LOW COST ECG

Group No: **B7**

Abhinav Yadav	06007003	abhinav_ee@iitb.ac.in
Siddharth Kataria	06007024	Siddharth.kataria@iitb.ac.in
Aniket Behera	06007026	aniketbehera@iitb.ac.in
Nitin Singh	06007039	naash.ee@iitb.ac.in

Under the supervision of

Prof. Jayanta Mukherjee

TA Sudip Nag

Abstract

The Objective of our project is to build a low cost portable ECG machine. This shall comprise of ECG probes which will feed the signal to an amplifying and filter circuit, which would then feed it to an ADC and finally display it on an LCD using a microcontroller.

This machine will help villagers, where there are no specialty hospitals, during emergencies and those in metropolis who do not have time to visit their doctors and wish to monitor their cardiac health. The estimated production cost is around Rs 700 to Rs 1000.

Contents

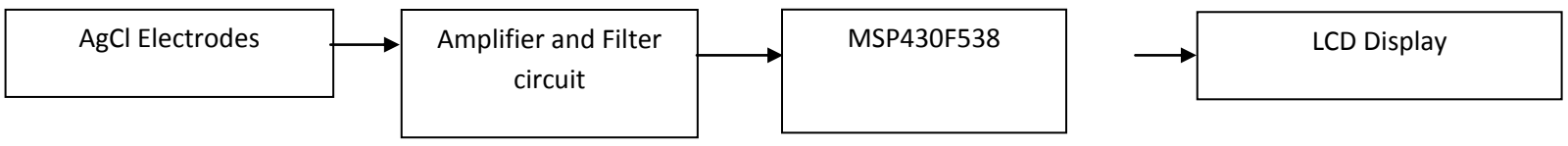
1) Introduction

In this era of personal monitoring, people prefer technologies that help them monitor at home or outside as they have no time to visit a doctor. This machine will help the patient to continue working, while the doctor can keep a tab on his health via mobile and can advice him to change medication over the phone. Our project aims at building a portable low cost ECG, so that it can also be used by the people to remote their health at remote places where the hospital facilities are rare.

2) Design Approach

The design approach has been to divide the circuit into two major parts and attempt to work on them separately and allow for integration later. The first being the analog circuit and the second being the digital circuit.

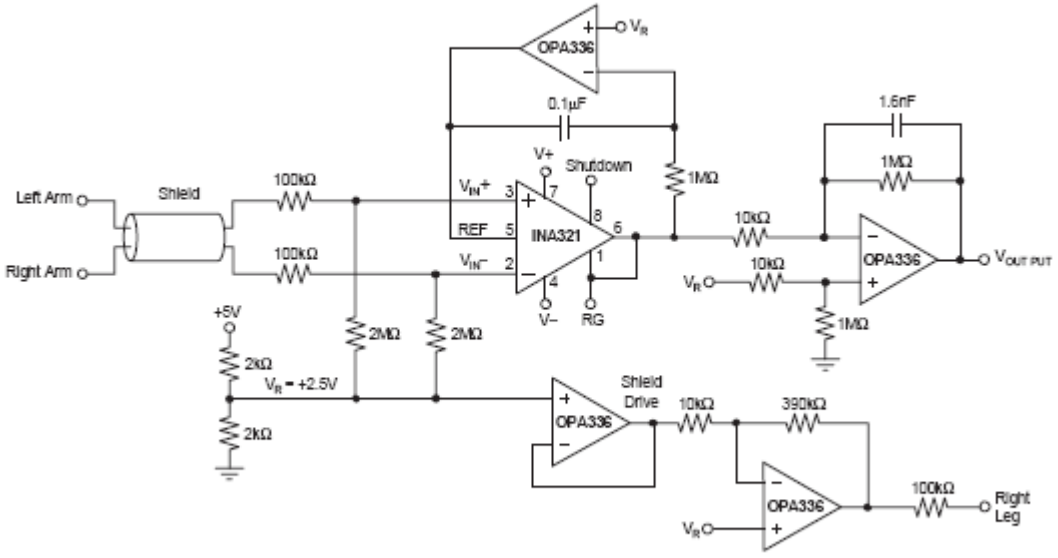
The analog circuit has been built as a filter and amplifier circuit to measure the input signal and send them to the ADC of the microcontroller while the digital part includes designing the microcontroller and LCD board and the necessary coding.



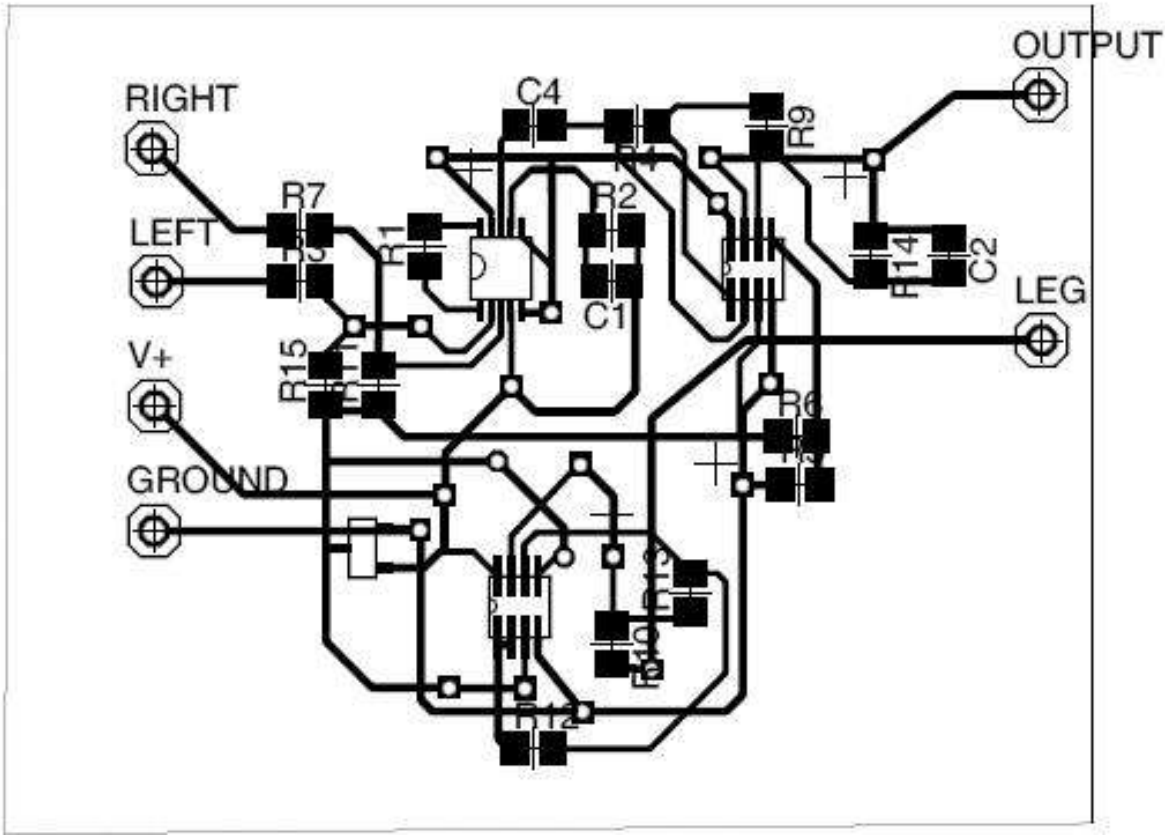
3) Design Considerations

1) The device should be cheap, low power consuming.
2) The analog circuit (filter + amplifier) should have a bandwidth between .04 – 150 Hz, and have a gain of the order of a few thousands to amplify the input from the electrodes (order of few mV).
3) Since the device operates in the low frequency range, it should not be prone to noise.

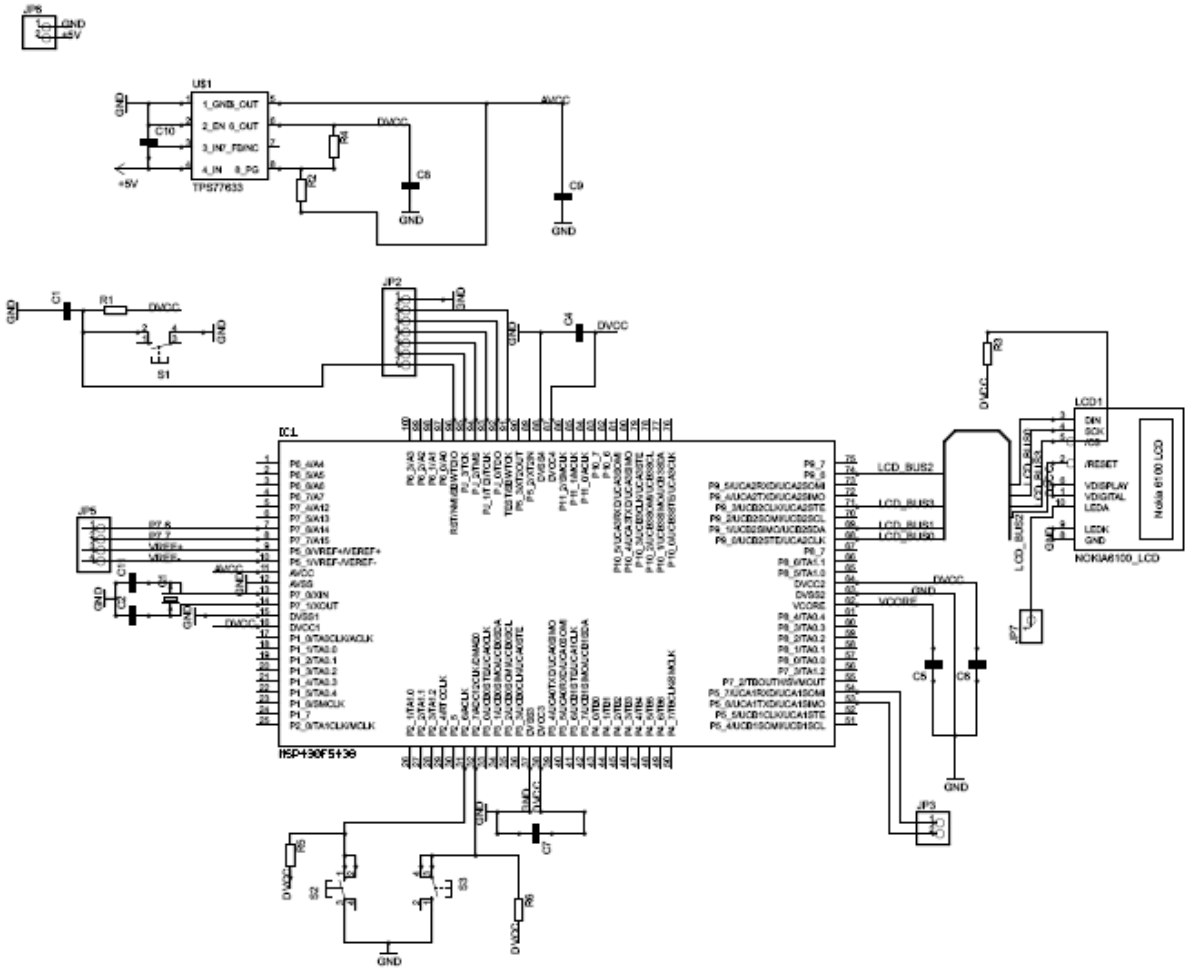
4) Design circuits



Circuit diagram, Analog part



PCB board, Analog part



Digital part schematic

5) Components

Instrumentation amplifier

An instrumentation amplifier INA 327 is used in the amplifier/filter circuit for the following reasons –

a. High CMRR – 100 dB minimum, this ensures that the amplifier does not contribute to any noise
b. Bandwidth at G=1000 = (kHz) – This ensures very low non-linearity of amplification ver the input range

Microcontroller

MSP430F5438 was chosen as the microcontroller because –

a) Ultra-low power consumption at 3V and 1 MHz, 2mA in active mode and 360µA in low power mode, wake-up from low power mode in less than 6µs.
b) 12 bit A/D Converter: Internal reference, sample-and-hold, and conversion channel for internal temperature sensor. When the ADC is not actively converting, the core is automatically disabled and re enabled when needed, thus reducing the power consumption.
c) Small LQFP package

LCD Screen:

The Nokia 3310 LCD screen has been chosen because of the following features:

a) Low Power Consumption:
b) Supply Range: 2.7–3.3V and hence compatible with the microcontroller power supply.
c) Small Display size: The screen measures 38x35mm only.
d) Only 1 External Component needed: 10µF. capacitor.

6) Implementation

a) Analog circuit –

INA – The gain of instrumentation amplifier has been set to the value 20. It takes electrical signals from right arm and left arm through electrodes and amplifies their difference.

OPA 2335 – It is an amplifier which acts as a voltage follower in biasing circuit and also a negative gain amplifier in filter circuit. Its gain has been set to the value 100. The low pass filter circuit has the lower limit of 150 Hz.

b) Digital circuit –

Power Supply –

The device is supposed to run two AA batteries which have a combined series voltage of 3V. 2 LDO voltage regulators TPS76633, 1 for AVCC and 1 for DVCC, are used for removing any noise from the circuit.

Analog to Digital converter:

The ADC used is the 12 bit internal ADC of the microcontroller. The 12 bit ADC has a count of up to 4096. The inbuilt analog reference voltages of the ADC are 1.25 V (VR-) and 2.5 V (VR+). They are set using accurate voltage references (REF 3212A and REF 3225A) as explained above. The output of the pressure sensor is about 4 V at ground, and is therefore scaled down to 2.4 V using a voltage divider (with resistance values 22 kΩ and 33 kΩ). The output value (NADC) the ADC varies linearly with the input voltage Vin as follows.

7) Work done so far –

1) PCB for both the analog and digital parts have been made. The analog PCB is working correctly. The digital PCB was tested but had to be replaced by an MSP410F1611 board, as an error caused the digital PCB to burn out at the last moment.
2) The code for displaying analog data on computer has been written and tested. The code for LCD has not been tested on new microcontroller.

8) Further suggestions and modifications possible

1) The device can be further extended to connect it to the computers through USB interface for storing the data for future reference or medical analysis.
2) Size of the circuit can be further reduced by using the components of lower size (04 packages SMD.)

9) References

www.ti.com
www.olimax.com

Datasheets
MSP430F5438
INA 321, 327
MSP430F1161
OPA 3225