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KORİNT YAYINCILIK

DESIGNING OF SMART SYRINGE PUMP WITH THE APPLICATION OF INTERNET OF THINGS (IOT) FOR END ALARM

Mahrus Bawafie bin Mhd Harip
Sultan Salahuddin Abdul Aziz Shah Polytechnic, Shah Alam, Malaysia, bawafiem@yahoo.com

Suryani binti Ilias
Sultan Salahuddin Abdul Aziz Shah Polytechnic, Shah Alam, Malaysia, kamasue77@gmail.com

ABSTRACT

A syringe pump controls the piston's movement to distribute fluids into intravenous tubing. Detecting and minimising such errors requires linking syringe pumps with the Internet of Things (IoT), which permits human engagement through mobile app. Wireless connection and mobile device technology have increased the use of two-dimensional barcodes in production, logistics, and sales. Many users report that most syringe pumps show 'END ALARM' after fully infused. The proposed system could potentially be used to notify the users or clinicians for the occurrence of end alarm which the fluid is completely infused to the patient. The objective of the proposed project is to design a system that can be used to detect end alarm for syringe pump application. After that, to notify the users or clinicians for the occurrence of end alarm which the fluid is completely infused to the patient. Then, to implement the Internet of Things (IoT) through mobile application. In order to bring the advantages of technology to the field of medicine, the combination of a syringe pump and an internet of things alarm was chosen for the purpose of this investigation since it would assist the user in being notified of the occurrence of an end alert. The development of an Internet of Things end alert that is able to tell the user via smartphone when the syringe pump has been entirely infused into the patient is expected to be the result of the study that is now being suggested. The user is able to monitor the machine from anywhere by utilising the Blynk application, which is made possible by the Internet of Things function.

Keywords: Syringe Pump, Internet of Things, KY-037, End Alarm, Blynk

INTRODUCTION

At present, the number of patients who are admitted to the hospital is increasing gradually due to certain diseases. Commercial intelligent syringe pumps nowadays have advanced features. Based on (Merhi, 2019) it have the features of syringe pump such as drug libraries, wireless communication, and a barcode scanner. In biomedical applications, syringe pumps

or syringe drives are motorised devices that accurately regulate the movement of liquid within a syringe by manually inserting or retracting a plunger. The use of syringe pumps to maintain steady and pulsation-free flow rates is restricted to batch processing. In these individuals, the ability to swiftly detect and resolve line blockage is even more crucial. It is utilised by medical practitioners in the diagnosis, treatment, and care of patients in vivo. Rather than research settings, they are often employed in hospitals and nursing homes, and sometimes (but not always) in palliative care. There are two types of syringe pumps utilised in hospitals: medical and laboratory.

IoT refers to the network of interconnected devices and the technology that permits communication between devices and the cloud as well as between devices. Blynk will be utilised as an IoT platform to control the alarm of a syringe pump for the proposed project. Blynk is a new platform that enables the rapid creation of interfaces for iOS and Android smartphones to control and monitor hardware projects. The benefit of implementing Blynk in Healthcare is that it enables real-time patient monitoring, hence drastically reducing unnecessary doctor visits, hospital stays, and readmissions. It also improves treatment by allowing clinicians to make decisions based on evidence and delivers complete openness.

Nowadays, many medical devices have widely been used in clinicals. Either directly or indirectly contact to the patient in order to save their life. Most problem encountered in the use of syringe pump that clinicians complain the problem of the syringe pump when the machine is infused completely, it will show ‘END ALARM’. This alarm will produce loud sound that can interrupt the patient comfort. According to (Donmez, 2005), detection of occlusion to flow of an infusion is an important problem with syringe pumps. it is even more important to be able to detect and resolve line occlusion quickly in these patients.

This idea of improvement could ease the user to notify the users or clinicians for the occurrence of End Alarm which the fluids is completely infused to the patient by using Blynk Application through a smartphone.

The objective of this project is to design a system that can be used to detect end alarm for syringe pump application. After that, to notify the users or clinicians for the occurrence of end alarm which the fluid is completely infused to the patient.Finally, to implement the Internet of Things (IoT) through mobile application

This improvement will primarily focus on notifying the users in ward Hospital by using a smartphone. With the implementation of IoT alarm to the syringe pump, it can ease the use of the user such as doctor and nurse when there are not in ward.

METHODOLOGY

Methods that are involved in this research along to the objectives that has been stated earlier. Data collection of this project will be obtained by using qualitative and quantitative analysis. For quantitative analysis, will be given by using a questionnaire for the user feedback. Meanwhile, for the qualitative analysis based on the performance test of the product.

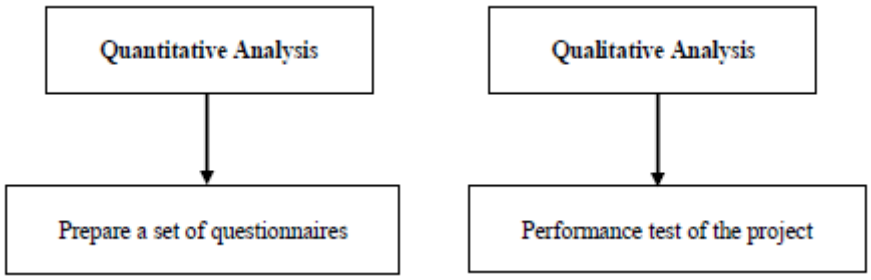

Figure 1. Method of Quantitative and Qualitative Analysis

HARDWARE DEVELOPMENT

Figure 2 below shows the flowchart of hardware development. First, we start by designing the product by using Thinkercad. After that, we finalize the design of product. If there is a mistake with the design, we redesign the product. Next, we find the suitable components for the product. We finish the product within the given time period. Finally, we touch up the prototype.

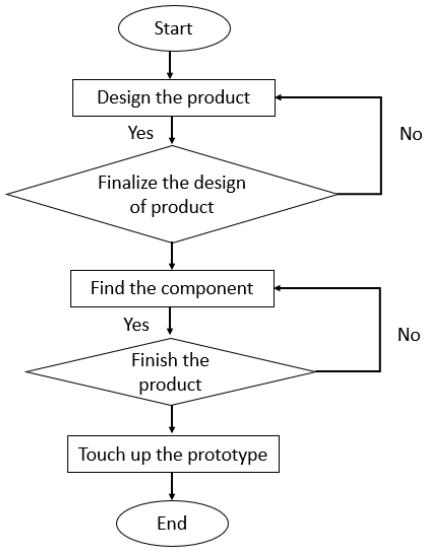

Figure 2. Hardware Development Flowchart

SOFTWARE DEVELOPMENT

Figure 3 below shows the flowchart of software development. First, we start by finding the suitable software for IoT Alarm system. For this product, we use Arduino to create and compile the coding to the system. After that, we finalize the suitable software for the product. If there is a mistake with the software, we find another software for the system. Next, we create and compile the coding. If there is an error when compiling the coding, we create again the coding. Finally, when the coding is successfully compiled, we upload the coding to the system.

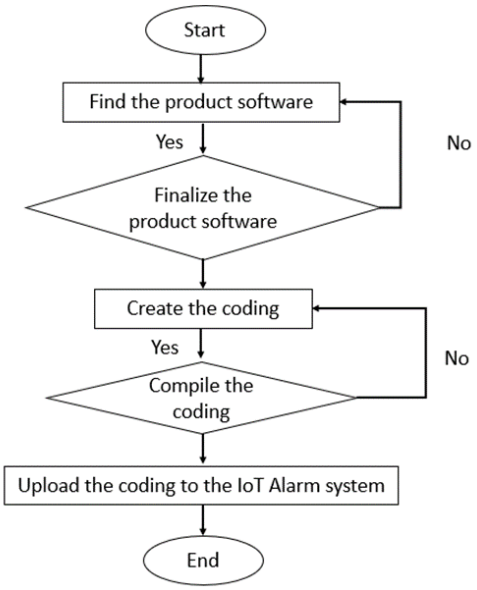

Figure 3. Software Development Flowchart

BLOCK DIAGRAM

Figure 4 below shows a block diagram of IoT End Alarm. It consists of NodeMCU ESP 8266 and KY-037 Sound Sensor. This project will use Wi-Fi connection. When the switch button is ON, the IoT alarm system will turn on. IoT alarm system will connect to the smart phone via Wi-Fi. Sound sensor will detect the occurrence of end alarm from the syringe pump. Input port consists of Battery, Switch Button, & KY-037 Sound Sensor. For Microcontroller, it uses NodeMCU ESP 8266. Finally, Blynk and Smartphone are the output port.

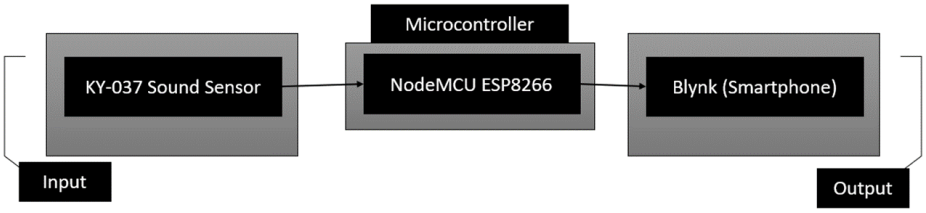

Figure 4. Block Diagram of the Project

DATA COLLECTION

Data is collected in two different tasks. The first one is qualitative task by doing performance test of the project and the second one is quantitative task by conducting a questionnaire for feedback from user. Figure 5 below shows the flowchart of data collection.

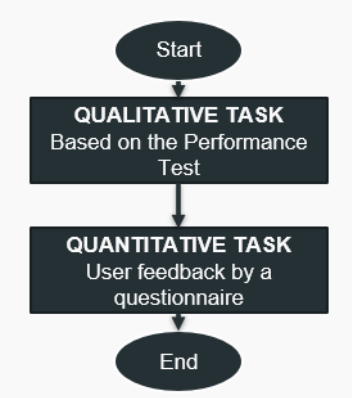

Figure 5. Flowchart of Data Collection

RESULT

Based on Figure 6 shows the circuit connection on bredboard and Figure 7 shows the result displayed on Blynk. Once sound sensor detects the end alarm, LED will start blinking, Blynk will display 'END INFUSED' which means the machine is completely infused to the patient

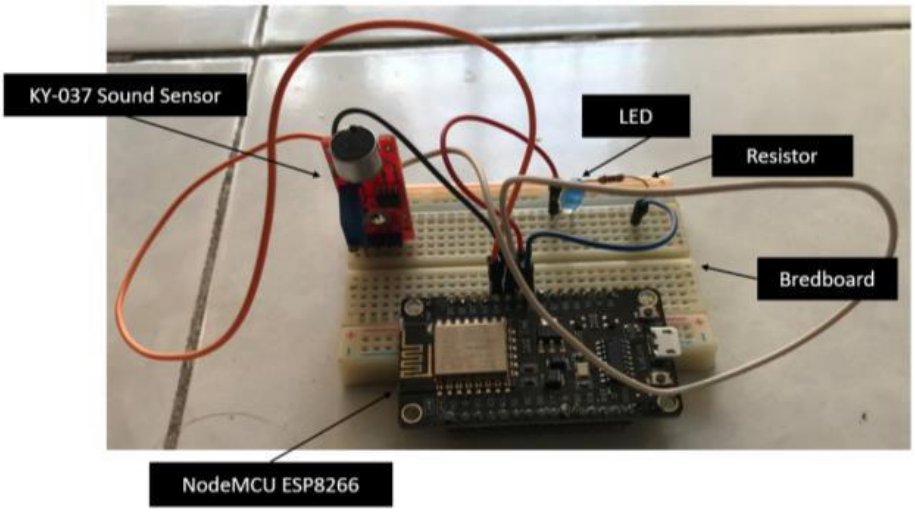

Figure 6. Circuit Connection on Bredboard

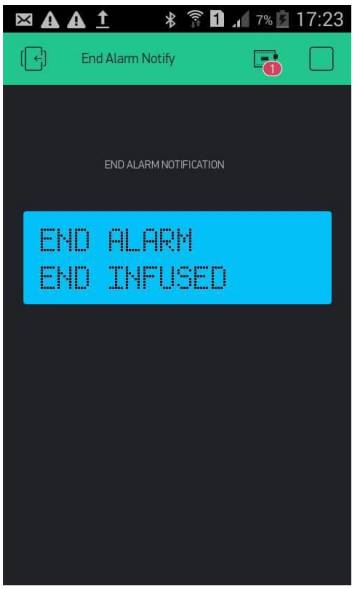

Figure 7. Blynk Result Displayed

FEEDBACK QUESTIONNAIRE

After the sound sensor detects the syringe pump's end alarm, the Blynk app on a smartphone will display the result. 10 responders fill a questionnaire after the user sees the project demo. This questionnaire has 6 questions. The questionnaire yielded a result.

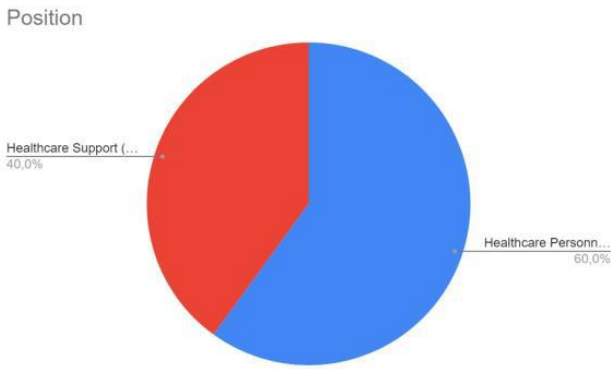

Figure 8. Pie Chart Questionnaire

Based on figure 8, 60% of 10 responders were Healthcare Persons and 40% were Healthcare Support. Respondent position is shown above.

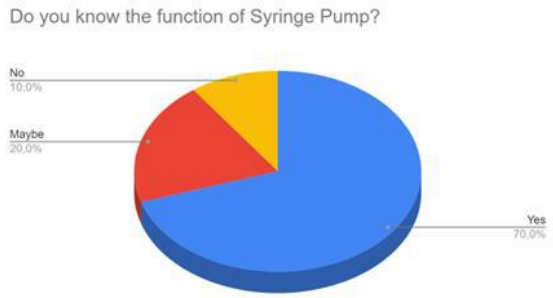

Figure 8. Pie Chart Questionnaire

Figure 8 shows 70% know the syringe pump's function. Then, 20% may know how a syringe pump works. 10% don't know how syringe pumps work.

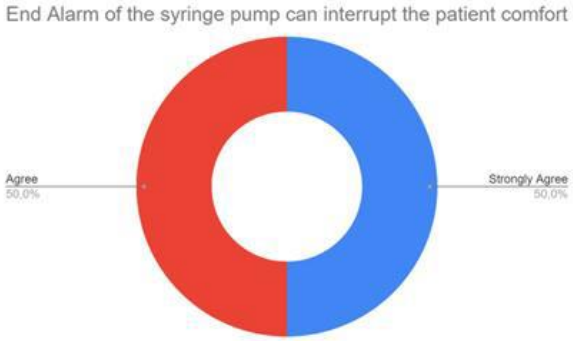

Figure 9. Pie Chart Questionnaire

From figure 9, 50% agree that syringe pump end alarms can disrupt patient comfort.

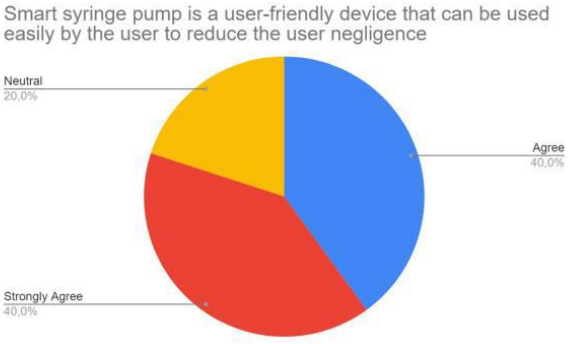

Figure 10. Pie Chart Questionnaire

From figure 10, 40% agree that smart syringe pumps are user-friendly devices that reduce user irresponsibility. 20% are neutral that the smart syringe pump is a user-friendly technology that reduces user carelessness.

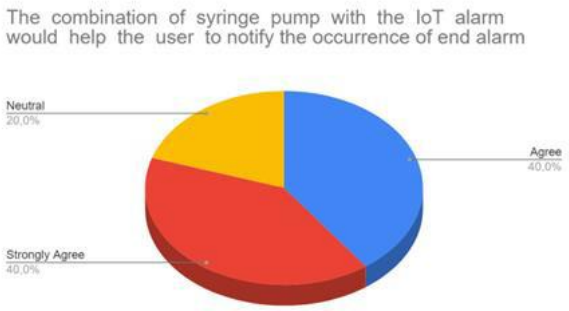

Figure 11. Pie Chart Questionnaire

From figure 11, it shows that 40 percent of respondents think that combining a syringe pump with an IoT alarm would assist users detect end alarms. After that, 20% are impartial that syringe pump with IoT alarm would help the user notify end alarm.

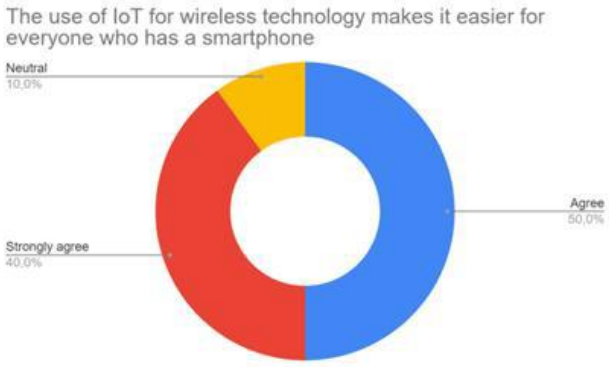

Figure 12. Pie Chart Questionnaire

Figure 12 shows that 50% agree IoT makes smartphone use easier. 40% agree that IoT makes smartphone use easier. Next, 10% are neutral on whether IoT makes smartphone use easier.

CONCLUSION

In conclusion, the objective of this project is achieved. Based on the first objective for this project, it can be concluded that a system that can be used to detect end alarm for syringe pump application has been designed successfully. The design of the IoT smart syringe pump is the combination of syringe pump with IoT alarm.

Based on the second objective of the project, the occurrence of end alarm which the fluid is completely infused to the patient has notified to the users or clinicians by using Blynk application through the smartphone. Users or clinicians can monitor the end alarm of the syringe pump wirelessly.

Based on the third objective of the project, Internet of Things (IoT) through mobile application has been implemented. The use of IoT for wireless technology makes it easier for everyone who has a smartphone. Now, the users can monitor the end alarm whenever they are not in the ward.

Finally, based on the research done, the device has been designed and developed successfully to overcome the problem statements related to disturbance of end alarm of the syringe pump. So that, the results are satisfied accordingly to the objective of the development.

RECOMMENDATION

Further works are recommended to improve the effectiveness of IoT Smart Syringe Pump by develop a system that can detect other alarm. This is one of the best ways to detect every sensor of syringe pump by using a smartphone. Alarm is used to notify and detect an event such as an invasion, fire, gas leak or environmental changes; determine if the event poses a threat; and then send a notification about the event.

We also recommend a cut off system for end alarm. For example, when the machine shows end alarm, it will turn off the machine automatically. This can be done by develop a cut off board to turn off the supply or machine.

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