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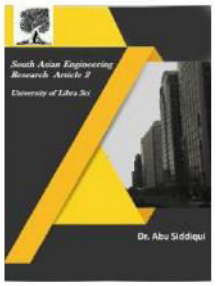

INTRAVENOUS INFUSION MONITORING SYSTEM

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ABSTRACT

Health, which is considered to be the important factor in our day to day lives, should be taken care very keenly when a person is hospitalized, especially in highly populated hospitals with insufficient number of nurses. In various medical fields, continuous monitoring of the Intravenous fluid is mandatory. If the rate of which the fluid flows is not monitored or if the Intravenous Fluid in the bottle completes, it would devastate the health condition of the patient, leading to the reflux of blood and also the formation of air bubbles on the completion. The main aim of the paper is to put forward the design and implementation of the Intravenous Infusion Monitoring System using Internet of things (IOT) as the platform. The proposed system consists of IR Sensor and Laser Sensor which would be experimented on Raspberry Pi using Wi-Fi. The IR Sensor will monitor the certain level of the fluid during the Intravenous Infusion. The Laser Sensor is placed at the surface of the drip chamber so as to monitor the drip rate at which the Intravenous Fluid flows through the thin tube into the patient body. Whenever the level of the Intravenous Fluid precedes the certain level, or when the drip rate of the fluid precedes or exceeds than the actual rate at which the fluid flows in the drip chamber, then an automatic notification alert is sent to the hospital staff. The hospital staff must have to install the App at which the notification pops up and the entire process would run using Internet. Any further medication which is to be given to the patient can be done by the instructions provided by the doctor in the App simultaneously. The proposed system terminates the continuous monitoring of the Intravenous Fluid by the nurses and would be easily available at low cost which can be used at the hospitals which cannot afford equipments of higher rates.

Keywords: Raspberry Pi controller, IR Sensor, Laser Sensor, Intravenous Infusion, Internet of Things, Saline Bottle, Drip Chamber, Mobile App, Internet

1.INTRODUCTION

As the technology is becoming advanced day by day, the dependency of humans on it has been increasing enormously as it makes their tasks easier without much needed efforts. The Internet Of Things (IOT) is one such platform, which has the ability to transfer and receive the data through an

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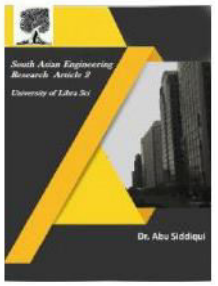

interconnection of the embedded computing devices in day to day objects using Internet without the human interaction. The Internet of Things is one among the top emerging technologies which is being widely used in Machine Learning, Embedded Systems, Farming, Analytics, In Flight services, Online Shopping, Home Automation and many more. When any patient gets hospitalized and would be kept under the Intravenous Infusion, the nurses or the patient relatives are responsible for its monitoring. Most often due to the emergency cases which is to be attended by the nurses or due to negligence, it would be a threat to the patient life if the Intravenous Fluid gets completed. There are the chances of the reflux, where the blood from the patient body flows in the reverse direction in the Intravenous Fluid due to the high pressure in the patient body and low pressure in the fluid bag. There are also possibilities of the formation of the air bubbles in the thin tube and obstruct the blood flow. Thus an automated system of monitoring the Intravenous Fluid is suggested in this paper so as to save the life of patient and also reduce the continuous monitoring of the fluid in the hospitals when there are many patients assigned to few nurses.

2.LITERATURE REVIEW

EXISTING SYSTEM

The important and the most significant drawback of this system is that it requires manual effort. The drip rates are adjusted using the drip chamber which delivers the solution at the required amount into the patient body. In the present scenario, the nurses or the caregivers must monitor the status of the Intravenous Fluid given to the patient very cautiously. There are possibilities of losing a life due to reflux. Here, the reflux can be explained as the backward flow of blood from the patient body to the saline bottle due to low pressure present in the bottle and high pressure of blood flowing in the patient body. There are also chances that the air present in the saline bottle, after the completion of the fluid, enters in the form of air bubbles from the saline bottle into the blood stream and stops the flow of blood leading to the dangerous condition of the patient.

PROPOSED SYSTEM

The proposed system automates the whole process of monitoring the Intravenous Fluid drip rate using Internet Of Things (IOT). It continuously monitors the drip rate of the Intravenous Fluid. Unusual drip rate would be updated automatically to the nurse/physician. This system monitors the drip rate flow using the sensors and diodes. If the drip rate of the fluid becomes abnormal or if the quantity of the solution is about to complete, then these sensors send the notification to the nurse via an App. The nurse on the other hand, on receiving the notification prior to the Intravenous Fluid completion, approaches the patient and changes the IV or detaches it from the patient body based on the instructions given by the doctor on the patient condition.

This system doesn't need continuous monitoring of the patient. If the nurse assigned to the particular patient is caught

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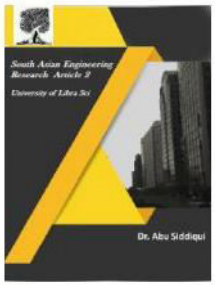

up with some other critical task on receiving the notification, he/she can assist the same to the other nurses available to change the IV of that particular patient via App. This is easy to use and is of low cost which can be affordable by the Govt. and private hospitals which cannot invest huge amount on such equipments.

3.SYSTEM REQUIREMENTS IR SENSOR

IR Sensor is used to check the saline level in the bottle. In this project, IR Object Detection sensor is used. It is placed at the neck of the saline bottle. If the saline level of the bottle precedes a certain level, then it notifies the Nurse through the App.

LASER SENSOR

Laser Sensor is used to monitor the rate at which the droplet drips from the drip chamber. In this project, Laser Diode Module is used. It is placed on the surface of the drip chamber. When the laser sensor, detects the unusual speed of drip rate, then it notifies the nurse through the App.

RASPBERRY PI

Raspberry Pi is a micro-controller. In this project, Raspberry Pi 3B+ is used. The IR Sensor and Laser Sensor are connected to the Raspberry Pi using jumper wires. These sensors receive the data from the saline bottle and the drip chamber and send it to the App through Firebase, which acts as the virtual database.

ANDROID STUDIO

Android Studio is an Integrated Development Environment(IDE) which is built on IntelliJ IDEA software. It is designed specifically for Android Development for Google's Android Operating System. The Apps are built in either Java or Kotlin Language and the Layouts for the Apps are built using XML. There are many versions of Android Studio. In this project, Android Studio 3.6.1 is used. In this project, we build an app, which would be deployed in the smart phones of the hospital staff. The role of the app is to give the information about the IV Fluid to the hospital staff.

FIREBASE

The Firebase Realtime Database is the cloud hosted NoSQL database which allows the users to store and sync data among themselves in realtime. The data is synced across all the clients in realtime, and it remains available even when the app goes offline. In this project, the firebase is used to store the sensor data which has been collected from Raspberry Pi and then sends it to the Nurses and Doctors.

THONNY IDE

Thonny is a free and dedicated Integrated Development Environment (IDE) for Python which is designed for beginners which has an easy-to-use interface. It consists of in-built Python 3.7. In this project, we use Thonny IDE for executing the programs in Raspberry Pi.

RASPBIAN OS

Raspbian is a Debian-based computer operating system for Raspberry Pi. This operating system is still under active development and has many versions which includes Raspbian Buster and Raspbian Stretch.

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4.ARCHITECTURE

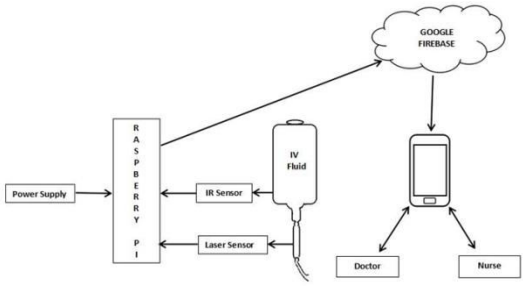

Fig.4 Architecture of the Intravenous Infusion Monitoring System

The above figure describes about the flow of implementation of the Intravenous Infusion Monitoring System. Initially, the Raspberry Pi is supplied with Power and then the IR Sensor and Laser Sensor are connected to Raspberry Pi. Next, the sensors receive the data from the IV Fluid bottle and send it to the Raspberry Pi, which further sends it to the Firebase. Later, the data from the Firebase is sent to the Nurses and Doctors through the App, wherein both the Doctors and Nurses can interact simultaneously and take the necessary action on the patient.

5.WORKING

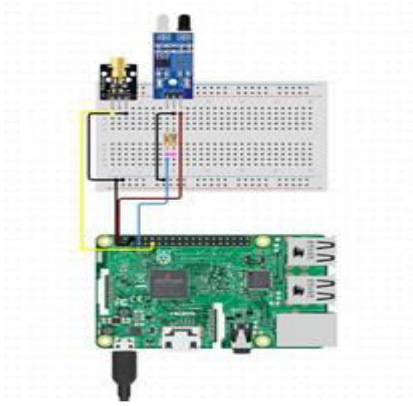

Fig.5 Circuit Diagram

Raspberry pi, which is known as the micro-controller, acts as a computer, when it is connected to all the components like the Keyboard, Mouse, CPU etc. In this project, initially to use Raspberry Pi, we need to set-up the device by following the certain steps. The Raspbian OS is flashed in the SD card and is placed in the Raspberry Pi. Then, when the power is supplied to Raspberry Pi, it is all set to work. Initially, we connect the Sensors to their pins accordingly and run the program in the Thonny IDE. When the program executes, the Raspberry Pi runs and the sensors collect the data from the Intravenous Fluid and send it to Raspberry Pi. And then, the Raspberry Pi sends the sensors data to the Firebase. Firebase is a cloud hosted realtime NoSQL database which is used to store and sync data among the users. Now the data fetched from the Raspberry Pi would be sent to the hospital staff so that they would take necessary action based on the notification received in the App. On the other hand, the App can also be used to communicate between the doctors and the nurses to instruct the nurses to give any further medication to the patient if any.

Screenshot 5.1

Screenshot 5.2

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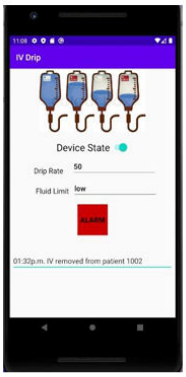
Initially, the nurse or the doctor will have to login to the App. Later, the nurse would calculate the drop factor using the drip rate calculator in the App. If the drip rate in the IV Fluid bottle exceeds the drip rate calculated through the calculator, then the notification pops up in the App to change the IV immediately.

Screenshot 5.3



Screenshot 5.4

Additionally, the nurse can update the removal of IV Fluid to the doctor simultaneously through the notepad given in the App, which can be accessible by the doctor too.

6.CONCLUSION

This paper proposes the automated way of monitoring the Intravenous Fluid in the bottle and also the speed of the drip rate in the drip chamber using microcontroller. This system can send data to the nurse's and doctor's smartphone through the app wirelessly and display the output in the form of the drip rate, the level of the intravenous fluid in the bottle, and what further action could be taken on the patient on the doctor's instruction. This system has non-touch droplet monitoring, easy to reuse, will fetch accurate data regarding the drip rate. It is also available at low cost, easy to deploy and can be integrated with the existing hospital management system. It is very much helpful for the nurses as well as the doctors especially at the hospitals where many patients are assigned to 2-3 nurses. Thus, this system is user friendly and any naive user with a little training can easily use this system.

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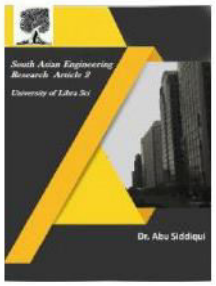

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