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# INTELLIGENT SALINE CONTROL MECHANISM

**Anil M. Bhadgale[1], Ankita Rani[2], Akshay Karnawat[3], Nitin Limhan[4], Sudhanshi Salke[5]**

*[1]Assistant Professor, Department of Computer Engineering*
*[2,3,4,5]Department of Computer Engineering*
*Pune Vidyarthi Griha's College of Engineering and technology,*
*Savitribai Phule Pune University,*
*Pune, India*

## ABSTRACT:

***We are proposing a system which is capable of remote monitoring and control system for hospitals which will overcome the constant manual monitoring in the present system which is time consuming job and huge use of manpower causes unnecessary disturbance to critical patients. The Arduino Mega2560 hardware platform is the proposed platform for controlling the whole system along with 4×4 matrix keypad (for manual control in case of emergency), smart phone (for remote access via web application or android application) and Wi-Fi module to control the flow of saline. The delineated flow sensor will be hanged in the drip chamber of the saline bottle to calculate the saline flow rate. The obtained outputs from sensor are continuously verified by the program and if any mismatch is found, the Arduino moves the servo motor to recalibrate the circulation rate to balance with the assigned flow rate. A speech recognition technique will also be present for the patient through which the concerned message is either sent to relatives or the nurse/doctor, depending upon the calculated frequency of the spoken words (message).***

**Keywords:** Automatic fluid control, saline monitoring and controlling device, Arduino Mega (2560), ESP8266 Wi-Fi Module, speech recognition module

## [1] INTRODUCTION

Conventional methods used for health care are becoming outdated. In today's hectic world and escalating death events, the need for developing a system that monitors remotely located patient is a must. Extraordinary success in medical technology has been achieved due to the combination of medical and engineering disciplines. Internet of Things (IoT) plays a significant role in health care monitoring. It opens the door for direct connectivity between the physical objects and into the computer-based systems.

Normal saline is a sterile solution of sodium chloride (NaCl) in standard water. Saline is often used in intravenous infusion in dehydration, nasal irritability and a variety of other problems. The quantity of saline needed depends on the state of the patient. Thus it is very crucial to measure the saline flow rate for each patient respectively. It is necessary to monitor the saline flow at regular intervals. Usually this is monitored by the nurses or doctors manually. Also the current methodology for saline level tracking is time consuming and annoying. It may happen that due to negligence, forgetfulness, hectic schedule, less number of working staff, the concerned person may forget to change the saline bottle as soon as it is consumed. As soon as the saline bottle is empty, blood flows back to saline bottle due to difference in blood pressure and the pressure in the inner part of the empty saline bottle. This may cause reverse flow of the blood. Therefore there is a need for automated saline flow control and saline level monitoring.

Growth of technology is at its peak. The main aim of this paper is to propose a system which can measure the saline flow rate and develop an automated infusion rate system remotely. It can also monitor the saline level. When it is below the critical level, immediately an alert is sent to the concerned authority and relatives of the patient through the use of internet. We also propose using speech recognition technique and depending on the frequency the concerned message is either sent to relatives or the nurse/doctor.

The proposed system is formed on the following technologies:

i. Arduino mega(2560)- the controlling unit
ii. Wi-Fi- for connection with the server
iii. Servo Motor- for controlling the rate flow
iv. IR Sensor- sensing the critical level
v. Keypad matrix- backup module if connectivity is lost
vi. Microphone- to take speech input

The important idea of the proposed system is to build a cost-effective, sound, simple, easy, convenient and mainly cost-effective system. The doctor/nurse can monitor the flow rate from anywhere and also are informed about the saline level. The constant monitoring of saline flow by visiting the patient is avoided through remote monitoring.

## [2] EXISTING APPROACHES

As the technology is improving, progress is taking place in every field. There has been research on automated saline monitoring for betterment of patient's health care. There is a proposed system of using Arduino Mega (2560) as a platform for controlling saline flow circulation using matrix keypad or Android phone. Bluetooth module is used to control the drop per minute flow using an android device. [1]

This paper [2] gives the insight of sending the information wirelessly to the central monitor placed at nurse's monitoring room. The central system receives data from several

monitoring devices and gives the analysis to the host personal computer (PC). The system removes the need for continuously on sight observation.

Another paper [3] uses a spring as a weight sensor to check the saline level. The weight of the filled and empty bottle is differentiated by the spring. Alarm is placed near to the nurse to alert about the saline level when it reaches its critical level. LED lights of green and red colour are used to indicate safe and low level respectively.

Another approach to indicate saline level is checked by using IR sensors [4]. IR sensors are located at critical level and also to sense saline completion status. DC motor is used to cause the movements in the spring. According to the commands to the DC motor the spring will be stretched and with the help of clamp it will pinch the intravenous tube to prevent reverse flow of the blood.

## [3] SYSTEM ANALYSIS AND DESIGN CONSIDERATION

### A. BLOCK DIAGRAM

The block diagram of the above 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 through keypad/android phone. A flow sensor is developed and employed to the drip chamber of the saline bottle to determine the flow rate of the saline accurately. It will continuously check the flow rate and balance with the command given by the user. And a speech recognition system will be helpful to convey the notification to the relatives or nurse/doctor depending upon the frequency of the concerned message.

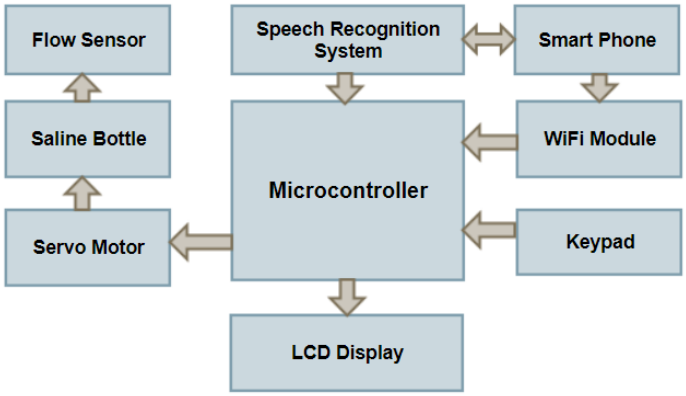


**Figure: 1. Block diagram of proposed automated fluid control device.**

### B. IMPLEMENTATION OF PROPOSED SYSTEM

The proposed idea aims to implement a saline monitoring and control system, which is automation, cost-effective, reliable and convenient. The system is implemented using Arduino Mega platform based on ATmega2560, a keypad 4x4 has been interfaced with the developed 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 Wi-Fi module ESP8266 to receive a command from android paired phone.

The microcontroller will receive the detected signal from the flow sensor and calculate the time between two drops to determine drop per second and give the command to LCD display for displaying the fluid flow rate. The user will give the actual flow rate via Android operated smart phone using Wi-Fi or manual keypad, and the microcontroller will compare the given command with the actual flow rate. Depending upon the command, the microcontroller will control a servo to rotate a valve clockwise or anti-clockwise rotation to increase or decrease the gap between valve and pipe for controlling the liquid flow. The valve will be mounted on the shaft of the servo and able to increase its depth smoothly from $0^0$ and become about the diameter of the saline pipe at $180^0$.When the servo will rotate from $0^0$ to $180^0$ the saline pipe will be pressed and released to control the liquid flow.

The speech recognition system will be helpful to convey the message from the patient to the relatives or nurse/doctor depending upon the frequency of the words and comparison of those frequencies with the threshold frequency to take the required decision of sending the message to the particular receiver.

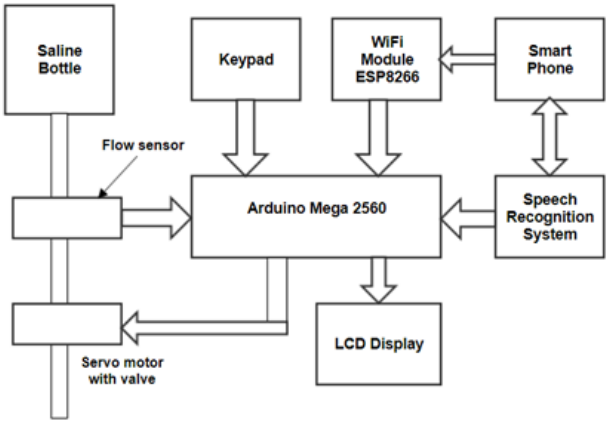


**Figure: 2. Functional diagram of hardware arrangement of proposed system**

## [4] HARDWARE DESIGN

- Arduino Mega 2560

The Arduino Mega 2560 is a microcontroller board which has 54 digital input/output pins 16 analog inputs, 4 UARTs(hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header and a reset button. The Mega 2560 can be powered via the USB connection or with an external power supply. The power source is selected automatically. External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery [5].

Arduino Mega is used to display the text “Enter the saline drop rate” on an Android phone so that user can enter number of drops per minute. Arduino also continuously reads the saline rate from the flow sensor. [1].

- ESP8266 Wi-Fi Module

The ESP8266 Wi-Fi Module is a self-contained System on Chip (SOC) with integrated Transmission Control Protocol/Internet Protocol (TCP/IP) protocol stack that can give any microcontroller access to your WIFI network. The ESP8266 is an extremely cost effective board. It has a powerful on-board processing and storage capability that allows it to be integrated with sensors [6].

Wi-Fi module is used to provide connectivity across the globe. It is used to connect the Arduino Mega 2560 to the software application.

- Servo Motor

A servo motor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. It consists of a motor coupled to a sensor for position feedback. It is a self-contained electrical device, which rotates parts of a machine with high efficiency and great precision. The output shaft of this motor can be moved to a particular angle [7].

The servo motor is used to control the saline flow rate. The servo motor is able to rotate from $0^o$ to $180^o$ to control the flow rate. If the saline flow rate is more than that specified in the command then the servo motor rotates anti-clockwise to reduce the flow rate and if the actual flow rate is less than that specified in the command then servo motor rotates clockwise to reduce the gap between the valve and pipe. When actual flow rate is same as the one specified in the command, then servo motor stops to keep flow rate same [1].

- Flow Sensor

Flow sensor consists of two metal wires arranged in parallel very close to each other. Flow sensor is used to detect the saline flow from the saline bottle. The flow sensor provides a digital pulse each time a certain amount of saline passes through the pipe. The output can easily be connected to a microcontroller for monitoring saline flow [1].

- Keypad Matrix

A keypad matrix consists of a set of push buttons or switches which are arranged in a matrix format of rows and columns. These keypads are available in different configurations.

We have used a 4x4 matrix configuration. Keypad Matrix is used to take the user inputs. In case Android phone is discharged or is not working, then the user can use Keypad Matrix to provide the saline drop rate [8].

- IR Sensor

An Infrared (IR) Sensor is an electronic instrument which is used to sense certain characteristics of its surroundings by either emitting and/or detecting infrared radiation. Infrared (IR) Sensor senses the saline drops from saline bottle when it reaches a particular critical level. After sensing that the saline in the saline bottle has come to a critical level, it transmits a signal to the sensor receiver [2].

- Microphone

A microphone is an instrument for converting sound waves into an electric signal which may be amplified or recorded. This electrical signal will be transmitted to arduino platform and frequency will be extracted using corresponding sampling rate.

## [5] CONCLUSION

Technology development in medical field for the betterment of people is an ultimate goal to serve the society. This paper proposes the system which can automatically observe and control the saline flow rate, and helps the nurses/doctors in remote monitoring of saline to large extent. To detect and control the flow rate accurately, a flow sensor made up of two metal wires is used, which is more sensitive than the one available in the market. The primary goal of this system is to offer dependable, hassle-free, simple and easy as well as a cost efficient method of saline level controlling. It will be advantageous at night as there will be no such requirement for the nurses to visit patient's bed every time to check the level of saline in the bottle since an alert notification will be sent to the nurses, doctors, caretakers when saline reaches the critical level. This low-cost medical device also consists of speech recognition system which will record patient's voice at critical times and extract the frequency and depending upon those frequencies, it will send alert notification to the nurses, doctors or the caretakers.

**REFERENCES**

[1] Humayun Rashid, Sarjahan Shekha, S M Taslim Reza , Iftekhar Uddin Ahmed, Qader Newaz, Md. Rasheduzzaman, " A Low Cost Automated Fluid Control Device using Smart Phone for Medical Application", Institute of Electrical and Electronics Engineers (IEEE), pp. 809-814, 2017

[2] Shyama Yadav, Preet Jain, "Real time cost effective e-saline monitoring control system", ICCCCM 2016

[3] Manoj Kumar Swain, Santosh Kumar Mallick, Rati Rajan Sabat, "Smart Saline Level Indicatorcum Controller", IJAIEM, ISSN 2319-4847

[4] "Automatic Intravenous Fluid Level Indication Systems For Hospitals", IJARSET, ISSN 2321-9653

[5] "Arduino- Arduino Board Mega 2560", Arduino.cc [Online].Available: https://www.arduino.cc/en/Main/ArduinoMega2560

[6] Ms. M Malathi, A. Gowsalya, M.Dhanushyaa, A.Janani, " Home Automation Of ESP8266"

[7] Geetanjalee A. Zarkar, Subhash S. Sankeshwari, "SIMULATION OF DC SERVO MOTOR POSITION CONTROL USING SLIDING MODE TECHNIQUE", IJET, Vol. 7, Issue 6.

[8] "Matrix keypad with microcontroller", embedjournal.com [Online]. Available: https://embedjournal.com/interface-4x4-matrix-keypad-with-microcontroller