Chapter-6

IoT based hybrid system for Patient Monitoring and Medication

6.1 Introduction

The fourth objective of the study is to implement the dynamic drug delivery interface. The proposed model is capable to deliver the drug(s) from the remote location. As a doctor cannot endorse medication without seeing the condition of the patient. Therefore, vital parameters of the patient are transmitted to the doctor in real time. The remote monitoring would help the doctors to diagnose and or deliver the drugs from the remote location. The final model is an IoT based hybrid system for patient monitoring and to endorse medication. By transmitting the imperative parameters of the patient to a specialist diminishes, the ideal opportunity for starting treatment and permits the emergency crew to be better prepared. This would help to remove a gap between the doctor and the patient, especially when the patient is in transit (see figure 6.1). Therefore, this could be used in ambulances to provide the virtual presence of the doctor inside the ambulance. By installing this system inside the ambulance would be helpful to decrease the rate of mortality (Athavan, K., Balasubramanian, G., Jagadeeshwaran, S., & Dinesh, 2012), especially when the ambulance is stuck in traffic and the patient reached late to the hospital.

The proposed model would assist the doctors to:

- Fetch the vital parameter of the patient in a graphical view
• Control the medication from the remote location after viewing the patient condition.
• Use the system in the hospitals/ ICU/ CCU and ambulance.

6.2 Status of syringe

Sensors are installed on the infusion pump to detect the status of the syringe as show in figure 6.2. An IR (Infrared) sensor MOC7811 is installed on the pump to check if the syringe is installed or not, because the infusion pump accepts the command only if the syringe is installed. If a syringe is installed on the pump, this sensor set the sensor flag, otherwise the flag remains reset. The controller read the flag value before giving instructions to the pump.
For the patient safety it is also necessary to detect whether syringe is filled with drug or not, because the infusion pump cannot start delivering the drug if the syringe is empty. Therefore, two IR sensors are also installed to detect whether syringe is empty or filled. These sensors detect the position of plunger flange. This plunger flange touches the syringe plunger when the syringe is empty.

Therefore, an IR sensor is installed to detect the status of an empty syringe as shown in figure 6.4. The syringe related information set/reset the syringe flags, which will be read by the microcontroller before initiating drug delivery. For the patient safety it is also necessary to detect whether syringe is filled with drug or not, because the infusion pump cannot start delivering the drug if the syringe is empty. Therefore, two IR sensors are also installed to detect whether syringe is empty or filled.

Position of the syringe is sensed with a feedback system via IR sensor MOC7811 (see figure 6.3) at both ends of limits. This sensor provides a feedback to system for motor extreme ends detection.
The popularity of internet of things and big data analytics is extremely increasing year by year.

6.3 IoT Based Health Monitoring System

The popularity of internet of things and big data analytics is extremely increasing year by year.
IoT and big data analytics is also gaining popularity in the areas of medical devices, software systems and services. The market is predicted around $300 billion by the end of 2022 according to the grand view research as shown in figure-6.5 (Firouzi et al., n.d.)

6.4 Methodology

Data communication between two devices refers to exchange the correct information well on time. Accuracy and timeliness are two major factors of data communication. Therefore, it is necessary to establish a connection between sender and receiver. It ensures that data is received by the intended recipient only.

Hence, application layer before sending the instruction to the hardware ensures the availability of the hardware through the communication protocol. Therefore, the first step is to establish a communication link between both application and hardware layer. The application layer starts sending instructions only after getting acknowledgement from the hardware.

Once the communication is established the infusion pump initialized the syringe sensors. This helps to detect the availability of the syringe. Therefore, infusion pump will start infusion only if the syringe is properly installed. Next step is to send the command to serial port of the microcontroller. It is the duty of the microcontroller to de-capsulate the packet and sends the command to appropriate motor driver.

The microcontroller ensures the required medicine in the syringe before starting the motor. Once it is assured the infusion is started. Methodology adopted to achieve the fourth objective is shown in the form of flow chart in figure 6.6.
Figure 6.6 Working of Infusion pump
6.5 Results and Discussion

Physiological data of a patient can be seen in graphical view by the doctor from the remote location. This data consists of Machine ID of the vital sign machine, HR, SPO2, Temperature, BP (SYS, DIA and Mean), current data and time. After viewing the data, the doctor can save the complete case history in an excel file. This can be reviewed later by the doctor(s) as a case study.

To maintain the authenticity a login page is designed (see figure 6.7), hence, the patient related information can be fetched only by an authentic user. After the successful login, next dialogue box appears where user has to fill patient related information such as patient name, patient ID, patient age, patient weight, patient contact and Aadhar number.

![Login form](image)

Figure 6.7 Login form

In the patient form patient’s weight and age are mandatory fields because these two parameters are required to transmit to the doctor. Patient related information can be accessed through the web-based application as well as
through the android application. All the information is stored in the database after encryption.

![Patient Information Form](image)

Figure 6.8 Patient Information Form

After filling the patient related information as shown in figure 6.8, a communication process is initiated between user and vital sign monitor by pressing start case button. The start case button indicates that a new session is started and the information of a new case in a new file is stored. This helps to read the information of an individual from the database. All the information is stored in an excel file, where every time a unique name is given to the file
which is patient id+ current date. ECG in the form of an image file (.png) can be saved in the local machine as shown in figure 6.9.

![Patient data in Graphical form](image.png)

Figure 6.9 Patient data in Graphical form
6.6 Chapter Summary

An IoT based hybrid system for patient monitoring and medication is proposed. This system allows healthcare professionals to monitor the patient's vital sign from the remote location through the android application. According to the guidelines given by the Health and Family Welfare Department of National Capital Territory (NCT) ("Guidelines for Registrations of Ambulances," n.d.), advanced life support ambulance must be capable of:

“Providing treatment of life-threatening medical emergencies through the use of techniques such as endo-tracheal intubations, administration of drugs or intravenous fluids, cardiac monitoring, and electrical therapy by a qualified person.”

Therefore, the proposed model can be effectively used for advanced life support ambulances. By transmitting the imperative parameters of the patient to a specialist diminishes, the ideal opportunity for starting treatment and permits the emergency crew to be better prepared. In this way, the proposed model would be effectively used when the patient is in transit by providing the virtual presence of the doctor inside the ambulance.