ANALYSIS OF PULSE OXIMETRY (SPO2) USING IOT BASED MONITORING DEVICE

Jaisly Meyeesan, Zarina Che Amin
Politeknik Sultan Salahuddin Abdul Aziz Shah

ABSTRACT

At Present majority working parents are handing over duties to monitor their child to babysitters. Numerous incidents have been resulted in premature infant demise due to babysitters' negligence. In order to address further premature death of babies and infants, an IoT Based monitoring device was designed to keep babysitters constantly alert to the baby's or infant's health condition and parents receive information concurrently on the child's health condition remotely. The focus of the device is to monitor babies' or infants' wellbeing, focusing on those having a congenital heart defect (CHD), sudden infant death syndrome (SIDS), and Hypothermia. The main components used to monitor is Pulse Oximetry (SPO2). Pulse Oximetry (SPO2) is a non-invasive method of measuring the oxygen saturation level in the blood, which are detect the health condition. This project is enhanced by using a wireless system to facilitate babysitters or parents to perform other tasks while monitoring the baby's health condition. The wireless function transmits messages when abnormal reading is obtained, message will notify parents and babysitters via mobile phones with toning alarms and data which will be recorded continuously. The result of this study was obtained through real-time reading transmitted to application and compared to theoretical reading. From the obtained result, this device deemed very usefully for the care and monitoring of the health of infants and babies.

Keywords: IIoT; CHD; SIDS; Hypothermia; SPO2.

INTRODUCTION

There was a 30,484 demise registered in 2017, an increase of 0.3% (or 94 premature dead) from 2016. According to the central statistical office, the death statistical of babies for every year increases are due to Congenital Heart Defects (CHD), Preterm Birth and Low Birth Weight, Sudden Infant Death Syndrome (SIDS), Lung Diseases, and Hypothermia. These causes can be monitored by Pulse Oximetry (SPO2) Pulse Oximetry (SPO2) is a noninvasive method of measuring the oxygenation level in the blood (MacGill, 2017).

The present lifestyle is making parents rush with their daily activities and hand over their children to babysitters. Creating an emotional vacuum in parents as they are constantly worried, they cannot monitor their children's health remotely. Alternatively, there are also parents who take their children to the medical center for monitoring but this is a solution for a short period of time. However, if a baby or infant needs specific care for a long period, such as chronic illness and lung disease, parents may need a trained babysitter to help them.

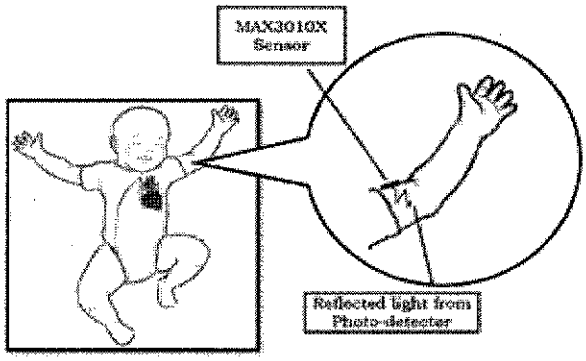
In order to solve this problem, a MyMed device was designed to keep babysitters constantly alert to the baby's and infant's health condition and as parents can monitor the child's health condition remotely. The communication system works based on WI-FI medium throughout the server. This device was detected through the SPO2 sensor. Allowing the device to alert the parents about the infant condition one hour once and any emergency case. Moreover, parents can do any activity without worrying about infant health. This device is also helpful for the caretakers who had their own care centers. This device will update data analysis in statistical wise to monitor the infant health condition and easy to refer the doctor with the data collection in device.

2.0 METHODOLOGY

2.1 Hardware of Device

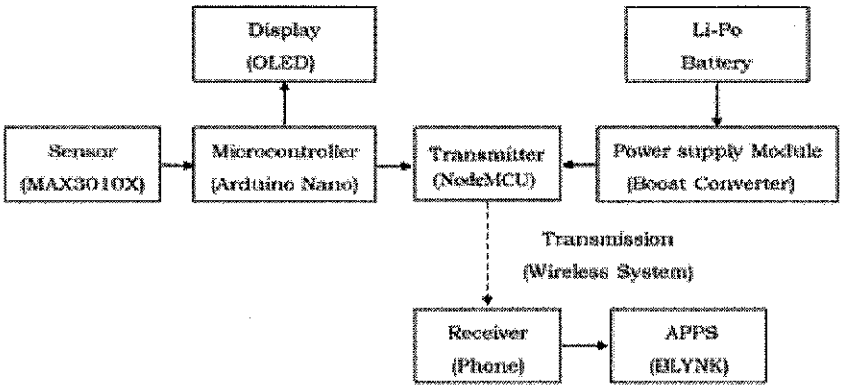
The MAX3010X sensor is an integrated High Sensitivity Pulse Oximeter and Heart Rate monitoring module. The sensor is included with internal LEDs, photo-detectors, optical elements, and low-noise electronics with ambient light rejection according Polina Gelfer. In this case, the module was used to indicate the reading of Pulse Oximetry (SPO2). The light is partially absorbed by underlying tissues, including peripheral blood. The photo-detector from the sensor was collected reflected light at both wavelengths and returns two corresponding relative intensities using I2C protocol. Since absorption spectra for oxygenated and deoxygenated hemoglobin different for both wavelengths, the reflected light has a variable component as the amount of arterial blood that is present under the skin pulses with each heartbeat as shown in fig. 1. Figuring out oxygen saturation is based on the signal processing software.

Figure 1 : Scenario of photo-detector transmits a signal to verify the reading.



Besides that, the device was developed with two microcontrollers, which are Arduino Nano and NodeMCU. This is because to reduce the latency while processing data of the device. So, the device is controlled systematically according to the programming and schematic diagram. Additionally, the block diagram of the component mention as fig. 2 based on the process of data throughout the component.

Figure 2 : The block diagram of the component



2.2 Software of Device

The device was programmed using two software such as Blynk and Arduino IDE. Blynk is an Internet of Things Platform aimed to simplify building mobile and web applications. It can control the device according to the programming which is created. This application will store the data statistically to monitor the condition. The open-source Arduino Software (IDE) is written in Java and based on Processing. This software has been used for programming according to the project to compile and upload without error.

2.3 Measurement limitation table

The programming codes are created in Arduino IDE throughout theoretical statement from medical health care. This is because each parameter contains a specific reading to monitor the health condition. In this case, the reading was taken from iheart sourced from the website, which is shown as table 1.

Table 1: Range of SPO2

< 90%	91-94%	95-100%
90% or less consider have to consult doctor.	Below average for population monitor closely.	3.27
	The red blood cells are well oxygenated and sufficiently transporting oxygen around the body.	

RESULTS AND DISCUSSIONS

3.1 The Development of Device and Application

The developed device and application was shown in fig. 3 and 4. The device was indicated Pulse Oximetry (SPO2) reading throughout the photo-detector of the sensor, which was placed below in the device to detect directly under the skin.

Figure 3 : The developed MyMed device

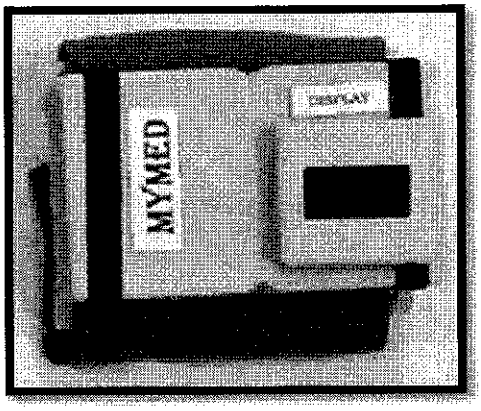
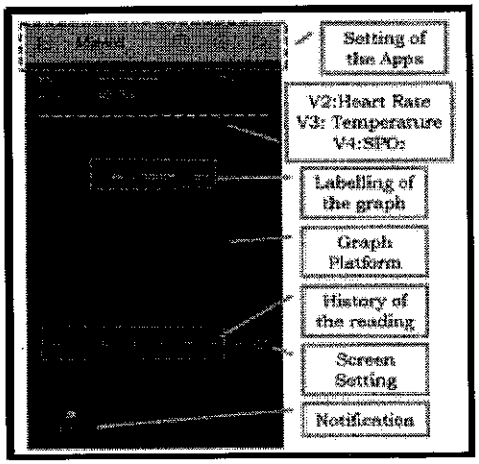


Figure 4 : The labeling of the MyMed application from Blynk platform



Based on the data collection, the result was plotted as a graph in statistical wise to identify the health condition and the history of the graph will send to email for extra monitoring and analysis purposes, which was shown in fig 5 and 6.

Figure 5 : The history of the graph from the application send to email

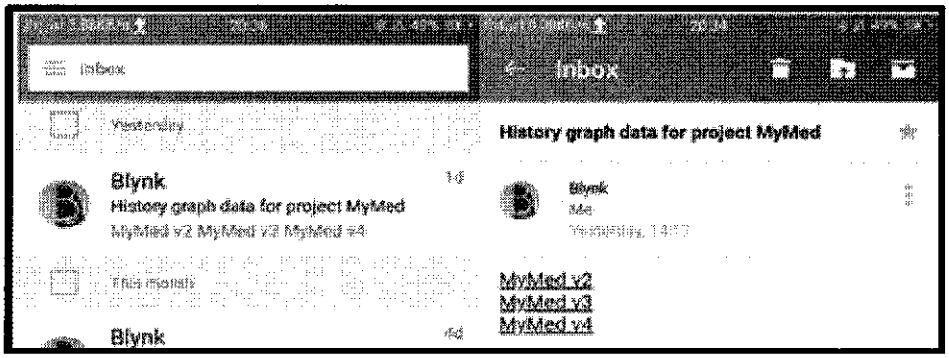
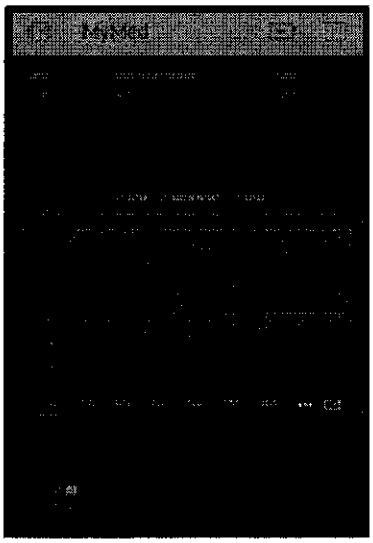


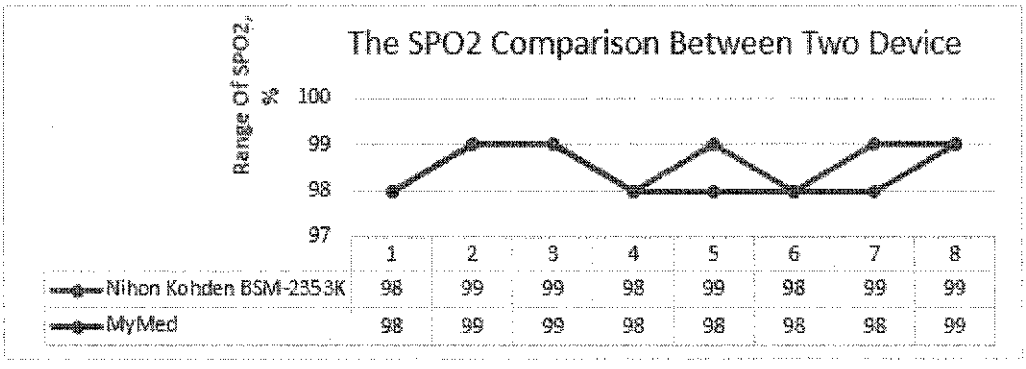
Figure 6 : The Statistical Data In The Mymed Application From The



3.2 Analysis of SPO2

The data of MyMed device was collected and compared with the actual medical device, which is Patient Monitor, model Nihon Kohden BSM-2353K as shown in Graph 1. Moreover, the comparison is done according to 8 times testing with 5 minutes wearing the actual device and 5 minutes wearing the prototype to the sample. This is to verify the data stabilization of a person while wearing the medical device. Besides that, the testing is carried out without wearing the same time both devices concurrently due to avoid the high electrical signal passing through the body to calculate a similar parameter. This is done to observe the accuracy of the MyMed device.

Graph 1 : The comparison of MyMed device and Patient Monitor



The reading comparison between the two devices is unparallel because the percentage of error is 0.01% due to the movement. Rather than that, the reading is also compared with the theoretical values as shown in Table 1 due to monitor the health condition range. The sample is healthy due to the tests.

CONCLUSIONS

As a summary, the device was developed to resolves the problem commonly occurred in-home, nursery, and health care industries. As a method to address the infants or babies needs to be monitored due to the health condition. As a result, it may help the users to reduce their burden and decrease the numbers of mortality. The SPO2 is an important diagnose system for health industries. So, the reaches undergoing to innovates an excellent product due to the potential level in the market.

The device was designed for monitoring purposes by applying the latest technology for the target society. Moreover, the latest technology mention for the MyMed device was the communication system and SPO2 sensor, which are used to detect the internal reading of the body and transmit through the wireless module. The communication system for the device is based on the Internet of Things (IoT). The device was harmless while wearing throughout the days. This innovation may help in diagnosing the yearly stage of health problems by using daily lifestyle. Besides that, the device reduces the burden while do not wait for a long queue in hospitals in order to check the health condition. According to this device, the data were recorded systematically. The data collection and also known as history was uploaded in email for monitoring purposes. The data from the device was accurate while compared to the actual device in the hospital.

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