IoT based Smart Bottle in Healthcare

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Abstract

IoT (Internet of things) technology becomes mandatory to real world problems to make them easy. IoT also takes part in the world in terms of our healthcare. Right now, there are many IoT applications available to solve real-world common problems. One of them is a saline monitoring system. Whenever a patient feels very bad, they need to recover through the saline bottle, then saline bottling to the patient. After that, the nurse should continuously check the level of the bottle. Our saline monitoring system involves a nurse monitoring the status of multiple patient's saline bottles simultaneously. The traditional system becomes complicated for the nurse to note each patient information and its status. So, to eliminate this issue, an IoT based Smart Bottle in the healthcare system is being developed, which could help the patient and a nurse in the hospital. This system measure saline level then transmits data through the server platform to the central Web Application. The system will continuously monitor the saline level as well as maintain the patient's data.

Keywords: - *Load Cell, ESP8266 server, IoT, Buzzer, Health Monitoring, Arduino controller, Web Application.*

INTRODUCTION

Internet of things (IoT) is the network of physical objects comprising all the devices, vehicles, buildings, and other items embedded with electronics software and sensors, which enable these objects to collect and exchange data. The internet of things has evolved due to the convergence of multiple technologies, real-time analytics, sensors and embedded system. Also, there are many systems made up for healthcare that reduce human effort. This system gives the full advantage of IoT in healthcare. The nurse's, patients and other doctor's need to think of them for their uses and new updating. With the help of devices, they can monitor an unlimited number of patients for a continuous period. But it will take time to realise the presents of this system's and its capabilities. This system helps the nurse's to monitor the level of saline level. So, patients can be observed in real time without the need for physical monitoring by the nurses. Once the saline bottle has been bottled to the patient, the nurses should continuously monitor the patient. This may make it hard to monitor everyone manually. If they

forget to watch the saline bottle, the reverse flow of the blood takes place as soon as the saline bottle is empty. This may cause a major problem for the patient.

So, to prevent this problem, we are working on a proposed IoT system that will automatically monitor the saline Level. With its use, when the saline level crosses the critical level, this system automatically alerts nurses through a Buzzer and SMS service, which contain the patient's bed number and name with the level of saline. This IoT system has been made for communication between Web Applications and the device.

This Proposed system has been implemented by using the components ESP8266 server and ESP8266 module, which is a Wi-Fi module, load cell for measure the saline level, 2x16 LCD display has been used for displaying the level of saline on the device spot, buzzer used for indication system, Web application has been developed in the browser to monitor multiple devices and to manipulate patient's data.

This is a lot of advancement and significant changes occurring in the field of IoT healthcare. Management of healthcare results and reduction of healthcare costs is enabled by the ever-growing information and communication solutions. The healthcare services are getting better and less costly by collecting, recording, analysing saline levels in real-time and efficiently.

We will see medical experts carrying out the diagnosis and critical tasks better and more reliably. This will ensure not only reliable results but also time-saving, which will be of maximum benefit.

The possibilities of IoT are genuinely unlimited and ever-growing. This paper proposes an IOT based health monitoring system that alerts the patient's doctor regarding their medical information, providing fast and reliable healthcare service. Moreover, in today's world, everyone is busy neglecting their minor healthcare problems like high blood pressure, low pulse rate etc. The paper helps to find a better and robust solution to this challenge.

Ease of Use

This system is straightforward to use. Any nurse or other relevant person can easily interact with it due to its digital functionality. A nurse or any related person attach the device with a bottle and easily monitor the saline level in the bottle through an innovative Android application. This system gives peace to nurse, doctors as well as patients without worry about the fluid injection.

AIM AND OBJECTIVE

Our Aim is the bottle should change at the correct time to prevent unexpected problems with the patient's health.

1. An IoT based device is proposed where load cell is used as a level sensor or weight sensor. It is based on the principle that it measures weight and generate output in analogue.
2. When the Saline level is critical, it will alert the nurse through the mobile phone SMS containing the patient's room number for quick recovery. This same system time also warns through the buzzer.
3. Hospital uses simple saline bottles with no indication. It may create a problem for the patient because the reverse flow will start, blood starts to flow from the body towards the bottle.

4. In Hospital ICU, OT, most hospital rooms required this kind of monitoring and indication system.
5. These proposed monitoring systems can be helpful in small, medium and large sizes of hospitals and helpful during home care. Developing this type of system will decrease the chances of patient hazards and increase healthcare accuracy in hospitals.
6. In the future, we can design a ready mate sensor on the sides of the bottle that can detect the level of saline inside bottles. As well as all data can also send to nurse's mobile/web application, and they can start or stop the saline and monitor it in every condition. Other things required security passwords also. The hospital nurse's requirement to manually monitor the saline level of bottles is avoided through this system. This is of high advantage to the patients, especially during night times.

APPLICATION

1. With its help, the caretaker keeps on watching the glucose level and the reverse flow of the liquid. Thus, patients can be monitored in real-time without frequent visits by the doctor or caretaker.
2. This device provides the real-time solution of observing the smart bottle with reliability, measure the liquid quantity.
3. Alarming system to indicate the critical level of bottle.
4. By using this system, the patient can be analysed by doctors in any part of the hospital.
5. It is used to transfer the information from the transmitter side to the receiver side wirelessly.
6. The whole monitoring system, which we have proposed, can be integrated into a small compact unit as small as a cell phone.

LITERATURE REVIEW

Apart from our new features, many systems are already implemented. But there are a few problems. After a study from various research papers, there a common limitation observed is the TDM system. That system cannot be able to monitor coma patients. Many other methods have monitoring limitations, like those systems only used for patients in normal conditions, but patients can monitor by this system for abnormal conditions.

Some of those systems are only able to measure only three-stage of saline levels. 1. Full 2. Alert 3. Critical. This system can only show the above three-stage stages of the system due to its design and functionality. Those systems use ultrasonic waves to measure the saline level, so they only react when their second receiver can pass from saline.

Another solution is with a GSM module and additional heartbeat sensor functionality. But these systems consume more space and need more power supply, so power consumption is high in this solution.

Cloud services are also part of our definition solutions, but the limitation is that not all cloud services are the same. Some provide only basic functionality, and some remain down at many times in a day.

So not widely in use. Some solutions come with additional functionality like a tilt sensor which measures the flow of saline injection. Still, the limitation is also a part of this system which is if

the patent turns in any direction, it starts the buzzer, which creates a lot of noise. Some solution contains large scale to attach the device. And most of the solutions contain only simple android applications, which only displays the saline level of 2 – 3 bottles.

PROPOSED METHODOLOGY

Terms required to accomplish our system:

- Database (External File)
- Load cell
- Arduino
- GSM Module
- Wi-Fi Module
- Buzzer
- LCD Display
- A2D converter
- Web Application

1. Database:

In this system Nurse and Doctors already registered by the admin. This database used to maintain user information like name, use rid, password and other information. They were also used to main details of the patient and the status of the device.

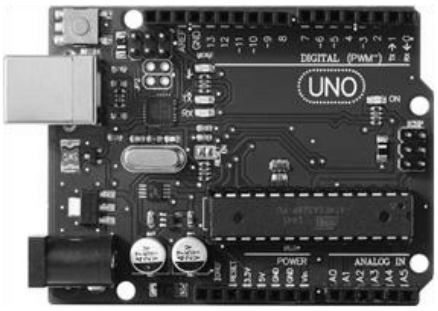
2. Load cell:

This component is the skeleton of the system. This component used to measure saline levels in the bottle. In this load cell, we measure the weight of the saline bottle.12v supply is required to operate the load cell. Its output will be analogue. The maximum weight estimated in the load cell is 1kg. If the weight of the glucose bottle is below 15%, the flow of liquid is stopped.

(Fig: Load cell)

3. Arduino:

Arduino UNO is an 8-bit microcontroller with 32KB flash memory. It is also the main controller of the saline level indicator. It is programmed in such a way to produce the output when the level of bottle become at a critical level as well as send SMS and Start Buzzer.



(Fig: Arduino)

4. GSM Module:

GSM 900 module is the work of Global System for Mobile. This component used to alert the Doctor and Nurse when the level of the bottle becomes a critical state.

(Fig: GSM900)

5. Buzzer:

The buzzer is used to indicate a sound when the level of the saline bottle reaches a critical state. This alerts the nurse about the change of removing the saline bottle to be administered to the patient.

(Fig: Buzzer)

6. Wi-Fi Module:

ESP8266 is a Wi-Fi Module highly integrated chip designed to provide full internet connectivity in a small package. ESP8266 can be used as an external Wi-Fi module, using the standard AT Command set Firmware by connecting it to Arduino using the serial UART, the main interface between the android application and Arduino. All information from the load cell is passed from this module. This module broadcast all this information on Nurse Web Application.

(Fig: ESP8266 Wi-Fi Module)

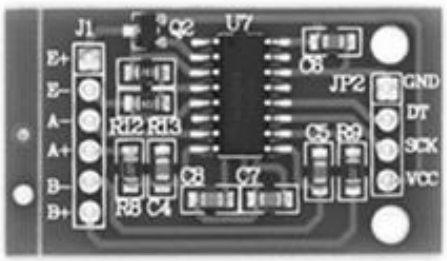
7. LCD Display:

16x2 is a fundamental electric component used with Arduino. In our system used it as a display level of saline. This device attaches to the device.

(Fig: 16x2 LCD)

8. A2D Converter:

HX711 A2d converter is used to convert the analogue output of the Load cell to the digital to manipulate further work.



(Fig: HX711 A2d converter)

1. Web Application:

Web Application is a GUI interface which also the main part of our system. This application can easily authenticate users, show Nurse details to the Doctor, Login information, saline level and status of the device.

Algorithm 1 (For Saline Monitoring):

- Step 1: Registration of Nurse
- Step2: Login into Web Application
- Step 3: Power on of Device
- Step 4: Check Level of Saline Level (Internal)

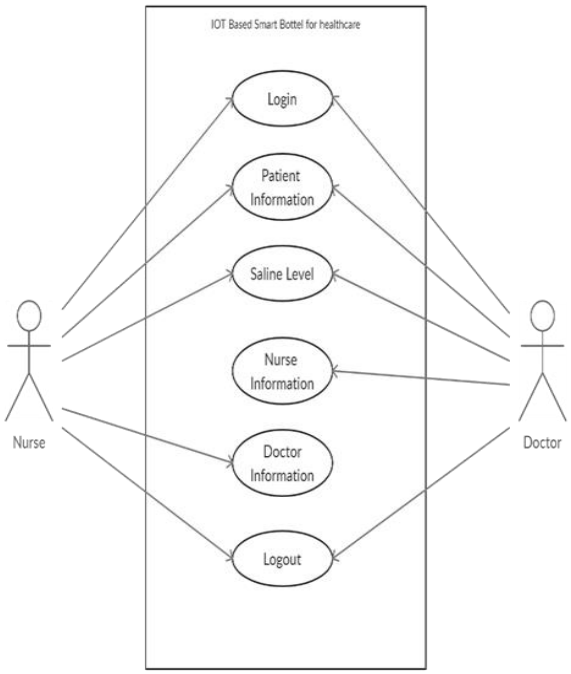
Step 5: if level < 20%:

```
{
    If level==5%:
        {
        Send SMS
        OFF device
        }
    Send SMS
    Start Buzzer
    Display level on LCD
    Go to Step4
}
Else:
    {
        Display on LCD
        Go to Step 4
}
```

Algorithm-2 (For check user information):

- Step 1: Registration of Nurse
- Step 2: Login into Web Application
- Step 3: Check User Information or Patient Information

LCD or else it simply level on16x2 LCD. After when level become at 5%, it initiates a continuous buzzer and passes an SMS to the nurse.

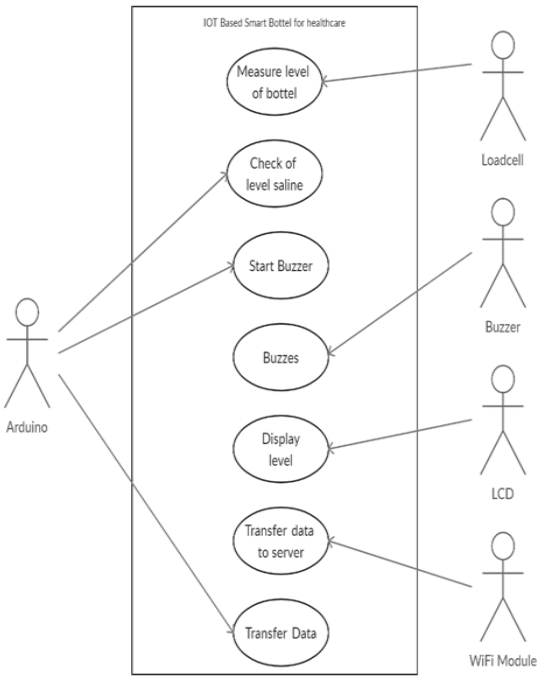


(Fig-Proposed. Use Case 2 in terms of IoT device)

According to the algorithm, our systems workflow starts from the Login stage. Each device has a unique number which displays on the Web Application. After login of user holes, system work starts.

The load cell measures the saline level and passes it to the HX711 A2D converter in an analogue signal. Then A2D converter converts it into digital format and gives it to the Arduino. Then Arduino, according to functionality, does some computation on it.

If the level is less than 20%, it passes SMS through GSM900 module and start buzzer for one time and display on16x2 LCD or else it simply level on16x2 LCD. After when level become at 5%, it initiates a continuous buzzer and passes an SMS to the nurse.



(Fig-Proposed. Use Case 2 in terms of IoT device)

The outcome of this project showed that it works on real time monitoring. The collected information from the bottle is transferred to the nurse and doctor via a programming interface. The real-time data provided through web applications improves the patient's health in an emergency and regular check-up. Further work must be invested in building a proper error-free health care monitoring and acquisition system using good quality bio-sensors and hardware devices. The final goal of this project is to appropriate treatment of the patient without saying anything. This will reduce the stress of continual monitoring by the doctor or nurse at an affordable cost. This automatic glucose level monitoring system provides more flexibility to doctors. Thereby the patients caring is enhanced. Hence it saves lots of time for doctor or nurse who is on duty. The system is reliable, cost-effective and convenient for nurses. It can be reused for the next glucose bottle. The system helps nurses to monitor the glucose flow from a distance. It is mainly advantageous at night timing

as there is no need for nurses to go to the patient's bed to check the glucose level in the bottle.

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