Smart IV fluid and oxygen control system

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Abstract - *During recent years due to the technological developments many sophisticated techniques has been evolved for assuring fast recovery of the patients in hospitals. For good patient care in hospitals, assessment and management of patient's fluid and oxygen need is the most fundamental thing required. All most in all hospital, an assist/nurse is responsible for monitoring the saline fluid level and oxygen level continuously. But unfortunately during most of the time, the observer may forget to change the saline bottle at correct time due to their busy schedule. This may leads to several problems to the patients such as backflow of blood, blood loss, drop oxygen level etc.*

The design and implementation of smart IV fluid and oxygen flow controlling method employing liquid flow sensor and pressure sensor. The micro-controller are presented here which has the ability to assist the health care provider to control the saline circulation rate and oxygen level using Matrix keypad or Android phone. The Arduino Mega (2560) platform has been used as controlling unit for providing necessary control along with a 3×4 matrix keypad to control manually and Bluetooth module to control using an android phone.

Key Words: **Saline flow control, Oxygen flow control, Arduino mega, Bluetooth, Smart phone**.

1. INTRODUCTION

The requirements for health care are rapidly rising with the continuous growing of the world population. Tremendous success in medical technology has been observed with the rapid advancement of sensors, microcontrollers, and computers' prompt development. Numerous technological innovation designs are taken for the advantage of medical service improvement. There have been researching and development of saline monitoring and controlling device for the betterment of people's health care.

The amount of Normal Saline intake taken by patient is totally depends on physiological condition of patient but normally it is between 1.5 to 3 liters per day for an adult. Oxygen flow intake is up to 2-4l/min. Generally, in hospitals flow level is monitored by nurses and patients relatives. There is always a need to check the saline level after certain time. Unfortunately during most of the time, the observer may forget to change the saline bottle at correct time due to their busy schedule. This may leads to several problems to the patients such as back flow of blood, blood loss etc. The existing system for flow monitoring is very time consuming and inconvenient for nurses.

The main objective of proposed system is to provide reliable, convenient, effortless and cost effective system for flow monitoring. The oxygen and saline is injected into blood by considering certain parameters like heart rate, blood pressure, body temperature, and pulse rate and body weight of patient. As the saline goes below the critical level, it is necessary to change the saline bottle. As well as the oxygen flow need to monitor continuously. An automatic monitoring system determine the flow rate. Due to the use of Bluetooth module, the notification can be sent to the nurse on her mobile.

2. Overview of proposed system

After examining a few paper based on the improvement of the automated saline monitoring system, it was seen that many complex circuit and modules were used which increase the cost of manufacturing. In some system GSM (Global system for mobile communication) system where used to monitoring the system. In all the previous system it was seen that there is no automatic control of flow rate. The proposed system of this paper is to detect and control the flow rate of IV fluid and oxygen label accurately and give the signal to the doctor or nurse so that the amount of flow can be controlled using a smartphone and manual control.

The block diagram of proposed system is shown in figure 1.The system will be able to control the flow rate automatically according to the command given to the device by the user. Sensors will be developed to determine the rate.

Once command will be given to the device it will continuously check the flow rate and balance with the command given by the user. A water drop flow detector sensor will detect the water drop accurately. Error reading can be determined by signal conditioning circuit and will be removed by an isolator circuit.

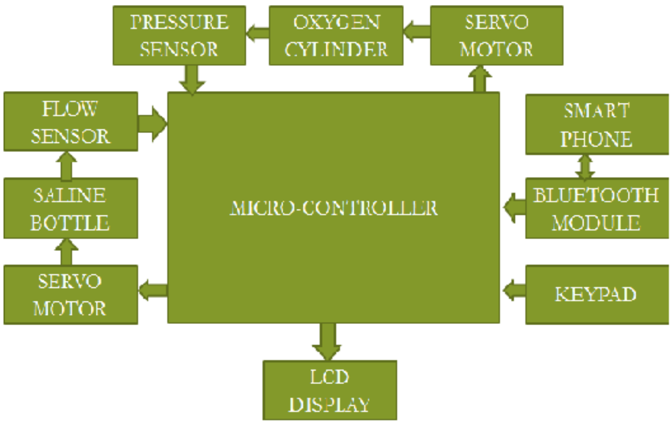

Fig. 1. Block diagram of proposed system

2.1 Circuit diagram of proposed system

Figure 2 shows the circuit diagram of a fluid control device consists of the flow sensor, pressure sensor and signal conditioning circuit, keypad servo with valve, LCD display, Arduino Mega 2560 and Bluetooth module.

The system has been proposed using Arduino Mega platform based on ATmega2560 contains 54 digital and 16 analog I/O including 15 PWM pins as well as 4 UARTs USB connection and a reset button. A keypad 3x4 has been interfaced with the system for giving the command to the user along with a 16x2 LCD monitor to monitor the information about current flow rate. The system has employed a Bluetooth module known as HC05 for pairing an Android mobile device to receive a command from android paired phone.

The row of the keypad has been connected to the digital pins of 5, 4, 3, 2 and column of the keypad has been connected to the digital pins of 6, 31, and 32 of Arduino Mega. LCD display has been connected to the digital pins 7, 8, 10, 11, 12,

13 of Arduino Mega. Pin 3 of the LCD has been connected to 5 volts through a potentiometer to change the LCD contrast. The servo has been connected to the PWM output pin 9 of the Arduino Mega. Bluetooth module has been interfaced with the microcontroller using two data pins RX and TX. RX of the Bluetooth module has been connected to TX of Arduino Mega which is digital pin 1 and TX of Bluetooth module has been connected to Rx of Arduino Mega which is digital pin 0.

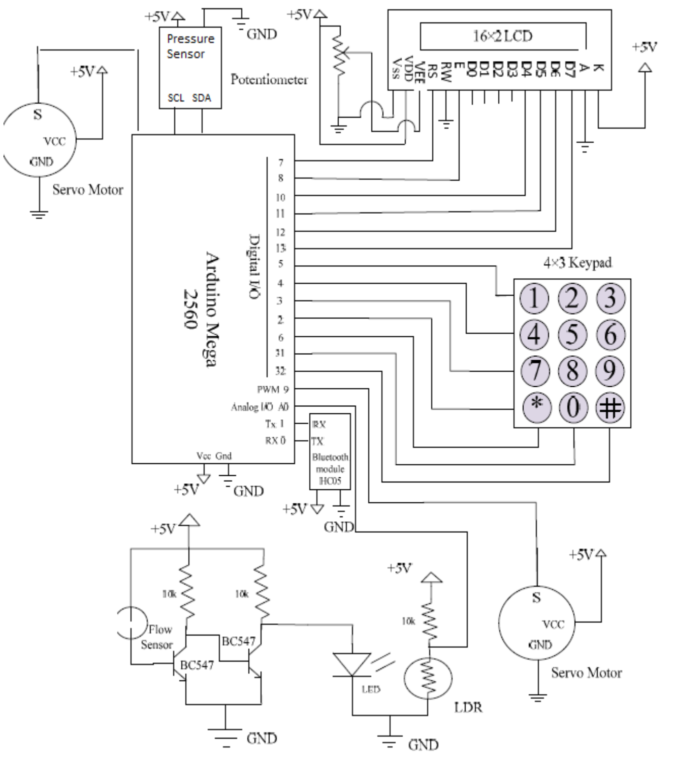

Fig. 2. Circuit diagram of proposed system

2.2 Hardware arrangement of proposed system

Figure shows hardware arrangement of proposed system.

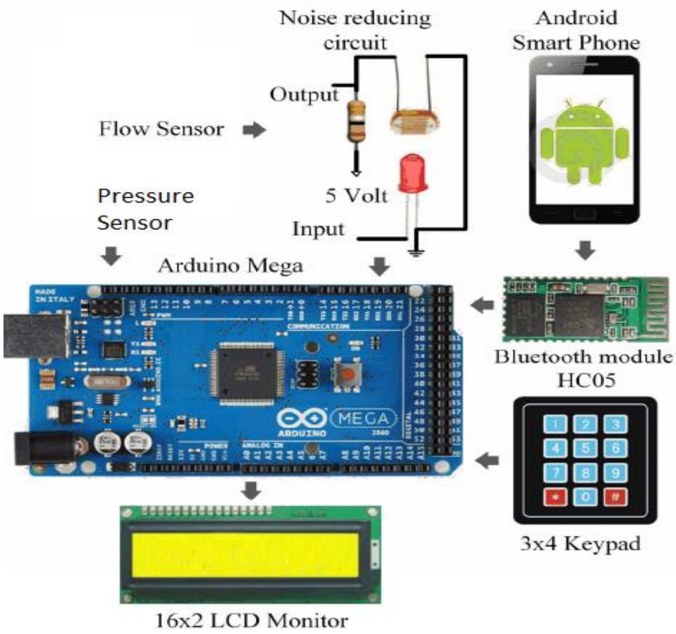

Fig. 3.Hardware arrangement of proposed system

2.3 Software design

An android app has been developed using Android Studio for pairing the smartphone with the developed system. The user interface of the android app is illustrated in fig 4.

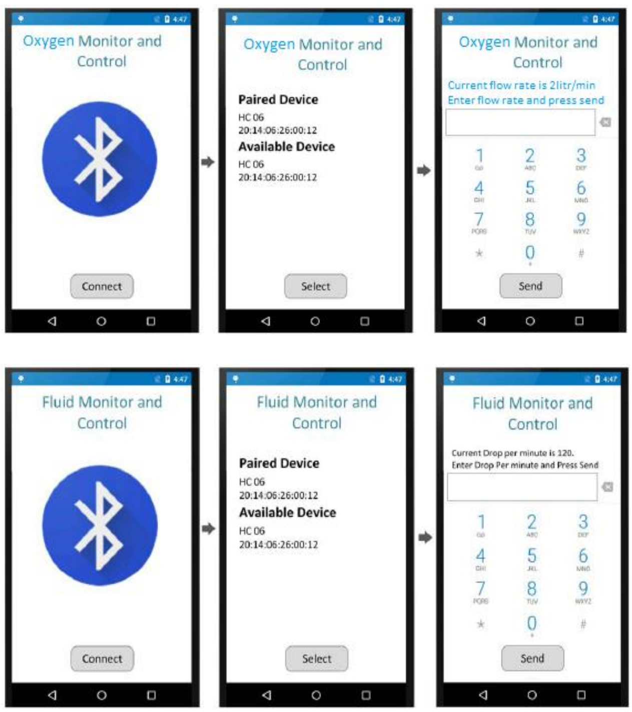

Fig. 4. User Interface of the android app

Programming of the microcontroller is developed based on the flow chart shown in Fig 5.

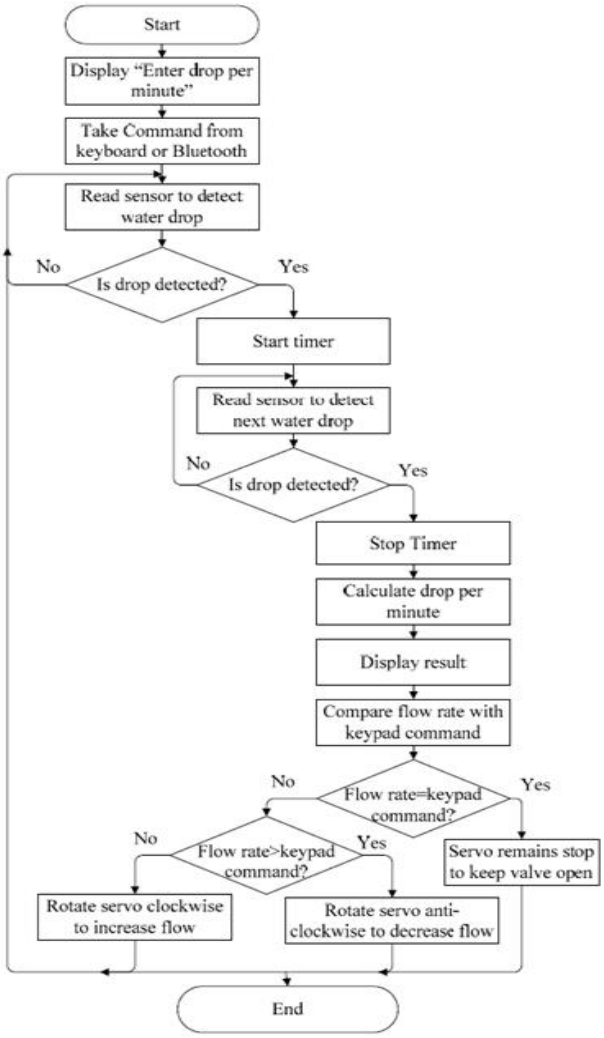

Fig. 5. Flowchart of Programming of IV Fluid control

The flow chart of fluid control device shows that at first, the Arduino is needed to give the command to the display and Bluetooth module to show the text "Enter number of drop per minute" on an android phone so that user can enter the number of drop per minute as wish. After entering the number Arduino continuously reads the flow sensor. When the sensor senses the first drop, the timer starts time and when the next drop will be detected by sensor, the timer will stop the time. Time will be calculated per minute. Then it will be compared with the flow rate given by the user. When actual flow rate has been greater than the command then servo has rotated anti-clockwise to reduce the flow rate and if the actual flow rate has been less than the command then servo has rotated clockwise to reduce the gap between valve and pipe. When both have been equal, servo has remained stop as well as the gap between valve and pipe to keep flow rate same. The loop has been continuously checked the actual flow rate of fluid and control the servo motor to rotate the valve along with wheel to control the flow of fluid automatically.

The flow chart of oxygen control device shows that at first, the Arduino is needed to give the command to the display and Bluetooth module to show the text "Enter oxygen flow in liter per minute" on an android phone so that user can enter the number of liter per minute as wish. After entering the number Arduino continuously reads the sensor. When the sensor detects the pressure, the timer starts time and after specific interval, the timer will stop the time. Time will be calculated per minute and it will be compared with the currant flow rate given by the user. When actual flow rate has been greater than the command then servo has rotated anti-clockwise to reduce the flow rate and if the actual flow rate has been less than the command then servo has rotated clockwise to reduce the gap between valve and pipe. When both have been equal, servo has remained stop as well as the gap between valve and pipe to keep flow rate same. The loop has been continuously checked the actual flow rate of fluid and control the servo motor to rotate the valve along with wheel to control the flow of oxygen automatically.

Programming of the microcontroller is developed based on the flow chart shown in Fig 6.

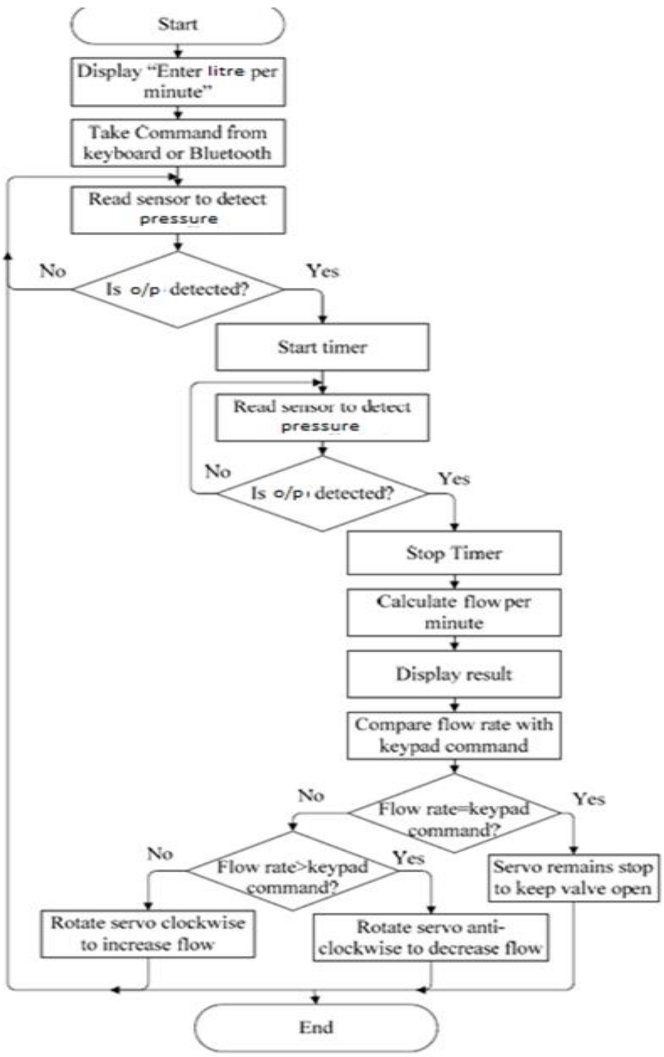

Fig. 6. Flowchart of Programming of oxygen control

3. Conclusion

Technology improvement is an ultimate aim in all sectors. Especially, more new technologies are emerging in medical field for the betterment of people and to serve the society. The proposed arduino based system acts as an assist to nurse and doctors in monitoring the patients. This also reduces the stress of repeated checking about the status of IV and oxygen set. It also has an appreciable advantage such as small size, affordable cost, and high precision, easy handling and completely automated. Certainly, this device makes a good change in medical field especially in patient monitoring system with less initial investment if implemented in real time work.

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