

AI in Healthcare

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Abstract:

Artificial intelligence simplifies the lives of patients, doctors and hospital administrators by performing tasks that are typically done by humans, but in less time and at a fraction of the cost.

According to the Rural Health Statistics report released by the Union Ministry of Health and Family Welfare in April 2021, there is an overall shortfall of 76.1 per cent specialists as compared to the requirement for existing CHCs in rural areas.

AI can be leveraged to help diagnose patients, and choose an appropriate course of treatment for them, in these rural areas and small towns.

Problem statement :

Acute shortage of specialist doctors in rural areas of India leading to misdiagnosis and wrong/no treatment.

Market / Customer/ Business Need Assessment :

While becoming a doctor anywhere in the world is not an easy task, it is even more difficult to do so in India, because of the high *population to the number of seats up for grabs* ratio.

After dedicating a major portion of their youth to their studies, doctors generally do not prefer to spend time in the rural areas due to obvious reasons, such as lack of any entertainment and adequate public facilities, which is the main reason why many state governments have mandatory rural postings. However, it is simply not feasible to force the doctors to work in the rural areas for years, and while this topic is a discussion for another paper, one thing is certain; rural areas need more good doctors, or an alternative solution to this issue of lack of doctors.

That's where the product comes in. Artificial Intelligence and Machine Learning can be leveraged to diagnose patients in those areas where no doctor is present.

External Search :

What Is the Future of Healthcare?

New advances in medicine and concepts that were once the futuristic topics of science fiction are gradually becoming a reality. Gene therapies, 3-D printing of human organs, liquid biopsies, robot-assisted surgeries, and voice-enabled personal assistants are now realities that are becoming more sophisticated as time goes on.

Advancements in technology are affecting not only practiced medicine but the public perceptions and attitudes toward health, lifestyle, and what it means to be healthy. Healthcare must implement innovation wisely to engage as many patients as possible.

Digital health technologies evolve at a lightning pace. The impact of data science, AI, machine learning, and connected healthcare technologies is tremendous and requires an unbiased mind and willingness to engage in a continually evolving environment with as much knowledge as possible.

Patient empowerment

Artificial intelligence has the ability to actually empower us as people to make better health decisions. Wearable technology is already being used by a large number of people all over the world to collect common data such as sleep patterns and heart rate. Using machine learning to analyse this data could alert people who are at risk of developing some diseases long before they become serious.

Patients with certain chronic diseases may be able to better control their disease and live healthier lives with the use of mobile apps that provide granular-level patient profile information. All of this has the potential to result in healthier populations and lower total costs (Ichikawa et al., 2016) (Vollmer et al., 2020).

AI-based smart prediction of clinical disease using random forest classifier and Naive Bayes

Artificial neural networks are the best effort classification algorithm for prediction of medical diagnosis due to its best efficiency parameter. The neural network comprises of the neurons with three layers such as input layer, hidden layer and output layer for the efficiency attainment. The training data are given as the input parameter with the support of back propagation algorithm.

The feed-forward neural network with support vector machine (SVM) is a best technique for prediction of cancer. The ANN is used to classify the labelled images based on the determination of the true positive (TP) and false-positive (FP) detection rates. The detection mechanism is performed with the self-organized supervised learning algorithm. ANN approach gives the promising result for the detection of micro-calcifications features and biopsy detection.

The ANN is segmented into two approaches, initially the classifier is applied to the image data with region of interest (ROI) and second includes the ANN learn the features from pre-processed image signals. SVM is a statistical learning theory-based machine learning approach. SVM works with the ANN to map the input space to the higher-dimensional space to split the labelled images. The labelled images are determined in a marginal space forming a hyper plane which reduces the generalization error.

A hybrid classifier is proposed here by hybridizing support vector machine and artificial neural network. A typical ANN consists of one input layer, one or more hidden layers and one output layer as in Fig. Each layer has several neurons, and the neurons in one layer are connected to the neurons in the adjacent layer with its own connection weights. The following figure shows the artificial neural network model with one input layer, one output layer and one hidden layer. The neuron represents node in the network. The input features are fed to the neurons in the input layer.

Initially disease dataset is taken as a input for the system. Diabetes, heart disease and cancer datasets are taken for the analysis, so many information are related to the patients' health care and general data there in disease dataset. These are the life-threatening diseases for human beings.

Data pre-processing is applied to the input datasets, it leads to reduce the unwanted information for the further analysis. Check the missing values and checking the correlation it helps to split the training data in to 70% original data and 30% testing data, for efficient data analysis.

Data-mining algorithms like random forest and Gaussian Naïve Bayes are applied to estimate the performance of the system against the input disease dataset. The classification results are compared with existing results, and it shows the better improvement.

Benchmarking alternate products:

Certain apps do exist which help diagnose diseases if you inform it about your symptoms, however, judgements cannot be made about its accuracy rate without accessing internal company data. Though, from a speculative point of view, they do not seem to be heavily reliant on ML models.

Few apps help connect people with doctors over the phone (telemedicine). This is also a possible alternative to the shortage of doctors in rural areas, however, we also need to take into account the fact that people in rural areas are not very well versed with using smartphones.

Applicable Regulations (Government and Environmental) :

1. Patents on ML algorithms developed
2. Laws related to privacy for collecting data from users
3. Protection/ownership regulations
4. Creating an e-mail service to mail the report to the patient and doctor.

5. Being responsible by design.
6. Ensuring open-source, academic and research community for an audit of Algorithms.
7. Review of existing work authority regulations.

Applicable Constraints

1. Requires a lot of research to obtain universal dataset of cancer patients in-order to provide more sophisticated and accurate results.
2. Confidential health data to be obtained to train the model.
3. Thorough understanding of dataset and verification of the results must be performed by the pathologist from the machine learning model to provide a great health prescription and service to the user.

Business Opportunity :

According to World Bank's data reported in 2020, 65.07 % of India's population lives in rural areas without proper healthcare facilities. Taking into account the huge population of India, that's a lot of people, a lot of people who need access to doctors, or an alternative; which is where our product comes in.

If we take advantage of this gap between doctors and patients using the AI and ML driven tool developed by us, we can tackle a very big problem for rural India while generating revenue.

Final Product Prototype :

The final product is a tool/model that tells the patients what disease they might be suffering from and what are the chances that the prediction is correct. It informs the patients which medicine they need to take and for how long, or if they need to visit their nearest doctor, in case an accurate prediction can not be made due to any reason such as lack of adequate information/symptoms/patient history.

Conclusion :

A large percentage of the population needs access to proper healthcare facilities and this tool/model is a great product to fill the gap between patients and doctors. With the help of this tool, every person, no matter where they are living, will be able to get access to proper healthcare facilities.

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