Digital Frequency Counter

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Abstract*— Digital frequency meter with LCD display can be used to measure frequency of square wave. With little bit modification in this embedded systems project we can also measure frequency of sine wave. We will also discuss it at the end of this article. In this digital frequency meter PIC16F877A microcontroller is used to measure frequency with the help of external interrupt and 16×2 LCD is used for digital display of frequency.

Keywords—Microcontroller, LCD display, frequency,555P Timer.

I. INTRODUCTION

This Digital frequency meter is a general purpose instrument that displays the frequency of a periodic electrical signal to an accuracy of three decimal places. It counts the number events occurring within the oscillations during a given interval of time. As the preset period gets completed, the value in the counter display on the screen and the counter reset to zero. Various types of instruments are available which operates at a fixed or variable frequency. But if we operate any frequency meter at different frequencies than the specified range, it could carry out abnormally. For measuring frequencies, we are using PIC16F877A microcontroller. For generating frequency we are using a NE555P timer IC.

II. METHODOLOGY

A. Componenet Discription

Required Instruments:

1. PIC16F877A Micro-Controller
2. 16x2 display module
3. 20 MHz Crystal Oscillator
4. Voltage regulator
5. 9V DC Battery
6. Potentiometer
7. Resistor
8. Capacitor
9. Jumper wires

Micro-Controller (PIC16F8773a):

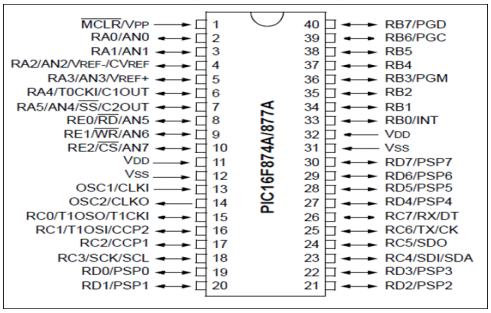


Fig.1. Microcontroller

- Operating frequency: 20MHz.
- ROM: 4k
- RAM 128 bytes
- Source current :25mA

20 MHz Crystal Oscillator:

Fig 2.Heart beat sensor module

- Frequency: 20 MHz
- Load Capacitance:20 pF
- Frequency tolerance: 20 ppm

16x2 Display Module:

Fig 3. 16*2 LCD Display Module [7]

- Perfect contrast and brightness
- The Blue Vision
- High contrast ratio by advance technology

Potentiometer:

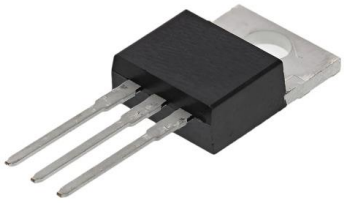
- Power rating: 0.3W
- Rotational life:2000k cycle
- Resistance: 0-100k

NE 555P Timer

- Operating voltage: +5V
- Trigger voltage: 1.6
- Source & sink current: 200mA

9V DC Battery:

Voltage Regulator:



- LM7805 voltage regulator that outputs +5V
- Output current up to 1.5A
- 3 terminal regulator

B. System Description

The PIC 16F877A-based Hz-MHz range frequency counter is the one that was built for this project's frequency counter. The highest level of microcontroller technology is employed to create high frequency range counters. Numerous PIC microcontrollers may function as frequency counters. PIC 16F877A is the chip used in this project. Figure 1 depicts the block diagram for this frequency counter.

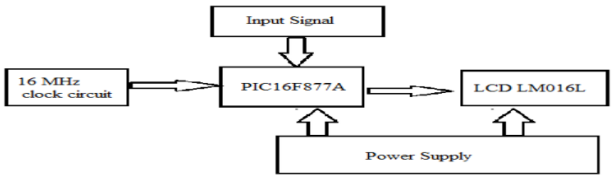


Figure 4: Block Diagram of PIC 16F877A based Frequency Counter

At PORT C's pin 15, the input is delivered to the PIC. PIC and LCD supply voltage is +5 V DC. With the aid of software, the PIC 16F877A measures the incoming signal. To manage the process as hardware, an LED is connected to pin 4 of PORT C. Pins 13 and 14 are used to connect to the oscillator. The desired oscillator type can be chosen by the designer based on the circuit. Figure 2 depicts the connections diagram for the HS, XT, and LT types of oscillator. The capacitors' values that are connected to the crystal are based on its frequency. the values of the capacitors that must be connected in relation to the crystal's frequency.

C. Circuit Diagram

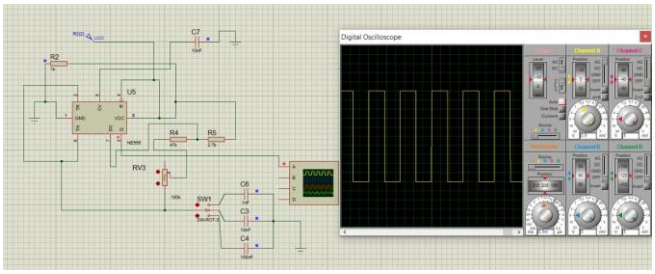


Figure 5: Square wave signal generator by NE555P Timer

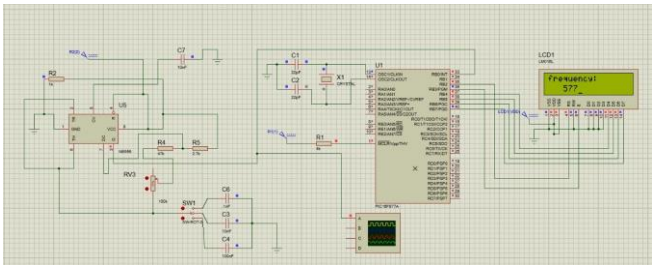
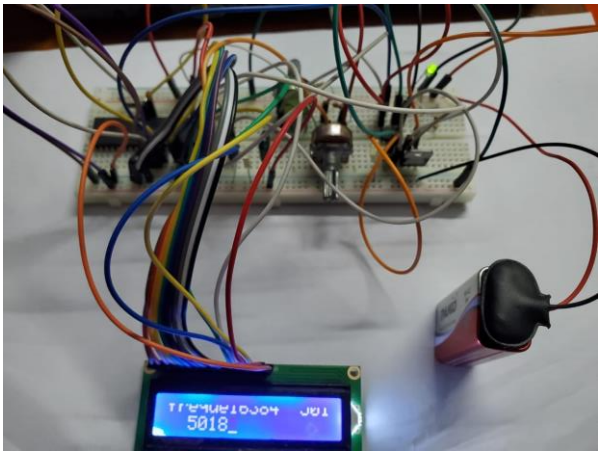


Figure 6: Digital Frequency Counter

D. Breadboard Implementation

The circuit has been implemented using a breadboard. Below is a description of the breadboard implementation without.



E. Working principle

The project is consist of two parts one is square wave signal generator and another part is to measure frequency of this generated signal and which is shown on LCD display with the help of PIC16F877A microcontroller.The signal generator is made with a timer NE 555P.In our project we works it like an astable multivibrator which generates square wave . By using potentiometer of 100k Ohm we can vary the range of frequency 0 to 1200khz which generated.After generating the frequency the output from this of pin no-3 connect it to the microcontroller input pin no 33.Like this way microcontroller get the square wave as a input.To show the generated signal in LCD display we connect the microcontroller output to LCD display. We are aware that the relationship between frequency and time is inversely proportional.

Frequency = 1 / time period

With this method, we are unable to directly estimate frequency based on the above connection. In this project, the square wave's time period is measured first and then transformed into frequency utilizing the relationship between frequency and time period mentioned above.
The timer and external interrupt at rising edge of the PIC16F8877A microcontroller are used to measure the square wave's period. An algorithm is created to translate frequency into time period. Digitally displayed measured frequency is shown on a 16 * 2 LCD.

F. Result

Finally, a frequency counter or frequency meter counts the number of events that occur within a predetermined time frame. Pulses are fed into the timer/counter, such as those from a square wave generator. The counter on the microcontroller then delays, counts, and accumulates the incoming signal pulses at predetermined intervals.

III. Cost analysis

Name	Quantity	Cost (Taka)
PIC16F8773A microcontroller	1	300
16*2 LCD display	1	200
LM7805 voltage regulator	1	15
Potentiometer	2	50
9V DC battery	1	35
20 MHz crystal oscillator	1	10
Breadboard	1	80
Resistor	5	10
Capacitor	6	12
NE555P Timer	1	12
Jumper wire	40	80
Total Cost		**804**

IV. Application

- To evaluate radio equipment
- Determining the pressure, temperature, and other physical parameters.
- Measuring strain and vibration
- Transducers for measurement

V. Limitation

- We can find the approximately exact value of square wave signal frequency on LCD display but can't find the exact value because of real time operating issues of microcontroller .
- We can only measure the frequency 0 to 12kHZ.
- Here we generate only square wave signal that's why our project can measure the square wave signal frequency.

VI. Conclusion

From the observation above, it can be concluded that the manufactured heart rate meter costs less (about Tk. 900) than the regular heart rate meter (Costs Tk. 1000, approximately). Due to the lack of complicated features, our designed meter can be operated by any non-medical experts. Because it is transportable, anyone can carry the meter without any difficulty. However, it is important to verify that the fingertip is placed correctly over the pulse sensor. If not, the meter can display false data. More and more, we should focus on designing and developing medical devices that are affordable and have the capacity to simultaneously record multiple physiological indicators. The use of a gadget that can simultaneously record multiple physiological parameters will make all types of treatment easier.

VII. FUTURE WORK ON THIS PROJECT

In our project we generate only square wave signal and measure the frequency of that signal. With little bit modification ;op- amp can be used as a comparator; in our project we can also generate others type of signal such as (triangular signal, sawtooth , sine wave) signal and also measure the frequency of these signal and measure the frequency of these signal and show them in our LCD display.

VIII. ACKNOWLEDGMENT

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[5]NE 555P Timer, https://datasheetspdf.com/pdf/454335/Fairchild/NE555/1