Visualization of measurement of heart rate, oxygen saturation in blood and body temperature with a non-invasive method

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Abstract. Visualization of the measurement results of magnitude is a matter that will facilitate us in understanding the measurement results. Visual media is more interesting to most people than text media. This study aims to design and create an application system based on GUI (Graphical User Interface) that can display the form of heart rate waves, oxygen saturation in the blood, and body temperature. The measurement information is computed to produce a decision stored in the database. From the test results, the system can display the waveform of heart rate, oxygen saturation in blood and body temperature and diagnosis appears.

1. Introduction
The human body consists of various vital organs that are interconnected and have a unique and complex function. The heart as a vital organ that serves to provide oxygen throughout the body and cleanse the body of the metabolism (carbon dioxide). Heart disease is the number one cause of death in the world, so the need for early detection of this disease. The pulse can be measured at any point on the body where the vibrations in the arteries are sent to the surface frequently when it is pressed against a structure that lies beneath such a bone [1]. Pulse oximetry is a non-invasive method for measuring the percentage rate of hemoglobin saturation. This method uses the different wavelengths of red light (660 nm) and infrared light (940 nm) captured by the detection sensors after passing through the veins and capillaries at the tip of the index finger [2]. Pulse oximetry serves to manage long-term patients with oxygen therapy and to identify patients with congenital heart disease. Pulse oximetry has a high accuracy for detecting congenital heart disease in newborns [3].

Photoplethysmography is an optical technique of detecting cardiovascular pulse waves (heart) from the fingertips. By exploiting optical sensor reflection then warming the area around the skin, this is evidenced by the increasing beats component of photoplethysmography [4]. The design of monitoring of integrated signal monitoring system on a platform of the system on chip (SoC) and wireless technology in hospital with monitored parameter is ECG and body temperature then processed using microcontroller. Results from data processing are sent to the webserver using wireless communications [5]. Detection of beat pressure (pulse) is an integration of most analytical techniques for arterial blood pressure (ABP), intracranial pressure (ICP) and pulse oximetry signals (SpO2). Pulse detection is used to estimate heart rate in ABP signals, to classify ICP morphology and to estimate blood pressure using pulse oximeter wave [6]. The use of sensors in e-health platforms connected to Matlab can display visually the quantities measured by the sensor, such as body temperature [7]. The
voltage changes or fluctuations detected by infrared LED mounted on the fingertips can be used to determine the heart rate [8]. Therefore, medical record media of heartbeat, oxygen saturation in blood and body temperature are computationally computed and study of observation approach of health condition of body without any surgery or physical or non-invasive, and is expected to prevent human death due to abnormalities heart early because of the less than optimal medical record and responsive.

2. Materials and Methods

2.1. Materials
Heart rate sensor and oxygen saturation in blood, body temperature sensor, Arduino Board Due, PC (Personal Computer), MULTISIM® software, BASCOM® SIMULATOR software, Matlab software, MySQL and Database Application, and Visual Basic 6.0.

2.2. Methods
Acquisition of data from heartbeat sensors, oxygen saturation in blood and body temperature placed on the fingers, presentation of measurement data on computer media that apply visual orientation and storage of database system, then by analyzing work characteristics and suitability of each component supporters of the design idea obtained the initial design of a stable and optimal in terms of mechanical, electronic and ergonomic (Figure 1 and 2).

![Figure 1. Block diagram of the system](image1.jpg)

![Figure 2. Visual design](image2.jpg)
3. Results and Discussion

A system is a form of visualization of the results of measurement of heart rate, oxygen saturation in blood and body temperature. This tool consists of heartbeat sensors, oxygen saturation in blood and body temperature mounted on the fingers. The signals that the sensor captures are further amplified and processed by the microcontroller.

Furthermore, with the device GUI (Graphical User Interface) Matlab data measurement results are displayed on the monitor screen. In addition, the data measurement results are also compared with the database that has been stored, so that from the measurement data results appear diagnosis. Table 1 shows the results of system testing of twelve respondents with sex and age varying.

| No. | Respondent   | Sex | Age (years) | Heart Rate (BPM) | SPO₂ (%) | Temperature (°C) |
|-----|--------------|-----|-------------|------------------|----------|------------------|
| 1   | Respondent 1 | Male| 48          | 82               | 98       | 32               |
| 2   | Respondent 2 | Female| 12        | 81               | 99       | 34               |
| 3   | Respondent 3 | Female| 54        | 82               | 97       | 35               |
| 4   | Respondent 4 | Male| 59          | 81               | 94       | 35               |
| 5   | Respondent 5 | Female| 5          | 94               | 98       | 35               |
| 6   | Respondent 6 | Male| 45          | 80               | 98       | 30               |
| 7   | Respondent 7 | Female| 34        | 93               | 97       | 34               |
| 8   | Respondent 8 | Male| 6           | 84               | 97       | 35               |
| 9   | Respondent 9 | Male| 9           | 84               | 97       | 35               |
| 10  | Respondent 10| Female| 16        | 83               | 97       | 35               |
| 11  | Respondent 11| Male| 25          | 85               | 96       | 35               |
| 12  | Respondent 12| Female| 25        | 82               | 97       | 36               |

Figure 3 shows the view of a patient’s biodata whose registration number, name, date of birth, sex, address, age, and other information are required. Biodata is stored in the database and one day can be changed if there are data changes.

Figure 3. View of patient’s bio data
Figure 4. Visualization of measurement results

Figure 4 shows the visualization of measurement results of heart rate, oxygen saturation in blood, and body temperature. The apparent heartbeat waveform shows a voltage of 48.876 mV and a time of 74.07 mS. If converted to frequency scale to 13.52 Hz.

Figure 5. Visualization of diagnostic results

Figure 5 shows the diagnosis arising from the measurement of heart rate, oxygen saturation in blood and body temperature. The result of the diagnosis is a reference for medical personnel (doctors) to determine further treatment.
4. Conclusion
From the test results can be concluded that the system is able to work in accordance with the planned, the system can display the form of heart rate waves, oxygen saturation in blood and body temperature. The measurement data is stored in the database so that it will produce an appropriate diagnosis.

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