

Exploration of Monitoring and Detection of Blood Pressure via Machine Learning

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Abstract

At beginning Machine Learning (ML) was only the endeavor of some computer geeks who wanted a program that can learn to play games by itself and the field of statistics which never employed any approaches based on computations. Now, it has developed into a independent field of study that has provided us base to develop self learning functions. ML has also developed various algorithm for interpretation of text, email filtering, recognizing pattern, and several different commercial aspects. The best way to analyze the real world dataset is to use the algorithmic concepts of machine learning. The field of machine learning generally comes under the umbrella of artificial intelligence. It is generally based on pattern recognition. It contains many types of algorithms that might be supervised or unsupervised. Machine learning can be utilized to do much research in various sectors or Fields. Detecting human systolic blood flow and hypertension in humans is one of its areas in processing which has already proven a great help in humanity.

Keywords: Learning, Human Learning, Machine Learning, Blood Pressure, Cognitive Science

Introduction

The measure of the force of the blood pushing blood vessels is known as blood pressure. The blood is pumped into the blood vessels by heart through which the blood is carried out through the body. Many people are not familiar with how their daily life activities affect their health in the long run. Having a high blood pressure may possess many risks which is dangerous in terms of health risks because it makes our heart to put more effort to pump the blood forcefully out to the body and in duration of the arteries, or coronary artery disease, to stroke, kidney disease, heart-failure. They take these things lightly and then pay for it having multiple diseases after a few years. By using such methods in machine learning to predict the systolic blood pressure helps to aware and gives early warnings to youth and middle-age people from country to country who do not measure their blood-pressure regularly, being an isolated blood-pressure measurement way which is been done by any type of sensor, so sometimes it may not be accurate due to daily activity or fluctuation in the human body. The real cause of low or high blood-pressure is unknown, but several things like smoking, being overweight, eating junk food, unbalanced daily routine, avoiding proper exercise time to time, lack of physical activities, excess salt in diet, excess of alcohol consumption (having more than two drinks per day). By doing a prior survey which states that life spawn any certain human can be increased if proper health conditions are taken care of their health issues from the young age or after a certain point of time by predicting the health condition of a certain human being before they turned into a serious problem or disease which may affect him in long terms by time and money also.

Another name of blood-pressure is Hypertension. It can cause serious health complications and increases the risk of heart related disease, strokes, sometimes death also. Blood-pressure is the force that is exerted by the blood against the wall of veins or we can say that the rate at which blood flows in our body. Hypertension is a chronic disease and leads to the very important risk factor of cardiovascular as well as cerebrovascular disease. It is also the most common leading preventable cause all over the world to increase premature death according to certain factors that were provided by different doctors and scientists. According to Mills [1], there will be approx. 1.33 billion having the disease of hypertension which will account for 19.3 % of the total world's population. According to Kearney [2], by the end of 2024, the number of hypertension patients will reach up to 1.56 billion which will account the approx. 25% of the total world's population.

This disease is now even common among youngsters, which might create a serious problem for their upcoming life. The result of hypertension is a clinically proven concept which might refer to a serious complication or even death that may occur in a patient of any age with hypertension. In the medical history, the outcome of this disease is not high yet, but once they occur they cause irreversible injuries to the patient which could be serious either in short term or in long term.

It is been always a great concern for research on hypertension. Generally what the medical institute and other research centers do is, first they go through the various types of people which may include people who are suffering from any disease or they might not. It includes the people having different age factor or living in different climate change, in a different city, state or country. They start doing a survey on these people and collect the different types of data to accumulate and repeat the process again and again in a specific period of time. After doing all this they started to analyze the data and gives the outcomes of certain diseases which is been caused by hypertension. It provides the data support for prediction of the result of hypertension and it is also used to identify the key factors using machine learning.

Using machine learning in such a learning model to identify automatically the significant factors to establish an effective and interesting model and also the knowledge gained from these models will help the doctors to make decisions, treatment plans, and give patient effective advice. It makes treatment easier in account of such diseases like hypertension.

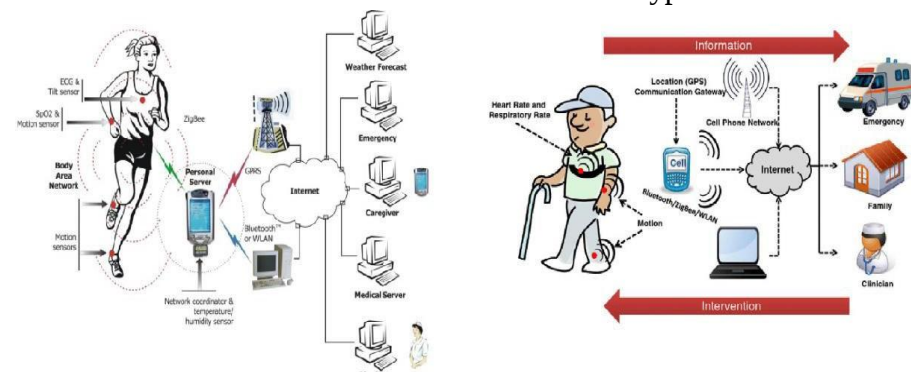


Figure 1: Capturing of real world dataset by various sensors

The figure above describes a person carrying a mobile phone or a sensor that provides us with the real-time sensory data of a person. That data is then sent to our already trained machine learning regression model for analysis. This is a proposed project so the extent to which the project is

implemented may vary. The predictions are made based on the data that is used to train the network. The data is taken from MIT research and is 95% accurate. The input data is used to make health prediction based on input data that includes current heart rate and blood pressure. The final output that the project gives is in the form of graphs and based on these graphs one can analyze his or her daily activity. Using these graphs further predictions can be made as to what changes one must make in its lifestyle to improve his current health condition. Once this project is fully implemented it can have a significant impact on today's society. The main reason behind this project's undertaking is due to the recent changes in the lifestyle of the young generation. They are heavily involved in intoxication and have very unhealthy eating and sleeping habits. So this project might bring a ripple in their lives if they take it seriously and help a countless number of people to a great extent.

Correlation of Blood Pressure with Other Variables

- **AGE:** According to the research, age is in strong relation with blood pressure, especially the systolic blood pressure (SBP). Multiple linear regression analysis is used to indicate that the SBP of a person aged over 50 years old will increase more rapidly than that of those whose age ranges between 20 and 39.
- **GENDER:** According to multiple researches it is shown that male of human species have on average higher blood pressure than their female counterpart and also they have higher risk for hypertension.
- **BMI:** BMI is calculated by dividing body mass (equivalent to weight on surface of earth) in kg by square of height in m. Obese crowd, with BMI that exceeds 30 kg/m², may have higher chances of attaining high blood-pressure (hypertension) because more nutrients and oxygen needs to be provided to the body tissues by hearts.
- **SMOKING:** Various experiments have shown after smoking there is a temporary increase in blood pressure. We can also see that effect of smoking on blood pressure differ from people who smoke very less from heavy smokers.
- **CHOLESTROL:** According to medical research, when the arteries get narrow and hardened with cholesterol plaque and calcium (atherosclerosis), pumping of the blood through them is done with more force by heart, which results in an abnormal rise in blood-pressure.

Tools and Methodology Used

The algorithm and concept we use for this research work is random forest. Multiple tree structures are formed in a model of the Random Forest. To arrange a new object that is built on new attributes every tree gives a classification and which is considered to be voted by the tree for that class. The forest selects the arrangement that has the most votes among all other trees in the forest and calculates the average difference using the output of the different trees. Multiple trees are built and combined together to get more precise result in general.

When a random tree is designed it gets split into different nodes and subsets further it finds for the perfect result from the random subsets. A better model of algorithm is then generated. Therefore with a random forest, only the random subset is taken into deliberation. This research work uses random forest algorithm mostly as it has higher accuracy when handling large set of data along

with different variables. Also as real world data is bound to have a lot of missing values the random forest algorithm can easily handle it.

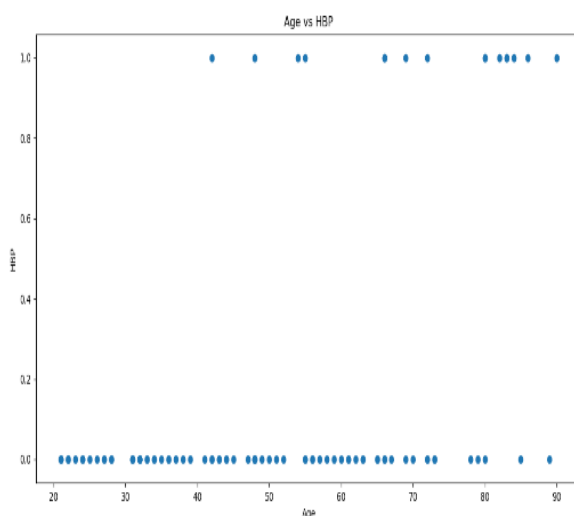
```
from sklearn.ensemble import RandomForestClassifier
forest = RandomForestClassifier(n_estimators=100)
forest.fit(x_train, y_train)
y_pred = forest.predict(x_test)
```

Above code is executed in python for predicting HBP with random forest algorithm. To execute it pandas and numpy libraries are imported to handle data then from Sklearnlibrary RandomForestClassifier class is imported for training the algorithm .As the dataset is huge it is assured that algorithm has enough decision trees to make more accurate prediction.

After training, the algorithm became capable of predicting HBP or Hypertension when provided with all the respective parameters like person's weight, height, systolic and diastolic blood pressure, cholesterol and smoking frequency. The algorithm accuracy of prediction of HBP when all other respective parameters are entered result out to be 93.2156 i.e, approximately 93 percent till now.

The proposed research work is based on the MIT Dataset (Resultant of National Health and Nutrition Survey - Hosmer and Lemeshow (2000) applied Logistic regression: 2nd Edition) for the mentioned parameters and the following graph is obtained.

Graph 1: Age vs. HBP

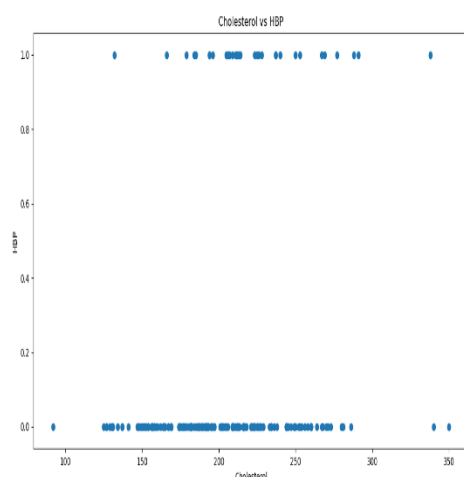


X-axis: Age

Y-axis: HBP

We can see that cases of HBP start occurring after the age of person crosses 40. And with increase in age the chances of HBP also increases.

Graph 2: Body Weight vs. HBP



X-axis: Body Weight

Y-axis: HBP

We can see that cases of HBP start occurring after an individual's weight exceeds 100 kg. A person's height also plays a major factor in it.

Graph 3: Cholestrol vs. HBP

X-axis: Cholesterol

Y-axis: HBP

We can see cases of HBP start occurring more frequently when a person's cholesterol level is more than 150 mg/dl.

The proposed work uses the above mentioned parameters as an input to the mentioned machine learning algorithm for the prediction of hypertension.

Conclusion

Machine learning methods are acquiring immense attention in the sector of curing chronic diseases. Blood pressure and hypertension are most important early metrics for the risk of growth of many types of dangerous diseases like stroke, heart attack and other cardiovascular diseases and renal injury. Using ML algorithms for predicting the systolic blood pressure of one by using the data which has been gathered from different persons of different age groups to analyse whether their body is physically fit or not. It helps doctors to easily examine the patient in such a way that they do not have any need to do pre-analysing tests to determine the different health issues of a particular patient.

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