The Heart Attack Detection by ESP8266 Data Communication at a Real Time to Avoid Sudden Death

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Abstract. The problem Heart attack is one of the causes of death at this time. A person may not realize that he suddenly experiences an improper heartbeat so that a sudden heart attack can result in sudden death. Usually a traditional heart rate calculation has been done using hardware such as oximeters or electrocardiogram devices. Although this device has a reliable method for normal users, the use of this device takes a long time to carry out the inspection process. In this paper, we propose a method that can detect heartbeats that are detect directly and can be shared to several telephone numbers of family users, hospitals, paramedics, or private doctors. We developed an internet of thing method that integrates a pulse sensor, microcontrollers and Wi-Fi series data communication device modules ESP8266. The detection of pulse sensors attached of the patient's body (users) and the microcontroller will be sent in a real time by the ESP8266 circuit module to the several smartphone numbers that have been set it before. The result and benefit of this method is that the patient (user) can be helped immediately if there is a heart rate abnormality, because of the heart rate detection results will spread to the several other people so that the patient (user) can be helped immediately before the condition becomes more fatal.

1. Introduction
The heart attack is also known as myocardial infarction occur when there is a reduced or blockage of blood flow to coronary artery for a period of time leading to myocardial ischemia. This results in a heart attack which can lead to death. In recent years, technology has been used for health care [1]. This technology is based on various types of devices, such as, embedded environment, personal devices such as cellphones, tablets, etc. Many patients use this device [2]. According to the World Health Organization (WHO), the main cause of death in the world is Cardio-vascular Disease (CVD), almost representing all global deaths. Around the world very many people die of heart attacks or strokes every year [3]. Sudden death from someone who has a heart attack often occurs because they do not know that the pain is due to a heart attack. Most people consider heart attack pain as a pain from several other physical problems such as the stomach. If you know what the pain really is, then we can minimize the victim. The condition of our heart can be measured by heart rate [4].
In recent years, medical technology has developed rapidly by using computer science components. Scientists have developed various devices to detect patients' heart attacks early. There are several basic functions called Vital Signs that can be measured from someone, which shows their physical condition whether the condition is normal or not. Through vital signs, most medical conditions can be diagnosed and confirmed by several special test kits of these signs. Every vital sign is measured using special equipment. There are four vital signs, which become the standard measurements of cardiac indications, including: Pulse rate, respiratory rate, blood pressure, and body temperature.

In medical science, "Pulse" is defined as rhythmic expansion and arterial contraction that describes each heartbeat [5]. Therefore, the pulse is identical to the human heartbeat. Pulse can be measured both in the neck wrist given by beats / minutes. The most prominent points for measuring beats are the fingers, wrist (Radial artery), neck (carotid artery), inside the elbow (Brachial artery), behind the knee (Popliteal artery) and ankle joint (Posterior tibia artery). If the pulse is higher or lower, it indicates an abnormality in the body [6].

2. Related Work

There are several works in the literature relating to heart disease, Heon Gyu Lee et al proposed a technique for developing multi-parametric features with linear and nonlinear characteristics of HRV (Heart Rate Variability). This technique uses HRV characteristics with several experiments carried out to assess several classifiers, such as SVM (Support Vector machine), CMAR (Classification based on Multiple Association Rules) [7] etc.

Another work is the Mobile Stethoscope application available on smart phone devices. Apple Computer, Inc. develop a moving stethoscope. It records the sounds of the heart, lungs and intestines. However, it cannot detect the heart condition of the human body. Other scientific works also try to use Fuzzy logic [8], to solve the problem of control system methodology. Fuzzy logic is useful in expert systems that can diagnose human diseases and can make predictions.

In addition, Health-Smart has developed a breathing exercise application that can help patients practice breathing properly. Common pulse oximeters are based on different light-absorbing characteristics of oxyhemoglobin and de-oxyhemoglobin at two different wavelengths (i.e., 660 nm red and 940 nm infrared) and pulsating properties of arterial blood flow [9]. With pulse oximeters, finger probes are used in red light emitting diodes (LEDs) and infrared LEDs are located on one side of the probe, and photo detectors are located on the other side [10]. The transmitted light is received by the photo detector and is divided into two components. Component A is transmitted light from variable intensity that occurs during systole and is a function of oxygenated arterial blood pulses. Component B is transmitted light that has a constant intensity and is a function of various networks. The pulse oximeter divides the pulsatile absorption of component A by absorbing the background light of component B, at two different wavelengths, to obtain the absorption ratio and calculate oxyhemoglobin saturation [11].

3. Proposed Approach

3.1 Diagram Block

Based on Figures 1 and 2 are diagram block and circuit schemes of detecting and controlling heart rate.
Figure 2 is the module of the ESP8266 circuit which is a media interface for data communication between the Arduino Uno Microcontroller and the smartphone in a real time, with a brief description as follows:

a) Pulse the sensor is a sensor to detect heart rate disturbances that will be forwarded to the Arduino Uno Microcontroller;

b) Arduino Uno Microcontroller, functions as a controller processor which is accommodate heart rate detection results by pulse sensors;

c) The module of ESP8266 circuit is a media interface for the data communication modules from the microcontroller to the smartphone in a real time. This tool uses WiFi connectivity as a tool to connect to the internet, and then connects to the Thingspeak.com as a data container;

3.2 The Circuit Scheme of Heart Detecting

The design consists of 2 main parts namely the design of hardware systems, and design of software systems. The hardware circuit is shown in Fig. 3.
In this study, we use the pulse sensors integrated to the Arduino Uno microcontrollers and the detection results are sent in a real time to the smartphone, as in Figure 3, through the following stages:

a) Install the pulse sensor by connecting it to the user's finger;
b) Turn on the device installed in the user's hand;
c) Turn on the WiFi router used by the tool;
d) Run a device application that has been installed on an Android smartphone;
e) Fill in the information requested on the Android Smartphone application;
f) Automatically the user will see the results of heart rate detection on an Android smartphone;
g) The pulse sensor and ESP8266 circuit will continue to work even if the Android application is turned off;
h) The tool will turn off if the user releases the device from his hand.

By figure 1, we can see the procedure performed on the Arduino board program design is for sampling, filtering, counting and output. Sampling collects signals by pulse sensor. Filtering is to reflect the pulse waves in the arteries. Finally, the result of pulse sensor detection be received by the microcontroller and forwarded by ESP8266 to the smartphone.

4. The System Test and Result

4.1 The Arduino Uno Software

The Arduino Uno program module is built using the C programming language and the Arduino’s compiler. The .ino extension program file is then inserted into the Arduino Uno microcontroller via a MINI USB cable. The following fig.4 is a screenshot of the making of the Arduino program.

Figure. 4 The Screenshot of Arduino Uno Program Module
4.2 C-BPM Results
Figure 5 shows an example of the C-BPM (Count-Beat Per Minute) results of pulse sensor detection in a real time on a smartphone monitor. The smartphone monitor can display the value of heart rate, pulse wave, time between heart rate and heart rate curve. The smartphone will give the warning if a heart rate is in an emergency situation, so it can to avoid the users from sudden death.

![Figure 5 Result detection Platform](image)

4.3 Testing with normal and abnormal conditions.
In this test, the tool will be detected in normal and abnormal conditions. The results is shown in the table 1, and in the Figure.6

| No. | Normal Condition  | Abnormal Condition  |
|-----|-------------------|---------------------|
| 1.  | 95 beats per minute | 120 beats per minute |
| 2.  | 88 beats per minute | 115 beats per minute |
| 3.  | 89 beats per minute | 117 beats per minute |
| 4.  | 93 beats per minute | 108 beats per minute |
| 5.  | 91 beats per minute | 119 beats per minute |

![Figure 6 The Results of detecting in normal and abnormal condition](image)
From the test results, it is found that when in the abnormal conditions, the heart rate count is more than when the user is in normal condition. If the heart rate condition is detected abnormally by the pulse sensor, the results will be seen on the smartphone monitor and the smartphone will generate a warning sound automatically.

5. Conclusions
Based on the discussion and the results of the research above, it was concluded that the data communication with the module ESP8266 circuit managed to connect the microcontroller with the smartphone in order to transmit the data from the detection of heart rate in a real time. The heart rate detector that is built can be used anywhere as long as it has WiFi connectivity. The use of Pulse Sensors as a heart rate detector has been successfully carried out as well as connected to a microcontroller. Pulse Sensor has very sensitive characteristics, so it is good to be used as a tool to detect heart rate. By this tool, the smartphone can continuously monitor in a real time the conditions of the user, we hope can to avoid death caused by sudden heart attacks.

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