Blood Leakage Detection During Self-Dialysis

M. Suresh Kumar [1, *]**, V. Vanmathi** [1]**, S. Poornima** [1]

[1] Department of Information Technology, Sri Sairam Engineering College, Chennai- 600044, Tamil Nadu, India.

*Corresponding author E-Mail ID: sureshssec@gmail.com

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Abstract

The main objective of our project *"Blood leakage detection during self-dialysis"* is, the patient can do their treatment by themselves whenever he/she feels comfortable and free. The IOT device is also designed as a warning tool for detection of blood leakage/loss. It can indicate the risk level in both end-sensing units and remote monitor devices via a wireless network and cloud.

Keywords: IOT, Wireless network, blood leakage, Cloud.

1. Introduction

Infiltration and blood leakage are serious life-threatening complications during dialysis. These events have been of concern to both healthcare givers and patients. More than 40% of adult blood volume can be lost in just a few minutes, resulting in morbidities and mortality. According to the information gained, among 76 percent of reporting countries, at least 80 percent of patients undergoing hemodialysis therapy method. In addition, more than 90% of dialysis patients in the United States undergo hemodialysis therapy. The current blood leakage detector, hemodialert products, specific for hemodialysis therapy is available, that needs the sensing sensitivity of less than 1 ml of blood, and the blood leaking condition can be detected in 15 to 20 seconds. Though there are many improvements and technologies available in recent years, a perfect solution for dialysis remains as a difficult one and the current treatments available are highly experimental and highly expensive. The patient generally depends on either technician or some other person who knows how to operate the dialysis machine. These techniques may fail sometimes if there is none to treat and monitor the patient during the dialysis process. If the blood leaks during dialysis, then, it may lead to severe problems to the patient and can cause even death due to heavy blood loss. If the patient tries to treat themselves without no one's help, it is difficult or can say even impossible. To address this pressing need, designed "Blood Leakage Detection during self-dialysis", a system or device that greatly increases the autonomy of the patient. It is designed as an IOT device, which can be easily handled by the patient itself and as a portable device, it made the process much easier. The force unit will measure the status of the patient. Through Bluetooth, the device starts up for processing the self-dialysis treatment. "Blood leakage detection during self-dialysis" also utilizes the photovoltaic interrupter for detecting the blood leak during self-dialysis.

2. Existing System

S.No	Existing System	Contribution	Limitations
1.	Blood leakage monitoring g system	It is a bracelet, a monitoring device for blood leakage during the	In this, the detector has the function of sending out the warning signals to the monitor

		dialysis treatment	via Bluetooth. The signals can be received within a certain range of distance i.e. the distance must be short. Hence eithean attender or a technician should baby the side of the patient during dialysis.
2.	Wearable impedance e monitoring system for dialysis patients	This device is to assess the hydration status of patients using the low power AD8302 component.	The output of this should be given to test cells to validate whether the patient is ready or not for the dialysis.
3.	Remote monitoring g system for patients on home dialysis	This is for patients undertaking long term home dialysis. The main objective is to provide a design with features to enhance patients perceived compresence e with their healthcare technicians.	Since it only analyses the old data of the patient, blood leakage is not detected.

3. Motive for our Innovation

The shortcomings of the existing system for the dialysis process are:

The patient requires to be dependent on the technician or family members during the dialysis process. Always they seek help from others. And also, during the process the patient must have to be in rest. The patient has to be monitored continuously by others, that makes them sometimes uncomfortable and facile awkward.

Though hemodialysis can also be done at home, in that the patient needs at least one near to them. The treatment process can be taken only when the patient is ready for treatment and the other one is available to monitor them. If blood leak occurs then it leads to further discomfort. To address all these pressing needs, a self- dialysis and blood leakage detection is developed to increase the anatomy of the patient.

4. Proposed System

The device gets started only after checking up the patient's body condition, as the patient is under normal state using the force sensor unit. The force sensor unit measures the patient's status, by the pressure made by them. then the patient can start their self-dialysis treatment process by themselves, through blue tooth connectivity. Bluetooth can get accessed only when the state measured by the force sensor unit of the patient is normal and the patient is ready for the process of self-dialysis. The application called Bluetooth terminal is used, especially for connecting the device with the mobile phone. The 12 V DC motor helps to pump-out blood from the patient's body. The pumped-out blood is heated using the heating unit, to make the blood in the same state and not to make it clotted. Then, the blood passes through the purifier and the impurities get deposited as a separate storage.

The purified blood inserted again into the patient's body, crossing the photo interrupter, which detects blood leakage, if leakage occurs while passing the blood into the patient's body. Our blood leakage detector is designed for the purpose of easy operation, light weight, small size, low amount of blood for detection, high sensitivity and low cost. If leakage is detected then, alarm

rings in order to alert the family members and simultaneously notification will be sent to the consultant doctor and also to the family members. The force sensor unit, 12V dc pumping motor and the photo interrupter are all connected to the node MCU unit, a controller. The node MCU utilizes and can be accessed using the software called Arduino IDE. Starting from checking the patient's body condition till the blood gets passed into their body, all the information is updated to the cloud and also notification sent to the doctor and the family members. Using the platform called "Thing speak" cloud can be accessed.

5. Experimental Design

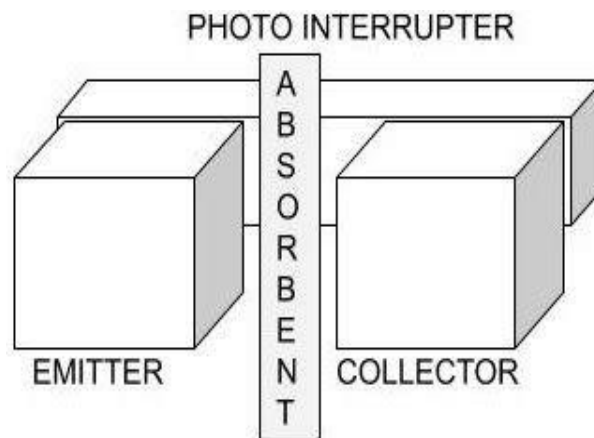### 5.1. Pressure Detection

Fig 1.1 Force Sensor

Force sensor fig.1.1 is used for measuring the pressure applied while injecting the dialysis needle into the patient's arm.

### 5.2. Blood Leakage Detection

Fig 1.2(a)

fig.1.2(a) represents the diagrammatic view of the detector along with the absorbent material, which is under normal state, without any detection of blood leak.

fig.1.2(b) represents the diagrammatic view of the detector, which depicts the detection of blood leak using the absorbent material.
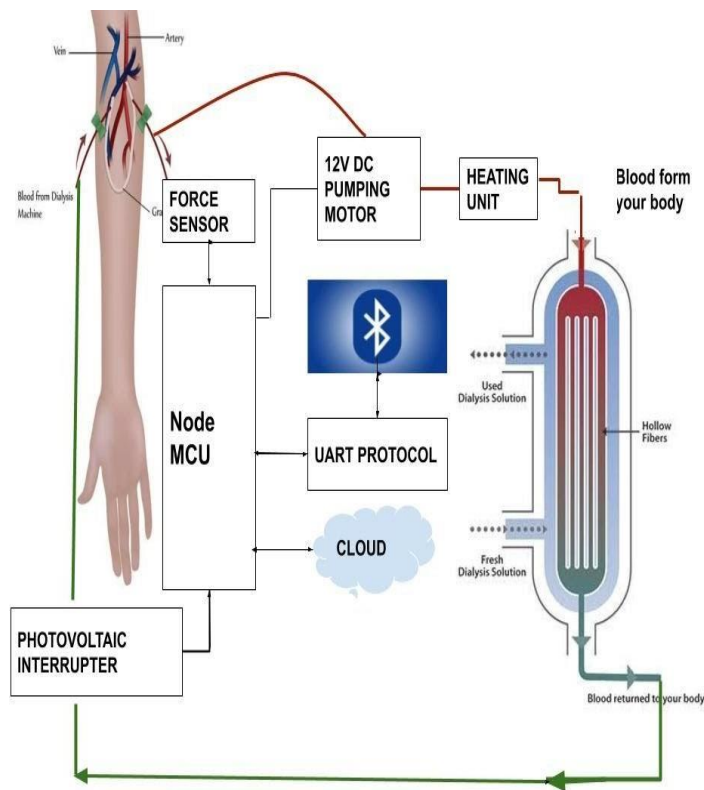
As in fig.1.2(b), if leakage is detected by the absorbent material then the further measures

like buzzer sound for family members and the notification will be sent as a warning about the leakage. Also, the dialysis process will be stopped
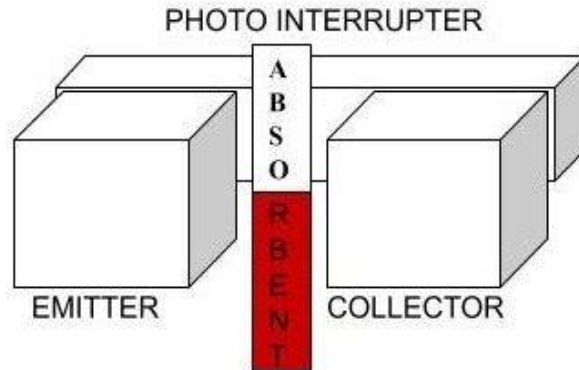
Fig 1.2(b)

6. Diagrammatic Representation

7. Hardware Requirements

7.1. Force Unit

Force-sensing resistor is a material whose resistance changes when a force, pressure or mechanical stress is applied. They are also known as "**force**-sensitive resistor" and are sometimes referred to by the initialism "FSR".

7.2. Heating Unit

Heating unit maintains the blood in the same state as it is pumped out from the patient's body and prevents the blood from getting thicker by heating it.

7.3. Blood Purifier

Hemodialysis membranes are used to remove accumulated uremic toxins, excess ions and water from the patient via the dialysate, and to supply insufficient ions from the dialysate.

7.4. Photovoltaic Interrupter

Photo interrupter is an optical coupling (OC) element which is electrically insulated and optically coupled to each other in the light emitting and receiving parts. Objective is to convert the input electrical signals into light, that is, the light-emitting unit emits an infrared light. The light receiving unit receives the infrared light and converts it into electrical signals so that the light emitting portion and the light receiving portion of the photo interrupter becomes conducted. The conduction between the emitter and collector can be detected by examining the signal, either high or low.

7.5. 12v Pumping Dc Motor

DC powered pumps use direct current from motor, battery, or solar power to move blood in a variety of ways.

7.6. Buzzer

In many electronic products, an electrical buzzer consists of electromagnetic or a piezoelectric element is used as an audible electronic component. In addition, it has a smaller volume compared to the electromagnetic one and the sound is created via a vibrating metal film due to the piezoelectric effect. As an auditory alert, a piezoelectric buzzer has to be installed on the blood leakage detector.

8. Software Requirements

8.1. Cloud

Cloud is used as a centralized storage unit, which is accessible only to authenticated users and it is used for large storage purposes.

8.2. Arduino Ide

Processing and other open-source software. This software can be used with any Arduino board. The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. It runs on Windows, Mac OS X, and Linux. The environment is written in Java and based on

8.3. Bluetooth

Bluetooth is adopted as the wireless transmission function of the detector Bluetooth 4.0 is its low-energy technology. This lets device manufacturers replace proprietary sensor technology with Bluetooth, which is a more widely adopted standard.

9. Conclusion

The purpose of developing "Blood leakage detection during self-dialysis" is to make a quality life for the patient during the treatment process. The main objective of the project is to make the dialysis process easier and self-dependent, which also detects blood leak if it occurs and alerts the doctor and the family members.

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Conflict of interest

None of the authors have any conflicts of interest to declare.