INDIAN INSTITUTE OF INFORMATION TECHNOLOGY NAGPUR

A Project Report

on

Digital Capacitance Meter

Submitted for partial fulfilment for the minor project of

Electronic Instrumentation

in

Department of Electronics and Communication Engineering

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Declaration

I hereby declare that the work reported in the B.tech report entitled "Digital Capacitance Meter" submitted at Indian Institute of Information Technology, Nagpur India is an authentic record of my work carried out under the supervision of Dr. Vipin Kamble. I have not submitted this work elsewhere for any other degree.

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Abstract

In this project our objective is to build a simple Digital Capacitance Meter, a device for measuring capacitance, with a range of about 1 nano Farad to 100 micro Farad. When we come across circuits in attempt to repair it, we need to know the capacitance of particular capacitor in the board to eliminate the fault. We face a problem in getting the exact value of capacitor from the board. We can buy equipment for measuring the capacitance, but such device is costly. So, with that in mind we have designed a simple Digital Capacitance Meter using Arduino to measure the capacitance of unknown capacitors. Digital capacitance meter using Arduino relies on the basic property of capacitor i.e. the time constant. Larger capacitors take more time to charge, and therefore have larger time constants. An Arduino can measure capacitance because the time a capacitor takes to charge can be measured using Arduino.

Chapter 1

Introduction

1.1 Arduino Uno

Arduino Uno is a microcontroller board based on the ATmega328P Microcontroller. It has 14 digital input/output pins, 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. Arduino is a open source platform that can be used to design various electronic projects. Arduino uses its own IDE which is a simplified version of C++, making it easier to learn to program.

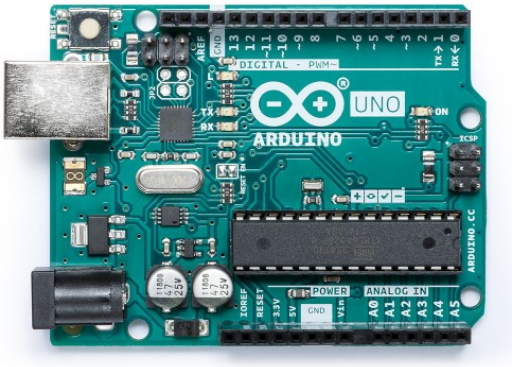

Figure 1.1: ARDUINO UNO

1.2 Schmitt Trigger

Schmitt trigger has a threshold voltage based on which the output is calculated. If the input voltage applied is greater than the threshold voltage, output goes high. If voltage applied is less than than threshold, output goes low. It is not safe to directly give the ic 555 output to arduino uno, hence it is first passed through Schmitt Trigger.

Figure 1.2: Schmitt Trigger

1.3 IC 555

IC 555 is a 8 pin IC. It is used in astable mode, in which output oscillate at a particular frequency and generate pulses in rectangular wave form. The capacitance of a capacitor cannot be measured directly using Arduino UNO, as the UNO deals with digital signals and it cannot measure capacitance directly. So we use 555 square wave generator circuit.

Figure 1.3: IC 555 Timer

Chapter 2

Problem Statement

Capacitor is one of the basic component of electronics and have host of various applications. It is a basic storage device to store electrical charges and release it as it is required by the circuit. Capacitor is widely used in electronics circuits to perform variety of tasks, such as smoothing, filtering, bypassing etc...
But sometimes they are broken or the value printed on the capacitor has become unreadable. And many multi-meter's does not have capacitor measurement. So we decided to make a simple easy to use capacitor meter that could be used in laboratories to measure capacitor values of range 1 nF to 1000 uF.

Chapter 3

How it works

This section explains the working of the Digital capacitance Meter.

3.1 Methodology

We have come up with a prototype of the Digital Capacitance Meter. In this project our objective is to build a simple digital capacitance meter, a device for measuring capacitance, with a range of about 1 nano Farad to 100 micro Farad. For range of 1 nF to 10 uF, we have used a Square wave Generator Circuit i.e. IC 555 in Astable mode. IC 555 is connected to Arduino, where we have connected the Capacitor whose capacitance needs to be measured. A Schmitt trigger gate (IC 74LS14) is used to ensure that only rectangular wave is fed to Arduino. For range of 10 uF to 1000 uF, we use pin 13 to charge the capacitor through the 10K ohm resistor. Once the charging of capacitor starts we start the time counter in micro seconds. We measure the voltage with the analog input A0 of the Arduino. The Arduino ADC has 10 bits so 0 volts would be 0 and 5 volts would be 1024. So 63.2 % of 1024 is 648. When the analog

read reaches this values we stop charging the capacitor and the time counter as well. We obtain the C value dividing the elapsed time by the resistor value. After getting the value of capacitor we display the value of the capacitor on the LCD dispaly and the scale used for measurement is also displayed.

3.2 Circuit Diagram

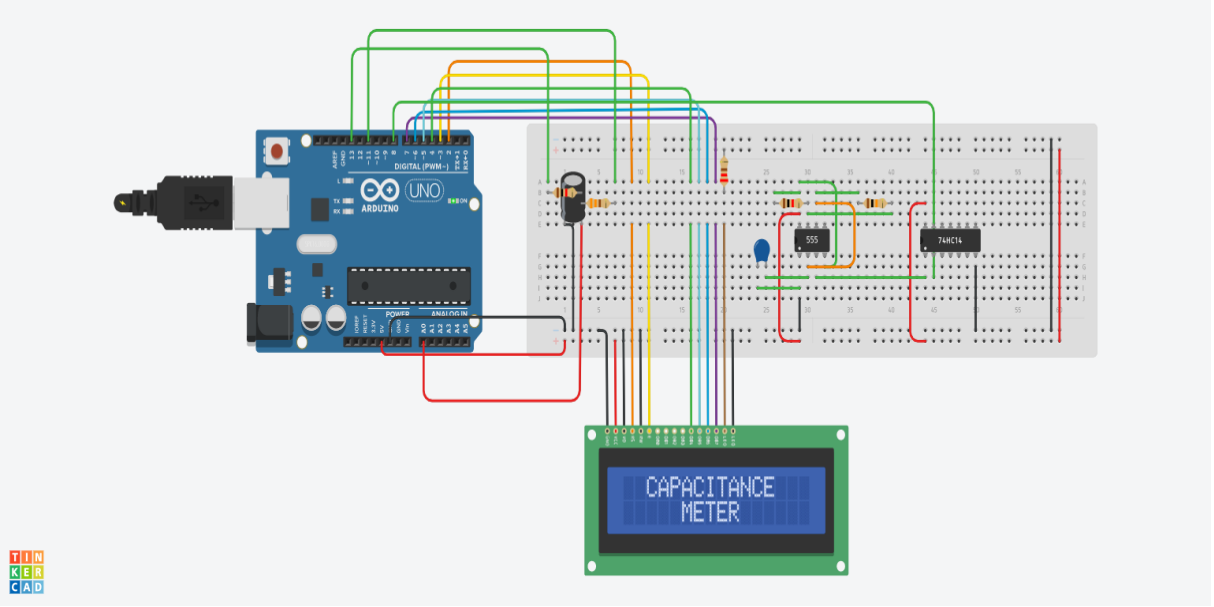

Figure 3.1: CIRCUIT DIAGRAM

3.3 Flowchart

FLOW OF CONTROL:

1. Digital Capacitor Meter Displays Message and prompts the user to Enter Choice.
2. Select the appropriate Range as displayed on Serial Monitor.
3. Enter the choice in the Serial Monitor.
4. LCD displays in which position Capacitor is to be inserted.
5. Insert the Capacitor in appropriate position. In each position black wire denotes ground terminal.
6. Digital Capacitor Meter displays the Scale and the value of the capacitor.

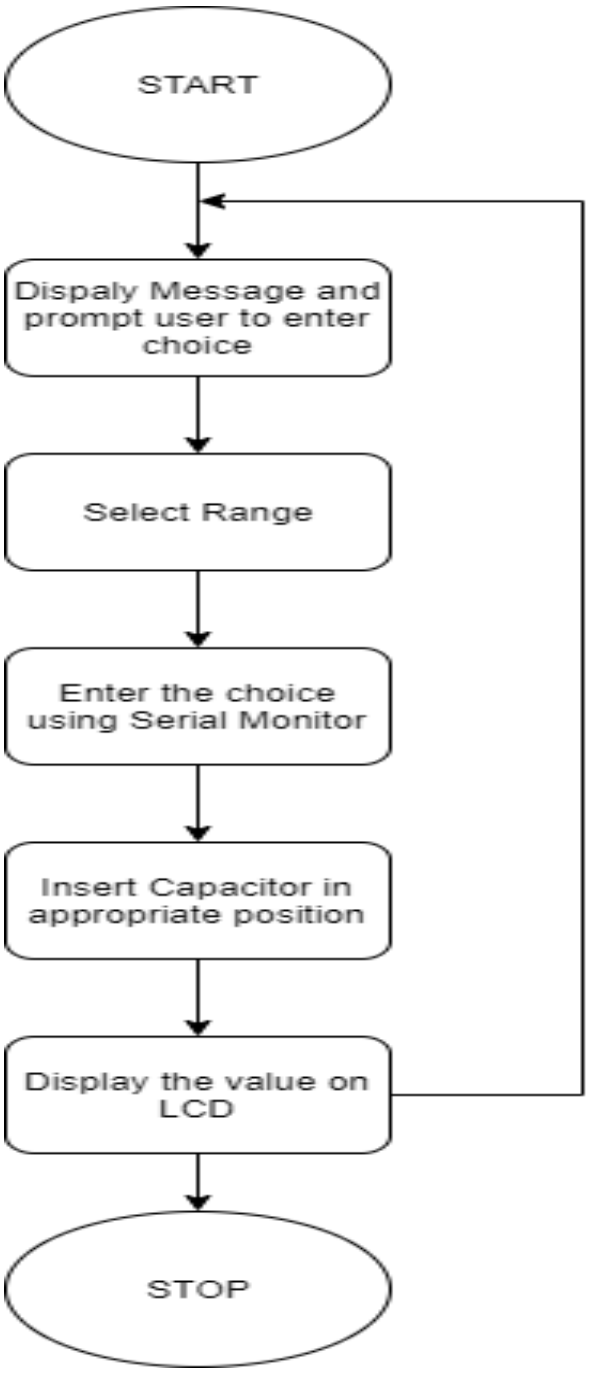

Figure 3.2: FLOW CHART

Chapter 4

Result

We have successfully measured the capacitance of the the capacitors in the range of 1 nF to 1000uF. Overall error of the Digital Capacitance Meter is approximately 3.7 %.

Figure 4.1: 470 uF Capacitor

Figure 4.2: 220 nF Capacitor

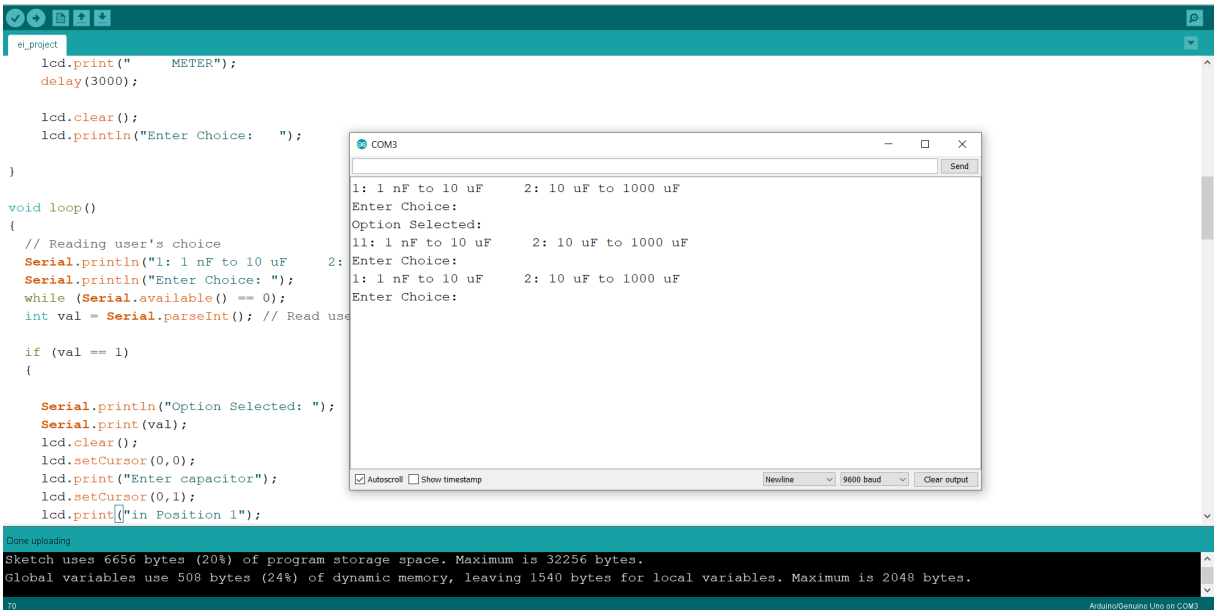

Figure 4.3: Display for User input

Chapter 5

Conclusion

The results after the successful completion of the project are as follows

- We had come to know that we can get the value of capacitor if we know time constant and if we use known resistance.
- We have learned that we can get time constant for the capacitor if we use IC 555 in Astable mode.
- The project mainly focuses on building capacitance meter as an alternative to expensive such meters available in market and we were successful in doing so.

Chapter 6

Difficulties Faced

In our way to complete this project we encountered many difficulties that are mentioned below.

- The interfacing of LCD display with Arduino.
- Interfacing of the switch with Arduino when two different part are to executed separetly.

References

[1] Dilip Raja. Capacitance meter using arduino, 2 2016.

[2] Wisnu Djatmiko. Capacitance measurements system using rc circuit. *3rd UNJ International Conference on Technical and Vocational Education and Training 2018*, February 2019.