PULSE OXIMETRY BASED AUTOMATIC VALVE CONTROL

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Abstract: The supplied oxygen content to a person is according to the measured value of the content in the body. Usually oxygen content is measured with pulse oximeter and supplied by a skilled individual operating the valve realizing oxygen, if not so correctly supplied might be fatal for the individual. We proposed an automated system where the supplied content is according to the individual content is to be realized with constant monitoring and control in this paper. Through the proposed model correct and accurate oxygen can be supplied along with alarm generation in form of text message, constant and distant monitoring using serial communication.

Keywords: automated system, oxygen, pulse-oximeter

I. INTRODUCTION

In the modern times medical applications has reached unimaginable heights with the help of instrumentation engineering from heart, liver transplant to laser surgery for eye however certain aspects although very small but vital to one's welfare has somehow left behind.

One such aspect is the 'valve release of oxygen according to the oxygen content of a person' as in medical applications, when a person is hospitalized or is required to be provided with oxygen the oxygen is monitored by using a pulse oximeter and oxygen is provided using an oxygen cylinder and releasing through a valve.

It is to be kept in mind that providing oxygen higher or lower than the oxygen level of a person might turn fatal.

It is here that a person with extreme precision uses his/her skill and experience to release the oxygen from the valve, this involves tremendous guess work which sometimes may not be accurate.

II. OBJECTIVE OF THE WORK

- Automatic monitoring and controlling of oxygen level.
- Micro-controller based circuit for minimizing complexity and space.
- Valve control system to maximize accuracy.
- Minimize manual involvement and constant monitoring.
- Alert generation.
- Compatible for wireless communication for remote monitoring

III. CONVENTIONAL METHOD

A. METHODOLOGY

- In the initial phase a simple overall circuit of the project was simulated.
- Using an Arduino Uno a circuit comprising a variable resistor,lcd,servo was create in PROTEUS

simulation software.

• The simulated circuit was physically realised using an Arduino Uno and the above components using bread board and jumper wires.

B. WORKING

The pulse-oximeter reading and variation is simulated using a variable potentiometer. We used the Arduino board as the core and a servo to study its rotation according to the input, while an LCD would constantly display the whole system status. The setup was realized using the PROTEUS simulation software and also hardware simulation was done. In the software simulation a virtual oscilloscope was used to monitor the change in input rate.

The potentiometer value was varied; accordingly the controller rotated the servo motor with respect to the mapped ranges defined in the code of the Arduino board. The LCD display constantly displayed the input value as well as the position of the servo defining the amount of oxygen to be allowed to the supply.

C. SOFTWARE AND HARDWARE SIMULATION

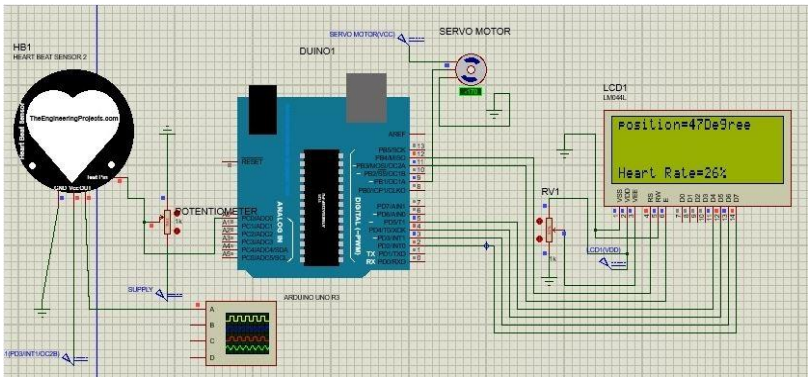

Fig.1(a) PROTEUS SIMULATION

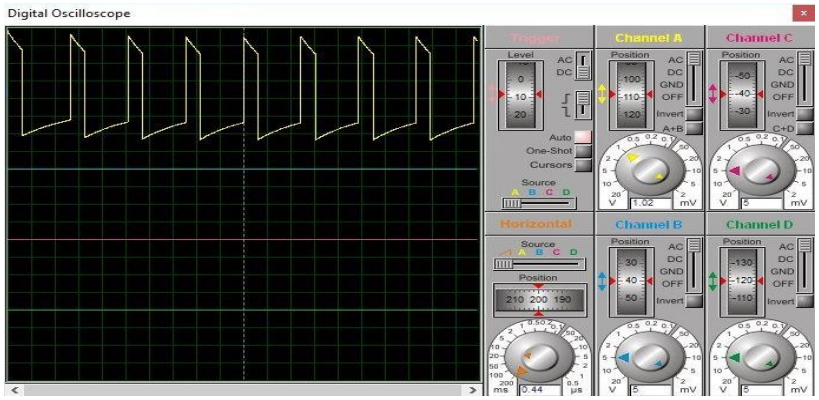

Fig.1(b) OUTPUT OF DIGITAL OSCILLOSCOPE

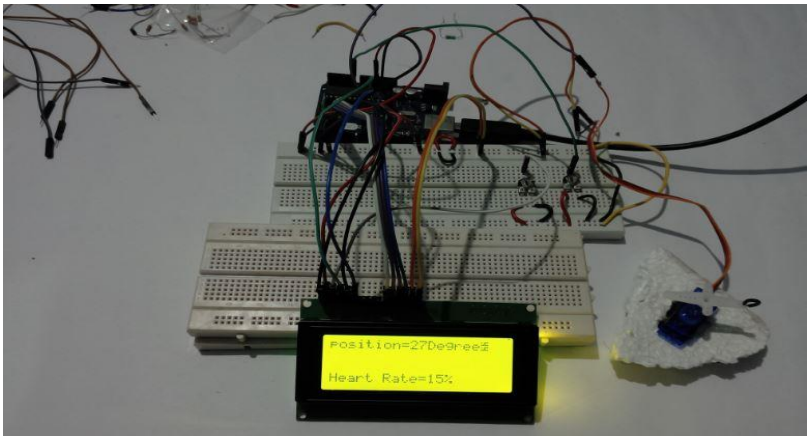

Fig.2 HARDWARE SIMULATION OF CONVENTIONAL MODEL

D. OBSERVATIONS AND CONCLUSION

- The hardware and software simulation of the total setup was successful.
- The ANALOG input of the POTENTIOMETER was correctly realized and mapped by the ARDUINO code and suitable OUTPUT was obtained.
- The SERVO MOTOR very specifically rotates according to the input.
- The LCD worked and displayed the correct reading as 'HEART RATE' and 'POSITION'.
- The overall set up was stable and worked well under normal condition.
- However, in certain cases major fluctuations were observed at times due to the use of the servo.

For the fluctuations caused by the servo we went on to use solenoid valves which were highly accurate and provided greater stability.

IV. NOVEL METHOD

A. METHODOLOGY

- AVR microcontroller was used to create a complete automated monitoring and controlling circuit.
- Three solenoid valves were simulated according to the level of oxygen requirement.
- A GSM module was incorporated to generate alarm in case of drop in oxygen concentration.
- A Bluetooth module was incorporated to interface with a laptop for remote monitoring.

B. WORKING

The total setup was developed along a AVR series microcontroller AT328PU.

The pulse oximeter max30100 module is interfaced with microcontroller. The digital output of the oximeter is read and supplied to the controller. The controller is interfaced with a GSM module SIM900 and also three valve drivers along with indicating LED's which corresponds to each of the three valves function operation.

The oximeter value is realized and according to the requirement of the oxygen supply the valves operate. If the oxygen value drops below a certain level the GSM module SIM900 generates a text message notifying the concerned person of the drop.

The value of the patient's oxygen content can be constantly monitored on the LCD display.

Also a Bluetooth module HC05 is used to interface the complete setup with a laptop for constant remote monitoring using SERIAL LAB software.

The condition of operation, valve operation, indicating LED's is detailed in the following table

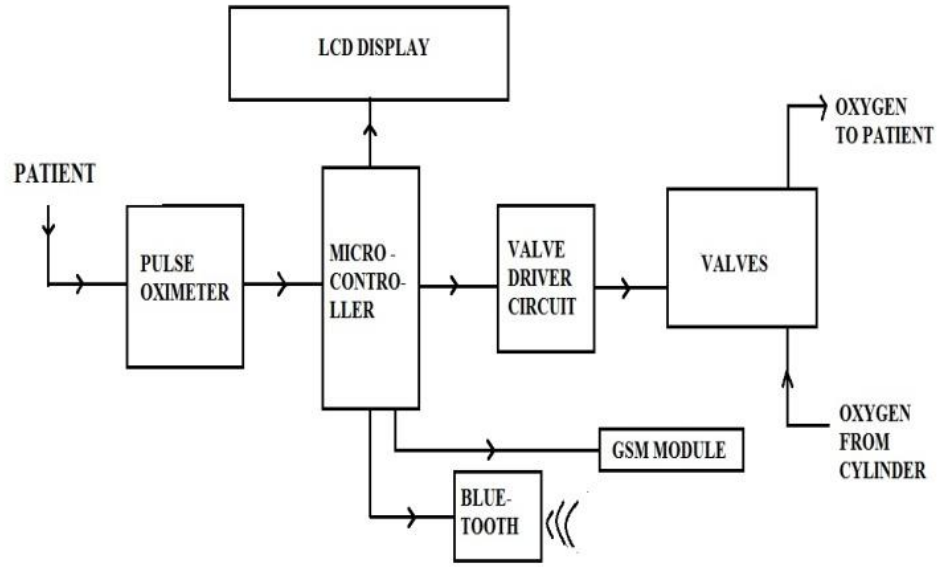

Fig.3 BLOCK DIAGRAM OF PROPOSED MODEL

C. TABLE AND FLOWCHART

TABLE : TOTAL WORKING CRITERIAS OF THE WORK

PULSE OXIMETER VALUE (%)	PATIENT STATUS (LCD DISPLAY)	VALVE STATUS (OPEN)	LED INDICATION (ON)	GSM STATUS (MESSAGE GENERATED)
>95	GOODSPO2	NO VALVES OPEN	NO LED ON	NO
60<SPO2<95	NORMALSPO2	SINGLE VALVE	SINGLE LED	NO
30<SPO2<60	VERYLOW	TWO VALVE	TWO LEDS	NO
<30	CRITICAL	ALL THREE VALVES OPEN	ALL THREE LEDS ON	TEXT MESSAGE GENERATED

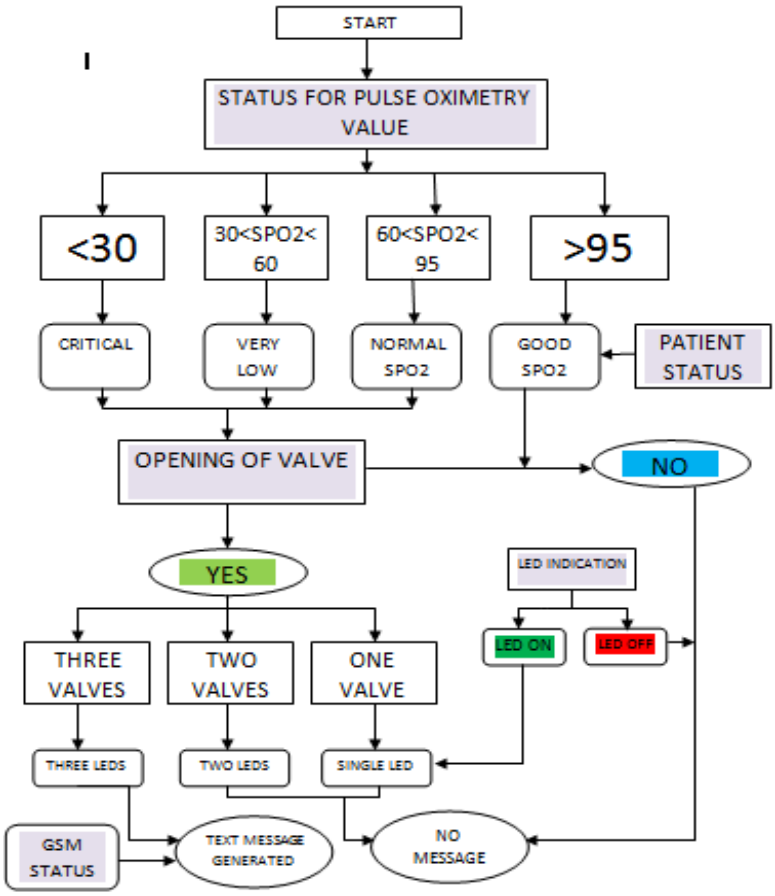

Fig.4 FLOWCHART OF THE MODEL

D. HARDWARE

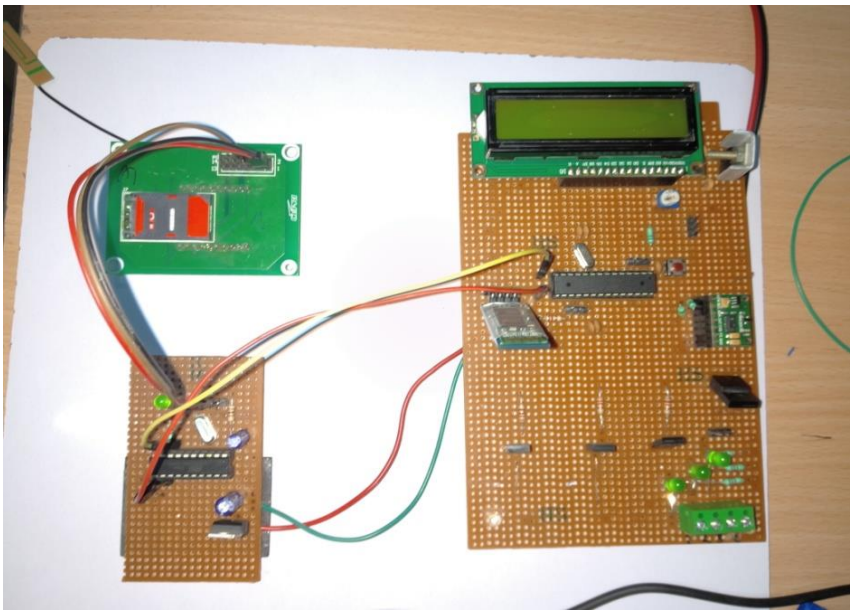

Fig 5.FINAL CIRCUIT

V. INTERFACING

The total set up was interfaced with a Bluetooth module HC05 for remote monitoring. The "SERIAL LAB" software is used to continuously monitor the patient. The built in function of the software allows to record the data in form of logs also continuous graphical visualizations can be achieved for constant remote monitoring.

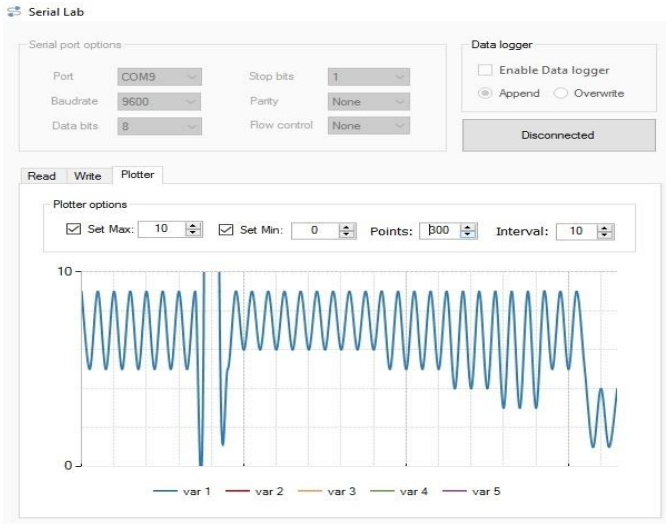

Fig 6(a) GRAPHICAL VALUES

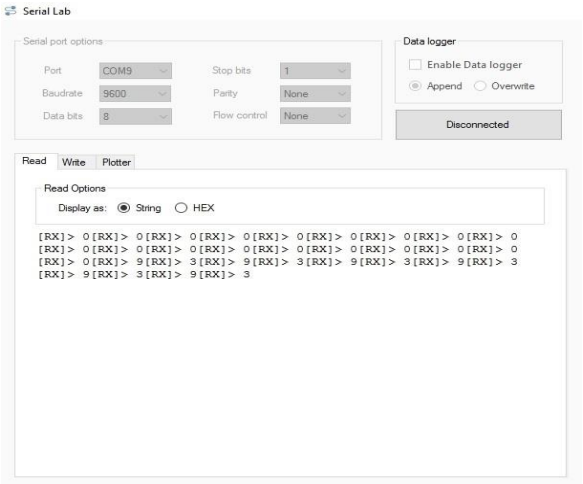

Fig6 (b) SIMULATION VALUES

VI. CONCLUSION

- The pulse oximeter value was realized successfully.
- The system sensed the oximeter value and accordingly the valves were switched as required.
- The LED's correctly switched according to the operation of the valves.
- The GSM successfully generated a text message in case of 'critical condition'.
- The total set up was successfully monitored using serial communication.
- The pulse oximeter value and status of the patient was continuously monitored in the LCD display.

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