VIVEKANAND EDUCATION SOCIETY'S

INSTITUTE OF TECHNOLOGY

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ELECTRONIC WORKSHOP - 2

REPORT

Report Title: Digital Voltmeter using 89C51

PROJECT MEMBERS:

1. Ajay Patkar 59
2. Prasad Pawaskar 61
3. **Vishal Thakur 74**

Digital Voltmeter Using 89C51 Micro controller

Prasad Pawaskar
Electronics T.E.
Vivekanand Institute Of technology Mumbai

Ajay Patkar
Electronics T.E.
Vivekanand Institute Of technology Mumbai

Vishal Thakur
Electronics T.E.
Vivekanand Institute Of technology Mumbai

Abstract – Digital voltmeter as the name suggests is a microcontroller based project. The main objective of this paper is to perform a project to get digital voltage reading from an analog source and display the voltage value digitally on a LCD display.

Index Terms – Introduction, Working Principle .Block Diagram, Circuit Diagram, Circuit Explanation, Features, Advantages, Disadvantages, Conclusion.

I. INTRODUCTION

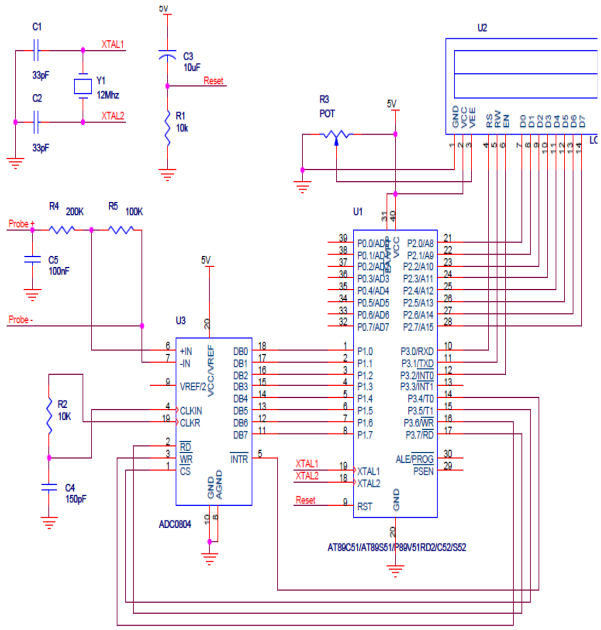
The digital voltmeter basically is the model of demonstrating the use of analog to digital converter with the most popular micro controller IC – 89C51.

What we have done is simply interface an ADC to a 89C51 and a LCD display to the output ports of 89C51. Thus , the ADC takes in input analog voltage and converts it to digital while 89C51 displays it on the LCD display

The basic schematical layout of this project is as shown in fig a.

This circuit consists of following components:

1. 89C51 Based Controller: 1
2. ADC0804: 1
3. LCD 16x1: 1
4. Potentiometer 10K: 1
5. Resistor 10K: 2
6. Resistor 200K: 1
7. Resistor 100K: 1
8. Capacitor 33pF: 2
9. Capacitor 10uF: 1
10. Capacitor 150pF: 1
11. Capacitor 100nF: 1
12. Crystal 12Mhz: 11



II. Circuit Explanation

The circuit shown in fig. is explained as follows showing the operation of each component:

ADC

This is used to convert the analog input voltage to digital output voltage. As seen in the figure a. the input probes i.e. Probe+ and Probe- are connected to the IN+ and IN- terminals of the ADC through a voltage divider circuit. The 8 bit output is connected to the Port 1.0 to Port pins P1.7. RD', WR' , CS' and INTR are interfaced with RD' WR' T1 T0 of 89c51 respectively. The o/p of ADC is 8 bit digital representation of the input analog voltage.

Micro controller 89c51

The micro controller 89c51 forms the basic heart of the project. It gets input from the ADC i.e. it reads the output of the ADC. While on the other hand it gives output to the LCD or in other words 89c51 drives the LCD unit

Voltage reference

This is a simple voltage divider network that is used to get input to the input pins of the ADC.

L C D driver

The micro controller itself acts as the LCD driver unit.

L C D Section

The LCD forms the output of the project. The digital voltage received by the micro controller as to be converted into some particular limit so that it can be displayed on the LCD. The output available on LCD is the digital representation of the analog input voltage. The inputs to it are the 8 bit digital output from the micro controller.

III. Block diagram

The operation of the entire circuit can be shown as follows in the form of following block diagram:

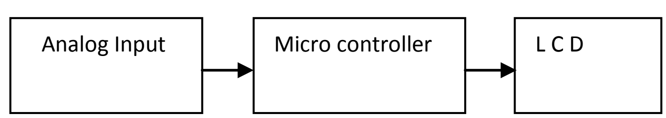


Fig b. Block Diagram

1. **Analog Input**

This is the input section of project. We apply analog voltage to positive and negative terminal of ADC. This voltage is applied to voltage divider network.

2. **Micro controller:**

This section provides controlling of digital voltage that is applied to ADC .The digital voltage which is taken from the ADC is compared to the reference level set in the micro controller. Port 1 is used as input port. Port 2 is used as output port. Port 3 is used as control signals. Port 0 is not used.

3. **LCD**:

LCD is used to display digital output. It is the output section of the project.

IV. Working Of Circuit

This project aims at building a Digital Voltmeter using an 8051microcontroller. All the data accessed and processed by them microcontroller is the digital data. And thus, the usage of an analog-to-digital converter finds its necessity here. A standard analog-to-digital converter ADC0804 is used in the current project. The input voltage (which is the analog input)is restricted to be in the range of 0-15V. The processed data in the 8051 is used to drive a display output on a LCD display unit. The display is in the form of digits and is accurate to a value of one decimal. The input voltage is desired to be that of a DC voltage for steady observations of the voltage value on the LCD panel. Rather, if an AC input voltage is given at the input terminals, the output varies indefinitely as is the nature of AC voltage. Thus, the instantaneous value of the AC voltage is not steadily shown on the LCD panel.

V. Applications Of DVM

- Used in conversion of analog voltage to digital voltage.
- In Laboratories for displaying digital voltage.
- It is used in applications where we require high accuracy.

VI. Advantages

The digital voltmeter designed uses a microcontroller which is said to be highly efficient in handling the data carrier operation in terms of being faster and being error-free and accurate. Thus, it can be considered as a reliable device for observing voltages of magnitudesfrom0 to 14V. Rather than using the obsolete analogue ways of finding out the voltages, the digital voltmeter provides much more precise and accurate values of voltages in a given circuit in the range of the voltmeter.

VII. Calculation

All we want is input voltage to ADC should not increase 5V and our maximum input voltage to voltmeter is 15V only. So we design the voltage divider circuit as follows.

V_{max} is Maximum input voltage to voltmeter.

V_{ip} is input voltage to ADC.

R_1 and R_2 are resistance of voltage divider circuit.

$V_{max} = 15V$

$V = R_2 * V_{max}/(R_1+R_2)$

$5/15 = R_2/R_1+R_2$

$3 = R_1/R_2+1$

$2 = R_1/R_2$

$R_2 = R_1/2$

Let's take R_1 as 200K and R_2 will be 100K

Maximum current: $I_{max} = (V_{max}-V_{i/pmax})/R_1$ (approx)

$V_{max} = 15V$

$V_{i/pmax} = 5V$

$R_1 = 200K$

$I_{max} = (15-5)/200 = 10/200 = 0.02mA$

VIII. References

The following were some of the websites used to prepare this paper.

1. www.electroschematics.com
2. www.youtube.com
3. www.efy.com
4. Multisim By National Instruments

IX. Future Scope

This project can be further improved by adding an Atmega8 IC technology to it and also making scope for measurement of very slight change by adding more decimals.

X. Code

```
lcd_cmd equ 0800h
lcd_st  equ 0801h
lcd_wr  equ 0802h
lcd_rd  equ 0803h
DAC equ 0600h
   ORG 08100h
DVM:    mov P2, #(lcd_cmd SHR 8)
   mov R0, #(lcd_cmd AND 255)
   mov R7,#00h
   mov dptr, #mesg3
   acall   wr_string

   mov R7,#40h
   mov dptr, #mesg3
   acall   wr_string

   mov R7, #01h
   mov dptr, #mesg1
   acall   wr_string

   mov R7, #41h
   mov dptr, #mesg2
   acall   wr_string
   acall   start

   acall   print_hex3

sjmp DVM
Start:
   mov dptr,#DAC
   mov R7,#10000000b
   mov a,#0
nxtbit: xrl a,r7
   movx    @dptr,A
   acall   delay
   jb  P3.5,keep
   xrl a,R7
keep:   xch a,R7
   clr c
   rrc a
   xch a,R7
   jnc nxtbit
   cpl a
   ret

wr_string:  acall   lcd_busy
   mov a, R7
```

```
    orl a, #080h
    movx    @R0, a
nxt_char:
    acall   lcd_busy
    clr a
    movc    a, @a+dptr
    inc dptr
    jz  str_end

    mov R1, #(lcd_wr AND 255)
    movx    @R1, a
    sjmp    nxt_char
str_end:    ret

lcd_busy:
    mov R1, #(lcd_st AND 255)
    movx    a, @R1
    jb  acc.7, lcd_busy
    ret

print_hex3:
    PUSH   ACC
    SWAP   A
    ANL    A,#0FH
    ADD    A,#HEXstring3-mvcoff3a
    MOVC   A,@A+PC
mvcoff3a:
    ACALL  char_from_Acc
    POP    ACC
    ANL    A,#0FH
    ADD    A,#HEXstring3-mvcoff3b
    MOVC   A,@A+PC
mvcoff3b:
    AJMP   char_from_Acc
HEXstring3:
    DB     '0123456789ABCDEF'

Char_from_ACC:  push    acc
        acall lcd_busy
        pop acc
        mov R1, #(lcd_wr AND 255)
        movx    @R1, a
        ret

mesg1:  db  "DVM Prog ",0
mesg2:  db  "Voltage = ",0
mesg3:  db  "                ",0

Delay:  MOV R0, #05h
loop1:  MOV R1, #08h
```

```
loop2:
   DJNZ    R1, loop2
   DJNZ    R0, loop1
   ret
div16_16:
  CLR C
  MOV R4,#00h
  MOV R5,#00h
  MOV B,#00h
div1:
  INC B
  MOV A,R2
  RLC A
  MOV R2,A
  MOV A,R3
  RLC A
  MOV R3,A
  JNC div1
div2:
  MOV A,R3
  RRC A
  MOV R3,A
  MOV A,R2
  RRC A
  MOV R2,A
  CLR C
  MOV 07h,R1
  MOV 06h,R0
  MOV A,R0
  SUBB A,R2
  MOV R0,A
  MOV A,R1
  SUBB A,R3
  MOV R1,A
  JNC div3
  MOV R1,07h
  MOV R0,06h
div3:
  CPL C
  MOV A,R4
  RLC A
  MOV R4,A
  MOV A,R5
  RLC A
  MOV R5,A
  DJNZ B,div2
  MOV R3,05h
  MOV R2,04h
 end
```