Making Monitoring Device of Infusion Liquid

Using Proximity Photodiode

as a Sensor Based on Arduino UNO

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Abstract

The purpose was to design a monitoring device of infusion liquid by applying proximity photodiode as detection sensor, and Arduino UNO as main control of operating this monitoring device. This device circuit also used buzzer and led which are used as an alarm when the sensor detected that the infusion liquid was running out. The respond plot of this device is started from that proximity photodiode sensor circuit detects the emptiness of the liquid in the infusion bag which is converted into the voltage and forwarded to the Arduino UNO in form of digital signal. The normal volume frequently used in a hospital is around 400 ml to 500 ml. This device was made in order to detect the infusion liquid which would have run out by giving a warning alarm as the infusion liquid was at a certain volume. Test on the device had a high accuracy because the alarm would ring with some interludes as the sensor detected that the liquid was at 100 ml of volume indicating that the infusion liquid would have run out, and the alarm would ring again without any interlude as the sensor detected that the infusion liquid was at 50 ml giving the warning that infusion had been run out and should be replaced. That could minimize the delay of replacing the infusion and cause of embolism in blood vessel.

**Keywords:** Proximity Photodiode Sensor, Arduino UNO, Buzzer. Infusion

1. Introduction

Intravenous fluids infusion is giving an amount of liquid into a body, through a needle, into a veins in order to replace the loss of liquid or any food substances of the body itself or the liquid through the intravenous into the body in order to fulfill the liquid need, equalize the electrolyte as treatment and give the nutrient. The mistake of giving infusion liquid is able to cause a serious trouble even a death. Besides installing process of the infusion, monitoring the infusion liquid regularly must be payed a serious attention. The medical personnel are often neglectful in monitoring the infusion liquid, so that the patient's blood raises to the infusion tube which will cause embolism in blood vessel. Therefore, infusion liquid monitoring device is needed so it can make the medical personnel easier to detect infusion liquid which will have run out, aside from that in the attempt of taking care of the safety, this device is also uses the alarm and the led as the infusion indicator, the alarm and the led will give the warning if the infusion liquid will have run out.

2. Materials and methods

a. Device Circuit

The whole circuit of Infusion Liquid Monitoring Device Using Proximity Photodiode as a Sensor based on Arduino UNO is shown on Figure 2.1.

a   b
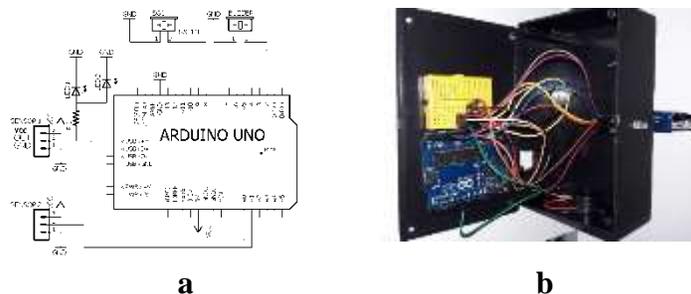
Figure 2.1. a. Device Circuit. b. Infusion Monitoring Device

Proximity sensor is a sensor that is able to detect the existence of things around it without physical contact. Specifically, proximity sensor is a sensor that is able to detect things without touching it. Proximity sensor works by using inductance principle. The inductance is a state that happens when the electric current fluctuations that flow on magnetic material induce electromagnetic force (emf) from a target of metal. The proximity sensor is shown on Figure 2.2.

Figure 2.2. Proximity Sensor.

Arduino UNO having 14 pins that function as the input and the output. In the Arduino UNO circuit in order to connect two sensors of proximity photodiode with port A.0 and port A.1 as the output receiver. This device uses buzzer and led as a sign of the emptiness of infusion liquid, which are installed in series in the circuit using port 6 and ground. Arduino UNO is shown on Figure 2.3

Figure 2.3. Arduino UNO.

The infusion liquid detection device will be installed on the side of infusion functioned to detect the loss of infusion liquid, when the infusion is almost running out. The data forwarded by the sensor to Arduino UNO is digital data which doesn't need any further conversion on the device itself.

b. Monitoring Device Program

Arduino UNO controlling program which will be loaded to the device is shown on Figure 2.4.

Figure 2.4. Infusion Liquid Monitoring Program

Arduino UNO controlling which will be loaded to the device is composed of three subprograms which are variable declaration subprogram, input/output subprogram and processing of sensor voltage measuring value of proximity photodiode, buzzer and led subprogram. 14 digital pins of Arduino UNO could be used as the input or the output using pinMode function, digitalWrite and digitalRead. Every pin works on 5 volt of voltages. Every pin is able to receive or to generate the maximum current of 40 mA and has internal pull-up resistor (cut by default) of 20-50 kOhm. On this device photodiode sensor will be installed to Arduino UNO on port A.0 and A.1 that are Port two-way input/output and ADC input converting analog signal on photodiode sensor to be digital signal consisting one and zero. Converting and processing digital data are received by Arduino UNO forwarded to port connected to buzzer and led.

C. Testing the infusion liquid monitoring device
The test result data of infusion liquid monitoring detector device using proximity photodiode sensor is shown on Table 2.1.
Tabel 2.1 The Data of Infusion Liquid Monitoring Device

Infusion liquid detector device is only able to detect infusion liquid that is in the clear bag[6] like asering, ringer asetat, deaktrosa, and any other types of the infusion, because the proximity photodiode sensor is only able to detect liquid, thing and the light so that the clear infusion bag is needed. Infusion liquid detector device is placed on the infusion bar, proximity photodiode sensor on the sensor is faced to the infusion bag which will be detected when the infusion liquid passes through proximity photodiode sensor. Sensor placement can be adjusted as needed as the volume which will be detected. Buzzer and led will be light on and ring in at the certain volume of 100 ml and 50 ml so that in the volume of 400 ml until 150 ml proximity photodiode sensor doesn't detect any emptiness on the infusion bag yet. In the volume of 400 ml until 150 ml buzzer and led are not ringing and lighting on otherwise, when the sensor detect the infusion liquid at volume of 100 ml, buzzer and led will be ringing periodically signing that the infusion is almost running out, otherwise on the volume of 50 ml, buzzer and led will be ringing without any interlude.

3. Result and discussion

Based on the analysis of all of the literature data available, our result shows that the delay in replacing the infusion has many dangerous risks, one of which is the raising of the blood on the infusion hose will have a chance to come back again to the blood vessel which causes embolism. So that monitoring infusion liquid is very important in order to get rid of delaying infusion liquid replacement. In the making of infusion liquid monitoring it has many kinds, monitoring infusion drop device could use web

online based ESP8266, using NodeMCU ESP8266-E12 as the controller, IR Obstacle Avoidance Sensor Module as the infusion drop detector. Infusion system that is able to monitor infusion periodically is needed. By using photodiode sensor with the diameter of 5 mm which will be the indicator of liquid height in the infusion tube and a potentiometer as the monitor clamp angle. On the other hand as the replacement of hose suppressor servo motor that will move to open or close the infuse drop flow is used. Monitoring intravenous infusion based on slot-coupled emitting infrared diode as a sensor, ATMEGE128L chip as the MCU and CC2420 chip as RF communication based on ZigBee. By using the ESP 8266 module connected to the load sensor to measure the bottle volume and send the data through internet. Monitoring the bottle volume is done successfully with the measurement recorded on MySQL database and could be access through web. Infusion drop detector with information system through SMS is also a new innovation by sending the massages to the nurse located in the nurse room or even the other room, by using SIM800L sensor which is able to send the command in the form of SMS based Arduino UNO. The use of potentiometer in this system is to measure the infusion liquid. Ethernet shield adds the ability of Arduino board in order to be able to connect to computer network. The use of Ethernet shield in this system acts as the connector media between the hardware installed on the infusion and the computer or even the smartphone. Sensor gauge has the ability to measure the transducer converting force into electrical signal in millivolt, microcontroller dual-18 pins modulate the signal from the transmitter to the receiver, bell indicator to notification voice, and display monitor of LCD. Infusion liquid volume detector using potentiometer and the spring as the sensor based on microcontroller AT89252. The spring has the function as the load brace and the potentiometer as the infusion liquid gauge. Infusion liquid control system on the patient by utilizing network sensor technology and microcontroller Arduino UNO. Sensor used is Ultrasonic HC-SR04 functioned to detect residual infusion liquid. The data read by the sensor is sent using the wireless network from transmitter (TX) in the patient room to Receiver (Rx) in the nurse room by using wireless Xbee s2 module[16]. Reading of infusion liquid drop and the emptiness of infusion liquid uses LED and photodiode. Automatic mechanical driver system uses servo motor. Its main controller is microcontroller AVR ATMega16.

4. Conclusion

Conclusion from the result of making infusion liquid monitoring device is that the proximity photodiode sensor will start detecting the infusion liquid in the volume of 100 ml and 50 ml. The alarm installed will be ringing where it will be the sign that the infusion liquid installed is running out. This device is only able to detect the emptiness of infusion liquid through alarm. In the further research it could be added

the monitoring of infusion liquid through medical personnel monitor which will make it easier to replace the empty infusion later on.

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