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A Novel Approach for the Prediction of Treadmill Test in Cardiology using Data Mining Algorithms implemented as a Mobile Application

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ABSTRACT

Objective: To develop a mobile app called “TMT Predict” to predict the results of Treadmill Test (TMT), using Data Mining techniques applied to a clinical dataset using minimal clinical attributes. To prospectively test the results of the app in realtime to TMT and correlate with Coronary Angiogram results.

Methods: In this study, instead of statistics, Data mining approach has been utilised for the prediction of the results of TMT by analysing the clinical records of 1000 Cardiac patients. This research employed the Decision Tree algorithm, a new modified version of K-Nearest Neighbour (KNN) algorithm, K-Sorting & Searching (KSS). Furthermore, Curve Fitting Mathematical Technique was used to improve the Accuracy. The system used six clinical attributes such as Age, Gender, BMI, Dyslipidemia, Diabetes mellitus and Systemic hypertension. An Android app called “TMT Predict” was developed, wherein all three inputs were combined and analysed. The final result is based on the dominating values of the three results. The App was further tested prospectively in 300 patients to predict the results of TMT and correlate with Coronary angiography.

Results: The accuracy of predicting the result of a TMT using Data Mining algorithms, Decision Tree and K-Sorting & Searching (KSS) were 73% and 78% respectively. The mathematical method Curve Fitting predicted with 82% Accuracy. The accuracy of the mobile app “TMT Predict”, improved to 84%. Age-wise analysis of the results show that the accuracy of the app dips when the age is more than 60 years indicating that there may be other factors like retirement stress that may have to be included. This gives scope for future research also. In the prospective study, the Positive and Negative predictive values of the App for the results of TMT and Coronary Angiogram were found to be 40% and 83% for TMT and 52% and 80% for Coronary Angiogram. The Negative Predictive value of the app was high, indicating that it is a good screening tool to rule out CAHD.

Conclusion: “TMT Predict” is a simple user-friendly android app, which uses six simple clinical attributes to predict the results of TMT. The app has a high negative predictive value indicating that it is a useful tool to rule out CAHD. The “TMT Predict” could be a future digital replacement for the manual TMT as an initial screening tool to rule out CAHD.

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1. Introduction

All over the world, cardiovascular diseases account for a considerable percentage of untimely deaths. A statistical study

conducted by WHO in 2012 revealed that, around 17.5 million people had died due to Coronary Artery Heart Disease (CAHD) around the world.¹ In India, nearly 45 million people suffer from cardiac diseases,² out of which one in four Indians die of CAHD every year.³ Inadequate awareness and lack of seriousness often result in the loss of precious lives. Periodical screening and risk factor modification are mandatory to minimize this epidemic of CAHD.

The earlier studies² found that the non-modifiable risk factors such as age, gender and family history were the main reasons

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responsible for the heart disease. But subsequent studies³ revealed that modifiable risk factors, namely, the lack of exercise, high fat intake, overweight, stress, smoking, alcohol, diabetes and systemic hypertension, were equally responsible for the development of heart diseases. As a result, the combination of non-modifiable and modifiable risk factors are identified as important parameters to be evaluated to predict CAHD.⁴

Exercise Treadmill Test (TMT) is an important screening test⁵ to detect provokable ischemia. TMT is time consuming and requires physical stress. There is also a small element of risk in case of serious silent CAHD. To simplify and safely perform a screening procedure, Data Mining and the Curve Fitting Mathematical procedure were applied to develop a mobile application called "TMT Predict" as a replacement for TMT. This app aimed at predicting the result of the TMT without the person actually undergoing a TMT.

The methodology for prediction includes Data mining algorithms such as Decision Tree, K-Sorting & Searching (KSS) which is a new modification in K-Nearest Neighbour (KNN) and the Mathematical Curve Fitting method.

2. Methods

At the global level, development of methods and models to improve the Accuracy of diagnostic techniques is an ongoing process and a lot of research is still underway.⁶ Automatic diagnosis of heart disease by taking into consideration, a number of clinical attributes (more than 13)^{7,8} using data mining algorithms and evaluating its Accuracy, have been done since 2001.⁹

The Data Mining strategies like Association, Clustering, Classification and Prediction are widely used in virtually every

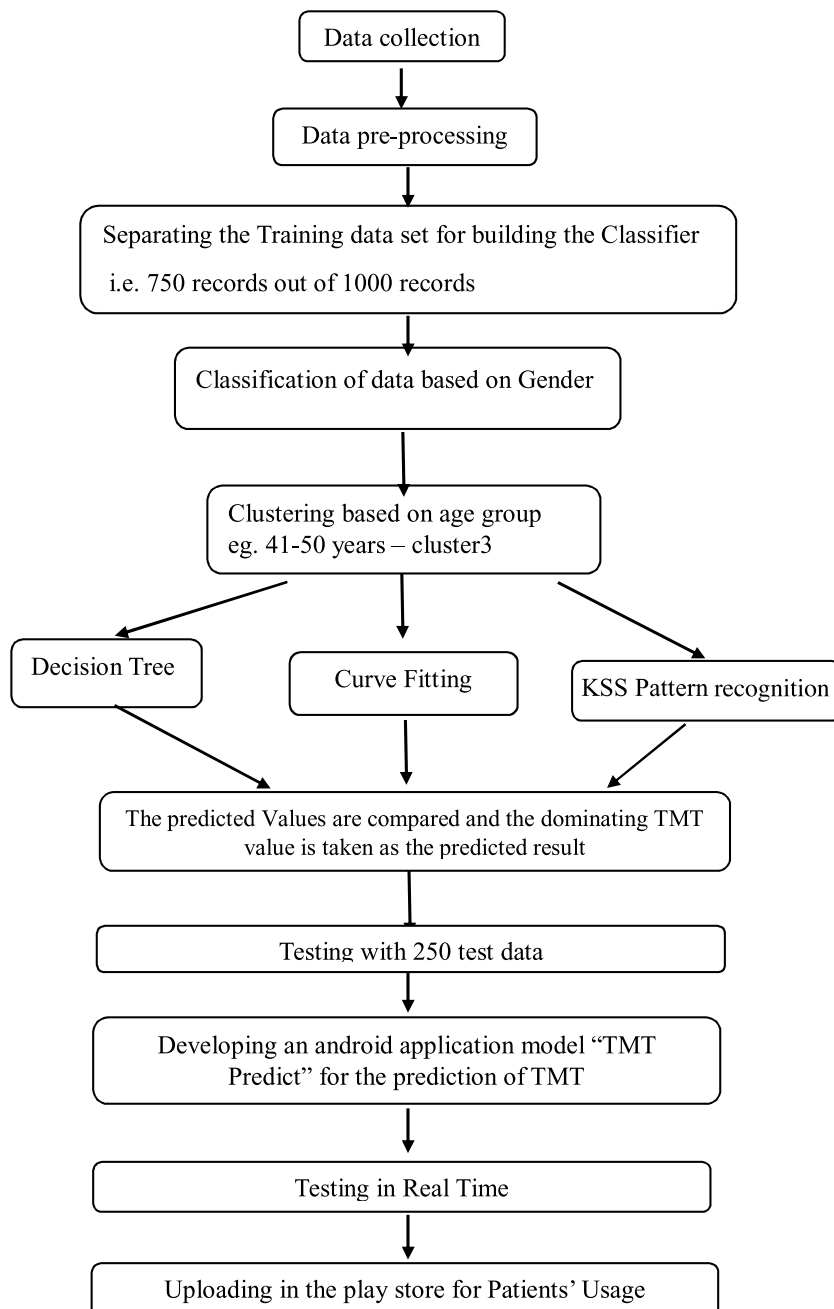


Fig. 1. Work flow of the Preparation of the Model.

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