

CORONARY HEART DISEASE PREDICTIONS USING EXPERT SYSTEM AND DEEP LEARNING

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ABSTRACT

Coronary Heart Disease (CHD) is a group disease like chest pain, heart attack, cardiac arrest etc and also one among cardiovascular disease which may leads to death. CHD is nowadays common among people and it will affect arteries in heart. This will affect the flow of blood due to plaque created in inner walls of these arteries. In this paper, a web based expert system which will predict the possibility or chance of person to get Coronary Heart Disease based on certain basic factors like cholesterol, diabetes, smoking etc. In this paper, a web based system is developed to predict the possibility or chance to get coronary heart disease. This system consist two artificial intelligence methods: rule based expert system and deep learning method. CLIPS is used to define rules for expert system and TensorFlow framework is used for deep learning which will train and test dataset for prediction. The aim of this project is checking the possibility of heart disease and thus to take a good care of heart before it get affected.

Keywords : *Artificial Intelligence, CLIPS, Coronary Heart Disease, Deep Learning, Expert System, TensorFlow.*

I. INTRODUCTION

Nowadays, health issues are very high due to change in life style and lack of awareness in proper health care. There are many diseases that may lead to death. It will be better if one could find the possibility of occurring such diseases. As health issues have increased medical field has also grown with many technologies to improve health care.

Artificial intelligence (AI) is an expert system or machine with intelligence that will perform like human. AI system perceives its environment and takes actions that maximize its chances of success [1]. Artificial intelligence in medicine is a new research area that combines sophisticated representational and computing techniques with the insights of expert physicians to produce tools for improving health care [2]. AI plays a significant role for contributing efficient systems in the medical field. It has grown to a level that it can assist both doctors and patients in treatment and health care. AI systems are developed based on rules as well as using learning algorithms. Based on these methods, there are systems to predict and treat disease related to heart, lungs, kidney such as cancers, stones, attacks etc.

Coronary heart disease (CHD), also known as ischemic heart disease (IHD) and coronary artery disease (CAD), is a group of diseases that includes: stable angina, unstable angina, myocardial infarction, and sudden cardiac death. It is within the group of cardiovascular diseases of which it is the most common type. It is a common term for the build-up of plaque in the heart arteries that could lead to heart attack. The risk factors for coronary artery disease are high LDL cholesterol, low HDL cholesterol, high blood pressure, family history, diabetes, smoking, being post-menopausal for women and being older than 45 for men, obesity etc [3].

In this paper, a web based system consisting of two methods, rule based expert system and deep learning method, to predict Coronary Heart Disease. This system allows user to select one of the system for prediction based on the basic risk factors such as gender, age, BMI (Body Mass Index), diabetes, cholesterol, smoking, blood pressure, family history and physical activity. User can also use both the systems for the prediction of CHD. This helps the user to confirm their possibility for occurring Coronary Heart Disease.

II. RELATED WORKS

Coronary heart disease is a death causing disease with no external symptoms. If CHD can be predicted earlier or its possibility of occurring in one can be predicted, then it will be good to prevent CHD and take care of heart and its related disease. There are many AI studies based on heart disease and its prediction using different learning methods as well as rule based system.

Heart disease is classified and predicted using Support Vector Machine and Artificial Neural Network method by, considering 13 attributes (taken from UCI dataset) where final results shows that SVM model is more accurate than ANN model[4]. Expert System for Diagnosis and Management of Kidney Diseases and it is a generic tool for renal failure and can be used by all type of people and can also detect various types of Renal Diseases. It provides a very fast and accurate diagnosis [5].

A web-based expert system for diagnosis and management of childhood pneumonia diseases in children. This system is user friendly and accessible to users irrespective of their location. It solve problems that facing children less than five years of age and also serves as a temporary assistance to those who are in need of instant help when expert consultant is not readily available[6].

An integrated medical ES (Expert System) called Expert Doctor Verdis (Ex-Dr Verdis) is developed for vertebral column diseases. It provides physicians with the opportunity to share and discuss their own patients, cases, experiences and expert knowledge with other colleagues [7]. KNN and ID3 algorithms are used for classifying and predicting the heart disease risk level of each person based on age, gender, Blood pressure, cholesterol, pulse rate is done and accuracy of the risk level is high by adding more number of attributes like hate rate and smoking[8].

An intelligent recommender system was developed, which uses an innovative time series prediction algorithm to provide recommendations to heart disease patients in the tele-health environment. Based on analytics of each patient's medical tests in records, the system provides the patient with decision support for necessity of medical tests. It helps to reduce the workload and cost in healthcare [9].

A system based on Extreme Learning Machine (ELM) algorithm replace a costly medical checkups with a warning system for patients of the probable presence of heart disease considering dependent factors such as age, sex, serum cholesterol, blood sugar, etc.. The system was implemented on real data collected by the Cleveland

Clinic Foundation where around 300 patients information has been collected. The system shows 84% of accuracy [10].

III. PROPOSED SYSTEM

A web based system is developed which consist of two efficient methods in AI to predict the possibility of a person to get coronary heart disease. One is rule based expert system and the other system is based on deep learning method. The basic factors that both systems consider for prediction are gender, age, cholesterol, blood pressure, diabetes, smoking, family history and physical activity. Expert system considers one more factor called Body Mass Index (BMI) which is related to body weight or obesity. Expert system predicts the possibility based on the rules that are already defined. The rules for system were created in CLIPS with 18 rules. Deep learning system predicts the result based on what they have learned by themselves while training and testing the given datasets. For deep learning, TensorFlow framework in python is used. Fig 1 shows the block diagram of the proposed system.

This paper describes that the proposed system provide a web based interface to the user with options of two systems, expert system and deep learning system, to predict the chance of occurring Coronary Heart Disease. User can choose any of the system to know about their heart health condition. If user chooses expert system, the page of expert system will appear where user can enter the details about the basic risk factors of Coronary Heart Disease. Using these details, system will predict the result based on the rules defined. If user chooses deep learning system, the page of deep learning system will appear. User can give details about the basic risk factors of CHD. These details are used to predict the result by checking it with the model created when the dataset is trained by using Deep Learning algorithm. Fig 2 shows the main page of the Coronary heart Disease Prediction system.

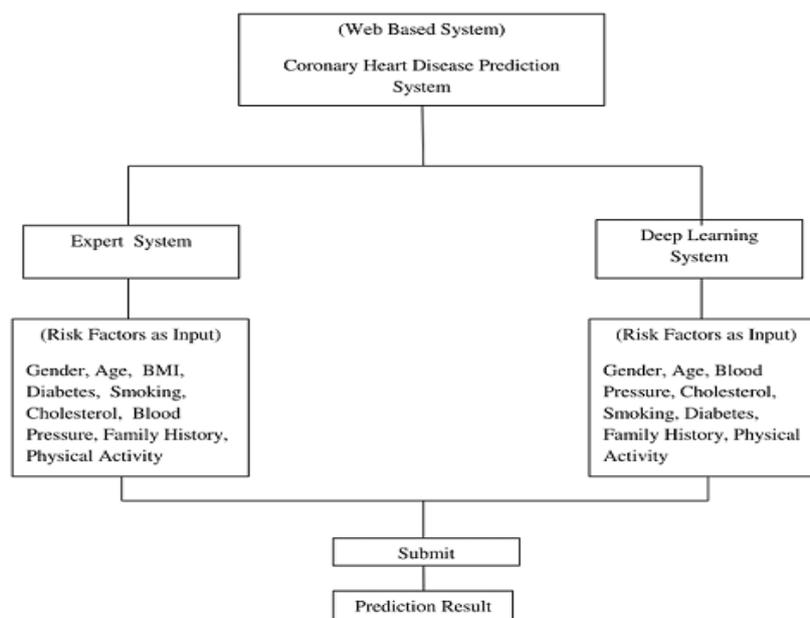


Fig 1: Block Diagram of Proposed System

When the accuracy of both the systems is compared, rule based expert system is found to be more accurate than deep learning system because it will predict results based on the rules that are predefined. But if the input doesn't match with the rules given it will not predict the result so it remains less efficient. Deep learning system will predict result in any of the cases as it is learned by its own training, so it is a efficient system. It will be more accurate as much as we train the system with lots of data. Both systems can be used so that the possibility of occurring heart disease can be finalized in a better way. The proposed system aims to find out the chance of getting coronary heart disease so that it may help to take care of heart and health before it leads to death. Thus it helps to maintain a healthy heart which will improve health care.

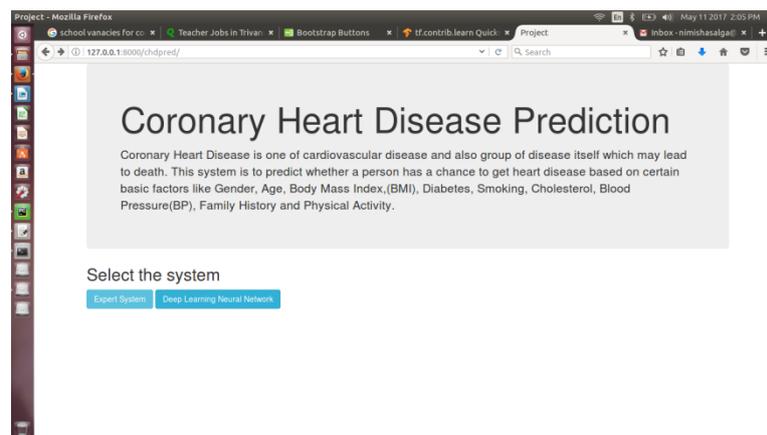


Fig 2: Main Web Page of CHD Prediction System

IV. IMPLEMENTATION METHODS AND TOOLS

A. Methods

- [1] **Expert System:** An expert system is a computer system that emulates the decision making ability of a human expert. Expert systems are designed to solve complex problems by reasoning about knowledge, represented mainly as if-then rules rather than through conventional procedural code. An expert system is divided into two subsystems: the inference engine and the knowledge base. The knowledge base represents facts and rules. The inference engine is an automated reasoning system that evaluates the current state of the knowledge-base, applies relevant rules and then asserts new knowledge into the knowledge base [11].
- [2] **Deep Learning:** Deep learning is a branch of machine learning based on a set of algorithms that attempt to model high level abstractions in data by using a deep graph with multiple processing layers, composed of multiple linear and non-linear transformations. It has more hidden layers and it can be trained under supervised and unsupervised learning. It can train a huge dataset and as much as it trains, the accuracy and efficiency is more [12].

B. Tools

- [1] **CLIPS:** CLIPS is a public domain software tool for building expert systems. It is designed to facilitate the development of software to model human knowledge or expertise. The name is an acronym for "C

Language Integrated Production System” [13]. CLIPS operates by maintaining a list of facts and a set of rules which operate on them. Facts are created by asserting them onto the fact database using the assert command [14].

- [2] **TensorFlow:** TensorFlow is a multi-purpose open source software library for numerical computation using data flow graphs. It has been designed with deep learning in mind but it is applicable to a much wider range of problems. It can run on multiple CPUs and GPUs. The computations of TensorFlow are expressed as stateful data flow graphs. It provides a Python API, as well as C++, Haskell, Java and Go APIs [15].
- [3] **Django:** Django is a free and open-source web framework, written in Python, which follows the model-view-template (MVT) architectural pattern. Django’s primary goal is to ease the creation of complex, database-driven websites. It helps to create a user interface so that that request from user can be taken and processed to give them results. For developing a Django project, no special tools are necessary, since the source code can be edited with any conventional text editor [16].

V. RESULT

Coronary Heart Disease Prediction System is a web based system created using Django and consist two systems in it with two methods of AI, rules based expert system and deep learning system to predict the possibility of occurring CHD. There is no need of login or sign up for user to check their status and user need not give any of their personal details. Any user can use the system directly. User has option to choose which system they want for predicting as shown in Fig 2.

to death. This system is to predict whether a person has a chance to get heart disease based on certain basic factors like Gender, Age, Body Mass Index,(BMI), Diabetes, Smoking, Cholesterol, Blood Pressure(BP), Family History and Physical Activity.

Basic Details

Gender: Male Female

Age Limit: Below 45 Between 45 and 65 Above 65

BMI: Below 25 25 and above

Diabetes: Yes No

Smoking: Yes No

Cholesterol: Below 200 Between 200 and 239 240 and above

BP: Below 90/60 90/60 to 120/80 Above 120/80 to 140/90 Above 140/90

Family History: Yes No

Physical Activity: Yes No

[Submit](#) [Home](#)

Fig 3: Input given to Expert System

When user chooses the ‘Expert System’, it directs to expert system page where the user have to give all details about the basic risk factors that is asked for in that page. Then they have to click on the ‘Submit’ button after giving all the details that are required. When they click ‘Submit’ button, server directs the details to CLIPS file where the rules defined. There the system will check the values with rules and the result that is most valid for the input will be displayed back to the user. If they want to go back to main page, then they can click on ‘Home’

button. Expert System is rule based system which consists of 18 rules for prediction. Fig 3 and Fig 4 shows the input given to Expert System and its result respectively.

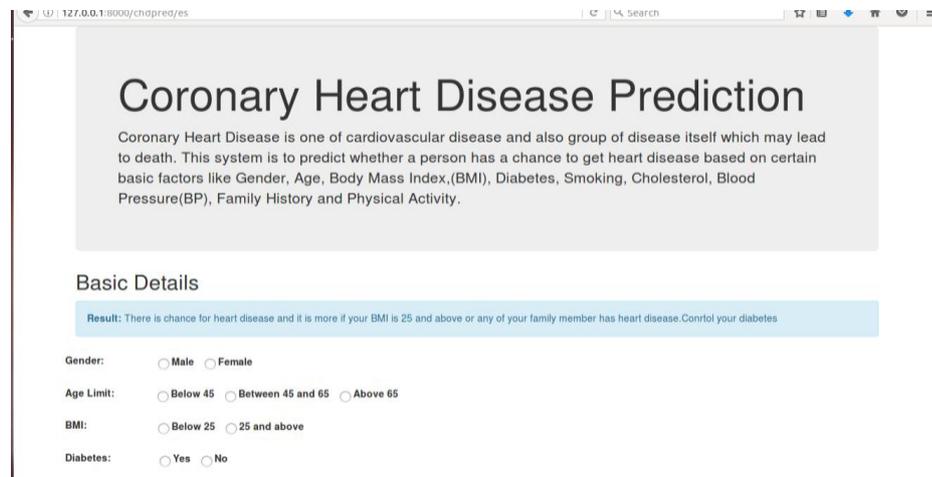


Fig 4: Expert System result

If the Deep Learning system is chosen, then the user is directed to the deep learning system interface. User should give the details that are asked for. BMI is not considered in this system. This system already creates a model while training with a dataset that contain data of 140 people and testing dataset of 50 people. The model is created based on what they learned during training and testing. When the input is given, the system will check the values based on the model created and gives the results back to user that mentions whether that person has a chance of getting Coronary Heart Disease.

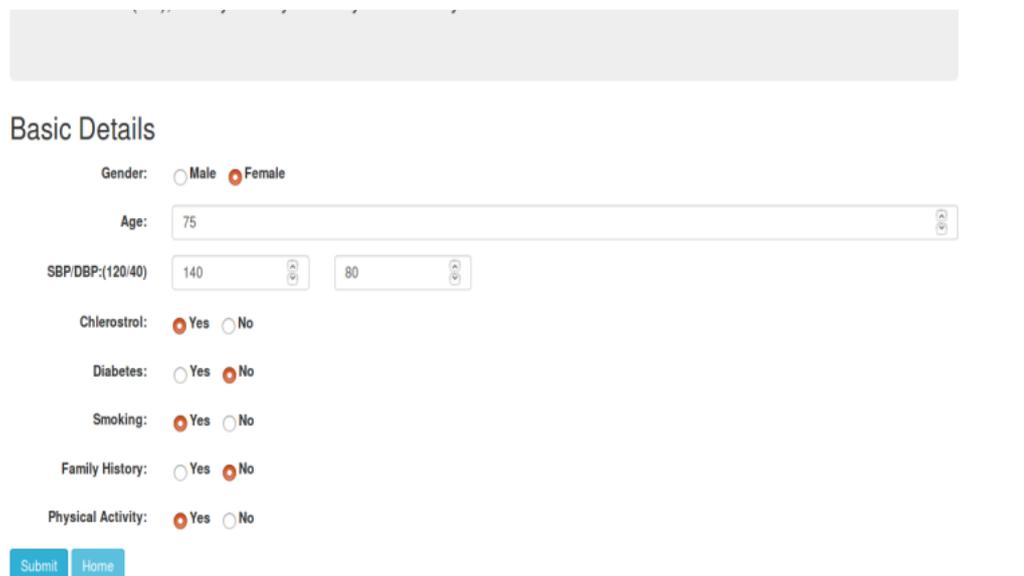


Fig 5: Input given to Deep Learning System

When user choose the 'Deep Learning System', it directs to deep learning system page where the user have to give all details about the basic risk factors that is asked for, in that page. Then they have to click on the 'Submit' button after giving all the details that are required. When they click 'Submit' button, the server directs the

details to the deep learning model that is trained and tested. Then the system checks the input value with the model of deep learning system and predicts the result which will be displayed back to the user. If they want to go back to main page, then they can click on 'Home' button. Fig 5 and Fig 6 shows the input given to Deep Learning System and its result respectively.

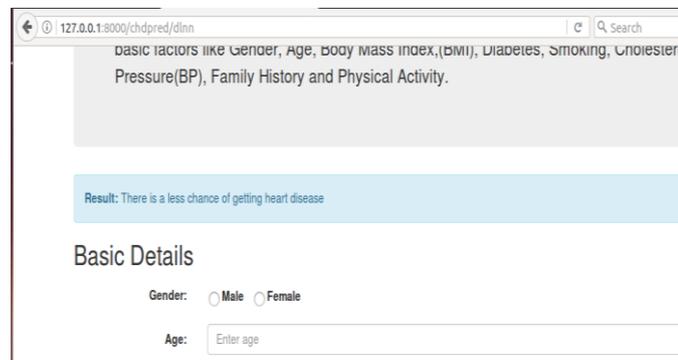


Fig 6: Deep Learning System result

User can use any of the single system or both the systems for prediction. By checking in both the system they can compare both results and get more accurate about result as well as their possibility of getting heart disease.

VI. CONCLUSION AND FUTURE WORKS

In this paper, the proposed system is a web based Coronary Heart Disease Prediction system where user can directly give details about basic risk factors of CHD without registering or giving any personal details. The main web system has two systems that are created by two different approaches in AI, rule based Expert System and Deep learning method, where user can select either or both system for prediction. When accuracy is considered, rule based expert system shows higher accuracy than deep learning system as it predicts based on the rules that already defined. But deep learning system is more efficient than expert system as it is learned by its own whereas expert can't learn by it and accuracy will be more if it is trained with more data.

In future, this system can be implemented only based on Deep Learning algorithm with more features such that it will be capable to perform learning on large datasets. This is the recent efficient learning algorithm that is applicable in many fields. The other scope for enhancement is a comparative study that can be done between the expert system and deep learning system or it can be compared with other methods of AI.

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