INNOVATIVE INTRAVENOUS FLUID CONTROL AND EMERGENCY MONITORING SYSTEM

Dr.K.Sampath kumar[1]
S.Abinaya[2], M.Abirami[3], S.Kesavan[4], Sethu.S[5]
Professor[1], Students[2,3,4,5]
Department of electrical and Electronics Engineering
Jay Shriram Group of Institutions
samprocessor@gmail.com

Abstract – In modern world the science and technologies are more advanced. Due to the technological development many sophisticated techniques has been evolved for assuring fast recovery of the patients in hospitals. In most of the hospitals a nurse is responsible for monitoring the IV (Intravenous) fluid level continuously. But unfortunately most of the time, the absorber may forget to change 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 etc. To overcome this critical situation, we developed new system by using software and hardware. So many automation health monitoring devices are developed to ensure patients safety and to reduce the stress of the doctors. Our system can be able to monitoring and controlling the saline level and update the status dynamically by Arduino based automation system. Meanwhile the liquid flow sensor and air pump valve is used to measure and control the flow of saline fluid respectively. Buzzer is connected to the bed, if the buzzer is ON, transmitter transmits the signal to the receiver through the Wi-Fi module and it allots the absorber by buzzer and LCD at the control room and it will indicates the room number of the patient for quick recovery.

Keywords: Intravenous fluid, IR sensor, Arduino, Buzzer, LCD, Gear motor, Air valve, ESP8266 Wi-Fi.

I .INTRODUCTION

Generally, as the population increases, the need for health care also increases. Hence it is a mandatory thing for everyone in this world to take care of their health properly. In this scenario, maintaining patient's safety is the top most priority to be given in all hospitals. Nowadays, many automatic health monitoring devices are developed to ensure patients safety and to reduce the stress of the doctors. The invention of such devices introduces a drastic change in medical field for monitoring the parameters like heart beat rate, detection of heart attack symptoms and much more automatically with interdisciplinary nature. Even though many advanced automatic devices are used, ensuring the safety of the patients during IV period is still a challenging issue. Intravenous therapy is treatment that infuses intravenous solutions, medications, blood, blood products directly into a vein. Intravenous therapy is an effective and fast-acting way to administers fluid are medications treatment in an emergency situations, and for patients who are unable to take medications orally. Approximately 80% of all patients in the hospital setting will receive intravenous therapy.

The flow measurement and control system can be developed by using flow sensor the output of the sensor which is in the form of pulses is given to the Arduino controller. It given the

signal to gear motor valve through L293D IC driver. Hence to assure the safety of the patient during IV period there is a need to develop an efficient health monitoring system. This can be achieved with proposed idea of IV fluid level indicating system where IR sensor, RF transmitter, receiver and buzzer are used to provide intimation to control room either bottle is empty or abnormality condition is occur in the patient. This will reduces the stress in continual monitoring by the doctor or nurse at an affordable cost.

II .LITERATURE SURVEY

Jinwook kim [1] and et al., proposes "Transit Time Difference Flow meter for Intravenous Flow Rate Measurement Using 1-3 Piezoelectric Composite Transducer". In this work, an ultrasonic flow meter (UF) with 1-3 piezoelectric composite transducer was designed, fabricated of flow rate. The transducer wedge for the angled beam propagation and an acoustic impedance matching layer were included in the design for transmission enhancement. To ensure measurement of flow rate the effect of flow distribution inside the IV tube was taken into the account.

Pratiksha W. Digarse [2] and et al., proposes "Arduino UNO and GSM Based Wireless Health Monitoring System for Patients". In this paper based on the wireless communication between the infusion pump and hospital network. A systematic self-testing of the processing, delivery, and safety systems is performed whenever the infusion pump is turned on, to verify readiness for operation. Automation is used to infusion pump for the wireless application as well such as the SMS received by our hardware system, maintenance, allow software upgrades etc.
Andrea Cataldo [3] and et al., proposes "Development of a Remote System for Real-Time Control of Intravenous Drip Infusions". This paper proposes the use of a microwave reflectometry-based system for the automatic control and real –time monitoring of the flow and of the liquid level in intravenous medical infusions. In this system combines microwave time domain reflectometry (TDR) measurements with a non-invasive sensing element.

Y.Zhang [4] and et al., proposes "Wireless Sensor Network-Enabled Intravenous Infusion Monitoring". In this system is a wireless sensor system based on taking a fork-type light barrier as a sensor, a micro-control unit (MCU) as a Zig bee-based radio frequency device. The systems performance is evaluated through some laboratory experiments using tuning algorithm to demonstrate that the result show the required accuracy of the system to meet practical needs.

III .FACTORS OF CALCULATION OF LIQUID FLOW RATE

From the physics of flow is helpful to safety use all the available pump options, including selecting the appropriate device; delivering he indicated therapy problem free; evaluating and altering parameters; and assessing the fluid pathway. Factors that affect the physics of flow are comprised of the following:

1. RATE

Flow rate impacts resistance and resistance impacts the amount of pressure required to achieve the flow rate.

FR=P/R

2. PRESSURE

Pressure is measure of the force applied to overcome resistance in a system, across a given area

P=F/A

The area is the internal fluid pathway or internal diameter. Pressure is the result of force and is measured in either PSI or mmHg.

A pressure gradient between the IV solution container and the venous pressure is necessary for flow to occur. The gradient depends on static pressure and patient's activity and dynamic pressure.

3. RESISTANCE

Resistance is anything that impedes flow. The greater the resistance in the fluid pathway, the greater the force required to move through it. Fluid viscosity, fluid pathway length and internal diameter of the administration set are the major resistors to flow.

4. VISCOSITY

Viscosity is defined as a fluid's resistance to flow. Temperature directly affects fluid viscosity colder fluids exhibit greater resistance to flow than warm fluids. Principle: Viscosity directly impacts resistance.

5. LENGTH

Length directly impacts resistance. Doubling the length reduces the flow rate by half. Many other factors like tube's internal diameter, infiltration affects the flow

IV.SYSTEM ARCHITECTURE

The system is contains two major design and this system is used to monitoring and controlling the saline level by Arduino controller. We used following component such as air pump valve, IR sensor, gear motor, L293D driver, Arduino controller and ESP8266 Wi-Fi module. The block diagram of the system is shown in the Fig.1. To measure the flow rate of the liquid by using IR sensor. The air pump valve is connected to the Intravenous fluid tube in which the flow to be controlled. The valve is connected with the IR sensor, the IR sensor measures the flow rate and generates the analog pulses.

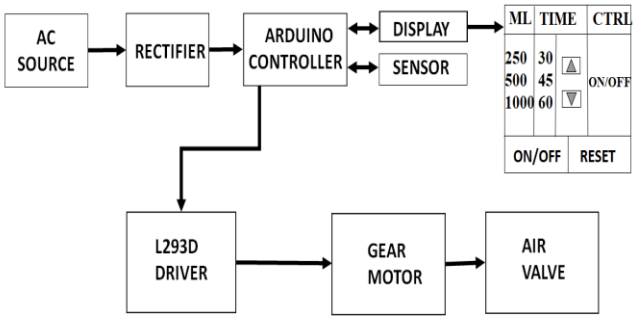

Fig.1 Arduino Uno based model

The IR sensor is connected with Arduino in order to read the analog pulses from the IR sensor and sends the signal to the main component of the air pump valve. By using the web server we set the liquid level and time were set by manually. The gear motor is connected to the gear motor drive L293D, The L293D drive is used to control the rotation direction and controlling the steps. The flow meter works on the principle of IR sensor, it is a transducer whose output voltage varies in response to a magnetic field.

As the liquid flows through the flow meter, IR sensor sense the liquid flow and sends the corresponding data to Arduino through the interface. If the bottle is empty the Arduino sends the signal to the gear motor valve and the valve is closed automatically. So to avoid the several problems occur in the patients.

If the patient is critical or other abnormality condition, the patient or observer press the push button. Transmitter transmit the signal through the ESP8266 Wi-Fi module to the receiver. In the monitor room has 2 LCD light, one is indicates the saline bottle is empty and another one is indicates the patients abnormalities.

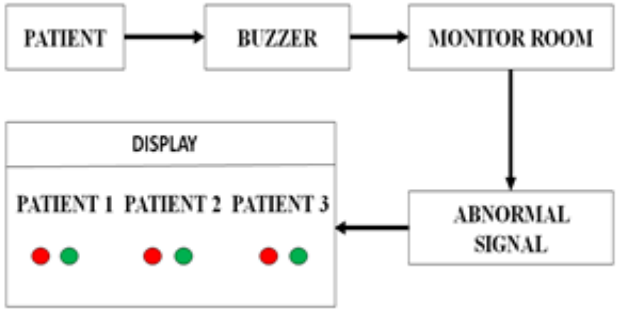

Fig.2 Block diagram of emergency monitoring system

V.OVER VIEW OF SYSTEM ANALYSIS

The major components used in proposed have been discussed briefly.

1. IR Sensor
2. Arduino
3. Gear Motor

1. IR SENSOR

An infrared sensor is an electronic instrument which is used to sense certain characteristic of its surrounding by either emitting or detecting infrared radiation. The sensor is designed specifically for liquid level detection by non-contact methods in clear or very translucent pipes. The sensor, features an infrared light beam from an infrared light sender that becomes refracted and undetected by the infrared light receiver when the liquid is present, can be mounted on a IV bottle that is between 3 to 13mm in diameter. This compact and non-invasive sensor device runs on 5 Volt DC. The 'thru scan' principle where liquid refract light beam insures reliable detection and the infrared beam technique can help penetrate slurries and other solids with similar detection effect as water or liquid.

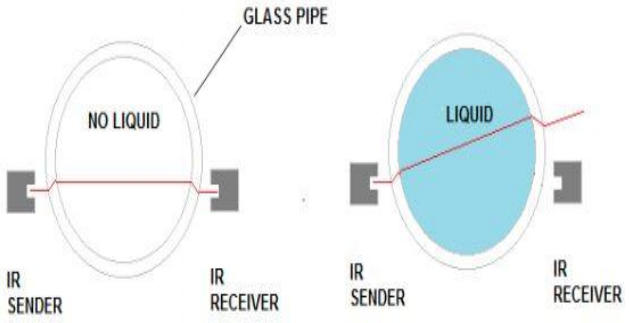

Fig.3 IR Sensor

2. ARDUINO

Arduino is a single board controller intended to make the application of interactive objects or environments more accessible. There are many types of Arduino available. The ARDUINO UNO REV3 model, has been used. The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins, 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header and a rest button. It contains everything needed to supports the micro controller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

In order to program Arduino, Arduino IDE is programming platform is installed in a windows pc. The program is written in the Arduino ide and then uploaded to the Arduino with the help of serial cable Universal Serial Bus directly connected to the pc. The Arduino will read the data from the flow meter and converter it as it is programmed. The data that is received from the flow meter in the form of analog data is converted to digital pulses by Arduino.

3. GEAR MOTOR

A gear motor is a specific type of electric motor that is designed to produce high torque while maintaining a low horsepower, or low speed, motor output. When you combines an AC gear motor with a series of gears or a gearbox reduces the speed of the gears and creates torque. When using a gearbox, a reduction shaft connects it to the main shaft and motor rotor, or armature. The rotor is the rotating part of a motor.

Fig.4 Gear Motor

A gear motor can be either an AC (alternating current) or a DC (direct current) electric motor. Most gear motors have an output of between about 1,200 to 3,600 revolutions per minute (RPMs). These type of motors also have two different speed specifications: normal speed and the stall-speed torque specifications.

VI .RESULT AND DISCUSSION

In this system by using the software and hardware, we can controlling and monitoring the saline level of the patient by using Arduino. If the saline bottle is empty, the transmitter transmit the signal through Wi-Fi module to the receiver in the monitor room and simultaneously the bottle is automatically stop of the process of drips flow in the patient. Anther output of this system is, if any abnormalities is occur in the patient the buzzer will be ON and send the signal from the transmitter to receiver through Wi-Fi module. Both the process are indicated in the monitor room by using Wi-Fi module.

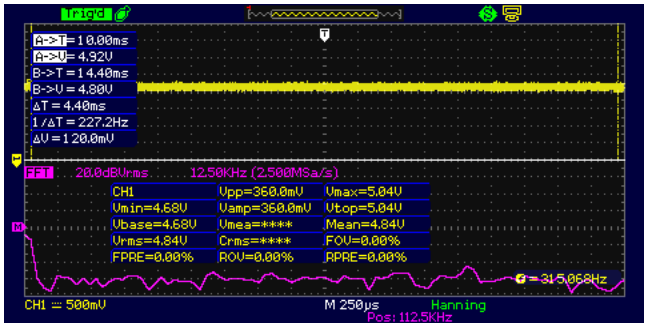

Fig.5 Frequency range of data receiving

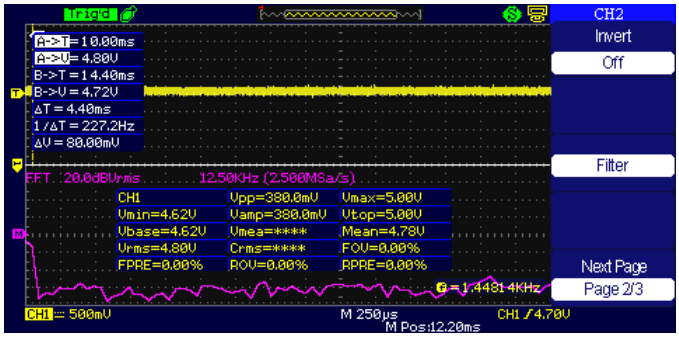

Fig.6 Frequency range of data sending

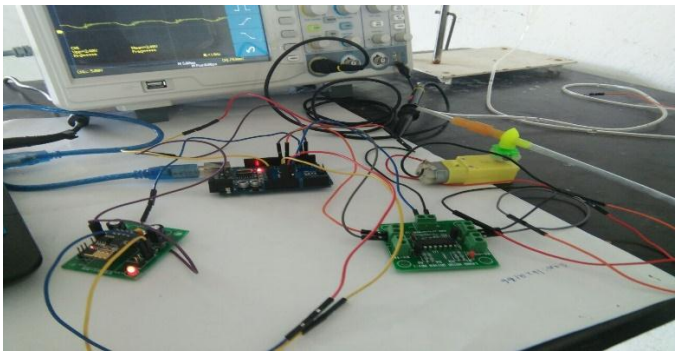
Fig.7 Flow of liquid is controlled by valve

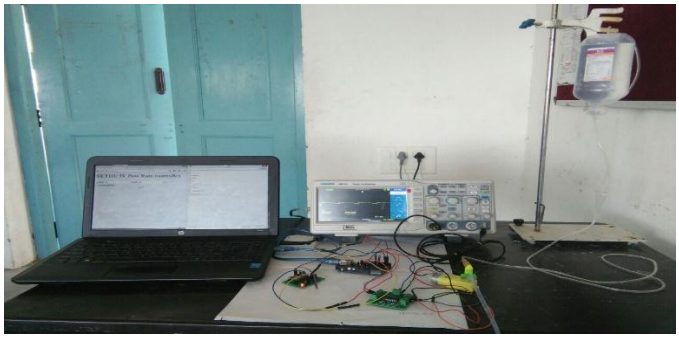
Fig.8 Overall output connection

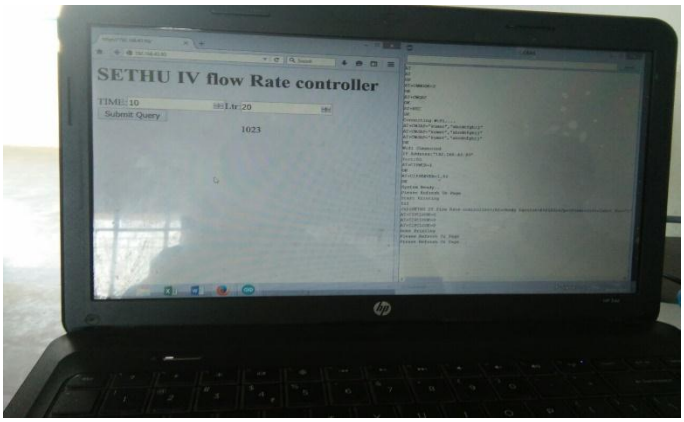

Fig.9 Input data through display

VII. CONCLUSION

Technology development is an ultimate aim in all sectors. Especially, more new technology are emerging in medical field for the betterment of people and to serve the society. The proposed Arduino based indicating device acts as an assist to nurse and doctors in monitoring the patients. This also reduces the stress of repeating check about the status of Intravenous fluid level. Our system is used to observe and control the level of saline bottle at instant of time due to their busy schedule. It is very helpful to avoid the unnecessary death of patients due to such as backflow of blood, paroxysm, hysteriform etc. It avoids manual errors and provides ultimate safety to patients. It also has an appreciable advantages such as small size, affordable cost and high accuracy, easy handling and completely automated.

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