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ECG Generation Using IoT Based System

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Abstract— ECG is one of the techniques to measure the heart's rhythm of the person. It helps to diagnose and monitor conditions affecting the heart. It can be used to investigate symptoms of a possible heart problem, such as chest pain, palpitations (suddenly noticeable heartbeats), dizziness and shortness of breath. With the help of AD8232 heart monitor sensor it is possible to generate an ECG.

Keywords—ECG (Electrocardiogram), hearts rhythm, palpitations, heart monitor sensor.

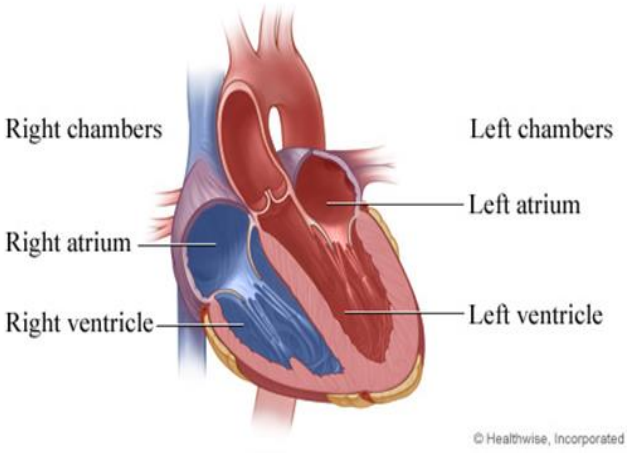
I. INTRODUCTION

As the country's population grows, so does the prevalence of numerous diseases. This could be a major setback for the middle class. Covid-19 has recently wreaked havoc on people's health and wealth. Cardiovascular disease is one of the world's greatest issues (CVDs). According to the World Health Organization (WHO), CVDs claim the lives of roughly 17.9 million of people worldwide. Myocardial Infarction (MI), or heart attack, is the most frequent cardiac condition among people. It occurs when blood flow to the coronary heart is reduced or stopped, causing damage to the heart muscle and vessels. Chest pain, discomfort in the left shoulder, chest pain, breathing issues, chest burn, back, neck, arm, or jaw aches, faintness, cold sweat, and back pain are the most prevalent symptoms [1] or jaw pain. This can result in heart complications such as heart failure, decreased heartbeat, cardiogenic shock, and cardiac arrest. In the case of severe heart failure, a heart transplant is a time-consuming procedure, so heart safety is crucial. The procedure is also too lengthy, and the cost is too exorbitant for a heart transplant. High blood pressure, an unhealthy diet, high cholesterol, diabetes, air pollution, obesity, cigarette usage, renal disease, physical dormancy, perilous liquor usage, and stress are examples of socioeconomic, behavioral, and environmental risk factors. The risk of cardiovascular disease is additionally impacted by a person's family history, sex, and age. Men's heart attack symptoms include severe chest discomfort and pain in the left arm. jaw is throbbing, and you're having trouble breathing. Women may have some of the same symptoms as men, but their discomfort is more widespread, affecting the shoulders, neck, arms, belly, and back. Women may have indigestion-like pain that isn't always consistent. There may not be any pain, but you may have unexplainable anxiousness, nausea, dizziness, palpitations, and cold sweating. Women's heart attack may well be gone before by unexplained fatigue.

II. THE HEART

The heart in humans is around the size of closed fist and is positioned between the lungs, in the middle compartment of the chest. The heart is a muscular that is surrounded by blood vessels, which the blood from flows as a circulatory system. The pumped blood carries oxygen and supplements (nutrients) to tissues and organs through the blood vessels, whereas carrying away metabolic waste such as carbon dioxide. The average human heart weight for man is around 10 ounces, whereas for [2] woman is around 8 ounces. Every day, heart beats around 100,000 times and pumps up to 7,500 liters of blood every day. our heart is separated into right and left side known to be septum. On each side of the wall, there exists a small collecting chamber called an atrium, which move the blood into large pumping chamber called ventricle. The heart has 4 chambers namely,

- Left atrium
- Right atrium
- Left ventricle
- Right ventricle



Upper chambers are the left atrium and right atrium, while lower chambers, the left ventricle and right ventricle. The

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right side of our heart collects blood and return to all the parts of the body. The blood flowing through right side of our heart is deficient in oxygen, the heart pumps the blood from the right side to lungs, where [3] it receives sufficient oxygen. Once the oxygen is received the blood returns directly to the left side of our heart, which then pumps it out again to all parts of the body through an artery. The heart is protected by a wall named as pericardium, in which it contains a small amount of fluid. The wall, for the heart is made of three layers namely,

- Epicardium
- Myocardium
- Endocardium

A. EPICARDIUM

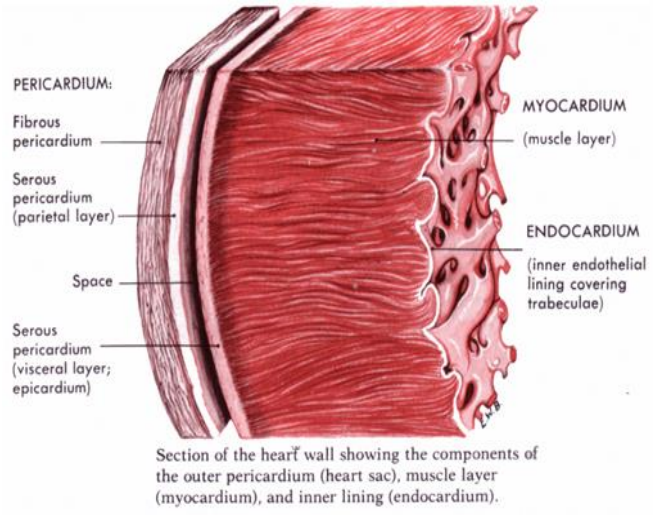
It is also known as visceral pericardium (it forms the inner layer of pericardium). It is the furthest layer of the heart, composed of connective tissue and fat. The epicardium function is to protect the inner heart layers and assists in the production of pericardial fluid. A little amount of lubricating fluid is secreted into the pericardial cavity by connective tissue.

B. MYOCARDIUM

It is the centre layer of the heart wall, that allows the heart to contraction. The thickest layer of the heart wall is myocardium. The heart is kept pumping blood around the body by this muscle tissue, which contracts and releases involuntarily. Specialized myocardial muscle fibres provide for cardiac conduction. [4] Cardiac conduction is made possible by specialized myocardial muscle fibers. These fiber bundles, consisting of the atrioventricular bundle and Purkinje fibers, carry electrical impulses down the center of the heart to the ventricles The muscle fibres in the ventricles contract as a result of these impulses.

C. ENDOCARDIUM

The endocardium is the heart's deepest layer, lining the chambers and extending over protruding structures including valves, chordae tendineae, and papillary muscles.

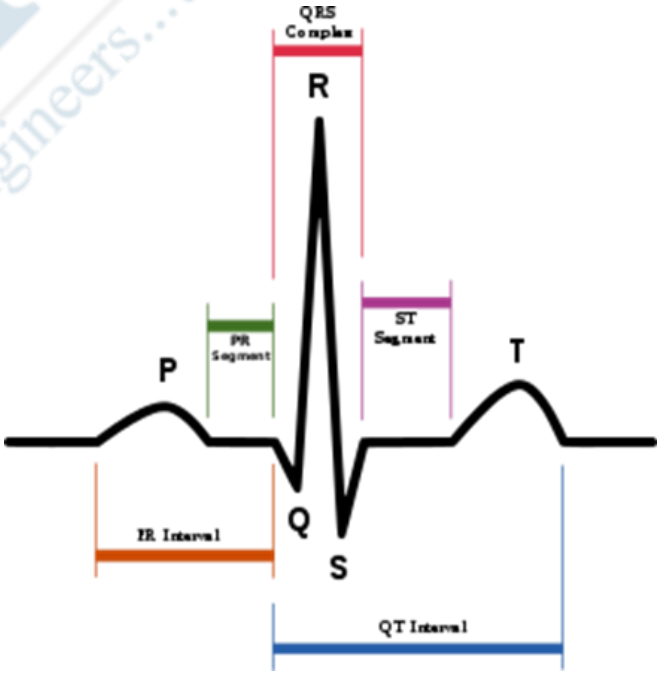


Section of the heart wall showing the components of the outer pericardium (heart sac), muscle layer (myocardium), and inner lining (endocardium).

III. ELECTROCARDIOGRAM

The process of recording hearts rhythm and electrical activity. The sensor which measures the heart rhythm is attached to the skin and detect the electrical signals produced by the heart at each beat. The electrodes are attached to the body and measures the heart beat in the form of graph, which is displayed on the monitor. There are three main components in the ECG, namely

- P wave
- QRS wave
- T wave



A. P WAVE

The most electrical vector is coordinated from the SA hub(node) towards the AV node, and spreads from the correct chamber to the cleared-out chamber. This turns into

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the P wave on the ECG, which is upright in II, III, and aVF (since the common electrical movement is going toward the positive terminal in those leads), and altered in aVR (since it is going absent from the positive anode for that lead). A P wave must be upright in leads II and aVF and altered in lead aVR to assign a cardiac beat as Sinus Cadence (Rhythm).

B. PR INTERVAL

The PR interval is measured from the beginning of the P wave to the beginning of the QRS complex. The length of this interval would [5] be 120 to 200 ms long. This corresponds to three to five tiny boxes on an ECG trace.

C. QRS INTERVAL

The QRS complex could be a structure on the ECG that compares to the depolarization of the ventricles. Since the ventricles contain more muscle mass than the atria, the QRS complex is bigger than the P wave. In expansion, since the His/Purkinje framework facilitates the depolarization of the ventricles, the QRS complex tends to see "spiked" instead of adjusted due to the increment in conduction speed. A typical QRS complex is 0.06 to 0.10 sec (60 to 100 ms) in length.

D. ST SEGMENT

The ST section interfaces the QRS complex and the T wave and contains a term of 0.08 to 0.12 sec (80 to 120 ms). It begins at the J point (intersection between the QRS complex and ST portion) and closes at the starting of the T wave. Be that as it may, since it is more often than not troublesome to decide precisely where the ST section closes and the T wave starts, the relationship between the ST fragment and T wave ought to be jointed. The commonplace ST section length is more often than not around 0.08 sec (80 ms). It ought to be basically level with the PR and TP section.

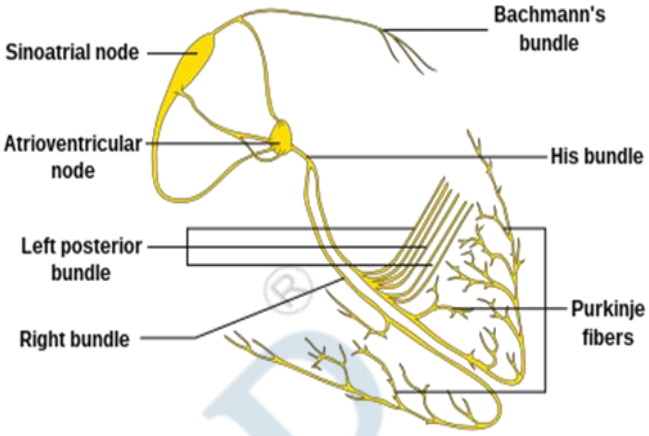
E. T WAVE

The T wave speaks to the repolarization (or recuperation) of the ventricles. The interim from the starting of the QRS complex to the summit of the T wave is alluded to as the supreme headstrong period. The final half of the T wave is alluded to as the relative hard-headed period (or helpless period).

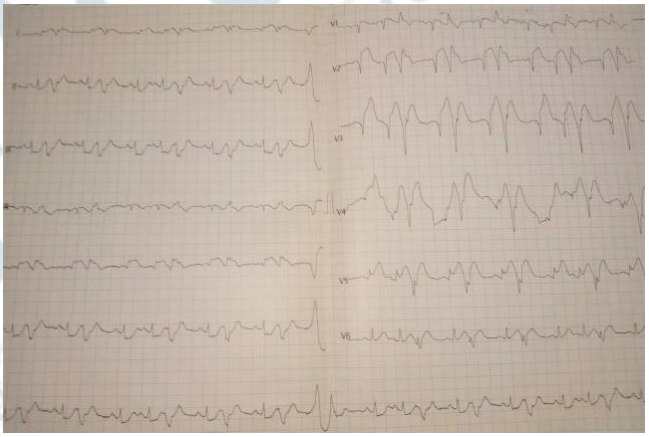
F. QT INTERVAL

From the begin of the QRS complex to the conclusion of the T wave is where the QT interim is measured. Ordinarily, an ordinary QT interim endures for 0.40 seconds. The QT interim and redressed QT interim are pivotal in deciding in the event that a understanding has long QT disorder or brief QT disorder. Diverse redress variables have been made to alter the QT interim for heart rate since the QT interim changes depending on the heart rate. The bazett's equation,

$$QTc = QT/\sqrt{RR} \qquad (1)$$



A. ABNORMAL ECG



The person had a heart attack because the ST elevation at the V1, V2, V3, V4, V5, and V6 ventricles was too high for them. It is calculated using all leads.

Observation:

PR Int.(ms) : 802 Sinus Tachycardia
P/QRS/T Int.(ms): 803 Sinus Arrhythmia
QT/QTc Int.(ms): 861 Premature Ventricular Complexes
P/QRS/T Axis (Deg.): 331 Negative PV1, Left Atrial Enlargement
RV1/SV5 Amp. (mV): 764 Anteroseptal Infarction (Acute)
RV5/SV1 Amp. (mV): 604 ST-T Abnormality (Maybe Ischemia)

B. NORMAL ECG

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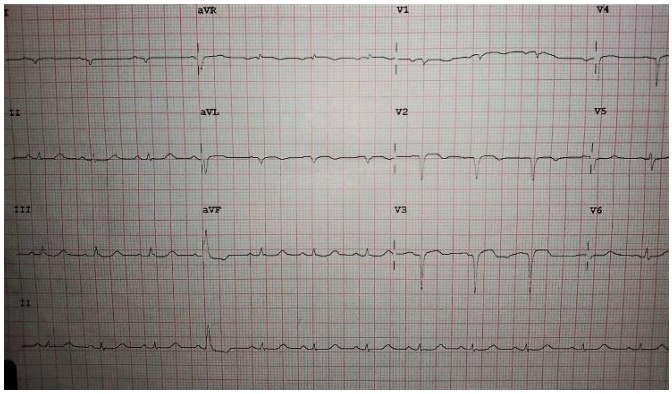


This ECG data shows that the person's heartbeat is normal.

Observation:

RR 714…. Sinus rhythm…. normal P axis, V-rate 50-99

PR 156…. Ventricular premature complex…. V complex w/short R-R interval

QRSD 93…. Anterolateral infarct, old……Q>40 ms, abnormal ST-T, V3-V6, I, aVL

QT 398

QTc 471

AXIS

P	QRS	T
52	122	86

This ECG data shows that the person's heartbeat is normal.

Observation:

RR 714…. Sinus rhythm…. normal P axis, V-rate 50-99

PR 156…. Ventricular premature complex…. V complex w/short R-R interval

QRSD 93…. Anterolateral infarct, old……Q>40 ms, abnormal ST-T, V3-V6, I, aVL

QT 398

QTc 471

IV. PROPOSED METHOD

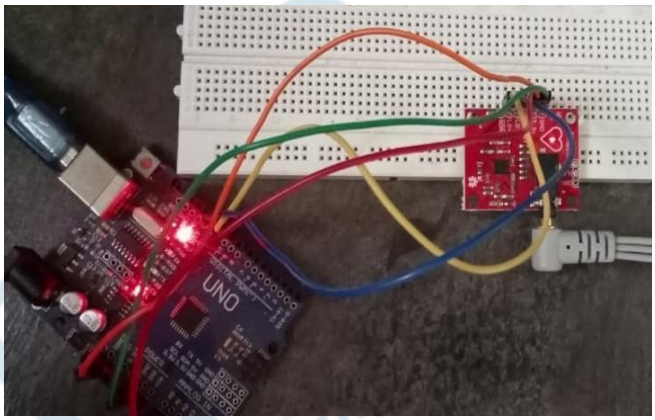
With the help of Arduino Uno board and the heart sensor AD8232 it is possible to generate the ECG signal.

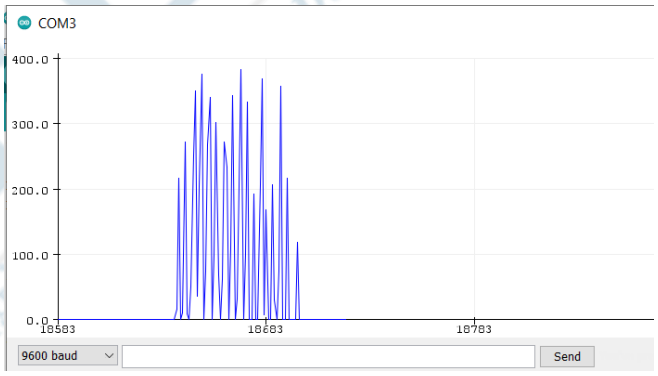
A. Components Required:

- Arduino Uno board
- AD8232 heart sensor
- ECG electrodes
- ECG Connectors
- Bread board
- Connecting wires

B. Algorithm:

- ✓ Connections are made to make the circuit work effectively.
- ✓ The pins on the Arduino board are connected with respect to the heart sensor
- ✓ Code is uploaded in the Arduino IDE.
- ✓ Compilation is done and uploaded on the board.
- ✓ The leads are placed on the body as per the procedure.
- ✓ The reading is noted in the serial plotter.
- ✓ This will show our heart rate with respect to time.





V. CONCLUSION

With the help of Arduino board and heart monitor sensor it is possible to detect the heart rate in a cost-effective manner.

The leads which are placed in our body measures the heart rhythm, so it should be placed on a proper position. Using various sensors, it is quite possible to measure the heart rate. The cost effective and user friendly is an Arduino uno board which has and IDE and all other features for the development for their project.

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