Core Project

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eHealth - Virtual Diagnostic Tool

Synopsis

Shivang Ahuja - 1800184C202 - Computer Science
Manas Yadav - 1800233C203 - Computer Science
Pranshu Sood - 1800252C203 - Computer Science & Engineering

ABSTRACT

Intelligent applications have recently become a part of our daily life. There are various medical self-diagnostic technologies available in the healthcare industry. Only a few of those, however, are open to the public. These systems are linked to specific hospitals, and only patients from such hospitals can utilize them. Furthermore, some of these systems are not available for free. This synopsis outlines the key content, motivation, problem statement, deliverables, related work and challenges for the project titled as **"eHealth - Virtual Diagnostic Tool"**. The virtual diagnostic tool will be powered by Machine Learning & Deep Learning technologies. In addition, it provides the patients with more information about the disease by directing them to some related medical websites. The tool will have separate features for normal users and registered doctors. Doctors can use the tool to get a second opinion on some set of diseases. Whereas, normal users can use this tool for self diagnosis of diseases like - Acne, Melanoma, Eczema, Seborrheic Keratoses. As future work, it is planned to extend the system to include more diseases.

MOTIVATION

The Indian healthcare scenario presents a spectrum of contrasting landscapes. At one end of the spectrum are the high tech hospitals delivering quality healthcare to mostly urban Indians. At the other end are the ramshackle outposts in the remote reaches of the "other India" trying desperately to live up to their identity as health subcenters, waiting to be transformed to shrines of health and wellness. With the rapid pace of change currently being witnessed, this spectrum is likely to widen further, presenting even more complexity in the future.

A serious drawback of India's health service is the neglect of rural masses. It is largely a service based on urban hospitals. Moreover the doctors are unwilling to serve in rural areas. Shortage of medical personnel like doctors, nurses etc. is also a problem in the health sector.

Access to quality healthcare and doctors has always been a concern in developing countries and remote areas. Moreover sometimes due to human errors patients can be misdiagnosed and can be treated wrongly or not treated at all. To deal with such issues and improve healthcare facilities for the masses, the eHealth - Virtual Diagnostic Tool provides a solution for both, the people looking for quality healthcare and for doctors looking to get a second opinion.

PROBLEM STATEMENT

The healthcare industry in developing countries and especially in India is as efficient and effective as possible. Currently, a very limited section of society has access to quality healthcare services. The lack of quality healthcare has been affecting a good section of the population. To improve the quality of healthcare and provide almost equal healthcare to every individual, a Virtual Diagnostic Tool should be developed that can be used as a helping hand for the existing healthcare infrastructure. This way, people can have access to quality healthcare and doctors will have a helping hand.

INTRODUCTION

Although numerous artificial intelligence-based autonomous diagnostic platforms have been developed, the diagnostic reports given by such computer systems are difficult to comprehend. Artificial intelligence that obtains diagnostic results from a computational perspective cannot provide the cause for a specific diagnosis that is depicted as clinical practice. Various researchers have tried to make the conclusion obtained from artificial intelligence methods explainable. For example, Raccuglia et al. used a decision tree to understand the classification result from the support vector machine [1]. Hazlett et al. used a deep belief network, a reverse trackable neural network, to find diagnostic evidence of autism [2]. Zhou et al. used the output of the last full-connected layer of the convolution neural network to determine which part of an image causes the results based on classification, providing evidence of classification [3]. Also, Zeiler et al. used the occlusion test to study which parts of images produce a given classification result [4]. These are the studies which are used by a lot of researchers to move forward and make diagnostic systems.

In the diagnostic system developed (Medical Self-Diagnostic System Using Artificial Neural Networks, 2019) they proposed to develop a system that predicted the availability of cervical cancer based on patients' symptoms. The system was trained and tested using an artificial neural network based on a dataset of cervical cancer patients information from UCI Machine Learning Repository [5].

Furthermore, from a research by Zagorecki, 2013 they developed a system which first diagnosed a disease with some matching symptoms, and then treated with diagnosis, in contrast with the differential diagnosis offered by their system. The system used a scalable and efficient distributed reasoning engine based on multiple Bayesian networks. An analysis of over 100,000 diagnostic cases was presented. The cases were analyzed based on population characteristics such as age and gender. The results showed the need for medical education and highlighted the most common problems in non-emergency medical care [6].

In the research (An Interpretable and Expandable Deep Learning Diagnostic System for Multiple Ocular Diseases: Qualitative Study, 2018) Kai Zhang devise and develop an interpretable and expandable diagnosis framework for automatically diagnosing multiple ocular diseases and providing treatment recommendations for the particular illness of a specific patient [7].

OBJECTIVES

- **Provide a second opinion to patients about certain diseases:**
  Medical tests are very important given they are a deciding factor based on which a patient takes treatment for a particular disease. Test results consist of true positive and true negative which are correct/true results but they also might be false positive and false negative. False negatives in particular can be very harmful if the disease being diagnosed is deadly and requires immediate treatment. This creates a sense of mistrust among people getting tested. Our website can prove to be very useful as it can ensure a double check for such diseases at no cost.
- **Cheap healthcare to people :**
  India with a staggering 7% of its huge population under poverty line and many in the lower class poses a major problem for these people when it comes to medical treatment. Medical treatment is costly everywhere around the globe and India is no exception to it. With very ineffective healthcare provided by the government, it is very hard for people to pay for treatment and there are added costs of testing. We aim to provide cheap healthcare to such people.
- **Healthcare to people in areas with no healthcare facilities:**
  In developing countries like India with a huge area having healthcare in every corner is a major challenge. Things are worse in African countries with people void of any immediate healthcare

facilities. Same is the situation with rural India. This shows that they are in a very dangerous situation. However with the coming of the digital revolution, almost every household has a smart mobile device. This creates an opportunity for us to serve their needs through our website.

- **Spreading awareness about diseases:**
  With the increase in the use of social media there's a rise in misinformation and fake news of diseases which is as dangerous as the disease itself. These can often lead to false rumors among not so educated people. Our platform will be a major source of information for these people with information posted from verified medical sources. It will also be helpful for people who want to get any kind of information for a given disease and its treatment.
- **Providing location of nearest disease specialist:**
  After getting diagnosed with a disease, the next step is to visit a disease specialist. People generally depend on word of mouth to go for such specialists. However we aim to provide them with information of the nearest possible verified healthcare specialist as soon as they are diagnosed with a disease. This reduces their precious search time. This makes our platform a one stop destination for almost every medical need of people.

DELIVERABLES

- **Different webpage for diseases:**
  Each disease will have a separate webpage containing all the information about that disease. Content of webpage is as follows:
  1. Info section which contains details of that disease. This information will be available in an easily understandable language. It will contain the information of different mutations, its origin etc.
  2. Preventive section will contain all the information regarding prevention of that disease. This will include different instructions one should follow to prevent getting infected from that disease.
  3. Cure section will contain all the instructions to be followed if a patient contracts a disease. If a patient reports to be infected his infection report will be shared with the government if required. He will immediately be suggested to the nearest disease specialist.
  4. Test section will contain a link to test that disease. This section will also contain information about how we test the disease and ensure near correct output. This is done to ensure the trust of patients in our testing process.
- **Test Webpage for disease:**
  This webpage will be used to test a patient for that particular disease. This page will have a form which will be used to take the information required for our algorithm to diagnose a particular disease. After the submission of details a report will be generated with the results and can be easily downloaded and stored in history for that particular patient.
- **Data security for the user HIPAA:**
  Information security is a major outcry among people today with many companies exploiting their valuable information. We will ensure data security of patients under The Health Insurance Portability and Accountability Act (HIPAA). No information whatsoever will be shared with any external company or partner. Regular vulnerability assessments will be done.
- **Tutorials for using website:**

This website although will be made with utmost simplicity may appear complex to few people. To ensure it is understandable to everyone we will be adding a separate page which will contain tutorials to use the website and test for a disease. These tutorials can be in the form of both videos as well as text.

- **Connecting to nearest disease specialist:**
  If a patient is diagnosed with a disease or reports himself as infected with a particular disease he/she will be immediately suggested with few cures for the disease. Furthermore they will be suggested with the nearest disease specialist. We will collaborate with specialists to give priority to the patients if their test results are extreme. Patients can also rate the specialist if they go to specialist through our platform.

CHALLENGES

- **Finding reliable data for Machine Learning Models**
  Since the web application uses the power of Machine Learning, it is challenge to find reliable data to train the models that can be used for real world patients
- **Making the web application scalable**
  The web application will be handling a huge amount of sensitive patient data, hence it will be a challenge to make the application as well as the data secure.
- **Finding reliable 3rd party APIs**
  The application will be using 3rd party APIs to integrate some functionalities like finding the right doctor near you, etc. These APIs should be reliable and finding these will be a challenge.

References

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