Wireless Communication System For Monitoring Heart Rate In The Detection And Intervention Of Emotional Regulation

Syahid Al Irfan
dep. Electrical Engineering
Ahmad Dahlan University
Yogyakarta, Indonesia
syhaid.alirfan91@gmail.com

Anton Yudhana
dep. Electrical Engineering
Ahmad Dahlan University
Yogyakarta, Indonesia
eyudhana@ee.uad.ac.id

Subhas Chandra Mukhopadhyay
dept. Mechanical/Electronics Engineering
Macquarie University
Sydney, Australia
subhas.mukhopadhyay@mq.edu.au

Ismail Rakip Karas
dept. Computer Engineering
Karabük University
Merkez/Karabük, Turkey
ragib@penta.gyte.edu.tr

Dewi Eko Wati
dep. early teacher training of Early Childhood education
Ahmad Dahlan University
Yogyakarta, Indonesia
dewi.ekowati@pgpaud.uad.ac.id

Intan Puspitasari
dep. teacher training of Early Childhood education
Ahmad Dahlan University
Yogyakarta, Indonesia
intan.puspitasari@pgpaud.uad.ac.id

***Abstract*—Based on data from the Indonesian Child Protection Commission (KPAI) cases of violence against children from 2010 to 2015 continued to increase which from 2010 only 171 cases increased to 2015 as many as 6006 which means that every year cases of violence against children continue to increase at least 1000 cases each year. Changes in heart rate in humans can be known through the flow of blood that flows in blood vessels. When the heart beats, the flow in the blood vessels will move so that's when the heart rate can be measured. In this study, a wireless heart rate condition data collection system will be developed and a heart rate condition sensing device that has the same capabilities as devices used in general medical activities. From the results of testing, the system designed the process of sending data goes well where of the 20 devices that send data all of that can be sent properly with a time interval of 1 second but for the sensor reading process some problem need to be solved such as interruptions in the data collection process when participants doing activities and some constraints on the choice of devices used on the server.**

Keywords—Wireless Communication, MAX30100, XAMPP, Emotion Regulation, Heart Rate.

I. INTRODUCTION

Emotion is one of the things that underlies human behavior both directly and indirectly[1], [2]. Good emotional control will affect decision making which will ultimately have an impact on social life. In family life the relationship between family members is not immune from the regulation of emotions both from the role as a child and parent. in Indonesia violence against children based on data from the Indonesian Child Protection Commission (KPAI) cases of violence against children from 2010 to 2015 continues to increase which from 2010 only 171 cases increased to 2015 up to 6006 which means that every year cases of violence against children continues to increase at least 1000 cases annually[3]. In conditions of anger there will be some changes in the human body such as increased heart rate, accelerated breathing, increased body temperature, and changes in facial expressions[4]. When someone experiences a change in emotional state it will be in line with changes in heart rate rhythm[5]. This can be used as a basis for determining one's emotional state simply.

Changes of heart rate in humans can be known through the flow of blood in blood vessels. As the heart beats, the flow in the blood vessels will move so that is when the condition of the heart rate can be measured. At present there are a lot of tools to measure heart rate that can be used by the general public and can be bought freely[6], [7]. The device's results for measuring heart rate are quite accurate but in terms of use it must be done manually so that if used on many users and at the same time it has not been effective. The most effective solution to the problem is the existence of a data collection system that can be done simultaneously on more than one subject. Another way for the data collection process is to use Big Data technology. The presence of Big Data in Indonesia increasingly popular almost in all circles. In terms of Government institutions, Big Data is a huge data set that will then be analyzed or processed again for specific purposes such as decision making, prediction, and others[8].

In this study, a wireless heart rate condition collection system and a heart rate sensing device will be developed with the same capabilities as devices used in general medical activities. This device can be used simultaneously and with a large number of users so that it can be used to monitor the condition of the user's heartbeat when data is collected.

Data was collected by collecting 20 participants consisting of parents who have children who are still attending elementary school. Participants will be given stimulations in the form of performances related to violence against selected children and several mini theater plays. When given a stimulus, the participant's heart rate will be monitored in real time and simultaneously using a device that has been designed. Based on several studies[9], [10] when the device is tested on participants and given a stimulus that has been prepared, then the condition of the measured heart rate does not change and the results are combined with several other facts taken outside the data collection process, the conclusions obtained are These participants have the potential to have a personality to commit acts of violence on children.

II. SYSTEM DESCRIPTION

A. Wemos D1 Mini

Wemos is a microcontroller which in its specifications has been integrated with the needs of the IoT system with a WiFi module and 4 Mb of storage memory. The chip used as a controller is the esp-8266ex chip with 1 analog pin and 9 active digital pins[11][12]. For more details can be seen in the table 1. The use of this device in the system bears a resemblance to the research conducted by Syafiqoh (2018) namely in the use of the esp8266 module and its method of sending data [13].

Tabel 1. Wemos D1 Mini Specifications

Pin	Function	ESP-8266 Pin
TX	TXD	TXD
RX	RXD	RXD
A0	Analog input, max 3.3V input	A0
D0	IO	GPIO16
D1	IO, SCL	GPIO5
D2	IO, SDA	GPIO4
D3	IO, 10k Pull-up	GPIO0
D4	IO, 10k Pull-up, BUILTIN_LED	GPIO2
D5	IO, SCK	GPIO14
D6	IO, MISO	GPIO12
D7	IO, MOSI	GPIO13
D8	IO, 10k Pull-down, SS	GPIO15
G	Ground	GND
5V	5V	-
3V3	3.3V	3.3V
RST	Reset	RST

B. MAX30100

MAX30100 is a sensor developed by Maxim that is used to measure oxygen content in the blood. Inside is a series of low pass filters, optical optimization, high SNR and low noise digital analog processing. In the sensor there are two light sources namely red LED light and IR light. This sensor belongs to the category of non-invasive devices in measuring blood conditions. The pulse sensing device takes advantage of the fact that deoxygenated and oxygenated has different optical properties. When LED light is fired at the deoxygenated blood flow and oxygenated blood absorbs different amounts of light and reflects back different amounts of light. A photo-detector detects the amount of light reflected. A sampler samples the signals, filters them and applies proper signal processing[6]. Fig 1 show the MAX301000 sensor.

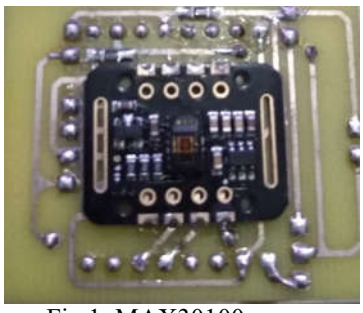


Fig 1. MAX30100 sensor

C. OLED

Organic light emitting devices (OLED) are expected to become the next-generation ecofriendly technology for large area displays and general lighting. For the practical application of next-generation OLED, low power consumption and long operation lifetime are absolutely essential. In this context, phosphorescent or thermally activated delayed fluorescent (TADF) emitters, called 2nd and 3rd generation emitters, are used to realize 100% electron-to-photon conversion using all of the electrogenerated molecular excitons of singlets and triplets[14]. OLED is used as a data viewer on the designed device. Fig 2 shows OLED when displaying text.

Fig 2. OLED

D. Power Supply

The power supply device used on each device is made portable so that each device is fitted with one battery as a power supply. The battery used is a LiPo type battery with a voltage of 3.5 v - 4.2 v and a capacity of 150mah. Fig 3 shows the type of battery used.

Fig 3. Power Supply

E. XAMPP

XAMPP is a web server application that is used as an internet-based data store and there are supporting programs such as Apache HTTP Server, MySQL Database and language translator written in PHP. XAMPP Stands for Cross platform (X), Apache (A), MariaDB (M), PHP (P), and Perl (P). Using XAMPP we will take the compressed input file movie. Normalized and convert it to JSON file[15]. The use of XAMPP itself is often applied to computer network systems and in some studies it is used as a security system testing tool for a network [16], [17]. The use of XAMPP as a web server requires the help of a web browser application which for the sake of confidentiality of the medical record data obtained needs to be made confidential because of several possibilities as explained in Umar's research (2018) which explains "Portable web browsers, web browsers tend to store large amounts of data about user surfing activities, username keywords, downloads, temp files, cache, form data and other browser-specific data on the user's hard disk,"[18]. Based on this statement, the security system used needs to be made safer.

III. SYSTEM PLANNING

The system developed is an Internet of Things (IOT) based system so that all devices are connected through the internet network. The relationship between the components in the device used can be seen in the block diagram shown in fig 4.

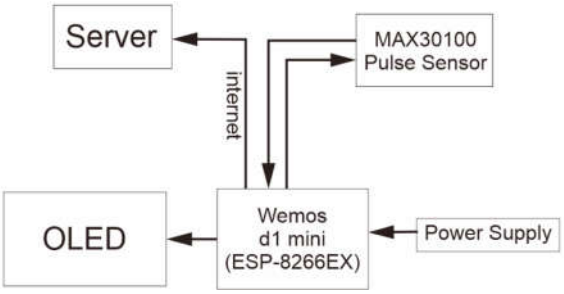
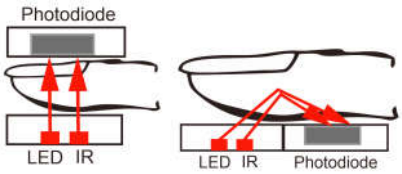


Fig 4. Block diagram device

In fig 4 it is seen that between Wemos and MAX30100 has a two-way relationship which means that between Wemos and sensors exchange information about when the data is collected and what kind of data is received. Apart from that Wemos relationship with other devices is only one-way.

In heart rate measuring devices used manually the placement of IR sensors is different from the one used in this study. In the manual measuring device the IR sensor is transmitted through parts of the body that are close to the bloodstream[19]. In the sensor used in this study the data collection method applied is different in the use of IR light. In this sensor IR light is reflected in parts of the body close to the bloodstream and reflected back so that it is received by the photodiode receiver on the sensor[7]. The difference can be seen in Fig. 5 (a) for sensors with manual use and Fig. 5 (b) for the sensors used.



(a) (b)

Fig 5. Strukture of the pulse rate sensor

After the sensor reading is done the data is processed and sent wirelessly through an access point to the server then the data is stored and displayed in real time from the server. A diagram of the relationship between these devices can be seen in Fig. 6. In some studies the process of sending data is done by utilizing other sending methods such as Bluetooth [20] or RF [21] but in this study the internet of things (IOT) technology is applied so that the process of sending data is done by utilizing an internet connection.

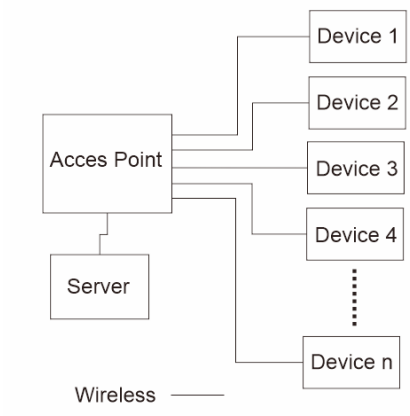


Fig 6. Block diagram for wireless communications

From fig 6 there are three main components, namely server, access point and devices. The three components are summarized in one system, the IoT system. The sensor data obtained is sent via a wireless network using the HTTP Request data sending method[22]. With this method the data transmission is carried out through the HTTP protocol and received and processed by the server with a programming language which in this study used the PHP programming language. For database that is used from the XAMPP feature there is data storage from the MySQL Database so that the PHP programming language with the MySQL database mutually communicates.

The sensor reading process is carried out by the microcontroller Wemos with I2C communication lines so that the data received is not in the form of analog data but serial data. Process flow chart for reading sensor data and sending data to the server can be seen in Fig. 7.

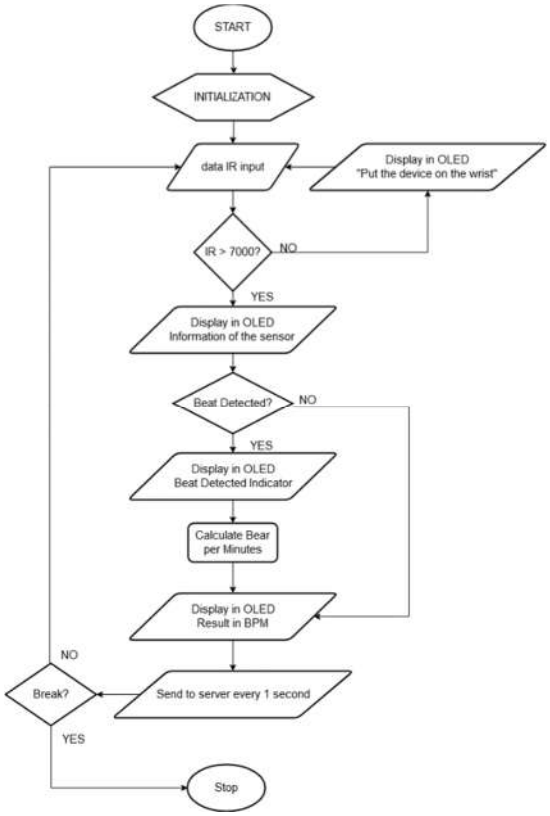


Fig 7. Flowchart Sensing Process

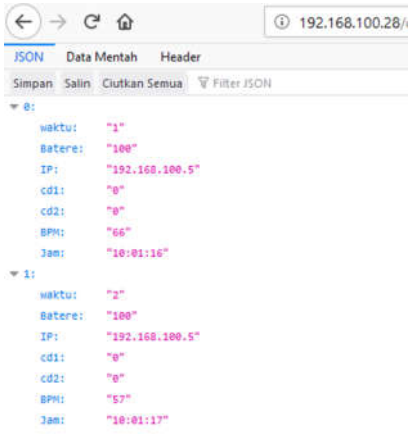


Fig 8.JSON formated data

To make it easier to observe the data which is still in the form of numbers, the appearance is changed into graphical form with the help of the Javascript programming language and chart library from ChartJS, the display is obtained as in Figure 9.

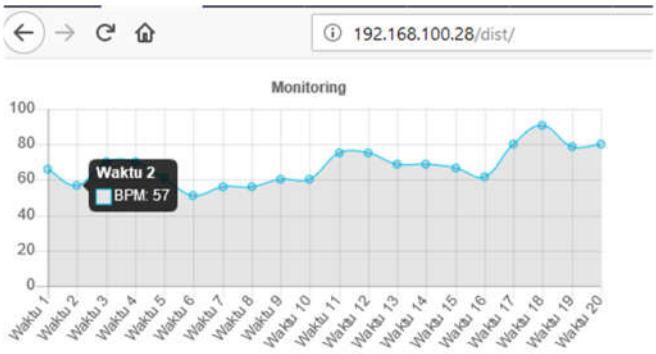


Fig 9. Grafic of Pulse Sensor

IV. DATA COLLECTION

To get the desired data the data collection process design with a system that has been designed must be determined in advance starting from the environment where the data is collected to the material that needs to be prepared as a stimulus that will be given to participants.

1. Scenarios For Data Collection

The first thing to prepare is the environment in which data is collected. In this study, the prepared environment is a place in the form of a classroom that has been provided by a camera to record all data retrieval activities, projectors, and seating for the participants. Illustration of the room can be seen in Fig. 10. In this room several people have been instructed to assist in the process of providing stimulus and data collection.

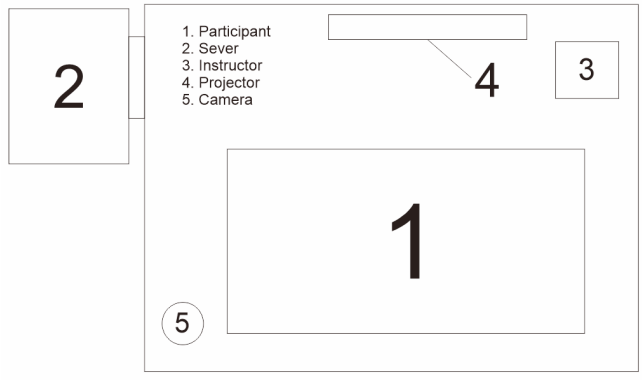


Figure 10. Illustration of the room

2. Use of the Device

The device that has been designed is made to resemble a watch so the user can simply attach it to the wrist as shown in fig 11. When the device is turned on the device will automatically connect to the prepared access points and send data to the server in real time.

On the device there is information about the condition of the device and the BPM value which can be seen directly so that when the device is not connected to the server the indicators can be seen on the device. This information can be seen in Fig. 12.

Fig 11. Monitoring device

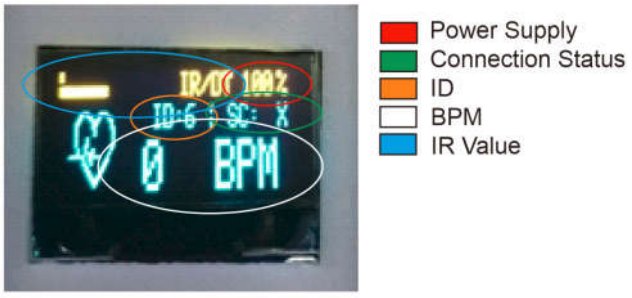


Fig 12. Information Display

The use of devices that have been designed can be done simultaneously with the number of devices provided as many as 20 units. Data that has been obtained from the device and stored in the database can also be directly observed as can be seen in Fig. 13 when retrieval of data in normal circumstances.

Fig 13. Results of collecting data simultaneously

3. The Stimulus Given

To find out indications of the possibility of parents who tend to commit acts of violence against children, participants are given triggers in the form of shows containing content related to child abuse and also shows that contain stories that touch hearts. The stimulus was given after preparations were made to adjust the participants' inner conditions such as by being given directions about the importance of parental treatment of children ranging from speech and similar activities.

Stimulus given varies from relaxed conditions to find out the condition of the heartbeat when the participants feel relaxed until when participants overflow emotions such as

sadness. The process when collecting data can be seen in Fig. 14.

Fig 14 Data collection process

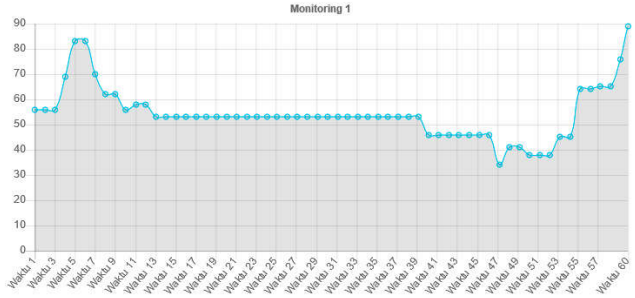
4. Data Collection Results

The data collected in this study consisted of three data collection sessions, the first session when the situation was relaxed, the second session when the circumstances were normal and the third session when the emergence of excessive emotions such as sadness.

Due to the use of devices that are designed to be attached to the wrist, the actual effectiveness of the MAX30100 sensor located on the fingers makes the sensor's performance not optimal. When the data is taken, participants' activities such as when taking data relax there are some hand movements so that the sensor reading process is slightly disrupted which causes the data to be invalid. Some of the results of data collection can be seen in fig 15 which consists of fig 15 (a) during normal conditions 15 (b) when relaxed and 15 (c) when emotions overflow. The results were taken from one of the participants by taking data in a span of 1 minute and measured per second.

From the results shown in fig 15 there are several parts when data collection is drastically increased because when data is taken there are disturbances such as activities carried out to obtain the desired conditions.

(a)



(b)

(c)

5. Implementation and Results

From the obtained data and some research that has been done [10], [23] measured heart rate reaction between the normal heart rate condition seen in fig15 (a) and the measured heart rate condition seen in fig 15 (c) when in a sad condition, showing quite relevant results, where the heart rate at the time The measured normal condition is 55 -70 BPM and when in a sad condition it is measured 40-90 BPM by taking into account the initial condition when the sad state is under normal conditions which is <55 BPM. This is relevant to some references[10], [23] that if a person is in a sad condition then the heart rate will slow down.

With the results obtained when viewed from a system developed for a wireless communication system the results obtained are quite good with a data transmission time span of 1 second each data transmission. When the data collection process takes place, if all devices are run simultaneously and send data to the server in real time, the load received by the server as a receiver will increase which causes the process of displaying data on the server interrupted. This can be overcome by replacing the server device, especially in the data storage section with better devices such as the use of Solid-State Drive (SSD) on the server. When viewed from the data collection process, the results obtained are still not optimal due to problems such as disruption of the data collection process when participants do activities.

V. Conclution and Sugestions

The design of a wireless communication system for monitoring heart rate in the detection and intervention of emotional regulation can be built by taking into account several aspects including disk speed on the server and hardware design which is more convenient. The disk on the server is preferred to have good performance to support multi-client processing during the data collection process.

. From the results of testing, the system designed the process of sending data goes well where of the 20 devices that send data all of that can be sent properly with a time interval of 1 second but for the sensor reading process some problem need to be solved such as interruptions in the data collection process when participants doing activities and some constraints on the choice of devices used on the server.

The suggestion for the next improvement is to evaluate the design of the device to be used and its placement so that the data collection process can be optimized.

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