DIGITAL FREQUENCY METER USING 8051

ESD MINI PROJECT

BACHELOR OF TECHNOLOGY

Submitted by

RONANKI BHANU SAMPATH (200932046)

PENMETSA PAVAN KUMAR VARMA (200906228)

KATARI YUVA SAI KIRAN (200932016)

I VARSHITA (200907232)

NATHANIEL VINNY ALEX (200932120)

MANIPAL INSTITUTE OF TECHNOLOGY

(A Constituent Institution of Manipal Academy of Higher Education)

MANIPAL – 576104, KARNATAKA, INDIA

INDEX

1. INTRODUCTION:

- Frequency is defined as the number of cycles per second (or) to sound more technical, the number of pulses that pass through a specific point in 1secound.

- Frequency counter also known as frequency meter is a device used to measure the frequency of an input signal.

- These are classified into analog and digital devices. We always prefer digital over analog because of the reduced human errors. A digital frequency meter is a device that displays frequency in digital form.

- Frequency counters are mainly used in the measurement of radio frequencies, audio frequencies and can be used as analog to digital converters, digital clocks, frequency dividers, timer circuits, etc.

- There are different ways to build the circuit for frequency counter, but we have chosen 8051 microcontroller and a 555 timer as it has the simplest, cost effective and reliable design.

- Frequency counter is widely used in industries and have been playing a very important role.

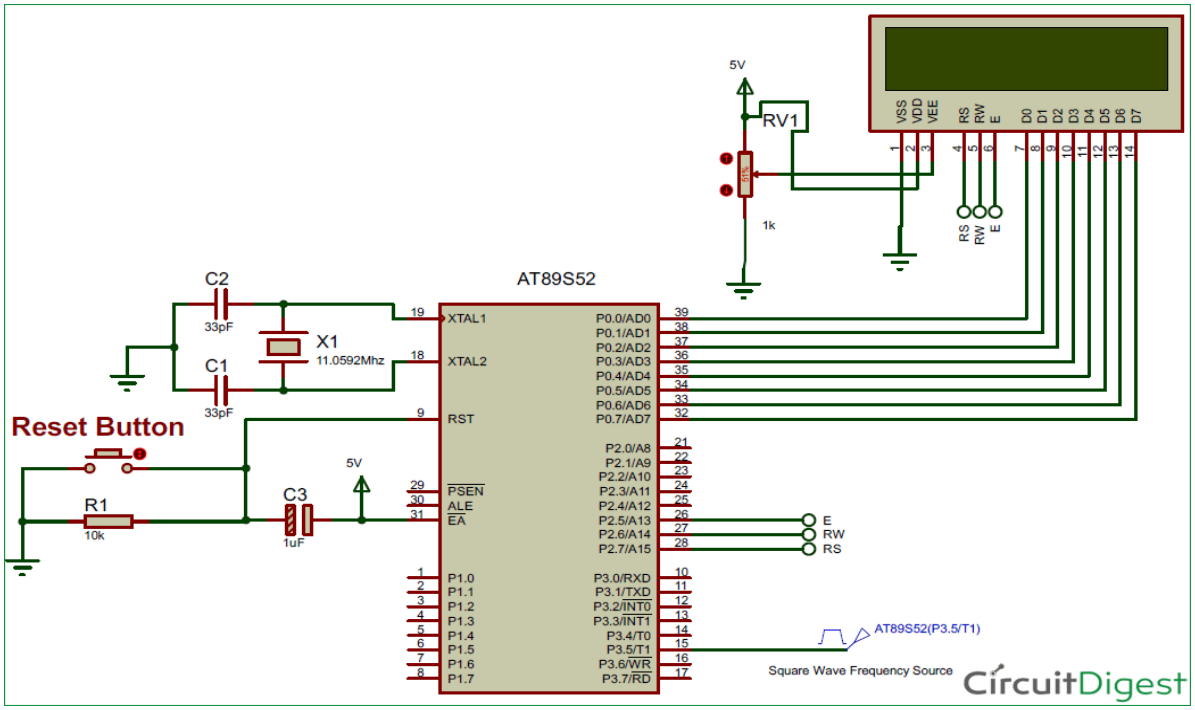
- These are used for the measurement of frequency of the periodic signals like sine wave, square wave signals, etc.

- Frequency meter is widely used for the precise measurement of frequency.

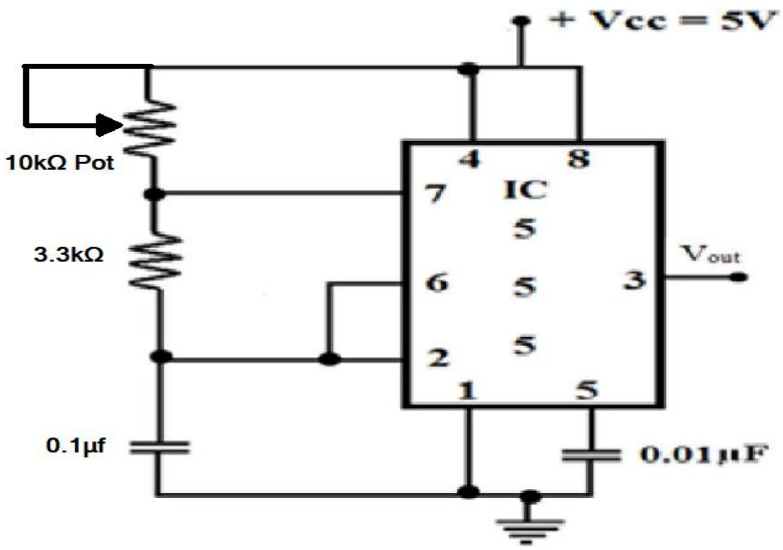
2. THEORY

i. a. CIRCUIT DIAGRAM:

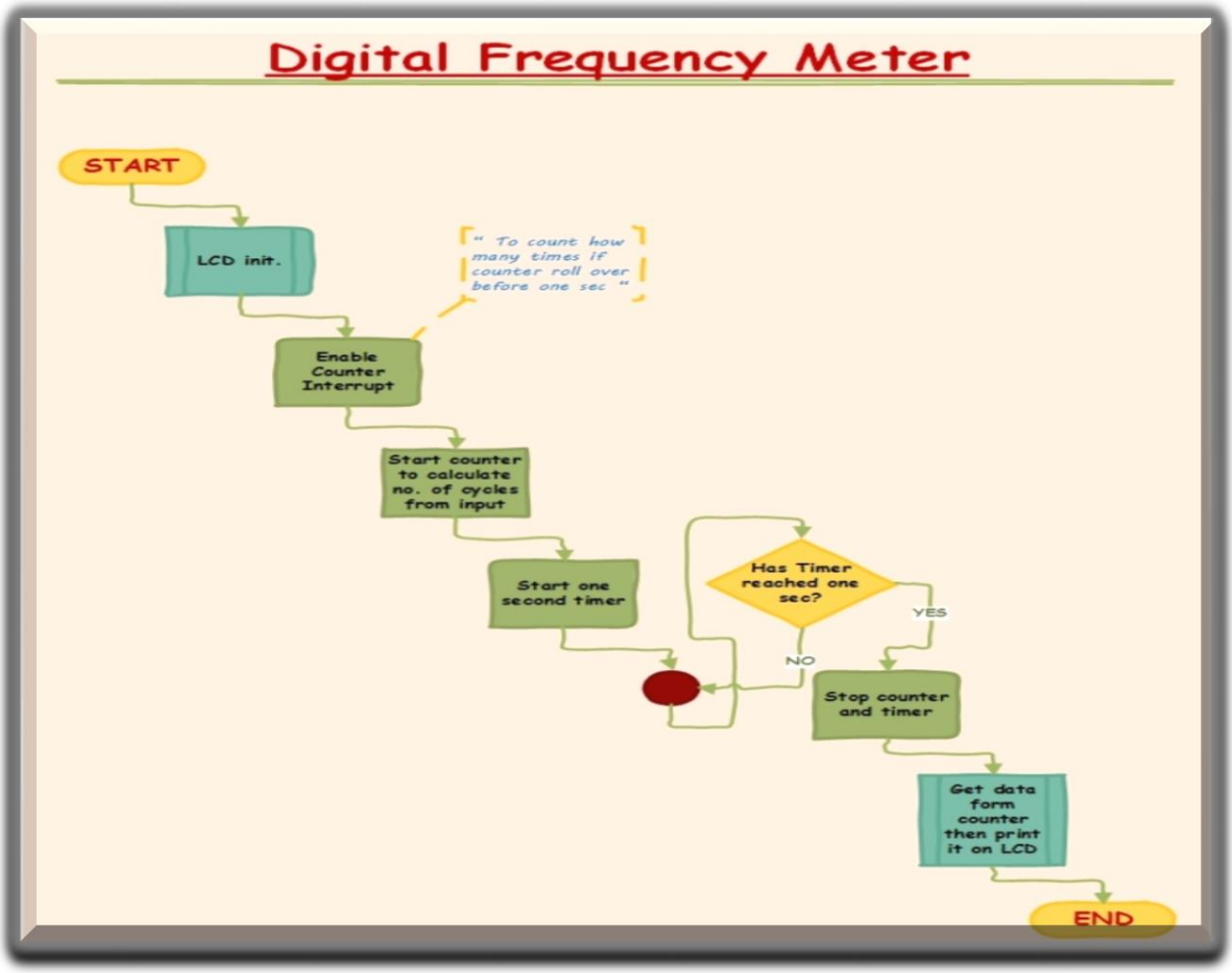
For interfacing 8051 with LCD display,



For interfacing 555 timer with 8051,



b. FLOW CHART:



ii. PRINCIPLE:

- The main principle of the circuit is that the frequency of the input signal that we would like to measure is passed through the counter for pre-determined period of time and as we know the counter is going to count number of pulses that were passed through it, hence can calculate the frequency of the signal.

iii. WORKING:

- In the above setup as shown, we are using 8051 microcontroller, 555 timer which is used for generating the periodic signal whose frequency has to be

measured which is fed to the microcontroller and an lcd display for displaying frequency.

- Here we are using 555 timer in the astable mode for square wave generation.

- Frequency of the input signal can be varied by rotating the pot connected to the 555 timer.

- Here we are counting the number of pulses entering Port-3.5 per second of 8051 and displaying it on 16*2 LCD display.

- The frequency source should produce square waves and the maximum amplitude is limited to 5V, as the ports of 8051 microcontroller cannot handle voltage greater than 5V. The maximum frequency it can measure is 655.35 KHz because of memory limitation of TH1 and TL1 registers.

- There is a constraint in the frequency that can be displayed on the LCD due to the frequency of the oscilloscope,
  (freq of the oscil= 11.0592MHz.)

  As we know, 1 Machine cycle= 12 clk cycles; -(a)

  1 clk cycle= 1/(frequency of the oscillator)=> 1/(11.0592MHz)- (b)

  Putting eq (b) in (a), 1 Machine cycle= 1.085 microsec.
  In each Machine cycle, the timer increments by 1.
  Hence the maximum frequency that can be measured if we consider the time period for counting to be 1000msec,
  => 1000msec / (1.085 microseconds) = 921.65 KHz.

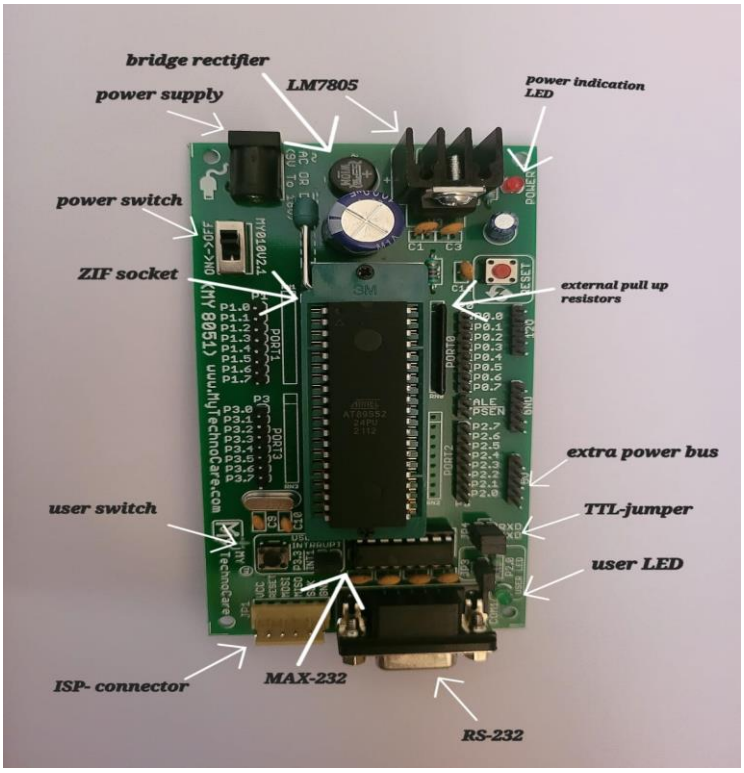
- Other parameters that constrain the frequency that can be displayed on the LCD are the design parameters- potentiometer, resistors, capacitors in the circuitry.

- Programmed 8051 using prong usb isp programmer and the software used is Prog isp172

iv. COMPONENTS REQUIRED:

- 8051 Development board
- 16*2 LCD display
- 555 Timer
- Potentiometers
- Jumper wires
- Programmer
- Bread board
- Resistors
- Capacitors

a) 8051 Development Board:

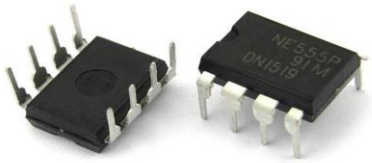


COMPONENTS,

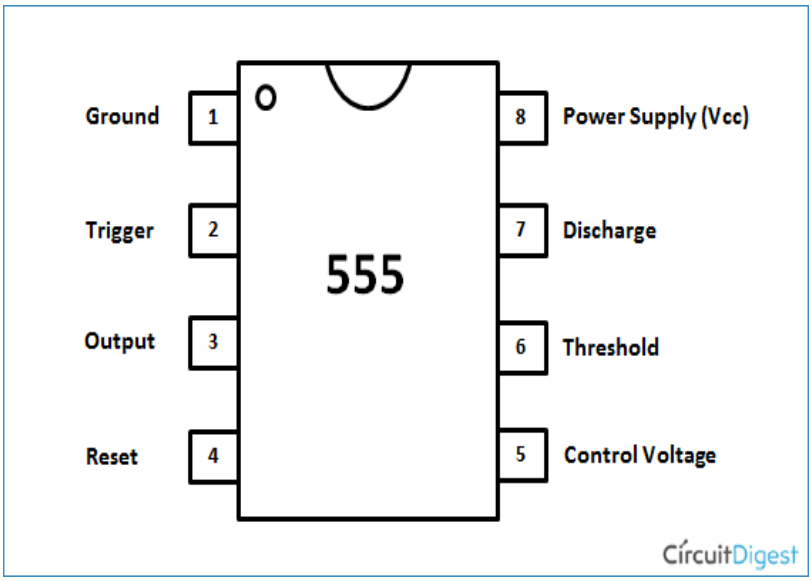
- User switch - used as input switch or used as external interrupt.

- User LED – used as output led.
- Power indication LED.
- LM7805 – 5V voltage regulator.
- Extra power bus – 5V, 12V and ground to power external peripherals.
- RS 232.
- MAX 232 – used as RS 232 driver.
- TTL jumper – connects TXD & RXD pins of microcontroller (TTL pins) to RS 232.
- External pullup resistors.
- Zero insertion force socket (ZIF).
- Reset.
- ISP connector – to connect ISP programmer to board to load hex file into microcontroller IC.
- Power supply.
- Power switch.
- Bridge rectifier – used for rectification of input voltage (both AC & DC inputs can be given).

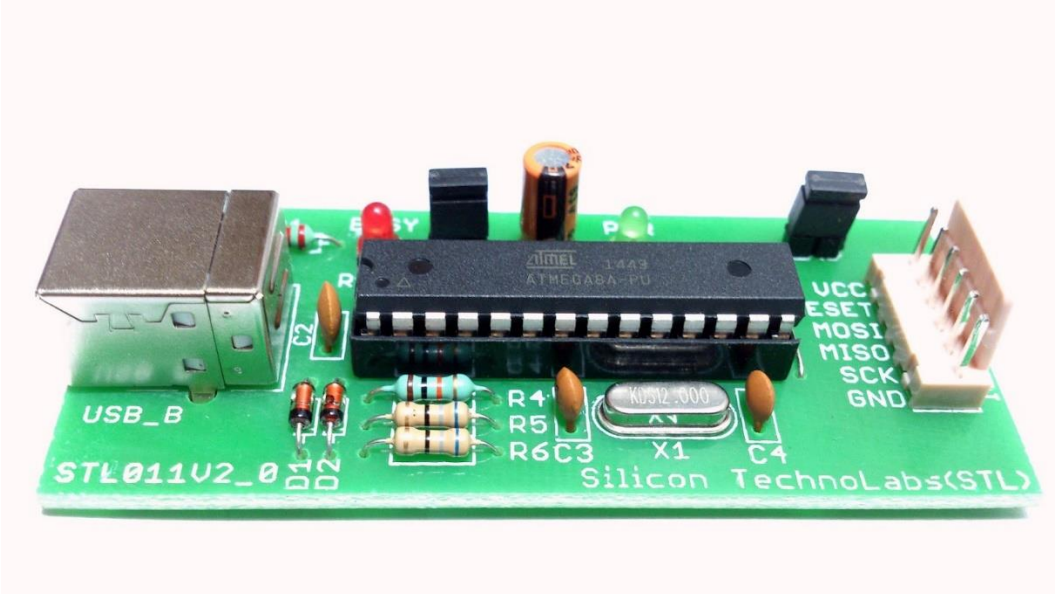
b) 555 Timer:



- The 555 Timer is a linear IC, precision timing circuit that can produce pulses of accurate and highly stable time delays.
- In the astable mode, the 555 timer acts as an oscillator that generates a square wave. The frequency of the wave can be adjusted by changing the value of the potentiometer connected to it.
- Pin diagram,

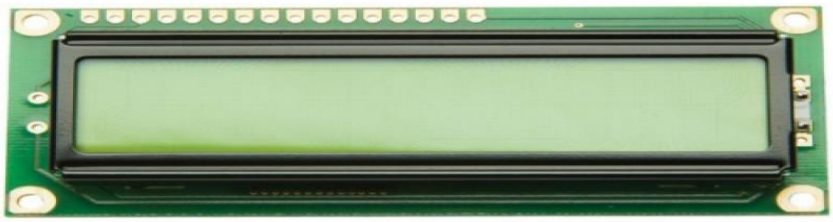


c) Programmer:

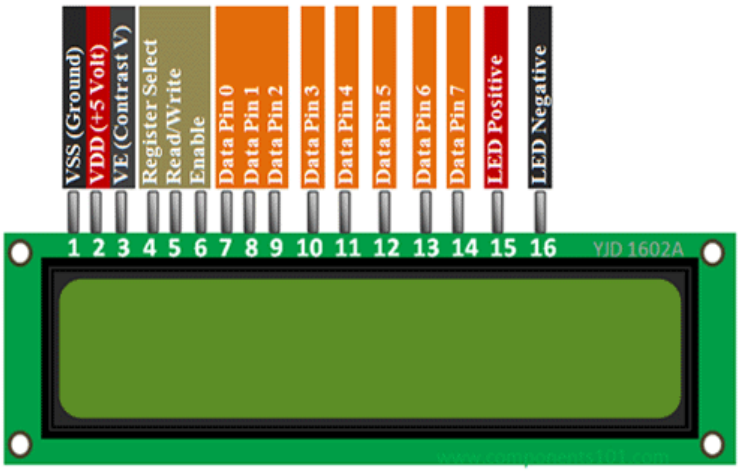


- Programmer is a hardware device accompanied by software that is used to transfer the machine language code to the microcontroller from the PC.

d) 16x2 Lcd Display:



- Its widely used because of its affordable price.
- As it's a 16x2 lcd display, it has 16 columns, 2 rows and can display a total of 32 characters.
- Pin configuration of lcd display,



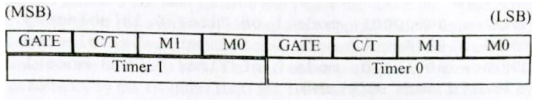
v. CODE:

```
#include<reg51.h>
sbit rs=P2^7;
sbit rw=P2^6;          // DEFINING PIN CONNECTION BTW LCD & 8051
sbit en=P2^5;

void delay(unsigned int)  ;
void cmdwrt(unsigned char);       // DEFINING 3 FUNCTIONS
void datawrt(unsigned char);
void main (void)
{
unsigned long int pulses;
unsigned char i;
unsigned int s1,s2,s3,s4;
unsigned char d1,d2,d3,d4,d5,d6;          // INITIALISING INT'S AND CHAR'S
unsigned char cmd[]={0x38,0x01,0x06,0x0c,0x82};
unsigned char msg[]={"Freq: "};
unsigned char msg2[]={" Hz"};

for(i=0;i<5;i++)
   {
   cmdwrt(cmd[i]);                        // FOR SENDING COMANDS TO LCD
   delay(1);

   }                                 // TMOD =>
```




```
while(1)
{
TMOD=0x51;              /*TIMER0, TIMER1 IN MODE-1 OPERATION &
```

```
TL1=0;                    TIMER1- COUNTER, TIMER0- DELAY GEN*/
   TH1=0;
TR1=1;                     // TO START TIMER1
      delay(100);
TR1=0;                     // TO STOP TIMER1

pulses= TH1*256 + TL1;     /*COUNT VALUES WILL BE STORED IN
pulses=pulses*10;             TH1,TL1 RESPECTIVELY*/

d1=pulses%10;
s1=pulses%100;
s2=pulses%1000;
s3=pulses%10000;
s4=pulses%100000;          /*FREQ IS MADE INTO 1BYTE TO MAKE
d2=(s1-d1)/10;                IT EASY TO DISPLAY IT ON LCD*/
d3=(s2-s1)/100;
d4=(s3-s2)/1000;
d5=(s4-s3)/10000;
d6=(pulses-s4)/100000;
cmdwrt(0x01);
delay(1);
for(i=0;msg[i]!='\0';i++)
datawrt(msg[i]);
if(pulses>=100000)
datawrt(0x30+d6);
if(pulses>=10000)          /*CONV OF FREQ VALUE TO ASCII
datawrt(0x30+d5);             FOR DISPLAYING IT ON LCD*/
if(pulses>=1000)
datawrt(0x30+d4);
```

```
if(pulses>=100)
datawrt(0x30+d3);
if(pulses>=10)
datawrt(0x30+d2);
datawrt(0x30+d1);
for(i=0;msg2[i]!='\0';i++)
  datawrt(msg2[i]);
delay(1000);
}
}

void cmdwrt (unsigned char x)   // FOR SENDING COMMANDS TO LCD
{
   P0=x;
   rs=0;
   rw=0;
   en=1;
   delay(1);
   en=0;
}

void datawrt (unsigned char y)    // FOR SENDING DATA TO LCD
{
   P0=y;
   rs=1;
   rw=0;
   en=1;
   delay(1);
   en=0;
}
```

```
void delay(unsigned int z)        //FOR DELAYGENERATION USING TIMER0
{
  unsigned int p;
  for(p=0;p<z;p++)
  {
   TMOD=0X51;
   TH0=0xfc;
   TL0=0x66;
   TR0=1;
   while(TF0==0);
   TF0=0;
   TR0=0;
  }
}
```

3. RESULT:

It has been observed that using a 10Kohm potentiometer has given a frequency range of 200Hz to 2000KHz on the LCD whereas replacing it with 20Kohm has extended the bandwidth by x10 i.e from 200Hz to 20KHz.

4. REFERENCES:

(1) EmbeTronicX
(2) SlideShare
(3) Electonicwings

THANK YOU