MICROCONTROLLER BASED WEIGHING MACHINE

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ABSTRACT
Embedded system is used in single task applications and it is important in process and control application such as temperature, pressure, flow, weight etc. This paper presents one such applications in which developed a model with objective of measurement and display weight. In this Load cell used as transducer, instrumentation amplifier designed by using OP-07E operational amplifier, microcontroller AT89S52 and ADC 0804 used for data processing .A program written in assembly language to display given weight on 16X2 matrix display. Finally the designed model has tested its working satisfied.

KEYWORDS: *Microcontroller, Instrumentation Amplifier, Weigh Machine*.

1. INTRODUCTION

Now a day precise measurement and storage of weight is one of the most important activities in industries. The mechanical weighing machines are now replaced by the electronics weighing machine [1] as electronic weighing machines are smart with the advantages like accuracy, reliability, and wide range. The Electronics weighing bridges are comparatively light weight and easy to operate with direct display. Earlier electronic weighing machine were designed using DPM, Microprocessor and Personal computer. The disadvantage of DPM type weigh machine has no facility to store data internally. Microprocessor and Personal computer based system cost is very high. To remove this drawback microcontroller based weigh machine has designed.
This communication presents block diagram, instrumentation amplifier, software, calibration, result and conclusion.

2. BLOCK DIAGRAM

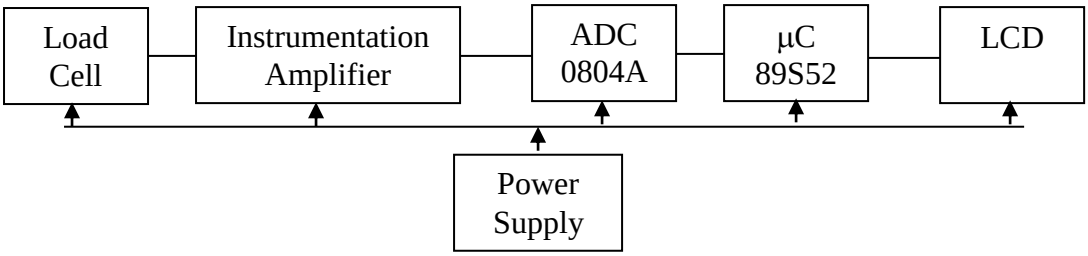

Figure 1. Block diagram Microcontroller Based Weigh Machine

Figure1 shows the complete block diagram of the microcontroller based weigh machine using microcontroller AT89S52.The load cell of aluminium material having sensitivity 1.82 mV/Kg is used. The block diagram mainly consists of instrumentation amplifier, designed by using OP07E operational amplifier. For digital data analog to digital converter (ADC0804) is used. The ADC

0804A is 8-bit Successive Approximation type of the ADC. Its conversion time is selected to 110 μs by proper selecting R and C. The Vref/2 pin is not connected so the range of the input voltage is 0-5V[2]. The O/P of ADC is given to the port P1 of microcontroller for further processing. The microcontroller AT89S52 is a 40 pin device and having 8 Kbytes ISP flash memory, 256 bytes of internal RAM, 32 bit programmable I/O lines, low power and power down mode, watch dog timer [3]. The microcontroller is interfaced to 16 X 2 matrix alphanumeric LCD to display given weight in Kg. The LCD displays alphanumeric, Greek, Roman, Japanese and Mathematical symbols [4].

3. INSTRUMENTATION AMPLIFIER

Instrumentation amplifier is a perfect differential amplifier. This circuit is the most important and sensitive part of the system, which amplifies the signal. A number of a single chip available commercially but most of these are costly components, comparatively simple and chipper has been developed. Instrumentation amplifier implemented using OP07E which is precision amplifier as shown in figure 2.

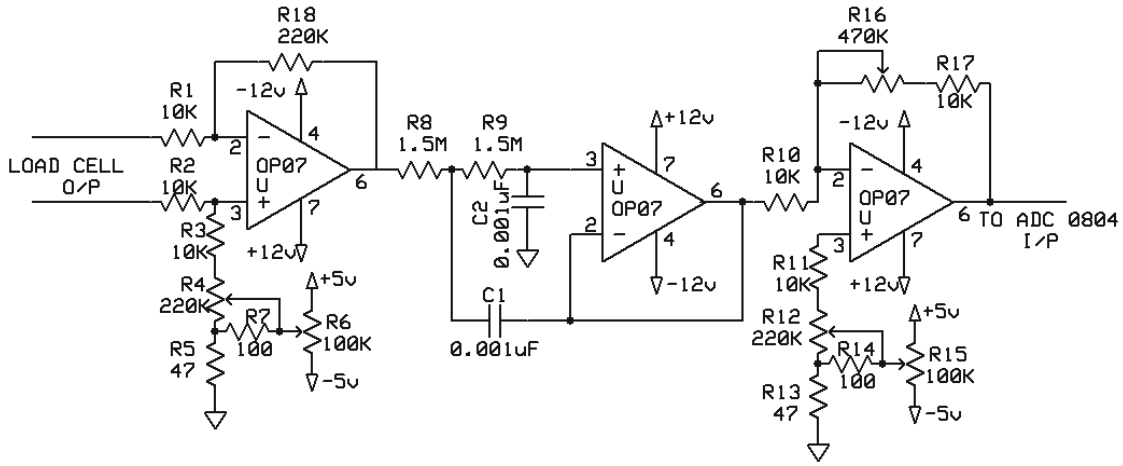

Figure 2 Instrumentation Amplifier

The first stage inverting amplifier gain,

Av1=-(R18/R1)=-(220K/10K)=-22.

The second stage reduce the noise effect, here electronic filter is used to pass the specified band of frequency. This instrumentation amplifier consists of the second order low pass filter is used for improve response. The third stage of inverting amplifier adjusts the gain by using potentiometer R16 to gain Av2= -10, so overall gain,

$A_v = A_{v1} \times A_{v2} = -22 \times -10 = 222$

Universal balancing technique is used for the offset null of OP-Amp. The OP07E is 8 pin with low Vos 75μVmax, wide input voltage range ±14V, wide supply voltage range ±3V – ±18V, low noise $0.6\mu V_{pp}$ max[2].

The table 1 shows load cell output and respected instrumentation amplifier o/p.

Table 1 Weight vs. Load cell & Instrumentation amplifier output

Sr. No.	Weight (Kg)	Load cell o/p (mV)	Instrumentation amplifier o/p (V)
1	0	5.0	1.34
2	1	6.9	1.66
3	2	8.8	1.90
4	3	9.7	2.25
5	5	13.5	3.31
6	7	17.1	3.94
7	10	20.3	4.63
8	11	21.7	4.90

4. SOFTWARE

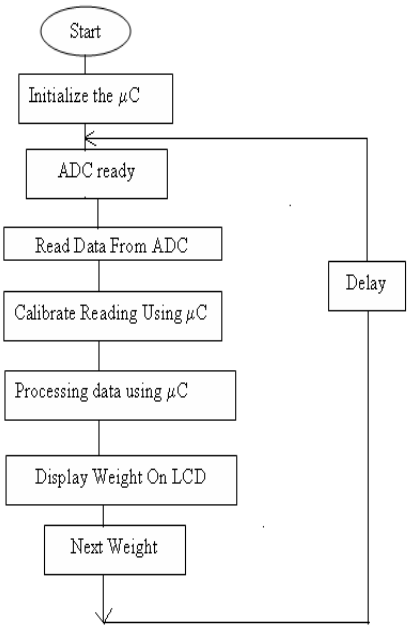

Figure 3 Flow chart Microcontroller Based weigh Machine

Figure 3 shows the various steps involved for the overall system software. The software for the microcontroller AT89S52 is programmed in the assembly language and developed hex file download in the microcontroller without removing microcontroller from the system because it has facility to in system programming. The MISO, MOSI and SCK pins of AT89S52 are mainly used for the programming flash in serial mode. After executing of the program LCD shows the data "00.00 Kg". When weight applied 10 Kg it display like 10.05 Kg.

5. CALIBRATION

Calibration of the bridge is very important and critical factor in the proper operation weighing bridge [1]. Once the system is implemented and installed along with the load cells and weighing platform placed over the load cells properly the system is ready for calibration. As soon as the switch is on, it goes in direction weighing mode it show some reading at the output of the load cell. This output at zero weight condition is amplified by the amplifier & gives some output at zero weight condition. Here calculate the hex equivalent. It directly subtracted from the given output which is called software type zero adjustment. It is easier way to the calibration and reduces the connection of external component.

6. RESULT

The table 2 shows displayed weight on LCD and weight applied to the load cell,

Table 2 Result displayed on LCD

Sr.No.	Weight (Kg)	O/P On LCD (Kg)	Error (Kg)
1	0	00.00	00.00
2	1	01.04	00.04
3	2	02.06	00.06
4	3	03.06	00.06
5	5	05.09	00.09
6	7	07.07	00.07
7	10	10.05	00.05
8	11	11.05	00.05

7. CONCLUSION

The designed machine is simple and economic. Measurement accuracy maintained through software type of calibration.

The merits of developed weigh machines are

- It can be programmed for different ranges of weight with some minor changes in software & hardware.
- It has small size, light weight and low power consumption.
- System has facility like automatic calibration, precision and range extension.

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