**NITTE MEENAKSHI INSTITUTE OF TECHNOLOGY**

(AN AUTONOMOUS INSTITUTION, AFFILIATED TO VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM, APPROVED BY AICTE & GOVT.OF KARNATAKA

****

**PROJECT REPORT**

on

**HEART DISEASE PERCENTILE PREDICTION USING ML ALGORITHM**

*Submitted in partial fulfilment of the requirement for the award of Degree of*

*Bachelor of Engineering*

*in*

*Computer Science and Engineering*

*Submitted by:*

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2022-23

**NITTE MEENAKSHI INSTITUTE OF TECHNOLOGY**

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Department of Computer Science and Engineering

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**CERTIFICATE**

This is to certify that the “**Heart Disease Percentile Prediction Using ML Algorithm”**  is an authentic work carried out by ANUBHAV YADAV (**1NT18CS017**), KINSHUK CHATURVEDI **(1NT18CS076),** NEHA V M **(1NT18CS106)** and MUSKAN KHATWANI **(1NT18IS202)** bonafide students of **Nitte Meenakshi Institute of Technology**, Bangalore in partial fulfilment for the award of the degree of ***Bachelor of Engineering*** in COMPUTER SCIENCE AND ENGINEERING of Visvesvaraya Technological University, Belagavi during the academic year ***2021-2022.*** It is certified that all corrections and suggestions indicated during the internal assessment has been incorporated in the report.

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| **Internal Guide** | | **Signature of the HOD** | |
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**DECLARATION**

We are hereby declare that

(i) The project work is our original work

(ii) This Project work has not been submitted for the award of any degree or examination at any other university/College/Institute.

(iii) This Project Work does not contain other persons’ data, pictures, graphs or other information, unless specifically acknowledged as being sourced from other persons.

(iv) This Project Work does not contain other persons’ writing, unless specifically acknowledged as being sourced from other researchers. Where other written sources have been quoted, then:

a) their words have been re-written but the general information attributed to them has been referenced;

b) where their exact words have been used, their writing has been placed inside quotation marks, and referenced.

(v) This Project Work does not contain text, graphics or tables copied and pasted from the Internet, unless specifically acknowledged, and the source being detailed in the thesis and in the References sections.

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**ABSTRACT**

Heart disease cases are increasing at an alarming rate, and it's critical and concerning to be able to predict such diseases in advance. This is a difficult diagnosis to make, so it must be done correctly and quickly. The focus of the research paper is on which patients are more likely to develop heart disease based on various medical characteristics. We created a heart disease prediction system that uses the patient's medical history to predict whether the patient will be diagnosed with heart disease. To predict and classify patients with heart disease, we used various machine learning algorithms such as Logistic Regression, Random Forest Classifier, Support Vector Classifier and K-Nearest Neighbors Classifier. To regulate how the model can be used to improve the accuracy of prediction of Heart Attacks in any individual, a very helpful approach was used. The proposed model's strength was quite satisfying, as it was able to predict evidence of heart disease with a minimum score of 86.88 % for Random Forest Classifier, 91.8 % for K-Nearest Neighbors Classifier, 90.16 % for Support Vector Classifier, and 88.52 % for Logistic Regression. So, by using the given model to determine the probability of the classifier correctly and accurately identifying heart disease, a significant amount of pressure has been relieved. Given's heart disease prediction system improves medical care while lowering costs.

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**CHAPTER 1: INTRODUCTION**

* 1. **ML AND HEART DISEASE PREDICTION**

"Machine Learning" [1] is defined as "a method of manipulating and extracting implicit, previously unknown/known, and potentially useful information about data." Machine Learning is a vast and diverse field, and its scope and application are expanding all the time. Machine learning includes supervised, unsupervised, and ensemble learning classifiers that are used to predict and find the accuracy of a dataset. We can apply that knowledge to our HDPS project, as it will benefit a large number of people. Cardiovascular diseases are a broad term that refers to a variety of conditions that can affect your heart. According to the World Health Organization, (Cardiovascular diseases), CVDs cause 17.9 million deaths worldwide [2]. It is the leading cause of death among adults. With the help of their medical history, our project can help predict who is likely to be diagnosed with heart disease [6]. It recognizes who has any heart disease symptoms, such as chest pain or high blood pressure, and can assist in diagnosing the disease with fewer medical tests and more effective treatments, allowing them to be treated appropriately.

This project focuses on four Machine Learning algorithms: (1) K Nearest Neighbors Classifier, (2) Random Forest Classifier (3) Support Vector Classifier and (4) Logistic Regression. The highest accuracy of our project comes from the K Nearest Neighbors Classifier (91.8%), which is better than the previous system, which used only one ML Algorithm. As a result, employing more ML Algorithms improved HDPS accuracy and efficiency.

* 1. **PROBLEM DEFINITION**

The main aim of developing this project is to achieve and overcome the below mentioned problems:

1. The problem is aiming to automate the process of heart disease identification.
2. The problem is aiming to resolve the human error done by medical professionals.
   1. **OBJECTIVES OF THE PROJECT**

Objectives of our system are:

* To identify which ML algorithms are used in Heart disease
* Automate the process of Heart disease identification
* To resolve the issue of human error done by medical professionals
  1. **FEASIBILITY STUDY**

A feasibility study is carried out to select the best system that meets performance requirements. The system/application prospers only if it is feasible. The main aim of the feasibility study is to determine whether it would be financially and technically feasible to develop the product.

* 1. **ECONOMICAL FEASIBILITY**

Economic analysis is the most frequently used technique for evaluating the effectiveness of the proposed system. We have conducted economic feasibility studies to determine the operational and maintenance cost. The project requires an android device to run the app and a PC/Laptop to run the system.

**CHAPTER 2: SOFTWARE DESCRIPTION**

**2.1 SYSTEM REQUIREMENT SPECIFICATION**

**2.1.1 SOFTWARE REQUIREMENTS**

* Programming Language: Python
* Machine Learning: Sklearn, Streamlit
* Data Pre-processing: NumPy, Pandas
* Data Visualization: Seaborn, Matplotlib
  + 1. **HARDWARE REQUIREMENTS**
* Cloud Computing (Kaggle, Google Collab)
* RAM : 8 Gb min
* HDD/SSD space : 64 GB
* GPU : GeForce 940 or higher with 4 Gb
* CPU : i5 5th Gen min

**2.2 EXISTING SYSTEM**

To date, heart diseases are diagnosed by medical professionals. Medical professionals consume a lot of time for identifying the disease and there is always the issue of human error.

* 1. **PROPOSED SYSTEM**

A machine learning-based system is proposed in this project. The model will predict heart disease in less time and the issue of human error will not occur. This system can be implemented in any pandemic situation as well.

**CHAPTER 3: LITERATURE SURVEY**

This work was motivated by a significant amount of work on the diagnosis of Cardiovascular Heart Disease using Machine Learning algorithms. This paper includes a brief review of the literature. Various algorithms, such as Logistic Regression, KNN, Random Forest Classifier, and others, have been used to make an effective cardiovascular disease prediction. Each algorithm has the strength to register the defined objectives, as shown in the Results [7]. Using the previous and new models of machine learning and deep learning, the model incorporating IHDPS was able to calculate the decision boundary. It made the most basic and important factors/knowledge, such as family history, associated with any heart disease, easier to access.

However, the accuracy of such an IHDPS model was far less than that of a new upcoming model for detecting coronary heart disease using artificial neural networks and other machine and deep learning algorithms. McPherson et al.,[8] identified the risk factors of coronary heart disease or atherosclerosis using an inbuilt implementation algorithm that employs some Neural Network techniques and was only able to accurately predict whether the test patient was suffering from the disease or not.

R. Subramanian et al.,[24], introduced the use of neural networks to diagnose and predict heart disease and blood pressure, as well as other attributes. A Deep Neural Network was built using the given disease attributes to produce an output that was carried out by the output perceptron and almost included 120 hidden layers, which is the most basic and relevant technique for ensuring an accurate result of having heart disease if the model is used for the Test Dataset. The use of a supervised network for heart disease diagnosis has been recommended [16]. When the testing of the model was done by a doctor using unfamiliar data, the model was used and trained from the previously learned data and predicted the result thereby calculating the accuracy of the given model.

**CHAPTER 4: METHODOLOGY**

* 1. **System Design & Architecture**

This section illustrates the entire concept of the research work which will aid to understand the whole notion of the paper. At first, we collected the data and preprocessed it. After preprocessing the data. Then the model is created and trained. The model is evaluated using a test dataset and further optimized. This process can be seen in the diagram 4.1.

**Diagram

Description automatically generated**

Figure 4.1: System architecture of chronic kidney disease prediction system.

* + 1. **DATA COLLECTION**

A heart attack (Cardiovascular diseases) occurs when the flow of blood to the heart muscle suddenly becomes blocked. From WHO statistics every year 17.9 million dying from heart attack. The medical study says that human life style is the main reason behind this heart problem. Apart from this there are many key factors which warns that the person may/maynot getting chance of heart attack.

This database contains 76 attributes, but all published experiments refer to using a subset of 14 of them as shown in the figure 4.1.1. In particular, the Cleveland database is the only one that has been used by ML researchers to this date. The "goal" field refers to the presence of heart disease in the patient. It is integer valued from 0 (no presence) and 1. Experiments with the Cleveland database have concentrated on simply attempting to distinguish presence from absence.

**Creators :**

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University Hospital, Zurich, Switzerland: William Steinbrunn, M.D

University Hospital, Basel, Switzerland: Matthias Pfisterer, M.D

V.A. Medical Center, Long Beach and Cleveland Clinic Foundation: Robert Detrano, M.D., Ph.D.

**Donor :**

David W. Aha (aha@ics.uci.edu) (714) 856-8779

**Table

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Figure 4.1.1: 14 attributes selected for the model processing

* + 1. **DATA PRE-PROCESSING**

**4.1.2.1 UNDERSTANDING DATASET**

Before training the model, proper analysis of data needs to be done. As shown in fig 4.2.

**Table

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Figure 4.2: Dataset Sample

**Graphical user interface, text

Description automatically generated**

Figure 4.3: Dataset Information

From Figure 4.3, it can be seen that there is no NULL value in the dataset. So, there is no need for imputing NaN values.

**4.1.2.2 ANALIZING DATA THROUGH GRAPH**

**A picture containing text, crossword puzzle, scoreboard, cabinet

Description automatically generated4.1.2.2.1 HEAT MAP**

Figure 4.4 (a**):** Heatmap

From Figure 4.4 (a), it can be seen from the correlation matrix that there is no single feature that has a very high correlation with the target. Similarly, the correlation between independent variables is also not high.

Chart, waterfall chart

Description automatically generated

Figure 4.4 (b): Correlation with ‘Target’ Column

Even from the figure 4.4 (b) we can observe that there is no single attribute which has a major impact on determining the outcome.

**Chart, box and whisker chart

Description automatically generated4.1.2.2.2 HISTOGRAM**

Figure 4.5: Histogram

The figure 4.5 depicts how each feature and label is spread throughout multiple ranges, confirming the requirement for scaling. Following that, the discrete bars indicate that each of them is a categorical variable. Before implementing Machine Learning, these categorical variables must be addressed.

**4.1.2.2.3 TARGET BAR CHART**

**Chart, bar chart

Description automatically generated**

Figure 4.6: Target Bar Chart

An unbalanced dataset is one in which the distribution of the classes in the dataset is highly skewed. This indicates that a dataset is skewed towards one of the dataset's classes. If the dataset favours one class, an algorithm trained on the same data will favour the same class. From Figure 4.6, it can be seen that the target is balanced.

**4.1.2.4 HANDLING CATEGORICAL DATA AND SCALING DATA**

Figure 4.7: Code for Handling Categorical data and Scaling data.

Figure 4.7, shows which features are categorical and these features are broken down. Standard Scaler is used to standardize the data. It normalizes the data so that the mean is 0 and the standard deviation is 1. Finally, the data is split into the train(80%) and test(20%). Various machine learning models are employed in this data.

* + 1. **MODEL CREATION**

**4.1.3.1 RANDOM FOREST CLASSIFIER**

A random forest is a meta estimator that employs averaging to increase predicted accuracy and control over-fitting by fitting several decision tree classifiers on various sub-samples of the dataset.

Chart, bar chart

Description automatically generated

Figure 4.8: Random Forest Graph

The figure 4.8 shows the accuracy value of the classifier for different estimator values. Taking a look at the bar graph, we can see that the maximum score of 86.88% was achieved for 100, 200,500, and 1000 trees.

* + - 1. **K-NEAREST NEIGHBOUR CLASSIFIER**

The K-Nearest Neighbour method is based on the Supervised Learning approach and is one of the most basic Machine Learning algorithms. The K-NN method assumes that the new case/data and existing cases are comparable and places the new case in the category that is most similar to the existing categories. The K-NN method saves all available data and classifies a new data point based on its similarity to the existing data. This implies that fresh data may be quickly sorted into a well-defined category using the K-NN method. The K-NN approach may be used for both regression and classification, however, it is more commonly utilized for classification tasks.

**Graphical user interface, chart, application, line chart

Description automatically generated**

Figure 4.9: K-Neighbors Classifier

From the figure 4.9, it is clear the model achieved the maximum score of 91.8% when the number of neighbors was 8.

**4.1.3.3 SUPPORT VECTOR CLASSIFIER**

By altering the distance between the data points and the hyperplane, SVM seeks to construct a hyperplane that can distinguish the classes as much as feasible. The hyperplane is determined depending on the number of kernels. In the current study, four kernels were used: linear, poly, RBF, and sigmoid.

**Chart, bar chart

Description automatically generated**

Figure 4.10: Support Vector Classifier

It can be seen from the figure 4.10, the RBF kernel performed the best for this dataset and achieved a score of 90.16%.

**4.1.3.4 LOGISTIC REGRESSION**

This classifier predicts the output of a categorical dependent variable. Therefore, the outcome must be a categorical or discrete value. It can be either Yes or No, 0 or 1, true or False, etc. but instead of giving the exact value as 0 and 1, it gives the probabilistic values which lie between 0 and 1.

The accuracy we got from this model was 88.52 %, which was equal to Decision Tree classifier.

**CHAPTER 5: CONCLUSION**

The project involved analysis of the heart disease patient dataset with proper data processing.

Four models were trained and tested with maximum scores as follows:

* Random Forest Classifier (86.88%)
* K Nearest Neighbors Classifier (91.8%)
* Support Vector Classifier (90.16%)
* Logistic Regression (88.52%)

Chart, bar chart

Description automatically generated

If we compare the results with our base papers:

Table

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We can see that among these models from all papers, K Nearest Neighbors Classifier performs the best.

The key factors from the dataset leading to heart diseases from the dataset are:

1. Exercise Induced Angina

2. Chest Pain

3. ST Depression when workout compared to the amount of Rest taken

4. Maximum heart rate achieved

5. Major vessels coloured by fluoroscopy

The F1 score for the four models are:

Chart, bar chart

Description automatically generated

Even F1 score for the K-Nearest Neighbour classifier, for the given dataset is 90%. As F1 score is balance between precision and recall, i.e. it’s the harmonic mean of both. Given by the equation:

Hence for our model we have preferred using K-Nearest Neighbour classifier.

**CHAPTER 6: REFERENCES**

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CHAPTER 7: SELF ASSESSMENT OF PO-PSO ATTAINMENT

|  |  |
| --- | --- |
| **Program Outcomes (PO)** | **Justification** |
| PO1. Engineering Knowledge: | We have been able to apply the knowledge of science, mathematics and engineering like machine learning, cloud ,visualization and problem solving. |
| PO2. Problem Analysis: | People face this problem, where they are unable to decide which clothes to wear. This activity requires effort and is time consuming. |
| PO3. Design Development of solutions: | To build a simple and easy to use AI wardrobe which can recognize clothes and recommend outfits based on the user’s preferences (color, style, type, etc). Additionally, to build a ML model for automatic categorization of fashion apparels. Can save unique outfits. |
| PO5. Modern Tools: | Google colab, Azure, Firebase, Postman , CNN, Pytorch |
| PO6. The Engineer and society: | We learnt how to handle a project professionally, maintaining safety and social responsibilities. |
| PO8. Ethics: | We were able to handle responsibilities and norms of ethical engineering practices and applied the same in the project. |
| PO9. Individual and Teamwork: | We performed our individual tasks and were able to collaborate as a team better. |

|  |  |
| --- | --- |
| PO10. Communication: | We were able to communicate and present our ideas with each other effectively. This is what made it possible for us to collaborate our work together and build a project. |
| PO11: Project management and finance: | We used some open source technologies and some resources that were for students at minimum charges. The team members were supportive and managed various disciplines in the project |
| PO12. Life-long learning: | We will be able to apply what we have learnt from this project in other real life scenarios as well. |

|  |  |
| --- | --- |
| **Program Specific Outcomes (PSO)** | **Justification** |
| PSO1. Professional Skills: | We have been able to apply the knowledge of machine learning, visualization and problem solving ability to various tasks including data cleaning, training, evaluating and analyzing . Outcomes and results were presented proficiently. |
| PSO2. Problem Solving Skills: | We were able to change our tools and technologies when required in the project. We shifted to better and newly released versions of some technologies and were able to make changes in the project accordingly. |
| PSO3. Ethics and career development: | We were able to handle responsibilities and norms of ethical engineering practices and applied the same in the project. There was effective communication between the team and evaluators and among the team members as well. We took their feedback and incorporated them in the project. |