INNOVATION FOR THE PREVENTION OF DEATHS AT ATTACKS TO THE HEART THROUGH THE DETECTION EARLY ALTERATIONS IN THE HEART RATE

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ABSTRACT

The following paper focuses on the implementation of a technological innovation, which through a microcontroller like arduino, and adapters for this, both Wi-Fi and heart rate sensor, can be established the heart rate of a person, and that he can,

When the number is different from the range established by the World Health Organization (OMS) as normal generate a notice and I sent it through the Wi-Fi network, either to a doctor personnel, or in general, to anyone who can act early in front of the possible heart attack that is happening.

KEYWORD: Heart Rate, Microcontroller, Arduino Modules, Pines Output & Tachycardia.

Received: Oct 13, 2020; **Accepted:** Nov 03, 2020; **Published:** Nov 11, 2020; **Paper Id.:** IJMPERDOCT202049

I. INTRODUCTION

Cardiology is one of the medical specialties of greater development in recent years, mainly in your diagnostic areas; however, it still turns out paradoxical that people continue to die for heart disease, being the main cause of death in the world. Family history, new consumption habits and lifestyles, as well as stress add to the factors of risk to have cardiovascular problems.

Therefore, today it is so important to bet on habits preventive and go to routine diagnostic tests to detect the disease early. A resting cardiac index for adults ranges from 60 and 100 beats per minute. It is important to know if the rhythm cardiac is normal, a heart rate too high or low may indicate a health problem underlying. [1]

Tachycardia is a condition when the heart rhythm it is faster than normal. Tachycardia is not an immediate danger to most people and cannot cause health complications however, you can interrupt the normal functions of the heart, which increases the risk of stroke or cause a sudden cardiac arrest. Bradycardia is a condition when the heart beats slower than normal.

Bradycardia can be dangerous if the heart is not pumping enough oxygen throughout the body. In some people, bradycardia will not cause complications Pacemakers can help hearts with low rates to maintain a heart rate normal, according to Mayo Clinic.

It is due to this problem that the intention is to create the prototype of an intelligent handle; this in order to help control the rhythm of the heart and warn if that this is affected. This handle will detect changes in the person's

organism such as the rhythm cardiac, which allows by studying this data; determine what is happening in determined situation. Once it is verified that the cause of the changes in these variables taken by the handle, this same will proceed to carry out the sending of the data, to entities that these cases merit, as well as the doctor in charge of the patient, or a special line of emergencies.

II. PREVIOUS STUDIES

2.1. Application for Frequency Monitoring Cardiac

In this article the application is shown in detail to carry out the heart rate measurement. This system is developed using a bracelet from the My Global company known as Mine Link, for take the data that is sent through Bluetooth communication to a Smartphone device with the previously installed application, this is responsible to take the management of a database with the values taken, plot them, compare them with the values of normalized heart rate and send an alarm by a text message informing of any abnormality. [2]

2.2. Technological Innovation Applied to Monitoring of Arrhythmias

The article defines the changes that it has found over the years, the way in which rhythms are calculated cardiac procedures and the various devices generated for this. This article is cited because talks about the Holter registration systems, used currently by the sensors that are used for the heart rate measurement. [3]

2.3. Development of a Wireless Monitoring System for Biomedical Signals

This article deals with the stages of acquisition, processing and transmission via wireless to a remote station of a similar biomedical signal as the heart rate, to be studied in doctors or health personnel. This work benefits patients who are in places distant or difficult to access, also has applicability in athletes that require that they be monitored for physical performance analysis. For this document, capture those signals and transmit them, will allow us to give notice to the authorities of that an act of aggression against the woman. [4]

2.4. Design of a Wireless System for Monitoring Ambulatory Patients, Using Sensors from Blood Pressure and Heart Rate and Implementation of a Test Prototype

The project develops a system that allows monitor blood pressure and heart rate of patients' ambulatory through a prototype that performs measurements automatically. The need for a continuous control to delicate patients of health constitutes the starting point of this project. He proposes a solution through the use of telecommunications, specifically communications wireless, due to the fact that scenarios have been promoted for a great development of these technologies in areas of health and medicine. [5]

2.5. Study of the heart rate of the soccer player professional in competition: an explanatory model from the context of the game situation

Many of the studies reviewed raise a type of analysis limited to effort quantification physiological, depending on the heart rate, linked intimately to the physical effort, dismissing the context of the gaming situation that took place in said effort. In this sense, our goal is to deepen the study of the behavior of the heart rate of the professional footballer in competition, focusing on identifying the criteria that can play a more relevant role within the context of the game situation where the player professional presents a marked increase in their heart rate values [6]

2.6. System for Heart Rate Monitoring Through Smartphone

There are a lot of people in the world who, unfortunately, they suffer from cardiovascular diseases and would benefit from continuous monitoring of their cardiac constants. This project intends to present a preliminary solution making use of the currently generally extended Smartphone and plates based on microcontrollers for that purpose. As well opens a line of possible extensions, all of them focused on the user's cardiac well-being. [7]

III. IMPLEMENTATION

3.1. Reception

The first step is to open the Arduino Editor, tool online provided by the official website of arduino.cc, from there the programming of the sensor of the heart rate, in addition the plugin must be installed, which allows the recognition of the computer and the compilation in the microcontroller.

```
Archivo  Editor  Programa  Herramientas  Ayuda
Sketch_001.ino
int pulso=0;

void setup() { //configuración inicial de arduino.
  Serial.begin(9600);
  pinMode(A5, INPUT);
  pinMode(11, OUTPUT);
}

void loop() { //repite infinitamente.
  pulso=analogRead(A5);
  if (pulso>=513){
    digitalWrite(11, HIGH);
    delay(30);
    digitalWrite(11, LOW);
  }
  delay(50);
  Serial.println(pulso);
}
```

Figure 1: Basic Configuration for the Operation of the Sensor. Source: Authors

With the configuration seen in Figure 2, and compiling the code within the Arduino UNO, you can already receive the signals received by the heart rate sensor. It is created the variable `int pulse = 0` which will store the information received by the sensor. `Serial.begin (9600)` will start the communication with the UNO Arduino, `pin Mode (A5, INPUT)` will be the input pin, A5 is the physical pin that is going to use. While the `pin Mode` code line `(11, OUTPUT)` will allow the beep with each pulse, such as the machines of the hospital centers work.

The next step is to create the `void loop ()` which is the code that is going to repeat infinitely. `Pulse = analogRead (A5)`, take the value it receives from the pin A5, read the value and store it in the entire variable `pulse`. A conditional is created which will analyze if there is a jump in the heart rate, if this is greater than the 513 value, it to generate the beep and then with the `delay (30)` is the time that will generate the noise. And then it goes back and goes off. To end the `Serial.println (pulse)`; print the information received.

Physically the connection would look like the figure shown then:

Figure 2: Connection between the Arduino UNO and the Sensor Amped Heart Rate. Source: Authors

In Figure 2 we can observe the physical connection between the microcontroller and the Amped sensor, you can observe that the cables coming from the sensor are connect on the pins mentioned in the described code in Figure 1, the A5 and the pin 11.

3.2. Information Management

This stage, everything is developed within the conditional created in Figure 2, it is here that apart from generating the beep when there is an increase in heart rate, it make the mail that is going to be sent to the entity relevant, once this is configured, it only remains configure the communication with the Wi-Fi module.

For him sent the email, it is necessary to have a functioning web server, for this project we generate this:

```

1 <?php
2 /*
3  * URL: http://gihena.com/?p=1000
4  * License: (CC) BY-NC-SA
5  *
6  * Example URL:
7  * http://domain.com/mail.php?key=s7x45tUFRH0tWdName=Arduino&from=arduino@domain.com&to=yourmail@domain.com&subject=Hello&message=This email was sent from Arduino!
8  *
9  * http://domain.com/mail.php
10  * ?key=s7x45tUFRH0tWdName=Arduino
11  * &name=Arduino
12  * &from=arduino@domain.com
13  * &to=yourmail@domain.com
14  * &subject=Hello
15  * &message=This email was sent from Arduino!
16  */
17
18 // Authentication key, required to use this service.
19 define("KEY", "s7x45tUFRH0tWdName");
20
21 // Possible output responses:
22 define("OK", "1");
23 define("ERROR_AUTHENTICATION", "2");
24 define("ERROR_PARAMETERS", "3");
25 define("ERROR_SEND_MAIL", "4");
26
27 // Parameters sent from the Arduino:
28 $key = $_GET['key'];
29 $name = $_GET['name'];
30 $from = $_GET['from'];
31 $to = $_GET['to'];
32 $subject = $_GET['subject'];
33 $message = $_GET['message'];
34
35
36 if (isset($key) || $key != KEY )
37 {
38     echo ERROR_AUTHENTICATION;
39 }
40 else if (isset($name) || !isset($from) || !isset($to) || !isset($subject) || !isset($message) )
41 {
42     echo ERROR_PARAMETERS;
43 }
44 else
45 {
46     echo mail($to, $subject, $message, "From: $name<from>\r\nReturn-path: $from" ) ? OK : ERROR_SEND_MAIL;
47 }
48 ?>

```

Figure 3: Source code of the Mail Web Server. Source: Authors

The web server receives the variables from and sends the mail, each handle is, each microcontroller will be customizable for each person, and so, this data will vary in each Arduino ONE. From the name of the person to the mail to which is directed.

The file will make us Web Service, and to function he needs us to pass certain parameters, all of them obligatory. The first one and the most important is a password without which we will not be able to use the service, so only who knows the password can send emails, our Arduino. The rest of parameters are the related to him sent from the mail: Name of the sender, sender's mail, recipient's mail, subject, and the message.

After the execution of the service we will receive a number which tells us the result of the execution:

- Email sent successfully.
- Authentication error.
- Missing parameters.
- Error sending the mail.
- The next one happened.

3.3. Communication

We already have the heart rate reception, from the sensor to the microcontroller, and the microcontroller already gets the information, process it and generate the mail to send, now the next step is to configure the Wi-Fi module, so that this information can come out, the first step is connect the microcontroller to the module as it is you can see in the figure below:

Figure 4: Physical Connection between the UNO Arduino and the ESP8266 Wi-Fi Module. Source: [8]

IV. ANALYSIS OF RESULTS

After completing the connection process and configuration, the result would be graphically what you is can see in Figure 5:

Figure 5: Graphic Visualization of the Heart Rate in the Computer. Source: Authors

The first step was to configure the microcontroller of such way as seen in Table 1.

Table 1: Heart Rate Reference Values in Men and Women. Source [9]

Men: Reference Values Resting Beats Per Minute				
Age (years)	Inadequate (PPM)	Normal (PPM)	Good (PPM)	Excellent (PPM)
20 - 29	86 or more	70-84	62-88	60 or less
30 - 39	86 or more	72-84	64-70	62 or less
40 - 49	90 or more	74-88	66-72	64 or less
50 o more	90 or more	76-88	68-74	66 or less
Women: Reference Values Resting Beats Per Minute				
Age (years)	Inadequate (PPM)	Normal (PPM)	Good (PPM)	Excellent (PPM)
20 - 29	96 or more	78-94	72-76	70 or less
30 - 39	98 or more	80-96	72-78	70 or less
40 - 49	100 or more	80-98	74-78	72 or less
50 o more	104or more	84-102	76-82	74 or less

So in this way, the microcontroller is configured, in where for the test then if the beats for minute (LPM) are greater than 87 for men and 97 for women, notification and mail will be generated electronic.

The test is performed on 3 different people (men), where the sensor is connected, and left for 10 minutes, and this is done during 3 different times; these are: Being at rest, after having a micro dream, and the third when exposed to a video that your heart rate will increase, the results we can see below:

Table 2: Heart Rate Source Samples

LPM	Repose		Microsleep		TV Program	
	Min	Max	Min	Max	Min	Max
Person 1	58	72	55	58	80	89
Person 2	60	68	55	57	79	91
Person 3	70	72	54	58	83	84

After taking the values, and comparing them with the Table 1, we observe that, on three occasions the value of the beats per minute was higher than the set of 87, it is to say that the microcontroller had to give notice in three occasions, as we can see below:

Figure 6: Receiving Emails after the Test Performed. Source: Authors

As far as can be seen, the test was satisfactory, every time the heart rate was above the levels programmed in the microcontroller, it was generated the respective alarm sent by mail electronic.

According to one of the related studies [7], connect the Arduino microcontroller to a smartphone via Bluetooth connection, unlike the Wi-Fi network what was used.

Table 3: Bluetooth and Wi-Fi Differences

	BlueTooth	WiFi
Frequency	2.4 GHz	2.4/3.6/5GHz
Bandwidth	24 Mbps	1 Gbps
Security	Low	Moderate
Rank	Up to 30 meters	Up to 300 meters
Consumption	Reduced	Elevated

Taking into account that the connection with the same source of energy, it can be evidenced in the below graph the duration of it, with respect to the different technologies used.

Figure 7: Battery Life for a Wi-Fi Module and a Bluetooth Module for Arduino. Source: Authors

As we can see the Bluetooth connector has a shorter battery life than the Wi-Fi module, which would cause greater discomfort because you have to recharge or change the battery more followed than with the module for Wi-Fi.

The connection they make is from Arduino to a smartphone using Bluetooth, what is generated in this case is the Arduino, directly to a web server.

Figure 8: Distance Reaches of the Different Classes of the Bluetooth Modules. Source: Authors

Figure 9: Distance Reaches of the Different Classes of the Wi-Fi Modules. Source: Authors

After analyzing both Figures, and clarifying that the common for Bluetooth devices] are for class 2 and class 3 hearing aids, and for mobile phones middle class 2 and high class 1, that is, in the other study, the person and their microcontroller should be less than 15 meters from the cell phone with the Bluetooth on so that in case of alarm in the often, this can send the information [14]. In the case of the Wi-Fi Network, it has a wider range depending on the connection; the common in homes is the Wi-Fi amplifier that comes along with the modem of the fixed telephony and internet services. In other words, it has greater distance which will allow diminishing possible problems in the sending of alerts.

Figure 10: Effect of Time to Defibrillation on Survival after Cardiac Arrest Due to VF. Source: Authors

When using this device, and according to Figure 10, a prompt attention to cardiac arrest, increases considerably the possibilities of being able to save a person who is suffering a cardiac arrest.

The artifact designed in this article fulfills its function, and is to notify by email, when the heart rate take dangerous values for person, whether very high or very low; however, what that was evidenced in the test is that the frequency cardiac disease can be affected by different factors, which they would not strictly imply a possible heart attack.

At first, we can use the sensor and the microprocessor to receive the information in time real, however for the detection of a heart attack more factors must be evaluated in addition to the rhythm cardiac, because this can be altered not only under an attack of violence, if not under other facts, that cause strong emotions.

So we conclude that in the future, we should take this project and complement it with more devices than make it possible to confirm that an attack, such as temperature sensors, or sensor blows, which are currently entering the market.

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