PROJECT REPORT

VITAL SIGNS MONITOR

SUBMITTED BY

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SEM VIII BIOMEDICAL ENGINEERING

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INTRODUCTION

The objective of Patient Monitoring Systems is to have a quantitative assessment of the important physiological variables of patients during critical periods of biological functions. For diagnostic and research purposes it is necessary to know their actual value or trend of change. Patient monitoring systems are used for measuring continuously or at regular intervals, automatically, the values of patient's important physiological parameters.

There are several categories of patients who may need continuous monitoring or intensive care. Critically ill patients, recovering from surgery, heart attack or serious illness, are often placed in special units, generally known as intensive care units, where vital signs can be watched constantly by the use of electronic instruments.

The main features of patient monitoring systems are:

1. Organising and displaying information in a meaningful form to improve patient care.
2. Correlating multiple parameters for clear demonstration of clinical problems.
3. Processing the data to set alarms on the development of abnormal conditions.
4. Ensuring better care.

The most often monitored biological functions are Electrocardiogram (ECG), heart rate, pulse rate, blood pressure, body temperature and respiratory rate.

LITERATURE ON PROJECT

The parameters which we intend to display are:

1. Electrocardiogram
   The recording of electrical activity associated with the functioning of the heart is known as Electrocardiogram. ECG acts as a generator of bioelectric events. The waveforms thus derived from ECG have been standardized in terms of amplitude and phase relationships and any deviation from this would reflect the presence of abnormality.

2. Oxygen Saturation (SpO_2)
   Oximeter is based on the concept that arterial oxygen saturation determinations can be made using two wavelengths. The two wavelengths assume that only two absorbers are present viz. oxyhaemoglobin and reduced haemoglobin. Light passing through the finger will be absorbed by skin pigments, tissue, cartilage, bone, arterial blood, venous blood. Therefore the absorbance by all these helps us in the determination for oxygen saturation in the blood.

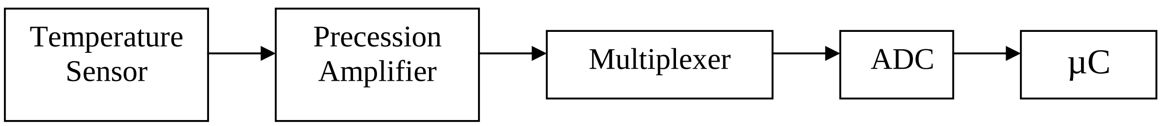
3. Temperature
   Using a temperature sensor the body temperature is calculated.

The main features of the project are:

1. To display the real time values of the three parameters
2. Alarm limits can be set for each parameter. (Lower limit & Upper limit)
3. To be majorly used for home use by post ICU & post ICCU patients.
4. Easy to view and use for common person.

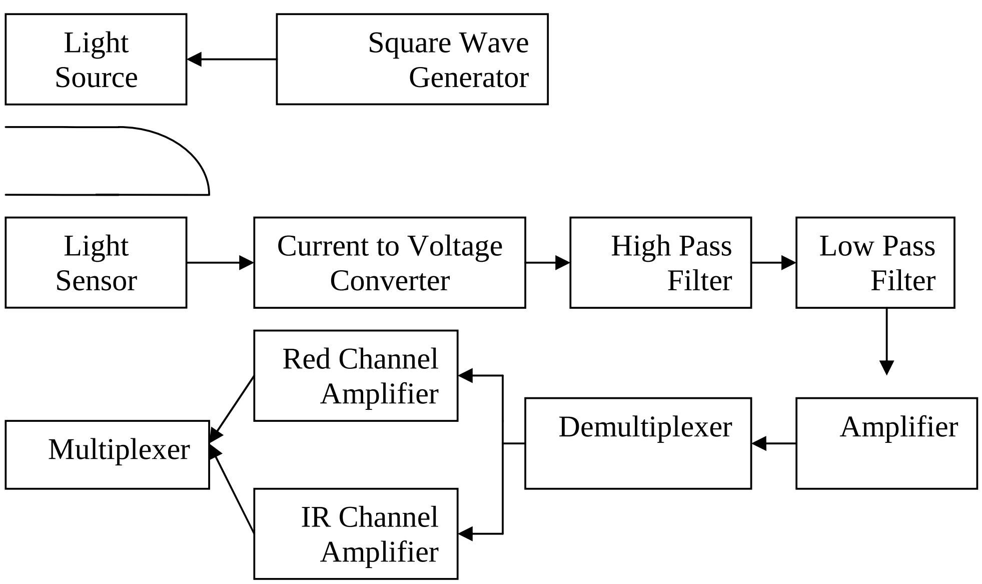
BLOCK DIAGRAM

TEMPERATURE



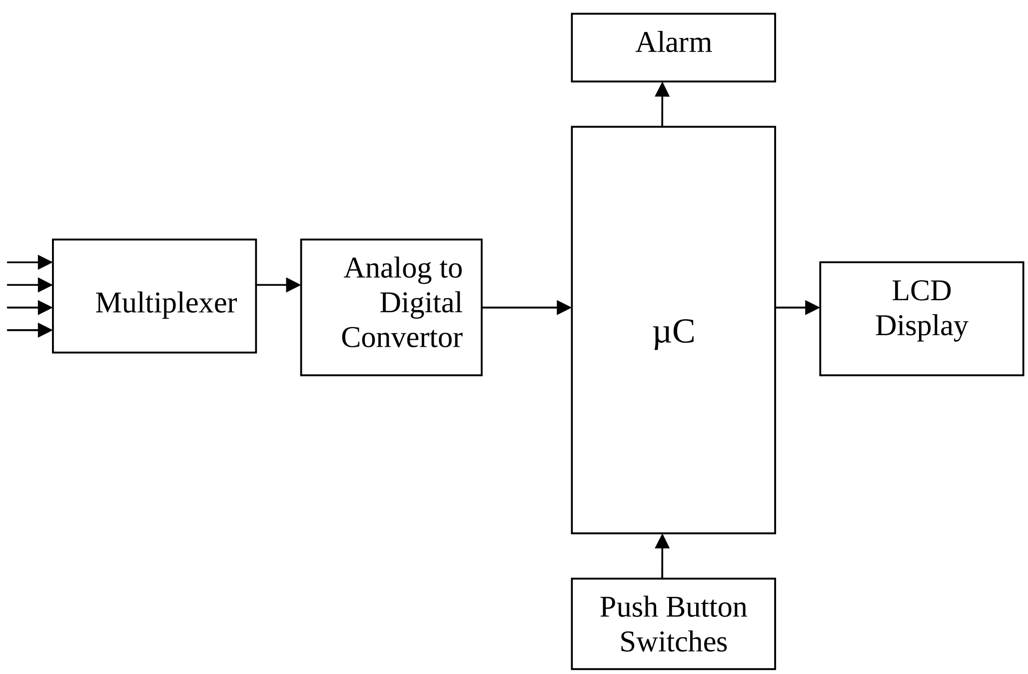
1. LM 35 from PHILIPS SEMICONDUCTORS is used as the sensor. It gives out voltage which is proportional to the temperature in ˚C.
2. Precession amplifier is used to increase the amplitude of the signal.
3. The analog signal is then given to ADC 0809 which is a 8 channel analog to digital converter via a multiplexer.
4. The output of ADC is given to the 89c52 which then converts the temperature into Kelvin and displays on the LCD display. It also checks for alarm condition.

OXYGEN SATURATION (SpO_2)



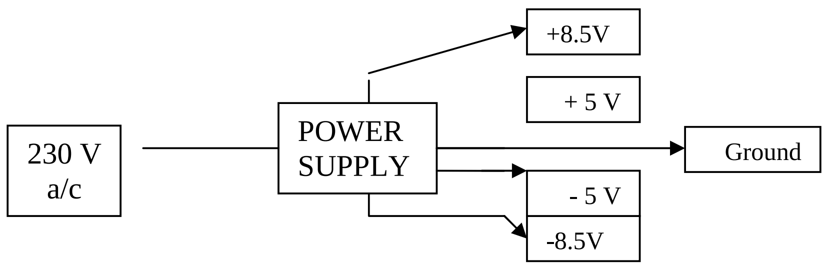
1. The finger is inserted between LED's on one side and the photo-diode sensor on the other side. External light interference is minimized by covering the assembly by black material.
2. Square wave generator operating at 250 Hz alternating activates the red and the infrared led which are connected back to back.
3. The signal is given to an I-V converter.
4. High frequency noise is removed from the signal by filtering.
5. Filtered signal is then given to a demultiplexer to separate the red and the infrared channel.
6. Output of the demux is given to a sample and hold circuit and then amplified.
7. The amplified signal is then fed to the microcontroller through multiplexer.
8. Heart rate can also be derived by passing the oxygen saturation signal to a threshold detector.
9. The heart rate is given to the input of a bar graph display which acts as a biofeedback for the patient as the movement of the bar graph is proportional to the heart rate.

DEMODULATOR



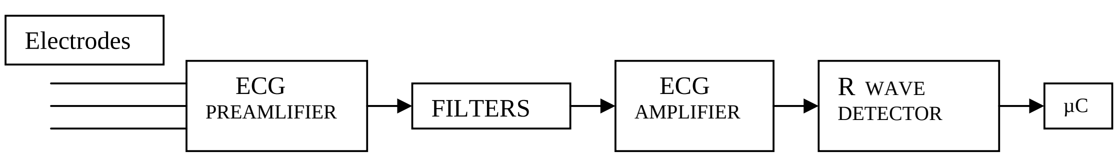
1. Atmel 89C52 Microcontroller with 8kb internal memory and 16 × 2 LCD display is used.
2. The microcontroller is used to monitor and display all parameters. It gives an audible alarm if any of the parameter exceeds set limit.
3. The microcontroller receives digitized signal from ADC 0809 which is a 8 channel analog to digital converter.
4. The preset limits and the alarms can be switched on or off using push button switches provided.

POWER SUPPLY



1. It is designed to supply regulated ± 8.5V for the analog IC's and ± 5V for the digital circuitry.
2. The alternating current from the 9-0-9 transformer is given to a bridge rectifier followed by a filter.
3. At the output of 7805 and 7905 voltage regulators we get a voltage of +5 and -5 respectively.

HEART RATE USING ECG SIGNAL



1. The ECG signal is obtained from chest electrodes using 3-lead system.

2. The signal is then given to INA 111 which is an instrumentation amplifier having a very high common mode rejection ratio.
3. The signal is then filtered to remove high frequency noise and amplified.
4. The amplified signal is then given to a threshold detector to count the R-wave which is equivalent to the heart rate.
5. The signal is given to a led which flashes when each R-wave is detected.
6. The output of the threshold detector is counted by the counter of 89c52, which then displays the corresponding heart rate on the LCD display.

CIRCUIT DIAGRAM

SPECIFICATIONS

Physical dimensions:	8*3*5 inches
Power supply:	230V/ 50 Hz
Weight:	Approximately 1 Kg.

TEMPERATURE

Measurement range:	0°F to 150°F
Resolution :	0.2°F
Accuracy :	±0.2°F
Alarm limit range :	0°F to 150°F
Alarm Adjustment	steps of 1°F
Preset alarm limits:	95°F and 100°F
Connector:	Stereo

ECG (Heart Rate)

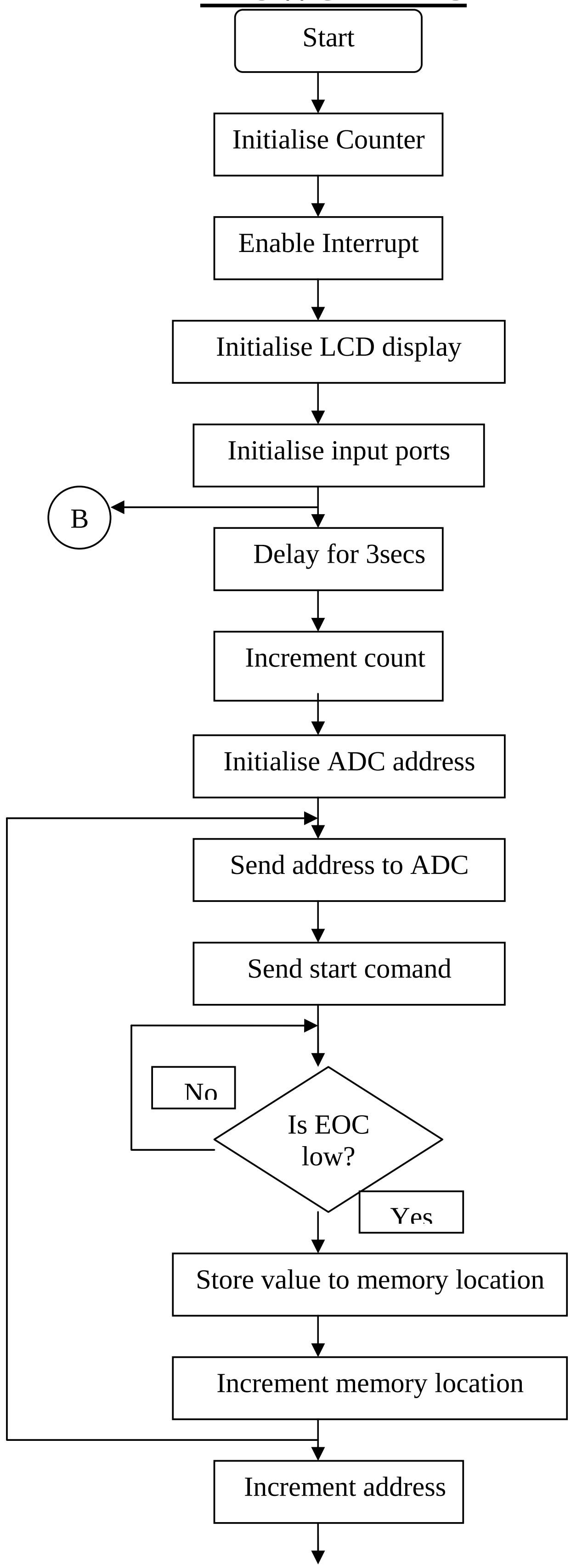
Frequency bandwidth:	2Hz to 100Hz
Signal gain	
Hr alarm limit range:	20 BPM to 300 BPM
Alarm Adjustment:	In the steps of 1 BPM
Connector:	Stereo
Resolution:	4 BPM

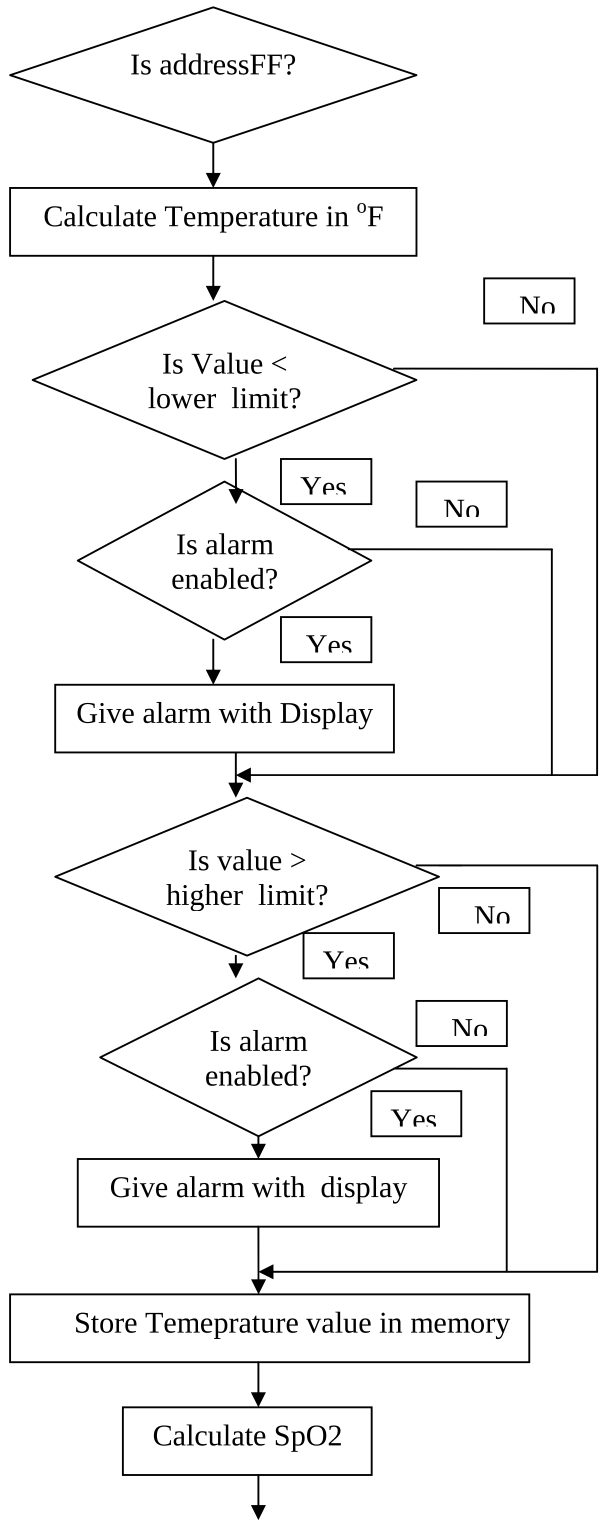
Averaged over 15 seconds.

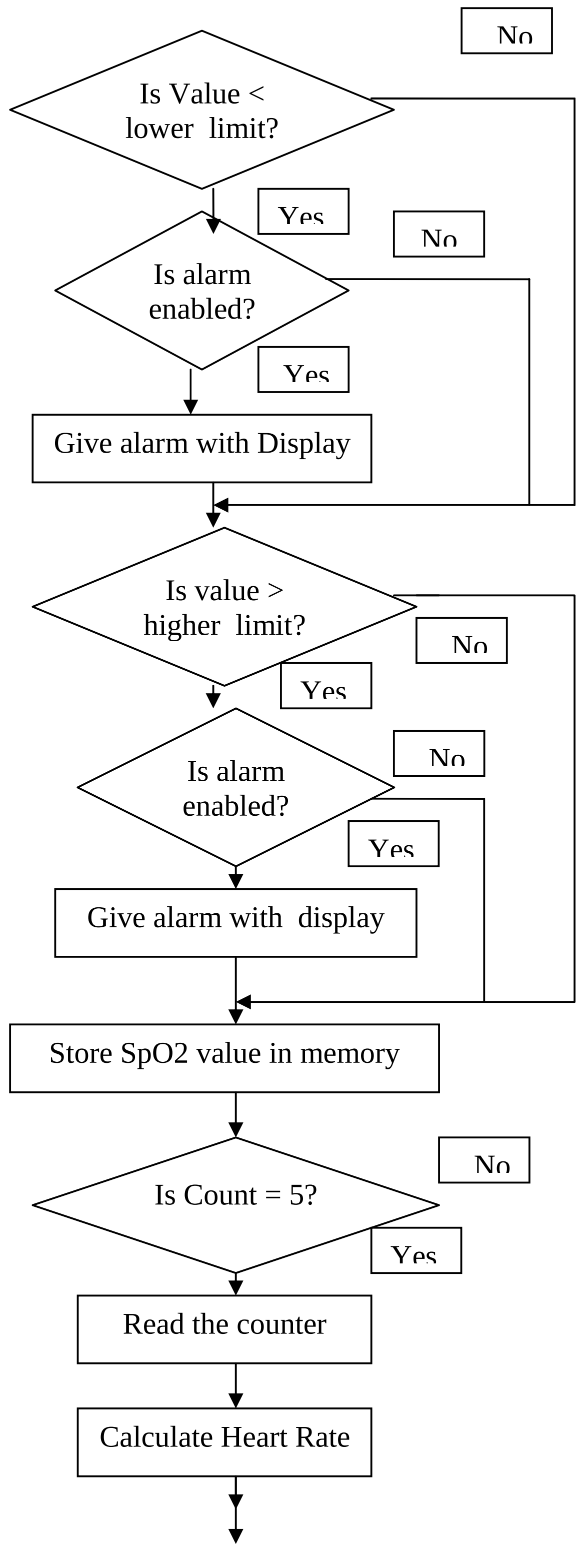
SpO_2

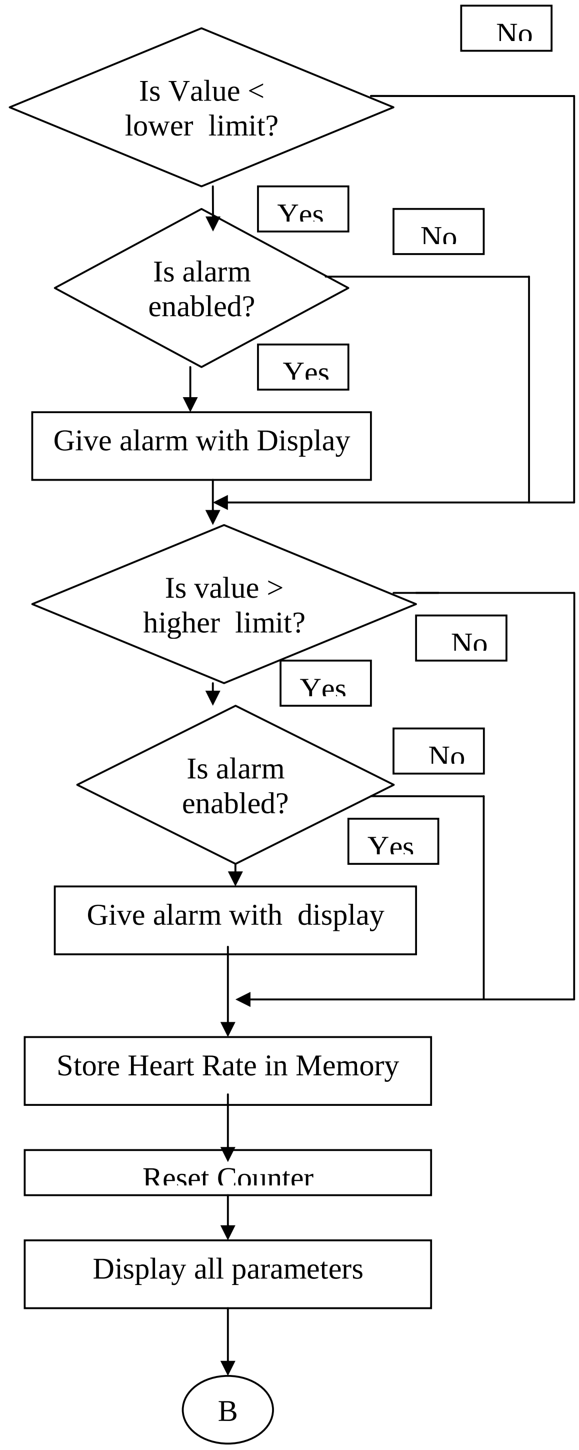
Emitted light energy:	<5mW
Measurement range:	0 to 100%
Alarm adjustment steps of 1%	
Preset alarm limits:	95%
Connector	5 Pin Amphenol

FLOWCHARTS

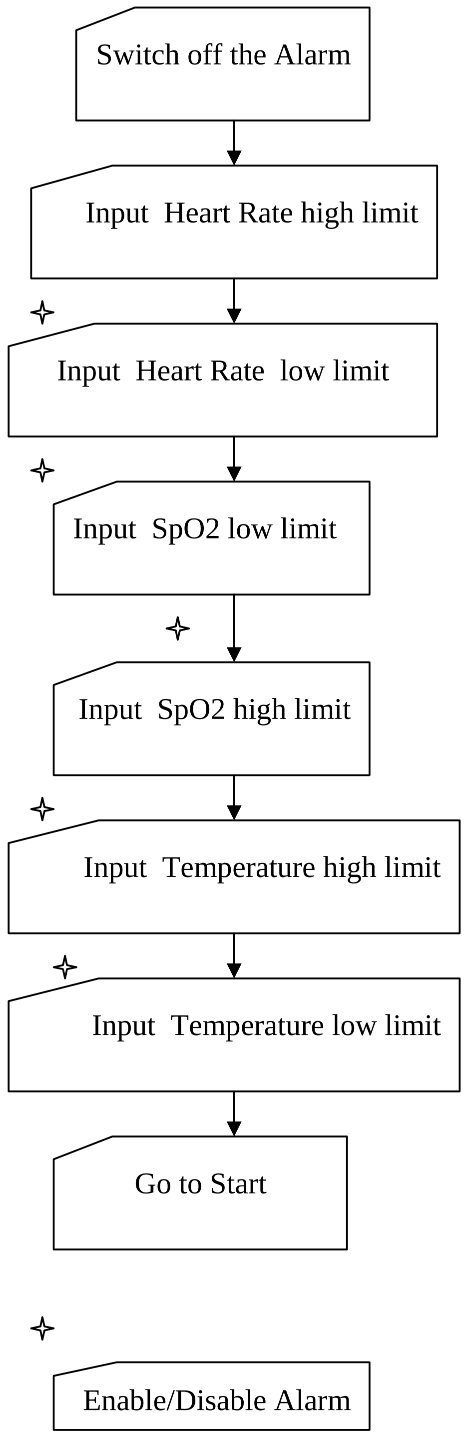

Start
Initialise Counter
Enable Interrupt
Initialise LCD display
Initialise input ports
B
Delay for 3secs
Increment count
Initialise ADC address
Send address to ADC
Send start comand
No
Is EOC low?
Yes
Store value to memory location
Increment memory location
Increment address


Is addressFF?
Calculate Temperature in °F
Is Value < lower limit?
No
Yes
Is alarm enabled?
No
Yes
Give alarm with Display
Is value > higher limit?
No
Yes
Is alarm enabled?
No
Yes
Give alarm with display
Store Temeprature value in memory
Calculate SpO2


No
Is Value <
lower limit?
Yes
No
Is alarm
enabled?
Yes
Give alarm with Display
Is value >
higher limit?
No
Yes
Is alarm
enabled?
No
Yes
Give alarm with display
Store SpO2 value in memory
No
Is Count = 5?
Yes
Read the counter
Calculate Heart Rate


No
Is Value <
lower limit?
Yes
No
Is alarm
enabled?
Yes
Give alarm with Display
Is value >
higher limit?
No
Yes
No
Is alarm
enabled?
Yes
Give alarm with display
Store Heart Rate in Memory
Reset Counter
Display all parameters
B

On processing mode switch, external interrupt occurs:



ALGORITHMS

Step 1: Start

Step 2: Initialise counter

Step 3: Enable interrupts

Step 4: Initialise LCD display

Step 5: Initialise input ports

Step 6: Delay for 3 seconds

Step 7: Increment count

Step 8: Initialise ADC address

Step 9: Send address to ADC

Step 10: Send start command

Step 11: If EOC is low, go to next step otherwise stay here

Step 12: Store value in memory location

Step 13: Increment memory location

Step 14: Increment address

Step 15: If address is FF H, go to next step, otherwise go to step 9

Step 16: Calculate temperature value in Fahrenheit

Step 17: If value is less than set limit and alarm is enabled, give alarm with display

Step 18: Store temperature value in memory

Step 19: Calculate SpO2

Step 20: If value is less than set limit and alarm is enabled, give alarm with display

Step 21: If count is 5, go to next step otherwise go to step 27

Step 22: Read the counter

Step 23: Calculate Heart Rate

Step 24: If value is less than set limit and alarm is enabled, give alarm with display

Step 25: Store Heart Rate value in the memory

Step 26: Reset counter

Step 27: Display all parameters

Step 28: Go to step 6

- On pressing the mode switch

Step 29: Switch off the alarm

Step 30: Input higher limit of Heart Rate

Step 31: Input lower limit of Heart Rate

Step 32: Input lower limit of SpO2.

Step 33: Input higher limit of Temperature

Step 34: Input lower limit of Temperature

Step 35: Go to step 1

DATASHEETS

CONCLUSION

In this project equal weightage has been given to software and hardware. The components used in hardware design were chosen after deep & exhaustive search which guaranteed better performance and higher efficiency.

Good data transfer & acquisition is very important for better analysis of the acquired physiolo
gical signal. The data acquisition was done directly by connecting the probes directly to the patient hence giving a real time analysis.

After five months of this project we have honed the skills of analyzing and logical approach to achieve the goal.

ACKNOWLEDGEMENT

We take this opportunity to express my deepest gratitude to our project guide Mrs. Manali J. Godse, Head of Biomedical Engineering Department for providing us the opportunity to do an In-house project.

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Finally, we acknowledge all those authors whose literature we referred to while designing the hardware and software part of our project.

BIBLIOGRAPHY

- Khandpur R. S., 'Handbook of Biomedical Instrumentation', Tata McGrow Hill Publication.

- Webster J. G., 'Medical Instrumentation', Wiley Publication.

- Predko Myke, 'Programming and customising 8051 Microcontroller', Tata McGrow Hill Publication.

- Mazidi M. A., 'The 8051 Microcontroller', Pearson Education.

- Guyton A. C., Hall A. J., 'Textbook of Medical Physiology', W. B. Saunders and company.

- www.frontline-electronics.com