International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 06 Issue: 05 | May - 2022 Impact Factor: 7.185 ISSN: 2582-3930

HEALTH ONE Making Health a Priority Using Machine Learning

[1] [2] [3] [4] [5]
Ritik Jain, Shubh Singh, Gourav Kumar, Sarthak, Dr. Meenakshi Yadav
[12345]
Department of Information Technology
[12345]
Dr. Akhilesh Das Gupta Institute of Technology and Management Shastri Park. Delhi

Abstract - Usage of mobile applications and wireless networks is growing rapidly at different sectors in the world. Mobile healthcare application is devotedly accepted by the healthcare organisations and also by patients. The reasons behind accepting mobile healthcare applications are as user friendly, reliable, low cost, time efficient, mobility etc. In this project we have presented an integrated architecture for secure mobile healthcare system using Machine Learning. This application provides management of patient medical records in a regional environment. Here we aim to bridge the gap between the Doctor and Patients. To provide the Patients with a seamless healthcare experience we have designed our site such that patients can choose the Doctors according to their specialisations and book appointments to receive hassle- free treatment. We are not only patient-oriented but we have focussed on the Doctors also, they can register their profile having their complete details, thus saving their advertisement cost.

Keywords: *Mobile healthcare, wireless network, security, Machine Learning*

1. INTRODUCTION

While hospitals and healthcare workers worldwide make valiant efforts to save lives during the pandemic, COVID-19 is still spreading fast. There is no respite for doctors or nurses at the front-line fighting endlessly[3]. As coronavirus hits the healthcare industry, practising social distancing is our only way to ease the burden on the hospitals. But, what about non-corona patients? How do they get help? The answer is simple: telemedicine and healthcare mobile apps[1].

Healthcare mobile applications connect doctors with patients who need help, easing the burden on healthcare workers. The appointment booking for doctors became contactless[1].

This app is an Online Medical Clinic where two users' authentication is implemented using passport.js and bcrypt and both doctor and patient can make their new account or login into the existing one. Patients can predict their problems/diseases using the AI Consultant, by entering their symptoms into the app and search for doctors according to their speciality and name as well and after that patients can book an appointment describing their problem in short and can upload image files as well using multer. When the doctor receives an appointment message, he/she can accept the appointment offline and can send the prescription that the patient can download in case he/she lost

the hard copy[2]. The patient can also give ratings to the doctor. Both patient and doctor can edit their profiles. AI Consultant is used for disease prediction using Machine Learning[3].

This project is based on Machine Learning and lies in the domain of Web Development and the entire app stands on Javascript, HTML, CSS, Node.js, MongoDB, Passport.js and Bcrypt which serves the purpose of Software as a Service. The Tech Stack for this purpose will be HTML, CSS, Javascript for the frontend and Node.js for the server- side, MongoDB for database management and passport.js and Bcrypt for security purposes.

2. OBJECTIVE

This Healthcare app is actually an Online Medical Clinic where Doctors and Patients can interact. This Web app has two users authentication implemented using passport.js and bcrypt. Both doctor and patient can make their new account or login into the existing one. Patients can predict their problems/disease using the AI Consultant, by entering their symptoms into the the app and search for doctors according to their speciality and name as well and after that patients can book an appointment describing their problem in short. When the doctor receives an appointment message, he/she can accept the appointment offline. The doctor can send the prescription that the patient can download in case he/she lost the hard copy. The patient can also rate the doctor. The goal of this health app is to make the experience of healthcare more efficient and satisfying for all stakeholders involved. Health apps are ultimately judged by their value to the healthcare system; their ability to improve the patient experience and patient outcomes as well as reduce the costs of care. Physicians often see the value of health apps in terms of patient engagement, promoting more efficient provider-patient communication, and creating new modalities for diagnosis and monitoring[5]-[13].

3. PURPOSE FOR RESEARCH

The purpose for research and the goal of this health app is to make the experience of healthcare more efficient and satisfying for all stakeholders involved. Health apps are ultimately judged by their value to the healthcare system; their ability to improve the patient experience and patient outcomes as well as reduce the costs of care. Physicians often see the value of health apps in terms of patient engagement, promoting more efficient provider-patient communication, and creating new modalities for diagnosis and monitoring[2]-[3].

4. SIGNIFICANCE

To resolve the issue of searching the best doctors among many and late diagnosis, to prevent standing in long queues, to save precious time of patient, this app was the need of the hour[4].This app very well understands the need of the users with simple registration and login facility, robust and accurate disease prediction by the AI Con-

sultant (using machine learning),easy appointment bookings, E-prescriptions, Doctor's rating feature[7].

5. LITERATURE SURVEY

This app is an Online Medical Clinic where Doctors and Patients can interact. This Web app has two users authentication implemented using Passport.js and Bcrypt. Both doctor and patient can make their new account or login into the existing one. Patients can predict their problems/disease using the AI Consultant, by entering their symptoms into the the app and search for doctors according to their speciality and name as well and after that patients can book an appointment describing their problem/s in short. When the doctor receives an appointment message, he/she can accept the appointment offline also the doctor can send the prescription that the patient can download anytime(in case he/she lost the hard copy).The patient can also give rarings to the doctor. Both patient and doctor can edit their profile and to upload the image files multer has been used in this webapp.

6. METHODOLOGY ADOPTED

The methodology adopted for AI Consultant (For disease prediction)[6] :

- Gathering the Data: Data preparation is the primary step for any machine learning problem. We will be using a dataset from Kaggle for this problem[5]. This dataset consists of two CSV files one for training and one for testing. There is a total of 133 columns in the dataset out of which 132 columns represent the symptoms and the last column is the prognosis[9].
- Cleaning the Data: Cleaning is the most important step in a machine learning project. The quality of our data determines the quality of our machine learning model. So it is always necessary to clean the data before feeding it to the model for training. In our dataset all the columns are numerical, the target column i.e. prognosis is a string type and is encoded to numerical form using a label encoder[10].
- Model Building: After gathering and cleaning the data, the data is ready and can be used to train a machine learning model[11]. We will be using this cleaned data to train the Support Vector Classifier, Naive Bayes Classifier, and Random Forest Classifier. We will be using a confusion matrix to determine the quality of the models[12].
- Inference: After training the three models we will be predicting the disease for the input symptoms by combining the predictions of all three models. This makes our overall prediction more robust and accurate[10].

Fig.1 Workflow for the implementation

Dual authentication for patient and doctor is used for security

PATIENT:

1) Http protocols for Patients

GET -

- Fetch all suitable doctor's profiles from the RGS database.
- Serves prescriptions for particular patient id provided by doctor .

POST -

- Patient fills details and filters for booking appointment for particular time .

DOCTOR:

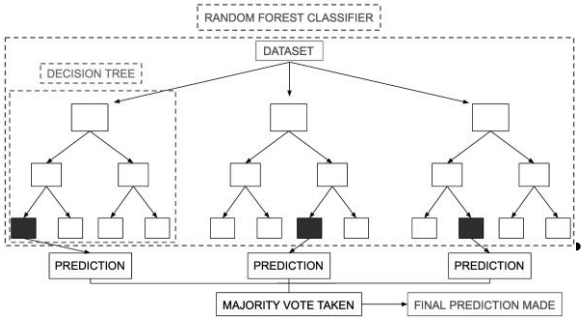
2) Http protocols for Doctors :

GET -

- This request serves all appointments booked by it's patients

POST -

- Doctor manages appointments by sending post request to the server and can do the actions like cancel , postpone and delete .
- Later he can provide prescription for particular medication and send to server



- Fig. 2 Workflow Representation

Random Forest Classifier

Random Forest is a popular machine learning algorithm that belongs to the supervised learning technique. It can be used for both Classification and Regression problems in ML. It is based on the concept of ensemble learning, which is a process of combining multiple classifiers to solve a complex problem and to improve the performance of the model[12].

As the name suggests, "Random Forest is a classifier that contains a number of decision tree on various subsets of the given dataset and takes the average to improve the predictive accuracy of that dataset." Instead of relying on one decision tree, the random forest takes the prediction from each tree and based on the majority votes of predictions, and it predicts the final output.

The greater number of trees in the forest leads to higher accuracy and prevents the problem of overfitting[13].

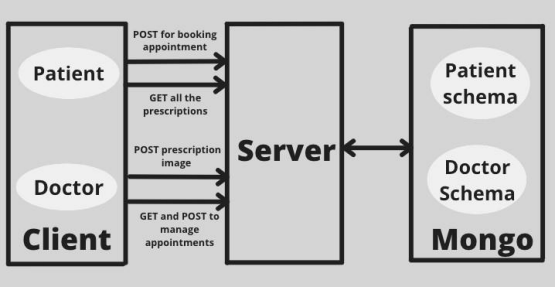


Fig. 3 Random Forest Classifier

Why use Random Forest?

Below are some points that explain why we should use the Random Forest algorithm:

It takes less training time as compared to other algorithms.

It predicts output with high accuracy, even for the large dataset it runs

efficiently.

- It can also maintain accuracy when a large proportion of data is missing[13].

Gaussian Naive Bayes

Naive Bayes is a probabilistic machine learning algorithm that can be used in several classification tasks. Typical applications of Naive Bayes are classification of documents, filtering spam, prediction and so on. This algorithm is based on the discoveries of Thomas Bayes and hence its name[15]-[16].

Gaussian Naïve Bayes

So far, we have seen that the X's are in categories but how to compute probabilities when X is a continuous variable? If we assume that X follows a particular distribution, you can use the probability density function of that distribution to calculate the probability of likelihoods.

If we assume that X's follow a Gaussian or normal distribution, we must substitute the probability density of the normal distribution and name it Gaussian Naïve Bayes. To compute this formula, you need the mean and variance of X[15].

In the above formulae, sigma and mu is the variance and mean of the continuous variable X computed for a given class c of Y.

Representation for Gaussian Naïve Bayes

The above formula calculated the probabilities for input values for each class through a frequency. We can calculate the mean and standard deviation of x's for each class for the entire distribution[16].

This means that along with the probabilities for each class, we must also store the mean and the standard deviation for every input variable for the class[15].

mean(x) = 1/n * sum(x)

where n represents the number of instances and x is the value of the input variable in the data.

standard deviation(x) = sqrt(1/n * sum(xi-mean(x)^2))

Here square root of the average of differences of each x and the mean of x is calculated where n is the number of instances, sum() is the sum function, sqrt() is the square root function, and xi is a specific x value[16].

Predictions with the Gaussian Naïve Bayes Model

The Gaussian probability density function can be used to make predictions by substituting the parameters with the new input value of the variable and as a result, the Gaussian function will give an estimate for the new input value's probability[16].

$$P(x_i \mid y) = \frac{1}{\sqrt{2\pi\sigma_y^2}} \exp\left(-\frac{(x_i - \mu_y)^2}{2\sigma_y^2}\right)$$

Naïve Bayes Classifier

The Naïve Bayes classifier assumes that the value of one feature is independent of the value of any other feature. Naïve Bayes classifiers need training data to estimate the parameters required for classification. Due to simple design and application, Naïve Bayes classifiers can be suitable in many real-life scenarios[16].

C-Support Vector Classification

Support Vector Machine (SVM) is a supervised machine learning technique that is widely used in pattern recognition and classification problems. The SVM algorithm performs a classification by constructing a multidimensional hyperplane that optimally discriminates between two classes by maximizing the margin between two data clusters. This algorithm achieves high discriminative power by using special nonlinear functions called kernels to transform the input space into a multidimensional space [14].

The basic idea behind the SVM technique is to construct an n-1 dimensional separating hyperplane to discriminate two classes in an n-dimensional space. A data point is viewed as an n-dimensional vector. For example, two variables in a dataset will create a two-dimensional space; the separating hyperplane would be a straight line (one dimensional) dividing the space in half. When more dimensions are involved, SVM searches for an optimal separating hyperplane called the maximum-margin separating hyperplane. The distance between the hyperplane and the nearest data point on each side (called support vectors) is maximized. The best scenario is that two classes are separated by a linear hyperplane[14].

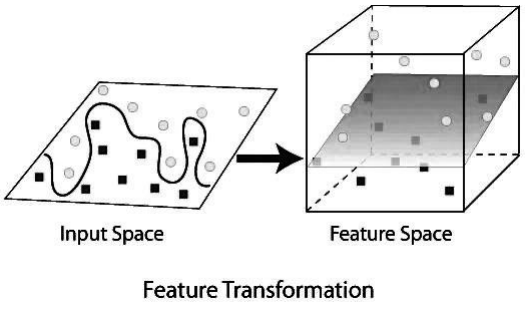


Fig. 4 Demonstration of finding a separating hyperplane in high dimensional space vs in low dimensional space.

7. SALIENT FEATURES

A WebApp based online clinic constructed using Machine Learning, HTML5, CSS3, Javascript, Node.js, MongoDB, Passport.js and bcrypt.

Developed a platform where Patients can find Doctors according to their speciality and book appointments to have a hassle-free experience.

Doctor can send the prescriptions which can be saved offline in case the Patient lost the hard copy as the pharmacist requires a signed prescription.

8. APPLICATIONS

- Positive Response to Patient's Condition- Doctors can monitor patient's condition from anywhere and can respond quickly before it leads to any chronic disorder. They

can keep a track of patient's health records, update care plans and maintain end-to- end communication, thereby facilitating better monitoring[19].

- Reduce Complexity- In the past few years, mobile apps development companies UAE have forged solutions that have changed the way we store health information of patients, in a secure way. It simplifies the healthcare provider's complicated work by providing patient's history on-time when they need to make patient care decisions. A physician can track the individual patient-related information by taking the help of well-designed user interface mobile app efficiently[17].
- Book an Appointment Timing- Using mobile apps, patients can book appointments with doctors easily. It helps healthcare providers to organize their availability time better, and notifies them when a patient books or cancels an appointment as well. This helps both the patients and the healthcare service providers to save time and effort they usually invest on a phone call[17].
- Increase the Branding- mHealth apps help in branding by approaching a maximum number of customers in almost all possible ways via sending push notifications, navigating customers to the organization, and provides access to your contact details such as email, phone, and website[19].
- Another one of the core aims of healthcare sector is keeping the patient's health and their information safely. Using app without proper standards can lead to unsafe practices. Healthcare service providers should implement a strategy that will help keep the quality of service high while keeping the patients safe[17].

9. RESULT

The healthcare industry is going under a massive transformation. The doctors are now providing efficient treatment to patients with ease and patient's comfort18]. There are several reasons to use a healthcare app. They make complex tasks simple and help in taking a decision correctly. The apps have already brought a revolution in the healthcare industry and with ever growing technology; much more features can be expected in the near future[20].

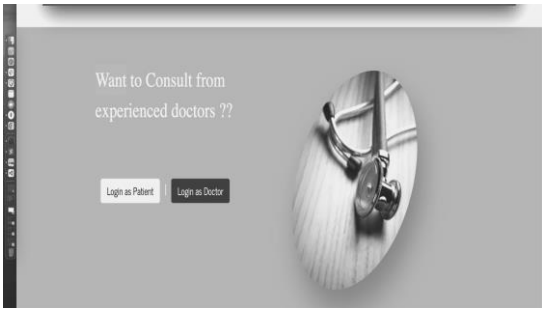


Fig. 5 Output

10. CONCLUSION

To ease the burden on healthcare workers and hospitals amid lockdowns and otherwise, the use of healthcare mobile apps is being emphasized[20].

11. MERITS

Managing & booking of appointments made easy & quick.

- Robust and accurate prediction of diseases from symptoms using AI Consultant
- Easily maintains all the previous medical reports & prescriptions.
- Finding doctors according to your need made feasible.
- Doctors can increase the reach of his/her clinic.
- Improved efficiency and speed – The healthcare apps can enhance healthcare delivery with more efficiency, as they can handle multiple queries and requirements at a time[17].
- Reduction in healthcare costs – The cost associated with the healthcare consultation reduced significantly with the usage of apps as the maintenance cost is less[10].
- Easier and convenient to use – The healthcare apps can be accessed at any time of the day. They have a 24/7 patient monitoring system. The mobile health app coupled with wearable devices can monitor vital stats such as blood pressure, heart rate, glucose levels, stress management, sleep quality, nutrition tracking, and several other important activities. Similarly, telemedicine is improving the accessibility of healthcare information to remote areas[5].
- Save patients and doctors time – With the healthcare apps, the patients can easily connect with the healthcare provider for consultation. It saves traveling time between home and the healthcare center and also requires fewer visits as compared to the traditional approach[18].
- Seamless exchange of data – The healthcare apps come with an inbuilt option to share and transfer the health data across the healthcare system. Similarly, the app provides an option for secure and hassle-free process payment options with different gateways for medical bills and subscriptions. If you forget to pay the bills, these apps send notifications as a reminder[18].

Encouragement to live a healthy lifestyle, easier communication, improved patient monitoring, appointment scheduling, and counseling are some other benefits of the healthcare apps[19].

12. DEMERITS

Data Privacy – The health apps continuously collect and analyze the health data of the person. The threat to the exposure of personal information by the hacker and sharing with the third parties is a major concern. Over the past few years, in several stances, news and updates regarding the leakage of health data have been reported by the reported apps manufacturers[18].

Accuracy of Data – The information and advice provided by healthcare apps is also an important concern with healthcare apps. Different apps use different methods and tools to analyze health data. In some cases, the data measured with the apps are found to be varying when compared with the MedTech devices[18].

Internet accessibility, the high cost of smartphones, lack of regulatory approval, high cost for in-purchase applications are some of the other key factors hampering penetration of the mobile health apps in the market, faltering their demand[19].

Physical Examination is Limited - Until relatively recently, live video com-

munications technology wasn't advanced enough to allow for comprehensive medical care. Today, most patients and providers have easy access to technology that allows high-quality video-conferencing. But for some providers, a virtual visit may not seem enough to diagnose or treat a patient[19]. Although virtual care can be very effective for many minor conditions, physicians may not feel comfortable conducting an examination over video chat. Some patients may also see this as a reason to choose in-person visit over virtual appointments[20].

- Telemedicine Equipment and Technology - Telemedicine facilitates many remote health services, including chronic patient monitoring, therapy appointments, and post-operative care. All these services run on software and hardware which can sometimes be costly–requiring training to use, additional IT staff to hire, and the purchase of servers or other ancillary equipment besides the software. Also, as is true of all technology, glitches occur. If problems arise during a virtual visit, the communication halts. That risk may be enough for some to steer clear of telehealth platforms.There may be a patient base which is not computer-literate, or may worry about equipment costs and setup. Still others may just not be able to find a user-friendly telehealth platform that fits their needs[18].

13. SCOPE OF THE PROJECT

Future of Medical Mobile App Market

Companies in the mobile app market target particular groups to meet their needs. However, with the growth in the user base and variable preference, companies are also widening their services to increased engagement, exposure, and revenue. Similarly, companies in the healthcare app market are also looking for new and innovative opportunities to widen their services[17].

Overall, the health apps hold a huge potential to transform the medical ecosystem thus providing better health outcomes for users. In the coming years, the demand for healthcare apps is likely to increase with the advancement in features (like attractive interface, eye-catching graphics, and icons and analytics option), awareness among the user, rise in the smartphone user, and also the penetration to the new geographies. Coupled with Artificial intelligence, the healthcare apps will transform the healthcare dynamics significantly. However, the lack of data security, policy issues regarding healthcare data and their management, and the regulatory issue will be the major factor affecting the usage and will act as a key barrier[19].

ACKNOWLEDGEMENT

We are highly indebted to our Project coordinator Dr. Meenakshi Yadav ma'am for her guidance and constant supervision as well as for providing necessary information regarding the Project & also for their support in completing the Project.

We would like to express our gratitude towards each other for our co-operation and encouragement which helped us in completion of this project[20].

REFRENCES

[1] Samuel AL. Some studies in machine learning. IBM Journal of Research and Development. 1959;3(3):210-229

[2] Koh HC, Tan G. Data mining applications in healthcare. Journal of Healthcare Information Management. 2005;19(2):64-72

[3] Silver D, Hassabis D. AlphaGo: Mastering the ancient game of go with machine learning. Google Research Blog. 2016

[4] Brewka G. Artificial intelligence—a modern approach by Stuart Russell and Peter Norvig, Prentice Hall. Series in Artificial Intelligence, Englewood Cliffs, NJ. The Knowledge Engineering Review. 1996;11(1): 78-79

[5] Alpaydin E. Introduction to Machine Learning. London: The MIT Press. 2014;3:640

[6] Kotsiantis SB. Supervised machine learning: A review of classification techniques. Informatica (Ljubljana). 2007;31(3):249-268

[7] Hastie T, Tibshirani R, Friedman J. The Elements of Statistical Learning - Data Mining, Inference,& Prediction. Springer Series in Statistics. Switzerland: Springer. 2009;2(1):93-85

[8] Libbrecht MW, Noble WS. Machine learning applications in genetics and genomics. Nature Reviews. Genetics. 2015;16(6):321-332

[9] Bardenet R, Brendel M, Kégl B, Sebag M. Collaborative hyperparameter tuning. In: 30th International Conference on Machine Learning; ICML. 2013. p. 2013

[10] Hutter F, Hoos H, Leyton-Brown K. An efficient approach for assessing the hyperparameter importance. In: 31st International Conference on ML; ICML. 2014. p. 2014

[11] Jothi N, Rashid NA, Husain W. Data mining in healthcare—A review. Procedia Computer Science. 2015;72(1):306-313

[12] https://www.javatpoint.com/machine-learning-random-forest-algorithm

[13] https://www.section.io/engineering-education/introduction-to-random-forest-in-machine-learning/

[14] https://bmcmedinformdecismak.biomedcentral.com/articles/10.1186/1472-6947-10-16

[15] https://machinelearningmastery.com/naive-bayes-for-machine-learning/

[16] https://www.upgrad.com/blog/gaussian-naive-bayes/

[17] https://medium.com/@andreausa/why-mobile-apps-are-gaining-importance-in-healthcare-sectors-56c6e6c9ec1b

[18] https://www.diva-portal.org/smash/get/diva2:644378/fulltext01.pdf

[19] https://www.sciencedirect.com/topics/computer-science/mobile-health-application

[20] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4029126/