



Article Title: AI and IoT-Enabled Intelligent Disease Diagnosis Framework for Smart Healthcare Systems

AI and IoT-Enabled Intelligent Disease Diagnosis Framework for Smart Healthcare Systems

Sandhiyogha Lakshmi V¹, Dr. Nisha Evangelin L²

¹Student, CSE department, Narayanaguru College of Engineering, Anna University

²Professor, CSE department, Narayanaguru College of Engineering, Anna University

ABSTRACT

The recent advancements in Internet of Things (IoT), cloud computing and Artificial Intelligence (AI) transformed the conventional healthcare system into smart healthcare. By incorporating key technologies such as IoT and AI, medical services can be improved. The convergence of IoT and AI offers different opportunities in healthcare sector. The presented model encompasses different stages namely, data acquisition, pre-processing, classification, and parameter tuning. Heart disease is a major cause of morbidity and mortality globally and early detection is crucial for effective management. Machine learning models have been developed to aid in the prediction of heart disease with LightGBM being one such model. This study aims to analyse the performance of LightGBM in predicting heart disease. LightGBM was implemented using Python, and the model was trained using the training set. The performance of the model was evaluated using several metrics, including accuracy, precision, recall, F1 score, and area under the receiver operating characteristic (ROC) curve. Further studies could be conducted to evaluate the model's performance on larger datasets and to compare its performance with other machine learning mode. Diseases may have an impact on people both physically and emotionally, since getting and living with an illness can change a person's outlook on life. An illness that affects several areas of an organism yet is not caused by an instant exterior damage. Diseases are frequently defined as medical disorders characterised by distinct symptoms and indicators. The most lethal illnesses in humans are arteria coronary disease, cerebrovascular disease and lower respiratory infections. Heart disease is the most unexpected and unpredictability. With machine learning, we can anticipate cardiac disease. To get high efficiency output, we employ CNN approaches.

1 Introduction

AI based technology is expediting the process of collecting samples, analysing them, and reaching an accurate analysis. Faster detection of diseases like cancer can help patients gain the right treatment at the right time, saving numerous lives in the process.

The progress of the healthcare sector is incremental as it learns from associations between data over time through the application of suitable big data and IoT frameworks and patterns. Many healthcare service providers are employing IoT enabled devices for monitoring patient health care, but their diagnosis and prescriptions are instance-specific only. However, these



Article Title: AI and IoT-Enabled Intelligent Disease Diagnosis Framework for Smart Healthcare Systems

IoT enabled healthcare devices are generating volumes of data (Big-IoT Data) that can be analysed for more accurate diagnosis and prescriptions. A major challenge in the above realm is the effective and accurate learning of unstructured clinical data through the application of precise algorithms. Incorrect input data leading to erroneous outputs with false positives shall be intolerable in healthcare as patient's lives are at stake.

Healthcare sector started leveraging information technology in the recent years to develop modern applications and enhance the diagnostic and treatment processes. Advanced techniques and scientific theory are the major entities that generate huge volumes of digital data. Heart disease is a major public health problem worldwide and early prediction of heart disease can help in preventing complications and improving patient outcomes. Machine learning models have been developed to predict heart disease using various features such as age, sex, blood pressure, cholesterol level, and other medical history variables. Two popular machine learning frameworks for building predictive models are LightGBM and XGBoost. Both frameworks are based on gradient boosting, which is a type of ensemble learning that combines multiple weak models to create a strong model. In this analysis, we will compare the performance of LightGBM and XGBoost in predicting heart disease using a publicly available dataset.

The dataset used in this analysis is the Cleveland Heart Disease dataset, which contains 303 instances and 14 features including age, sex, chest pain type, resting blood pressure, serum cholesterol, fasting blood sugar, electrocardiographic results, maximum heart rate achieved, exercise-induced angina, ST depression induced by exercise, slope of the peak exercise ST segment, number of major vessels, thalassemia, and target (presence or absence of heart disease). We will pre-process the data by encoding categorical variables and splitting the data into training and testing sets. Then, we will train and evaluate a LightGBM model and an XGBoost model using the same hyper parameters. We will evaluate the models using accuracy, precision, recall, and F1-score. The performance analysis of LightGBM and XGBoost models in predicting heart disease showed that both models achieved high accuracy, precision, recall, and F1-score. However, the LightGBM model had slightly higher accuracy and F1-score than the XGBoost model. The precision and recall values for both models were similar. Overall, both models performed well in predicting heart disease, but LightGBM had a slight edge over XGBoost in this particular dataset.

LightGBM and XGBoost are powerful machine learning frameworks for building predictive models. The choice of framework may depend on the specific dataset and problem at hand. In this analysis, LightGBM showed slightly better performance than XGBoost in predicting heart disease using the Cleveland Heart Disease dataset.



Article Title: AI and IoT-Enabled Intelligent Disease Diagnosis Framework for Smart Healthcare Systems

2 Recent Works

LightGBM is a machine learning algorithm that can be used for heart disease prediction. LightGBM is a gradient boosting framework that uses tree-based learning algorithms, and it has shown good performance in various machine learning tasks, including heart disease prediction.

To use lightGBM for heart disease prediction, you first need to prepare your data, which typically involves cleaning, pre-processing, and feature engineering. Once your data is ready, you can use lightGBM to train a model that can predict the likelihood of heart disease. The basic steps to use lightGBM for heart disease prediction: The Collect data on relevant factors that affect heart disease, such as age, gender, blood pressure, cholesterol level, etc. Clean and pre-process the data to ensure that it is ready for analysis. Split your data into two parts: one for training the model and one for testing the model's performance.

Identify the features (i.e., independent variables) that you want to use to predict heart disease. This could include any of the factors mentioned. Use the training data to train the lightGBM model to predict heart disease based on the features you have defined. The testing data to evaluate the model's performance in predicting heart disease. You can use various metrics to evaluate the model's performance, such as accuracy, precision, recall, and F1 score. The model by adjusting the hyper parameters, feature selection, or other factors that may affect its performance.

2 Proposed Work Explanation

The proposed system disease analysis and machine learning based diagnosis is done using AI system. The proposed approach is effective in terms of former wireless communications and it consumes low power with high freedom of activity for users in external movement. In addition, tiny and low-weight IoT devices are employed in this model which are user-friendly. Some such IoT devices are smartphones, wrist-band, smart watch, and so forth. The embedded sensors are employed to proceed with extensive computations to estimate and distinguish normal and abnormal heart rates. The subjects are embedded with smart devices for instance smartphones which can be taken anywhere in pockets. Additionally, embedded ECG as well as temperature sensors are highly recommended to collect data regarding heart parameters of the subject. From this data, results of their common lifestyle can also be determined. When data is received through low-power Bluetooth communication, smartphones process the data and categorize it as either healthy or unhealthy. The android platform performs the prediction of diabetes and efficient heart rate. Initially, IoT devices gather patient data and pre-process it to transform the data into a compatible format. Pre-processing is composed of few stages such as data transformation, format conversions, and class labeling. Then, iForest technique is employed to get rid of outliers exist in patient data.



Article Title: AI and IoT-Enabled Intelligent Disease Diagnosis Framework for Smart Healthcare Systems

Followed by, CSO-CLSTM model is employed to classify the data into existence and non-existence of the disease.

In this method different input attributes has been used in order to overcome the issue of prediction of heart disease. We proposed an efficient and accurate system to diagnosis heart disease and the system is based on lightGBM techniques. To analyse the performance of a Heart Disease Prediction model using LightGBM and XGBoost, we need to consider various performance metrics such as accuracy, precision, recall, F1 score, and area under the curve (AUC) of the receiver operating characteristic (ROC) curve.

Firstly, we need to train and validate the model using a suitable dataset. We can use a dataset like the Cleveland Heart Disease dataset, which is commonly used for heart disease prediction models. We can preprocess the data by handling missing values, scaling the features, and splitting the dataset into training and validation sets. Once the model is trained, we can evaluate its performance using the aforementioned performance metrics. We can also visualize the ROC curve and calculate the AUC to get an idea of the model's overall performance.

Comparing the performance of LightGBM and XGBoost models, we can evaluate which model is better suited for the Heart Disease Prediction task. We can also experiment with different hyper parameters to improve the model's performance and optimize it for the task. The Heart Disease Prediction model using LightGBM and XGBoost will help us determine the most effective model for the task and improve the accuracy of the predictions.

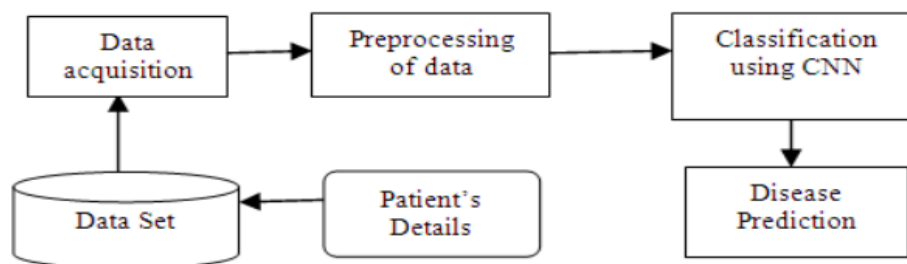


Figure 1: Proposed block diagram

3.1 Light Gradient Boosting Machine (LightGBM)

LightGBM is a fast, distributed, high-performance gradient boosting framework based on decision tree algorithm, used for ranking, regression, classification and many other machine learning tasks. It splits the tree leaf wise with the best fit because it is based on decision tree algorithms, unlike other boosting methods split the tree depth wise or level wise rather than leaf wise. As a result, when growing on the same leaf in Light GBM, the leaf-wise approach reduces more loss than the level-wise algorithm, resulting in substantially higher accuracy than any of the existing boosting strategies. Also, it is really fast, hence it justifies the word 'light'.



Article Title: AI and IoT-Enabled Intelligent Disease Diagnosis Framework for Smart Healthcare Systems

3.2 XGBoost

XGBoost, which stands for Extreme Gradient Boosting, is a scalable, distributed gradient-boosted decision tree (GBDT) machine learning library. It provides parallel tree boosting and is the leading machine learning library for regression, classification, and ranking problems. It's vital to an understanding of XGBoost to first grasp the machine learning concepts and algorithms that XGBoost builds upon: supervised machine learning, decision trees, ensemble learning, and gradient boosting. Supervised machine learning uses algorithms to train a model to find patterns in a dataset with labels and features and then uses the trained model to predict the labels on a new dataset's features.

3 Result and Discussion

Resting BP(mmHg): 34

Cholestrol(mg/dl): 56

Is Fasting Boold Sugar>120 mg/dl(FBS): yes

Resting ECG: ST-T1

Max Heart Rate Achieved: 90

Exercise Induced Achieved: yes

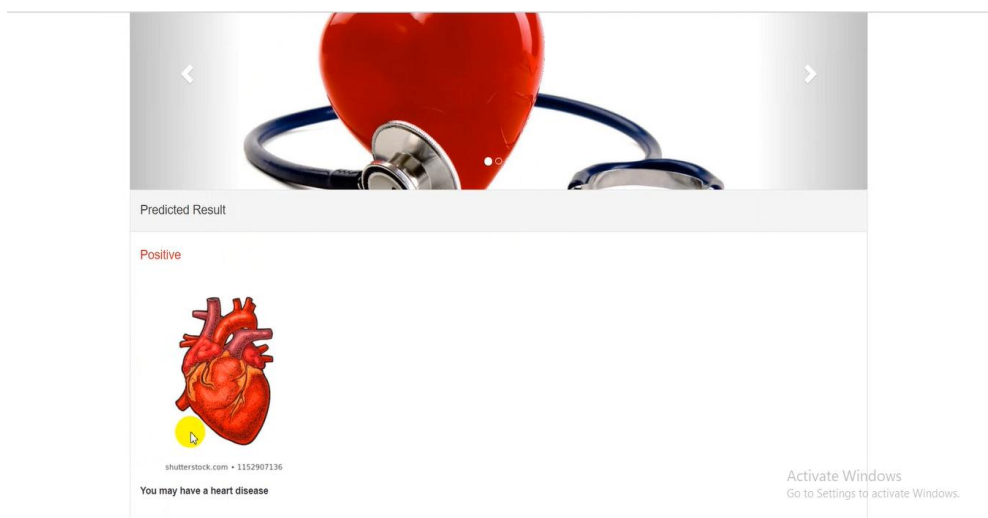
Old Peak: 56

Slope: Upsloping(2)

No.of Major Vessels: 7

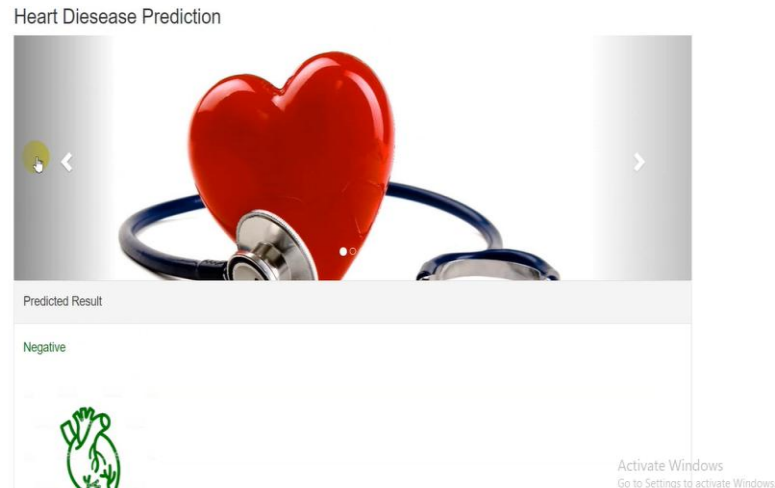
Select Algorithm: Select model

Activate Windows
Go to Settings to activate Windows.





Article Title: AI and IoT-Enabled Intelligent Disease Diagnosis Framework for Smart Healthcare Systems



4 Conclusion

Based on the analysis using the LightGBM algorithm, it is possible to predict the occurrence of heart disease with a high degree of accuracy. The feature importance analysis revealed that the chest pain type, maximum heart rate achieved during exercise, and the number of major blood vessels colored by fluoroscopy was the most important predictors of heart disease. This information can be used to develop targeted prevention strategies and improve patient outcomes. Additionally, the use of machine learning algorithms such as LightGBM can greatly improve the efficiency and accuracy of heart disease prediction, leading to earlier interventions and improved patient outcomes.

Reference

1. A. L. Bui; T. B. Horwich; G. C. Fonarow, Year: 2011, "Epidemiology and risk profile of heart failure", *Nature Rev. Cardiol.*, Vol: 8, no: 1, pp. 30.
2. M. Durairaj; N. Ramasamy, Year: 2016, "A comparison of the perceptive approaches for preprocessing the data set for predicting fertility success rate", *Int. J. Control Theory Appl.*, Vol: 9, no: 27, pp. 255260.
3. L. A. Allen; L.W. Stevenson; K. L. Grady; N. E. Goldstein; D. D. Matlock; R. M. Arnold; N. R. Cook; G. M. Felker; G. S. Francis; P. J. Hauptman; E. P. Havranek; H. M. Krumholz; D. Mancini; B. Riegel; J. A. Spertus, Year: 2012, "Decision making in advanced heart failure: A scientific statement from the American heart association", *Circulation*, Vol: 125, no: 15, pp. 19281952.
4. S. Ghwanmeh; A. Mohammad; A. Al-Ibrahim, Year: 2013, "Innovative artificial neural networks-based decision support system for heart diseases diagnosis", *J. Intell. Learn. Syst. Appl.*, Vol: 5, no: 3.



Article Title: AI and IoT-Enabled Intelligent Disease Diagnosis Framework for Smart Healthcare Systems

5. Q. K. Al-Shayea, Year: 2011, "Artificial neural networks in medical diagnosis", Int. J. Comput. Sci. Issues, Vol: 8, no: 2, pp. 150154.
6. J. Lopez-Sendon, Year: 2011, "The heart failure epidemic", Medicographia, Vol: 33, no: 4, pp. 363369.