MICROCONTROLLER BASED DRUG INFUSION SYSTEM

A PROJECT REPORT

Submitted by

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BONAFIDE CERTIFICATE

Certified that this project report titled **"MICROCONTROLLER BASED DRUG INFUSION SYSTEM"** is the bonafide work of

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Internal Examiner   External Examiner

ACKNOWLEDGEMENT

ACKNOWLEDGEMENT

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We are highly grateful to our beloved Project Coordinator, **Mr. S. Arun Jayakar**, Assistant Professor.

Project Guide, **Mrs. S.A. Nirmala**, Assistant Professor, Electronics and Instrumentation Engineering Department for their valuable guidance, timely help, constant encouragement and advice rendered throughout the project period for the successful completion of the same.

We are grateful to all the faculty members of the Department of Electronics and Instrumentation Engineering who have helped us innumerable ways.

We also thank our parents without whom we could not have come so far and friends for their timely help enabled us to successfully complete our project.

DEDICATED TO

OUR PARENTS

ABSTRACT

LIST OF TABLES

ABSTRACT

The main aim of our project is to monitor and control the amount of drug infused into the patient.It also contains an extra feature of monitoring the temperature of the patient.The drug can be infused in mL/min.The main concern in our project is volume to be infused and not the rate.The reliable functioning of such a type of infusion system depends on the accurate no. of drops infused into the patient.It also features various alarms so as to attract the attention of the operator in case of any malfunction.

These systems are used in hospitals for fluid therapy and for dehydration for paediatric patients.LabVIEW interfaces with the system, so that various infusion systems in a defined region can be monitored and controlled from a single control room.

LIST OF FIGURES

ACRONYMS & ABBREVIATIONS

LCD	-	Liquid Crystal Display
CMOS	-	Complementary Metal Oxide Semiconductor
LED	-	Light Emitting Diode
TX/RX	-	Transmitter / Receiver
RISC	-	Reduced Instruction Set Computer
TTL	-	Transistor Transistor Logic
IE	-	Interrupt Enable
PIC	-	Peripheral Interface Controller
EEPROM	-	Electrically Erasable Programmable Read Only Memory
POR	-	Power-On Reset
PWRT	-	Power-On Timer
OST	-	Oscillator Start-up Timer
WDT	-	Watch Dog Timer
ICSP	-	In Circuit Serial Programming
SSP	-	Synchronous Serial Port.

TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION

1.1 OBJECTIVE:

The main objective of our project is to monitor and control the amount of drug infused into the patient.It also contains extra feature of monitoring the temperature of the patient.The drug can be infused in mL/min.The main concern in our project is volume to be infused and not the rate.The reliable functioning of such a type of infusion system depends on the accurate no. of drops infused into the patient.It also features various alarms so as to attract the attention of the operator in case of any malfunction.

These systems are used in hospitals for fluid therapy and for dehydration for paediatric patients.LabVIEW interfaces with the system, so that various infusion systems in a defined region can be monitored and controlled from a single control room.

1.2 CASE STUDY:

Sri Ramakrishna Hospital

Coimbatore

Tamil Nadu.

0422 4500000

We started our project by studying the different models of drug infusion systems available in the market. To get a first hand information and feedback about them we visited Sri Ramakrishna Hospital focusing on the Intensive Care Unit. The doctors and the nurses as well as the bio-medical staff were very helpful and we were able to get some valuable information from them.

One thing all of them mentioned was the problem of not having a single server or system to monitor the entire drug infusion systems in the ICU. If this is achieved, it could be taken further by integrating temperature, heart rate, blood pressure etc.

The doctors also mentioned the lack of a proper alarm system in the cheaper versions of the drug infusion systems. The cheaper models also did not have any methods of varying the flow for different fluids due to the lack of proper interfacing.

We set out to design and implement a prototype of a drug infusion system which has a proper interfacing and also is quite economical to manufacture and could be afforded by hospital and medical centres which could not afford the expensive imported models.

1.3 FLOWCHART DEPICTING PROJECT FLOW:

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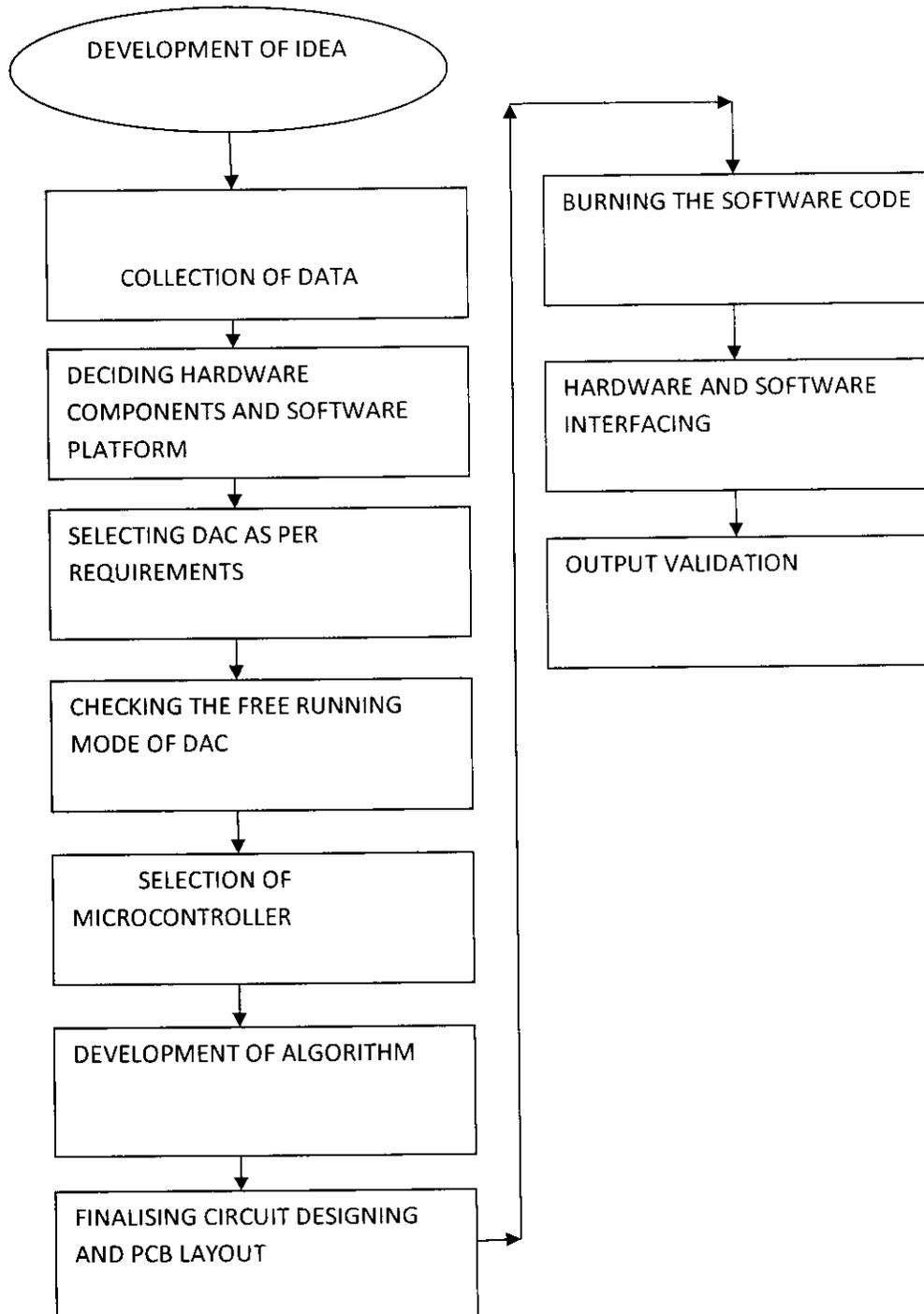
CHAPTER 2

METHODOLOGY

2.1 BLOCK DIAGRAM:

The block diagram of our project as shown has been put together in a simple manner to illustrate clearly the various components and the order in which they are to be placed in the original system.

Fig 2.1 shows general block diagram of drug infusion system

1. Drug container
2. IR transmitter and receiver
3. Signal conditioning unit
4. DAC
5. DC pump

6. PC (labVIEW)
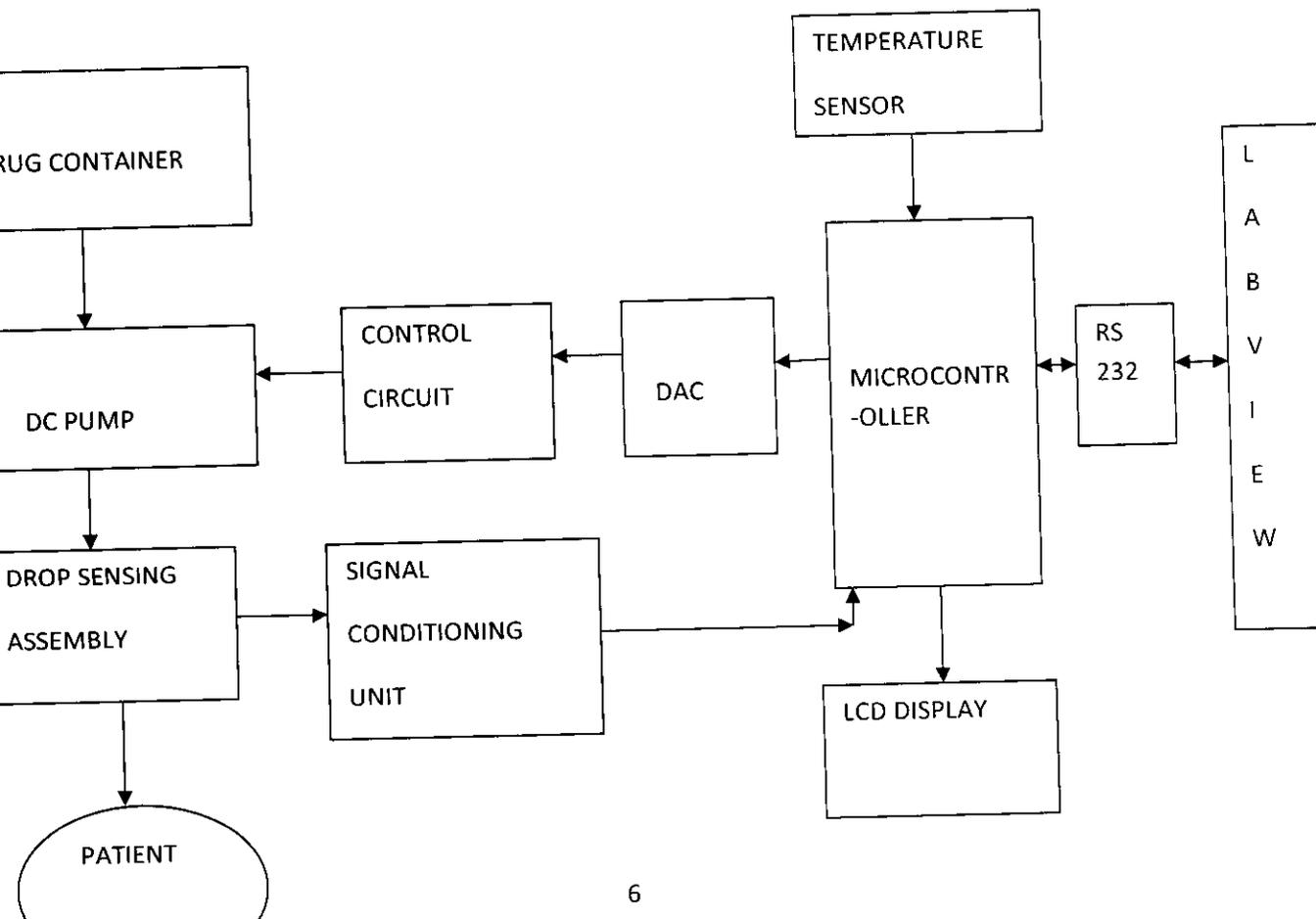
2.2 SENSORS:

2.2.1 Basic IR sensor :

Infrared transmitter is one type of LED which emits infrared rays generally called as IR Transmitter. Similarly IR Receiver is used to receive the IR rays transmitted by the IR transmitter. One important point is both IR transmitter and receiver should be placed straight line to each other.

2.2.2 FEATURES:

• Wavelength= 880 nm
• Chip material = AlGaAs
• Package type: T-1 3/4 (5mm lens diameter)
• Matched Photosensor: QSD122/123/124
• Medium Wide Emission Angle, 40°
• High Output Power

## 2.2.3 CIRCUIT DIAGRAM OF IR SENSOR:

:
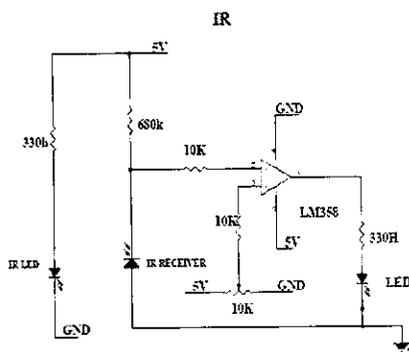
The transmitted signal is given to IR transmitter whenever the signal is high, the IR transmitter LED is conducting it passes the IR rays to the receiver. The IR receiver is connected with comparator. The comparator is constructed with LM 358 operational amplifier. In the comparator circuit the reference voltage is given to inverting input terminal. The non inverting input terminal is connected IR receiver. When interrupt the IR rays between the IR transmitter and receiver, the IR receiver is not conducting. So the comparator non inverting input terminal voltage is higher then inverting input. Now the comparator output is in the range of +5V. This voltage is given to microcontroller or PC and so LED will glow.

When IR transmitter passes the rays to receiver, the IR receiver is conducting due to that non inverting input voltage is lower than inverting input. Now the comparator output is GND so the output is given to microcontroller or PC. This circuit is mainly used to for counting application, intruder detector etc.

2.3 TEMPERATURE SENSOR:

2.3.1 THERMISTOR:
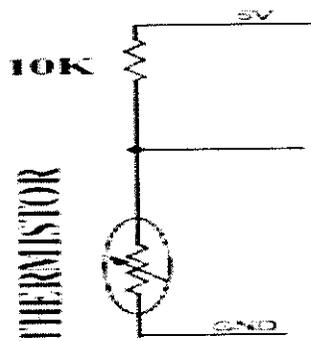
A **thermistor** is a type of resistor used to measure temperature changes, relying on the change in its resistance with changing temperature. Thermistor is a combination of the words thermal and resistor. The Thermistor was first invented by Samuel Ruben in 1930, and has U.S. Patent #2,021,491.

If we assume that the relationship between resistance and temperature is linear (i.e. we make a first-order approximation), then we can say that:

$$\Delta R = k\Delta T$$

Where

ΔR = change in resistance

ΔT = change in temperature

k = first-order temperature coefficient of resistance

Thermistors can be classified into two types depending on the sign of k. If k is positive, the resistance increases with increasing temperature, and the device is called a positive temperature coefficient (**PTC**) thermistor, **Posistor**. If k is negative, the resistance decreases with increasing temperature, and the device is called a negative temperature coefficient (**NTC**) thermistor. Resistors that are not thermistors are designed to have the smallest possible k, so that their resistance remains almost constant over a wide temperature range.

THERMISTOR

LM324

LM324

LM324

LM324

10
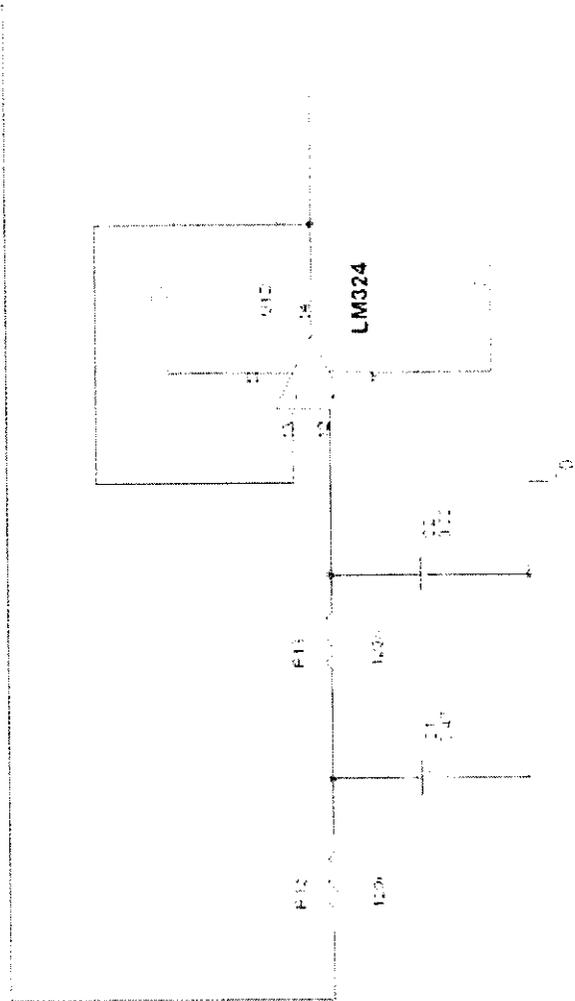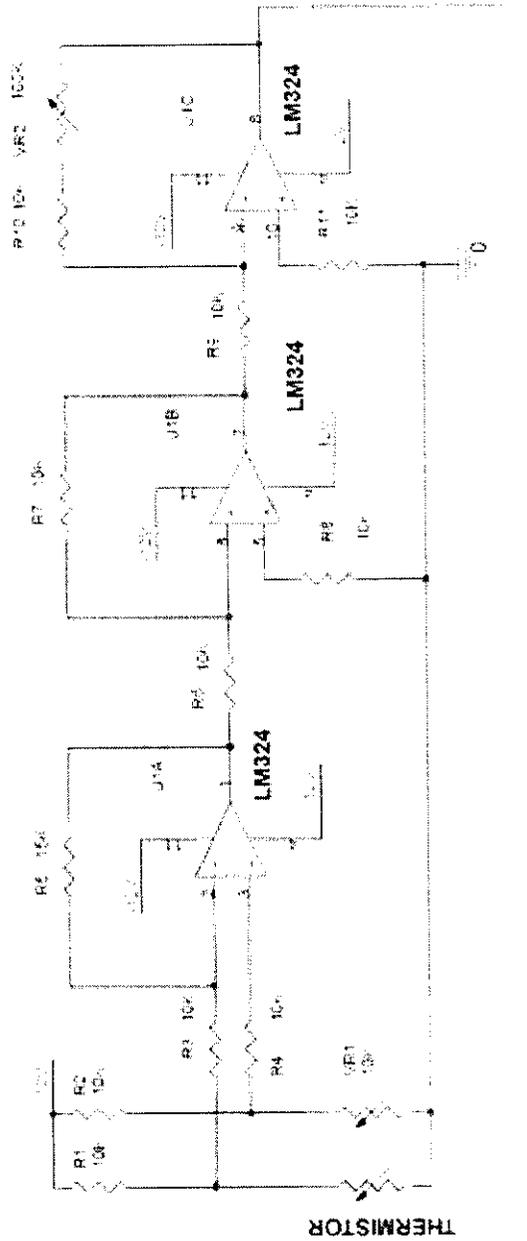
2.3.2 CIRCUIT DESCRIPTION:

In this circuit the thermistor is used to measure the temperature. Thermistor is temperature sensitive resistor. There are two type of thermistor available such as positive temperature co-efficient and negative temperature co-efficient. Here we are using negative temperature co-efficient in which the resistance value is decreased when the temperature is increased.

Here the thermistor is connected with resister bridge network. The bridge terminals are connected to inverting and non-inverting input terminals of comparator. The comparator is constructed by LM 324 operational amplifier.

The LM 324 consist of four independent, high gains, internally frequency compensated operational amplifier which were designed specifically to operate from a single power supply over a wide voltage range.

The first stage is a comparator in which the variable voltage due to thermistor is given to inverting input terminal and reference voltage is given to non-inverting input terminal.

Initially the reference voltage is set to room temperature level so the output of the comparator is zero. When the temperature is increased above the room temperature level, the thermistor resistance is decreased so variable voltage is given to comparator. Now the comparator delivered the error voltage at the output. Then the error voltage is given to next stage of preamplifier. Here the input error voltage is amplified then the amplified voltage is given to next stage of gain amplifier. In this amplifier the variable resistor is connected as feedback resistor. The feedback resistor is adjusted to get desired gain. Then the AC components in the output are filtered with the help of capacitors. Then output voltage is given to

final stage of DC voltage follower through this the output voltage is given to ADC
or other circuit.

CHAPTER 3

COMPONENTS DESCRIPTION

3.1 DC PUMP:
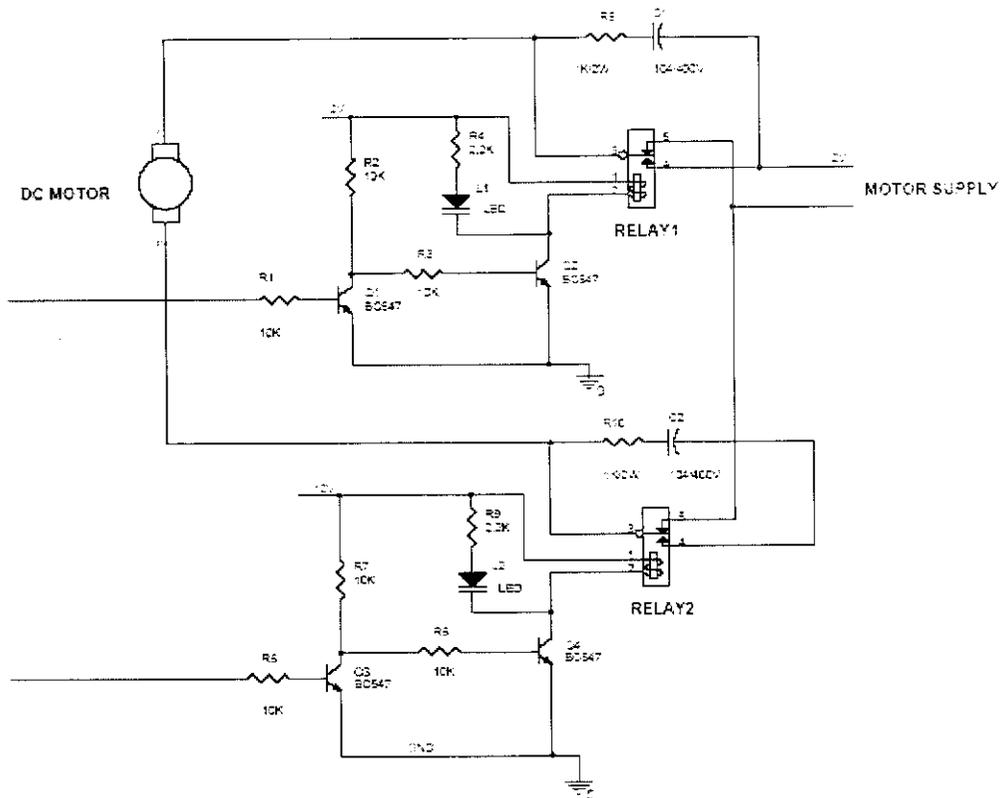
3.1.1 CIRCUIT DESCRIPTION:

This circuit is designed to control the motor in the forward and reverse direction. It consists of two relays named as relay1, relay2. The relay ON and OFF is controlled by the pair of switching transistors. A Relay is nothing but electromagnetic switching device which consists of three pins. They are Common, Normally close (NC) and normally open (NO). The common pin of two relay is connected to positive and negative terminal of motor through snubber circuit respectively. The relays are connected in the collector terminal of the transistors T2 and T4.

When high pulse signal is given to either base of the T1 or T3 transistors, the transistor is conducting and shorts the collector and emitter terminal and zero signals is given to base of the T2 or T4 transistor. So the relay is turned OFF state.

When low pulse is given to either base of transistor T1 or T3 transistor, the transistor is turned OFF. Now 12v is given to base of T2 or T4 transistor so the transistor is conducting and relay is turn ON. The NO and NC pins of two relays are interconnected so only one relay can be operated at a time.

The series combination of resistor and capacitor is called as snubber circuit. When the relay is turn ON and turn OFF continuously, the back emf may fault the relays. So the back emf is grounded through the snubber circuit.

- ➢ When relay 1 is in the ON state and relay 2 is in the OFF state, the motor is running in the forward direction.
- ➢ When relay 2 is in the ON state and relay 1 is in the OFF state, the motor is running in the reverse direction.

3.2 MICROCONTROLLER:

3.2.1 INTRODUCTION

A microcontroller is a complete microprocessor system built on a single IC. Microcontrollers were developed to meet the need for microprocessors to be put into low cost products. Building a complete microprocessor system on a single chip substantially reduces the cost of building simple products, which use the microprocessor's power to implement their function, because the microprocessor is a natural way to implement many products. This means the idea of using a microprocessor for low cost products comes up often. But the typical 8-bit microprocessor based system, such as one using a Z80 and 8085 is expensive. Both 8085 and Z80 system need some additional circuits to make a microprocessor system. Each part carries costs of money. Even though a product design may require only very simple system, the parts needed to make this system as a low cost product.

To solve this problem microprocessor system is implemented with a single chip microcontroller. This could be called microcomputer, as all the major parts are in the IC. Most frequently they are called microcontroller because they are used to perform control functions.

The microcontroller contains full implementation of a standard MICROPROCESSOR, ROM, RAM, I/0, CLOCK, TIMERS, and also SERIAL PORTS. Microcontroller also called "system on a chip" or "single chip microprocessor system" or "computer on a chip".

3.2.2 PIC MICROCONTROLLER

The microcontroller that has been used for this project is from PIC series. PIC microcontroller is the first RISC based microcontroller fabricated in CMOS (complimentary metal oxide semiconductor) that uses separate bus for instruction and data allowing simultaneous access of program and data memory.

The main advantage of CMOS and RISC combination is low power consumption resulting in a very small chip size with a small pin count. The main advantage of CMOS is that it has immunity to noise than other fabrication techniques.

Various microcontrollers offer different kinds of memories. EEPROM, EPROM, FLASH etc. are some of the memories of which FLASH is the most recently developed. Technology that is used in pic16F877 is flash technology, so that data is retained even when the power is switched off. Easy Programming and Erasing are other features of PIC 16F877.

3.2.3 CORE FEATURES

- High-performance RISC CPU

- Only 35 single word instructions to learn

- All single cycle instructions except for program branches which are two cycle

- Operating speed: DC – 20 MHz clock input

    DC – 200 ns instruction cycle

- In-Circuit Debugging via two pins

- Processor read/write access to program memory

- Wide operating voltage range: 2.5V to 5.5V

- High Sink/Source Current: 25 mA

- Commercial and Industrial temperature ranges

- Low-power consumption

3.2.4 PERIPHERAL FEATURES

- Timer0: 8-bit timer/counter with 8-bit prescaler

- Timer1: 16-bit timer/counter with prescaler, can be incremented during sleep

- Timer2: 8-bit timer/counter with 8-bit period register, prescaler and postscaler

- Two Capture, Compare, PWM modules

     Capture is 16-bit, max resolution is 12.5 ns,

     Compare is 16-bit, max resolution is 200 ns,

     PWM max. Resolution is 10-bit

- Up to 8\K x 14 words of Flash Program Memory,

  Up to 368 x 8 bytes of Data Memory (RAM)

  Up to 256 x 8 bytes of EEPROM data memory

- Pin out compatible to the PIC16C73/74/76/77

- Interrupt capability (up to 14 internal/external

- Eight level deep hardware stack

- Direct, indirect, and relative addressing modes

- Power-on Reset (POR)

- Power-up Timer (PWRT) and Oscillator Start-up Timer (OST)

- Watchdog Timer (WDT) with its own on-chip RC Oscillator for reliable operation

- Programmable code-protection

- Power saving SLEEP mode

- Selectable oscillator options

- Low-power, high-speed CMOS EPROM/EEPROM technology

- Fully static design

- In-Circuit Serial Programming (ICSP) via two pins

- Only single 5V source needed for programming capability

3.2.6 PIN CONFIGURATION

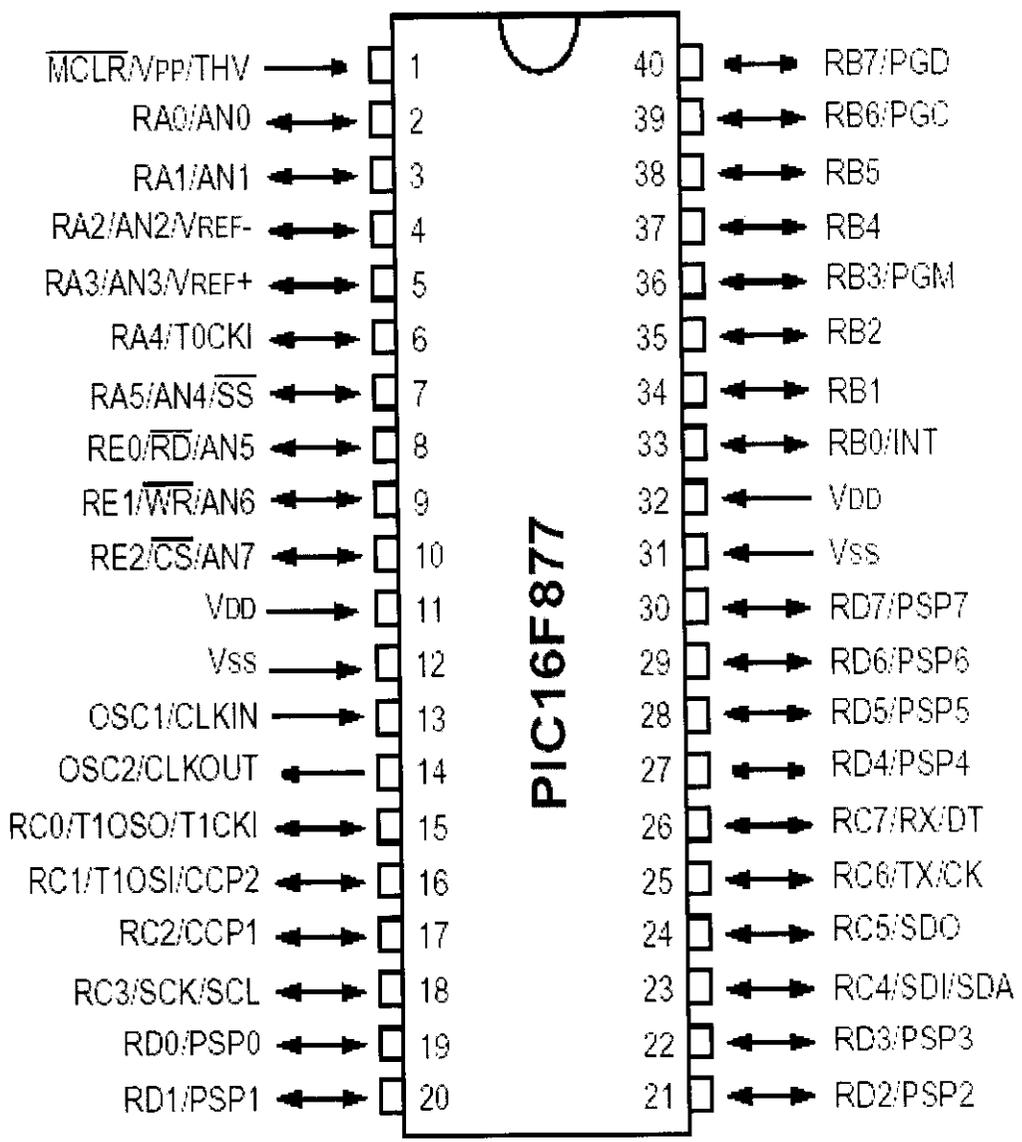|				
$\overline{MCLR}$/VPP/THV →	☐	1	40	☐ ↔ RB7/PGD
RA0/AN0 ↔	☐	2	39	☐ ↔ RB6/PGC
RA1/AN1 ↔	☐	3	38	☐ ↔ RB5
RA2/AN2/VREF- ↔	☐	4	37	☐ ↔ RB4
RA3/AN3/VREF+ ↔	☐	5	36	☐ ↔ RB3/PGM
RA4/T0CKI ↔	☐	6	35	☐ ↔ RB2
RA5/AN4/$\overline{SS}$ ↔	☐	7	34	☐ ↔ RB1
RE0/$\overline{RD}$/AN5 ↔	☐	8	33	☐ ↔ RB0/INT
RE1/$\overline{WR}$/AN6 ↔	☐	9	32	☐ ← VDD
RE2/$\overline{CS}$/AN7 ↔	☐	10	31	☐ ← VSS
VDD →	☐	11	30	☐ ↔ RD7/PSP7
VSS →	☐	12	29	☐ ↔ RD6/PSP6
OSC1/CLKIN →	☐	13	28	☐ ↔ RD5/PSP5
OSC2/CLKOUT ←	☐	14	27	☐ ↔ RD4/PSP4
RC0/T1OSO/T1CKI ↔	☐	15	26	☐ ↔ RC7/RX/DT
RC1/T1OSI/CCP2 ↔	☐	16	25	☐ ↔ RC6/TX/CK
RC2/CCP1 ↔	☐	17	24	☐ ↔ RC5/SDO
RC3/SCK/SCL ↔	☐	18	23	☐ ↔ RC4/SDI/SDA
RD0/PSP0 ↔	☐	19	22	☐ ↔ RD3/PSP3
RD1/PSP1 ↔	☐	20	21	☐ ↔ RD2/PSP2

PIC16F877

FIG. 3.2.6 PIN DIAGRAM

- 10-bit multi-channel Analog-to-Digital converter

- Synchronous Serial Port (SSP) with SPI. (Master Mode) and I2C. (Master/Slave)

- Universal Synchronous Asynchronous Receiver Transmitter (USART/SCI) with

  9- Bit addresses detection.

- Brown-out detection circuitry for Brown-out Reset (BOR).

3.2.5 ARCHITECTURE OF PIC 16F877

FIG 3.2.5 ARCHITECTURE OF PIC 16F877
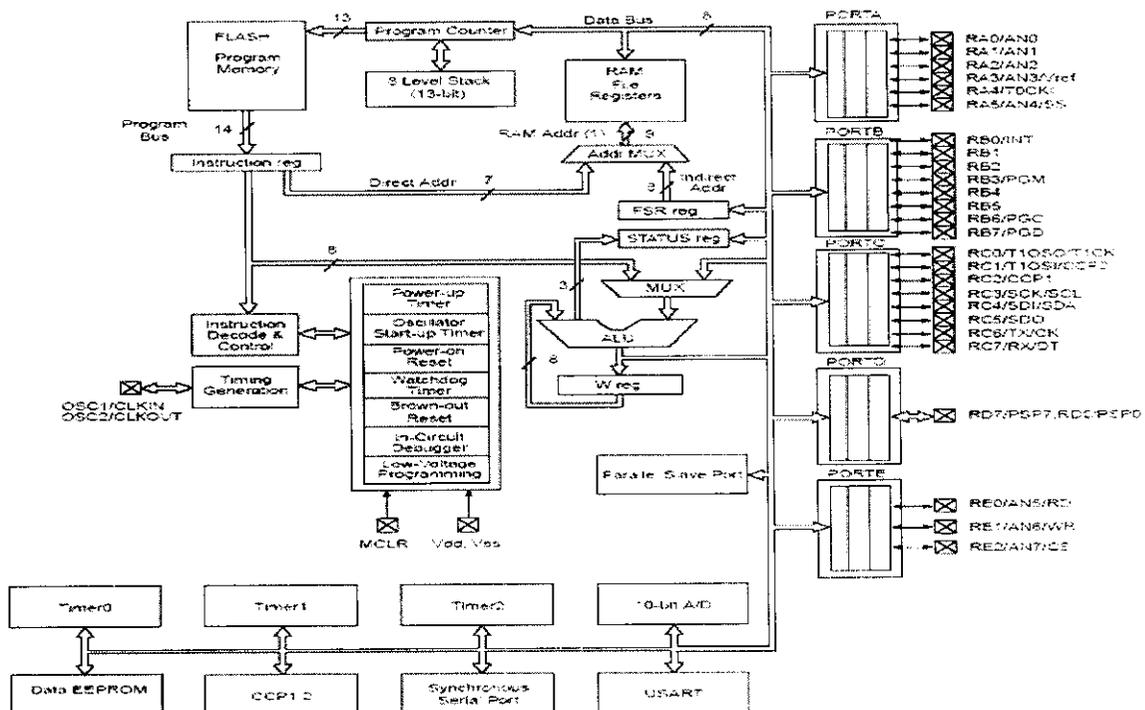
Note 1: Higher order bits are from the STATUS register.

3.2.7 INPUT/OUTPUT PORTS

Some pins for these I/O ports are multiplexed with an alternate function for the peripheral features on the device. In general, when a peripheral is enabled, that pin may not be used as a general purpose I/O pin. The pins can be selected as input or output port by setting the bits in the respective TRIS registers.

PORTA AND THE TRISA REGISTER

PORTA is a 6-bit wide bi-directional port. The corresponding data direction register is TRISA. Setting a TRISA bit (=1) will make the corresponding PORTA pin an input, i.e., put the corresponding output driver in a Hi-impedance mode. Clearing a TRISA bit (=0) will make the corresponding PORTA pin an output, i.e., put the contents of the output latch on the selected pin.

PORTB AND TRISB REGISTER

PORTB is an 8-bit wide bi-directional port. The corresponding data direction register is TRISB. Setting a TRISB bit (=1) will make the corresponding PORTB pin an input, i.e., put the corresponding output driver in a hi-impedance mode. Clearing a TRISB bit (=0) will make the corresponding PORTB pin an output, i.e., put the contents of the output latch on the selected pin. Three pins of PORTB are multiplexed with the Low Voltage Programming function; RB3/PGM, RB6/PGC and RB7/PGD.Each of the PORTB pins have a weak internal pull-up. A single control bit can turn on all the pull-ups.

The PORTE pins become control inputs for the microprocessor port when bit PSPMODE (TRISE, bit 4) is set. In this mode, the user must make sure that the TRISE (0 to 2) bits are set (pins are configured as digital inputs). Ensure ADCON1 is configured for digital I/O. In this mode the input buffers are TTL.

PORTE pins are multiplexed with analog inputs. When selected as an analog input, these pins will read as '0's.

3.2.8 MEMORY ORGANISATION

There are three memory blocks in each of the PIC16F877 MUC's. The program memory and Data Memory have separate buses so that concurrent access can occur.

PROGRAM MEMORY

The PIC16f877 devices have a 13-bit program counter capable of addressing 8K *14 words of FLASH program memory. Accessing a location above the physically implemented address will cause a wraparound.

The RESET vector is at 0000h and the interrupt vector is at 0004h.

DATA MEMORY

The data memory is partitioned into multiple banks which contain the General Purpose Registers and the special functions Registers. Bits RP1 (STATUS, bit 6) and RP0 (STATUS, bit 5) are the bank select bits.

This is performed by clearing bit RBPU. The weak pull-up is automatically turned off when the port pin is configured as an output.

PORTC AND THE TRISC REGISTER

PORTC is an 8-bit wide bi-directional port. The corresponding data direction register is TRISC. Setting a TRISC bit (=1) will make the corresponding PORTC pin an input, i.e., put the corresponding output driver in a hi-impedance mode. Clearing a TRISC bit (=0) will make the corresponding PORTC pin an output, i.e., put the contents of the output latch on the selected pin. PORTC is multiplexed with several peripheral functions. PORTC pins have Schmitt Trigger input buffers.

PORTD AND TRISD REGISTERS

This section is not applicable to the 28-pin devices. PORTD is an 8-bit port with Schmitt Trigger input buffers. Each pin is individually configurable as an input or output. PORTD can be configured as an 8-bit wide microprocessor Port (parallel slave port) by setting control bit PSPMODE (TRISE, bit 4). In this mode, the input buffers are TTL.

PORTE AND TRISE REGISTER

PORTE has three pins RE0/RD/AN5, RE1/WR/AN6 and RE2/CS/AN7, which are individually configurable as inputs or outputs. These pins have Schmitt Trigger input buffers.

RP1:RP0	Banks
00	0
01	1
10	2
11	3

Each bank extends up to 7Fh (1238 bytes). The lower locations of each bank are reserved for the Special Function Registers. Above the Special Function Registers are General Purpose Registers, implemented as static RAM. All implemented banks contain special function registers. Some frequently used special function registers from one bank may be mirrored in another bank for code reduction and quicker access.

CHAPTER 4

HARDWARE IMPLEMENTATION

4.1 RS 232:

RS232 SERIAL COMMUNICATION

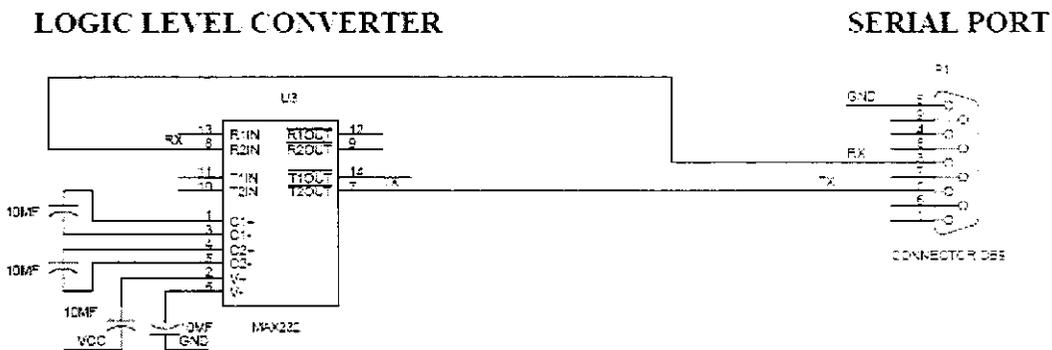LOGIC LEVEL CONVERTER   SERIAL PORT

Fig : 4.1 RS232 Serial Communication

In telecommunications, **RS-232** is a standard for serial binary data interconnection between a *DTE* (Data terminal equipment) and a *DCE* (Data Circuit-terminating Equipment). It is commonly used in computer serial ports.

4.1.1 Scope of the Standard:

The Electronic Industries Alliance (EIA) standard RS-232-C [3] as of 1969 defines:

- Electrical signal characteristics such as voltage levels, signaling rate, timing and slew-rate of signals, voltage withstand level, short-circuit behavior, maximum stray capacitance and cable length
- Interface mechanical characteristics, pluggable connectors and pin identification
- Functions of each circuit in the interface connector
- Standard subsets of interface circuits for selected telecom applications

The standard does not define such elements as character encoding (for example, ASCII, Baudot or EBCDIC), or the framing of characters in the data stream (bits per character, start/stop bits, parity). The standard does not define protocols for error detection or algorithms for data compression.

The standard does not define bit rates for transmission, although the standard says it is intended for bit rates lower than 20,000 bits per second. Many modern devices can exceed this speed (38,400 and 57,600 bit/s being common, and 115,200 and 230,400 bit/s making occasional appearances) while still using RS-232 compatible signal levels.

Details of character format and transmission bit rate are controlled by the serial port hardware, often a single integrated circuit called a UART that converts data from parallel to serial form. A typical serial port includes specialized driver and receiver integrated circuits to convert between internal logic levels and RS-232 compatible signal levels.

4.1.2 Circuit Description:

In this circuit the MAX 232 IC used as level logic converter. The MAX232 is a dual driver/receiver that includes a capacive voltage generator to supply EIA

232 voltage levels from a single 5v supply. Each receiver converts EIA-232 to 5v TTL/CMOS levels. Each driver converts TLL/CMOS input levels into EIA-232 levels.
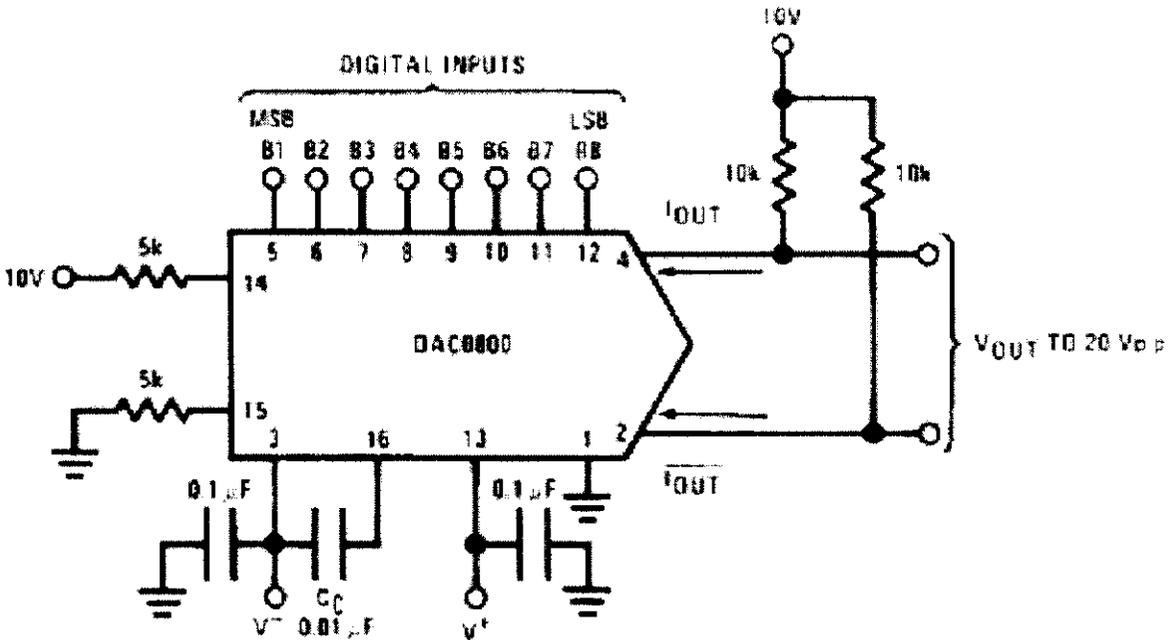
4.1.3 APPLICATION INFORMATION:
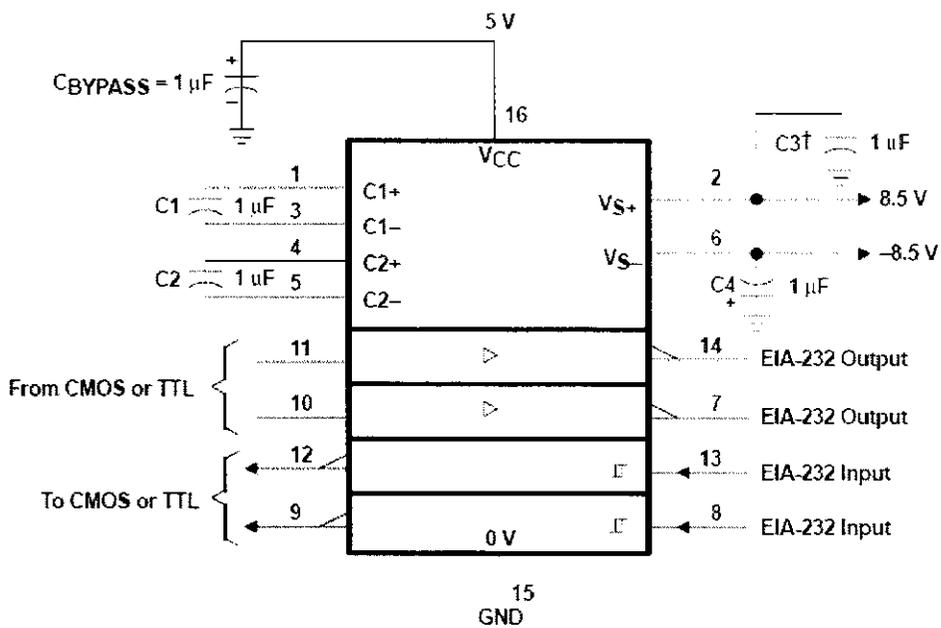
Applications:

- ➢ TIA/EIA-232-F
- ➢ Battery-Powered Systems
- ➢ Terminals
- ➢ Modems
- ➢ Computers.

4.2 DAC0800:

4.2.1 DESCRIPTION:

The DAC0800 series are monolithic 8-bit high-speed current-output digital-to-analog converters (DAC) featuring typical settling times of 100 ns. When used as a multiplying DAC, monotonic performance over a 40 to 1 reference current range is possible. The DAC0800 series also features high compliance complementary current outputs to allow differential output voltages of 20 Vp-p with simple resistor loads. The reference-to-full-scale current matching of better than ±1 LSB eliminates the need for full-scale trims in most applications, while the nonlinearities of better than ±0.1% over temperature minimizes system error accumulations.

The noise immune inputs will accept a variety of logic levels. The performance and characteristics of the device are essentially unchanged over the ±4.5V to ±18V power supply range and power consumption at only 33 mW with ±5V supplies is independent of logic input levels.
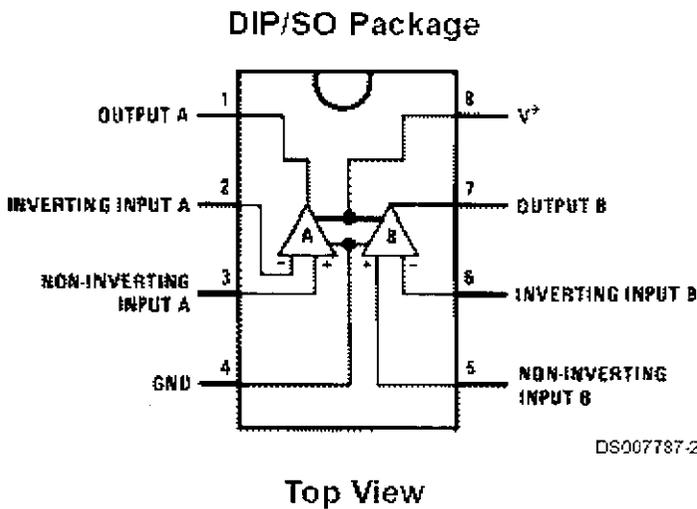
4.2.2 APPLICATION INFORMATION:
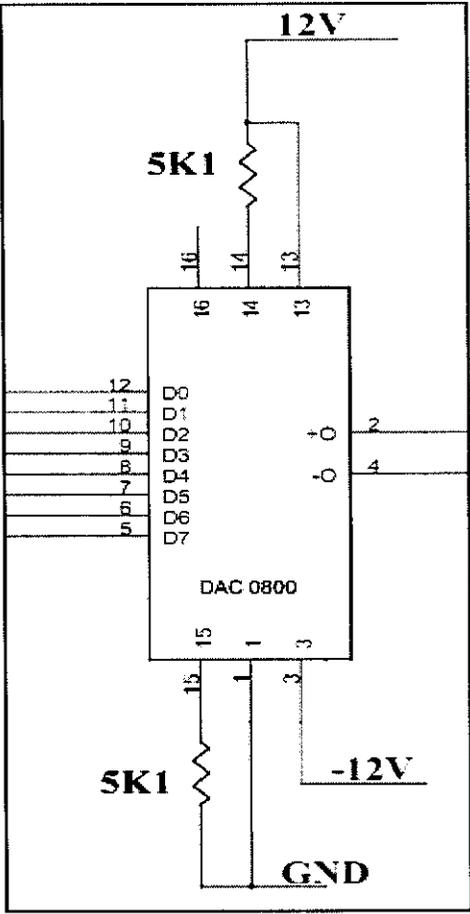
INPUT TO D0-D7: PORT RB0-RB7 OF PIC16F877

OUTPUT TO CONTROL CIRCUIT THROUGH LM 741.

APPLICATIONS:

> ➤ SINGLE SUPPLY OPERATION

> ➤ CURRENT FEEDBACK AMPLIFIERS

> ➤ HIGH SPEED OP-AMP

4.3.3 PIN OUT DIAGRAM:

DIP/SO Package

OUTPUT A — 1   8 — V⁺

INVERTING INPUT A — 2   7 — OUTPUT B

NON-INVERTING INPUT A — 3   6 — INVERTING INPUT B

GND — 4   5 — NON-INVERTING INPUT B

DS007787-2

Top View

APPLICATIONS:

➢ TRANSDUCER AMPLIFIERS

➢ ALL DC BLOCKS

➢ SINGLE POWER SUPPLY SYSTEMS.

➢ DATA ACQUISITION.

➢ VOLTAGE CONTROLLED OSCILLATORS.

4.4.2 THREE-TERMINAL VOLTAGE REGULATORS:

The fixed voltage regulator has an unregulated dc input voltage, Vi, applied to one input terminal, a regulated output dc voltage, Vo, from a second terminal, with the third terminal connected to ground. For a selected regulator, IC device specifications list a voltage range over which the input voltage can vary to maintain a regulated output voltage over a range of load current. The specifications also list the amount of output voltage change resulting from a change in load current (load regulation) or in input voltage (line regulation).

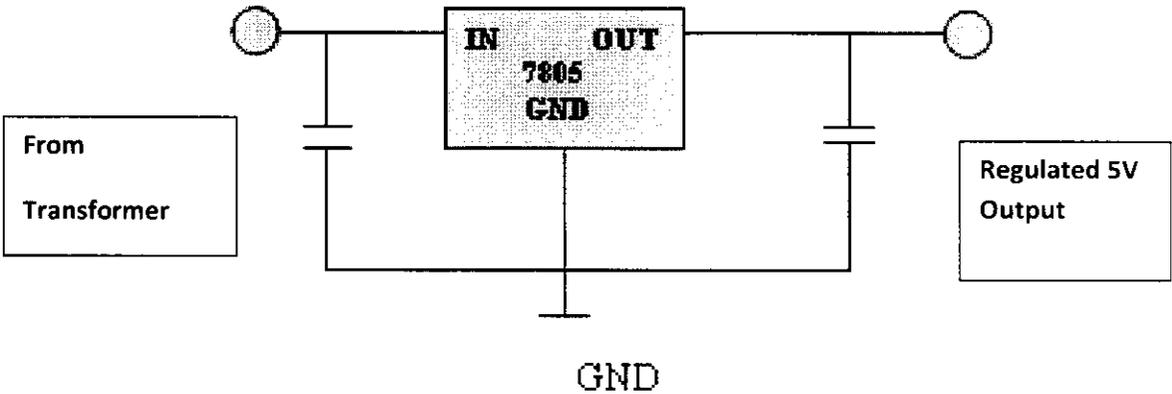## 4.4.3 Fixed Positive Voltage Regulators:

GND

Fig 4.4.3 Fixed Positive Voltage Regulators

The series 78 regulators provide fixed regulated voltages from 5 to 24 V. As shown how one such IC, a 7812, is connected to provide voltage regulation with output from this unit of +12V dc. An unregulated input voltage Vi is filtered by capacitor C1 and connected to the IC's IN terminal. The IC's OUT terminal provides a regulated + 12V which is filtered by capacitor C2 (mostly for any high-

4.3 SIGNAL CONDITIONING UNIT:

LM358:

The LM358 series consists of two independent, high gain, internally frequency compensated operational amplifiers which were designed specifically to operate from a single power supply over a wide range of voltages.Operation from split power supplies is also possible and the low power supply current drain is independent of the magnitude of the power supply voltage.

4.3.1 CHARACTERISTICS:

In the linear mode the input common-mode voltage range includes ground and the output voltage can also swing to ground,even though operated from only a single power supply voltage. The unity gain cross frequency is temperature compensated. The input bias current is also temperature compensated.

4.3.2 CIRCUIT DESCRIPTION:

In an industrial application, one is required to measure and control physical quantities. Here, we are measuring the intensity of light which should be measured and controlled. This physical quantity are usually measured with help of transducers(IR sensors). The output of transducer to be amplified so that it can drive the indicator or display system. This function is performed by LM358.

4.4 POWER SUPPLY

4.4.1 IC VOLTAGE REGULATORS:

Voltage regulators comprise a class of widely used ICs. Regulator IC units contain the circuitry for reference source, comparator amplifier, control device, and overload protection all in a single IC. Although the internal construction of the IC is somewhat different from that described for discrete voltage regulator circuits, the external operation is much the same. IC units provide regulation of either a fixed positive voltage, a fixed negative voltage, or an adjustably set voltage.

A power supply can be built using a transformer connected to the ac supply line to step the ac voltage to a desired amplitude, then rectifying that ac voltage, filtering with a capacitor and RC filter, if desired, and finally regulating the dc voltage using an IC regulator. The regulators can be selected for operation with load currents from hundreds of milli amperes to tens of amperes, corresponding to power ratings from mill watts to tens of watts.
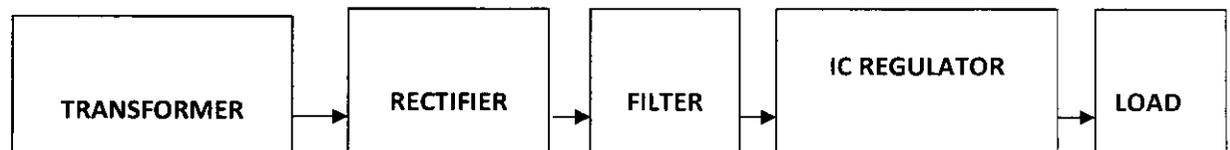
```
TRANSFORMER → RECTIFIER → FILTER → IC REGULATOR → LOAD
```

FIG 4.4.1 BLOCK DIAGRAM OF POWER SUPPLY

frequency noise). The third IC terminal is connected to ground (GND). While the input voltage may vary over some permissible voltage range, and the output load may vary over some acceptable range, the output voltage remains constant within specified voltage variation limits. These limitations are spelled out in the manufacturer's specification sheets. A table of positive voltage regulated ICs is provided below.

TABLE 4.1 : Positive Voltage Regulators in 7800 series

IC Part	Output Voltage (V)	Minimum Vi (V)
7805	+5	7.3
7806	+6	8.3
7808	+8	10.5
7810	+10	12.5
7812	+12	14.6
7815	+15	17.7
7818	+18	21.0
7824	+24	27.1

4.5 TRIAC CONTROL CIRCUIT:

4.5.1CIRCUIT DESCRIPTION:

This circuit is designed to control the 230V AC load such as heater, motor etc. The 230V AC voltage is step down with help of step down transformer. The step down voltage is rectified by the full wave rectifier. After the rectification the pulsating rectified voltage is given to base of the transistor Q1. Whenever peak pulse is come the transistor Q1 is conducting and ground voltage is given to Q2 transistor base. Rest of the time 12V is given to base of the Q2 transistor which is connected across the feedback capacitor of U1A saw tooth generator. The saw tooth generator is constructed by LM1458 operational amplifier.

The LM1458 is the general purpose duel operational amplifier with sharing common supply. U1A delivered the saw tooth wave output which is given to non inverting input terminal of comparator. The comparator is constructed by the U1B.

The 12V square wave signal is given to inverting input terminal. The 12V square wave signal is generated by the comparator U5 which is constructed by LM 741 operational amplifier.

The U1B comparator compares the input saw tooth wave and square wave signal and outputs the +12V to -12V square pulse. The -12V square pulse is rectified by D3 diode.

The positive 12 square pulse is given to isolation circuit. The isolation is constructed by the MOC3011 Opto coupler.

The isolation is used to separate the 230V AC voltage and DC voltages. The opto coupler consists of photo LED and photo transistor. Whenever the 12V

signal is given to photo LED the light rays' falls on the photo transistor. Now the photo transistor is conducting and high pulse is given to Triac gate. So the Triac is conducting and 230V AC voltage is given to load. Depending on the pulse given to Triac gate the conduction angel is varied. Then the variable AC voltage is rectified by the full wave rectifier unit. So that DC voltage flowing through load varied in order to control the load to desired level.

CHAPTER 5

SOFTWARE IMPLEMENTATION

5.1 Lab VIEW

Lab VIEW (Laboratory Virtual Instrument Engineering Workbench) is a graphical programming language that uses icons instead of lines of text to create applications. In contrast to text-based programming languages, where instructions determine the order of program execution, Lab VIEW uses dataflow programming, where the flow of data through the nodes on the block diagram determines the execution order of the VIs and functions. VIs, or virtual instruments, is Lab VIEW programs that imitate physical instruments.

In Lab VIEW, you build a user interface by using a set of tools and objects. The user interface is known as the front panel. You then add code using graphical representations of functions to control the front panel objects. This graphical source code is also known as G code or block diagram code. The block diagram contains this code. In some ways, the block diagram resembles a flowchart.

Lab VIEW is integrated fully for communication with hardware such as GPIB, VXI, PXI, RS-232, RS-485, and data acquisition control, vision, and motion control devices. Lab VIEW also has built-in features for connecting your application to the Internet using the Lab VIEW web server and software standards such as TCP/IP networking and ActiveX.

Using Lab VIEW, you can create 32-bit compiled applications that give you the fast execution speeds needed for custom data acquisition, test, measurement, and control solutions. You also can create stand-alone executables and shared libraries, like DLLs, because Lab VIEW is a true 32-bit compiler.

Lab VIEW contains comprehensive libraries for data collection, analysis, presentation, and storage. Lab VIEW also includes traditional program

development tools. You can set breakpoints, animate program execution, and single-step through the program to make debugging and development easier.

Lab VIEW also provides numerous mechanisms for connecting to external code or software through DLLs, shared libraries, ActiveX, and more. In addition, numerous add-on tools are available for a variety of application needs.

5.1.1 Why Lab VIEW?

Lab VIEW empowers you to build your own solutions for scientific and engineering systems. Lab VIEW gives you the flexibility and performance of a powerful programming language without the associated difficulty and complexity.

Lab VIEW gives thousands of successful users a faster way to program instrumentation, data acquisition, and control systems. By using Lab VIEW to prototype, design, test, and implement your instrument systems, you can reduce system development time and increase productivity by a factor of 4 to 10.

Here, LabVIEW has been used as user-interface and the control of whole drug infusion system can be done with this interface.

5.2 ALGORITHM FOR DRUG INFUSION SYSTEM:

STEP 1: Reset

STEP 2: Set the Set value for drop rate(in mL/min) in labVIEW interface.

STEP 3: Convert the drop rate into no. of counts using this formula,

$$\text{Drop size(mL)} = \frac{\text{volume to be infused(mL)}}{\text{Time for infusion (min) x drop rate(mL/min)}}$$

STEP 4: Check for DROP RATE =0,if YES GO TO STEP 2.

STEP 5: Using PIC interface or DAQ card ,acquire data to the computer.

STEP 6:Display the drop rate and wait for the START button to be pressed.

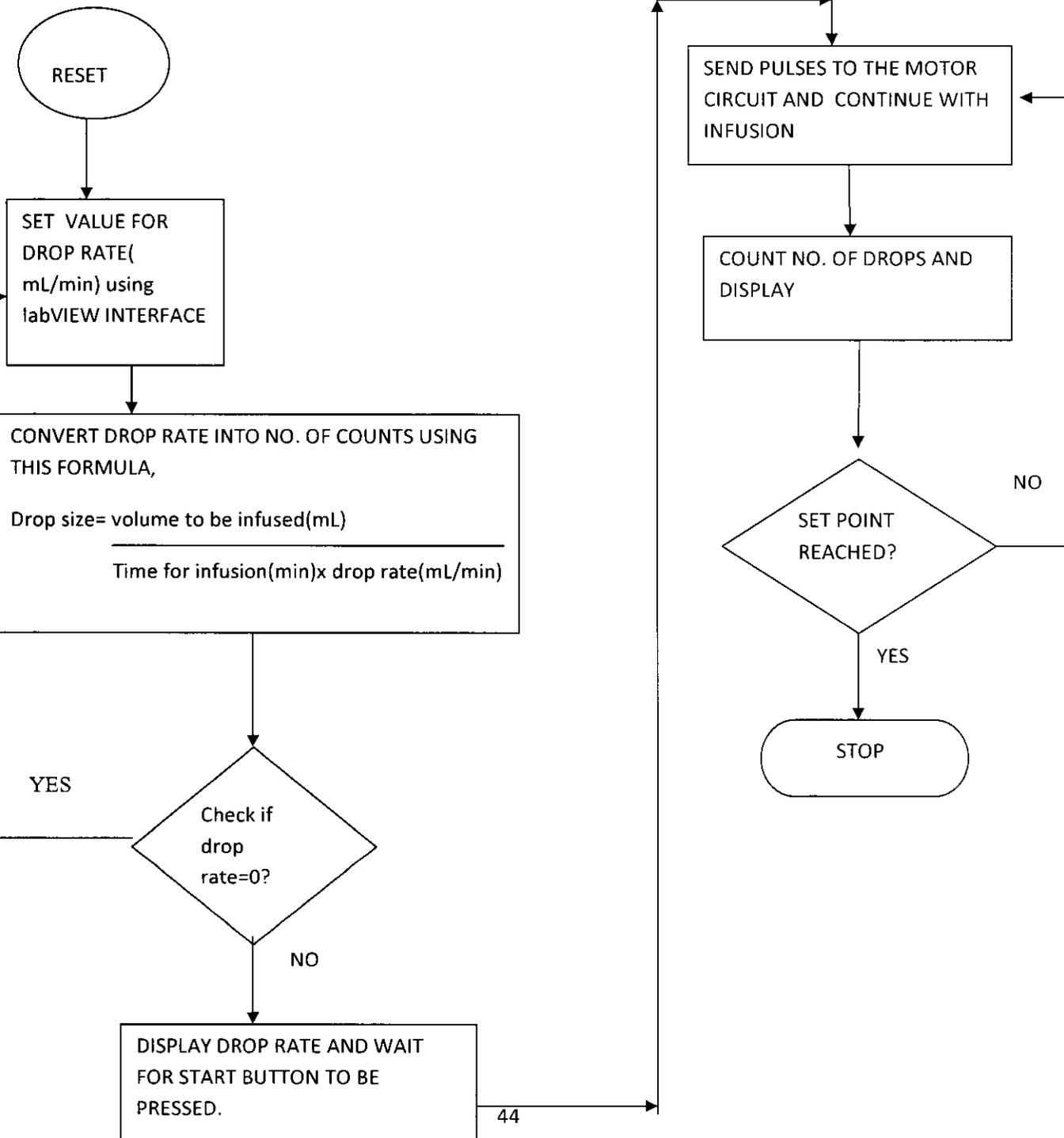STEP 7:Send pulses to the motor circuit and start the infusion.

STEP 8: Count number of drops and Display.

STEP 9: Check for no. of drops reached the set value, if YES GO TO STEP 10.

Otherwise, continue with infusion.

STEP 10: Stop the process.

5.3 FLOWCHART FOR DRUG INFUSION SYSTEM:

RESET

SET VALUE FOR DROP RATE(mL/min) using labVIEW INTERFACE

CONVERT DROP RATE INTO NO. OF COUNTS USING THIS FORMULA,

Drop size= $\dfrac{\text{volume to be infused(mL)}}{\text{Time for infusion(min)x drop rate(mL/min)}}$

YES

Check if drop rate=0?

NO

DISPLAY DROP RATE AND WAIT FOR START BUTTON TO BE PRESSED.

SEND PULSES TO THE MOTOR CIRCUIT AND CONTINUE WITH INFUSION

COUNT NO. OF DROPS AND DISPLAY

SET POINT REACHED?

NO

YES

STOP

44

6.TEST DATA

TABLE 6.1: TEST DATA

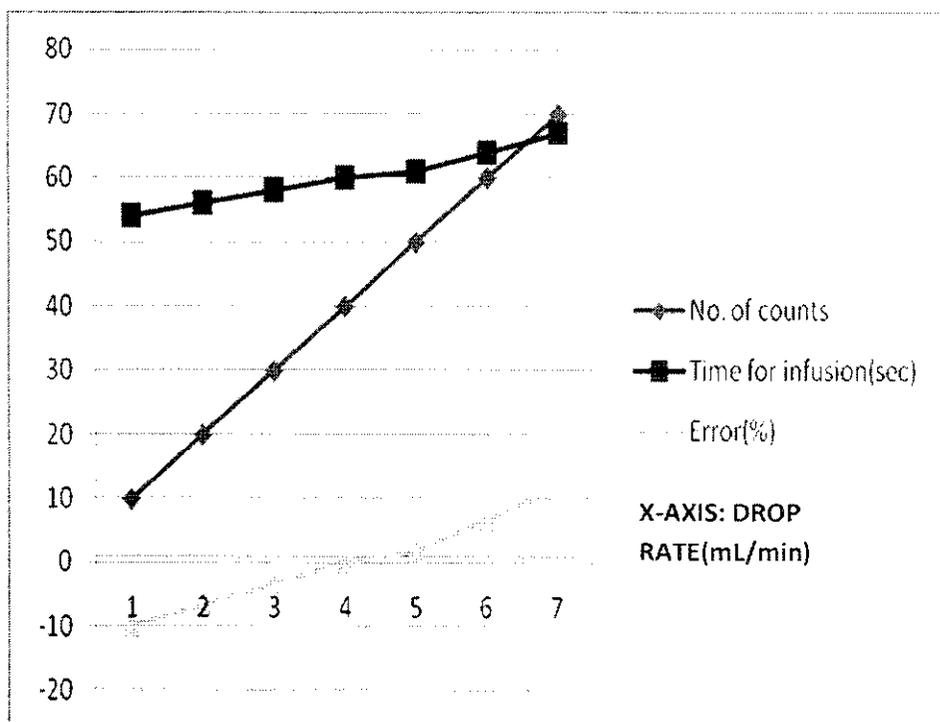| DROP RATE(mL/min)	No. of counts	Time for infusion(sec)	Error(%)
1	10	54	-10
2	20	56	-6.66
3	30	58	-3.333
4	40	60	0
5	50	61	1.666
6	60	64	6.66
7	70	67	11.66

FIG 6.1 TEST GRAPH

TEMPERATURE DURING THE WHOLE TESTING PROCESS IS 29° C.

7.CONCLUSION AND FUTURE SCOPE:

Thus the drug infusion system was successfully designed and implemented with all features explained above along with the peripheral devices.This system has also been tested and checked for errors as depicted in the graph.

The system can be further enhanced by including a battery backup setup along with advanced sensors.The main advantage of our system is cost effectiveness.

8. BIBLIOGRAPHY

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Source: JSIR Vol.64(10) [October 2005]

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3.infusion pump,wikipedia.

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1.Drug Delivery Systems BY Vasant V.Ranade,Second Edition,CRC PRESS.

2.Handbook of Biomedical Instrumentation By Khandpur(AUTOMATED DRUG DELIVERY SYSTEMS)

3. Embedded Computing with PIC16F877.

APPENDICES

10.1 CODING – PIC16F877

```c
#include<pic.h>

#include"pic_lcd8.h"

#include"pic_adc.h"

#include"pic_serial.h"

unsigned char temp,val[10],k,count,ml;

unsigned int temp1;

#define pulse RB0

bit aa;

void interrupt serial(void)

{
    if(RCIF)

    {
        RCIF = 0;

        val[k] = RCREG;

        if(val[0]=='*')k++;
    }
    /*if(INTF)

    {
        INTF=0;pulse++;
    }*/
}
```

```c
void main()

{

TRISC=0xc0;

TRISD=0x00;

TRISB=0x01;

ADCON1=0x09;

TRISA=0xFF;

GIE=1;

PEIE=1;

//INTE=1;

//INTEDG=1;

Lcd8_Init();

Serial_Init(9600);

Receive(1);

Lcd8_Display(0x80,"Microcntrlle bsd",16);

Lcd8_Display(0xC0,"Drug Infusion Sys",16);

Delay(65000);Delay(65000);

Lcd8_Display(0x80,"Temp:    SC:       ",16);

Lcd8_Display(0xC0,"Count:   ml:       ",16);

PORTB=0;

    while(1)

    {
```

```
temp=Adc8_Cha(0);

Lcd8_Decimal3(0x85,temp);

if(!pulse && !aa){aa=1;}

else if(pulse && aa){aa=0;count++;}

if(count>10){ml++;Lcd8_Decimal3(0xCd,ml);count=0;}

Lcd8_Decimal3(0xC6,count);

Serial_Out('*');

Serial_Out(temp%1000/100+0x30);

Serial_Out(temp%100/10+0x30);

Serial_Out(temp%10/1+0x30);

Serial_Out(count%1000/100+0x30);

Serial_Out(count%100/10+0x30);

Serial_Out(count%10/1+0x30);

Delay(20000);

        if(k>2)

        {

        //      Lcd8_Display(0xC0,"---------------------",16);


//for(pp=0;pp<4;pp++){Lcd8_Write(0x84+pp,val[pp]);Delay(5000);}

                k=0;

                val[0]=0;

                temp1=((val[1]-0x30)*100)+((val[2]-0x30)*10)+(val[3]-0x30);
```

```
                temp1=temp1-100;

                Lcd8_Decimal3(0x8d,temp1);


        }


if( temp1 && ml<temp1){PORTB=temp1+90;}
else {PORTB=0;}



    }
}
```
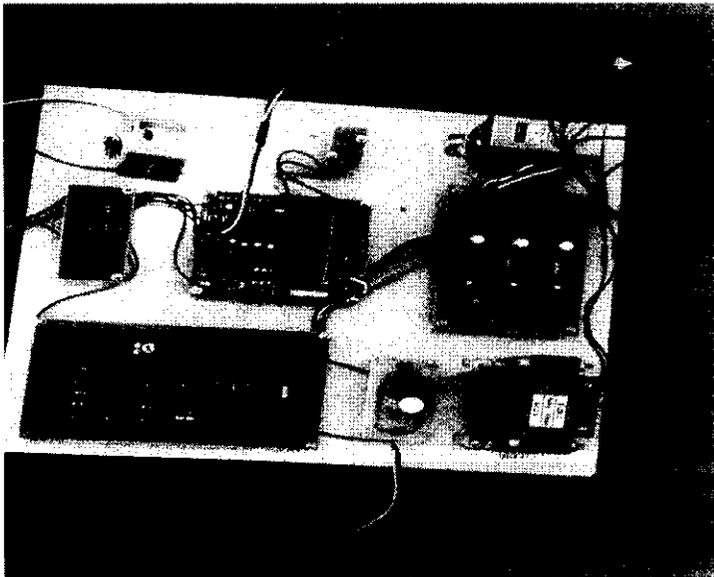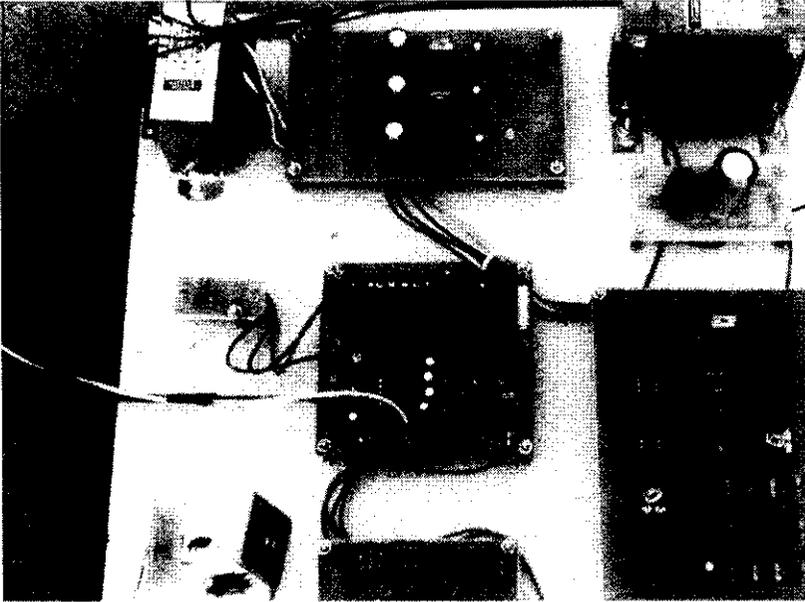
10.2 CIRCUIT DIAGRAM:

SCREEN SHOTS:

SENSOR CIRCUIT: