Department of Electronic and Telecommunication Engineering

University of Moratuwa

EN1093 – Laboratory Practice I

WEIGHT SCALE PROJECT REPORT

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Abstract

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Introduction

Main Steps of the project

Logical approach

Testing on breadboard and Simulation

Testing:

As the first step, we used Multisim to draw schematic diagrams to model the functionality of the circuit. We measure the output voltages of the power supply that voltages to load cell and microcontroller circuit.

Simulation:

As the next step, we test the circuits on the breadboards. Also we get the output voltages with respect to known weights.

Manufacturing PCBs

Frist of all we drew schematics using ALTIUM we got layouts of power supply circuit, amplifier circuit and microcontroller circuit. After that we manufactured PCBs using screen printing method. After that we drilled holes and soldered components to the PCBs.

Coding

While we were manufacturing PCBs, we developed a code using C programming language.

Testing full product

Having done all these above steps, we tested the overall functionality of the weight scale.

Making enclosure

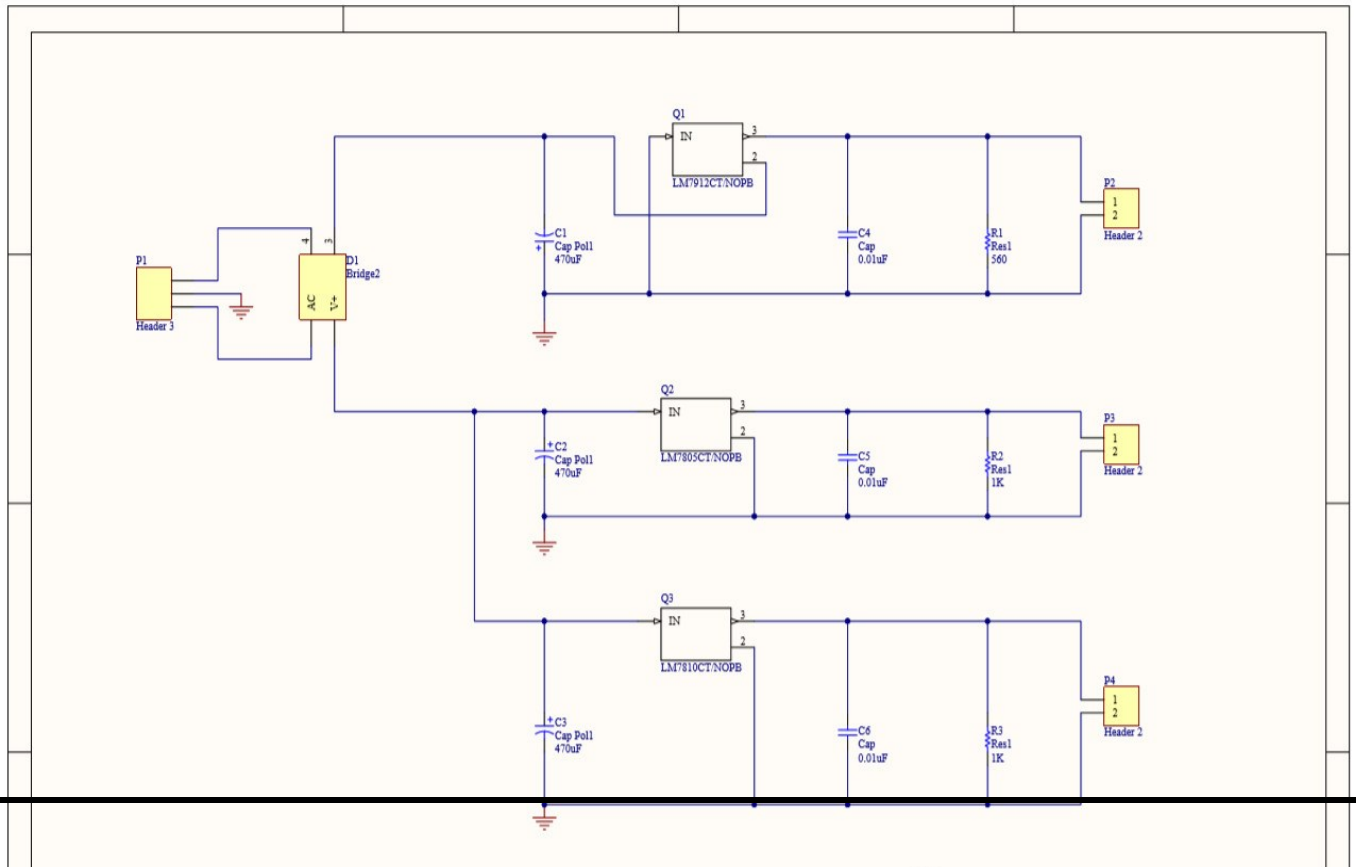
Using SOLID WORKS software, we created a suitable enclosure for weight scale. We manufactured it using wood.

1.1.1. Components Used

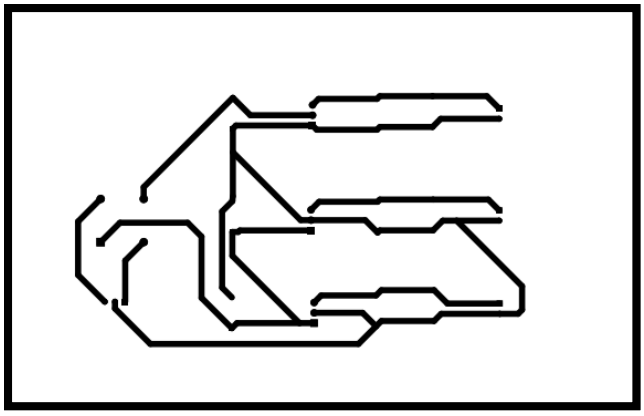
This is used to get +5V, +10V and -10V which are needed for the function of other categories. So the components used are,

- Transformer
- Rectifier IC
- Voltage regulators (LM7805, LM7810, LM7912)
- 3- 470uF, 3- 0.01uF capacitors
- 2- 1k ohm, 560ohm resistors
- Headers

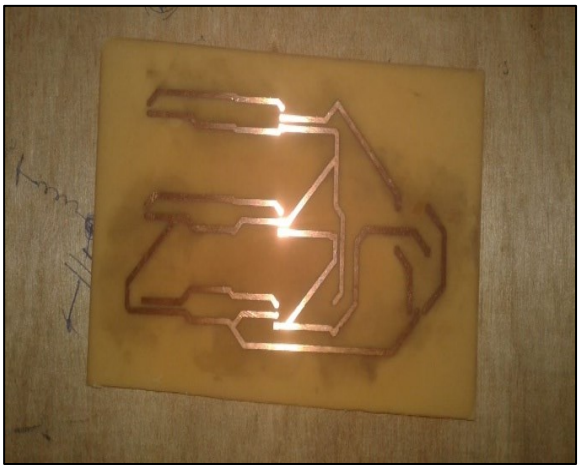
Schematic of the power supply circuit

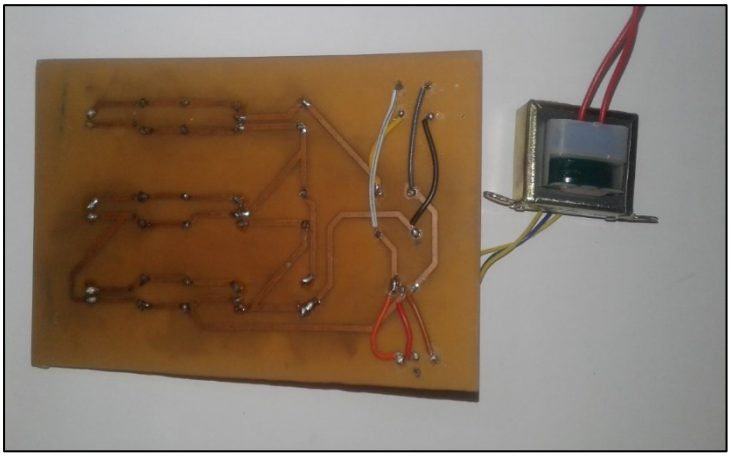


Layout of the power supply circuit



PCB of the power supply circuit





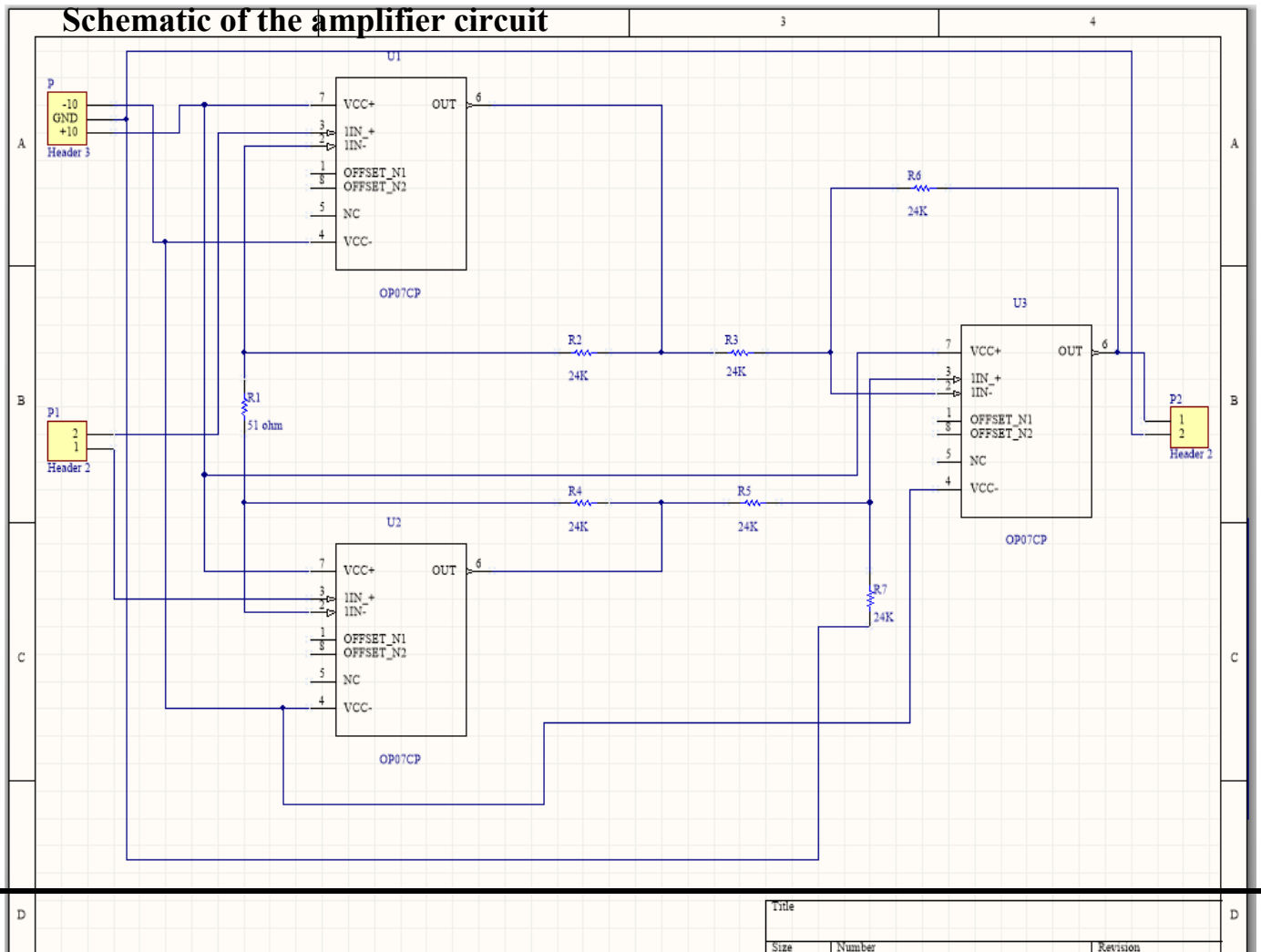
1.2. Amplifier Circuit

This is used to amplify the output voltage (mV) of the load cell.

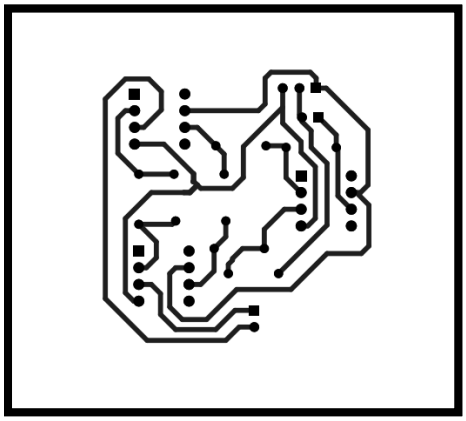
1.2.1. Components Used

- 3- Op Amps (OP07CP)
- 6- 24k ohm, 51ohm resistors
- Headers

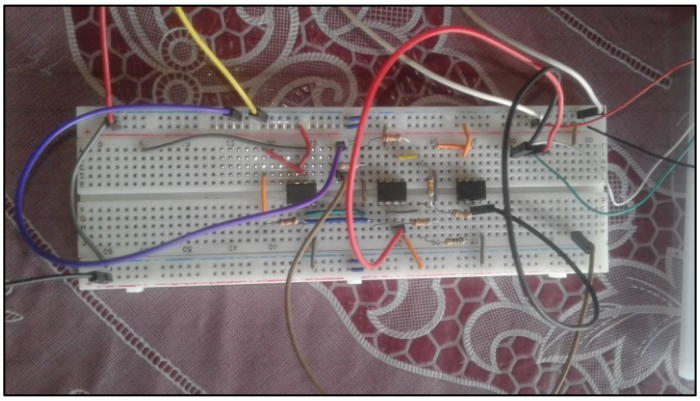
Schematic of the amplifier circuit

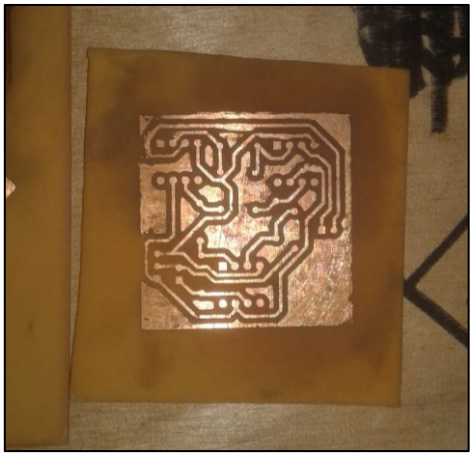


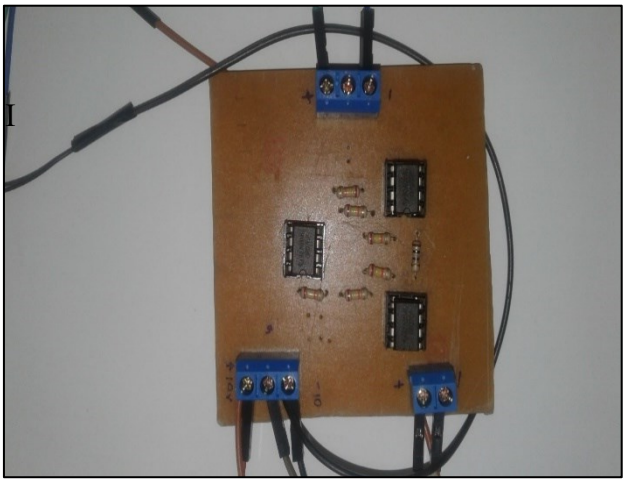
Layout of the amplifier circuit



PCB of the amplifier circuit

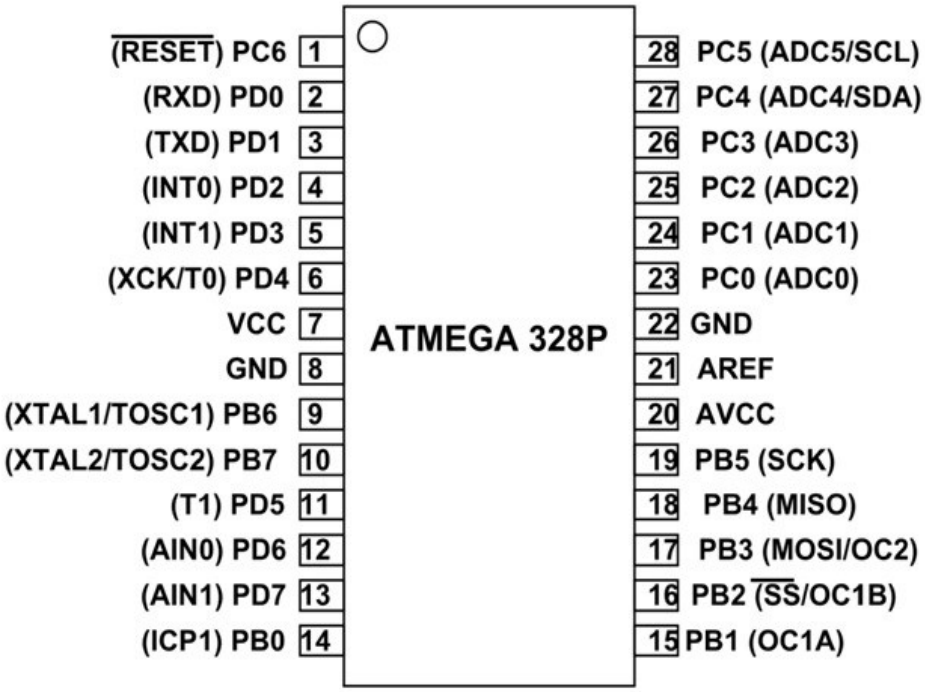






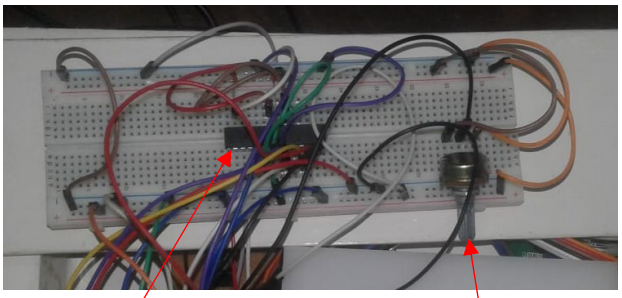
n microcontroller circuit we used Atmega 328-pn microcontroller.

1.2.2. Pin-out

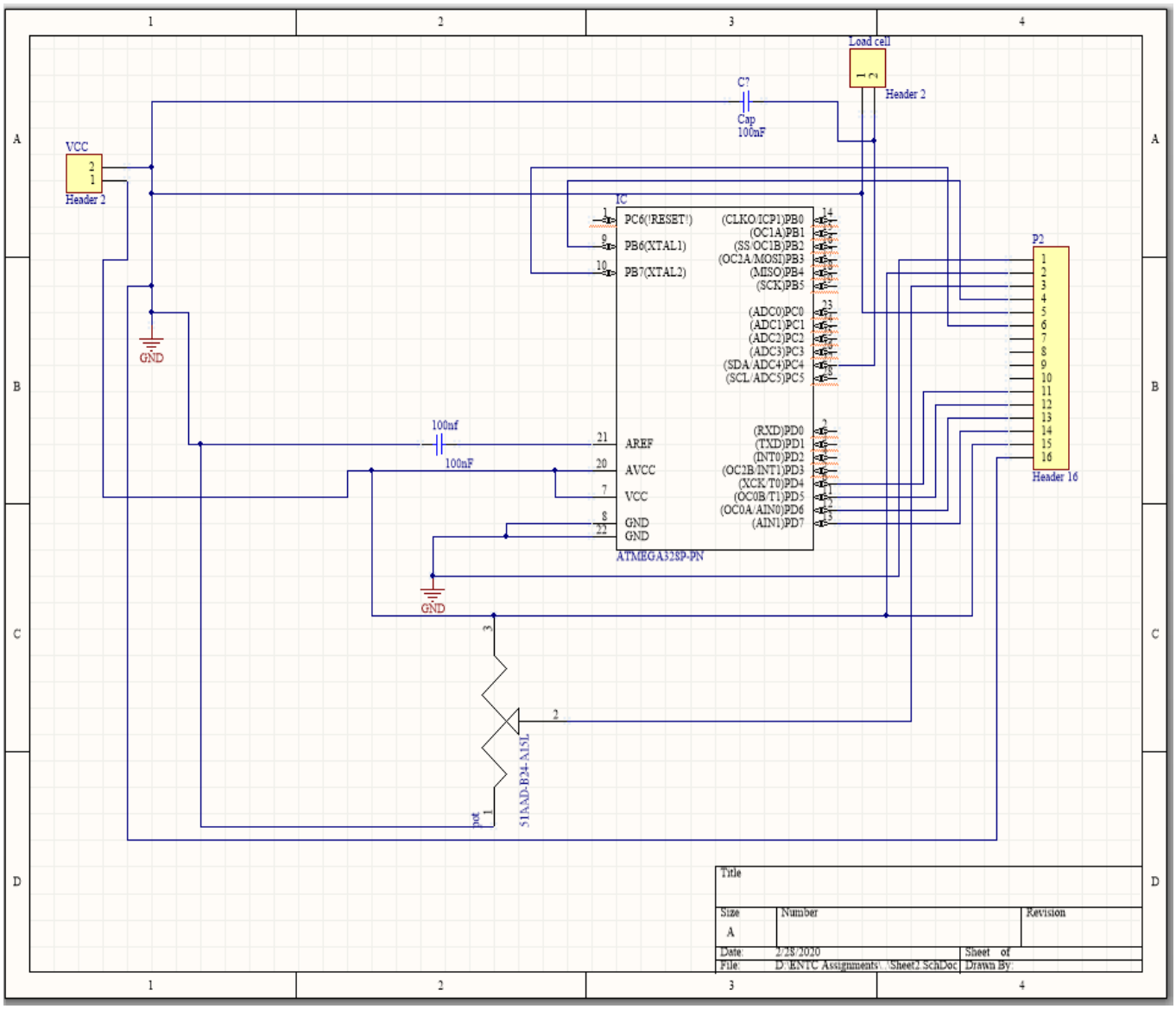


1.2.3. Components Used

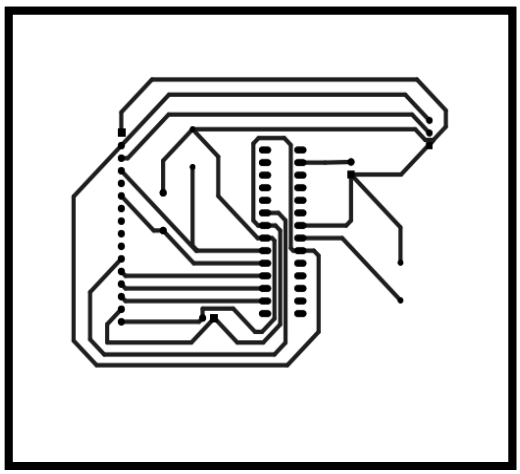
- Microcontroller (ATMEGA 328P)
- 5k ohm potentiometer
- 3- 1nF capacitors
- Headers



Layout of the microcontroller circuit



Layout of the microcontroller circuit



Code

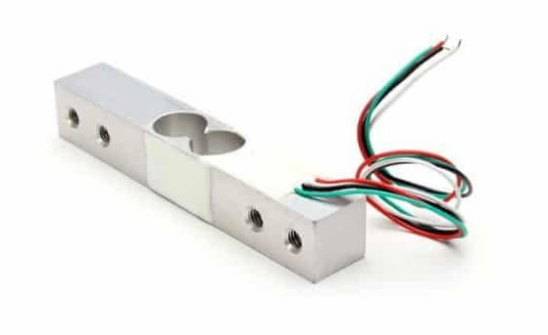
```
#define F_CPU 1000000UL
#define D4 eS_PORTD4
#define D5 eS_PORTD5
#define D6 eS_PORTD6
#define D7 eS_PORTD7
#define RS eS_PORTB6
#define EN eS_PORTB7

#include <stdlib.h>
#include <avr/io.h>
#include <util/delay.h>
#include "lcd.h"



void Adcinit()
{
	DDRC= 0b00000000;     // make port c as input
	ADMUX=0b01000100;      // using Avcc with external capacitor at vref and 10bit
	//ADMUX=0b01100000;
	ADCSRA = (1<<ADEN);


}

float AdcRead(int a)
{
	unsigned short x;
	//ADMUX=0b01100000 + a;
	ADMUX=0b01000000 + a;
```

```
	ADCSRA = ADCSRA|(1<<ADSC);
	while (ADCSRA & (1<<ADSC));
	//x=ADCH;
	x = ADC;
	return x ;
}

float y_axis,b;
int i;
char *n = "weight(g)";
int main(void)
{
	DDRB=0xFF;
	DDRD=0xFF;
	Adcinit();
	Lcd4_Init();
	 while (1)
	 {
		b = 0;
		for (i = 1; i < 1000; ++i)
		{
			y_axis=AdcRead(4);
			y_axis=(y_axis*11 -2939);
			_delay_ms(1);
			b = b + y_axis  ;
		}
		b = ((b/999)-116);
		char *y="00000";
		itoa(b,y,10);
		Lcd4_Clear();
```

```
            Lcd4_Set_Cursor(1,0);
            Lcd4_Write_String(n);
            Lcd4_Set_Cursor(2,0);
            Lcd4_Write_String(y);
            _delay_ms(1000);
        }


}
```

Calibration

What is a load cell?



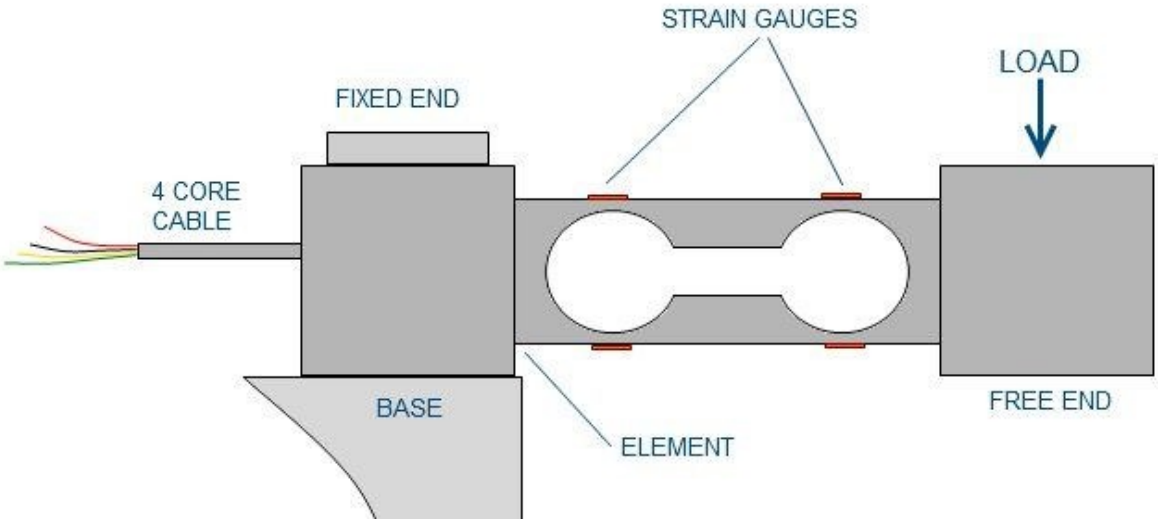
This is a type of transducer. A transducer is a device which converts energy from another parameter like an electric signal. It converts a force such as tension, compression, pressure, or torque into an electrical signal that can be measured and standardized. As the force applied to the load cell increases, the electrical signal changes proportionally.

Type of load cells,

- Cantilever load cell
- Pancake load cell
- Canister load cell
- S-type load cell

In this project we used cantilevered load cell. Cantilevered load cell is a strain gauge based low profile bending beam load cell. It is for precision single point load applications.

Functionality of a load cell

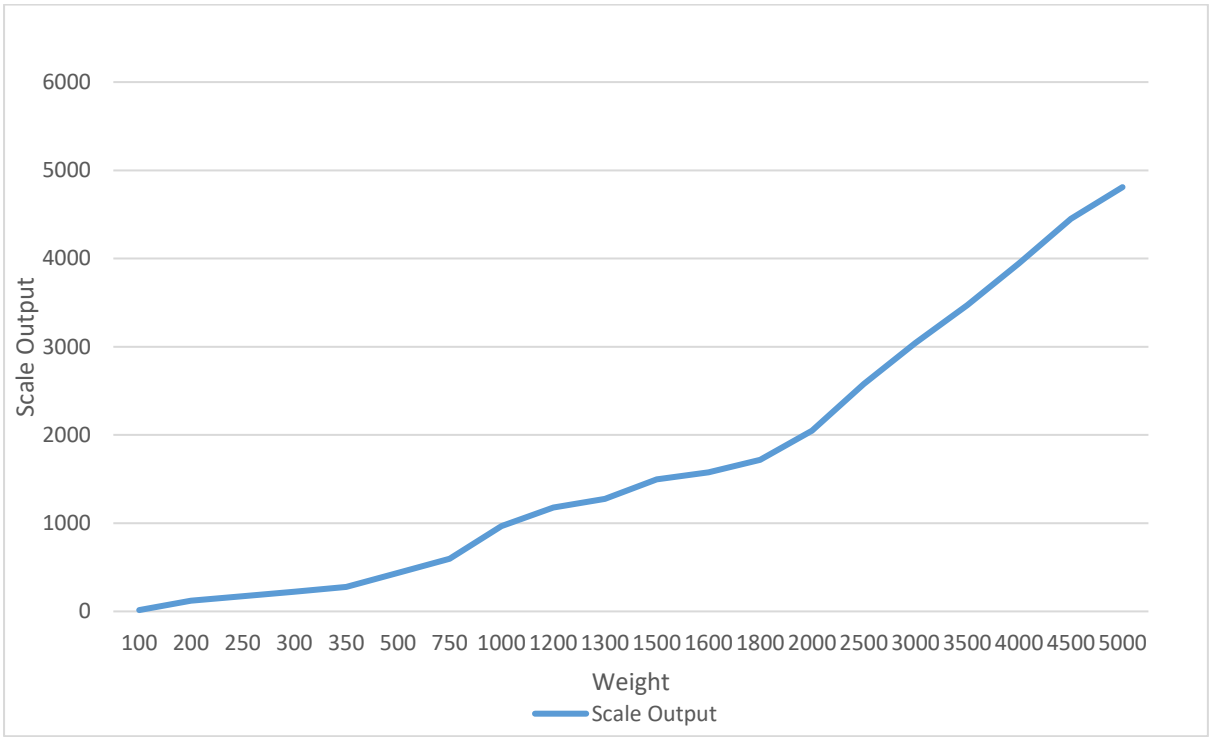


Cantilever load cell

The **Cantilever load cell is** a strain gauge based low profile bending beam load cell and is for precision single point load applications. It is designed for eccentric load sensitivity. A precision machined flexure with superior quality strain gauges **is** used as the load sensing element.

How was the weight scale calibrated…?

Frist we took know weights. Known weights were put on the weight scale and we took output voltages. Output voltages were millivolt range. So we used amplifier circuit to amplify the output millivolt age into voltage range. When we put known weight, we could observe, the output voltages slightly linear. So we assume, when we put unknown weight on it, it gives relevant linear output voltage.



Final Outcome

Finally, we could design a really good weight scale. By using this weight scale we can ***measure up to 5kg with nearly 50g accuracy***. The cause of noise of the connected wires, we were unable to get full accuracy. But we modified the code to get higher accuracy by taking an average value of 500 readings.

Reference

What is load cell and How does it work? - https://www.youtube.com/watch?v=bI1Vv4b6mPo

Digital scale calibration -https://www.youtube.com/watch?v=DeEOUoL3uVk

How to calibrate your weight scale- https://www.doityourself.com/stry/how-to-calibrate-your-digital-weight-scale

Atmega 328P - http://ww1.microchip.com/downloads/en/DeviceDoc/Atmel-7810-Automotive-Microcontrollers-ATmega328P_Datasheet.pdf

END !