regulation is very poor, which makes them not very usable for digital circuit experimenter unless a better regulation can be achieved in some way. The following circuit is the answer to the problem.

This circuit can give +5V output at about 500mA current. The circuit has overload and terminal protection.

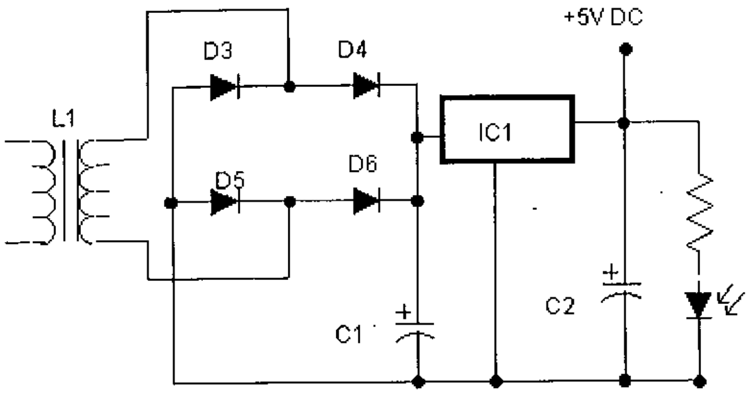


Fig 6.9-Circuit Diagram of Power Supply

The above circuit utilizes the voltage regulator IC 7805 for the constant power supply. The capacitors must have enough high voltage rating to safely handle the input voltage feed to circuit. The circuit is very easy to build for example into a piece of Zero board.

6.6 4049 INVERTING BUFFER

We have used an inverter buffer in the circuit for two reasons:

When used in the input section, it acts as isolation is made between the controller and the rest of the circuits.

When used in the output, it increases the current drive capability.

In particular, we have preferred an inverting buffer to an ordinary buffer because in an inverting buffer, even 2.5V or 3V will be read as high and then inverted to zero and vice versa. The advantage is that the microcontroller will get either 5V or 0V in an inverted fashion and we can modify the program accordingly.

These hex inverter buffers are monolithic complementary MOS (CMOS) integrated circuits constructed with n- and p-channel enhancement mode transistors. These devices feature logic-level conversion using only one supply voltage when these devices are used for logic-level conversions. These devices are intended for use as hex buffers, CMOS-to DTL/TTL converters or CMOS current drivers and can drive directly two DTL/TTL loads over the full operating temperature range.

Chapter 7

PROGRAMMING AND ALGORITHM

7.1 Algorithm

Algorithm Of Microcontroller Operation

Step 1: Initialize P1.0, P1.1, P1.2, P1.3 (output ports) to 0.

Step 2: If P3.0 = 0, jump to step 6, to *move forward.*

Step 3: If P3.1 = 0, jump to step 8, to *move backward*

Step 4: If P3.2 = 0, jump to step 10, to *turn left.*

Step 5: If P3.3 = 0, jump to step 12, to *turn right.*

Step 6: Jump to step 1.

Step 7: Set values as -> P1.0 = 1, P1.1 = 0, P1.2 = 0, P1.3 = 1.

Step 8: Hold these values for a moment (*Call Delay*).

Step 9: Jump to step 1.

Step 10: Set values as -> P1.0 = 0, P1.1 = 1, P1.2 = 1, P1.3 = 0.

Step 11: Hold these values for a moment (*Call Delay*).

Step 12: Jump to step 1.

Step 13: Set values as -> P1.0 = 1, P1.1 = 1, P1.2 = 0, P1.3 = 1

Step 14: Hold these values for a moment (*Call Delay*).

Step 15: Jump to step 1.

Step 16: Set values as -> P1.0 = 1, P1.1 = 0, P1.2 = 1, P1.3 = 1.

Step 17: Hold these values for a moment (*Call Delay*).

Step 18: Jump to step 1

7.2 Programming

```
$MOD51

DATAREADY EQU P2.3

org 0000h

mov p3,#0ffh  ; reset port 3

mov r2, #00h

mov r3,#00h

mov r4,#00h

mov r5, #00h

CHECK:

        MOV A, P2

        JNB DATAREADY, LEVEL2

        SJMP CHECK

LEVEL2:

        MOV A, P2

        ACALL LOOKUP

        ACALL DELAY1

        SJMP CHECK

LOOKUP:

ACALL DELAY1

ACALL DELAY1

ACALL DELAY1

        XRL A, #0FFH
```

```
        ANL A, #0F0H
        SWAP A
        SUBB A, #01H
        JZ ONE1
        SUBB A, #01H
        JZ TWO1
        SUBB A, #01H
        JZ THREE1
        SUBB A, #01H
        JZ FOUR1
ONE1: LJMP ONE
TWO1: LJMP TWO
THREE1: LJMP THREE
FOUR1: LJMP FOUR
;-----device switching-------
ONE:
inc r2
mov a, r2
clr p3.0
clr p3.1
cjne a, #02h, CHECK
setb p3.0
setb p3.1
```

```
mov r2, #00h

ljmp CHECK


TWO:

inc r3

mov a, r3

clr p3.2

clr p3.3

cjne a, #02h, CHECK

setb p3.2

setb p3.3

mov r3, #00h

ljmp CHECK

THREE:

inc r4

mov a, r4

clr p3.0

cjne a, #02h, CHECK

setb p3.0

mov r4, #00h

ljmp CHECK

FOUR:

inc r5
```

```
mov a, r5

clr p3.1

cjne a, #02h, CHECK

setb p3.1

mov r5, #00h

ljmp CHECK

DELAY1:                 ;0.5 SECOND DELAY

AGAIN1: MOV R0, #255

AGAIN:  MOV R1, #255

HERE:

;nop

;nop

;nop

;nop

;nop

;nop

;nop

 DJNZ R1, HERE

 DJNZ R0, AGAIN

 CLR C

RET

end
```

Chapter 8

Components Used

SEMICONDUCTORS

(1) IC-1 .... 7805 (Regulator)

(2) IC2................... CD8870 (DTMF decoder)

(3) IC-4.................... 89C51 (Micro-controller)

(4) IC3.................. 4049 (Not Gate)

(5) LED .... Light Emitting Diode

(6) T1-T4..............(PNP) 369

(7) XTL1................Crystal 3.5 Mhz.

(8) XTL2................Crystal 11.0592 Mhz.

RESISTOR

(1) R1-R3, R14-R17................10K Ohm.

(2) R4..................................... 330K Ohm.

(3) R5-R8 .... 100K Ohm.

(4) R10-R13........................... 1K Ohm.

CAPACITOR

(1) C1,C2 .... 100uf.

(2) C3, C4............. 0.1uf.

(3) C5..................10 Mfd.

(4) C6,C7 .... 33 PF

MISCELLANEOUS

(1) RL1-RL4 .... RELAY 6V \100 0Hm.

(2) S1 .... PUSH -TO- ON

(3) GAER DC MOTOR

(4) WIRELESS CAMERA

APPLICATION OF THE PROJECT

This prototype is very useful in the following applications:

1. Spying
2. Mining
3. Defence applications
4. Exploration

CONCLUSION

The necessary code has been made and downloaded in microcontroller by using appropriate software. The Analog instructions received by the receiving mobile phone were successfully converted into digital strobes as interrupt signals to the microcontroller through DTMF to BCD converter IC. The actuation of the motor is driven by the output ports of the microcontroller.

The proposed work has following advantages over the existing models:

(i) The robot can be controlled from anywhere on the globe.

(ii) A number of devices can be controlled through a dedicated output port bits by writing the individual controlling algorithm for each device.

(iii) The system is not bulky as the programming device is a microcontroller instead of a personal computer.

(iv) Depending upon the requirement of output device the microcontroller can be reprogrammed.

(v) The present work takes the advantage of using existing GSM, CDMA, landline telephone network thereby reducing the added cost of installation of a separate dedicated network.

(vi) This also overcomes the range limitation of Bluetooth.

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