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Smart Saline Monitoring System

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Abstract: As technology is moving at a very high speed, it becomes mandatory to occupy the current change that is happening in the world in terms of our health with the advancement in medical science due to the technology.
Traditional system for saline monitoring is to involve a nurse or the caretaker to continuously monitor the status of the glucose, which becomes very difficult for the nurse to note each patient information and its status. Secondly, the flow system has to be managed with the saline drip by physically coming to the patient and doing which in turn waste a lot of time of the nurse. Therefore, to countermeasure, the above issue a saline monitoring system is being developed which could help the patient as well as a nurse in the hospital.
Keywords: LPC 2148 Microcontroller, ESP 8266 Wi-Fi, AWS

I. INTRODUCTION

Existing working of the Health Care System is problematic because the patients had to visit the hospital for their check-up and treatment, They had to stand in the long queue and secondly, patient remain admitted in the hospital then the nurse has to continuously monitor the status and report it to the doctor.
Intravenous drip infusion is commonly used for running medicine in the hospital. The infusion pump is a medicinal device, which infuses fluids, medications into patient's circulatory system. It is a healthcare facility used universally in hospitals and at domicile. However, it is backbreaking to constantly examine administration or supervision, as it can give up more than one hour. Therefore, it is tough to immediately observe incidents
In order to solve the above problem where the patient will have knowledge of the treatment, we can use the technology in a smarter way. Internet of Things (IoT) is such an idea where the entire Bio Medical instrument, sensors will communicate with each other with the help of the Internet. These microchips can be placed on the monitoring equipment. The data that the microchip has collected will be sent to the destination server of the hospital for remote monitoring purpose.

II. RELEATED WORK

Manoj et.al automated a saline monitoring system in which whenever a patient is fed any saline bottle nurse has to continuously monitor the patient or any caretakers. Most often due to more number of patients and the carelessness, the saline is totally consumed this could later lead to a process where a moment saline bottle is over the blood could rush back to the saline bottle due to the pressure in the bottle. So he designed a device which could help the nurse to countermeasure the above problem and she can monitor the saline by just sitting in the control room[1]. The moment saline is reached to a certain threshold a red LED would glow along with the buzzer to alert the nurse. Even if the nurse is still not able to reach for some issue then an arrangement is made to squeeze the saline pipe till it's completely flattened so that the pressure generated by the empty bottle should not allow blood to rush in.
In another approach by Humayun *et.al* they have implemented a system which is able to control the flow rate automatically according to the command given to the device by the user through the matrix keyboard, a flow will be developed and employ to the drip chamber of the saline bottle to determine the circulation rate. Flow sensor will detect drops of the saline and that detected information will be sent to the microcontroller .the controller will check the user inputted value for drops rate and accordingly it will adjust the valve to clockwise or anticlockwise[3].
Harish chekka developed a real-time patient monitoring system, which consists saline level sensor, temperature sensor, heartbeat sensor, pressure sensor, ECG sensor, sleep/standby sensor[2]. All these sensors are connected using ARM7 (LPC 2148) microcontroller, to send all these information a Bluetooth is being used to view the information in the mobile. For the saline level, they have used the IR sensor to detect drop radiation and they have maintained a threshold of 70ml as an alert to the nurse that a saline is about to empty.
Afratasneem et.al describes the development in the saline monitoring system with the help of low-cost Load cell and the GSM technology which in turn helps the doctors and the nurses to view the status saline at a certain distance[4]. Load cell act as a weight

sensor, which is used to weight the amount of saline in the bottle. and the status of the saline is transmitted to a distant mobile using the GSM technology and to the LCD.

Shivam Gupta designed a health monitoring system as a development in microcontroller system which can be used in the home as well as in the hospital. In the Circuit connection part they have used the heartbeat monitoring circuit using LM358, by placing a finger in-between, a LED and photo resistance, person can easily detect pulses of the heart[5]. An LM35 temperature sensor is being used. An ECG sensor which operates on the phenomenon “piezoelectric effect” to measure pressure, acceleration, force by converting them to an electrical signal. All the above sensor information is communicated using ESP8266 Wi-Fi, which provides Wi-Fi connection to any microcontroller and works on TCP/IP protocol.

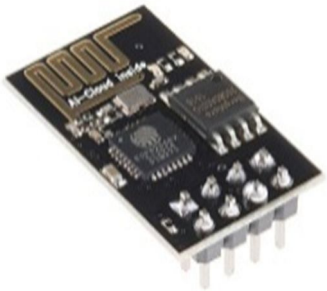
III.HARDWARE COMPONENTS

The major hardware components used in the proposed system are discussed

A. LPC 2148 Microcontroller

The LPC2148 micro controllers are based on a 16-bit/32-bit ARM7TDMI-S CPU with real-time simulation and embedded trace support, that combine micro controller with embedded high-speed flash memory ranging from 32 KB to 512 KB. A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at the maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30 % with a a minimal performance penalty.

B. ESP8266WROOMWi-Fi Module



ESP8266 is a wifi SOC (system on a chip) produced by Espressif Systems. It is a highly integrated chip designed to provide full internet connectivity in a small package. ESP8266 can be used as an external Wifi module, using the standard AT Command set Firmware by connecting it to any microcontroller using the serial UART, or directly serve as a Wifi-enabled micro controller, by programming a new firmware using the provided SDK.

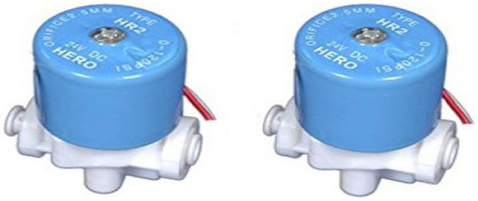
C. Load Cell.

In this load cell, we are measuring the weight of the glucose bottle.12v supply is required to operate the load cell. its output will be analog in nature. The maximum weight measured in the load cell is 1kg. If the weight of the glucose bottle is below 30 ml, the flow of liquid is stopped.

D. Water Pump

The water pump is mainly used to control the flow of the saline, which in turn is being connected to the relay, which operates at different voltages that are provided. Its operating Flow rate is 80-120L/H, Outside diameter of water outlet: 7.5mm / 0.3" and Inside diameter of water outlet: 5mm / 0.2".

E. Solenoid Valve.



A solenoid valve, otherwise known as an electrically operated valve, is an automatic valve that removes the need for an engineer to operate a valve manually. Solenoids operate using an electromagnetic solenoid coil to change the state of a valve from open to closed, or vice-versa. If the solenoid valve is 'normally closed', when the coil is energized, the valve gets lifted open by the electromagnetic force produced by the coil.

IV. PROPOSED SYSTEM

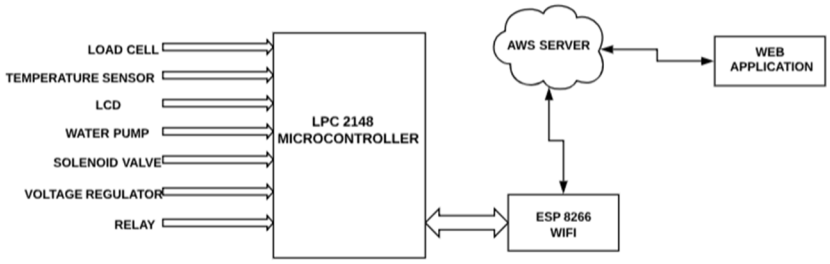


Fig 1: Proposed Architecture of the Saline Monitoring System

Above figure 1 describes the block diagram of the saline monitoring system in which Load cell sensor, Temperature Sensor, LCD, Water Pump, Solenoid Valve, voltage regulator, Relay all this sensor are connected to the LPC 2148 Microcontroller.
Load cell weighs the amount of saline left in the bottle. As we connect the saline bottle and start the flow, the user selects one of the three flow rates as per the patient requirement from the web application and water pump will start with the selected voltage of the flow rate.
The moment saline is 30ml or more a message will be generated at the server side saying saline is about to empty and the solenoid valve will get close and the flow processes will be stopped with the help of a relay.
The entire sensors, which are, connected to the microcontroller, communicate with the help of the additional voltage regulator to satisfy the operating voltages of the sensor. The controller is programmed in such a way that as it receives the information about the sensor; it sends the data to the ESP Wi-Fi module, which in turn sends the data to the server. At the server side, AWS is used from which we obtain a static IP address.
At the software design part a socket programming is performed using JavaScript and a small web application is designed using HTML and CSS ,from which, we are controlling the flow rate of the saline bottle for the given IP address.

V. RESULT & DISCUSSION

The Proposed saline system shown below with all the circuit connection, it's tested with Normal saline bottle and the results were obtained when the saline bottle is full and about to get empty.

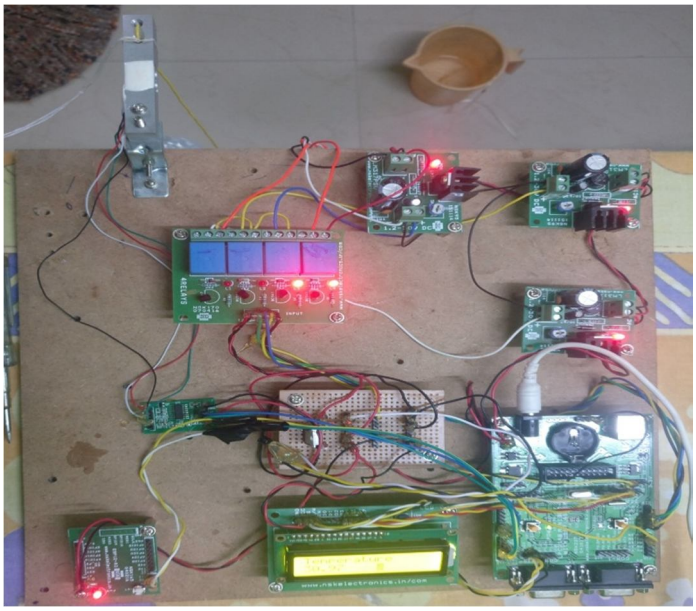


Fig 2: -Full circuit design of the saline monitoring system

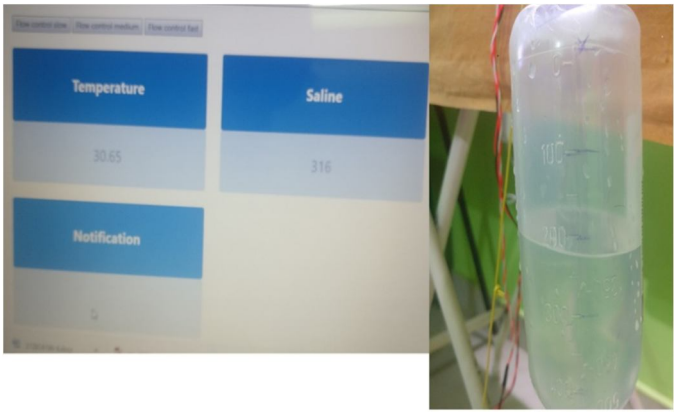


Fig 3: -when saline bottle is 310 ml

Fig 4: -when saline bottle is 40 ml

VI. CONCLUSION

The proposed saline system will not only monitor the saline status but also control the drop rate of the saline, which can be increased and decreased as per the requirement. The system can be further improved for multiple patients with a single web application through which we can monitor the saline status of multiple patients and control their drop rates remotely.

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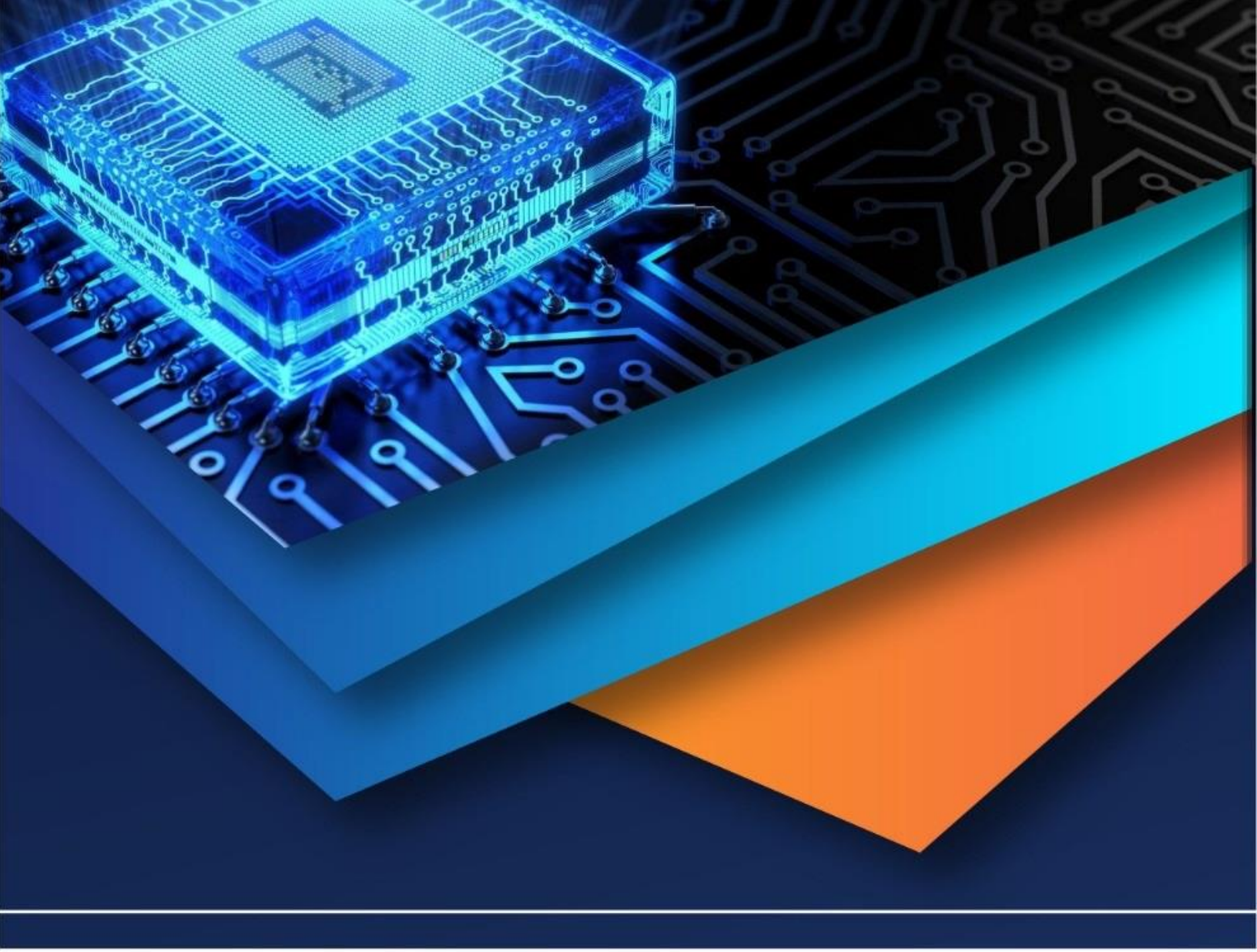

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