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Electronic devices control by mobile phone
التحكم في الاجهزة الالكترونية بواسطة الهاتف المحمول

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Chapter one

Introduction

Introduction

1.1 Background:

Control system is integral part of modern society numerous applications are all around the whorled. The rockets live and the space shuttle lifts of the orbit in splashing cooling water, a malleable part is automatically machined a self guided vehicle delivering mechanical to work station in an a era space assembly planet glides along the floor speaking it's destination.

In modern industries the maintaining and handling of disturbance has a grate significance of efficiency and cost effectiveness of manufacturing so the control system is an interconnection of component which provide a desired system response by controlling the out put of a system or processing some prescribed manner by the inputs through the element of the control system as shown in figure (1.1)

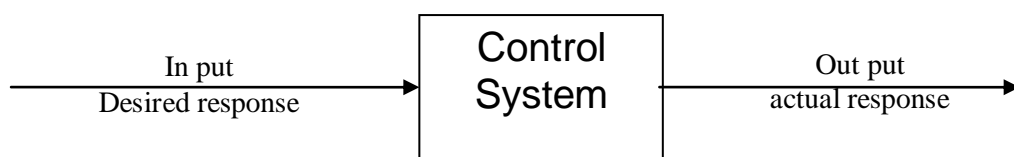


Figure (1.1)

Simplified description of a control system

Large equipment can be moved with control system with precision so that with otherwise be impossible. Huge antennas can point to word the farthest reached of the universe to pick up faint radio signals,

controlling these antennas by hand would be impossible because of control system elevators carry us quickly to our destination stopping at the right floor. So the power and control system regulate the position and speed could not provide alone.

Control system was build for four primary reasons

1.1.1 Power amplification.

In application that which positioned by low power and need to require a large amount of power to drive the device the control system can produce the needed power amplification or power gain.

1.1.2 Remote control.

Remote control can solve all problem of controlling in dangerous aria or environment for example we use a remote –controlled robot arm to pick up material in radioactive environment

1.1.3 Convince of input form.

Control system can also be used to provide convenience by changing the form of input, for example temperature control system the input is position on a thermostat we can change it to electrical signal by sensors to be controlled.

1.1.4 Compensate for disturbance.

Let now take a look to other advantages of control system, the ability to compensate for disturbance. Also variable can be controlled typically such as voltage, current or frequency in electrical system, temperature in thermal system and position and velocity in mechanical system. The system must be able to yield the correct output with a disturbance.

1.1.5 Type of remote control:

Control system Consideration of Robotic technologies are widely suppress and very useful to be applied in real-time development. Some can be solved by hardware technology and by the advance used of software, so control system is analyzed easily and detail.

There are many type of remote control which depending on the way communicates with there respective controlling devices installed at distance from their remote control panels, so the way of communication can be divided in a tow mane types:

1.1.5.1 Wired remote control:

In the wire communication type the control panel connected to its respective remote equipment by several Medias such as a material and fiber optical cables.

1.1.5.2 Wireless remote control:

There are many types of wireless remote using several to communicate between the remote control system and controllable unit at distance, described as following:

- Infrared IR.
- Radio frequency RF.
- Laser.
- Audio remote control.
- Ultra sonic.
- Bluetooth.
- Mobile network.

In this object the searching will be about last one "mobile network" to controlling the heavy current devices.

1.2 Problem statement:

The problem of this research includes the control of electronic and electrical devices by using a mobile phone.

1.3 Objectives:

The objective of this research discussed on the following point:

- Introduce basic control system technology concepts.
- Describe the different functions of control system.
- Discuss control system services and applications.
- Circuit design of wireless control system.
- Interfacing the system to the remote controllable unit to operate in heavy current devices.

1.4 Methodology:

Design electric devices control by using local mobile phone network can be achieved by building electric control circuit include three main parts, the first part is MOBILE 1 which generate and sending wireless signal. MOBILE 2 is the second part designed to receive the wireless transmitted signal send from the MOBILE 1 and the third part is DTMF decoder which physically linked to MOBILE 2. So this design can be interface to the remote control unit.

1.5 Research outline:

- Introduction to the control system concepts and application.
- Kinds of control system (open loop control system and close loop control system).
- Type of remote control (wire remote control and wireless remote control).
- Overview of heavy current devices.
- Mobile tone decoding and application.
- Practical circuit element construction design.

Chapter two

Control Systems

History of control systems

Although control systems various types date back to antiquity, a more formal analysis of the field began with a dynamic analysis of the centrifugal governor. Conducted by the physicist James clerk Maxwell in 1868 entitled on governors. This described and analyzed the phenomenon of “hunting” in which lags in the system and lead to over compensating and unstable behavior this generated flurry of interesting the topic during which Maxwell classmate Edward John Routh generalized the results of Maxwell for the general class of linear system. Independently Adolf Hurwites analyzed system stability using differential equations.

In 1877 this results is called the routh Hurwiz criterion a notable application of dynamic control was in the area of manned fight on December 17.1903 and were distinguishing by their ability to control their fights for sub situational periods (more so than ability to produce lift from and air foil which was known) control of the air plan was necessary for safe flight kinds of control system.

2-1 Kinds of control systems:

There are many kind of control system and below is the history definition of control system.

- 1- Open-loop control system.
2. Closed – loop (feed back control) system

2.1.1 Open – loop control system:

As stated already any physical system which dose not automatically correct for variation in its out is called on open loop system such a system may be represented by block diagram of fig (2.1). In this system the out put remains constant for a constant input signal provided

the external condition remain unaltered the out putt may be changed to any desired value by appropriately changing the input signal, but variation in external conditions or very internal parameter of the system may cause the out put to very from the desired of the system may cause the out put to very from the desired value in uncontrolled fashion. The open – loop control is therefore satisfactory only if such fluctuations can be system components are designed and contracted so as limit parameter variations and environmental conditions are well controlled.

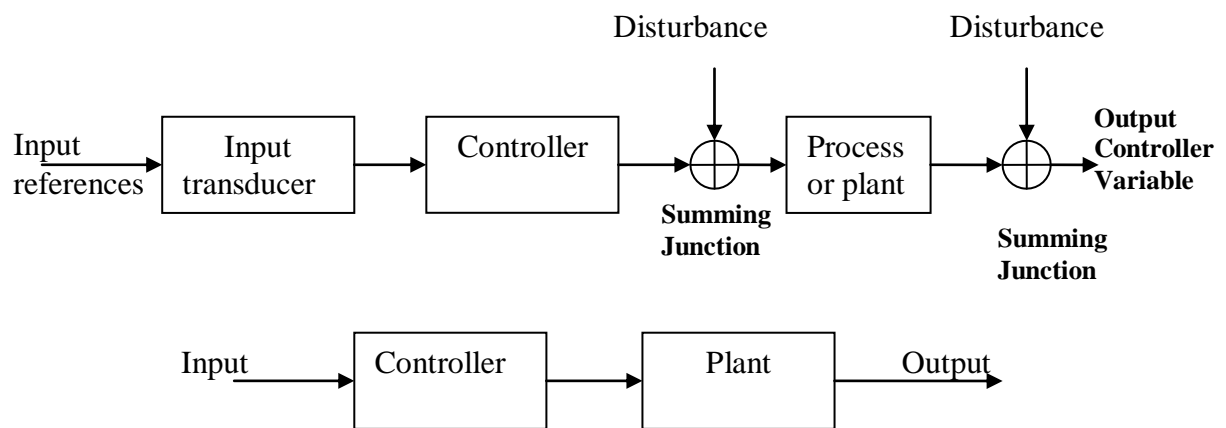


Figure (2-1) central block diagram of open loop system

It's important to note that the fundamentals differences between an open and closed – loop control system is that of feedback action consider for example a traffic control system for regulating the flow of traffic at crossing of two road. The system will be termed open – loop in red and green lights are but on by a timer mechanism set for predetermined fixed intervals of time, it's obvious that such as arrangement takes no account of varying rates of traffic following that road crossing from the directions it one the other hand a scheme in

introduced in which the rates of traffic flow along both directions are measured (some distance a hand of the crossing) and are compared and the different is used to control the timings of red and green lights a closed – loop system (feedback results thus the concept of feedback can be usefully employed to traffic control.

2.1.2 closed loop-(feedback) system:

The disadvantages of open – system namely sensitively to disturbance and inability to control for this disturbance may be overcome in closed – loop system.

The give architecture of closed –loop is shown in figure (2.2).

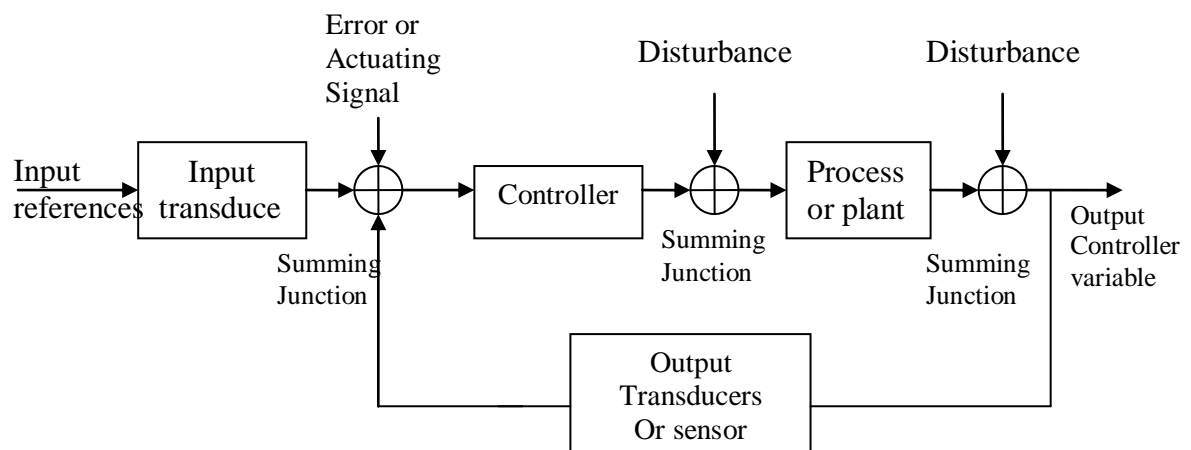


Figure (2-2) block diagram of close loop control system

IN the input transducer converts the form of the input to the form used by the controller and out but transducer or sensor measures the put response and converts it into the form used by the controller.

The first summing junction algebraically adds the signal from the input to the signal from the out put which arrives via feedback both, the return path from the output of the summing junction. The out put signal is

subtracted from the input signal the result is generally called the activating signal. However in system where both the input and transducer have unity gain. The actuating signal's value is equal to actual difference between the input. Under this condition the actuating signal is called the error.

The closed loop system compensates for disturbance by measuring the output response. Feeding that measurement back through a feedback path. And comparing that response to the input at the summing junction. If there is any difference between the two responses. The system drives the plant via the actuating signal to make a correction. If there is now difference, the system does not drive the plant since the plant's response already is the desired response.

Closed – loop systems then have the obvious advantages of greater accuracy than open – loop systems. They are less sensitive to noise disturbance and or changes in the environment. Transient response and steady state error can be controlled more conveniently and with greater flexibility in closed – loop system often by a simple adjustment of gain (amplifications) in the loop and some times by redesigning the controller. By referring to redesigning as compensating the system and resulting hardware as a compensator. On the other hand, closed – loop systems are more complex and expensive than open – loop system.

In summary, system that performs the previously described measurement and correction are called closed – loop or feedback control system.

2-2 Digital computer control system:

In some of the examples of control system of high level complexity it is seen such control system need a digital computer as control element to digitally process a number of input signals to generate

a number of control signals so as to manipulate several plant variables. In these control systems signals in certain parts of the plant are in analog form. Continuous function of the time variable, while the control computer handles data only in digital (or discrete) form. This requires signal discretization and analog – to – digital interfacing informed A/D and D/A converters.

It is seen above that computer control is needed in large and complex control schemes dealing with a number of inputs, output variables and feedback channel. For example in chemical plant, a number of variables like temperature, pressure and fluid flows have to be controlled after the information on throughput, its quality and its constitutional composition has been analyzed on line.

Such systems are referred to as multivariable control system whose general block diagram is shown in fig (2-3).

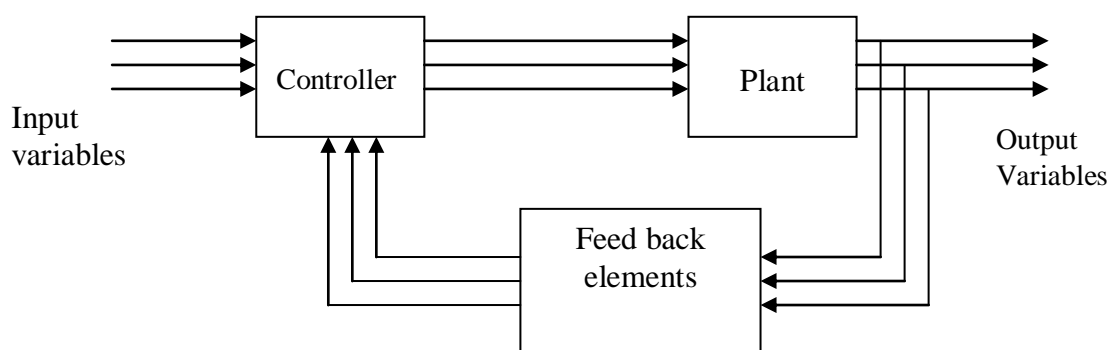


Figure (2-3) general block diagram of multivariable control system

Where of variable are to be controlled with a limited number of commands and the control algorithm is of moderate complexity and the plant process to be controlled is at given physical location a general purpose computer chip. The microprocessor (MP) is commonly employed

such systems are known as Mp-based control system. Of course at the input/ out put inter facing A/D and D/A converter chips would be needed.

For large system a control computer is employed for simultaneous control of several subsystems where in certain hierarchies are maintained keeping in view the overall system objective. Additional function like supervisory control fault recording date logging etc.

2.3 Control system conditions:

For excellent control system there is a many conditions, here two condition of control system will be discussed, optimal control system and adaptive control system.

2.3.1 Optimal control:

Optimal control is particular control techniques in which the control signal optimizes a certain cost index for example in the cast of satellite. The jet thrusts needed to bring it to desired trajectory that consume the least amount of full. Two optimal control design , methods have been widely used in industrial applications as it has been shown they can guarantee closed – loop stability these are Model Predictive Control (MPC) and Linear Quadratic Gaussian (LQC).The first can more explicitly take into account constraints on the signal in the system , which is an important feature in many industrial processes . However, the optimal control structure in MPC is only means to achieve such a result as it dose not optimize a true Performance index of the closed – loop control system. Together with PID controllers MPC system are the most widely use control technique in process control.

2.3.2 Adaptive control:

Adaptive control uses in line identification of the process parameters or modification of controller gains there by obtaining strong robustness properties. Adaptive were applied for the first time in the

aerospace industry in the 1850 and have found particular success in that field.

2.4 Non - linear control system:

Processes in industries like robotics and the aerospace industry typically has strong non linear dynamics in control theory it's some time possible to linearism such classes of system and apply liner techniques but in many cases it can be necessary to device from scratch theories periling control of non linear system. These normally take advantage of result based on Lyapunovs theory. Differential geometry has been widely used at tool for generalizing well known liner control concepts to the non liner case as well showing the stability that make in more challenging problem.

Chapter three

Heavy current devices

Heavy current devices

There are many kind of heavy current devices , so all electric devices or machines in our life which are operate at normal current and voltage (220 volt for single phase applications and 415 volt for three phase applications) all of them can be consider as heavy current devices. It include electric motors, transformers, house hold devices, lighting devices, warning devices, Alarming devices, Audio and video devices, telecommunication devices and all machines operate at same current and voltage.

This chapter includes discussing about kinds of devices like:

- Electric motors.
- Lightening devices.
- House holds devices.
- Warning and alarming devices.
- Electric tools.

3-1 electric motors:

Electric motor is one of important devices in industries and all missions that needed is a motion or torque to drive other device, there are many kinds of motors so the two main kinds here are:

- Synchronous motors.
- Induction motors.

3.1.1 Synchronous motors:

The construction of the synchronous motors is essentially the same as the construction of the silent pole alternator. In fact such an alternator may be run as on AC motor. It is similar to the drawing in fig (3-1). Synchronous motors have the chrematistics of the constant speed between no load and full load .They is capable to correcting the low power factor

of an inductive load when they are operated under certain conditions. They are often used to drive DC generators. Synchronous motors are design in size up to thousands of horsepower. They may be designed as either single phase or multiphase machines. The discussion that follows id based on a three – phase design.

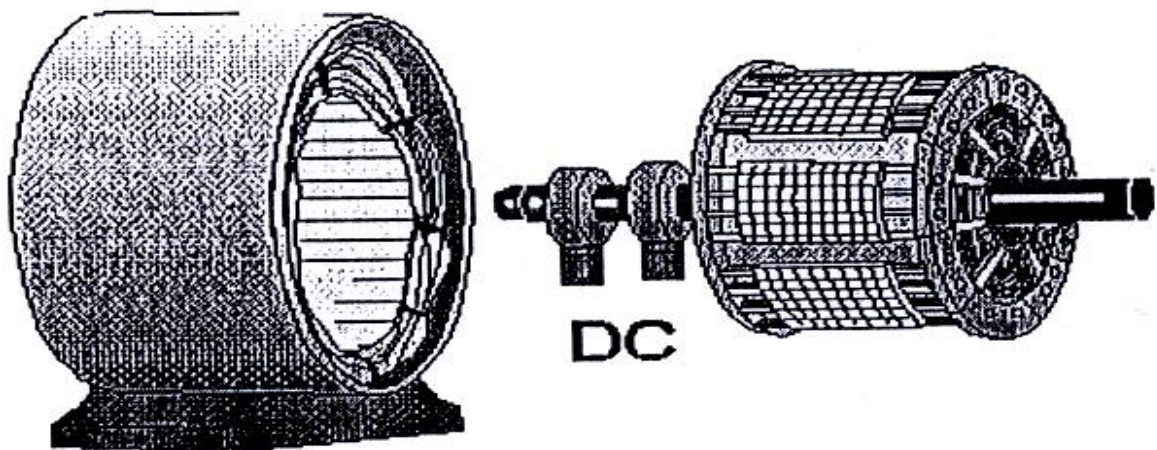


Figure (3-1) Revolving field synchronous motor

To understand how synchronous motors works, assume that the application of three –phase Ac power to the stator causes a rotating magnetic field to be setup around the rotor. The rotor is energized with DC (It like a bar magnet). The strong rotating magnetic field attracts the strong rotor field activated by the DC. This results in strong turning force on the rotor shaft. The rotor is therefore able to run a load as it rotates step with rotating magnetic field.

It works this way once it's started. However, one of disadvantages of synchronous motor that it can not be started from a stand still by applying three – phase AC power to the stator. When AC is

applied to the stator a high speed rotating magnetic field appears immediately. This rotating field rushes the rotor poles so quickly that the rotor does not have a chance to get started. In effect the rotor is repelled first in one direction and then the other. Asynchronous motor in its purest form has no starting torque. It has torque only when it's running at synchronous speed.

Squirrel cage type of winding is added to the rotor of synchronous motor to cause it to start. The squirrel cage is shown as the outer part of the rotor in fig (3-2). It is so named because it is shaped and looks something like turntable squirrel cage. Simply the windings are heavy copper bars shorted together by copper rings. Allow voltage is induced in these shorted winding by the rotating three – phase stator field. Because of short circuit a relatively large current flows in squirrel cage. Thus causes a magnetic field the motor starts.

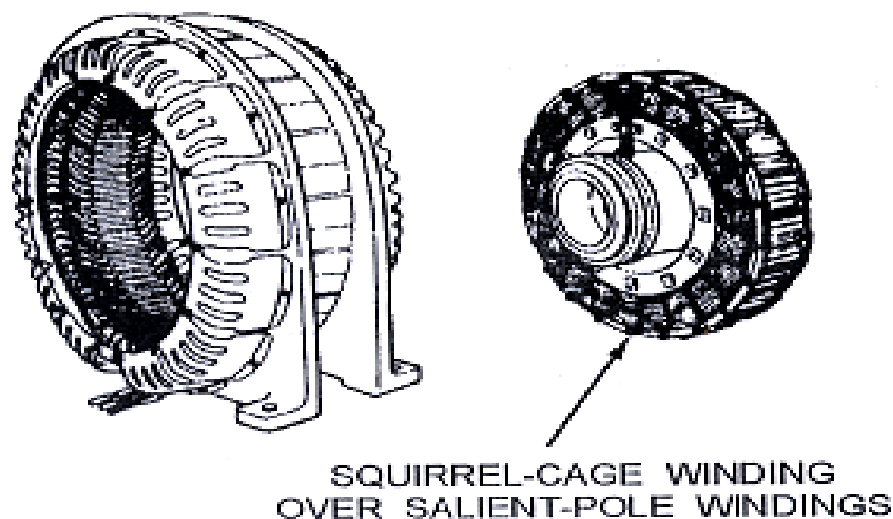


Figure (3-2) Self starting synchronous ac motor

To start practical synchronous motor the stator is energized but the DC supply to the rotor field is not energized. The squirrel – cage winding brings the rotor near synchronous speed. At that point the DC

field energized this locks the rotor in step with rotating stator field full torque is developed and the load is driven.

The particular synchronous motor has the disadvantages of requiring DC exciter voltage for the rotor. This voltage may be obtained either externally or internally depending on the design of the rotor.

3.1.2 Induction motor:

The induction motor is the most commonly used type of AC motor its simple rugged construction cost relatively little to manufacture.

The induction motor that is not connected to an external source of voltage. So its devices are name from the fact that AC voltage is induced in the rotor circuit by the rotating magnetic field at the stator. In many ways induction in this motor is similar to the induction between primary and secondary winding at transformers.

Large motor and permanently mounted motor that drive load at fairly constant speed is often induction motor. Example washing machine, refrigerator compressors, bench grinders and table saws.

The stator constructions of three – phase induction motor and three – phase synchronous motor are almost identical. However, their rotor is completely different. See fig (3-3).

The induction motor is made of laminated cylindrical with slots in it surface. The winding in these slots are one of two types (shown in fig (3-4)). The most common is the squirrel cage winding. This entire winding is made up of heavy copper bars connected together at each end by a metal ring made of copper or brass. This is because of the very low voltage generated in the rotor bars. The rotor type of winding contains actual coils placed in the rotor slots. The rotor is then called a wound rotor.

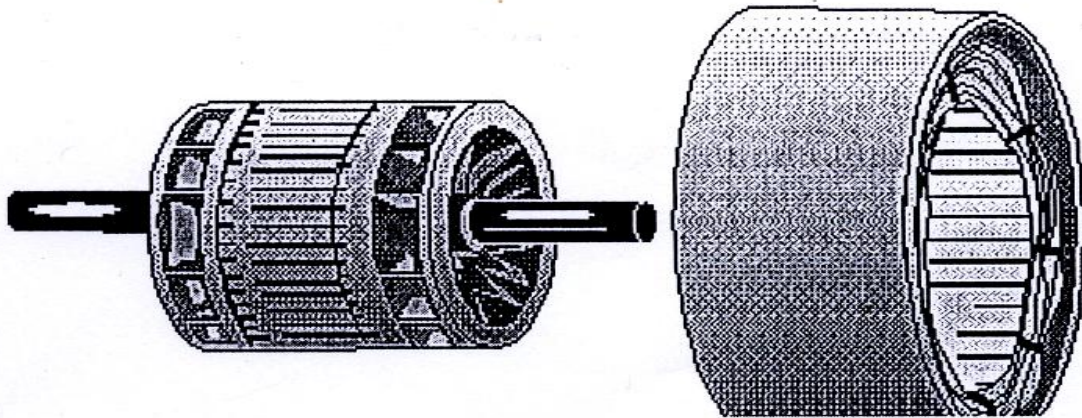


Figure (3-3) Induction motor

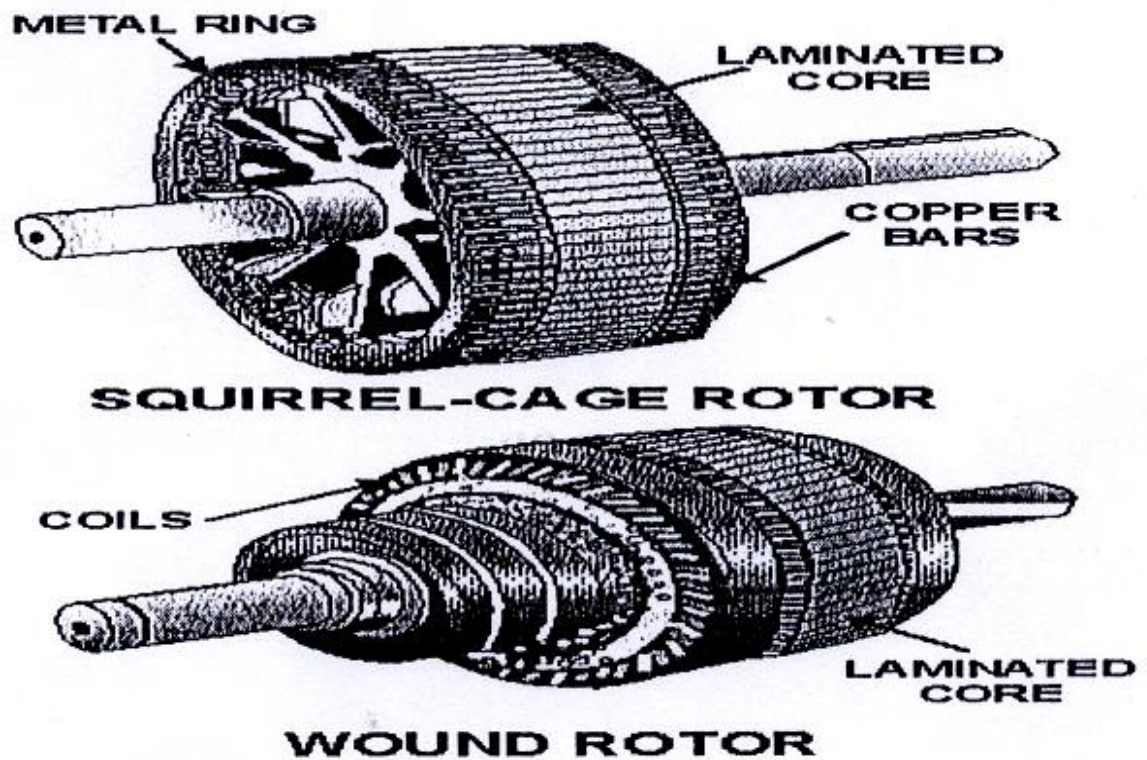


Figure (3-4) Type of induction motor rotor

Regardless of the type of rotor used basis principle in the same. The rotating magnetic field generated in the stator induced magnetic field in the rotor. The two fields interact and cause the rotor turn. To obtain

maximum interaction between the field. The air gap between the rotor and stator is very small.

The speed of the rotor depends upon the torque requirement of the load. The bigger the load, the stronger the turning force needed to rotate the rotor turning force can increase only if the rotor induced e.m.f increase. This e.m.f can increase only if the magnetic field cuts through the rotor at a faster rate. To increase the relative speed between the field and rotor. The rotor must slow down. Therefore, for heavier loads the induction motor turns slower than for lighter loads.

Actually, only a slight change in speed is necessary to produce the usual current changed required for normal changes in load. This is because the rotor winding have such a low resistance as a result induction motors are called constant- speed motor:

3.1.3 Types of induction motors

There are two main types of induction motors

Single – phase induction motor

Three - phase induction motor

3.1.3.1 Single – Phase induction motor:

There is probably more single–phase induction motor in use today then the total of all the other types put together.

It is logical that the least expensive lowest maintains type of AC motor should be use most often the single – phase AC induction motor fits that description.

Unlike polyphase induction motors, the stator field in the single – phase motor does not rotate instead it simply alternates polarity between poles as the ac voltage changes polarity.

Voltage is induced in the rotor as result of magnetic induction, and magnetic field produced around the rotor. This field will always be in position to the stator field “Lenz’s law”.

The interaction between the rotor and stator field will not produce rotation. However the interaction is shown by the double ended, arrow in fig (3.5) view A. Because this force is across the rotor and through the pole pieces there is no rotary motion just a push and / or pull along this line.

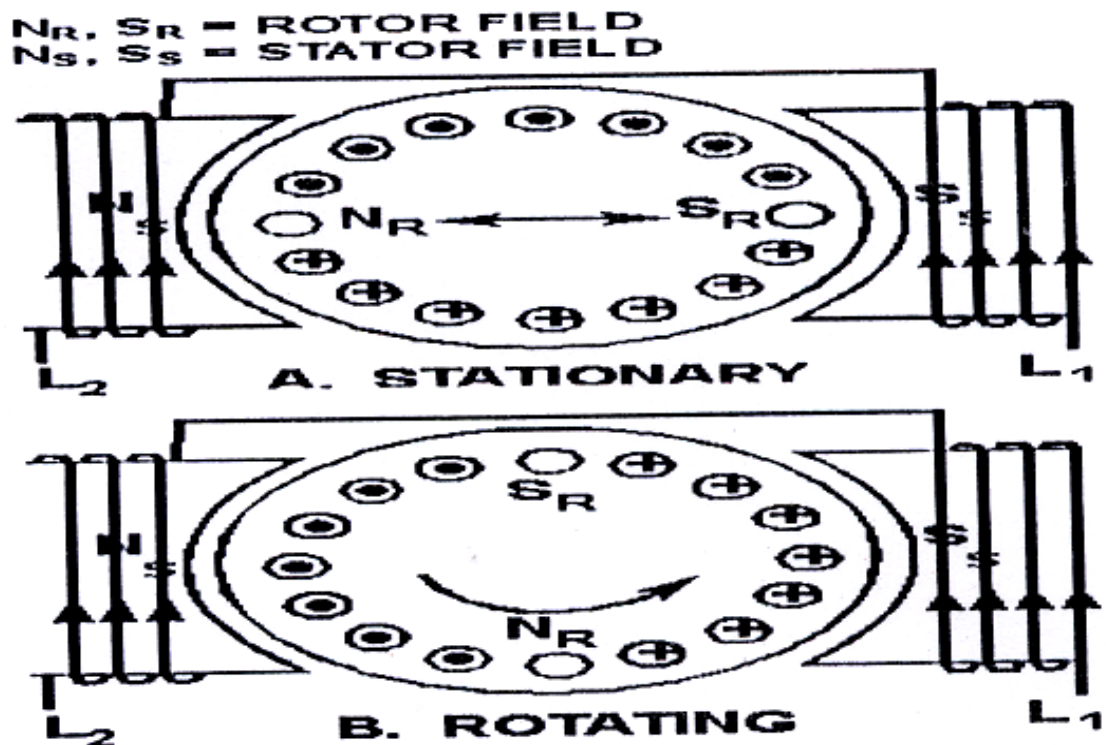


Figure (3-5) Rotor current in a single-phase ac induction motor

3.1.3.2 Three phase induction motor:

Single-phase is used in domestic applications for low power applications but it has some drawback. One is that it turns of 100 times per second (don't notice that the fluorescent lights flicker at this speed because the eyes are too slow even 25 pictures per second one the TV is fast enough to give the illocutions of continuous motion).

The second is that it is making it awkward to produce rotating magnetic field. For this reason some high power (several KW) domestic devices may require three-phase installation. Industrial applications use three extensively and the three – phase induction motor is a standard work horse for high power application. The three wires (not contain earth) carry three possible potential differences which are out of phase with each other by 120°, thus three stators give a smoothly rotating field.

3.2 Lighting devices:

The lighting devices is important kind of electric devices which it has a widely uses in our life in houses, offices, factories, roads and all places. The lighting lamp in technical usage is replaceable component such as an incandescent light bulb which is designed to produce light from electricity. These components usually have a ceramic or metal base which makes an electrical connection in the socket of a light fixture. This connection may be made with a threaded base. Two metal pins or a “bayonet mount” Re-lamping is the replacement of only the removable lamping a light fixture.

3.2.1 Types of Lamps:

3.2.1.1 Incandescent Light bulb:

The incandescent light bulb was the first type of modern electric light introduced in the early 19th century and still basically inefficient at converting electricity to light. About 90% of the electricity

input is wasted as heat. This excess heat is then dumped into the air which in warm climates must then be cooled by ventilation or air conditioning resulting in more energy wastage.

3.2.1.2 Florescent lamp:

Fluorescent lamps have an efficiency of about 40% meaning that for same amount of light generated they use 1/4 the power and produce 1/6 the heat of regular incandescent. Fluorescents were limited to linear and around “Circle line” lamp until the 1980s when the compact fluorescent lamp. (CFL) was invented CFLs can have a built in electrical ballast which fits into a standard screw base or make use of a remote ballast compact and linear fluorescent lamps trouble in very cold weather when installed outside.

Fluorescents most often come in cool white (CW) with some home bulbs being a warm white (WW) which has a pinkish color. In between are “enhanced white” (EW) which is more neutral. There is also a very cold daylight white (DW). Compact fluorescent lamps are usually considered warm white though many have a yellowish cast like an incandescent “warm” and “cool” are entirely relative terms and almost arbitrary so color temperature and the color rendering index (CRI) are used as absolute scales of color for fluorescents and sometimes for other types of lighting.

3.2.1.3 Hid Lamp:

High- intensity discharge lighting first started with the mercury-vapor street light and later the high pressure sodium one with their characteristic orange color.

Modern ones metal halide used in everything from head lights to floodlights and with a more pleasant color balance. Like fluorescents all HID bulbs require a ballast but they also require a few minutes (or second for head lights) to start bulbs are over 60% and up to 80% efficient.

3.2.1.4 ARC Lamp:

An arc lamp consists of two electrodes which are separated by gas including neon argon xenon sodium metal halide and mercury very high voltage is needed to “ignite” or “strike” the arc. This requires an electrical circuit sometimes called “igniter” which is part of a larger circuit is called the “ballast”.

After the arc is struck, the internal resistance of the lamp drops to a very low level that would allow an instantly, destructive high current to limit it to the lamp's normal operating current. The ballast is typically designed to maintain safe operating conditions and constant light output over the life of the lamp.

3.2.1.5 LED Lamp:

University researchers have made recent advances in the production of white light emitting diodes (LEDs) which lead to the introduction to solid state lighting (SSL) fixtures for general illumination. Before this time colored LEDs were used as indicator light for electronic devices. These lamps are still more expensive than other lamps but they last extremely long time up to 100000 hours (compared to around 10,000 for fluorescent and 1000 for Incandescent) it appears that for now these white light emitting LEDs can also be used for accent lighting and even in ice cubes for drinks at parties. They are also being increasingly used as Christmas light. White LEDs are about the same efficiency as fluorescent lamps white LEDs can be up to 90% efficiencies. LED technology is useful for lighting designers because of its low power consumption low heat generation instantaneous on /off control continuity of color throughout. The life of diode and relative low cost of manufacture.

In the last few years software has been developed to merge lighting and video by enabling lighting designees to stream video content to their LED fixtures creating two resolution video walls.

3.3 Household Device:

Household device contain in household and which used for similar appliance like:

- 1. Refrigerators and food freezers.**
- 2. Electric fans:** Electric fans with single – phase alternate current for household and similar use.
- 3. Air –conditions:** Air condensations are available in many types as show in fig (3.6) and it used Motor – compressor as freezing appliance.
- 4. Washing Machine:** it is available with out devices of water heater and spinning extraction and drying.
- 5. Storage water heaters:** including fixed storage water heaters and instantaneous water heater, heating water to a temperature below its boiling point.
- 6. Vacuum cleaners:** vacuum having the function of suction dust or liquid.
- 7. Appliances for skim and hair care:** Appliances with electric heating component for skim and hair care of both human and animals.
- 8. Electric Irons:** Electric dry irons and steam irons for household and similar purpose.
- 9. Electromagnetic cookers:** Electromagnetic heating kitchen appliance with may contain electromagnetic heating component for cooking and similar purpose.
- 10. Electric food processors:** food processors machine and similar multiple use food machine.

11. Audio and video Apparatus: it is like audio power amplifier, tuners, radio receiver, recorders, players, dealers of audio and video with kinds carries, televisions, satellite receiver, equipment and component for cable distribution systems of sound and television signals.

12. Information technology Equipment: personal computer, displayer units connected with computer, painters and leering machine.

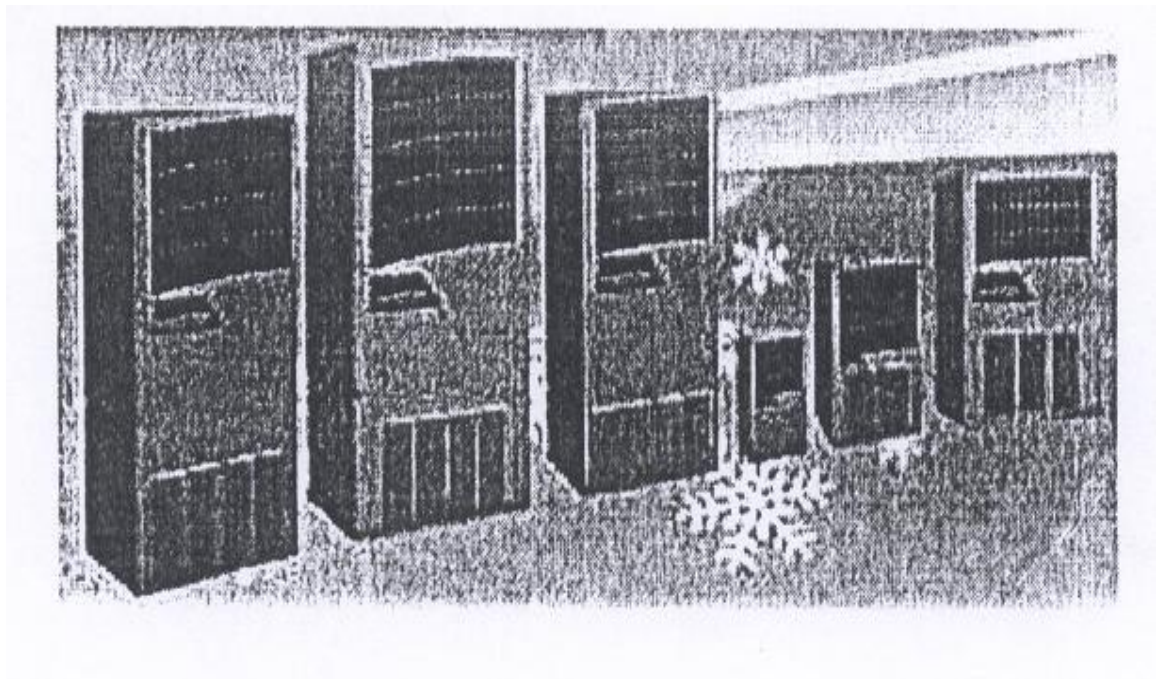


Figure (3.6) Type of air condition

3.4 Warning and Alarming devices:

Warning and alarming devices are widely uses in industrial and dangerous area for safely work and without accidents which may cause by fire or thieves and nuclear pollution in nuclear stations for electric generation or other purpose .Here we show some types of these device.

3.4.1 Fire Alarm Equipment:

The fire alarm equipment like point type smoke fire detector. Heat sensitive point fire detector fire control unit. Control for fire protection equipment.

3.4.2 Detector for intruder alarm system:

The detector for intruder using types of techniques like microwave Doppler detector for use in building, Active infrared intrusion detector for use also in building.

Also in Alarming devices we can discuss about a loud speaker which can be used to alarm about any danger in towns and factories by use it to send an alarming message.

3.5 Loud speakers:

A loud speaker is linear motor with a small. It has single moving coil that is permanently but flexibly wired to the voltage source, so there are no brushes. The coil moves in the field of permanent magnet, which is usually shaped to produce maximum force on the coil. the moving coil has no core, so its mass is small and it may be accelerated quickly, allowing for high frequency motion. in loud speaker, the coil attached to a light weight paper cone, which is supported at the inner and outer edges by circular, pleated paper “springs” in the photograph below, the speaker is beyond the normal upward limit of its travel, so the coil is visible above the magnet poles.

For low frequency, large wave length sound, one needs large cones, speakers designed for low frequencies are called woofers. They have large mass and are therefore difficult to accelerate rapidly for high frequency components. Tweeters-loud speaker, designed for high frequencies may be just speakers of similar design, but with small low

mass cones and coils. Alternatively they may use piezoelectric crystals to move the cone.

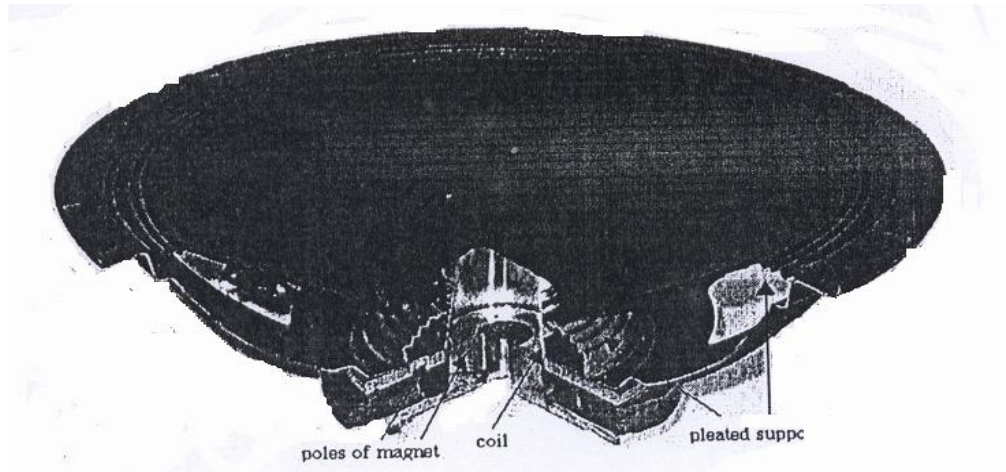


Figure (3.7) loud speaker

3.6 Electric Tools:

Electric tools which used in industries and other application these tools like drills “include impact drills” screw drivers and impact wrenches electric grinders. Sander, circular saws, electric hammer “electric pickax” spray guns for non flammable liquid, electric scissor “electric scissor for double-edged blades, electric impact scissors and electric tapping machine.

CHAPTER FOUR

Mobile Tone Decoding

Mobile tone Decoding

4-1 Description:

The mobile tone decoding is a complete DTME receiver integrating both the band split filter and decoder functions.

The filter section uses switched capacitor techniques for high and low group filters, the decoder uses digital counting techniques to detect and decode all 16 DTMF tone – pairs into a 4- bit code.

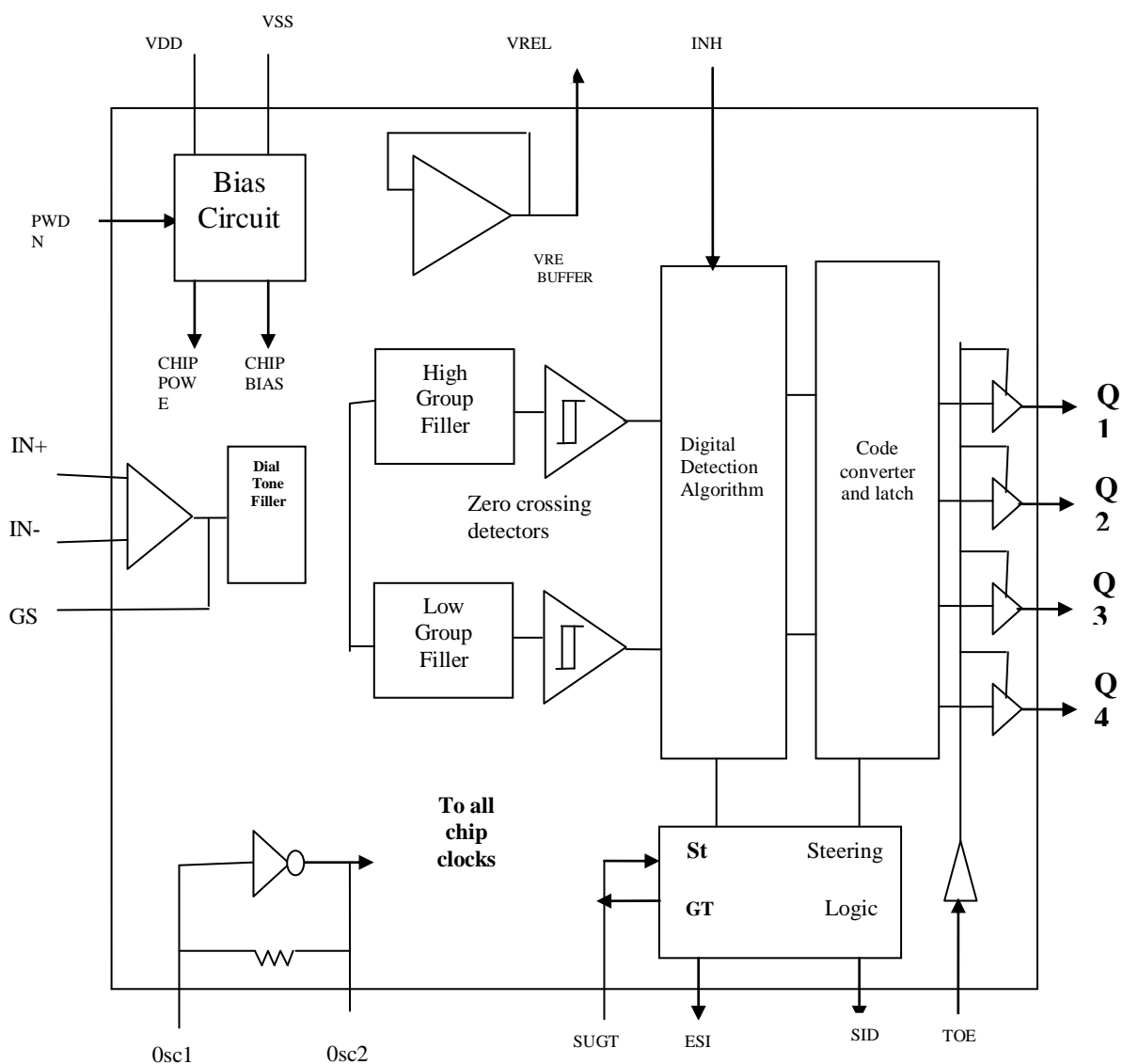


Figure (4-1) functional Block Diagram of DTMF

4-2 Applications:

- Receiver system for British telecom (BT).
- Paging system /Mobile radio
- Credit card systems
- Remote control
- Personal control
- Telephone answering machine

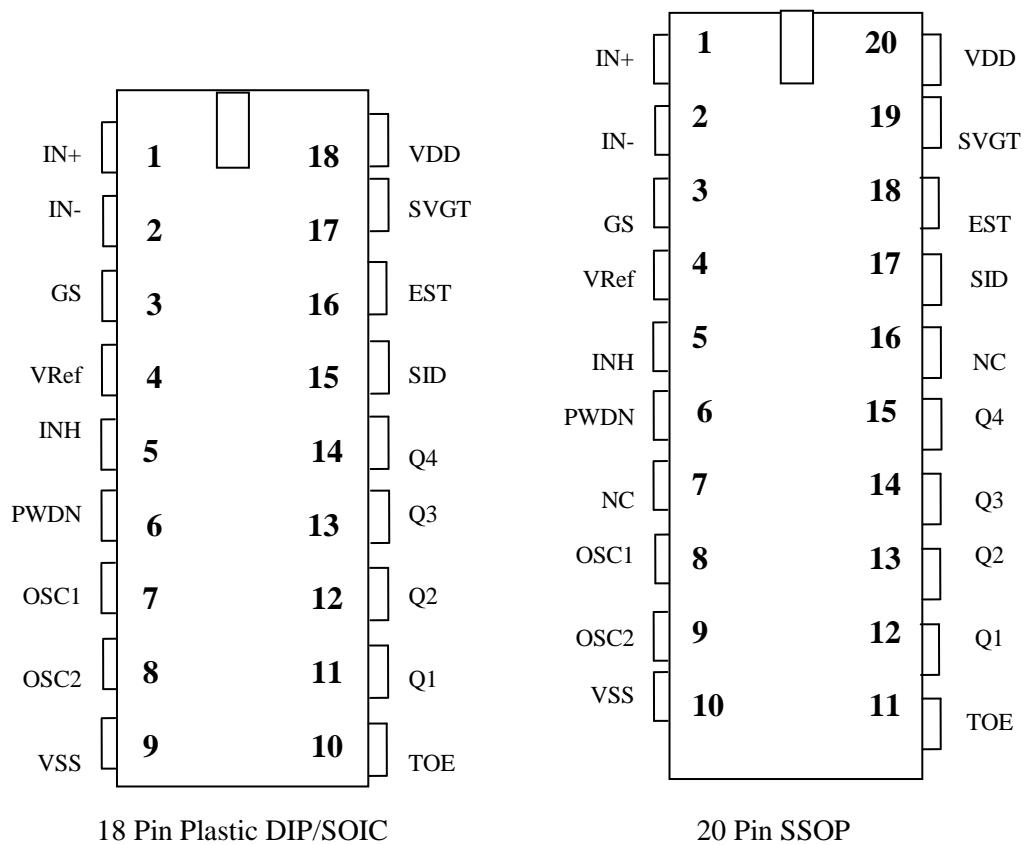


Figure (4.2) Pin Connection

In mobile tone decoding the external component count is minimized by on chip provision of differential input amplifier clock oscillator and latched three- state bus interface

Table (4.1) description:

Pin#		Name	Description
18	20		
1	1	IN+	Non-inverting op –Amp (input)
2	2	IN-	Inverting op – Amp – (input)
3	3	GS	Gain Select Gives access to output of front end differential amplifier for connection of feedback resistor
4	4	VRef	References voltage (output) Nominally VDP/2 is used to bias in puts at mid – rail (see fig (4-6))
5	5	INH	Inhibit (input) Logic high inhibit the detection of tones representing character A.B.C and D This pin input is internally pulled down.
6	6	PWDN	Power down (Input) Active high , powers down the device and inhabits the oscillator. This pin input is internally oscillator failed down.
7	8	OSC1	Clock input
8	9	OSC2	Clock (out put) A3 579545 MHZ crystal connected between pins OSC1 and OSC2 completes the internal oscillator circuit
9	10	VSS	Ground (Input) 0v typical
10	11	TOE	There stats output enable (Input) logic high enables the outputs Q1-Q4, this pin is pulled up internally
11-14	12-15	Q1-Q4	There state date (out put) when enabled by TOE. Provide the code corresponding to the last valid tone pair received when TOE is logic low. The data outputs are

			high impedance.
15	17	StD	Delayed steering (output) presents a logic high when a receiver tone pair has been registered and the output latch updated, returns to logic low when the voltage on ST/GT talk below VTst
16	16	ESst	Early steering (out put) presents a logic high once the digital algorithm has detected a valid tone pair (signal condition) Any momentary loss of signal condition will cause ESst to return to a logic low.
18	20	St/GT	Steering input /Gurad time (out put) Bidirectional. A voltage greater than Urst detected at St causes the device to register the detected tone pair and update the output latch, A voltage less than VFst frees the device to accept a new tone pair. The Gt out put acts to reset the external steering time- constant , its state is a function of Est and the voltage on St
18	20	VDD	Positive power supply (input) +5v typical
	7-16	NC	No connection

4-3 Function Description:

The mobile tone decoding monolithic DTMF receiver offers small size low power consumption and high performance its architecture consists of a band split filter section which separates the light and low group tones followed by a digital counting section which verities the frequency and duration of the received tones before passing the corresponding code to the out bus .

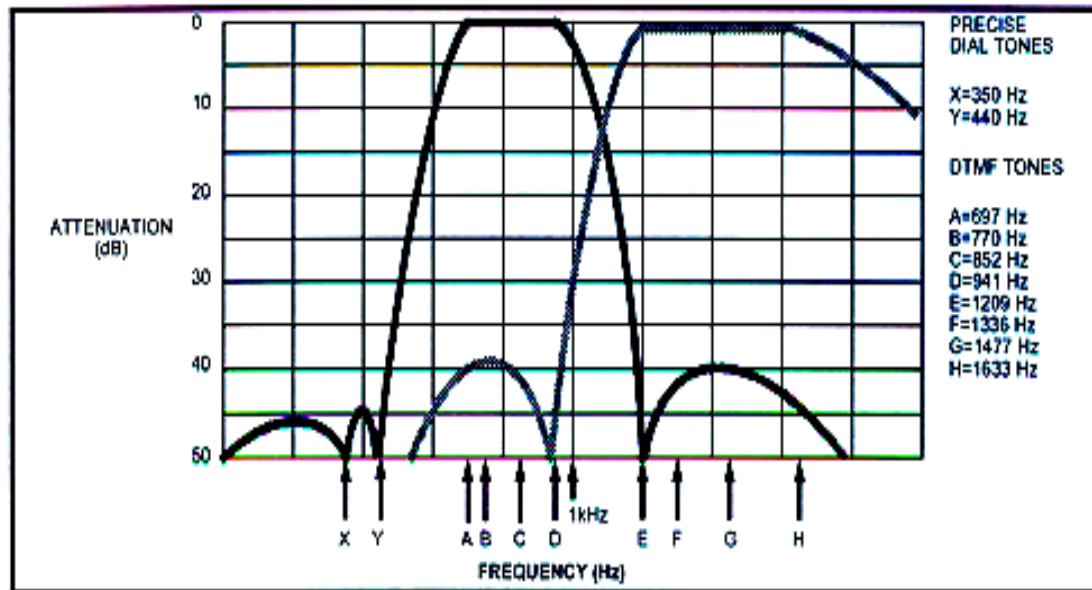


Figure (4-3) filter response

4-4 Filter section:

Separation of the low group and high group tones is achieved by Applying the DTME signal to the input to two sixth Order switched capacitor band pass filters, the bandwidths of which correspond to the low and high group frequencies. The section also incorporates notches of 350 and 440Hz for exceptional dial tone rejection (see figure (4.3)) each filter out put is followed by a single order switched capacitor filter section which smoothes the signals prior to limiting. The Limiting is performed by high- gain comparators which are provided with hysteresis to prevent detection of unwanted low level signals. The output of the comparators provided full rail logic swings at the frequencies of the incoming DTME signals.

4-5 Decoder section:

Following the filter section is a decoder employing digital counting techniques to determine the frequencies of the income tones and to verity that they correspond to standard DTME frequencies. A complex

averaging a logarithm protects against tone simulation by extraneous signals such as voices while providing tolerance to small frequency deviations and variations. This averaging a logarithm has been development to ensure an optimum combination of immunity to talk off and to tolerance to the detector recognize the present of tow valid tones "this referred to as" signal condition "this referred to as signal condition" in some industry specification " the early steering" (EST) output will go to an active stat Any active stat. Any subsequent loss of Signal condition will cause EST to assume an inactive state (see) steering circuit.

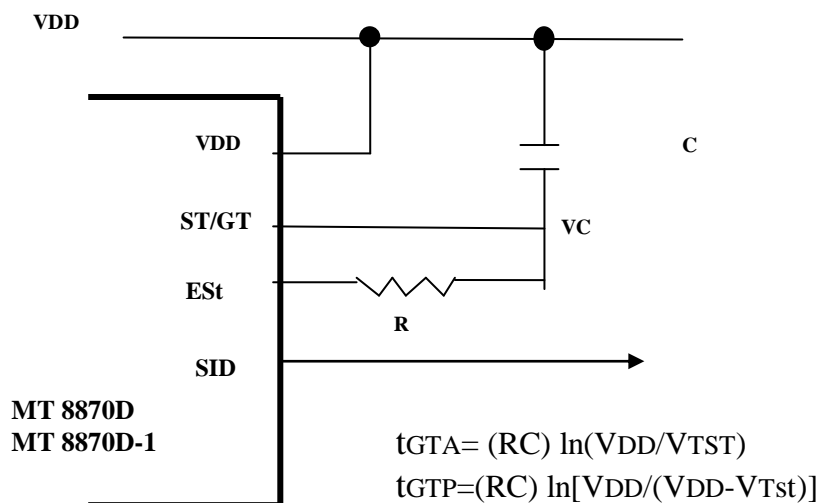


Figure (4-4) Basic steering circuit

4-6 steering circuit:

Before registration of decoded tone pair the receive checks for valid signal duration referred to as character recognition conduction. This check is performed by an external RC time constant driven by EST. Logic high on ESt causes VC "see figure (4.4) "to rise as the capacitor discharge. provided signal condition is maintains high for the

validation on period (TGTP) VC reaches the threshold (VTSt) of the steering logic to register the tone pair, latching its corresponding 4-bit code “see table 1” into the out put latch. At this point the GT out put is activated and drives VC to VDD. GT continues to drive high as long as EST remains high. Finally after a short delay to allow the output latch to settle. The delayed steering out put flag (StD) goes high. Signaling that a received tone pair been registered. The contents t the out put latch are made available on the 4 bit out put bus by raising the there state control input (TOE) to logic high. The steering circuit works in reverse to validate the inter digit palls between signals thus as well as rejecting signals too short to be considered valid. the receiver will tolerate signal interruption (dropout) too short to be considered a valid pause this facility together with the capability of selecting the steering lame constants externally allows the designer to tailor performance to meet a wide variety of system requirements.

4-7 Guard time Adjustment:

In many situations requiring selection to tone direction and inter digital pause the simple steering circuit shown in figure (4-5) is applicable component values are chosen according to formula:

$$T_{Res} = + DP + t_{GTP}$$

$$T_{iD} = t_{DA} + t_{GTA}$$

The value of tDp is device parameter and free is the minimum signal duration to recognize by the receiver A value for C of 0.1 mf is recommended for most applications learning R to be selected by the designer.

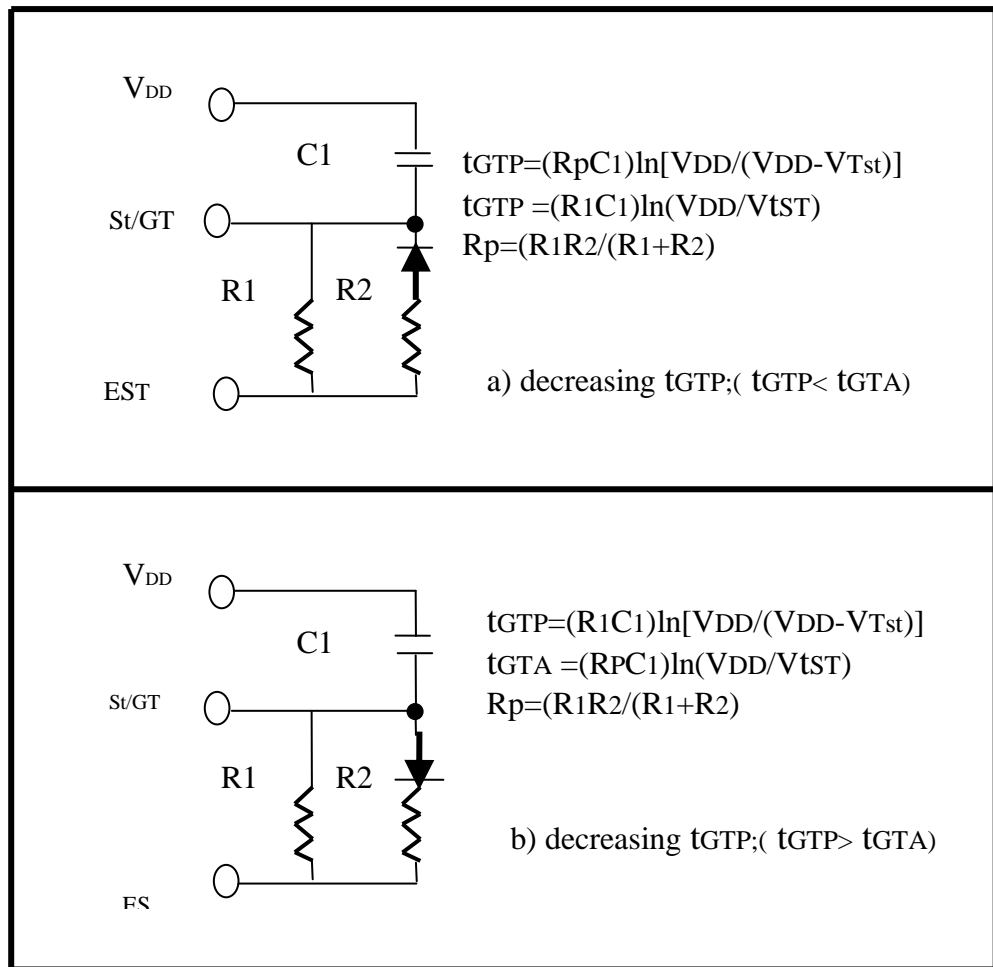


Figure (4-5) guard time adjustment

Table (4.2) functional decode table

Digit	TOE	INH	EST	Q4	Q3	Q2	Q1
ANY	L	X	H	Z	Z	Z	Z
1	H	X	H	0	0	0	1
2	H	X	H	0	0	1	0
3	H	X	H	0	0	1	1
4	H	X	H	0	1	0	0
5	H	X	H	0	1	0	1
6	H	X	H	0	1	1	0
7	H	X	H	0	1	1	1
8	H	X	H	1	0	0	0
9	H	X	H	1	0	0	1

0	H	X	H	1	0	1	0
*	H	X	H	1	0	1	1
#	H	X	H	1	1	0	0
A	H	L	H	1	1	0	1
B	H	L	H	1	1	1	0
C	H	L	H	1	1	1	1
D	H	L	H	0	0	0	0
A	H	H	L	Undetected, the output code will remain the same as the previous detected code			
B	H	H	L				
C	H	H	L				
D	H	H	L				

L= logic low

H= logic high

Z=high impedance

X=Don't Care

Different steering arrangement may be used to select independently the guard time for tone present (tGTP) and tone absent present (tGTA) this may be necessary to meet system specifications which place both accept and reject limits on both tone duration and inter digital pause. Guard time adjustment also allows the designer to tailor system parameters such as talk off and noise immunity increasing tREC improves talk – off performance since it reduces the probability that tones simulated by speech will maintain signal condition long enough to be registered. Alternatively, a relatively short tREC with a long tDO would be appropriate for extremely noisy environment where fast a requisition time and immunity to tone drop outs are required design information for guard time adjustment is shown in fig (4-5).

4-8 power down and inhibit mode:

Logic high “applied to pin 6” (PWDN) will power down the device to minimize the power consumption in stand by mode. It stops the oscillator and the functions of the filters.

Inhibit mode is enabled by a logic high input to the pin 5 (INH). It inhibit the detection to tone representing characters A, B, C and D. the output code will remain the same as the previous detected code (see table (4.1)).

4.9 differential input configurations:

The input arrangement of the mobile tone decoding provide a differential input operational amplifier as well as a bias source (VRet) which is used to bias the inputs at mid-rail. Provide is made for connection of a feedback resistor to op-amp output (GS) for adjustment of gain. In a single – ended configuration, the input pins are connected the op-amp connected for unity gain and VRet biasing the input at $\frac{1}{2}$ VDD. Figure (4-6) shows differential configuration which permits the adjustment of gain with the feed back resistor R5.

4-10 Crystal Oscillators:

The internal clock circuit is completed with the addition of an external 3.79545 MHz crystal and is normally connected as single Ended input configuration. However, it possible to configure several mobile tone decoding devices employing only single oscillator crystal. The oscillator out put of the of first device in the chain coupled trough a 30 pf capacitor to the oscillator input (OSCI) of the next device . Subsequent devices are connected in similar fashion. Refer to figure (4-7) for details. The problems associated with unbalanced loading are not a concern with the arrangement shown, i.c precision balancing capacitors are not required.

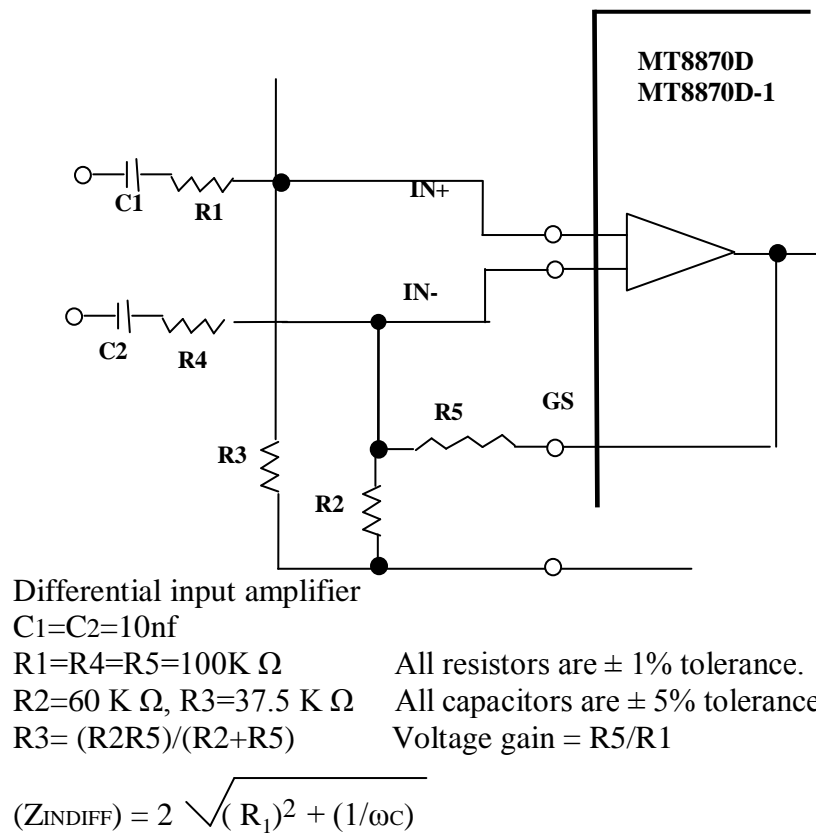


Figure (4-6) differential input configuration

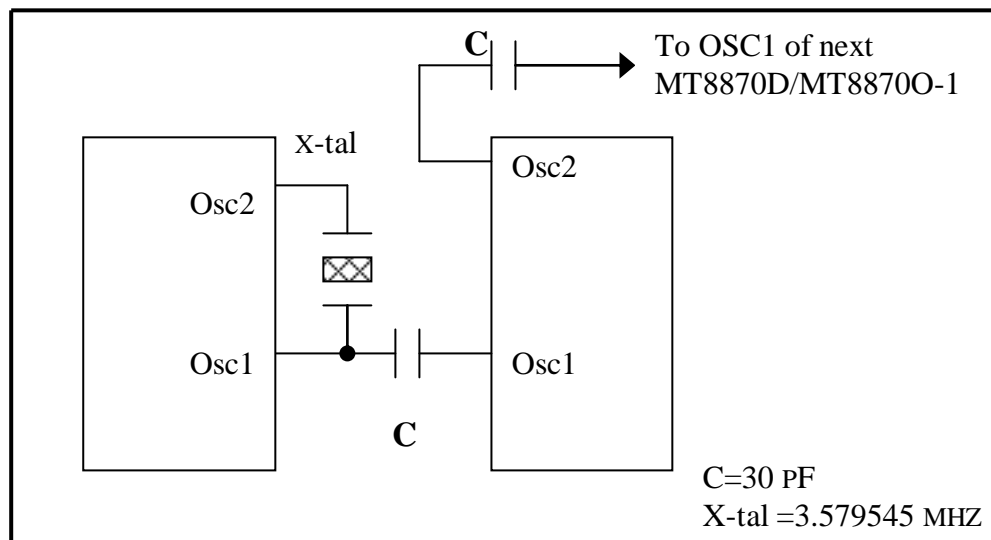


Figure (4-7) Oscillator connection

Chapter five

Hardware Organization and Implementation

5.1 Overview:

In the past few chapters we gave an introduction to the basics of what we are going to implement practically in this chapter. What we are trying to do is to control any process remotely using a microprocessor based circuit. Any cellular mobile can be used to generate a DTMF signal which can be received by another mobile in the other end where the devices to be controlled are located. The signal received is further decoded and fed to PC through the parallel port using a D-25 male connector. A specially written software is going to process the received signal as per the process requirements. Accordingly, the required control signal to the devices interfaced to the PC through a latch.

5.2 Parts list:

Besides the main part which is the PC there are some other active devices which are going to interface in the coming few lines.

5.2.1 DTMF Generator /Decoder.

In DTMF there are 16 distinct tones. Each tone is the sum of two frequencies: one from a low and one from a high frequency group. There are four different frequencies in each group.

The phone only uses 12 of the possible 16 tones. If you look at your phone there are only 4 rows (R1, R2, R3 and R4) and 3 columns (C1, C2 and C3).

The rows and columns select frequencies from the low and high frequency group respectively. The exact value of the frequencies is listed in Table 5.1 below:

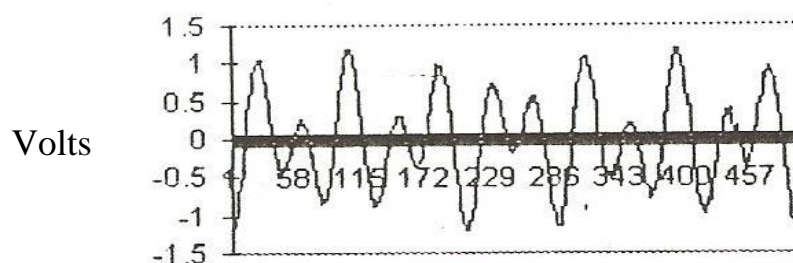
Table 5.1 DTMF Generated frequencies.

DTMF Row / Column Frequencies

LOW – FREQUENCIES	
ROW #	FREQUENCY (HZ)
R1 : ROW 0	697
R2 : ROW 1	770
R3 : ROW 2	852
R4 : ROW 3	941
HIGH – FREQUENCIES	
COL#	FREQUENCY (HZ)
C1:COL0	1209
C2:COL1	1336
C3:COL2	1477
C4:COL3	1633
C4 not used in phones	

Thus, to decipher what tone frequencies is associated with particular key look at the phone again. Each key is specified by its row and column locations .For example the "2" key is row 0 (R1) and column 1 (C2) Thus using the above table, “2” has frequency of $770 + 1336 = 2106$ Hz. The "9" is row 2 (R3) and column 2 (C3) has a frequency of $852 + 1477 = 2329$ Hz.

The following graph is a captured screen from an oscilloscope. It is a plot of the tone frequency for the “1” key



Sample

Figure 5.1 Tone frequency for “1” key

In the sample can be clear that the DTMF generated signal is very distinct and clear. The horizontal axis is in samples. The frequency of the tone is about 1900 Hz – close to the 1906 Hz predicted by Table 5.1 (697+1209).

5.2.2 D-25 male connector:

The DB-25 connector (named for its "B" –size "D" –shaped shell and 25 pins) is practically ubiquitous in the electronics industry. The DB-25 connector is used for variety of purposes. Two common applications are RS-232/ELA-232 (serial) connections and the parallel printer interface on the IBM PC. The DB-25 connector is also used for SCSI connections.

The lines in DB25 connector are divided in to three groups, they are:

1. Data lines (data bus).
2. Control lines.
3. Status lines.

As the name refers, data is transferred over data lines, control lines are Used to control the peripheral and of course, the peripheral returns status signals back computer through Status lines. These lines are connected to Data, Control and Status registers internally. The details of parallel port signal lines are given below in figure 5.2 and table 5.2.

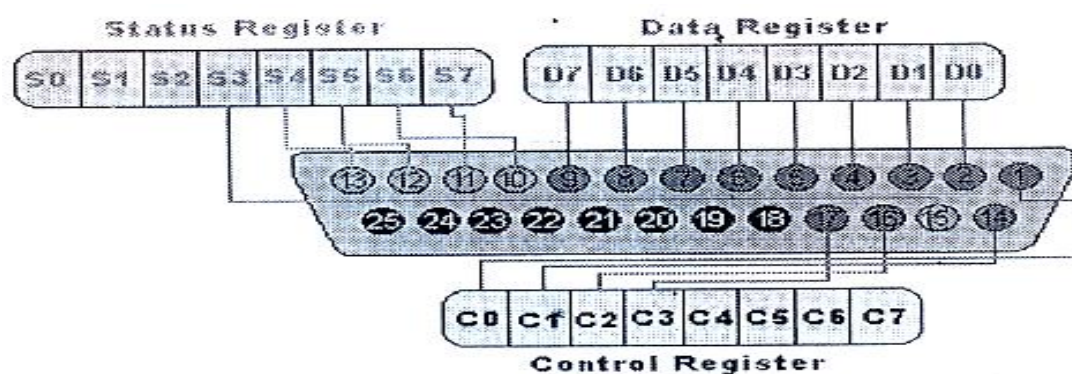


Figure 5.2 parallel port signal lines

Table(5.2) parallel port signal lines

Pin No (DB25)	Signal name	Direction	Register bit	Inverted
1	nStrobe	Out	Control – 0	Yes
2	Date 0	In / Out	Date 0	No
3	Date 1	In / Out	Date 1	No
4	Date 2	In / Out	Date 2	No
5	Date 3	In / Out	Date 3	No
6	Date 4	In / Out	Date 4	No
7	Date 5	In / Out	Date 5	No
8	Date 6	In / Out	Date 6	No
9	Date 7	In / Out	Date 7	No
10	nAck	In	Status -6	No
11	Busy	In	Status -7	Yes
12	Paper – Out	In	Status -5	No
13	Select	In	Status -4	No
14	Linefeed	Out	Control – 1	Yes
15	nError	In	Status -3	No
16	NInitialize	Out	Control – 2	No
17	nSelect-Printer	Out	Control – 3	Yes
18-25	Ground			

5.2.2.1 The registers:

In an IBM PC, these registers are IO mapped and will have unique address. These addresses must be found to work with parallel port. For typical PC, the base address of LPT1 is 0x378 and of LPT2 is 0x 278 .The data register resides at this base address , status register at baseaddress +1 and the control register is at baseaddress +2. So once the base address is ready, each registers address can be calculate in this

manner. The table 5.3 below shows the register addresses of LPT1 and LPT2.

Table 5.3 parallel port Address

Register	LPT1	LPT2
Data register (baseaddress + 0)	0x378	0x278
status register (baseaddress + 1)	0x379	0x279
register (baseaddress + 2) control	0x37a	0x27a

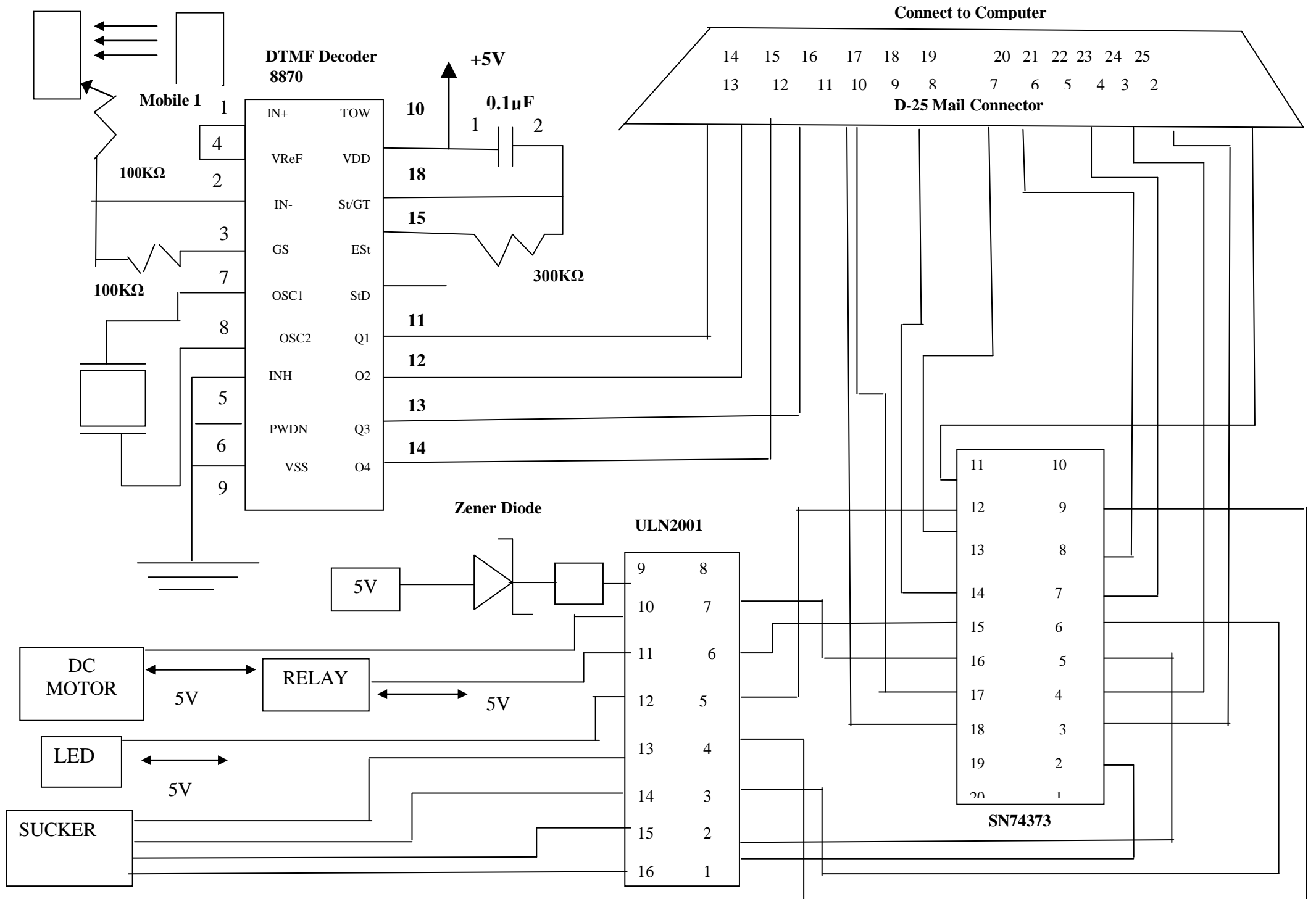
5.2.3 The 74373 Latch

The HD74LS373.8 – bit register features totem – pole three – state outputs designed specifically for driving highly – capacitive or relatively low – impedance loads. The high – impedance third state and increased high – logic – level drive this register with the capacity of being connected directly to and driving the bus lines in a bus – up components. They are particularly attractive for implementing buffer registers, I/O ports, bidirectional bus drivers, and working registers.

The eight latches are transparent D-type latches meaning that while the enable (\overline{G}) is high the Q outputs will follow the data (D) inputs. When the enable is taken low the output will be latched at the level of the data that was setup.

5.2.4 ULN2001 A Darlington pair

Ideally suited for interfacing between low – level logic circuitry and multiple peripheral power loads, the series ULN20xx A/L high – voltage, high – current Darlington arrays feature continuous load current ratings to 500 mA for each of the seven drivers. At an appropriate duty cycle depending on ambient temperature and number of drives turned ON simultaneously, typical power loads totaling over 230 W ($350\text{ mA} \times 7, 95\text{ V}$) can be controlled. Typical loads include relays, solenoids stepping motors, magnetic print



hammers ,multiplexed LED and incandescent displays , and heaters . All devices feature open – collector outputs with integral clamp diodes . It is recommended to connect a 12 v zener diode between the power supply and VDD (pin 9) on the chip , to absorb reverse (or " back ") EMF from the magnetic field collapsing when motor coils switched off

5.2.5 Stepper Motor:

A stepper motor is a type of electric motor which is used when something has to be positioned very precisely or rotated by an angle.

In a stepper motor, an internal rotor containing permanent magnets is controlled by a set of stationary electromagnets that are switched electronically. Hence, it is a cross between a DC electric motor and a solenoid Stepper motors. Stepper motor do not use brushes commutators.

Stepper motors have fixed number of magnetic poles that determine the number of steps per revolution. Most common stepper motor controllers can utilize pulse – width modulation to perform micro steps, achieving higher position.

Operation Some micro stepping controllers can increase the step resolution from 200 steps /rev to 50.000 micro steps / rev.

Stepper motors are rated by the torque they produce .A unique feature of steppers is their ability to provide position holding torque while not in motion. To achieve full rated torque, the coils in stepper motor drivers must employ current regulating circuits to realize this. The voltage rating (if there is one is almost meaningless.

Computer controlled stepper motors are one of the most versatile forms of positioning system, particularly when digitally controlled as part of a servo system. Stepper motors are used in floppy disk drives, flatbed scanners, printers, plotters and many more devices. Note that hard drives no longer use stepper motors, instead utilizing a voice coil and servo feedback for head positioning.

5.2.6 Series Motor:

An electric motor converts electrical energy into mechanical motion. The reverse task that of converting mechanical motion into electrical energy is accomplished by a generator or dynamo. In many cases the two devices are identical except for their application and minor construction details.

Most electric motors work by magnetism, but motors based on other electromechanical phenomena, such as electrostatic forces and the piezoelectric effect, exist. The overarching concept is that a force is generated when a current – carrying element is subjected to a magnetic field.

In a cylindrical motor, the rotor rotates because a torque is developed when this force is applied at a given distance from the axis of the rotor.

A simple DC electric motor, when the coil is powered, a magnetic field is generated around the armature. The left side of the armature is pushed away from the magnet and drawn toward the right, causing rotation.

The armature continues to rotate. When the armature becomes horizontally aligned the commutator reverses the direction of current through the coil reversing the magnetic field. The process then repeats.

5.2.7 Relay:

A relay is an electromechanical switch that uses an electromagnet to open or close one or many sets of contacts. When a current flows through the coil, the resulting magnetic field attracts an armature that is mechanically linked to a moving contact. The movement either makes or breaks a connection with a fixed contact. When the current is switched off, the armature is returned by a spring to its resting position.

5.2.8 LEDs:

An LED is special type of semiconductor diode. Like a normal diode, it consists of a chip of semiconducting material impregnated, or doped, with impurities to create a structure called a pn junction. Charge – carriers - electrons and holes flow into the junction from electrodes with different voltages. When an electron meets a hole, it falls into a lower energy level, and releases energy in the form of a photon as it does so. The wavelength of the light emitted , and therefore its color , depends on the band gap energy of the materials forming the pn junction .A normal diode , typically made of silicon or germanium , emits invisible far – infrared light , but the Materials used an LED have band gap energies corresponding to near - infrared visible or near – ultraviolet light (24).

5.3 Design concepts and theory of operation:

Our aim is to send some control signal remotely from a cellular mobile phone. this signal will be received n the other side where the process to be controlled is located .The signal received is encoded and further processed with the help of a software specially written for this purpose .Accordingly the signal is sent to the device to controlled after a appropriate buffering using special IC's and gates. The whole circuit can

be divided into four main blocks as shown in figure below .These blocks are discussed one by one in the next few paragraphs:

5.3.1 Cellular Mobile Block:

In this block the first Control signal is sent from the first mobile phone. The Propagating is either an analog or digital type of signal .The frequency of the signal is determined by the key pressed as discussed earlier in unit 5.2. Certainly, some Carrier frequency will be used to carry the generated Signal as that Signal is in audible range of frequencies .With analog system, the audio is modulated directly onto a carrier. This is very much like FM radio where the audio signal is translated to the RF Signal.

With digital systems , the audio is converted to digitized samples at about 8000 samples per second or more .The digital samples are number that represent the time – varying voltage level at specific points in time . These samples (number) are now transmitted as 1s and 0s .At the end, the samples are converted back to voltage levels and “smoothed out” so that you get about the same audio signal. (There is some loss, but it may be unnoticeable – depending on how it’s done)

5.3.2 DTMF Decoder Block.

When received at the other side by mobile 2 the signal is extracted from the carrier .Through the audio output of the Mobile 2 phone the signal used at that point and it to the 8870 decoder Chip .The analog Signal received from the headset out put is fed to pins of the 8870DTMF receiver . Pin 2 is the inverted input of an operational an operational amplifier. In this design typical single ended input configuration haring rarity gain is used.

$$\text{Voltage gain} = \frac{R_F}{R} * \left(\frac{S}{S + 1/RC} \right)$$

The input stage is followed by a low pass continuous RC active filter which performs an antialiasing function. Dial tone at 350 and 440 Hz is then rejected by a third order switched capacitor notch filter. The signal, still in its composite form, is then split into its individual high and low frequency components by two sixth order switched capacitor and pass filters. Each component tone is then smoothed by an output filter and squared up by hard limiting comparator. The two resulting rectangular waves are applied to digital circuitry where a counting algorithm measures and averages their periods. An accurate reference clock is from an inexpensive external 3.58 MHz color burst crystal. Upon recognition of a valid frequency from each tone group the Early Steering (ESt) output is raised . The time required to detect the presence of two valid tones , t_{DP} , is a function of the decode algorithm , the tone frequency and the previous state of the decode logic . ESt indicates that two tones of proper frequency have been detected and initiates an RC timing circuit. If both tones are present for the minimum guard time t_{GTP} , Which is determined by the external RC network , the DTMF signal is decoded and the resulting data (Table 5.4) is latched in the output register. The Delayed Steering (StD) available . The time required to receive to receive a valid DTMF signal, t_{RCE} , is equal to the sum of t_{DP} and t_{GTP} .

Table 5.4 MT8870 out put Truth

F Low	F High	Key	TOE	Q4	Q3	Q2	Q1
697	1209	1	1	0	0	0	1
697	1336	2	1	0	0	1	0
697	1477	3	1	0	0	1	1
770	1209	4	1	0	1	0	0
770	1336	5	1	0	1	0	1
770	1477	6	1	0	1	1	0
852	1209	7	1	0	1	1	1
852	1336	8	1	1	0	0	0
852	1477	9	1	1	0	0	1
841	1209	0	1	1	0	1	0
841	1336	*	1	1	0	1	1
841	1477	#	1	1	1	0	0
697	1633	A	1	1	1	0	1
770	1633	B	1	1	1	1	0
852	1633	C	1	1	1	1	1
941	1633	D	1	0	0	0	0
		ANY	0	Z	Z	Z	Z

0=LOGIC LOW 1= LOGIC HIGH Z= HIGH IMPEDANCE

Output truth table. Note that key "0" is output as "1010₂ (ie :10₁₀)"

Corresponding to standard telephony coding

5.3.3 Personal Computer Block:

The output Signal from the 8870 encoder is fed to the computer Via paellas port inputs .The Soft ware written to Complete the interface cycle dictates the Processor to make a sequential polling for the parallel port Controller to cheek it any signal is available to any of the input pins .The signal detected is handled by the micro-processes according to the subroutines written in the software . Corresponding signal is then sent via the output pins of the parallel port to the 743773 latch

5.3.4 Latching block:

The signal received from the parallel port of the personal computer must be latched to be available to the device to be controlled till a further change in the signal occurs. Different types of latches are available but the HD74LS373 octal D- type transparent latch will be use.

As discussed earlier this type of latch is suitable for driving high capacitive and low impedance loads. The output of the latch output pins follow the data input pins when the out put enable G is high; the truth table for the HD74LS373 latch is show below.

Table 5.6 Function Tables of HD74LS373.

Inputs			Outputs
Outputs Control	Enabled	D	Q
L	H	H	H
L	H	L	L
L	L	X	Q0
H	X	X	Z

When G high the previous value Q0 will appear on the output pin when the output control is high the output pins will go to a floating high impedance state.

5.3.5 Darlington pairs B lock

The output of the latch pins are fed to the input pins of the ULN 2001A Darlington pair chip. This is the ideal solution for the interface between the low logic circuitry and multiple peripheral power loads. The Logic Diagram of ULN 2001A shown in figure 5.4 below

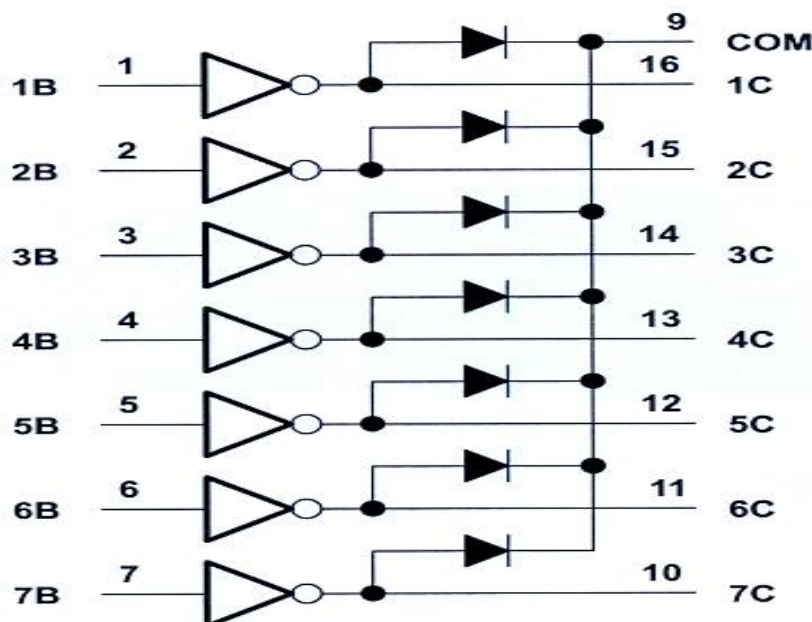


Figure 5.4 Logic Diagram of ULN 2001A

The electrical characteristics of ULN 2001A are shown in table 5.7 below.

The zener diode connected to the pin 9 of the ULN 2001A is used to absorb any reversed or back EMF generated from the magnetic field collapsing when stepper motor coils are switched off. (21)

The final output signal from the ULN 2001A is fed to the devices under control. The whole scenario is illustrated in figures 5.5.

Table 5.7 output characteristic of ULN 2001 A

PARAMETARS	TEST FIGURE	TEST CONDITIONS		ULN2001A			ULN2002A			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
VI (on) On-stage input voltage	8	$V_{CE}=2v$ $I_C=300mA$							13	V
VCE (sbt) Collector emitter station voltage	5	$I_I=250mA$ $I_C=100mA$			0.9	1.1		0.9	1.1	V
		$I_I=350\mu A$ $I_C=200mA$			1	1.3		1	1.3	V
		$I_I=500\mu A$ $I_C=300mA$			1.2	1.6		1.2	1.6	V
VF Class forward voltage	8	$I_f=350mA$			1.7	2		1.7	2	V
ICEX Collector cutoff circuit	1	$V_{CE}=50v$ $I_C=0$				50			50	μA
	2	$V_{CE}=50v$ $T_A=70\text{ C}$	$I_I=0$ $V_I=0$			100				μA
II (off) off state input current	3	$V_{CE}=2v$ $I_C=300mA$ $T_A=70C$							500	μA
II Input current	4	$V_I=17V$		50	65		50	65		μA
IR Clasp reverse current	7	$V_R=50\text{ V}$ $T_A=70\text{ C}$						0.82	1.25	mA
		$V_R=50\text{ V}$				100			100	μA
hFE Static forward-current transfer ratio	5	$V_{CE}=2V$ $I_C=350mA$		1000		50			50	μA
Ci Input cap aster		$V_I=0$ $F=1\text{ MHz}$			15	25		15	25	PF

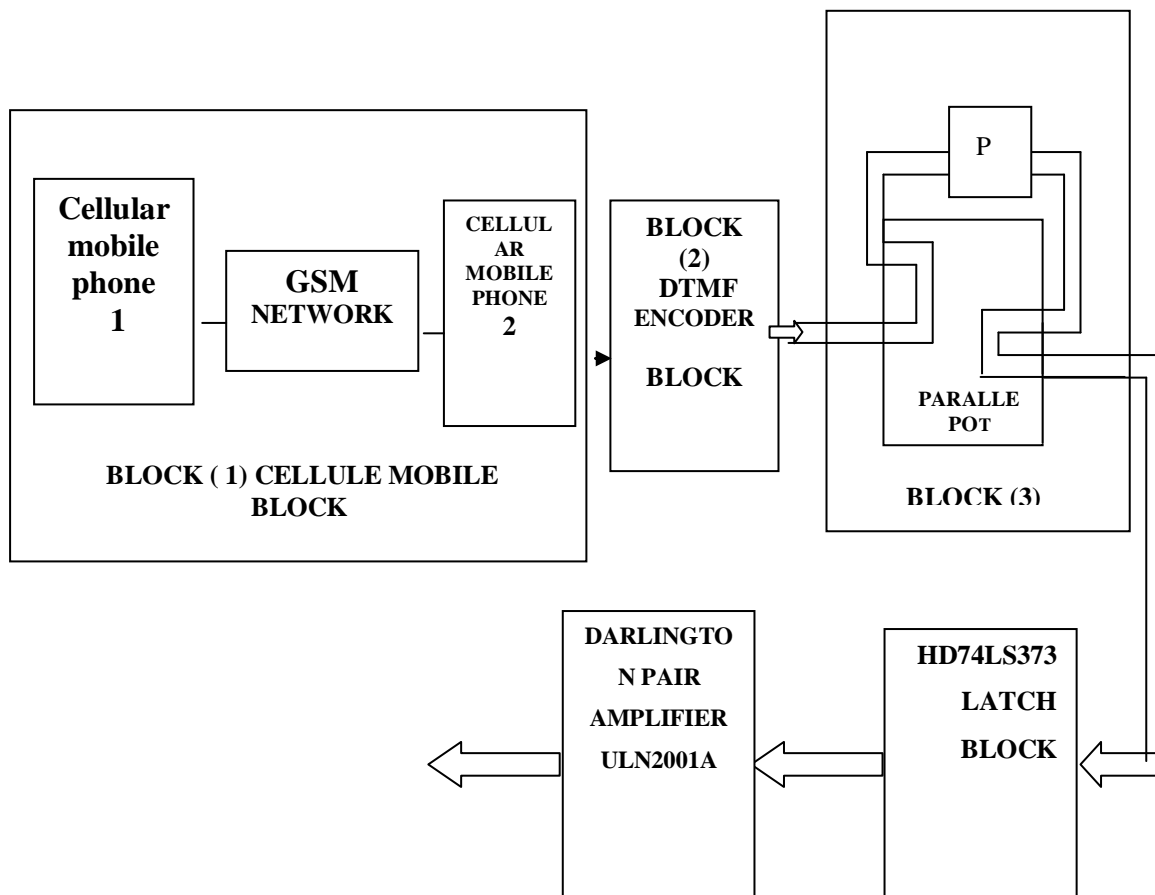


Figure 5.5 block diagram of the controller

CHAPTER SIX

CONTROL SOFTWARE

6.1 introductions:

In this chapter a brief explanation must be given for the software program which will use to operate the control circuit. Whenever there is any type of m based control there should be a software to guide hardware used and complete the interface process .

The software used here in is written in C++ programming language. This computer programming language is considered to be one the most powerful languages.

The program is first written using the C++ editor and then compiled through the C++ compiler. Finally, the program is run to start execution. In the coming few pages well introduce the flow chart which summarizes program algorithm then we are going to explain that algorithm by breaking the program in to small blocks finally , well give a complete discussion for each block .

6.2 Programming Concepts:

Almost all programming languages allow programmers to access parallel port using some library function. for example , Borland C is providing " Inportb " and " Outportb " languages or support to access parallel port directly , but it is possible to add such capabilities to our VB application by writing a all in VC++ and calling its exported functions from VB . VC++ provides two function to access IO mapped peripherals “_inp” for reading and “_outp” for writing these functions are declared in “conio. h”

There are a few major advantages to using C++

1.C++ allows expression of abstract ideas.

C++ is a third generation language that allows a programmer to express their ideas at a high level as compared to assembly languages.

2. C++ still allows a programmer to keep low – level control

Even though C++ is third generation language, it has some of the “feel “of an assembly language. It allows programmers to get down into the low – level working and tune as necessary. C++ allows programmers strict memory management.

3. C++ has national standards (ANSI):

C++ is language with national standards. This is good for many reasons. Code written in C++ that conforms to the national standards can be easily integrated with preexisting code. Also, this allows programmers to reuse certain common libraries, so certain common functions do need to be written more than once, and these functions behave the same anywhere they are used.

4. C++ is reusable and object – oriented.

C++ is an object – oriented language. This makes programming conceptually easier (once the object parading has been learned) and allows easy of code, or parts of code through inheritance.

5. C++ is widely used and taught

C++ is a very widely used programming language .Because of this there are many tools available for C++ programming and there is a broad base of programmers contributing community”.

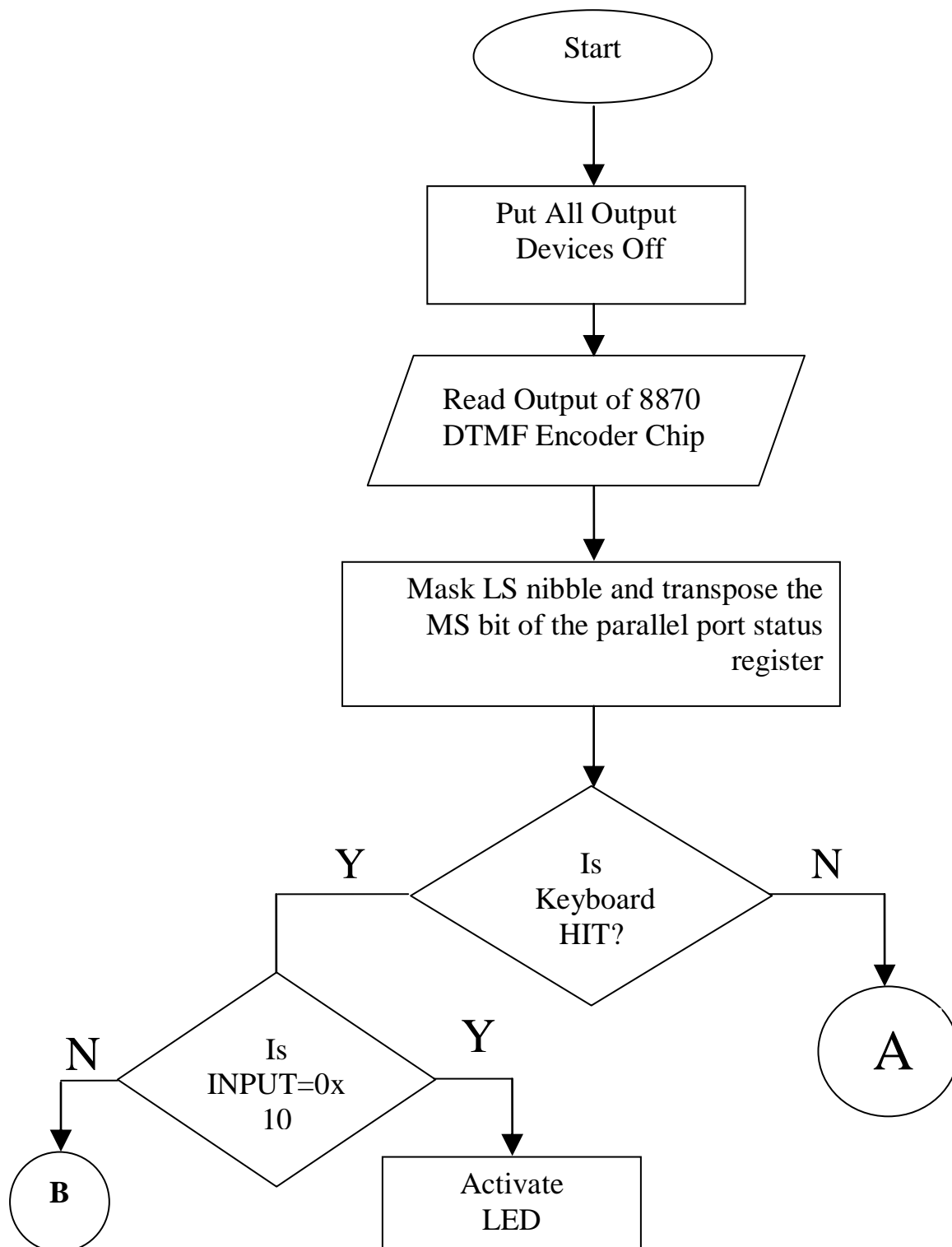
6.3 Program algorithm and flowchart

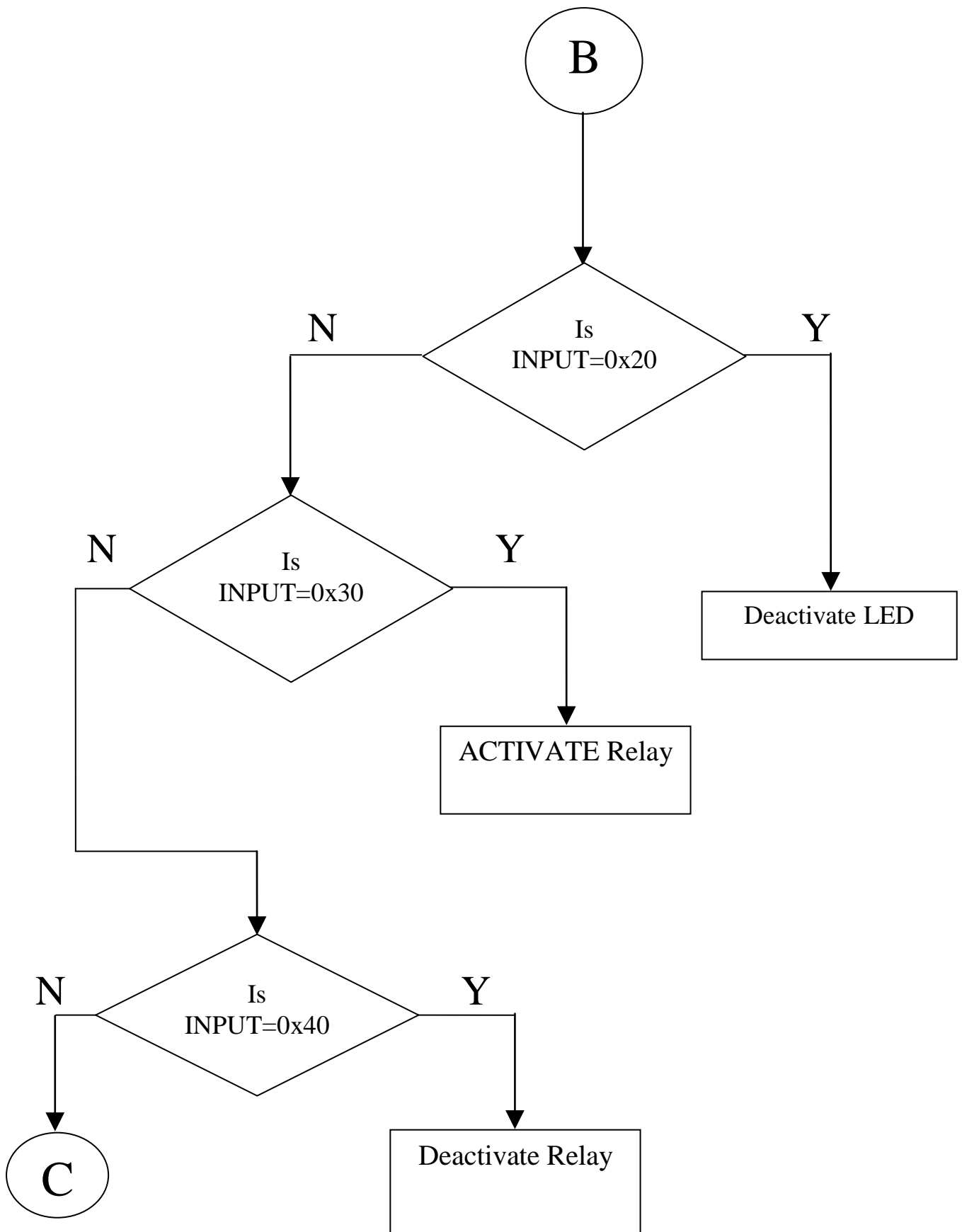
As mentioned above what trying to do is write software which dictates the CPU to stop in regular intervals to process the program to check now with every connected device, if an action of the CPU is required. Consequently, the program should perform the following tasks:

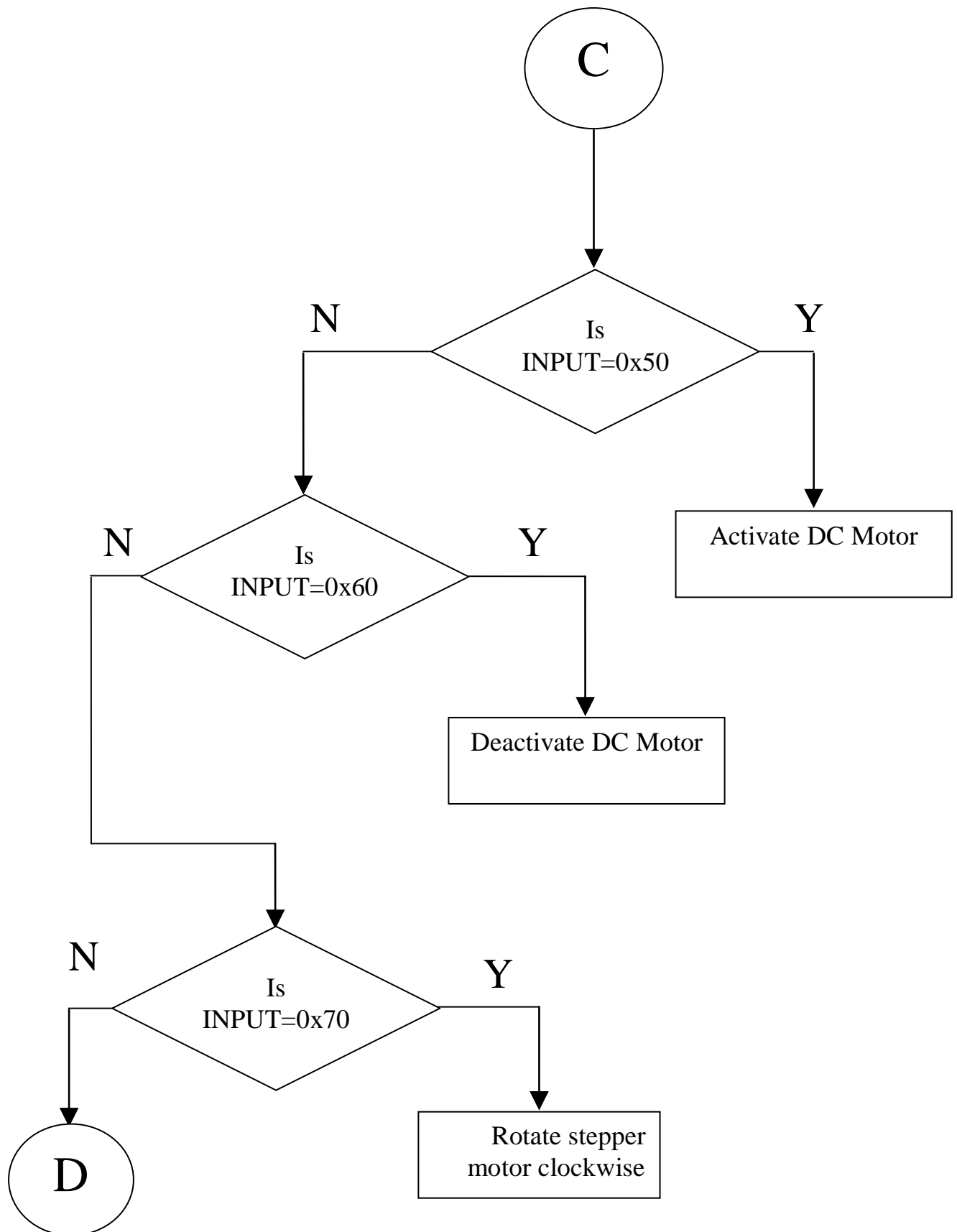
1. Put all the devices off
2. Read the output of the 8870DTMF encoder chip which is available at address (0x397) _H which ids the parallel port LPT 1

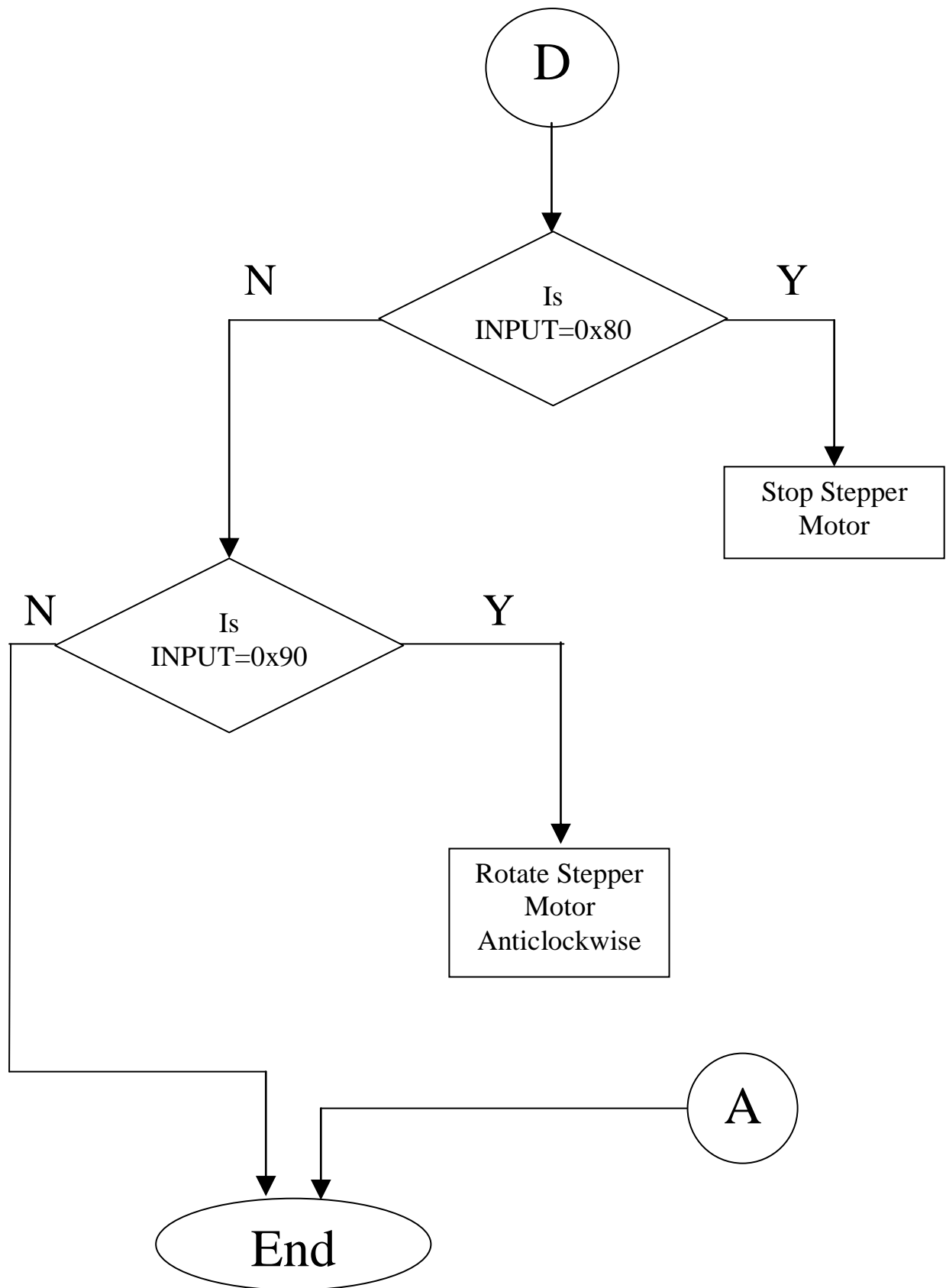
3. Mask the values available at LS nibble of the status register parallel port and invert the value available at LSB of the same register.
4. Check the values at the above mentioned pin and take an action accordingly.

The whole scenario is shown in the flowchart shown in the next pages blow.









6.4 Software:

The Software written as per the previously explained flowchart is available in the coming few pages. This software is written, and complied using the c++ editor and compiler.

```
# include < stdio.h >
# include < conio.h >
# include < dos.h >
Main ()
{
int x;

/* put all output devices off */
outport ( 0x378, 0x00 );
beg
/* read the output of (8870) */
X= inportb (0x379);

X= ( x& 0xf0);
X= ( x ^ 0x80);
/* check for ( Q1 ) */
if ( kbhit ()) goto finish;
if ( x== 0x10 ) goto q1; /* activate the LED */
if ( x== 0x20 ) goto q2; /* deactivate the LED */
if ( x== 0x30 ) goto q2q1; /* activate the relay */
if ( x== 0x40 ) goto q3; /* deactivate relay */
if ( x== 0x50 ) goto q3q1; /* activate the dc motor */
if ( x== 0x60 ) goto q3q2; /* deactivate the dc motor */
if(x== 0x70) goto q3q2q1; /* rotate the stepper motor clockwise */
```

```

If (x== 0x80) goto q4; /*stop the stepper motor */
If (x== 0x90) goto q4q1; /*rotate the stepper motor anticlockwise */
/* activate the LED */
q 1:
textmode (1) ;
gotoxy (10,10) ;
textcolor (WHITE + BLINK ) ;
textbackground (RED);
cprintf ( "LED is active \ n" ) ;

output (0x37a, 0x00);
output (0x278,0x10);
goto beg;

/*deactivate the LED*/
q 2:
textmode( 1);
gotoxy (10,10) ;
textcolor (WHITE + BLINK );
textbackground (GREEN);
cprintf ("deactive the LED / n" );

outportb (0x37a,0x00);
outputb (0x378,0x00);
goto beg :

/* activate the relay*/
q 2q1;

```

```

textcolor (1) ;
gotoxy(10,10)
textcolor (WHITE + BLINK) ;
textbackground (RED);
cprintf ("the relay is active\ n ") ;

outportb (0x37a,0x00);
outportb (0x378,0x20);
goto beg;

/* deactivate the relay */
q 3:
textmode (1) ;
gotoxy(10,10)
textcolor (WHITE + BLINK ) ;
textbackground ( RED ) ;
cprintf ("the relay is not active / n ") ;

outportb ( 0x37a,0x00);
outportb ( 0x378,0x00);
goto beg;

/*activate the dc motor*/
q3q1:
text mode (1) ;
gotoxy(10,10)
textcolor(WHITE + BLINK ) ;
textback ground ( RED ) ;
cprintf ("the dc motor is active/ n ") ;

```

```

outportb (0x37a,0x00)؛
outportb (0x378,0x040)؛
goto beg؛
delay (1000)؛

/*deactivate the dc motor*/
q3q2:
text mode (1) ؛
gotoxy(10,10);
textcolor(WHITE + BLINK ) ؛
textback ground ( RED ) ؛
cprintf (“the dc motor is not active/ n “) ؛
outportb ( 0x37a,0x00)؛
outportb ( 0x378,0x00)؛
goto beg؛

/* rotate the stepper motor clockwise */
q3q2q1:
text mode (1) ؛
gotoxy(10,10);
textcolor(WHITE + BLINK) ؛
textbackground (RED) ؛
cprintf (“the stepper motor rotate clockwise / n “ ) ؛

outportb (0x37a,0x00)؛
outportb (0x378,0x01)؛
delay (1000)؛

outportb (0x378,0x02)؛

```

```
delay (1000)؛
```

```
outportb (0x378,0x04)؛
```

```
delay (1000)؛
```

```
outportb ( 0x378,0x08)؛
```

```
delay (1000)؛
```

```
goto beg؛
```

```
/* stop the stepper motor */
```

```
q 4:
```

```
textmode (1) ؛
```

```
gotoxy(10,10)
```

```
textcolor(WHITE + BLINK ) ؛
```

```
textbackground (RED) ؛
```

```
cprintf (“stepper motor is off / n “ ) ؛
```

```
outportb (0x37a,0x00)؛
```

```
outportb (0x378,0x010)؛
```

```
goto beg ؛
```

```
/* rotate the stepper motor anticlockwise */
```

```
q 4q1
```

```
textmode (1) ؛
```

```
gotoxy(5,10)
```

```
textcolor(WHITE + BLINK ) ؛
```

```
textbackground (RED) ؛
```

```
cprintf (“stepper motor rotates anticlockwise / n ”) ؛
```

```
outportb(0x37a,0x00);  
outportb(0x378,0x08);  
delay(1000);
```

```
outputb(0x378,0x04);  
delay (1000);
```

```
outportb(0x378,0x02);  
delay(1000);
```

```
outportb(0x378,0x01);  
delay(1000);  
goto beg ;
```

```
finish :  
    getch();  
    return(0);  
}
```

CHAPTER SEVEN

Conclusion and recommendation

7.1 The PID Controller

A feedback controller is designed to generate an output that causes some corrective effort to be applied to a process so as to drive a measurable process variable, $y(t)$, towards a desired value, known as the set-point or reference, here noted $r(t)$. The concept is based, as shown in figure 7.1, on the re-input of the system own output according to certain laws (hence the name feedback'). It is desired for the systems output to follow the reference $r(t)$. All feedback controllers determine their output by observing the difference, called error, here noted $e(t)$, between the step point and the actual process variable measurement. This theory is valid for a wide class of systems, which include, but is not restricted to, linear systems.

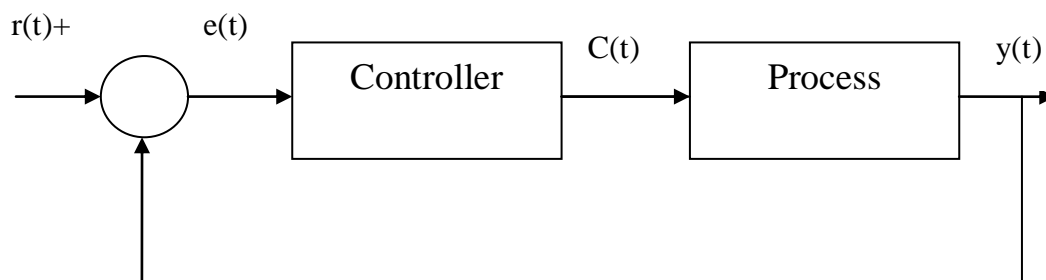


Figure (7.1) feed back control system

For the class of the linear systems, a very widely used controller is the PID (Proportional Integral Derferential).The PID looks at (a) the current value of the error, (b) the integral of the error over a recent time interval, and (c) the current derivative of the error signal to determine not only how much of a correction to apply, but for how long. Each of those three quantities are multiplied by a 'tuning constant' and added together. Thus the PID output, $c(t)$, is a weighted sum as shown in figure 7. 2:

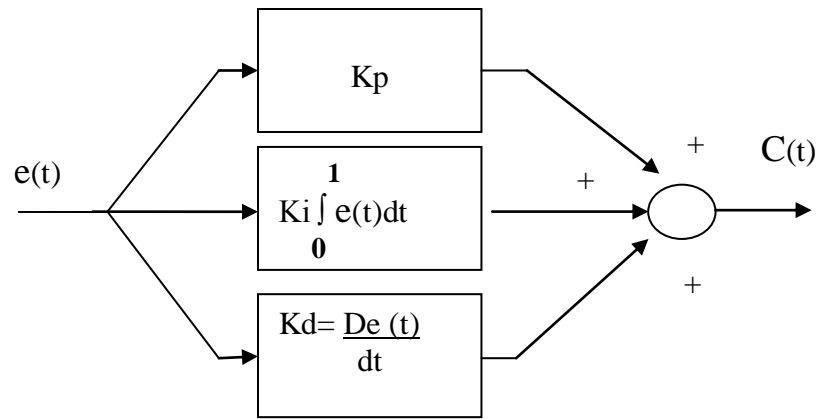


Figure 7.2 PID Controller

Depending on the application one may want a faster convergence speed or a lower overshoot. By Adjusting the weighting constants, k_p , k_i and k_d , the PID is set to give the most desired performance.

7.2 The Digital PID Controller

As explained so far, time continuous main and analog variables considered. Today, digital controllers are being used in many large and small-scale control systems, replacing the analog controller.

It is now a common practice to implement PID controllers in its digital version, which means that they operate in discrete time domain and deal with analog signals quantized in a limited number of levels.

The trend toward digital rather than analog controls mainly due to the availability of low-cost digital computers. A digital version of the PID controller is shown in figures 7.3:

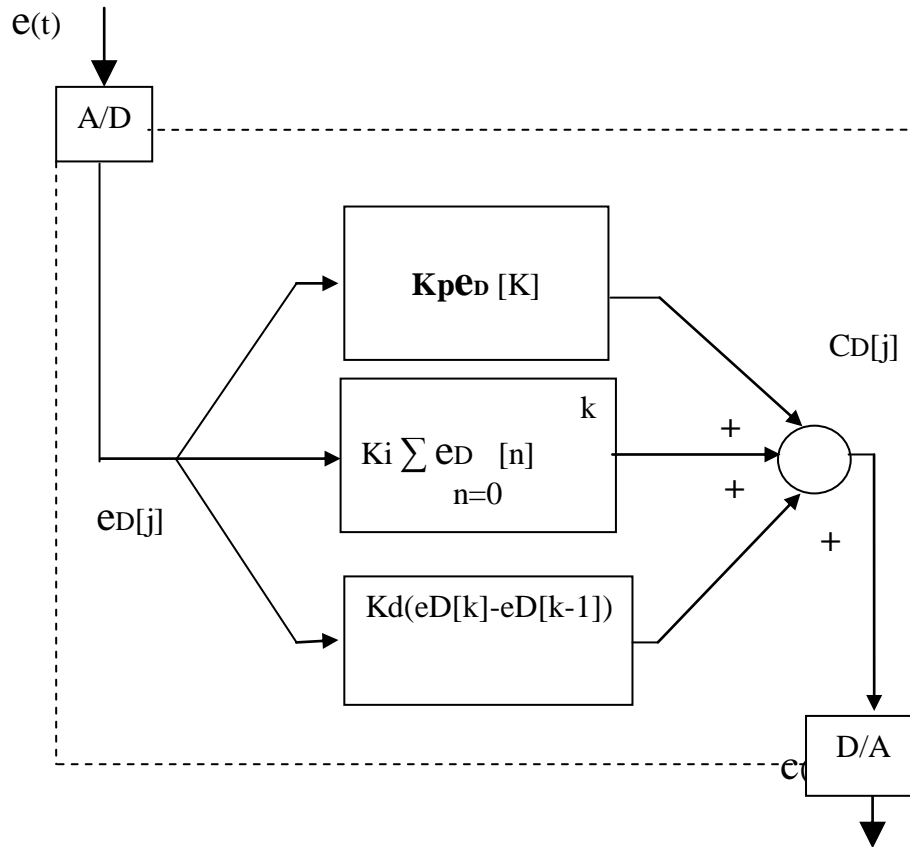


Figure 7.3 Digital PID controllers

In its digital version, the integral becomes a sum and the deferential become deference. The continuous time signal (t) is sampled in fixed time intervals equals determined sample period, here called T_c (in figure $T_c = 1$). An *A/D* (analog to digital) converter interfaces the input and a *D/A* (digital to analog) converter interfaces the output. This sampled and digitalized input, called $eD[j]$, exists only in time instants $t = kT_c$ for all $k \geq 0$. It is assumed that these digital values are processed instantly and the result is posted immediately, which obviously is not true. Even if it is possible to deliver the results faster from time to time it is most desirable to maintain a fixed and rigid sample period.

Then it is desirable for the controller (a) to have the sample period T_c as small as possible and (b) to have many levels of quantization as possible. A lower bound for the sample period is the

computing time of whole cycle of the digital PID (Which includes the A/D and D/A conversion). In most practical situations Noise filtering may imply another lower bound for the sampling period. The number of levels of quantization of the input and output analog variables will depend on the resolution of the A/D and D/ A converters respectively.

7.3 Interface.

There are special-purpose, multi-purpose, and general-purpose interfaces. The keyboard, sound card, mouse, etc. Connectors represent the special-purpose interfaces. They cannot be used for any other device.

The parallel port (printer port), serial port, universal serial bus (USB), and IEEE 1394 FireWire represent multi-purpose interfaces since they can be used for various peripheral devices, including data storage devices.

The slots on the motherboard, such as PCI and ISA slots, can be used to connect various devices (via the plug-in cards) and represent truly general-purpose interfaces.

A basic definition of an interface is a hardware and / or software data transmission regulator that controls data exchange between the PC and other devices, including such data storage devices as hard disk drives, floppy drives, tape drives, CD drives, DVD drives, etc. The interface is supported by the electronics of the data transfer controller and the drive electronics. There are standards adopted for the interface protocols allowing connection of any standard peripheral device.

7.3.1 Interface Choices Summary

- Parallel: Set up is easy. External. Slow.
- USB: Set up is very easy. Good performer. Hot swappable.
Requires Windows 98 and higher.
- IDE. Set up is moderately difficult. Requires opening your PC and connecting some cables inside.

Performance is much better than parallel- or USB-devices.

- IEEE 1394 FireWire: Set up is easy. Excellent performer. Costly.
Requires Windows 98 and higher.
- SCSI: Set up is even more difficult than for IDE. Best performer.
Best when multiple devices are used. Generally needs a separate SCSI card.
- PC Card: Set up is easy. Good performance. For notebook use only.

7.4 observations and results

Observations and results be see in the truth table in next page.

By look at that table notice the following:

- 1.The output of Q1 , Q2 and Q3 of the DTMF Encoder appear exactly the same at bits S4 , S5 and S6 of the status register of the parallel port controller . The output of Q4 of the DTMF Encode appears inverted at S7 of the status register of the parallel port controller.
- 2.The values at the 8 bits the Date Register of the parallel port controller depend on the value of the integer X as calculated by the software program
- 3.The values shown as X1,X2,X3and X4 at the LSB s of the Date Register are a gain the values of the in this integer X as calculated by the software program but the are variables in this case to allow the stepper motor to rotate for equal intervals of time . When key 7 of the keyboard is pressed these values take sequence that allows the stepper motor to rotate in a clockwise direction when key 9 of the keyboard is pressed these values take a sequence that allows the stepper motor to rotate in anticlockwise direction
4. The C0 bit of the control register if the parallel port controller is assigned a value that makes its output to be 1. The output of C0 is connected to the latch Enable pin of the HD74LS373 Latch This allows the values which are at the inputs of the latch to appear at outputs of the latch.
5. The values at the output of the date register of the parallel port controller appear at the output of the latch and again at the output pins of the ULN2001A Darlington pair array. And these same values are fed to the systems and devices to be controlled

Table 7.1 Output true table of different stage of the control circuit

Cellular			DTmf encoder					ULN 2001A Darlington pair							
Low	High	Key	TOE	Q4	Q3	Q2	Q1	C7	C6	C5	C4	C3	C2	C1	
697	1209	1	1	0	0	0	1	0	0	1	0	0	0	0	
697	1336	2	1	0	0	1	0	0	0	0	0	0	0	0	
697	1477	3	1	0	0	1	1	0	1	0	0	0	0	0	
770	1209	4	1	0	1	0	0	0	0	0	0	0	0	0	
770	1336	5	1	0	1	01	1	1	0	0	0	0	0	0	
770	1477	6	1	0	1	1	0	0	0	0	0	0	0	0	
852	1209	7	1	0	1	0	1	0	0	0	X1	X2	X3	X4	
852	1336	8	1	1	0	0	0	0	0	0	0	0	0	0	
852	1477	9	1	1	0	1	1	0	0	0	X4	X3	X2	X1	
841	1209	0	1	1	0	1	0	0	1	0	0	0	0	0	
841	1336	*	1	1	0	0	1	0	1	1	0	0	0	0	
841	1477	#	1	1	1	0	0	1	0	1	0	0	0	0	
697	1633	A	1	1	1	1	1	1	0	0	0	0	0	0	
770	1633	B	1	1	1	1	0	1	1	0	0	0	0	0	
852	1633	C	1	1	1	1	1	1	1	1	0	0	0	0	
941	1933	D	1	0	0	0	0	0	0	0	0	0	0	0	
-	-	ANY	0	Z	Z	Z	Z	Z	Z	Z	0	0	0	0	

7.5 Recommendations

In these both open loop and closed loop control were discussed theoretically though, when the practical implementation made only open loop control was illustrated for further studies so it recommended the following:

1. Expanding the circuit capabilities so that closed loop prototyping is included this can be done adding some sensor to give a feed back signal which can be compared to set point and consequently an action is taken as per the software written
2. Expanding the circuit capabilities so that other types of remote control application can be used by suggest using the LAN, WAN or even the internet to access our control circuit. This can help to give better flexibility and better implementation.
3. By suggest making a compact circuit but based on a microcontroller rather than the general purpose microprocessor so it recommend using 8051 micron roller chip which is manufactured by the famous electronic company Intel
4. Suggesting adding monitoring capabilities to the circuit. this can be done by simply adding some special sensors and different types of monitor like the 7- segment displays LCD's or even flat screen monitors .
5. Also, recommend designing the circuit for a specific real time application rather than making it general purpose circuit. A patient monitoring system with some control capabilities might be a very efficient example for illustration.
6. also control adding the possibility of activating our system by voice using an IC voice direct 364 which is an IC which can recognize up to 15 phrases . Accurate this might be helpful in a vast of applications

specially when there is a problem in using hands or there a difficulty in interacting with the keyboard.

REFERENCES

1. Ramesh S.Gaonker, Microprocessor Architecture, programming and Applications with the 8085 ,, prentice – Hall inc ,, 1996.
2. Thomas L.Folyd Digital Fundamentals, Prentice– Hall International 2000.
3. Stuast Asser, Vincent Stigliano Richard Bahrenburg. Microcomputer servicing publishing company 1990.
4. M.Morris Mano, Computer system architecture prentice – Hall international 1993.
5. Mohamed Rafiquzzman ,, Microprocessor and Microcomputer Based system Design mm universal book stall 1990
6. Malvino Brown ,,Digital computer electronics ,, Mitchell mc grown – hill book company 1999.
7. barry b brey the Intel microprocessor 8086 / 8088, 80 186 /80188 .80286 80386.80486 Pentium and Pentium and Pentium pro processor architecture programming and interfacing ,, prentice – hall of India private limited 2000
8. M.Morris Mano ,,, Digital Design prentice – hall international 1999
9. Rodney Zaks , Austin lesea ,, microprocessor interfacing
10. Hans-petterMessmer, the indespensablePC Hard wareBook, Addison Weasly puplushing Cumpany,1995.
11. The TTL logic data book Dallas: TEXAS INSTRUMENT INCORPURATED, 1998.
12. Hans-peter Mesmer. the Indispensable PC hardware book, Addison-Wesley purplish company,1995.a
13. William Stlling, computer Organization and architecture Design for performance, prentice Hall.1999.
14. M.Gopal. Digital control engineer (1988).

15. Curtis D.johanson, Micro-processor based process control (1984).
16. George j. Thaler, Automatic control system (1989)
17. M.Gopal, Modren control system theory (1987).
18. Darell Williamson, Digital control and implementation (1991).
19. Conistantine H.Houpis Gar y B.Lamot, Digital control system (1992)
20. Gerald Val and, control system modeling and analysis (1986).
21. <http://www.chipcatalog.com>
22. <http://outworld.compuserve.com>
23. <http://dolphin.wnin.ac.uk>
- 24 <http://www.electronic-oems.com>
25. <http://www.jhu.edu>
26. <http://loren.dui.upm.es>
27. <http://www.gamesx.coml>
28. <http://en.wikipendia.org>
29. <http://www.logix4u.net>
30. <http://www.epanorama.net>
31. <http://dcwww.camp.dtu.dk>
32. <http://www.eeci.com>
33. <http://user.pandor.be>
34. <http://hem.passager.se>
35. <http://www.aplac.com>
36. <http://www.chm.bri.c.uk>
37. <http://www.pcguide.com>
38. Osman Al-Agha and other, industrial standard PID controller using 8751 Microcontroller (1996).
39. Nahal Mohammed, study and design of direct Memory access controller (2003).
40. Hind Osman, study and design address Decoding techniques for microprocessor Based system. (2003).