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AUTONOMOUS PATIENT MONITORING AND BLOOD FLOW CONTROL USING IOT METHOD

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Abstract: This paper describes the implementation of detection and control system using colour sensors instead of using Laser Diodes in drop measurement system. The realization and design of a sensor capable of measuring the volume of a drop in free fall. The sensor realized is made of a simple low-cost red laser and a photodiode and optics to focus the beam on the light sensor. This system may be very useful together with a drip chamber to have accurate and low-cost volume and flow rate measurements of the infused substances. it is designed to be added on the typical intravenous infusion systems already present in the market, to constantly monitor the solution volumes with good accuracy and reliability.

Keywords: Biomedical monitoring, colour sensor, pulse oximetry, respiration sensor, blood flow measurement, analog to digital converter (ADC), IOT.

1. INTRODUCTION

In clinical practice, infusion systems are very common. They are utilized to administer intravenous liquids and solutions to a patient. There are many different ways to administrate these medical liquids: via pumping systems or using apparatuses that exploit the principle of drop by gravity. In these cases, there is a need for pumps specially built and regulated through electromechanical systems, with high performances in terms of precision of volume flowing out without any leakage. For this reason, these types of pumps have a very high cost of purchase, which when combined with the maintenance costs, makes their usage in hospitals very limited, preferring, where possible, the cheapest gravity drip systems.

The infusion technique most widely used is the intravenous therapy. The intravenous apparatus is very simple and low cost, and it is formed by an intravenous bag on a pole connected to intravenous lines and an infusion needle. The outflow of the medicinal solution occurs through a drop chamber and a terminal: the former is the responsible for the descent of the liquid, by force of gravity, in the form of drops and the latter regulates the flow velocity.

We are going to implement detection and control system which can be implemented in the hospitals. In the hospitals drip measurement is used to measure the volume of the blood given to the patient. To monitor leakage in the flow of the blood is detected by color sensor. When the color sensor detects then the information is transmitted to PC through wireless communication. Pulse oximetry is used to measure the heart rate of the patient. Flow sensor is used to measure the flow of the blood and according to the values the motor speed is controlled. LCD is used to display the values of the sensors.

fig.1 intravenous theraphy

2. SYSTEM DESCRIPTION:

The paper presents a color sensor system that can process light reflected from a surface and produce a digital output representing the color of the surface. The end-user interface circuit requires only a 3-bit analog-to-digital converter (ADC) in place of the typical design comprising ADC, digital signal processor and memory. For scalability and compactness, the ADC was designed such that only two comparators were required regardless of the number of color/wavelength to be identified. The complete system design has been implemented in hardware (bread board) and fully characterized. The ADC achieved less than 0.1 LSB for both INL and DNL. The experimental results also demonstrate that the color sensor system is working as intended at 20 kHz while maintaining greater than ADC. This work proved the design concept and the system will be realized with integrated circuit technology in future to improve its operating frequency.

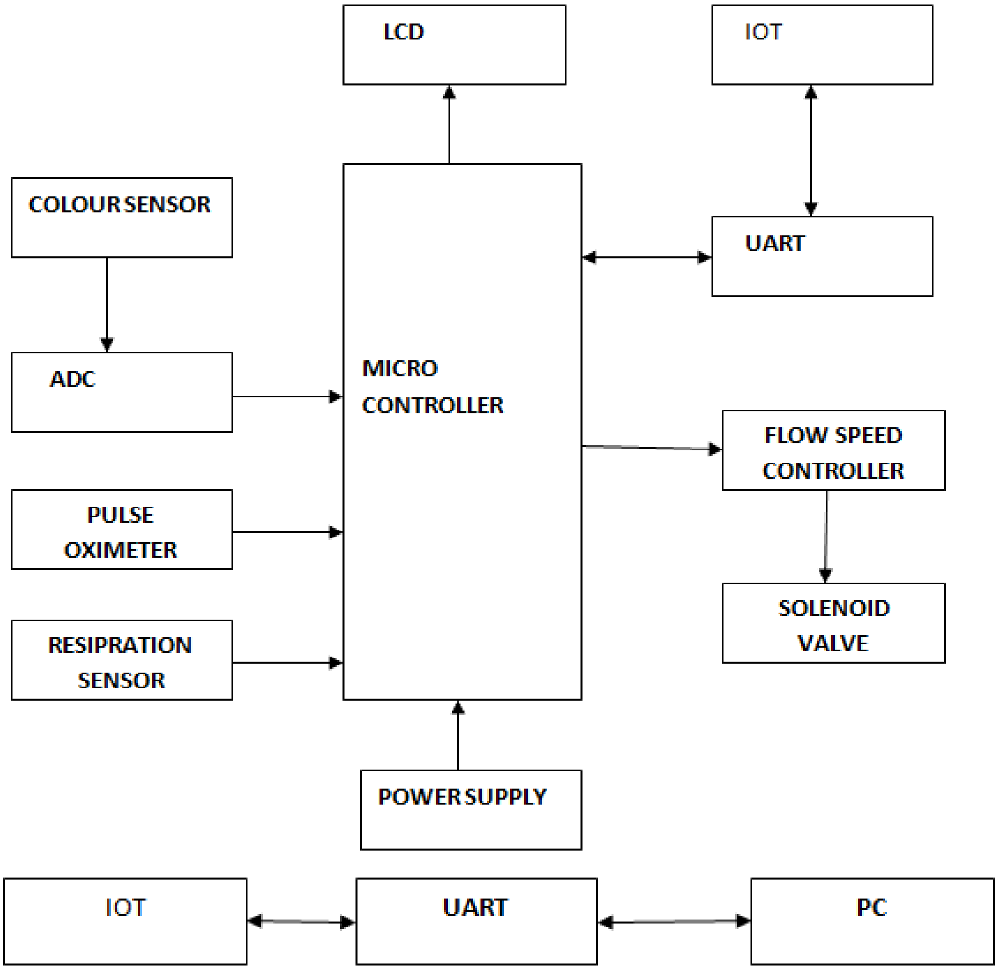

fig.2 block diagram for patient monitoring

2.1 ADC 0808/0809:

fig.3 ADC 0808/0809

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The ADC0809 data acquisition component is a monolithic CMOS device with an 8-bit analog-to-digital converter, 8-channel multiplexer and microprocessor compatible control logic. The 8-bit A/D converter uses successive approximation as the conversion technique. The converter features a high impedance chopper stabilized comparator, a 256R voltage divider with analog switch tree and a successive approximation register. The 8-channel multiplexer can directly access any of 8-single-ended analog signals.The device eliminates the need for external zero and full-scale adjustments. Easy interfacing to microprocessors is provided by the latched and decoded multiplexer address inputs and latched TTL TRI-STATE® outputs.The design of the ADC0808, ADC0809 has been optimized by incorporating the most desirable aspects of several A/D conversion techniques. The ADC0808, ADC0809 offers high speed, high accuracy, minimal temperature dependence, excellent long-term accuracy and repeatability, and consumes minimal power.These features make this device ideally suited to applications from process and machine control to consumer and automotive applications. For 16-channel multiplexer with common output (sample/hold port) see ADC0816 data sheet.

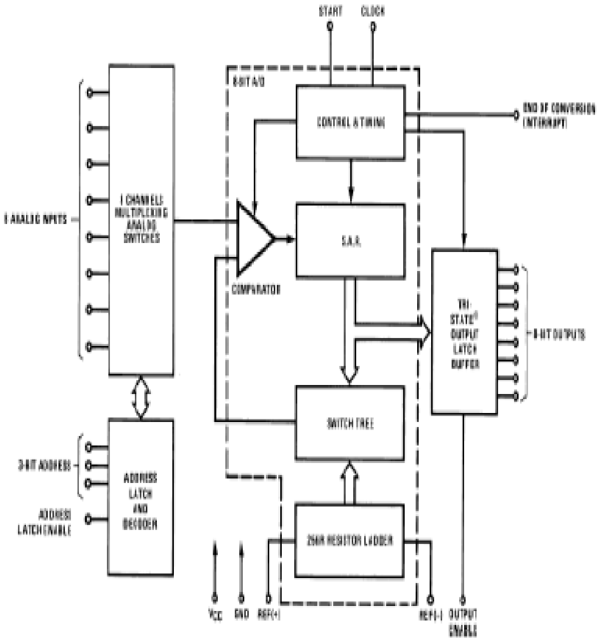


fig.4 block diagram for ADC0808/0809

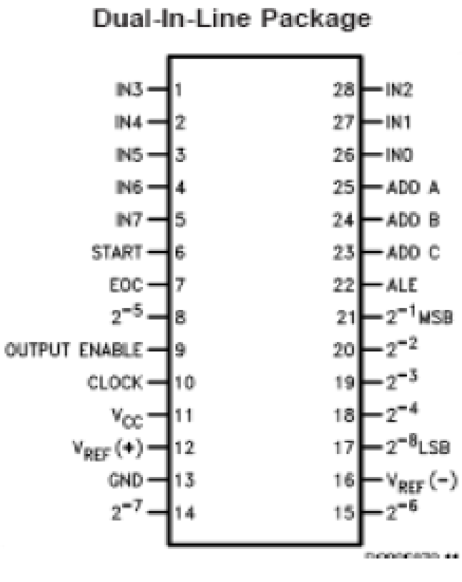


fig.5 pin diagram for ADC0808/0809

3. INDENTATIONS AND EQUATIONS

In ADC conversion process the input analog value is quantized and each quantized analog value will have a unique binary equivalent.

(1).The quantization step in ADC0809/ADC0808 is given by,

$$Q_{step} = \frac{V_{REF}}{2^8} = \frac{V_{REF}(+) - V_{REF}(-)}{256_{10}}$$

The digital data corresponding to an analog input (V_{in}) is given by,

$$\text{Digital data} = \left(\frac{V_{in}}{Q_{step}} - 1 \right)_{10}$$

4. FIGURES AND TABLES

The device contains an 8-channel single-ended analog signal multiplexer. A particular input channel is selected by using the address decoder. The address is latched into the decoder on the low-to-high transition of the address latch enable signal.

SELECTED ANALOG CHANNEL	ADDRESS LINE		
	C	B	A
IN0	L	L	L
IN1	L	L	H
IN2	L	H	L
IN3	L	H	H
IN4	H	L	L
IN5	H	L	H
IN6	H	H	L
IN7	H	H	H

Table 1 shows the input states for the address lines to select any channel

4.1. COLOUR SENSOR

The circuit can sense eight colours, i.e. blue, green and red (primary colours); magenta, yellow and cyan secondary colours); and black and white. The circuit is based on the fundamentals of optics and digital electronics. The object whose colour is required to be detected should be placed in front of the system. The light rays reflected from the object will fall on the three convex lenses which are fixed in front of the three LDRs. The Convex lenses are used to converge light rays. This helps to increase the sensitivity of LDRs. Blue, green and red glass plates (filters) are fixed in front of LDR1, LDR2 and LDR3 respectively. When reflected light rays from the object fall on the gadget, the coloured filter glass plates determine which of the LDRs would get triggered. The circuit makes use of only 'AND' gates and 'NOT' gates. When a primary coloured light ray falls on the system, the glass plate corresponding to that primary colour will allow that specific light to pass through. But the other two glass plates will not allow any light to pass through. Thus only one LDR will get triggered and the gate output corresponding to that LDR will become logic 1 to indicate which colour it is. Similarly, when a secondary coloured light ray falls on the system, the two primary glass plates corresponding to the mixed colour will allow that light to pass through while the remaining one will not allow any light ray to pass through it. As a result two of the LDRs get triggered and the gate output corresponding to these will become logic 1 and indicate which colour it is. When all the LDRs get triggered or remain untriggered, you will observe white and black light indications respectively. Following points may be carefully noted:

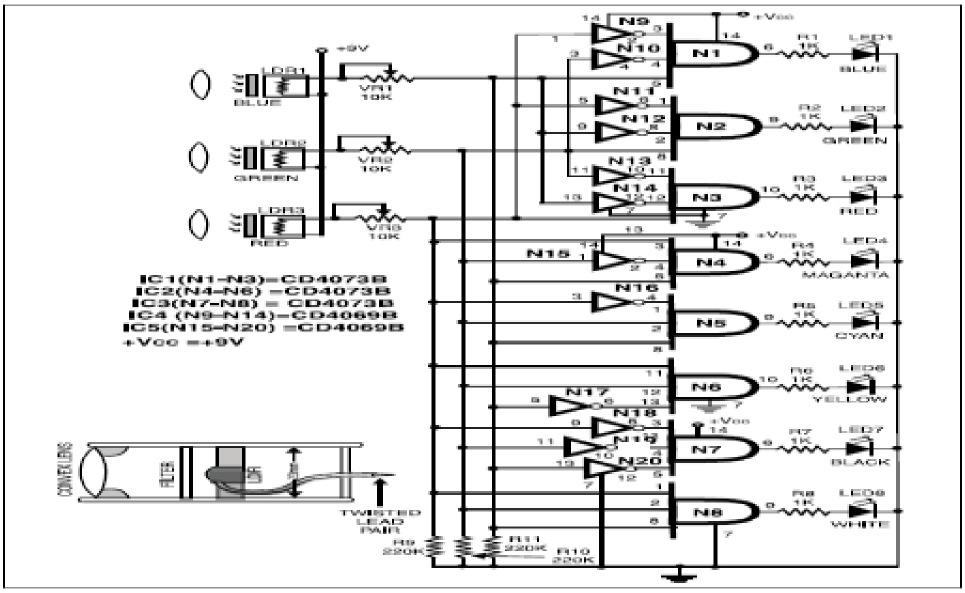


Fig.6 circuit diagram of colour sensor

Potmeters VR1, VR2 and VR3 may be used to adjust the sensitivity of the LDRs. Common ends of the LDRs should be connected to positive supply Use good quality light filters. The LDR is mounded in a tube, behind a lens, and aimed at the object.The coloured glass filter should be fixed in front of the LDR as shown in the figure. Make three of that kind and fix them in a suitable case. Adjustments are critical and the gadget performance would depend upon its proper fabrication and use of correct filters as well as light conditions.

fig.7 PIC16F877 chip (Microcontroller)

This controller is widely used for experimental and modern applications because of its low price, wide range of applications, high quality, and ease of availability. It is ideal for applications such as machine control applications, measurement devices, study purpose, and so on. The PIC 16F877 features all the components which modern microcontrollers normally have. PIC16F877 has 5 basic input/output ports. They are usually denoted by PORT A (R A), PORT B (RB), PORT C (RC), PORT D (RD), and PORT E (RE). These ports are used for input/ output interfacing. In this controller, “PORT A” is only 6 bits wide (RA-0 to RA-7), ”PORT B” , “PORT C”,”PORT D” are only 8 bits wide (RB-0 to RB-7,RC-0 to RC-7,RD-0 to RD-7), ”PORT E” has only 3 bit wide (RE-0 to RE-7).

PORT-A	RA-0 to RA-5	6 bit wide
PORT-B	RB-0 to RB-7	8 bit wide
PORT-C	RC-0 to RC-7	8 bit wide
PORT-D	RD-0 to RD-7	8 bit wide
PORT-E	RE-0 to RE-2	3 bit wid

All these ports are bi-directional. The direction of the port is controlled by using TRIS(X) registers (TRIS A used to set the direction of PORT-A, TRIS B used to set the direction for PORT-B, etc.). Setting a TRIS(X) bit '1' will set the corresponding PORT(X) bit as input. Clearing a TRIS(X) bit '0' will set the corresponding PORT(X) bit as output.(If we want to set PORT A as an input, just set TRIS(A) bit to logical '1' and want to set PORT B as an output, just set the PORT B bits to logical '0'.

4.2. PULSE OXIMETER SENSOR

Fig.8 Heart beat indication by LED

It is designed to give digital output of heat beat when a finger is placed on it. When the heart beat detector is working, the beat LED flashes in unison with each heart beat. This digital output can be connected to microcontroller directly to measure the Beats Per Minute (BPM) rate. It works on the principle of light modulation by blood flow through finger at each pulse.

4.3. HARDWARE SETUP:

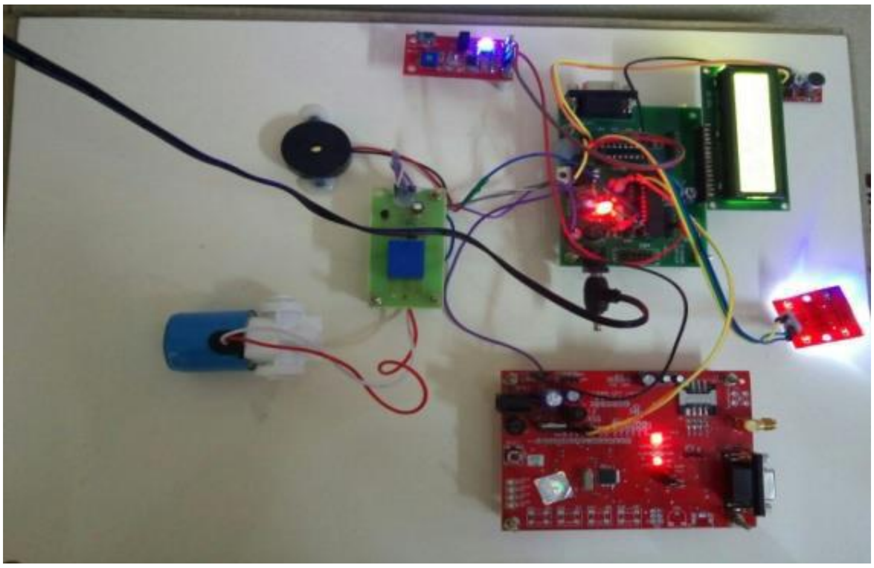


Fig.9 hardware kit for monitoring patient status using IOT

This projects describes the sensor consists of a super bright red LED and light detector. The LED needs to be super bright as the maximum light must pass spread in finger and detected by detector. Now, when the heart pumps a pulse of blood through the blood vessels, the finger becomes slightly more opaque and so less light reached the detector. With each heart pulse the detector signal varies. This variation is converted to electrical pulse. This signal is amplified and triggered through an amplifier which outputs +5V logic level signal. The output signal is also indicated by a LED which blinks on each heart beat.

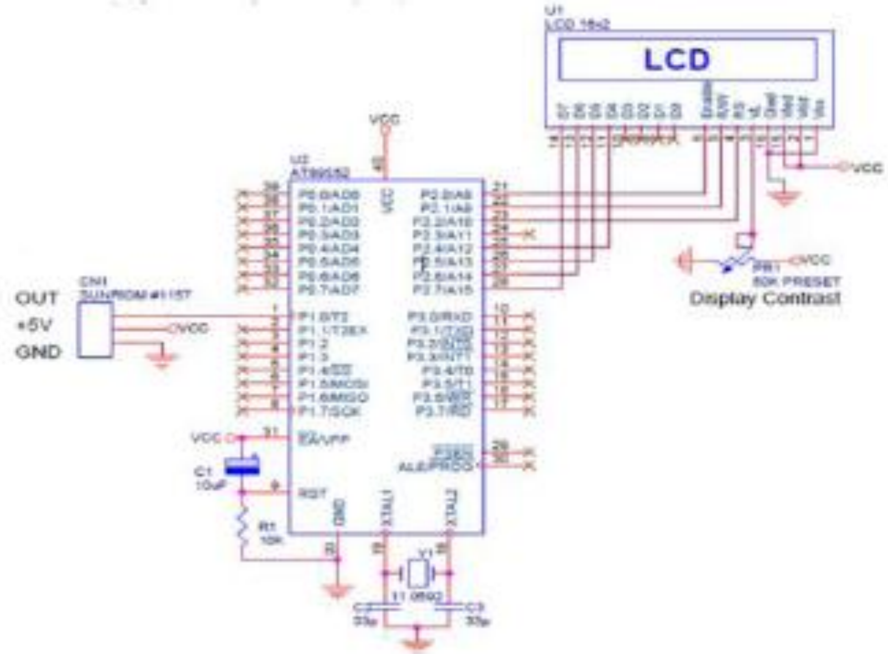
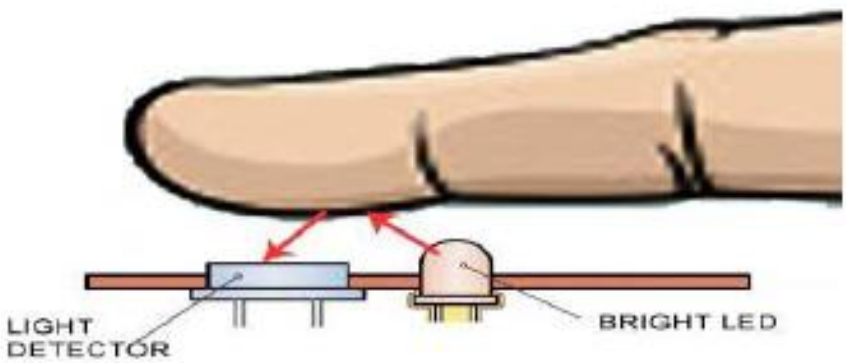
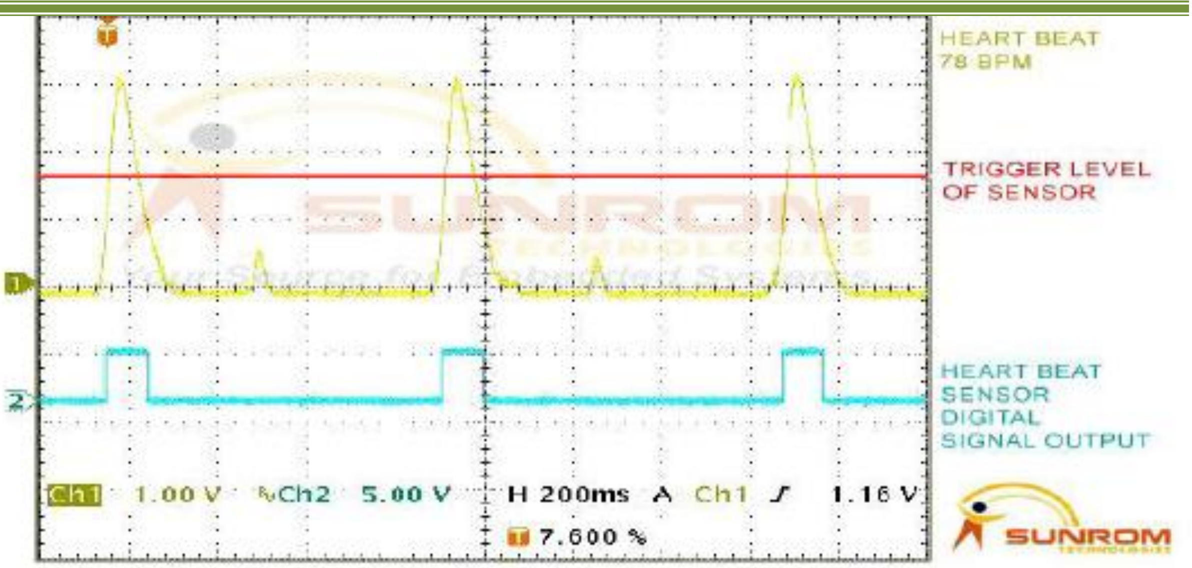


Fig.10 circuit diagram for sensor

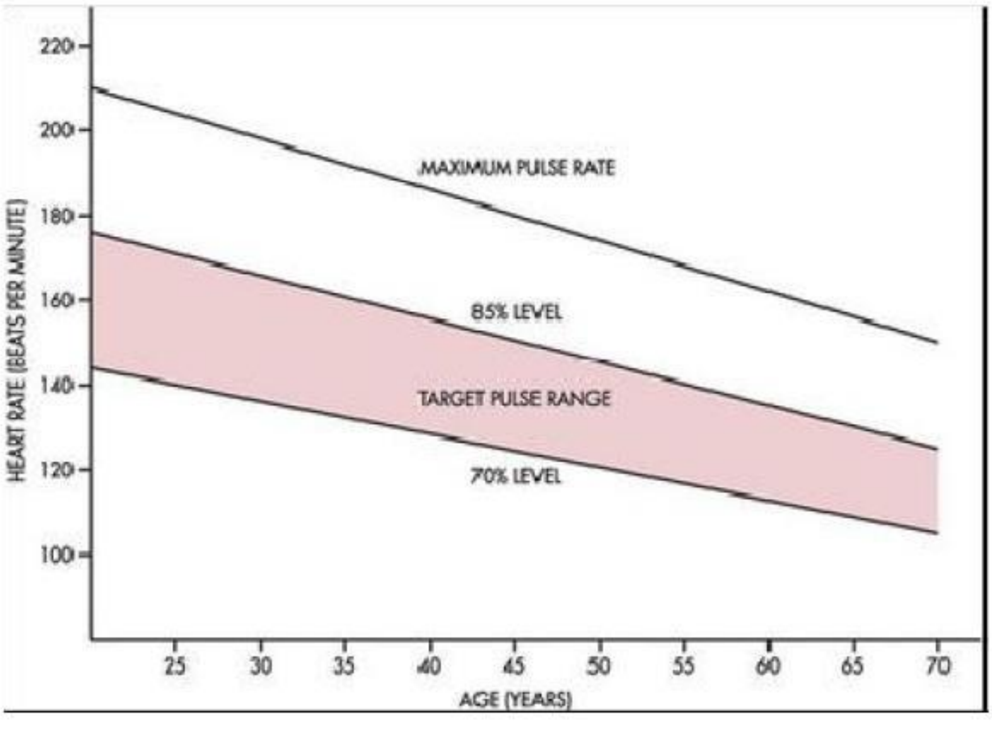
The pulse signal is applied to the P1.0 input of U2 that is AT89S52 (Can be any 8051 type) which is monitored by the program whenever this input goes high. Internally to U2, there is a counter which counts how many 1ms intervals there are between two high going heart beat pulses. This number is then divided by 60,000 and the result is the pulse rate. For example, if the pulse rate is 60 BPM(beats per minute) there will be a pulse every second. The duration of one heart beat will be oneseconds or 1000 x 1ms. Dividing 60,000 by 1000 will give the correct result of 60 which is shown on the display. If there is invalid result (BPM>200) it is invalid and waits for next cycle.



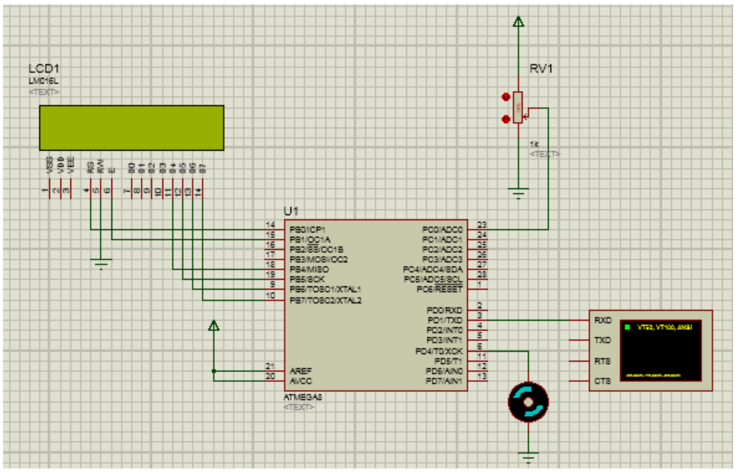
Below figure shows signal of heart beat and sensor signal output graph. actual heart beat received by detector (Yellow) and the trigger point of sensor (Red)after which the sensor outputs digital signal (Blue) at 5V level.



Below figure shows target pulse rates for people aged between 20 and 70. The target range is the pulse rate needed in order to provide suitable exercise for the heart. For a 25-year old, this range is about 140-170 beats per minute while for a 60-year old it is typically between 115 and 140 beats per minute.



4.4. EXPERIMENTAL RESULTS:



Color sensor monitor the x and y value when x- white and y- red pixel and If detects the color sensor value is x then it sends the status of the patient as normal else goto controller and then send high logic to motor driver.The gate motor activate and it closes the solenoid valve. The system sends the status patient is normal to IOT. Respiration sensor detects the sounds then store the z value x and y status and z status monitoring through the display and this status send to IOT.The Analog domain systems Sensor (transducer) physiological property of tissue converted into electrical signals and Amplifier Sensor output converted into input requirements of measuring system .The Analog to digital converter (A/D) Signal is transmitted into binary coded sample sequence Digital domain systems. The Microcontroller Process automates the measurement to display process and Digital signal processing (DSP) Digital domain filtering Storage Interface sends the status into information systems.

Date	Glu1	Res2	Hp3
February 20, 2017, 2:25 pm	clear	clear	����
February 20, 2017, 8:23 pm	clear	clear	Hp:0073
February 20, 2017, 8:23 pm	clear	clear	Hp:0045
March 5, 2017, 12:40 pm	check	clear	Hp:0045
March 5, 2017, 12:41 pm	check	clear	Hp:0045
March 5, 2017, 12:42 pm	check	clear	Hp:0045
March 5, 2017, 12:43 pm	check	clear	Hp:0045
March 5, 2017, 12:43 pm	check	clear	Hp:0073
March 5, 2017, 12:44 pm	check	clear	Hp:0045
March 5, 2017, 12:45 pm	check	clear	Hp:0045
March 5, 2017, 2:03 pm	check	clear	Hp:0000
March 5, 2017, 2:04 pm	check	clear	Hp:0000
March 5, 2017, 2:05 pm	check	clear	Hp:0000

5. CONCLUSION

The proposed system implements and detects the flow of the blood and the color sensor detects then the information is transmitted to PC through IOT communication. For the operational usage of the instrument, we have designed and realized a dedicated data-handling system, with an analog processing stage. This system will be implemented in a low-cost embedded electronics. The preliminary measurements have given us encouraging results; this system is a good and affordable solution to be implemented in many medical devices requiring both accurate and low-cost system for blood flow measurements. Future developments regard the complete engineering of the prototype very promising for a future commercialized system.

6. REFERENCES

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