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SALINE MONITORING SYSTEM USING SPI PROTOCOL FOR WIRELESS NETWORKS

Dr. B. Pragathi*, A. Tarakanadh, K. Chaitanya Sri**, S. Harshini Reddy**, B. Bhanu Shankar**, K. Mahesh Babu**, K. Nathan Israel**, N. Saranya** & G. Avinash****

* Associate Professor, Department of Electronics and Communication Engineering, DVR& Dr. HSMIC College of Technology, Kanchikacherla, Andhra Pradesh

** Department of Electronics and Communication Engineering, DVR & Dr. HSMIC College of Technology, Kanchikacherla, Andhra Pradesh

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Abstract:

The main motto behind this project is to build a strong monitoring system to monitor saline levels that has been connected to patient. In hospitals, Saline is fed to patients to treat dehydration and use of saline improves their health. In current health care system, whenever a saline is fed to any patient, the patient must be continuously monitored by nurse, doctor or caretaker. So inherently, in all the hospitals nurse or medic is liable for observing the saline level. Due to the absence of nurses towards observing the saline level can harm the patients' health. And in order to take care of saline level in saline bottle we have proposed a device that intimates to the care takers about the level of saline bottle. This device forward a notification to the caretaker or medic about the level of saline in the saline bottle. It accelerates a notification when saline bottle is about to finish, so that the caretaker can arrange the changes required for saline bottle.

Key Words: IR Sensor, Saline, GSM Module, Nrf24l01 Transceiver, Arduino, Patient, Hospital

Introduction:

The medical field is advancing rapidly due to the advancement in the technology. The coalition of engineering and medical disciplines has been evading the modern medical practices. In the recent decades we have gone through and presently going through different phases in the field of Health system. Conventional methods used for health care system are becoming obsolete due to increase in population. So due to the various changes in the environment such as pollution & rise in temperature and food, our health is getting affected with various kinds of diseases. In order to get cure for these diseases we are entering into hospitals. In this way many of the people becomes patients and admitting in the hospitals to get cure for these diseases. Each patient is connected with saline to provide glucose to the body. In a similar fashion the whole world gets affected by a disease called COVID-19. At that time even the caretakers / nurses didn't get near to the patients to change the saline, since it is fast spreading. By taking such situations we had come up with a solution i.e., "Saline Monitoring System" where the device sends a SMS to the caretaker's mobile. A Microcontroller & RF based saline monitoring system is a perfect example of such innovative health management system. This system can be easily and readily installed in every hospital which will help out the medic and doctors for efficient observance of saline flow in the hospitals. Then they can reach out near to the patients fastly and provide the care needed to the patients.

2. Block diagram & Hardware Description:

In this phase we confer about block diagrams and hardware components used

2.1 Block Diagrams:

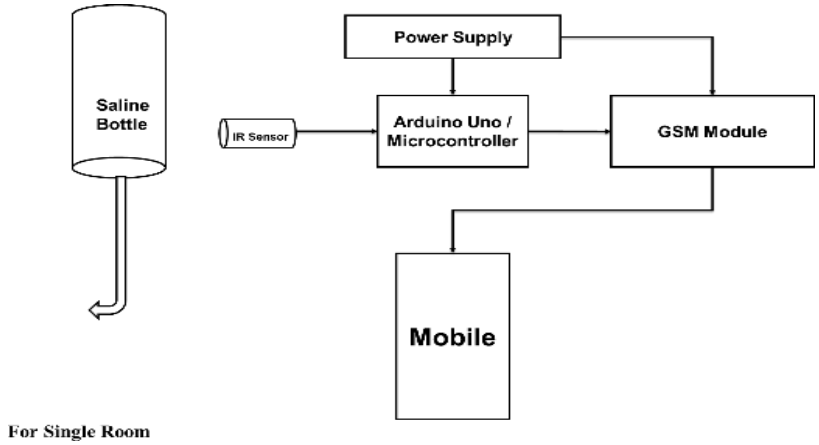


Figure 2.1.1: Block diagram for general ward

The figure shown above is the block diagram for Individual room. It consists of IR sensor, GSM

module, Arduino board. The code is dumped into Arduino board using Arduino software. The working is, when saline level crosses the limit set by the caretaker then the IR sensor detects that the saline level and indicates that the saline level is low and sends the information to Arduino board. Then Arduino board triggers the GSM module, then the GSM module completes its role by sending a message to then caretaker.

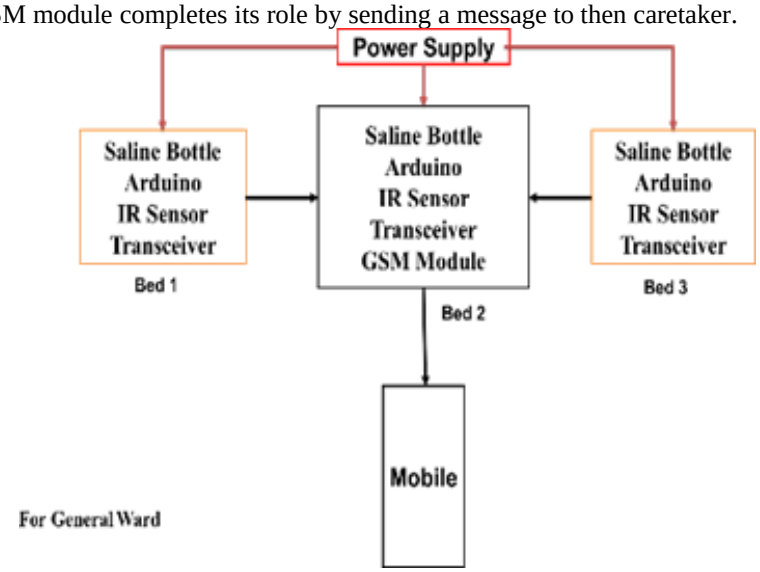


Figure 2.1.2: Block Diagram for General ward

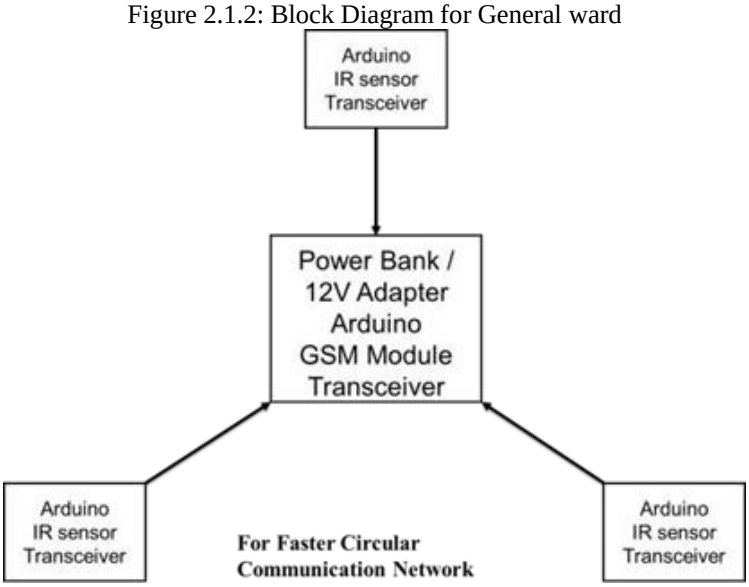


Figure 2.2.3: Alternative Block Diagram for General ward

The figure shown below is the block diagram for General ward. It consists of IR sensors, GSM module, Transceivers, Arduino boards. Here we have two type of connections which are Transmitting end connection for Arduino board and Receiving end connections to a separate Arduino board.

Hardware Description:

In this chapter we will discuss about the components used in the project

Arduino:

It is an integrated development project board mostly used in academic and research projects which is accumulated with ATmega8 (Advanced technology mega 8). It is programmed with c language using Arduino IDE. From a long-ago Arduino has been the brain of multiple number of projects, from everyday objects to complex scientific instruments. Other than Arduino board we have a numerous micro controller. Board such as MSP432 (from TEXAS Instruments), STM32 (from STMicroelectronics) etc,.. At the end we come up with a conclusion that Arduino is best fit for this project because it is of low cost with good efficiency when compared with other boards. Here we used Arduino IDE software for writing the code required to accomplish the project.

In this device we are using an Infrared LED and a Photodiode. The combination of this both will form an Infrared sensor, which consists of three external pins they are Vcc, Ground, Output pin. Vcc is used to supply power to this device. Gnd was connected to form a closed circuit in the D.C circuits. The Vcc and gnd should be connected to form a closed circuit. The Output pin is used to read the sensor value after crossing the saline level. The range of IR is changed by changing the potentiometer value by rotating the screw on it.

GSM Module:

The Global switching for mobile communication is a second-generation equipment which is used in academic projects which can be configured with the Arduino and any other development boards. The GSM module is mainly used to establish the communication between two devices through the 2G network. Here the purpose of GSM module is to send a SMS to the respective caretaker / medic as soon as the IR sensor triggers it through Arduino. Three pins of GSM module are used to connect with the Arduino. The main reason behind using GSM module rather that LTE, VoLTE modules is that it can be used in rural areas also where the 2G network is present. If in urban areas we can use of LTE, VoLTE modules as well. So, we prefer this module in our project.

nRF24L01:

This transceiver can be utilised with a variety of wireless sensor network protocols and in applications where it can act as both transmitter and as receiver. The manufacturer of this item is Nordic. This is used to transmit the data from one transceiver to another transceiver. The device's 2400Hz initial frequency is indicated by the number 24L. This device has the following pins: Vcc, Ground, CNE, CE, MOSI, SCK, and MISO. A power amplifier with an external antenna ought to be a part of the nRF24L01. The nRF24L01 in our prototype uses the SPI protocol to operate as six simultaneous transmitters and one receiver.

3. Flow Chart:

The power supply was given to the Arduino which is mounted with the microcontroller and we programmed it with the code which we want to execute and the IR sensor was connected to the power supply through the Arduino and the out was given to the 2 pin. The code was written in a way that if the 2 digital pin of Arduino get any signal then it will send that info to the gsm and the gsm will send the information to the medic and the medic will respond about that.

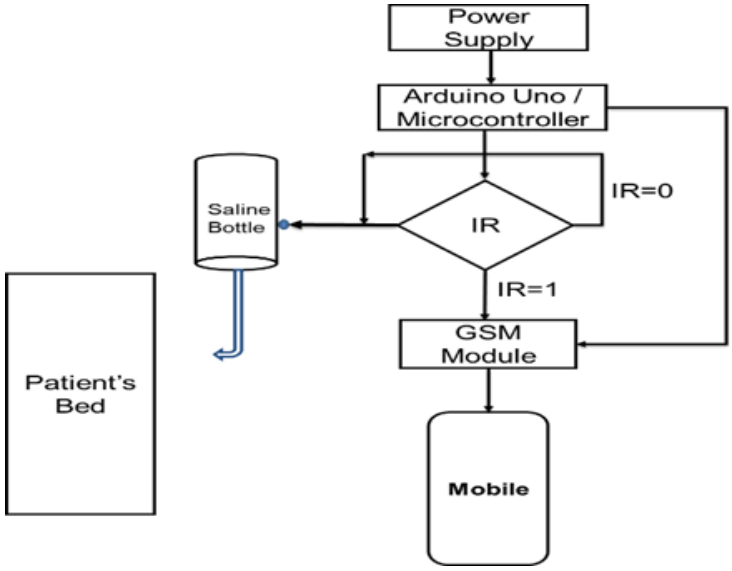


Figure 3.1: Flow chart for single bed

4. Connections & Working:

This chapter mainly concentrate on the connections between the components and working of the device

Connections for Single Bed:

The Arduino UNO 2nd digital pin is connected to the Output pin of IR sensor and where we are giving the 3.3v to the Vcc (supply or power input) pin of IR and GND was connected to Ground pin of IR sensor which makes a closed loop. And the GSM module is connected to the 7,8 digital output pins of the Arduino UNO.

Connections for Multiple Beds:

In addition to the above connections', we need to add the transceivers to the Arduino boards in the following way. Vcc to 5volts of Arduino, Gnd to gnd of Arduino, CE to 9th pin, CSN to 10th pin, MOSI to 11th pin, MISO to 12th pin, SCK to 13th pin of Arduino.

Single Bed Working:

For a single room we are mounting a single device to the saline stand. Once the saline is connected the device gets on manually and the IR sensor is mounted to the saline bottle. Once the saline crosses the limit set by the caretaker then automatically a SMS was sent to the medic / caretaker. They will reach near to the patients.

Multiple Beds Working:

The multi bed prototype is mainly focused for the government hospitals and private hospitals (general wards). This prototype also helps the medics to look over additional patients as it provides some more time rather than sitting near the patient and looking at the saline. Our device will notify when the saline level gets lower through a SMS so that the medic will reach near to the patient for the removal or change of saline. The nRF24L01

which are used for transmission and receiving the data, for this we are using the SPI protocol. In this protocol we can use the nRF24L01 as6 transmitters and 1 nRF24L01 as a receiver which isconnected to the GSM. Each and every transceiver has to connect to an Arduino along with IR sensor .This IR is configured with the Arduino to detect the minimum saline level and it will send this info to the Arduino and the nRF24L01 connected to the transmitter will send the information to the receiver and after the receiver receives this signal. It will initiate a call to the GSM to send the message to the corresponding medic and supervisor as well.

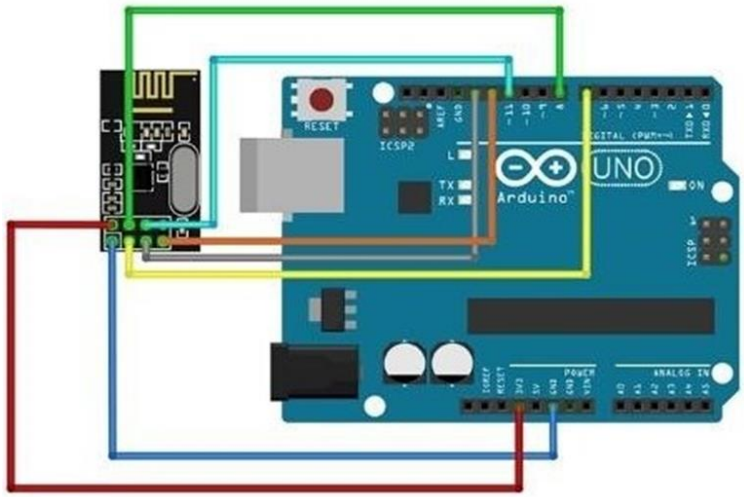


Figure 5.1: nRF connections with Arduino

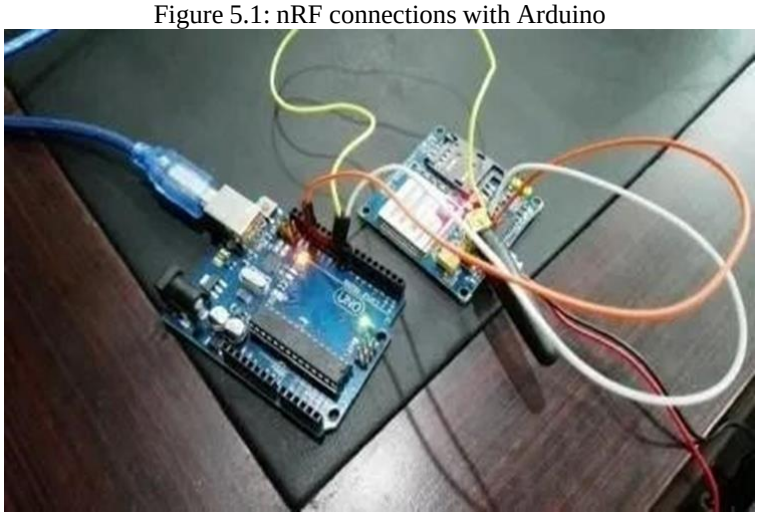


Figure 5.2: GSM module connections with Arduino

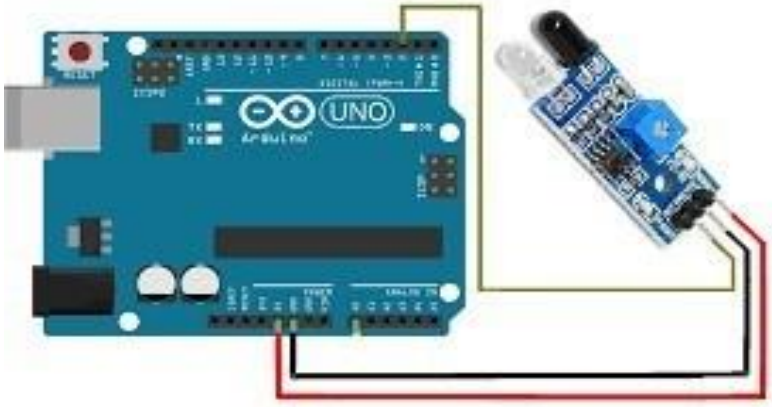


Figure 5.3: IR sensor connections with Arduino

6. Conditions for Accurate Output:

Here we discuss about the accurate conditions for accurateoutput.

IR Sensor Mounting:

The IR sensor should be placed exactly Perpendicular (90 angle) to the saline bottle so that IR sensor detects the saline level easily.

GSM Module Signal Strength:

The SIM present in the GSM module is chosen based on thatarea high speed network. If network speed is more, then accordingly the time for sending the message is more.Ultimately the Caretakers receives the message at a faster rate.

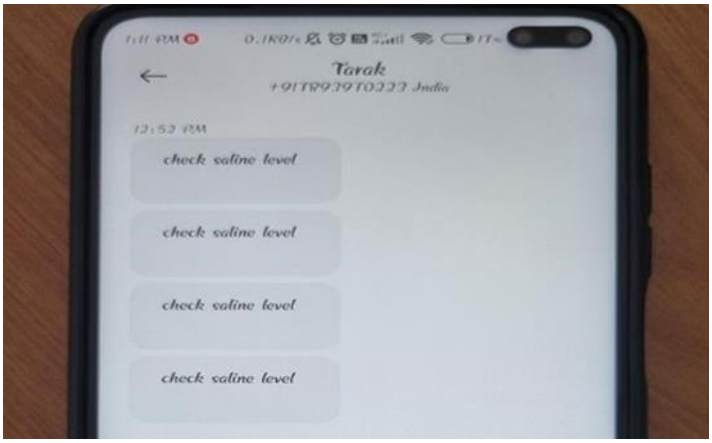
nRF24L01 Operation:

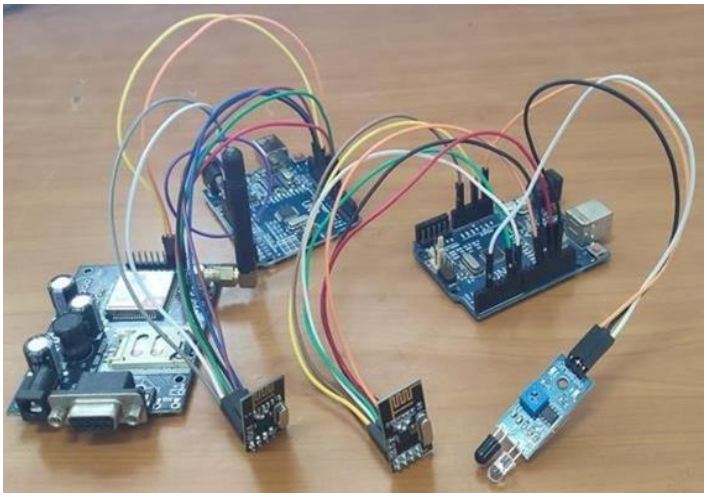
The rate of transmission of data from nRF24L01 and rate of receiving the data to nRF24L01 is very much important.

Stability of Power:

There should be continuous power supply when the salineconnects to the patient. So, the stability of the power is a major factor. In order to supply continuous power, we canuse the concept of “Power Banks”.

7. Results:





8. End Sections:

Appendix A:

Appendix A includes the Arduino IDE source code, which is based on the C programming language and utilizes the Microsoft environment to build the Arduino IDE software. The code must be dump intothat software, then uploaded, and the results must bechecked.

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9. Future Scope:

- We can modify completely with the help ofWIFI module by using INTERNET.
- By adding some other features to the prototype, it gets converted into a very smart device.
- Planning to make automatically switch off the saline bottle.
- In order to save power, we had a thought to implant a small device under the bed which automatically switch on the device.

10. Conclusion:

Finally, we conclude that by the help of this device we can notify the caretakers or nurses about the saline level present in the saline bottle so that they can reach out the patients on time and can change thesaline if required or they can simply disconnect fromtheir hands. And as soon as they come near to the patients, they can take the feedback about their condition and can arrange if anything required. So finally, by the help of this device we can send an alert message or notification message to the caretakers or nurses so that we can throw out the problem of air embolism and change the saline if needed or simply stops the saline if not needed.

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