TELEMETRY BASED MEDICAL MONITORING SYSTEM

SUBMITTED TO THE DEPARTMENT OF BIOMEDICAL ENGINEERING
OF
NEAR EAST UNIVERSITY

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MOHAMMED ABU DAQQA

AHMAD ABDULWAHED

In Partial Fulfillment of The RequirementsFor
The Degree of Bachelor of Science
in
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ABSTRACT

Patients monitoring is one of the major role of the health care staff. This job requires a lot of staff to be achieved which is impossible to be done especially when there is an emergency state with a large number of patients and less staff or even when the patients is in home. Therefore, in this project a biosensor device was designed with a vital signs monitoring system that measures the heart rate, electrical activity of heart, body temperature and humidity, and room air quality. This device is mainly based on telemetry, which is the process of measuring the remote phenomenon using the sensor system, This concept is important because when we take measurements wirelessly it gives us more options to show the measured parameters, so instead of just showing them on a screen near the patient, we can also send it to any other place we want. Here, we will send our measurements wirelessly using Bluetooth. An Android application have been designed to communicates with the device and to show the measured parameters on the phone's screen After the phone receives these parameters, it can send it using internet or a local network whether to the medical staff in the hospital, or to the patient's family in other rooms at home, or even to any other location in the world. This concept is important since the parameters of the patients will be available with the health care staff even they are out of patient room instead of just showing it in a screen beside the patient.

Keywords: Patients monitoring, biosensor device, vital signs monitoring system, telemetry, Bluetooth.

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LIST OF SYMBOLS AND ABBREVATIONS

AQI:	Air Quality Sensor
ECG:	ELECTROCARDIOGRAPHY
LCD:	Liquid Crystal Display

CHAPTER 1
INTRODUCTION

The human body is exposed to many diseases and there are many different conditions that require us to take several measurements of the human body, such as measuring the temperature of the human body and humidity, which enables us to know whether there is sweating or not, we must know the measurement of heartbeat and heart rate and Electrocardiography So that we can make sure that the patient's room is free of any poisonous gases and keep the room air pure so as to maintain the health of the patient from inhaling any toxic gases.

We can take these measurements for many pathological conditions, including diseases ranging from mild illnesses to incurable diseases. We can do this after surgery. We can also make measurements for the patient at home or in the hospital, keeping the patient under full care wherever he is.

Our project aims to design a vital signs monitoring system that measures the heart rate, electrical activity of heart, body temperature and humidity, and room air quality, and sends these parameters wirelessly to a computer, which in turn sends them to the other computers in the hospital through the local network, or views them on the home computer

The device has alarm system that's alerts the medical staff or the family if one of the parameters is more or less than the normal value. This device can be used in hospital, as well as homes and it's affordable, and doesn't occupy too much space and uses the principle of telemetry.

CHAPTER 2
LITERATURE REVIEW

2.1.Circulatory System:

It allows the blood to take all the importantgases and nutrients and other important components to the body to the other cells of all the bodyfor nourished and help assist fight disease and control the temperature of the body and pH of the body and keep good balance.

The system may be taken into consideration a blood distribution network, but we are able to say that the circulatory system must include of the cardiovascular system that distributes blood, and the lymphatic system, which helps in the circulation of the lymphatic fluid. The blood circulation is divided into two parts: the systemic blood circulation and the pulmonary circulation, In the systemic blood circulation passes the blood from the heart to all parts of the body except the lungs then back to the heart and in the pulmonary circulation the blood passes from the heart to the lungs only then back to the heart, the blood is the fluid consists of plasma, red blood cell, white cells Blood, and platelets. The circulatory system in humans is a closed system, meaning that blood never leaves blood vessels, while nutrients and oxygen pass through the layers of the blood vessel to the interstitial fluid, which carries oxygen and nutrients to target cells and carbon dioxide in the opposite direction.

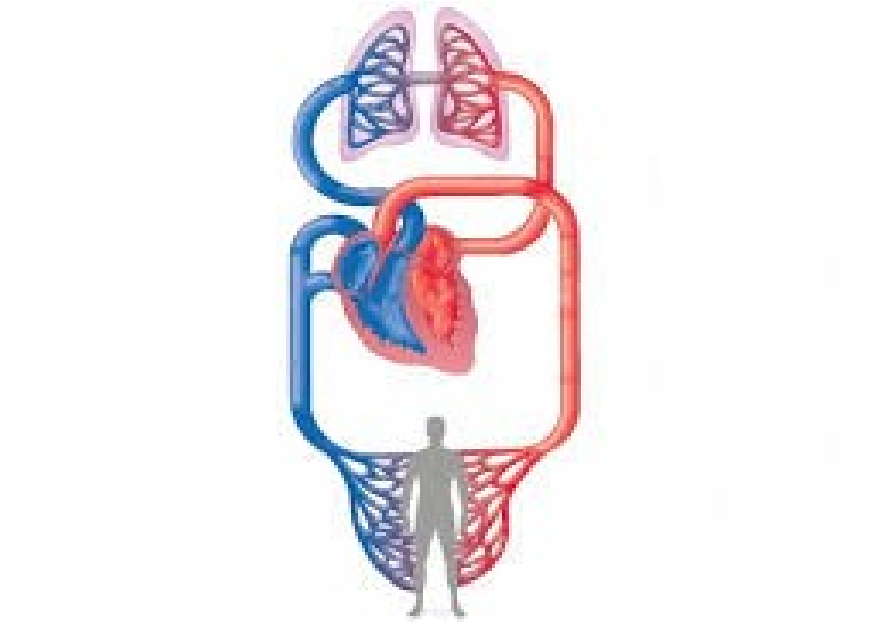

Figure 2.1: Humans blood distribution network

2.2.The Heart:

The heart is a main organ of the human body and it is a hollow muscle in the human and the rest of the animals (fig2.2). The function of the heart is a pump of blood across the blood vessels of the body's various cells to provide them with food and oxygen. It also helps to eliminate the waste from metabolism in the human body. The heart is located in the human body in the bones of the thoracic cage, and the heart is slightly shifted to the left - some may suffer from deformities that cause the displacement of the heart to the right - so the left lung is slightly smaller than the right as a result of the displacement of the heart towards it. The heart is part of the circulatory system Body, or can be considered the center of the circulatory system. The heart in the human body is conical, weighing between 250 to 350 grams in an adult and almost the size of the hand. The heart is also affected by the rest of the body's muscles by exercise; the size, health and strength of the heart increases in athletes and high fitness. The heart in the human body consists of four chambers: the right and left ventricles, and the right and left atrium. The function of the atria consists of receiving the blood coming from the veins, while the two ventricles pump blood to the parts of the body through the arteries. There are also four valves in the heart, Called ventricular valves, and two separate the arteries from the ventricles, called the valves of the crescent, and operate these valves to allow blood to move to one side only without going back to the opposite side.

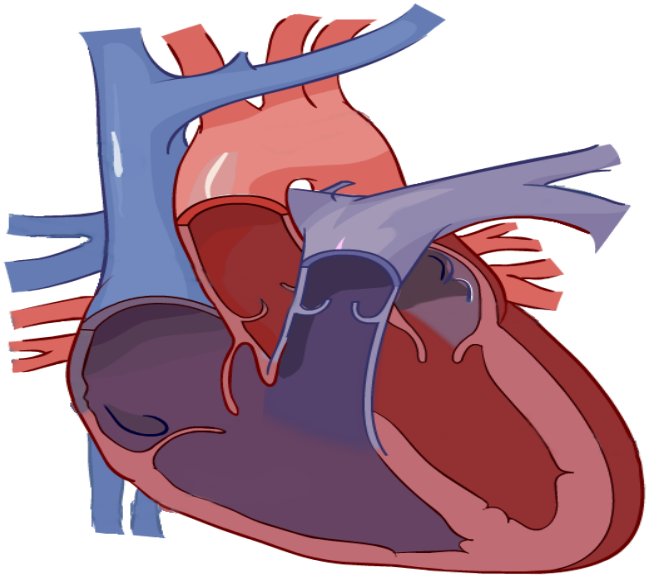

Figure 2.2:The heart in the human body

2.3.Electrocardiography:

Is the device that records the electrical activity of the heart, as the heart produces small electrical pulses that spread through the heart muscle and cause constriction (fig3). These impulses can be detected through the ECG. Doctors are often referred to an electrophoresis test to help determine the cause of the heart. Some symptoms, such as palpitations or chest pain, are sometimes performed as part of routine tests, for example, before surgery. Do not produce any damage or aches due to electrocardiogram test.

The most important functions of ECG:

4. How fast the heart beats
5. Check the rhythm of the heart rate
6. Check the strength and timing of electrical signals and their passage from each part of the heart

2.3.1. When Is ECG Performed?

The doctor can perform ECG in the clinic to quickly find out some heart problems that may need rapid intervention. Among the most important symptoms that the doctor can use ECG are:

1. Chest pain
2. Irregular heartbeat and strong heartbeat
3. Having breathing problems
4. Fatigue and weakness
5. If the heart works abnormally when the doctor listens to his pulse
6. Cardiology can be used to diagnose some heart diseases

Figure 2.3:ECG device

The ECG appears in the form of a graph consisting of several small and large waves with specific measurements and any abnormalities in the normal function of the heart muscle that the doctor can diagnose through a difference in planning measurements. The drawing begins with a small wave (P) resulting from the removal of the atrial fibrillation (constriction). This continues in 80 parts of a second that is shaped as a small plateau that does not naturally rise more than one square. Followed by a large wave (QRS) resulting from the removal of the polarization of the ventricles (constriction), which lasts for 100 parts of the second is a sharp peak up to four squares. Another wave shown in the intact heart muscle layout is a small (T) wave similar in shape and wave size (P) showing the result of re-polarization of the ventricles (extrusion).

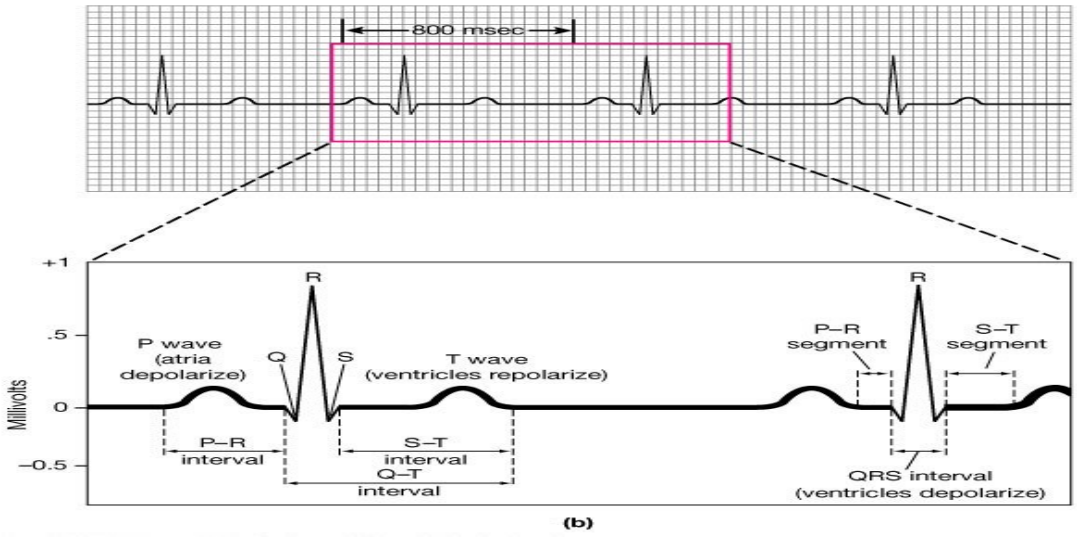

Figure 2.4:Result of ECG as graph form

The ECG is performed by connecting the electrodes of the device to the four sides of the patient while lying on its back in a state of calm and relaxation and connecting 6 other electrodes to certain points on the patient's chest as follows: (fig2.5)

The patient is connected to the device accurately and to improve the delivery of electricity from the body of the patient to the device can wipe the patient's skin wet cotton or put a small amount of gel designed for planning devices and any radio or mobile phone should be removed and the removal of anything metallic on the patient's body such as clock and jewelry.

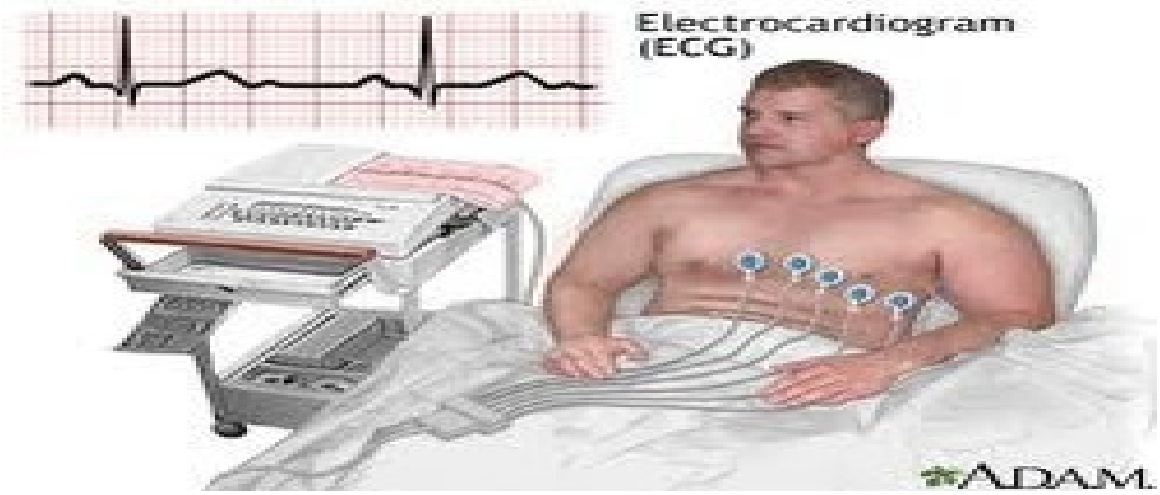

Figure 2.5:The connection between human body and device

2.4.Temperature

The temperature of the human body at unsatisfactory natural rates is about 37 degrees Celsius if measured under the tongue of the mouth, but if measured from the anus, the normal temperature is 37.5 degrees Celsius, and must keep the thermometer in the mouth or anus for Two minutes until the correct reading is taken. The body temperature in the evening is often higher than in the morning, and the average temperature of the body is at 6 am, especially in young children, approaching 37.6-36 degrees Celsius. While the highest is at about 6 pm, approaching 37.6 degrees Celsius. If the temperature is higher than 37.8 degrees Celsius from the mouth or 37.2 degrees from the anus, this means that the temperature is above normal, known as fever.

The hypothalamus or the hypothalamus region of the brain is responsible for regulating temperature in the human body. It acts as a balancing function between the loss of heat from the surface of the body and the production of heat from within the tissues of the body's muscles and liver area, Equivalent temperature of 37-38 ° C in the normal state of the body.

Symptoms of high temperature

1. Feeling hot, hot and chills also.
2. Feeling thirsty and dehydrated, unwilling to eat.
3. The temperature rises to above 37 ° C and has been up to 42 ° C.
4. The causes of high body temperature vary. It may be mild and transient, and it is cured after a short period without any side effects.
5. It may be an indication that you have another disease, and you need a lot of treatment to get rid of it.

2.4.1. Temperature Sensor Types:

- Thermistor

Is a device that changes its electrical resistance according to degreeheat. These sensors usually consist of a mixture of two or three types of metal oxide and are coated from the bottom with a ceramic layer and come out. Of which two lead wires are installed into a layer or semi-tanker, then covered with epoxy resin or a layer ofthe glass.

There are two different types of thermistors:

1- Negative cathode (NTC)
2- Positive cathode (PTC)

- Resistance ThermometerDetector (RTD)

An RTD, also known as a resistance thermometer, some materials have the potential to change their resistance to temperature change. This resistance is used as a temperature sensor with a PTC and the temperature change will be linear. This makes the RTDs a precise instrument for measurement and is connected to the control circuit, where resistance is placed within a bridge circuit. Changing the resistance as the temperature changes the output of the bridge circuit changes in proportion to the temperature.

- Thermocouple:

One of the common tools for thermal measurements in industrial applications consists of two different metals welded together at one end (the measuring link). When the welded link is heated or cooled, an electric voltage is generated between the other ends. After this voltage is amplified using a magnifier, It is observed that the output voltage of Vout is between the reference voltage (cold) J 2, which is known as the temperature, the voltage of the measuring link (hot) (J 1) is required to measure its temperature, and the signal is amplified Using my amplifier because the output voltage is in mille-volt order

2.5.Humidity

Humidity the term describes the amount of water vapor in the air. The humidity varies according to the temperature and the pressure of the air. The warmer the air, the greater the amount of water vapor it carries, and when the air contains the maximum amount of water vapor that can be carried under certain temperature and pressure, Water vapor saturation.

In the summer, humidity affects people. When relative temperature and humidity rise, most people feel uncomfortable and viscous because their sweat does not evaporate. Many people use air conditioners and humidifiers in summer to rid the air of water vapor.

In the winter, the warm air inside the buildings is dry, and the relative humidity inside can be reduced to a very high degree. These conditions can cause dry nasal sinuses and other health problems. As a result, people often use humidifiers in winter to spread water vapor Air.

CHAPTER 3
MATERIALS AND METHODS

3.1.The Aim ofthe Project:

This projects aims to monitor multiple vital signs for patients whether the patient is in the hospital or at his home. The vital signs we will measure include temperature, humidity, heart rate, electrical activity of the heart, and air quality.

Our project is mainly based on telemetry, which is the process of measuring the remote phenomenon using the sensor system, the measurement result is converted to digital data and transferred to the analysis place to be processed and used. This concept is important because when we take measurements wirelessly it gives us more options to show the measured parameters, so instead of just showing them on a screen near the patient, we can also send it to any other place we want. Here, we will send our measurements wirelessly using Bluetooth, which is a good method for our project, since it can communicate with computers, mobile phones, and even another device like our device. We have also designed an Android application that communicates with our device and shows the measured parameters on the phone's screen After the phone receives these parameters, it can send it using internet or a local network whether to the medical staff in the hospital, or to the patient's family in other rooms at home, or even to any other location in the world.

Since our project takes many parameters into consideration, it can be used to a wide range of patients, not only these who are suffering from a particular disease or disorder, but also those who are recovering from surgery.

3.2. Working Principle:

We have a microcontroller and we connect it sensor we are using first a humidity and temperature sensor so we connect this sensor to microcontroller and we will place this sensor on the patient body on the place that we can measure the temperature with an accurate result .like on the neck.

We will also design an oximetry will design it by ourselves, and we will also connect on ECG model that we connect it to the patient body, appropriate that with the standard connection of the ECG to show the heart rate and finally we will connect air quality sensor and we will put it near

the patient to measure air quality of the room and these will detect some signals and this signals will go to the microcontroller.

we will program the microcontroller to deal with the sensor and calculate them and then and output the results, these results will be send wirelessly and we will use wireless communication a Bluetooth module and this Bluetooth module will send the signals that we have measured to phone using an android application that we have designed, this application will take the data and distribute it to medical staff.

We will program Arduino to make the calculation and we will do the connection and we will connect also the power supply to supply to all components.

To make our design more solid and reliable, we got rid of the breadboard and all the wires that were taking a lot of space from the design. Instead of that old design, we brought a prototyping PCB, and drew the circuit of our design on a paper, then we copied this design on the PCB but using connections, and soldered all the components on that very small PCB, in a way that they can be easily removed and attached again. The PCB with all the other sensors have the size of one Arduino UNO board, and they can be connected to it as a shield, and connected to a small battery to be placed on the patients shoulder

3.3. The Materials:

1. Power supply: which supply the electrical components of our project with power.
2. Microcontroller: which controls the signals obtain from the sensor and send the output to the Bluetooth module.
3. Humidity & Temperature Sensor: which measures and reports the relative temperature and humidity of the patient.
4. Air Quality Sensor: which tells you how clean or polluted your air is, and what associated health effects might be a concern for you
5. Android Application: is designed by us to receive the parameters and show them on the screen.
6. ECG Module : to recognize and record any electrical activity within the heart
7. Bluetooth modules: will send the signals that we have measured to computer, this computer will take the data and distribute it to medical staff.

3.4. Components:

3.4.1. Power Supply:

Supply all the components of our device with power specially the microcontroller which need power supply that is higher than 5 volt so we will use 9 volt battery because Arduino has voltage regulator inside it so we don’t need to regulate the voltage by ourselves and other component will have a regulated voltage coming from Arduino by using the power supply which is 9 volt to Arduino.

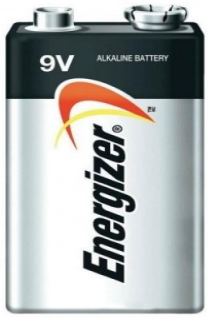

Figure 3.1: Electric circuit of power supply produced

3.4.2. Microcontroller:

The microcontroller is the main component of the device, because it is responsible of processing and storing the signals. Here we are using Arduino UNO microcontroller. The reason of using it is because it is an open source software and hardware, and it's cheap, easy to use, and easy to program. The uploaded program is written with C, which controls the signals obtain from the sensor and send the output to the Bluetooth module.

Figure 3.2: Microcontroller Arduino Uno

3.4.3. Humidity & Temperature Sensor:

The RHT03 (also known by DHT-22) is a low cost humidity and temperature sensor with a single wire digital interface. The sensor is calibrated and doesn't require extra components so you can get right to measuring relative humidity and temperature.We connect this sensor to microcontroller and we will place this sensor on the patient body onthe place that we can measure the temperature with an accurate result .like on the neck

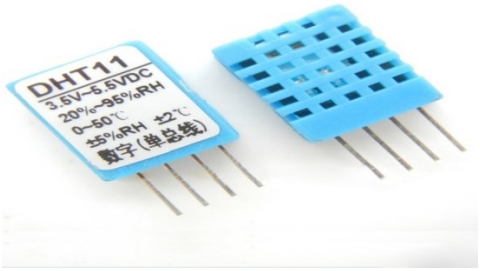

Figure 3.3: Humidity & Temperature Sensor

3.4.4. ECG Module :

We are using an ECG module which is designed to be connected to microcontrollers, such as Arduino, which we are using in our project. It has disposable electrodes attached directly to the chest to detect every heartbeat. The electrodes of ECG sensor will convert the heart beat to electric signal. It's very light, slim and accurate to measure the electrical activity of the heart. Electrodes of ECG module have 3 pins. The cables plug-ins are male audio jacks which will make the cable easily inserted into the amplifier board. We can also choose the type of measurement of the electrical activity of the heart.

Figure 3.4: Electrodes of ECG sensor to attached

3.4.5. Air Quality Sensor:

Is an index for reporting daily air quality? It tells you how clean or polluted your air is, and what associated health effects might be a concern for you. The AQI focuses on health affects you may experience within a few hours or days after breathing polluted air. They can be used for both indoor and outdoor environments. These sensors can be built at home, or bought from certain manufactures.

Figure 3.5: Air Quality Sensor

3.4.6. Android Application:

We have designed an Android application that communicates with our device and shows the measured parameters on the phone's screen. The app is designed using the website "MIT App Inventor", which is a service provided by Massachusetts Institute of Technology. It has a very easy platform to use, with already written codes that the programmer only has to select between them. The designed app shows the values of temperature, humidity, heart rate, and air quality, and it has also a button to connect to Bluetooth

3.4.7. Bluetooth Module:

An Android smartphone, a Bluetooth transceiver, and an Arduino. HC 05/06 works on serial communication. The Android app is designed to send serial data to the Arduino Bluetooth module when a button is pressed on the app .

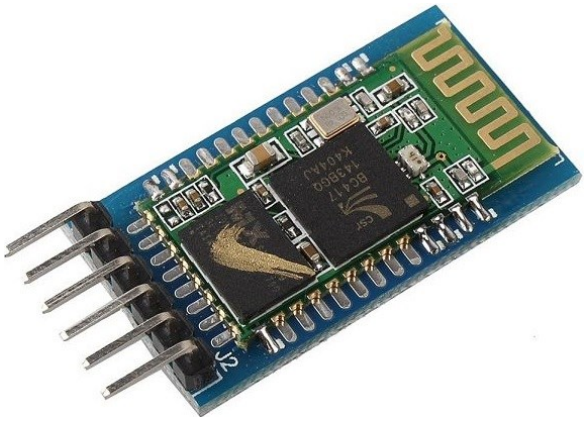

Figure 3.6: Bluetooth Module

CHAPTER 4
DISCUSSION

4.1.What New In Our Project:

This project combines four sensors in one device so it will be easier to use and will be very efficient and we are also using telemetry which is wireless communication so we can take wireless communication so we can take wireless measurement from the body and we are also sending this parameters and results to all people that are concerned with him like a doctor and nursing and medical stuff.

4.2. Advantages of Our Device:

1. It combines 4 sensors in one device.
2. It use the principle of telemetry which is wireless measurement.
3. It can be uses by the patient or his family, very easily and doesn't required experience.
4. It can inform to everybody thatit’s relative to the patient with all the parameters.
5. It's cheap and it can be available by everybody.
6. It comes with android application which makes it easy to use.

4.3. Disadvantages of Our Device:

Some of the measurement may not be very accurate because we are use cheap sensor.

4.4. Development of the Future

1. We can calibrate our sensors and use more advance sensors to get better results.
2. We can use WiFi instead of Bluetooth for better transmission.
3. We can show a graph of the heart electricity on the application.
4. We can show a graph of the heart electricity on the application.

CHAPTER 5
CONCLUSION

We Conclude, that we can design and create a device very cheap that anyone can afford, and our expectation it will spread in the world so fast and will be recommended from hospitals and doctors to stay alert to the patient healthy.

In addition, this device that we created in our project is very simple to use and nothing complicated as far as we can tell just small paper of instruction with simple drawing as user manual is enough to make the user is expert about the device.

Furthermore, during our researches and in fixing the devices it is quite simple and few electronic device connected to each other can make great medical device that can save many people life and help them get best cure.

Finally, the future of medical care will make huge difference in saving peoples life and make scientist searches easy in noticing the changes of human body and how it vary from century to another. It makes us ask many questions, like is it possible that scientific movies as fairy tales in past is now more possible to make.

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