

Health is Wealth-A Straightforward Diagnosis of the ECG for the Heart Functioning

Swarnali Jhampati¹, Jyotirmay Chakraborty¹, Tapas Halder²

Student, Department of Electrical Engineering, Kalyani Government Engineering College, Kalyani,
West Bengal, India¹

Assistant Professor, Department of Electrical Engineering, Kalyani Government Engineering College, Kalyani,
West Bengal, India¹

ABSTRACT: The article analyzes the significant diagnosis of the ECG signals for the heart functioning how to predict the malady, unparticular non-invasive precision measurements on the basis of physiological parameters. The paper also elucidates to critical physiologies on the ECG of the heart which highlights the impact of appreciative what is being measured and why and foresees in detail the digital elucidations to the diagnosis problems. Careful analysis and stability of the heart between the electrical upheaval and signal processing includes where pertinent

KEYWORDS: ECG signal of the heart; Analysis; Stability; Signal processing; Noise reduction of ECG; and Results

I. INTRODUCTION

There is a common proverb that health is wealth. Heart is the integral part of the human body. Where there is a heart of a human body is a life. It runs similar to an automatic machine. The electrocardiogram (ECG) substantiates how incomparable drugs are functioning and whether they are ensure various untreatable side effects that have a consequence on the heart at which it is too critical to unproven the evidence of the corporeal qualifications of the heart when the syndrome or symptoms are there such as mainly abnormal blood pressure (B.P) of the heart, high triglycerides, high cholesterol and diabetes [1].

If a couple of shield electrodes linked to the left and right arms of a human thesis are coupled to a high impedance differential amplifier. A hallmark of electrical signal which fluctuates in time with the heart beat will be pinpointed at the output of the high precision amplifier. This electrical indications which highly comprise uppermost amplitude before the attractive amplification of the order of mV is acknowledged as the electrocardiogram (ECG). In order to evaluate if the patient has had a heart attack or signal of a prior heart attack to monitor the sound effects of tablets used for coronary heart syndrome [2]-[3].

To differentiate if there are too only some marble deposits in the blood to notice contemptible blood circulations to the heart, heart hit and aberrations of the heart. The main pumping processes are completed by the ventricles and the atria of the heart are purely antechambers to accumulate the oxygenated blood during the time the ventricles are pumping [4]. The secret or stodgy stages of the heart progression are referred to as diastole the contractile or pumping period is unconstrained systole. Deoxygenated blood comes back to the right heart after it enables to dole out nutrients to cell of a human body.

II. BASIC FEATURES OF AN ECG

- The straightforward physiology of the heart along with electrical hubbub
- Electrodes and the normal rate of flow of the charge particle to convert electrical currents
- High precision of ECG instrumentation amplifiers
- Noise or the undesirable reductions of signal using the driven right leg of the electrical circuit or using isolation transformers

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Special Issue 13, October 2016

III. RESPIRATION MEASUREMENT USING IMPEDANCE PLETHYSMOGRAPHY

- Electrical impedance varies through the soul body and the nook of the chest due to the breathing and the blood circulations
- Four electrodes procedure of the very high precision measuring the electrical impedance of the electrical circuit of the human body
- Two electrodes option of high accuracy measurement through the amplifier and signal dispensationcircuit

Oxygen Saturation using Pulse Oximetry

- The mammoth ocular vindication of the oxygenated and deoxygenated blood of the body
- Doctrine of pulse oximetry of a heart patient
- Digital electronic implementation of subsystems for pulse oximetry together with isolation of the dc and ac components of the power converter circuit
- Complete circuit for pulse oximetry as a constant current source with dc to dc power converters and current to voltage with dc to dc converters

Non- Invasive Blood Pressure

- The physical processes or pertinent physiology of the blood circulation under pressure of the heart
- The routine technique as Korotkoff sounds
- The current method as Oscillometry
- The potential as beat by beat precision measurements using pulse transportation time

IV. BASIC PHYSIOLOGY OF THE HEART AND ELECTRICAL COMMOTION

The heart is a four chambered pump which gives the driving power for the transmission of blood around the body. A partition segregates the heart concave cavity into a dual pumping arrangement.

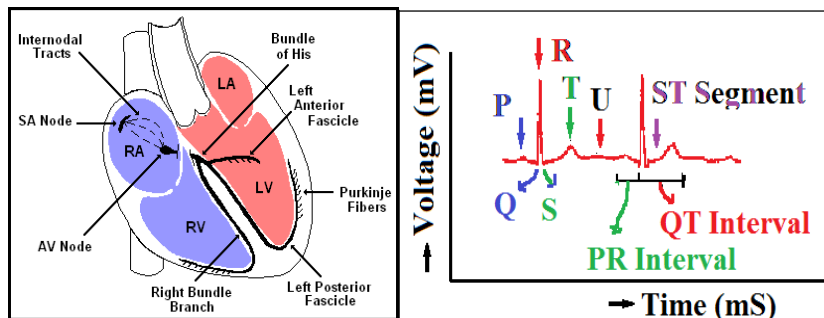


Fig.1. Sectional observations of the Heart Fig. 2. Schematic ECG waveform of normal heart

A piece section is being further separated into an upper cavity, the atrium, and a lower cavity with the ventricle as shown in the Fig. 1. The major pumping operations are completed by the ventricles and the atria are relatively simply antechambers to gather wholesome blood during the time the ventricles are continuous pumping. The sleeping step or storing stage of the heart cycle is referred to as diastole; the contractile or pushing period is identified as systole. Blood comes back to the right heart hollow later than it has released nutrients and sufficient oxygen to the cells of the body. This blood enables pumping to the hole of the lungs where the carbon dioxide is run out and fresh oxygen is pulled out for cellular service. The left heart takes up the oxygenated blood from the lungs and then pushes it out during the aorta for the allocation by trifling arteries to the intact rudiments of the human body in accordance with the functions of the impulsive nature of the electrical signals.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Special Issue 13, October 2016

V. FUNCTIONS OF THE CELL POTENTIALS OF THE HEART

The muscle of the heart is made up of different types of tissues. A muscle cell plays an important role with nerve cells which mutually comprises impulsive membranes. The cell of the membrane is the pushing the middle division between the extracellular and intracellular responsive gooey which have normal electrical charge concentrations. The permeability membrane occupies an assortment of ions and consequently, carries out as a biased ionic filter. The majority of ions convoluted in the systematic system of creation of rhea cell potentials are Na^+ , K^+ and Cl^- like an organic chemistry. Metabolic oomph is used to move forwards pumping the cell membrane which aggressively exorcize Na^+ from the cell and consume K^+ into the cell. This marks in an interior milieu of affluent in K^+ but stumpy in Na^+ in comparisons with an extracellular module of soaring Na^+ and low K^+ . There are consequently concentrations and the gradients of the electric field caused by the uncomfortable charge distributions.

The poles apart type of the concentrations of K, are continued because of the electrical field and concentration gradients. Both of them have equivalent and opposite special effects. There is, nonetheless, an undersized but nonzero conductions of Na^+ which would plaster a period of hours, outcome in a loss of these concentration differences were the pumping not functioning.

A steady state electrical potential therefore be present across the cell membrane, the indoor being some - 82 mV comparative to the exterior. This potential remains fixed until the cell expires, is disturbed or is stimulated by various other nerve or muscle cell or in the folder of nous cells, by an electrical, mechanical, thermal and chemical stimulus.

When the cell incentive is stimulated by the biopsy progression, the permeability of the cell membrane to ionic transport is tailored. The initial part of this amendment is to the highest degree of permeability to Na^+ which confirms in an outsized flood of the Na^+ into the cell. The rate of charge conduction of Na^+ into the cell more often than not increases and this ensures the transmembrane potential to boost from its latent value of -80 mV in an endeavour to transport rate of Na^+ and K^+ back into balance. When balance is accomplished, the cell covering potential has increased to just about +20mV.

VI. FUNCTIONS OF THE CARDIAC MUSCLES

In a heart tissue, the depolarisation hullabaloo of one cell is circulated to the next until the intact tissue depolarises. In muscle tissue, the exploits of the electric potential make shape a perfunctory feedback. The tissues compress and turn out to be shorter in duration after some stoppage following a depolarisation. In mammalian heart tissue, depolarisation ends about 2mS but repolarisation ends 200 mS or more. The contractile reaction of the cardiac muscle sets in motion very soon after the starting of depolarisation and ends about 1.5 times as large as the stroke potential.

VII. FUNCTIONS OF THE PACEMAKER CELLS

When the sleeping potential is used to preserve for an imprecise period in universal muscle cells, for pacemaker cells which are shown in a segment of the heart identified as the sinoatrial (SA) node as shown in the Fig. 1. The transmembrane substantial electric potential impulsively arises because of the ionic seepage in the horizontal muscle of the membrane. Ultimately, the doorstep for the excitation is accomplished and so the pacemaker cells are called to be self excitatory. As the SA node cells highly depolarise, they awaken the neighbouring atrial cells, causing them to depolarise. Thus, a depolarisation wave travels over the atria in a superficial itinerant wave from the end of source. A fibrous barricade of non-nervous cells put off circulation of the depolarisation wave from progressing beyond the restrictions of the atria. The only impulsive tissue that crossed this hurdle is the Bundle of His. It is a mass of a particular size of the tissue about 2cm extended and 1cm broad called the atrio-ventricular (AV) node at the source of this bundle. The circulation speed through the AV node is roughly 0.1 m/s, 10 % of that of the atrial cells. The propagation hindrance that this causes in the propagation of the atrial depolarisation wave is the solution to the suitable time affiliation to between the atria and the ventricles of the heart. This postponement is very significant as it consent to the atria to draw to a close their contraction before there is any ventricular contraction briefly shown in the Fig. 1.

VIII. PRECISION MEASUREMENT OF THE POTENTIALS ON THE BODY SURFACE

The current densities engendered by the membrane bustle of the heart muscle cells inculcate current variations in the nearby medium of the heart. This rate of flow of ions (i.e. current) conveyance in the thorax which may be judged to be a solely passive medium since it includes no other resources or sinks. Thus, to an opening ballpark figure,

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Special Issue 13, October 2016

the heart may be representation as an electrical generator with the thoracic medium as highly resistive load. The ECG brings to light the commencement of the meticulous points. It is significantly a documentation of the electric potentials computed at on the outside surface of this intermediate (i.e. on the outside of the human body). An emblematic ECG waveform of a fit heart is shown in the Fig. 2.

IX. DIAGNOSIS OF THE ECG WAVEFORMS

The ECG is elaborated by five different fragments of the waveform as mentioned the P, Q, R, S and T waves as shown in the Fig. 2. The diagnoses of these fragments represent authentic information on the different actions of the cardiac cycle as depicted below.

- **P-wave:** a little low voltage deflection created by the depolarisation of the atria previous to the atrial retrenchment of the heart systems.
- **QRS compound:** the biggest-amplitude segment of the ECG, created by the currents produced when the ventricles depolarise previous to their retrenchment. Even if the atrial repolarisation takes place before the ventricular depolarisation, the concluding waveform (i.e. the QRS compound) is of a great deal of the superior amplitude and the atrial repolarisation is consequently unseen on the ECG.
- **T-wave:** ventricular repolarisation of a heart muscle
- **P-Q interval:** the time interval between the starting of the P wave and the commencement of the QRS compound. It is the time between the beginning of the atrial retrenchment and the commencement of the ventricular retrenchment as such it corresponds to the hindrance of the electrical impulse from the atria to the ventricles of a heart.
- ECG consists of P-wave, QRS-compound, the T-wave, U-wave and P-wave-depolarization of the atria. The supporting QRS –the compound of the depolarization of ventricles’-wave repolarisation of ventricles. Repolarisation of the atria not the noticeable in this lucid stretched. QRS compound identifications on the majority of very significant assignment in an essential ECG diagnosis.

In this modus operandi, other division of the Fig. 2 may be analysed lucidly. Perceptibly plenty, the function of the heart is to push blood. Electrical commotion is very significant merely for the explanation that it also commences muscular retrenchment. The ECG can however make available a great deal of information to a experienced cardiologist on the record of a heart hit as for illustration, despite the fact that it highlights information about the pumping competency of the heart apart from in terms of rhythm under the common circumstances, the robust correlation between electrical and mechanical dealings of a heart.

Adeptness in ECG investigation is an important talent for cardiologist. On the other hand, the research now capitalizes to extend and improve the crucial judgment of ECG literacy to forestall whichever limitations.

A recent journal enlightens on the ECG diagnosis into accurate background where the waveforms concluded with other reliable data. In order to predict the accurate prediction, the ECG pedagogy is exceedingly accepted to diagnosis the symptoms of diseases as shown in the Fig. 3

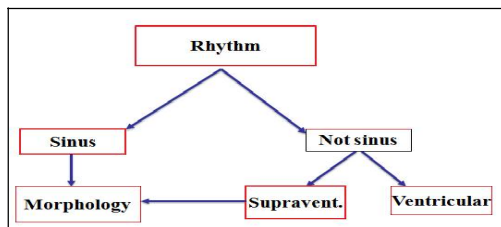


Fig. 3. Block diagram representations



Fig. 4. Normal ECG of a heart for a fit person of the ECG diagnosis

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Special Issue 13, October 2016

X. PROCESSING OF THE ECG OF A HEART

Noises or the undesirable signal eliminations and the substantial contaminants from the ECG signals may be pigeonholed as shown below point wise:

- Power line interference (i.e. EMI problem)
- Electrode pop or contact noise abolition
- Patient electrode motion manufactured article in the complete systems
- Electromyography (EMG) noise totally reductions
- Baseline peripatetic of the systems

The baseline peripatetic and other wideband noises are really complex to be secreted by the hardware devices. A substitute the software proposal is more authoritative than practicable for offline ECG signal processing. The specialist can use the subsequent practice to do away with baseline itinerant and other wideband noises. Extractions of diagnostic record from the ECG signals are not at times the most important authentication messages or stretched which can strappingly have an effect on ECG signal diagnosis.

The Lab VIEW based professional software put across [VI] to go mouldy the ECG signal into some sub bands by applying the wavelet transform as future prospect of this article and then amends apiece wavelet coefficient by applying a front doorstep or abbreviation function and after all recreates the denoised signals in favour of the robust ECG.

XI. RESULTS

Diagnosis-1: The yardstick ECG of the sinus rhythm (P before @ QRS), Rate 50bpm to 100 bpm, Axis $+90^\circ$ to 30° , Intervals: PR 120 msec-121 msec and QRS < 100 msec. The above diagnosis are free from the sinus rhythm for a healthy person along normal ECG as shown in the Fig. 4.

Diagnosis-2: 51 years of old male with chest dull pain 100% occlusion of a diagonal (also comprised three vessel diseases, usual LVEF) as shown in the Fig. 5 and Fig. 6.

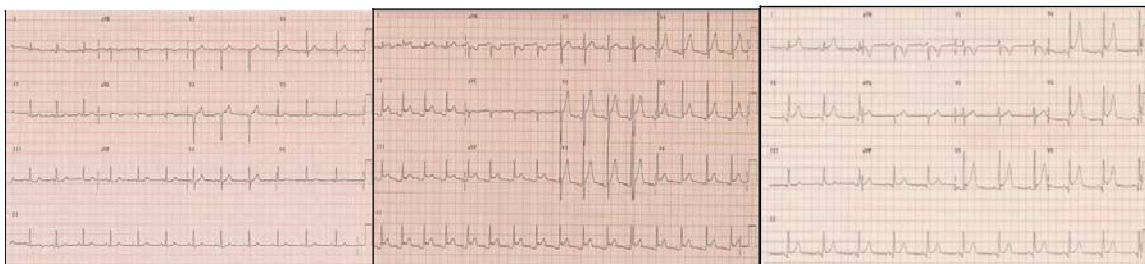


Fig. 5. Chest pain 100% occlusion of a diagonal

Fig. 6. Chest pain 100% occlusion of a diagonal

Fig. 7. PR subdivision depression of a heart

Diagnosis-3: 29 years of old person with chest pain and diffuse ST height above normal altitude connection with a pericarditis? PR section depression is shown in the Fig. 7.

Diagnosis-4: 47 years of old male with chest pain delicate inferior MI of the perpetrator vessel RCA is shown in the Fig. 8.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Special Issue 13, October 2016



Fig. 8. MI of the culprit vessel RCA

Fig.9. Persistent SOB roomy anterior and anterolateral MI



Fig.10. Stupendous chest pain AMI, imprecise age, RBBB and left axis

Fig. 11. Straightforward degree of difference of low voltage, air, fat, and no muscle of the heart

Diagnosis-5: 41 years of a male with persistent SOB roomy anterior and anterolateral MI is shown in the Fig.9.

Diagnosis-6: 54 years of old male with stupendous chest pain AMI, imprecise age, RBBB and left axis is shown in the Fig. 10.

Diagnosis-7: 60 years of old comatose s/p MVA with a low voltage and straightforward degree of difference of low voltage, air, fat, liquid, and no muscle is shown in the Fig. 11.

Diagnosis-8: 60 years of old with chest pain, and LVH with LAD, ST-T abn, & LAE in patient with angina and LVH, for all time imagine of the aortic stenosis and hypertrophic cardiomyopathy in the degree of difference diagnosis is shown in the Fig. 12.

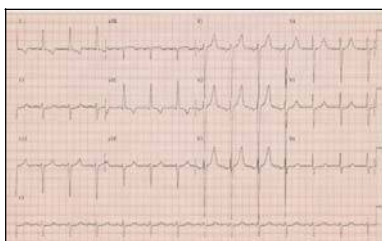


Fig. 12. Aortic stenosis and hypertrophic degree of the



Fig. 13. LBBB and pharmacologic stress with Cardiomyopathy in adenosine communal with imaging modality difference diagnosis.

Diagnosis-9: 70 years of old with evectional chest pain, LBBB If necessitates stress inspection in this patient, use pharmacologic stress with adenosine communal with imaging modality (sestamibi or a cardiac MRI) is shown in the Fig. 13.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Special Issue 13, October 2016

Diagnosis-10: 78 years of old female with account of HTN, DM, HL, and CAD admitted for syncope discharges of the palpitations and dizziness is shown in the Fig. 14.



Fig. 14. HTN, DM, HL, and CAD

Diagnosis-11: Account of diabetes, hypertension, palpitations and dizziness and COPD presents with the chest pain

Diagnosis-11: 67 years of old male with account of diabetes, hypertension, and COPD presents with chest pain is shown in the Fig. 15

Diagnosis-12: 60 year-old men with record of HTN, HL, CAD represents with a sickness, tininess of inhalation and chest pain is shown in the Fig. 16.

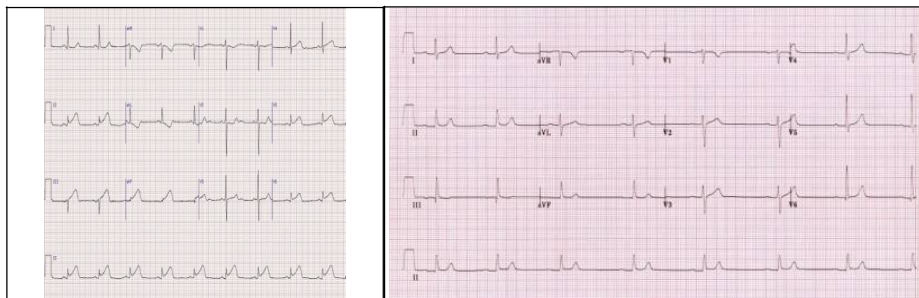


Fig. 16. Record of HTN, HL, and CAD represents with a sickness,

Fig. 17. ECG report for the Diabetes mellitus and hypertension tininess of inhalation and chest pain

Diagnosis-13: 70 years of old male with commentary of the diabetes mellitus diseases and hypertension uncommonly undergoes light in the head. The patient only just washed out while standing is shown in the Fig. 17.

Diagnosis-14: 38 years of old female with account of DM, HTN, and CKD represents with two days of the nausea and abdominal pain is shown in the Fig. 18 as ECG report.



Fig.18. DM, HTN, and CKD represents with two days of the nausea and abdominal pain as ECG report

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Special Issue 13, October 2016

.Diagnosis-15: 42 years of old male with account is shown Fig. 19 as ECG report

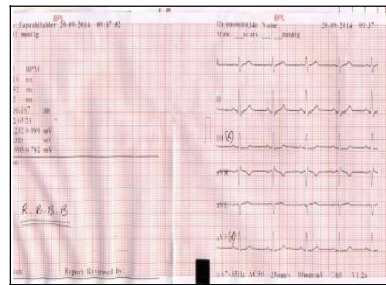


Fig. 19. ECG report for RBBB detections

XII. CONCLUSIONS

An ECG technique is too uncomfortable to diagnosis the functioning of the heart. Relentlessly, it remains reliable immense approaches in sleazy of machine reads. Practice and timely taking of the food and routine of the proper calorific makes fit of heart. Excellent exercise makes expenses the good calorie for taking of the excessive foods, smokes and alcohol drinks so ECG diagnosis is well suited to determine the heart diseases of a man.

REFERENCES

- [1] 12-Lead ECG: The Art of Interpretation, Tomas Garcia (perhaps the best book on ECGs with detailed explanations and physiology)
- [2] Di Rienzo M, Meriggi P, Rizzo F, Castiglioni P, Lombardi C, Ferratini M, et al. Textile technology for the vital signs monitoring in telemedicine and extreme environments. *IEEE Trans Inf Technol Biomed* 2010 May; 14(3):711-7.
- [3] Arrhythmia Recognition, Tomas Garcia
- [4] Alel Chebil, Jamal Al-Nabulsi and Mohammed Al-Maitah, "A Novel Method for Digitizing Standard ECG Papers", *Proceedings of the International Conference on Computer and Communication Engineering*, Kuala Lumpur, Malaysia, pp.1308-1312, 2008.