ABSTRACT

Cardiac diseases are one of the disorders occurring in the heart and blood vessels due to various reasons. The coronary hard diseases directly impact the blood vessels and restrict blood pumping frequency that follows the blood vessel pumping towards the brain also. Frequent occurrences of cardiac health diseases directly impact the regular activities of the brain and muscles to interrupt the regular functionality. The proposed system considers the critical factor called blood vessel detection and coronary hard disk detection using blood clothes present in the veins. The proposed system considers the heart disease data set collected from MIT BIH physionet website where the data consists of various heart diseases such as ventricular cardiac arrhythmia even more. In which the cardiac abnormal condition is detected based on the symptoms (SACHA). An optimized multi nominal regression (OMNLR) is implemented to detect the free contacts of normality in the heart data set. From the optimized multinomial Logistic regression and compared with various data for approaches.

Keywords: Health care, Health care monitoring, Internet of things, Machine learning, Pulmonary diseases.

CONTENTS

LIST OF FIGURES

LIST OF ACRONYMS

S.NO	ACRONYMS	DESCRIPTION
1	CVD	Cardio vascular diseases
2	WHO	World Health Organisation
3	ECG	Electro Cardiogram
4	CHD	Coronary Heart Diseases
5	MIT DB BIH	Massachusetts Institute Data Base Beth Israel Hospital

CHAPTER 1
INTRODUCTION

Cardiovascular diseases (CVDs) are a group of disorders of the heart and blood vessels and they include : coronary heart disease – disease of the blood vessels supplying the heart muscle ; cerebrovascular disease – disease of the blood vessels supplying the brain ; peripheral arterial disease – disease of blood vessels supplying the arms and legs ; rheumatic heart disease – damage to the heart muscle and heart valves from rheumatic fever, caused by streptococcal bacteria ; congenital heart disease – malformations of heart structure existing at birth.

Deep vein thrombosis and pulmonary embolism – blood clots in the leg veins, which can dislodge and move to the heart and lungs.Heart attacks and strokes are usually acute events and are mainly caused by a blockage that prevents blood from flowing to the heart or brain. The most common reason for this is a build-up of fatty deposits on the inner walls of the blood vessels that supply the heart or brain. Strokes can also be caused by bleeding from a blood vessel in the brain or from blood clots. The cause of heart attacks and strokes are usually the presence of a combination of risk factors, such as tobacco use, unhealthy diet and obesity, physical inactivity and harmful use of alcohol, hypertension, diabetes and hyperlipidaemia.

RISK FACTORS

The most important behavioral risk factors of heart disease and stroke are unhealthy diet, physical inactivity, tobacco use and harmful use of alcohol. The effects of behavioural risk factors may show up in individuals as raised blood pressure, raised blood glucose, raised blood lipids, and overweight and obesity. These “intermediate risks factors” can be measured in primary care facilities and indicate an increased risk of developing a heart attack, stroke, heart failure and other complications.

Cessation of tobacco use, reduction of salt in the diet, consuming fruits and vegetables, regular physical activity and avoiding harmful use of alcohol have been shown to reduce the risk of cardiovascular disease. In addition, drug treatment of diabetes, hypertension and high blood lipids may be necessary to reduce cardiovascular risk and prevent heart attacks and strokes. Health policies that create conducive environments for making healthy choices affordable and available are essential for motivating people to

adopt and sustain healthy behaviour. There are also a number of underlying determinants of CVDs or "the causes of the causes". These are a reflection of the major forces driving social, economic and cultural change – globalization, urbanization and population ageing. Other determinants of CVDs include poverty, stress and hereditary factors.

COMMON SYMPTOMS

Symptoms of heart attacks and strokes

Often, there are no symptoms of the underlying disease of the blood vessels. Men may feel pain and numbness in the left arm or the side of the chest. In women, these symptoms may appear on the right side. Women may experience unexplained exhaustion, or feel drained, dizzy or nauseous. Women may feel upper back pain that travels up into their jaw.A heart attack or stroke may be the first warning of underlying disease. Symptoms of a heart attack include:

- pain or discomfort in the centre of the chest;
- pain or discomfort in the arms, the left shoulder, elbows, jaw, or back.

In addition the person may experience difficulty in breathing or shortness of breath; feeling sick or vomiting; feeling light-headed or faint; breaking into a cold sweat; and becoming pale. Women are more likely to have shortness of breath, nausea, vomiting, and back or jaw pain.

The most common symptom of a stroke is sudden weakness of the face, arm, or leg, most often on one side of the body. Other symptoms include sudden onset of:

- numbness of the face, arm, or leg, especially on one side of the body;
- confusion, difficulty speaking or understanding speech;
- difficulty seeing with one or both eyes;
- difficulty walking, dizziness, loss of balance or coordination;
- severe headache with no known cause; and
- fainting or unconsciousness.
- People experiencing these symptoms should seek medical care immediately.

RHEUMATIC HEART DISEASE

Rheumatic heart disease is caused by damage to the heart valves and heart muscle from the inflammation and scarring caused by rheumatic fever. Rheumatic fever is caused by an abnormal response of the body to infection with streptococcal bacteria, which usually begins as a sore throat or tonsillitis in children. Rheumatic fever mostly affects children in developing countries, especially where poverty is widespread. Globally, about 2% of deaths from cardiovascular diseases is related to rheumatic heart disease.

Symptoms of rheumatic heart disease

- Symptoms of rheumatic heart disease include: shortness of breath, fatigue, irregular heart beats, chest pain and fainting.
- Symptoms of rheumatic fever include: fever, pain and swelling of the joints, nausea, stomach cramps and vomiting.
- painless nodules under the skin near joints and/or a rash consisting of pink rings with a clear centre
- At least three quarters of the world's deaths from CVDs occur in low- and middle-income countries.

People in low- and middle-income countries often do not have the benefit of integrated primary health care programmes for early detection and treatment of people with risk factors compared to people in high-income countries. People in low- and middle-income countries who suffer from CVDs and other noncommunicable diseases have less access to effective and equitable health care services which respond to their needs. As a result, many people in low- and middle-income countries are detected late in the course of the disease and die younger from CVDs and other noncommunicable diseases, often in their most productive years.

The poorest people in low- and middle-income countries are affected most. At the household level, sufficient evidence is emerging to prove that CVDs and other noncommunicable diseases contribute to poverty due to catastrophic health spending and high out-of-pocket expenditure.At macro-economic level, CVDs place a heavy burden on the economies of low- and middle-income countries.

CARDIO DISEASE REDUCTION FACTORS

"Best buys" or very cost effective interventions that are feasible to be implemented even in low-resource settings have been identified by WHO for prevention and control of cardiovascular diseases. They include two types of interventions: population-wide and individual, which are recommended to be used in combination to reduce the greatest cardiovascular disease burden.

- comprehensive tobacco control policies
- taxation to reduce the intake of foods that are high in fat, sugar and salt
- building walking and cycle paths to increase physical activity
- strategies to reduce harmful use of alcohol
- providing healthy school meals to children.

At the individual level, for prevention of first heart attacks and strokes, individual health-care interventions need to be targeted to those at high total cardiovascular risk or those with single risk factor levels above traditional thresholds, such as hypertension and hypercholesterolemia. The former approach is more cost-effective than the latter and has the potential to substantially reduce cardiovascular events. This approach is feasible in primary care in low-resource settings, including by non-physician health workers.

For secondary prevention of cardiovascular disease in those with established disease, including diabetes, treatment with the following medications are necessary:

- aspirin
- beta-blockers
- angiotensin-converting enzyme inhibitors
- statins.

The benefits of these interventions are largely independent, but when used together with smoking cessation, nearly 75% of recurrent vascular events may be prevented. Currently there are major gaps in the implementation of these interventions particularly at the primary health care level.

In addition costly surgical operations are sometimes required to treat CVDs. They include:

Coronary artery bypass

Balloon angioplasty (where a small balloon-like device is threaded through an artery to open the blockage) ,valve repair and replacement , heart transplantation, artificial heart operations Medical devices are required to treat some CVDs. Such devices include pacemakers, prosthetic valves, and patches for closing holes in the heart.

TYPES OF HEART DISEASE

Cardiovascular disease is the leading cause of death in the United States. More than 62 million Americans have some form of cardiovascular disease. At Covenant HealthCare, we want to see individuals live a long and healthy life. That's why we're working hard to tackle the issue of heart disease here in mid-Michigan.

There are many different types of heart disease. Some are congenital (people are born with heart problems), but a majority of heart diseases develop over the course of time and affect people later in life. You'll find some of the most common heart diseases listed below.

1. Coronary Artery Disease

Blockage in the coronary arteries is called coronary artery disease—a condition in which the heart muscles don't get enough blood and oxygen. The most serious effect of coronary artery disease is sudden death without warning. This usually happens in individuals who have had heart attacks or other heart damage. Heart and blood vessel disease (also called heart disease) includes numerous problems, many of which are related to a process called atherosclerosis. Atherosclerosis is a condition that develops when a substance called plaque builds up in the walls of the arteries. This buildup narrows the arteries, making it harder for blood to flow through. If a blood clot forms, it can block the blood flow. This can cause a heart attack or stroke.

2. Heart attack

A heart attack occurs when the blood flow to a part of the heart is blocked by a blood clot. If this clot cuts off the blood flow completely, the part of the heart muscle supplied by that artery begins to die. Most people survive their first heart attack and return to their normal lives, enjoying many more years of productive activity.

But experiencing a heart attack does mean that you need to make some changes.The medications and lifestyle changes that your doctor recommends may vary according to how badly your heart was damaged, and to what degree of heart disease caused the heart attack.

3. Stroke

An ischemic stroke (the most common type of stroke) occurs when a blood vessel that feeds the brain gets blocked, usually from a blood clot. When the blood supply to a part of the brain is cut off, some brain cells will begin to die. This can result in the loss of functions controlled by that part of the brain, such as walking or talking. A hemorrhagic stroke occurs when a blood vessel within the brain bursts. This is most often caused by uncontrolled hypertension (high blood pressure). Some effects of stroke are permanent if too many brain cells die after being starved of oxygen. These cells are never replaced.

The good news is that sometimes brain cells don't die during stroke — instead, the damage is temporary. Over time, as injured cells repair themselves, previously impaired function improves. (In other cases, undamaged brain cells nearby may take over for the areas of the brain that were injured.)

Either way, strength may return, speech may get better and memory may improve. This recovery process is what stroke rehabilitation is all about.

4. Heart failure

Heart failure, sometimes called congestive heart failure, means the heart isn't pumping blood as well as it should. Heart failure does not mean that the heart stops beating that's a common misperception. Instead, the heart keeps working, but the body's need for blood and oxygen isn't being met.

Heart failure can get worse if left untreated. If your loved one has heart failure, it's very important to follow the doctor's orders.

5. Arrhythmia

Arrhythmia refers to an abnormal heart rhythm. There are various types of arrhythmias. The heart can beat too slow, too fast or irregularly.

Bradycardia, or a heart rate that's too slow, is when the heart rate is less than 60 beats per minute. Tachycardia, or a heart rate that's too fast, refers to a heart rate of more than 100 beats per minute.

An arrhythmia can affect how well your heart works. With an irregular heartbeat, your heart may not be able to pump enough blood to meet your body's needs.

COMMON TREATMENTS

Here are some common treatments for different types of cardiovascular disease:

- Heart Valve Problems
- Medications
- Heart valve surgery
- Arrhythmia
- Medications
- Pacemaker
- Heart Attack
- Medications — clotbusters (should be administered as soon as possible for certain types of heart attacks)
- Coronary angioplasty
- Coronary artery bypass graft surgery
- Stroke

1. Heart valve problems

When heart valves don't open enough to allow the blood to flow through as it should, a condition called stenosis results. When the heart valves don't close properly and thus allow blood to leak through, it's called regurgitation. If the valve leaflets bulge or prolapse back into the upper chamber, it's a condition called prolapse. Discover more about the roles your heart valves play in healthy circulation.

2. Medications

Clot busters (must be administered within three hours from onset of stroke symptoms for certain types of strokes). Carotid endarterectomy (PDF)(link opens in new window). Diagnostic tests, surgical procedures and medications. In the hospital and during the first few weeks at home, the doctor may perform several tests and procedures.

These tests help the doctor determine what caused the stroke or heart attack, and how much damage was done. Some tests monitor progress to see if treatment is working.

3. Cardiac medications

The medications prescribed in the wake of a cardiac event can aid in recovery and work to prevent another stroke or heart attack. If you're a caregiver, make it your responsibility to help your loved one take medications as directed and on time. Educate yourself about the medications that your loved one must take. Know what those medicines do, and what their goal is. It's important to follow your doctor's directions closely, so ask questions and take notes. Learn more about cardiac medications.

4. Silent Ischemia

A form of coronary artery disease in which the blood flow to the heart muscle is reduced but produces very little pain or symptoms. When discomfort is experienced, it is usually during physical exertion.

5. Angina

Angina is discomfort or pain that occurs when your heart is not getting enough oxygen and nutrients. Angina may be caused by a narrowing of the arteries or muscle spasms in the coronary arteries. These spasms may be induced by cigarette smoke, cold temperatures, strong emotions, and other sources. It is important to note that angina isn't a heart attack and doesn't usually cause permanent heart damage, even though it causes pain.

The causes of angina are generally atherosclerosis or coronary artery spasm. Angina is not the same for everyone. While it usually occurs when the heart is working harder than normal, such as after a meal or during physical or emotional stress, it can also occur when resting.

Traditionally, angina occurs primarily in the chest and radiates down the left arm. However, it can be any discomfort that radiates in the chest, across the shoulders, in the upper back, arms (both left and right), neck, throat, or jaw.

Symptoms of Angina

- Aching
- Burning
- Cramping
- Discomfort
- Heaviness
- Indigestion
- Numbness or Tingling
- Pain
- Pressure
- Shortness of Breath
- Sweating or Dizziness
- Squeezing
- Tightness
- Stop your activity, sit or lie down, and relax.
- Take a nitroglycerin (NT6) tablet or use NTG spray as prescribed by your physician.

Be sure to notify your physician if these symptoms increase in frequency or severity but are not so severe that you feel the need to go to an emergency room.

1. Heart Attack (Myocardial Infarction)

Part of the heart muscle can be damaged or die as a result blood flow is blocked. If the blockage is brief, and the heart eventually receives enough blood, oxygen, and nutrients, the damage is often reversible. This is why it is especially important for the heart attack victim to get medical help fast.

Warning signs of a heart attack include:

Heavy feeling, pressure, or intense pain or squeezing in the chest that lasts for more than a few minutes.

- Light headedness or fainting
- Nausea or vomiting

- Pain that radiates to the shoulders, neck or arms.
- Profuse Sweating
- Rapid heartbeat
- Shortness of breath
- Severe weakness

2. Heart Failure

Heart failure happens when the heart isn't pumping enough blood to meet your body's needs. While many people believe the misconception that heart failure means an individual is about to die or that their heart has stopped, this is not true. Heart failure simply indicates that the heart is not squeezing as well as it should. It usually does not occur suddenly but gradually worsens over the time.

Heart failure can be caused by:

- Cardiomyopathies (diseases that damage the heart muscles)
- Coronary Artery Disease
- Diabetes
- Diseases of the Heart Valves
- Heart Defects present at Birth
- High Blood Pressure
- Lung Disease such as Emphysema
- Past Heart Attacks
- Fluid which builds up in the lungs, known as pulmonary congestion
- Swelling in the feet, ankles or legs, known as edema
- Other symptoms may include wheezing, sleep apnea, cough, and fatigue
- Arrhythmia

Sometimes the heart's electrical system does not function normally. It may race, become slow, irregular, skip beats or sometimes the heart's electrical signal does not move in the proper sequence. This causes the heart to beat faster or slower than normal, or erratically. These abnormal rhythms are called arrhythmias. They can cause a variety of symptoms: dizziness, fainting, fatigue, shortness of breath and chest pain or rapid

palpitations that may feel like flutters or pounding of the heart. If left untreated, arrhythmias can be life threatening.

There are four major types of arrhythmias:

1. **Bradycardia:** Occurs when the heart's electrical signal is delayed too long or blocked, resulting in a slower than normal heartbeat. If it happens only once in a while, bradycardia is not a problem. However, if it continues over a long period of time, the body will not receive an adequate blood supply, which can be very serious. Heart disease and some drugs can cause bradycardia, and a physician should evaluate it to determine if treatment is required. Treatment can include a pacemaker to make sure the heart beats at a normal rate and/or discontinuing a mediation.
2. **Irregular or extra heartbeats:** Even people with excellent health have irregular or extra heartbeats every once in a while. In some cases, irregular or extra beats can lead to rapid heartbeats.
3. **Ventricular Tachycardia (VT):** Occurs when the heart's electrical signal begins in the ventricles (lower chambers of the heart) and the heart beats too rapidly. When the ventricles pump too fast, they cannot deliver enough blood to the body. In some cases, VT can create a very rapid, erratic heartbeat (ventricular fibrillation), or cardiac arrest. If VT lasts for only a second or two, it may not be noticed and probably will not cause any serious problems. However, if it lasts longer, it can be very serious and should be evaluated by a physician.
4. **Supraventricular Tachycardia (SVT):** Occurs when the heart's electrical signal begins above the ventricles (the lower chambers of the heart) causing the heart to beat very rapidly or erratically. As a result, the heart is strained, and the body receives an inadequate blood supply. There are three types of SVT – Atrial flutter, Atrial fibrillation and Paroxysmal SVT. A number of underlying conditions can lead to SVT. Medication and/or electrical shock treatment (cardioversion) can restore normal heartbeat. To prevent recurrences, additional treatment and medication may be necessary.

Several diagnostic tests are available to identify arrhythmias including an electrocardiogram (ECG), Holter Monitor, a stress test, a tilt table test, and/or sometimes an electrophysiology study (EP) if necessary. In addition, if an arrhythmia is not revealed with routine testing then an implantable loop recorder may be indicated.

Heart Defects

An obstruction is a heart defect that partly or completely blocks the flow of blood. Obstructions called stenosis can occur in the heart valves, arteries or veins.

- Aortic stenosis
- Bicuspid aortic valve
- Mitral valve prolapse
- Pulmonary stenosis
- Subaortic stenosis

PERIPHERAL ARTERIAL DISEASE

Like the heart, all tissues of the body need oxygen and other nutrients to survive and work. Fatty plaques or atherosclerosis can also affect arteries that supply oxygen rich blood to other areas of the body. For example, peripheral arterial disease (PAD) occurs when the flow of oxygen-rich blood to the legs and feet is blocked or decreased. This blockage in the vessels deprives the feet and legs of oxygen and nutrients, and produces symptoms usually in the thigh, calf muscle and feet.

Symptoms of PAD

- Brown spots on the skin
- Changes in color of the skin on the leg: foot goes from pink to blue
- Coldness
- Loss of hair on the lower leg
- Numbness and tingling
- Pain or cramping after walking short distances
- Slow healing of wounds
- Swelling
- Ulcers

1.1 DETAILED DESCRIPTION OF THE PROJECT

The project of "Cardiac Abnormality Monitoring through Optimized Regression" is aimed at developing a machine learning model that can effectively monitor and predict cardiac abnormalities based on various physiological and clinical factors. The model would utilize regression analysis techniques to predict the occurrence of abnormal heart function based on input data.

The project would begin by collecting relevant datasets related to cardiac abnormalities, which would include data related to electrocardiograms (ECG), vital signs, medical history, and other relevant information. The dataset would then be preprocessed, which would involve cleaning and filtering the data, handling missing values, and transforming the data into a suitable format for analysis.

Once the data has been preprocessed, it would be split into training and testing sets. The training set would be used to train the regression model, while the testing set would be used to evaluate the performance of the model. Various regression algorithms such as Linear Regression, Polynomial Regression, Random Forest Regression, and Neural Networks would be tested and optimized to achieve the best results. During the optimization phase, feature selection techniques would be utilized to identify the most important variables that contribute to predicting the occurrence of cardiac abnormalities. The selected features would be used to train and test the model to ensure that it can make accurate predictions while avoiding overfitting.

This model will be designed to analyze patient data and identify patterns that are associated with an increased risk of heart disease. The ultimate goal of the project is to provide physicians with a tool that can help them make more informed decisions about patient care and improve overall patient outcomes.

The project will involve several steps, including data collection, data preprocessing, model training, and model evaluation. The first step will be to collect data from various sources, including electronic health records, medical devices, and other relevant sources. This data will include patient demographics, medical history, lifestyle factors, and clinical measurements such as blood pressure, cholesterol levels, and heart rate.

The next step will be to preprocess the data to ensure that it is clean, complete, and ready for analysis. This will involve data cleaning, normalization, and feature engineering to extract relevant information from the raw data. The goal of this step is to create a high-quality dataset that can be used to train the machine learning model.

The third step will be to train the machine learning model using the preprocessed data. The model will use a regression algorithm to predict the risk of cardiovascular disease based on the input parameters. The model will be optimized to achieve high accuracy and generalizability, and will be tested using cross-validation techniques to ensure that it is robust and reliable.

The model will be evaluated using various metrics such as accuracy, precision, recall, and F1 score. The goal of this step is to determine the effectiveness of the model and identify any areas for improvement. The results of the evaluation will be used to refine the model and improve its performance. The cardiac abnormality monitoring through optimized regression project is a comprehensive effort to develop a machine learning model that can accurately predict the risk of cardiovascular disease. This model has the potential to significantly improve patient outcomes and help physicians make more informed decisions about patient care.

Finally, the performance of the optimized model would be evaluated using various metrics such as accuracy, precision, recall, and F1-score. The model would also be tested on new datasets to verify its generalizability.

Overall, the project aims to develop a reliable and accurate model for monitoring and predicting cardiac abnormalities, which could potentially assist healthcare providers in identifying patients at risk and taking timely actions to prevent further complications.

1.2 PROJECT OBJECTIVES

The primary objective of this project is to develop a cardiac abnormality monitoring system using optimized regression techniques. The system will be designed to identify and monitor abnormal cardiac patterns in real-time, allowing for early intervention and treatment.

The specific objectives of the project include:

- **Data collection and preprocessing:** Collecting relevant data related to cardiac abnormalities from various sources and pre-processing it to remove noise and inconsistencies.
- **Feature engineering:** Identifying the most relevant features that can help in accurately predicting cardiac abnormalities and engineering new features if required.
- **Regression model selection:** Selecting the most suitable regression model for predicting cardiac abnormalities based on the characteristics of the data.
- **Model training and optimization:** Training the regression model on the preprocessed data and optimizing it to achieve the highest accuracy possible.
- **Model evaluation:** Evaluating the performance of the trained model on a separate test set to ensure that it generalizes well.
- **Deployment and monitoring**: Deploying the model to monitor cardiac abnormalities in patients in real-time and continuously monitoring its performance to ensure that it remains accurate and reliable.
- **Develop a comprehensive dataset of cardiac patterns:** The first objective of the project is to collect and preprocess a comprehensive dataset of cardiac patterns. The dataset will include electrocardiogram (ECG) signals and other relevant parameters, such as age, gender, medical history, and medication history. The dataset will be used for training and testing the optimized regression models.
- **Select an optimized regression technique:** The second objective of the project is to select an optimized regression technique that can effectively identify and monitor cardiac abnormality patterns. The regression technique will be selected based on its accuracy, computational efficiency, and ability to handle high dimensional data.
- **Train and optimize the regression model:** The third objective of the project is to train and optimize the regression model using the collected dataset. The regression model will be optimized using hyperparameter tuning, feature selection, and regularization techniques to improve its accuracy and generalizability.
- **Evaluate the performance of the regression model:** The fourth objective of the project is to evaluate the performance of the regression model using standard metrics such as accuracy, sensitivity, specificity, and area under the receiver

operating characteristic curve (AUC-ROC). The evaluation will be done using a separate test dataset to ensure the generalizability of the model.

- **Develop a real-time cardiac monitoring system:** The final objective of the project is to develop a real-time cardiac monitoring system that can detect and alert healthcare professionals of abnormal cardiac patterns. The system will be designed to integrate with existing hospital monitoring systems and provide alerts in real-time.

1.3 PROJECT SCOPE

People who experience a heart attack do not recognize the symptoms or delay seeking medical attention, which can lead to a more severe heart attack and poorer outcomes. Therefore, an accurate and reliable cardiac attack detection system can help identify individuals at high risk of a heart attack and prompt them to seek medical attention promptly.

Finally, cardiac attack detection can also help healthcare providers identify individuals who may benefit from preventative interventions, such as lifestyle changes, medications, or medical procedures, to reduce their risk of a heart attack in the future.

In summary, the need for cardiac attack detection is critical for improving outcomes for individuals who experience a heart attack, reducing the risk of future heart attacks, and ultimately, saving lives.

CHAPTER 2

LITERATURE SURVEY

2.1 SUMMARY OF EXISTING ARTICLES

TITLE: A Data Mining Approach for Cardiovascular Disease Diagnosis Using Heart Rate Variability and Images of Carotid Arteries

YEAR: 2016

AUTHORS: Hyeongsoo Kim , Musa Ibrahim M. Ishag , Minghao Piao ,Taeil Kwon ,

RESEARCH FINDINGS:

In this paper, we proposed not only an extraction methodology of multiple feature vectors from ultrasound images for carotid arteries (CAs) and heart rate variability (HRV) of electrocardiogram signal, but also a suitable and reliable prediction model useful in the diagnosis of cardiovascular disease (CVD). For inventing the multiple feature vectors, we extract a candidate feature vector through image processing and measurement of the thickness of carotid intima-media (IMT) The HDPS system
predicts the likelihood of patient getting a Heart disease. For prediction, the system uses sex, blood pressure, cholesterol like 13 medical parameters. As a complementary way, the linear and/or nonlinear feature vectors are also extracted from HRV, a main index for cardiac disorder. The significance of the multiple feature vectors is tested with several machine learning methods, namely Neural Networks, Support Vector Machine (SVM), Classification based on Multiple Association Rule (CMAR), Decision tree induction and Bayesian classifier. As a result, multiple feature vectors extracted from both CAs and HRV (CA+HRV) showed higher accuracy than the separative feature vectors of CAs and HRV. Furthermore, the SVM and CMAR showed about 89.51% and 89.46%, respectively, in terms of diagnosing accuracy rate after evaluating the diagnosis or prediction methods using the finally chosen multiple feature vectors. Therefore, the multiple feature vectors devised in this paper can be effective diagnostic indicators of CVD. In addition, the feature vector analysis and prediction techniques are expected to be helpful Btools in the decisions of cardiologists.

TITLE: Heart Disease Prediction Using Effective Machine Learning Techniques

YEAR: 2019

AUTHORS: Avinash Golande, Pavan Kumar T

RESEARCH FINDINGS:

In today's era deaths due to heart disease has become a major issue approximately one person dies per minute due to heart disease. This is considering both male and female category and this ratio may vary according to the region also this ratio is considered for the people of age group 25-69. This does not indicate that the people with other age group will not be affected by heart diseases. This problem may start in early age group also and predict the cause and disease is a major challenge nowadays. Here in this paper, we have discussed various algorithms and tools used for prediction of heart diseases.

TITLE: Intelligent Diagnosis of Cardiac Disease Prediction using Machine Learning

YEAR: 2019

AUTHORS: Ravindhar NV, Anand, Hariharan Shanmugasundaram, Ragavendran, Godfrey Winster

RESEARCH FINDINGS:

Cardiac disease have become worldwide common public health issue, mainly due to lack of awareness of health, poor lifestyle and poor consumption. Practitioners may have different concerns when it comes to disease diagnosis, which result in different decisions and actions. On the other hand, even in the specific case of a typical disease the amount of information available is so massive that it can be difficult to make accurate and reliable decisions. With adequate patient and non-patient medical constraints, it is possible to accurately predict how likely it is that a person with heart disease and to obtain potential information from these systems. A mechanized framework for therapeutic analysis would also dramatically increase medical considerations and reduce costs. We developed a framework in this exploration that can understand the principles of predicting the risk profile of patients with the clinical data parameters. In this article, four machine learning algorithms and one neural network algorithm were used to compare performance

measurements to cardiac diseases identification. We evaluated the algorithms with respect to accuracy, precision, recall and F1 settings to achieve the ability to predict cardiac attacks. The results show our method achieved 98 percent accuracy by neural network algorithm to predict cardiac diseases.

TITLE: Prediction of Coronary Heart Disease Using Routine Blood Tests

YEAR: 2016

AUTHORS: Ning Meng, Peng Zhang, Junfeng Li, Jun He and Jin Zhu1

RESEARCH FINDINGS:

This work was designed as a retrospective, single-center study of a hospital-based cohort. The 5060 CHD patients (2365 men and 2695 women) were 1 to 97 years old at baseline with 8 years (2009–2017) of medical records, 5051 health check-ups and 5075 cases of other diseases. We developed a two-layer Gradient Boosting Decision Tree(GBDT) model based on routine blood data to predict the risk of coronary heart disease, which could identify 86% of people with coronary heart disease. We built a dataset with 15,000 routine blood tests results. Using this dataset, we trained the twolayer GBDT model to classify healthy status, coronary heart disease and other diseases. As a result of the classification after machine learning, we found that the sensitivity of detecting the health data was approximately 93% for all data, and the sensitivity of detecting CHD was 93% for disease data that included coronary heart disease. On this basis, we further visualized the correlation between routine blood results and related data items, and there was an obvious pattern in health and coronary heart disease in all data presentations, which can be used for clinical reference. Finally, we briefly analyzed the results above from the perspective of pathophysiology.

TITLE: Improving the accuracy of prediction of heart disease risk based on ensemble classification techniques

YEAR: 2019

AUTHORS: Author links open overlay panelC. Beulah ChristalinLathaS. CarolinJeeva

RESEARCH FINDINGS:

Machine learning involves artificial intelligence, and it is used in solving many problems in data science. One common application of machine learning is the prediction of an outcome based upon existing data. The machine learns patterns from the existing dataset, and then applies them to an unknown dataset in order to predict the outcome. Class ification is a powerful machine learning technique that is commonly used for prediction. Some classification algorithms predict with satisfactory accuracy, whereas others exhibit a limited accuracy. This paper investigates a method termed ensemble classification, which is used for improving the accuracy of weak algorithms by combining multiple classifiers. Experiments with this tool were performed using a heart disease dataset. A comparative analytical approach was done to determine how the ensemble technique can be applied for improving prediction accuracy in heart disease. The focus of this paper is not only on increasing the accuracy of weak classification algorithms, but also on the implementation of the algorithm with a medical dataset, to show its utility to predict disease at an early stage. The results of the study indicate that ensemble techniques, such as bagging and boosting, are effective in improving the prediction accuracy of weak classifiers, and exhibit satisfactory performance in identifying risk of heart disease. A maximum increase of 7% accuracy for weak classifiers was achieved with the help of ensemble classification. The performance of the process was further enhanced with a feature selection implementation, and the results showed significant improvement in prediction accuracy.

TITLE: Effect of Preoperative Education on Postoperative Outcomes Among Patients Undergoing Cardiac Surgery: A Systematic Review and Meta-Analysis

YEAR: 2017

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RESEARCH FINDINGS:

A comprehensive literature search was made on PubMed, CINAHL, Ovid, ProQuest, ScienceDirect, Scopus, Web of Science, and the Cochrane database between 1995 and 2015. Fourteen randomized controlled trials were included. Data analysis was performed with RevMan software and created the Supplementary Appendix using the GRADE approach. Meta-analysis showed that preoperative education reduced anxiety scores (standardized mean difference = −0.96, 95% confidence interval: −1.37, −0.54; P < .0001). However, there was no significant effect of preoperative education on pain, depression, and length of hospital stay. There is low-quality evidence, and reasons for downgrading are due to study design limitations, inconsistency, and imprecision of effect estimates.

CHAPTER 3

SYSTEM ANALYSIS

3.1 EXISTING SYSTEM

- Cardiac abnormality monitoring systems typically involve the use of various physiological sensors that measure vital signs such as heart rate, blood pressure, and electrocardiogram (ECG) readings. These sensors generate large amounts of data, which can be analyzed using machine learning algorithms to identify patterns and anomalies that may indicate the presence of a cardiac abnormality.
- One approach to developing an optimized regression model for a cardiac abnormality monitoring system would be to use a supervised learning algorithm, such as linear regression or logistic regression. The model could be trained using a labeled dataset of physiological sensor readings and corresponding diagnosis or outcome data.
- To optimize the performance of the regression model, it is important to carefully select the input variables or features used in the analysis. This could involve feature selection techniques such as principal component analysis (PCA) or regularization methods such as Lasso or Ridge regression. These methods can help to identify the most relevant variables for predicting cardiac abnormalities, while also reducing the risk of overfitting the model to the training data.
- Once the regression model has been optimized, it can be integrated into an existing cardiac abnormality monitoring system. The system can be designed to automatically analyze incoming sensor data and generate alerts or notifications when abnormal patterns are detected. This can enable healthcare professionals to quickly identify potential cardiac abnormalities and provide timely treatment.
- Overall, developing an optimized regression model for a cardiac abnormality monitoring system requires careful attention to the selection of input variables, the choice of regression algorithm, and the optimization of model parameters. However, with the right approach and tools, it is possible to develop a highly accurate and effective system for detecting and monitoring cardiac abnormalities.

3.1.1 DISADVANTAGES OF EXISTING SYSTEM

The existing cardiac abnormality monitoring systems have several disadvantages, including:

- **Limited accuracy**: The current systems often rely on a limited set of data and use simplistic regression models, which can lead to inaccurate predictions and false alarms.
- **Lack of real-time monitoring**: Many existing systems only provide retrospective analysis of cardiac data, which can delay necessary interventions and treatments.
- **Inefficient use of resources**: The current systems often generate a high volume of false alarms, leading to unnecessary medical interventions and increased healthcare costs.
- **Limited scalability**: Some systems are designed for specific populations or conditions, limiting their ability to be applied more broadly.

3.2 PROPOSED SYSTEM

- The proposed system, heart disease detection using a machine learning algorithm, is implemented. An optimized methodology using multi-nomial Logistic regression as implemented in which the input data are collected from the MITBIH Standard benchmark website.
- The ECG data's abnormality is kindly monitored using the cardiac attack dataset. For the system, consider the Data Analytics technique to make available the presence of abnormality in the heart using the ECG data. In the initial stages, that training data is divided into 80% for training and 20% for testing data.
- The model is created using optimized multi-nominal Logistic regression. The symptoms multi-nominal regression algorithm combines the various historical parameters of the patient towards the detection of heart disease, and further, the classification accuracy is measured.
- cardiac abnormality monitoring system that utilizes optimized regressions to detect and track abnormalities in the heart's functioning. The system will be designed to analyse various physiological data such as ECG, blood pressure, heart

rate, and other relevant parameters to detect any abnormalities in the cardiac functioning of the patient.

- The system will use machine learning techniques such as regression analysis, which will be optimized to ensure the accuracy and reliability of the system. The system will be trained on a large dataset of patient records to identify patterns and correlations that indicate cardiac abnormalities. The regression models will be constantly updated and improved through the use of feedback from medical professionals and the analysis of new patient data.
- The system will be able to generate real-time alerts to medical professionals when it detects any abnormalities in the patient's cardiac functioning, allowing for early intervention and treatment. Additionally, the system will also provide visual representations of the patient's physiological data, making it easier for medical professionals to interpret and analyse the data.

3.2.1 ADVANTAGES OF PROPOSED SYSTEM

There are several advantages of implementing a cardiac abnormality monitoring system through optimized regressions. Here are some of the key advantages:

- **Early Detection of Cardiac Abnormalities**: One of the main advantages of this system is that it can detect cardiac abnormalities at an early stage. This allows patients to receive timely medical intervention and treatment, which can help prevent further complications and improve their overall health outcomes.
- **Accurate Predictions**: The use of optimized regression models can lead to more accurate predictions of cardiac abnormalities. This can help healthcare providers make better decisions regarding patient care and treatment.
- **Personalized Care**: The system can be tailored to the individual patient's needs, taking into account their unique medical history and risk factors. This allows for more personalized and targeted care, which can lead to better outcomes for the patient.
- **Cost-Effective**: Early detection and timely intervention can help prevent costly hospitalizations and procedures. This can lead to significant cost savings for both patients and healthcare providers.
- **Continuous Monitoring**: The system can provide continuous monitoring of a patient's cardiac health, which can help detect any changes or abnormalities in

real-time. This allows for prompt action to be taken if necessary, improving patient outcomes.

- **Improved Patient Experience**: The system can provide patients with greater control over their own healthcare and allow for more efficient communication with healthcare providers. This can improve the overall patient experience and satisfaction.

CHAPTER 4

SYSTEM REQUIREMENTS SPECIFICATION

4.1 HARDWARE REQUIREMENTS

- **Operating System:** Windows 10, 8.1, 7
- **Processor:**

  * Minimum: Any Intel or AMD x86-64 processor

  * Recommended: Any Intel or AMD x86-64 processor with four logical cores
- **Storage:** RAM: 8 GB
- **HDD or SSD:** 256 GB is strongly recommended

4.2 SOFTWARE REQUIREMENTS:

- **Coding Language**: Python (version 3.11.0)
- **Python Libraries:** NumPy, Pandas, Sklearn
- GOOGLE COLLAB

CHAPTER 5

FEASIBILITY STUDY

The feasibility of the project is analyzed in this phase and business proposal is put forth with a very general plan for the project and some cost estimates. During system analysis the feasibility study of the proposed system is to be carried out. This is to ensure that the proposed system is not a burden to the company. For feasibility analysis, some understanding of the major requirements for the system is essential Three key considerations involved in the feasibility analysis are

- Economical feasibility
- Technical feasibility
- Social feasibility

5.1 ECONOMICAL FEASIBILITY

This study is carried out to check the economic impact that the system will have on the organization. The amount of fund that the company can pour into the research and development of the system is limited. The expenditures must be justified. Thus the developed system as well within the budget and this was achieved because most of the technologies used are freely available. Only the customized products had to be purchased.

5.2 TECHNICAL FEASIBILITY

This study is carried out to check the technical feasibility, that is, the technical requirements of the system. Any system developed must not have a high demand on the available technical resources. This will lead to high demands on the available technical resources. This will lead to high demands being placed on the client. The developed system must have a modest requirement, as only minimal or null changes are required for implementing this system.

5.3 SOCIAL FEASIBILITY

The aspect of study is to check the level of acceptance of the system by the user. This includes the process of training the user to use the system efficiently. The user must not feel threatened by the system, instead must accept it as a necessity. The level of acceptance by the users solely depends on the methods that are employed to educate the

user about the system and to make him familiar with it. His level of confidence must be raised so that he is also able to make some constructive criticism, which is welcomed, as he is the final user of the system.

CHAPTER 6

SYSTEM DESIGN

6.1 DATAFLOW/BLOCK DIAGRAM

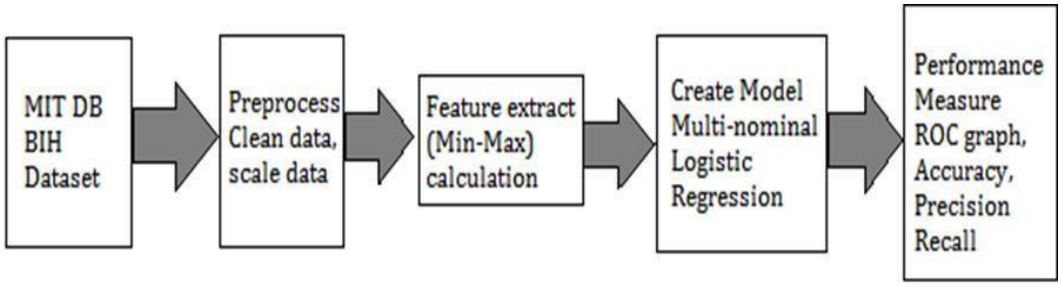

Fig 6.1 Shows the system architecture of the proposed model.

6.2 DESCRIPTION OF THE FLOW

Symptoms aware cardiac health analysis (SACHA) using optimized multinomial logistic regression (OMNLR).

Patient monitoring systems help monitor the remote access data of patience at every instant of time. It is required to provide a high level of care to the patients after high-risk post-surgical conditions that replace various physiological issues and changes. Monitoring systems are highly occupied with recent technologies helpful to make the automated computing and assessment of abnormal conditions. The development of artificial intelligence technology in medical equipment place and its significant role in detecting the normal condition of patience after surgery are regular care to be provided by wearables.

IMPLEMENTATION SUMMARY

The data analysis methodology is adopted here to identify critical patterns of cardiac abnormality. The design is initiated with the reprocessing step.The input dataset is completely read into the design analysis window and further scales the dimensionality. Since the data is unstructured, the preprocessing step reduces the unwanted data.The data is visualized, and features are extracted by evaluating the minimum and maximum value of the input pattern.

DATA ANALYSIS USING MIT BIH DATASET

The raw dataset is collected from Pysionet.org. The data is preprocessed to

remove noise and unwanted values, junk values and visualize the plots.

FEATURE EXTRACTION

The transformed data provides the frequency constant and the peak vector values. Normalize the values to the nearest round-off filtering method. Visualize the graphs. Model the data into training data and testing data. Classify the training data and testing data to find the maximum match. Classify the cardiac abnormalities such as ventricular arrhythmia, cardiac arrhythmia, Heart attack, and Normal. Measure the performance by evaluating the Confusion matrix, Calculating the accuracy using the formula below and Visualize the results.Efficient classification of Cardiac disease classification using the presented dataset. Comparatively good accuracy than existing approaches.

ALGORITHM

OPTIMIZED MULTINOMIAL REGRESSION ALGORITHM

It is a regression analysis algorithm in which the relationship between the input and the target values is identified by one more independent category of variables, namely softmax regression evaluation through a maximum entropy classifier.

The OMNLR model divides the input into dependent and independent variables. Based on the absolute values being continuous values, the classification takes place. The probability of occurrence increases as the input variable and the target variable correlate with each other. The softmax layer converges the linear feature with the probabilistic values; hence, the functional correlation makes sense of pattern matching.

OMNLR model classifies the given input into multiple classes of category.

The OMLR model is evaluated with the common expression given below

log(odd_data) = log_i(p)=ln(r/(1-p)) = a+b1x1+b2x2+b3x3+…

p=exp(log_i(p))/ 1+log_it(p)

Where:

p denotes the probability of occurrence of a particular class,

exp denotes the 2.72 exponential value considered,

a denotes the constant utilized in the equation,

b denotes the coefficient of the predicted variable areindependent values

Overall, developing an optimized regression model for a cardiac abnormality Monitoring system requires careful attention to the selection of input variables, the choice of regression algorithm, and the optimization of model parameters. However, with the right approach and tools, it is possible to develop a highly accurate and effective system for the detecting and monitoring cardiac abnormalities.

CHAPTER 7

PROJECT IMPLIMENTATION

7.1 SOFTWARE TOOL PYTHON

Python is an easy to learn, powerful programming language. It has efficient highlevel data structures and a simple but effective approach to object-oriented programming.

Python's elegant syntax and dynamic typing, together with its interpreted nature, make it an ideal language for scripting and rapid application development in many areas on most platforms.

The Python interpreter and the extensive standard library are freely available in source or binary form for all major platforms from the Python web site, https://www.python.org/, and may be freely distributed. The same site also contains distributions of and pointers to many free third party Python modules, programs and tools, and additional documentation.

The Python interpreter is easily extended with new functions and data types implemented in C or C++ (or other languages callable from C). Python is also suitable as an extension language for customizable applications.This tutorial introduces the reader informally to the basic concepts and features of the Python language and system. It helps to have a Python interpreter handy for hands-on experience, but all examples are selfcontained, so the tutorial can be read off-line as well.

For a description of standard objects and modules, see The Python Standard Library. The Python Language Reference gives a more formal definition of the language. To write extensions in C or C++, read Extending and Embedding the Python Interpreter and Python/C API Reference Manual. There are also several books covering Python in depth.

This tutorial does not attempt to be comprehensive and cover every single feature, or even every commonly used feature. Instead, it introduces many of Python's most noteworthy features, and will give you a good idea of the language's flavor and style. After reading it, you will be able to read and write Python modules and programs, and you will

be ready to learn more about the various Python library modules described in The Python Standard Library.

GOOGLE COLLAB

Google is quite aggressive in AI research. Over many years, Google developed AI framework called **TensorFlow** and a development tool called **Colaboratory**. Today TensorFlow is open-sourced and since 2017, Google made Colaboratory free for public use. Colaboratory is now known as Google Colab or simply **Colab**.

Another attractive feature that Google offers to the developers is the use of GPU. Colab supports GPU and it is totally free. The reasons for making it free for public could be to make its software a standard in the academics for teaching machine learning and data science. It may also have a long term perspective of building a customer base for Google Cloud APIs which are sold per-use basis. Irrespective of the reasons, the introduction of Colab has eased the learning and development of machine learning applications.

Jupyter notebook previously, you would quickly learn to use Google Colab. To be precise, Colab is a free Jupyter notebook environment that runs entirely in the cloud. Most importantly, it does not require a setup and the notebooks that you create can be simultaneously edited by your team members - just the way you edit documents in Google Docs. Colab supports many popular machine learning libraries which can be easily loaded in your notebook.

As a programmer, you can perform the following using Google Colab.

- Write and execute code in Python
- Document your code that supports mathematical equations
- Create/Upload/Share notebooks
- Import/Save notebooks from/to Google Drive
- Import/Publish notebooks from GitHub
- Import external datasets e.g. from Kaggle
- Integrate PyTorch, TensorFlow, Keras, OpenCV
- Free Cloud service with free GPU

- you will create and execute your first trivial notebook. Follow the steps that have been given wherever needed.

Note: As Colab implicitly uses Google Drive for storing your notebooks, ensure that you are logged in to your Google Drive account before proceeding further.

Step 1: Open the following URL in your browser : https://colab.research.google.com Your browser would display the following screen (assuming that you are logged into your Google Drive)

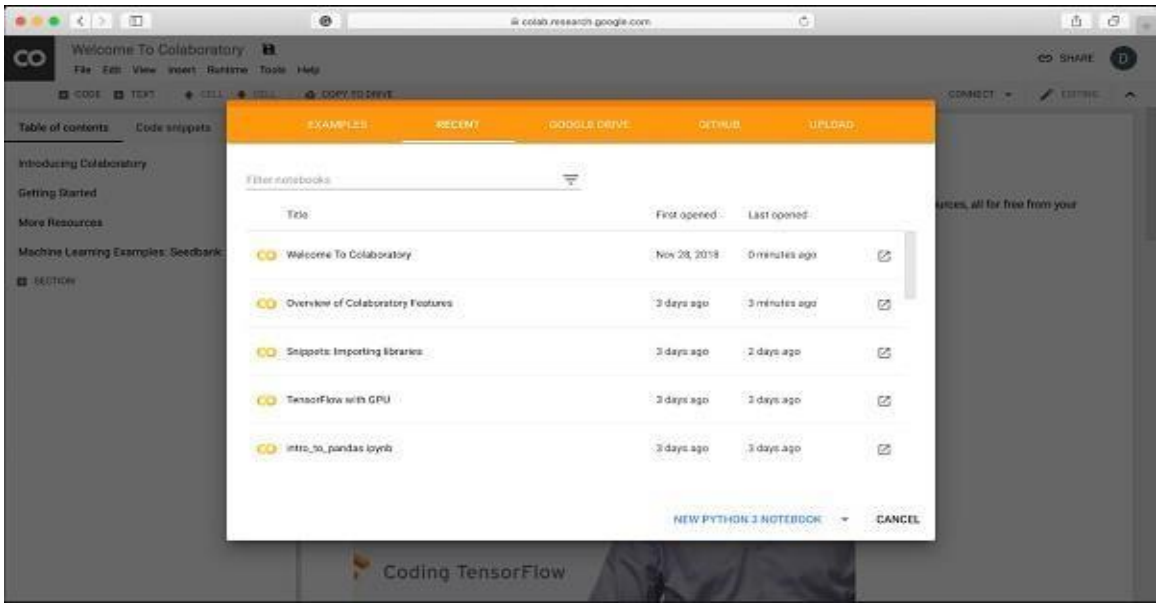

Fig 7.1 Browser URL

Step 2: Click on the **NEW PYTHON 3 NOTEBOOK** link at the bottom of the screen. A new notebook would open up as shown in the screen below.

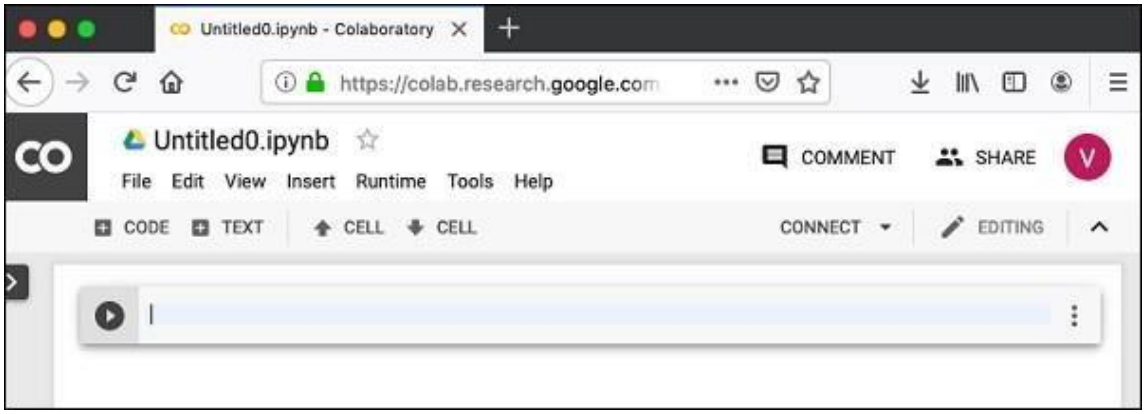

Fig 7.2 New Python 3 Notebook

As you might have noticed, the notebook interface is quite similar to the one provided in Jupyter. There is a code window in which you would enter your Python code. As the code cell supports full Python syntax, you may use Python **comments** in the code window to describe your code. However, many a time you need more than a simple text based comments to illustrate the ML algorithms. ML heavily uses mathematics and to explain those terms and equations to your readers you need an editor that supports LaTex a language for mathematical representations. Colab provides **Text Cells** for this purpose.

A text cell containing few mathematical equations typically used in ML is shown in the screenshot below

Setting Notebook Name

By default, the notebook uses the naming convention UntitledXX.ipynb. To rename the notebook, click on this name and type in the desired name in the edit box as shown here

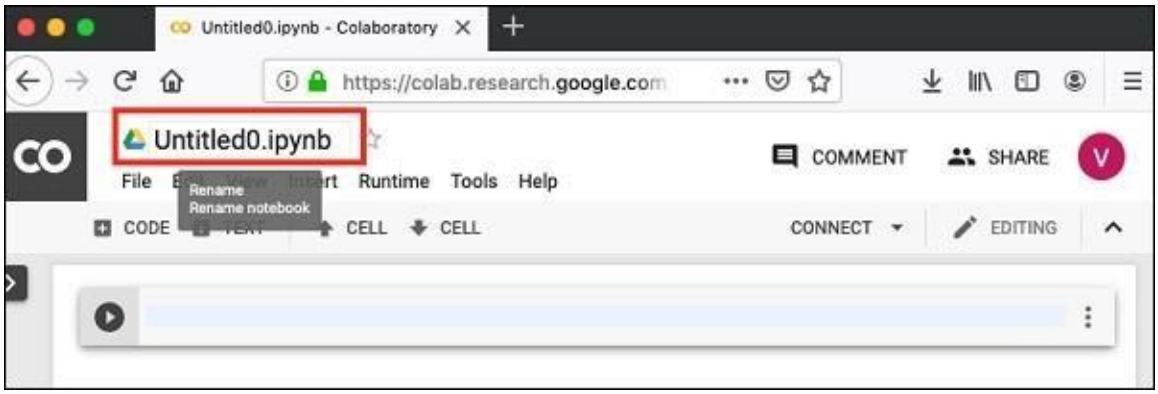

Fig 7.3 Untitled Notebook

We will call this notebook as **MyFirstColabNotebook**. So type in this name in the edit box and hit ENTER. The notebook will acquire the name that you have given now.

Entering Code

You will now enter a trivial Python code in the code window and execute it.

Enter the following two Python statements in the code window :

```
import time
print(time.ctime())
```

Executing Code

To execute the code, click on the arrow on the left side of the code window.

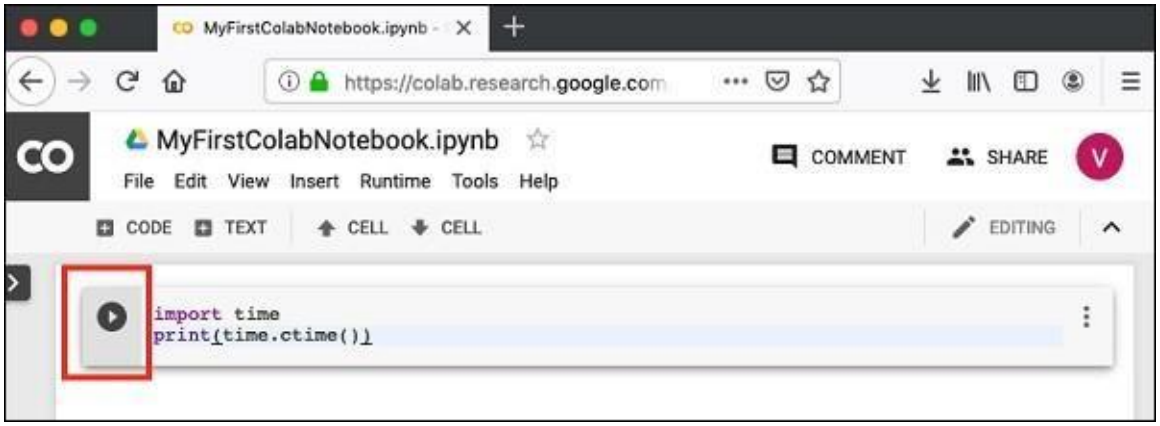

Fig 7.4 MyFirstColabNotebook.ipynb

After a while, you will see the output underneath the code window, as shown here :

Mon Jun 17 05:58:40 2019

You can clear the output anytime by clicking the icon on the left side of the output display.

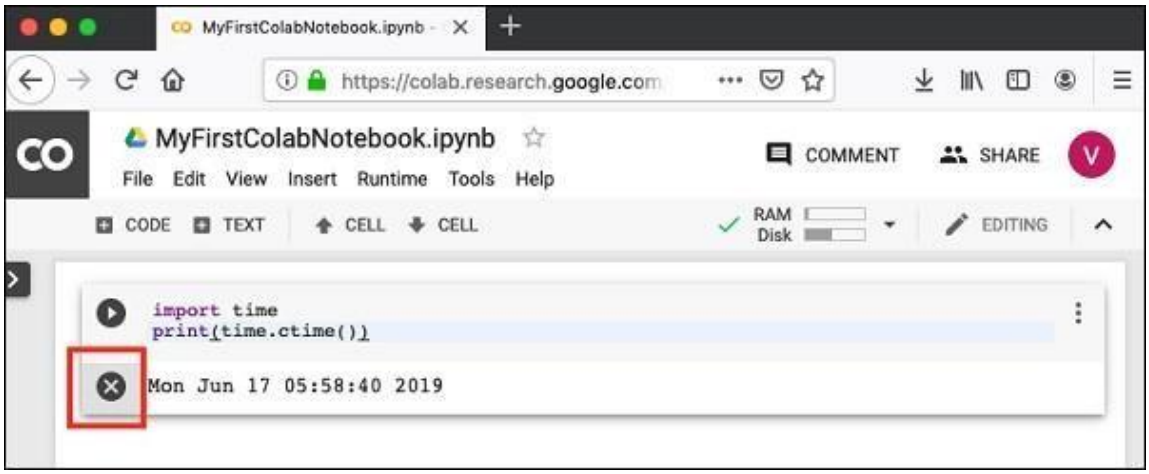

Fig 7.5 Output of cell

Adding Code Cells

To add more code to your notebook, select the following **menu** options :

Insert / Code Cell

Alternatively, just hover the mouse at the bottom center of the Code cell. When the **CODE** and **TEXT** buttons appear, click on the CODE to add a new cell. This is shown in the screenshot below :

Fig 7.6 Adding Code and Text

A new code cell will be added underneath the current cell. Add the following two statements in the newly created code window :

time.sleep(5) print

(time.ctime())

Now, if you run this cell, you will see the following output :

Mon Jun 17 04:50:27 2019

Certainly, the time difference between the two time strings is not 5 seconds. This is obvious as you did take some time to insert the new code. Colab allows you to run all code inside your notebook without an interruption.

Run All

To run the entire code in your notebook without an interruption, execute the following menu options :

Runtime / Reset and run all…

It will give you the output as shown below :

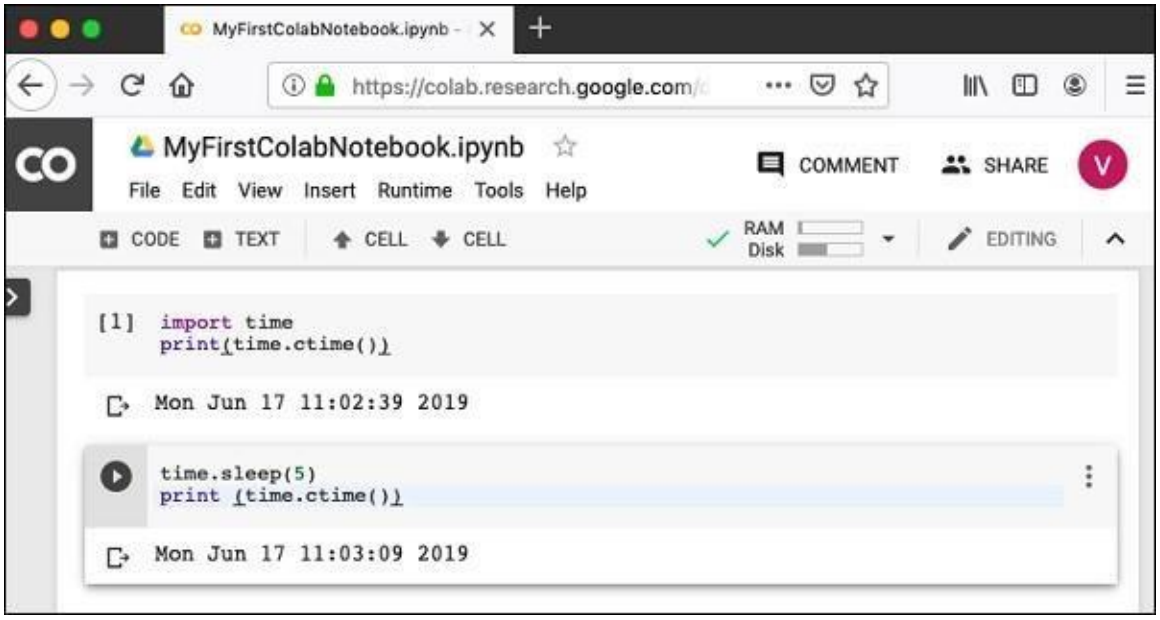

Fig 7.7 Runtime / Reset

Note that the time difference between the two outputs is now exactly 5 seconds.

The above action can also be initiated by executing the following two menu options :

Runtime / Restart runtime… or
Runtime / Restart all runtimes…

Followed by

Runtime / Run all

Study the different menu options under the **Runtime** menu to get yourself acquainted with the various options available to you for executing the notebook.

Changing Cell Order

When your notebook contains a large number of code cells, you may come across situations where you would like to change the order of execution of these cells. You can do so by selecting the cell that you want to move and clicking the **UP CELL** or **DOWN CELL** buttons shown in the following screenshot :

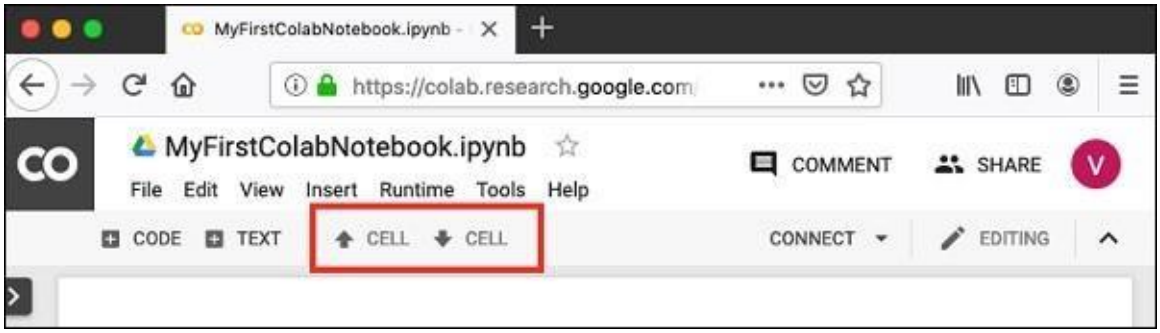

Fig 7.8 Up cell or Down cell

You may click the buttons multiple times to move the cell for more than a single position.

Deleting Cell

During the development of your project, you may have introduced a few nowunwanted cells in your notebook. You can remove such cells from your project easily with a single click. Click on the vertical-dotted icon at the top right corner of your code cell.

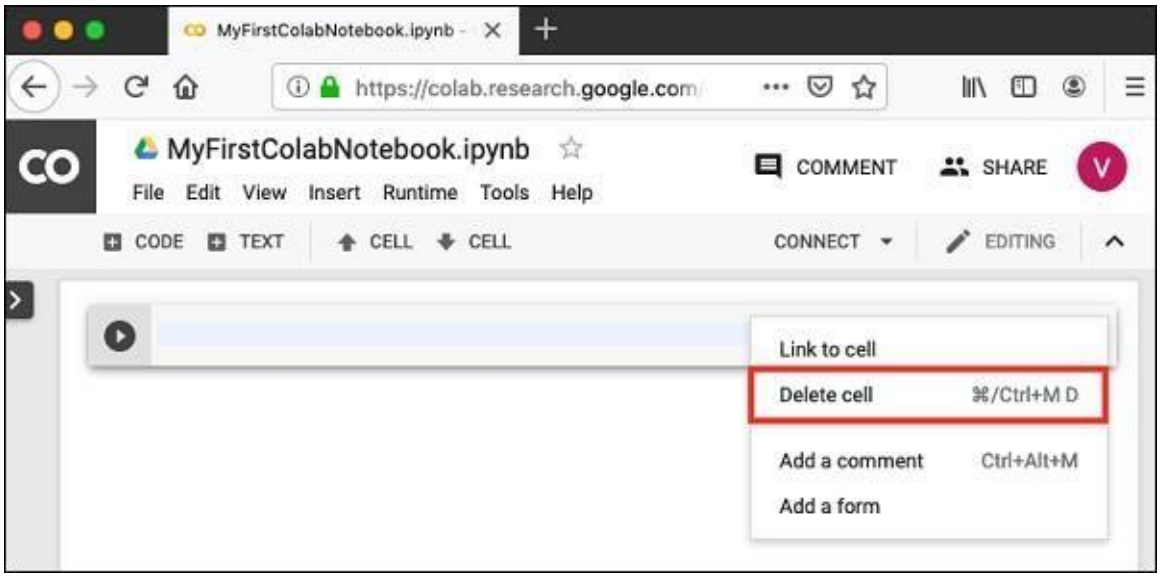

Fig 7.9 Deleting cell

Click on the **Delete cell** option and the current cell will be deleted.

7.2 PROGRAMMING

```
from google.colab import drive drive.mount('/content/drive')
#STEP 1 : Importing Libraries import pandas as pd import
matplotlib.pyplot as plt import numpy as np
#STEP 2 : Importing Datasets
dataset=pd.read_csv('/content/drive/MyDrive//reading2.csv'
) dataset.head()
plt.plot(dataset.ecg, c='g')
plt.xlabel('Raw ECG') plt.ylabel('Recorded
samples') plt.title('ECG Peak Points') #Data
Preprocessing from sklearn.preprocessing
import LabelEncoder
columnlist=['ecg','hb','eeg','px'] for
i in columnlist:
#STEP 3:      labelencoder_X=LabelEncoder()
dataset[i]=labelencoder_X.fit_transform(dataset[i])
print(dataset) plt.plot(dataset.ecg, c='r')
plt.xlabel('Preprocessed ECG') plt.ylabel('Recorded
samples') plt.title('Heart Beats Peak Points')
X=dataset.iloc[:,0:-1].values

X.shape
Y=dataset.iloc[:,4:].values
Y.shape
#STEP 4 : spliting the Datasets from
sklearn.model_selection import train_test_split
X_train,X_test,Y_train,Y_test  = train_test_split(X,Y,test_size =0.2,random_state=0)
```

```
#Building the Model from sklearn.linear_model
importLogisticRegressionregressor=
LogisticRegression()
H=regressor.fit(X_train,Y_train)
#Training Data X_train
plt.plot(X_train, c='b')
plt.xlabel('Values of Distributed
ECG') plt.ylabel('Recorded samples')
plt.title('Training Data') #TestingData
plt.plot(X_test, c='b') plt.xlabel('Values of
Distributed ECG') plt.ylabel('Recorded samples')
plt.title('Testing Data') from sklearn.metrics
import classification_report Y_pred =
regressor.predict(X_test)
print(classification_report(Y_test,Y_pred))
import random
n = random.randint(1,100) test_index =
int(input("enter patient ID to test"))
#test_index=5;
oxyy=np.append([dataset.ecg], [Y_pred])
oxyy if(oxyy[test_index]==0):
print("Level= Normal")
  n
elif(oxyy[test_index]==1):
print("Level= Cardiac Arythmia")
 n
```

```
elif(oxyy[test_index]==2):
 print("Level= Cardiac Attack")
 n else:
  print("Ventricular Arythmia") #output
data of patient
oxyy
```

CHAPTER 8

IMPLEMENATION

8.1 MODULE DESCRIPTION WITH ALGORITHM/ PSEUDOCODE

Optimized Multinomial Logistic Regression (OMLR)

Optimized Multinomial Logistic Regression (OMLR) is a statistical technique used to model the relationship between multiple categorical dependent variables and one or more independent variables. It is an extension of binary logistic regression, which is used to model the relationship between a binary dependent variable and one or more independent variables.

The goal of OMLR is to find the optimal set of coefficients that maximizes the likelihood of observing the data. This is achieved by iteratively estimating the coefficients that minimize the deviance, which measures the difference between the predicted probabilities and the actual outcomes. The process is repeated until convergence, where the estimated coefficients are stable and do not change significantly between iterations. OMLR is commonly used in fields such as marketing, social sciences, and healthcare to model the relationship between multiple categorical variables and a set of predictors. For example, it can be used to predict the probability of a customer purchasing a product based on their demographic information and previous purchasing behavior.

To apply OMLR, it is essential to select the appropriate set of independent variables and categorical dependent variables. It is also crucial to check the assumptions of the model, such as the linearity of the relationship between the independent variables and the log-odds of the dependent variables.

In summary, OMLR is a powerful statistical technique that can help researchers and practitioners model the relationship between multiple categorical dependent variables and one or more independent variables, allowing them to make predictions and identify factors that influence the outcomes of interest.

CHAPTER 9

TESTING

CODE TESTING AND VALIDATION

9.1 CODING STANDARDS

Coding standards are guidelines to programming that focuses on the physical structure and appearance of the program. They make the code easier to read, understand and maintain. This phase of the system actually implements the blueprint developed during the design phase. The coding specification should be in such a way that any programmer must be able to understand the code and can bring about changes whenever felt necessary. Some of the standard needed to achieve the above-mentioned objectives are as follows:

Program should be simple, clear and easy to understand.

- Naming conventions
- Value conventions
- Script and comment procedure
- Message box format
- Exception and error handling

9.2 NAMING CONVENTIONS

Naming conventions of classes, data member, member functions, procedures etc., should be self-descriptive. One should even get the meaning and scope of the variable by its name. The conventions are adopted for easy understanding of the intended message by the user. So it is customary to follow the conventions. These conventions are as follows:

- Class names
- Class names are problem domain equivalence and begin with capital letter and have mixed cases
- Member Function and Data Member name, Member function and data member name begins with a lowercase letter with each subsequent letters

Value conventions

Value conventions ensure values for variable at any point of time. This involves the following:

- Proper default values for the variables.
- Proper validation of values in the field.
- Proper documentation of flag values.

Script writing and commenting standard

Script writing is an art in which indentation is utmost important. Conditional and looping statements are to be properly aligned to facilitate easy understanding. Comments are included to minimize the number of surprises that could occur when going through the code.

Message box format

- When something has to be prompted to the user, he must be able to understand it properly. To achieve this, a specific format has been adopted in displaying messages to the user. They are as follows:
- X – User has performed illegal operation.
- ! – Information to the user.

9.3 TEST PROCEDURE

System testing

Testing is performed to identify errors. It is used for quality assurance. Testing is an integral part of the entire development and maintenance process. The goal of the testing during phase is to verify that the specification has been accurately and completely incorporated into the design, as well as to ensure the correctness of the design itself. For example the design must not have any logic faults in the design is detected before coding commences, otherwise the cost of fixing the faults will be considerably higher as reflected. Detection of design faults can be achieved by means of inspection as well as walkthrough.Testing is one of the important steps in the software development phase. Testing checks for the errors, as a whole of the project testing involves the following test cases:

- Static analysis is used to investigate the structural properties of the Source code.
- Dynamic testing is used to investigate the behavior of the source code by executing the program on the test data.

9.4 TEST DATA AND OUTPUT

9.4.1 Unit testing

Unit testing is conducted to verify the functional performance of each modular component of the software. Unit testing focuses on the smallest unit of the software design (i.e.), the module. The white-box testing techniques were heavily employed for unit testing.

9.4.2 Functional test

Functional test cases involved exercising the code with nominal input values for which the expected results are known, as well as boundary values and special values, such as logically related inputs, files of identical elements, and empty files.

Three types of tests in Functional test:

- Performance Test
- Stress Test
- Structure Test

9.4.3 Performance test

It determines the amount of execution time spent in various parts of the unit, program throughput, and response time and device utilization by the program unit.

9.4.4 Stress test

Stress Test is those test designed to intentionally break the unit. A Great deal can be learned about the strength and limitations of a program by examining the manner in which a programmer in which a program unit breaks.

9.4.5 Structured test

Structure Tests are concerned with exercising the internal logic of a program and traversing particular execution paths. The way in which White-Box test strategy was employed to ensure that the test cases could Guarantee that all independent paths within a module have been have been exercised at least once.

Exercise all logical decisions on their true or false sides.

- Execute all loops at their boundaries and within their operational bounds.
- Exercise internal data structures to assure their validity.
- Checking attributes for their correctness.
- Handling end of file condition, I/O errors, buffer problems and textual errors in output information

9.4.6 Integration testing

Integration testing is a systematic technique for construction the program structure while at the same time conducting tests to uncover errors associated with interfacing. i.e., integration testing is the complete testing of the set of modules which makes up the product. The objective is to take untested modules and build a program structure tester should identify critical modules. Critical modules should be tested as early as possible. One approach is to wait until all the units have passed testing, and then combine them and then tested. This approach is evolved from unstructured testing of small programs. Another strategy is to construct the product in increments of tested units. A small set of modules are integrated together and tested, to which another module is added and tested in combination. And so on. The advantages of this approach are that, interface dispenses can be easily found and corrected.

The major error that was faced during the project is linking error. When all the modules are combined the link is not set properly with all support files. Then we checked out for interconnection and the links. Errors are localized to the new module and its intercommunications. The product development can be staged, and modules integrated in

as they complete unit testing. Testing is completed when the last module is integrated and tested.

9.5 TESTING TECHNIQUES / TESTING STRATERGIES

A) Testing

Testing is a process of executing a program with the intent of finding an error. A good test case is one that has a high probability of finding an as-yet –undiscovered error. A successful test is one that uncovers an as-yet- undiscovered error. System testing is the stage of implementation, which is aimed at ensuring that the system works accurately and efficiently as expected before live operation commences. It verifies that the whole set of programs hang together. System testing requires a test consists of several key activities and steps for run program, string, system and is important in adopting a successful new system. This is the last chance to detect and correct errors before the system is installed for user acceptance testing.

The software testing process commences once the program is created and the documentation and related data structures are designed. Software testing is essential for correcting errors. Otherwise the program or the project is not said to be complete. Software testing is the critical element of software quality assurance and represents the ultimate the review of specification design and coding. Testing is the process of executing the program with the intent of finding the error. A good test case design is one that as a probability of finding an yet undiscovered error. A successful test is one that uncovers an yet undiscovered error. Any engineering product can be tested in one of the two ways:

B) White box testing

This testing is also called as Glass box testing. In this testing, by knowing the specific functions that a product has been design to perform test can be conducted that demonstrate each function is fully operational at the same time searching for errors in each function. It is a test case design method that uses the control structure of the procedural design to derive test cases. Basis path testing is a white box testing.

- Flow graph notation
- Cyclometric complexity

- Deriving test cases
- Graph matrices Control

C) Black box testing

In this testing by knowing the internal operation of a product, test can be conducted to ensure that "all gears mesh", that is the internal operation performs according to specification and all internal components have been adequately exercised. It fundamentally focuses on the functional requirements of the software.

The steps involved in black box test case design are:

- Graph based testing methods
- Equivalence partitioning
- Boundary value analysis
- Comparison testing

D) Software testing strategies:

A software testing strategy provides a road map for the software developer. Testing is a set activity that can be planned in advance and conducted systematically. For this reason a template for software testing a set of steps into which we can place specific test case design methods should be strategy should have the following characteristics:

- Testing begins at the module level , works "outward" toward integration of the entire computer based system.
- Different testing techniques are appropriate at different points in time.
- Testing and Debugging are different activities but debugging must be a accommodated in any testing strategy

E) Integration testing:
F)

Integration testing is a systematic technique for constructing the program structure while at the same time conducting tests to uncover errors associated with. Individual modules, which are highly prone to interface errors, should not be assumed to work instantly when we put them together. The problem of course, is "putting them together"- interfacing. There may be the chances of data lost across on another's sub functions, when combined may not produce the desired major function; individually acceptable impression may be magnified to unacceptable levels; global data structures can present problems.

Program testing:

The logical and syntax errors have been pointed out by program testing. Program testing is the process of executing a program with the intent of finding errors. A good test is one that has a high probability of finding an error. Program testing cannot show the absence of errors. It can only show if errors are present.A syntax error is an error in a program statement that in violates one or more rules of the language in which it is written. An improperly defined field dimension or omitted keywords are common syntax error. These errors are shown through error messages generated by the computer. A logic error on the other hand deals with the incorrect data fields, out-off-range items and invalid combinations. Since the compiler s will not deduct logical error, the programmer must examine the output. Condition testing exercises the logical conditions contained in a module. The possible types of elements in a condition include a Boolean operator, Boolean variable, a pair of Boolean parentheses A relational operator or on arithmetic expression. Condition testing method focuses on testing each condition in the program the purpose of condition test is to deduct not only errors in the condition of a program but also other a errors in the program.

G) Security testing

Security testing attempts to verify the protection mechanisms built in to a system well, in fact, protect it from improper penetration. The system security must be tested for invulnerability from frontal attack must also be tested for invulnerability from rear attack. During security, the tester places the role of individual who desires to penetrate system. Security Testing is a type of Software Testing that uncovers vulnerabilities, threats, risks in a software application and prevents malicious attacks from intruders.

H) Validation testing

At the culmination of integration testing, software is completely assembled as a package. Interfacing errors have been uncovered and corrected and a final series of software test-validation testing begins. Validation testing can be defined in many ways, but a simple definition is that validation succeeds when the software functions in manner that is reasonably expected by the customer. Software validation is achieved through a series of black box tests that demonstrate conformity with requirement. After validation test has been conducted, one of two conditions exists.

- The function or performance characteristics confirm to specifications and are accepted.
- A validation from specification is uncovered and a deficiency created.

Deviation or errors discovered at this step in this project is corrected prior to completion of the project with the help of the user by negotiating to establish a method for resolving deficiencies. Thus the proposed system under consideration has been tested by using validation testing and found to be working satisfactorily. Though there were deficiencies in the system they were not catastrophic.

I) User acceptance testing

User acceptance of the system is key factor for the success of any system. The system under consideration is tested for user acceptance by constantly keeping in touch with prospective system and user at the time of developing and making changes whenever required. This is done in regarding to the following points.

- Input screen design.
- Output screen design.

Software testing

General

The purpose of testing is to discover errors. Testing is the process of trying to discover every conceivable fault or weakness in a work product. It provides a way to check the functionality of components, subassemblies, assemblies and/or a finished product It is

the process of exercising software with the intent of ensuring that the Software system meets its requirements and user expectations and does not fail in an unacceptable manner. There are various types of test. Each test type addresses a specific testing requirement.

DEVELOPING METHODOLOGIES

The test process is initiated by developing a comprehensive plan to test the general functionality and special features on a variety of platform combinations. Strict quality control procedures are used.

The process verifies that the application meets the requirements specified in the system requirements document and is bug free. The following are the considerations used to develop the framework from developing the testing methodologies.

Types of Tests

Unit testing

Unit testing involves the design of test cases that validate that the internal program logic is functioning properly, and that program input produces valid outputs. All decision branches and internal code flow should be validated. It is the testing of individual software units of the application .it is done after the completion of an individual unit before integration. This is a structural testing, that relies on knowledge of its construction and is invasive. Unit tests perform basic tests at component level and test a specific business process, application, and/or system configuration. Unit tests ensure that each unique path of a business process performs accurately to the documented specifications and contains clearly defined inputs and expected results.

Functional test

Functional tests provide systematic demonstrations that functions tested are available as specified by the business and technical requirements, system documentation, and user manuals.

Functional testing is centered on the following items:

Valid Input - identified classes of valid input must be accepted.

Invalid Input - identified classes of invalid input must be rejected.

Functions - identified functions must be exercised.

Output - identified classes of application outputs must be exercised.

Systems/Procedures: interfacing systems or procedures must be invoked.

System Testing

System testing ensures that the entire integrated software system meets requirements. It tests a configuration to ensure known and predictable results. An example of system testing is the configuration oriented system integration test. System testing is based on process descriptions and flows, emphasizing pre-driven process links and integration points.

Performance Test

The Performance test ensures that the output is produced within the time limits, and the time taken by the system for compiling, giving response to the users and request being send to the system for to retrieve the results.

Integration Testing

Software integration testing is the incremental integration testing of two or more integrated software components on a single platform to produce failures caused by interface defects.

The task of the integration test is to check that components or software applications, e.g. components in a software system or one step up software applications at the company level interact without error.

Acceptance Testing

User Acceptance Testing is a critical phase of any project and requires significant participation by the end user. It also ensures that the system meets the functional requirements.

Acceptance testing for Data Synchronization:

- The Acknowledge will be received by the Sender Node after the Packets are received by the Destination Node

- The Route add operation is done only when there is a Route request in need
- The Status of Nodes information is done automatically in the Cache Updating process

Build the test plan

Any project can be divided into units that can be further performed for detailed processing. Then a testing strategy for each of this unit is carried out. Unit testing helps to identity the possible bugs in the individual component, so the component that has bugs can be identified and can be rectified from errors.

CHAPTER 10

RESULTS

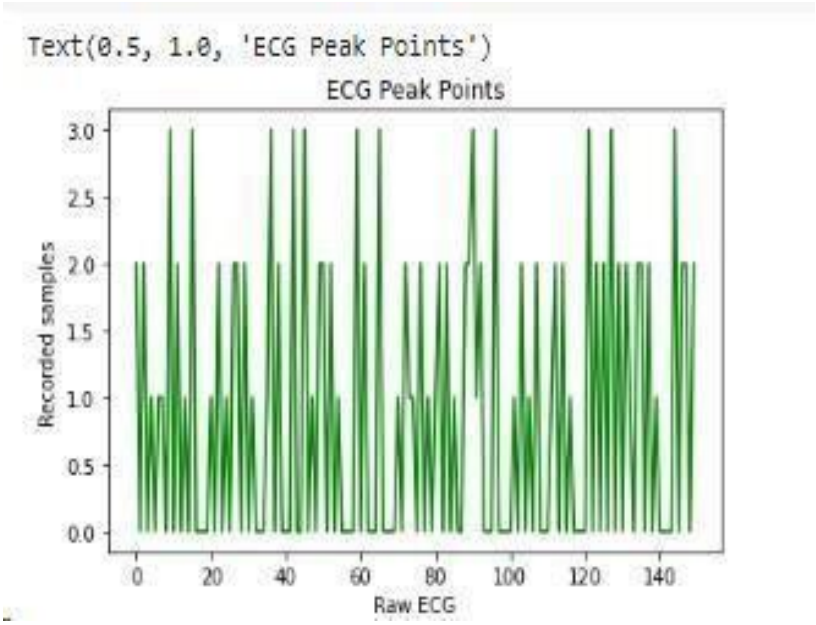

Fig 10.1 Raw ECG data

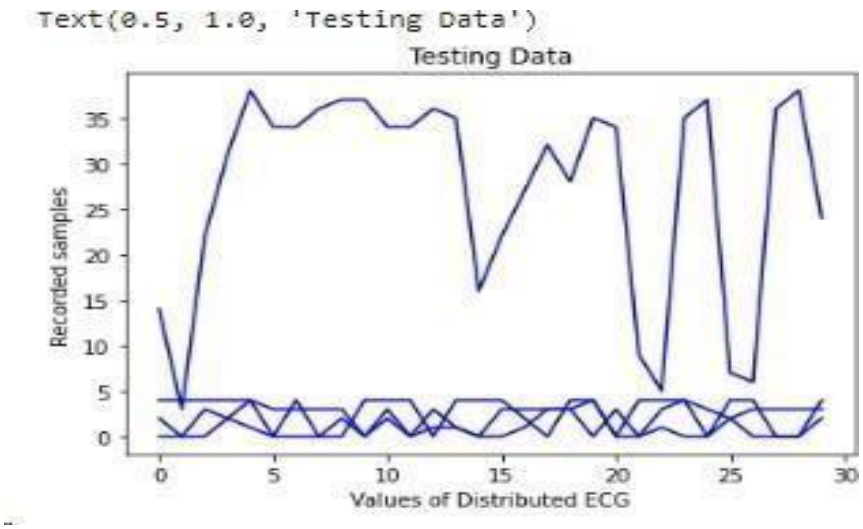

Fig 10.2 shows the raw ECG data visualization with respect to time vs. peak value of the ECG is graphically shown here

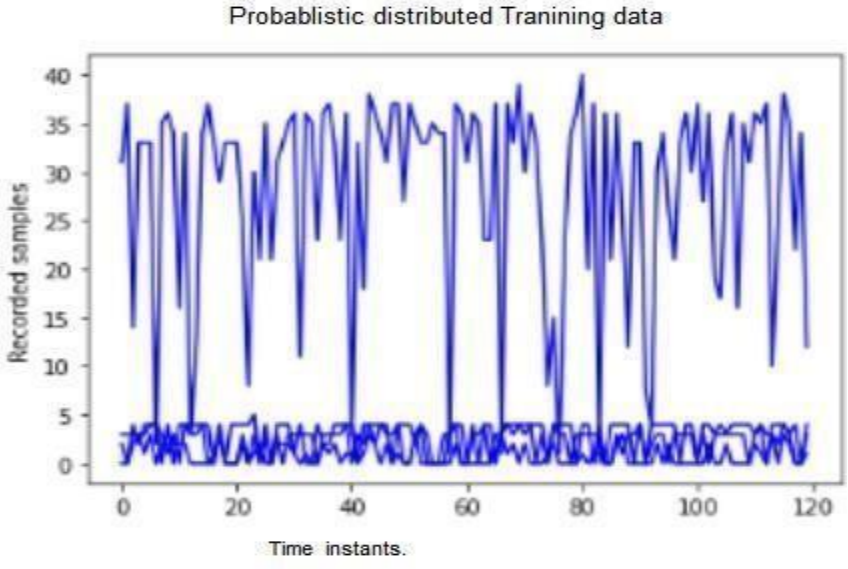

Fig 10.3 shows the training data on probabilistic distributed values hence the instants of all data is displayed over here.

S No	References	Methodology	Dataset	Quantitative measures
1	E. Alonso et al. (2020)	Live ECG + SVM classifier	OHPD	Acc=92.6%
2	S. Chandra et al. (2023)	Cloud based Bio sensor	Arrythmia Static data	Acc=97.8%
3	Z. Cui et al., 2021	Unsupervised model (ANN)	MICCAI 2017 MM-WHS datase	Acc=85.8%
4	Proposed method	Optimized multinomial Logistic regression model(OMNLR)	MITBIH arrhythmia dataset	Acc=98%

Table 1. Comparison of Proposed approach with Existing methods

CHAPTER 11

CONCLUSION

Majority of the peoples impacted by the cardiac problems due to life style changes, irregular health maintenance, chronic diseases that impact the major organs such as diabetics etc. the light weight analysis model that considers the data and statistics behind each data on normal and abnormal condition. In the proposed system efficient model to test the cardiac abnormality is using Symptoms aware cardiac health analysis (SACHA) with optimized multinomial logistic regression (OMNLR) is tested. the optimization mechanism tune the data into adaptive weights adjusted till better prediction. The ECG data are converted and tested as frames of 1x1000 samples at a time. The accuracy of 98% is achieved with prediction duration of 52 seconds is formulated.

CHAPTER 12

FUTURE ENHANCEMENT

Further, the study also showed that the ARIMA and linear regression models performed the best in all experiments, and the KNN, LSTM and random forest regressor models performed very poorly; the decision tree regressor model had average performance for the 30 s and 1 min windows. The SVR model also performed better in the first two experiments, i.e., the 30 s and 1-min windows; however, similar to the other models such as KNN, decision tree regressor, random forest regressor and the LSTM, the performance for other experimental sliding windows was relatively better but unstable. However, our results also indicated that the RMSE and SI were the best in ultra-short (i.e., between 30 s and 4 min) sliding window durations. This is due the fact that there is a decrease in bias towards the HR as a result of limited HR fluctuations, which is also a good parameter to measure the heart rate variability.

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