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Tech-Care: Personal Health Monitoring and Prediction System

Adesh Tajane, Ronish Zadode*, Ashutosh Kedar, Prabhat Pandey and Shilpa Sonawani

Massachusetts Institute of Technology, Pune, India

Abstract: Tech-care is system designed and developed to monitor user's health and give future disease risks prediction based on the collected data. The system is a four tier system which helps the user creates his own electronic health record with minimal daily efforts. Based on these records the system provides user with daily analysis as well as risk prediction based on the recorded data. The system also includes a front-end directly connected to the doctor to facilitate easy access of the records and provide doctor with intelligent insights. The overall aim of Tech-care is to develop a unique approach towards maintaining Health records and predict the future risks enabling better and user specific daily routine and daily health management.

Keywords: Electronic Health records, Health risk prediction, Neural network

I. INTRODUCTION

Since the age of industrialization human health risk has increased significantly and new life threatening diseases have come up. Unmanaged daily routine and insufficient information has been the root cause of today's unhealthy life we are living. Since then humans are trying to increase the life standard by various means like indoor exercise, diet, personal trainers etc. But all this is limited to a specific group of people. Most of the other developments are in the field of advanced medications which helps to cure diseases. None of these facilitated better standard of life for common people [1].

With the advancements in computer technologies, high computation speed, low cost memory, user friendly GUI and internet facility, it is now possible to collect data directly from the user through smartphone and use it to derive intelligent inferences and communicate it to users with better visualizations for awareness.

Tech-care application development is an approach towards building a system which enables user to create their own health history or Electronic Health records using their smartphones. The system aims to collect data and at the same time provide privacy and autonomy to the user. Using this data, Tech-care provides intelligent outcomes in the form of future risk predictions, graphical analysis of overall user routine and other insights derived using neural network machine learning approach. Tech-care also provide this data to doctors to take better decisions. It is a system that collects user's daily health data and some other parameters like temperature, location, mood and provide risk predictions as a cumulative impact of all these factors. It will provide better insight into human health and helps doctor and the user. Researchers can discover many different factors that can affect human lives [2-5].

II. SIMILAR APPLICATIONS

Many applications are developed for smartphones that track users' fitness, food habits, daily activities etc. All these applications are static sensor recording applications which work on the accelerometer, gyrometer, GPS or other similar sensors to track these parameters. These records are highly dependent on sensor sensitivity, hardware capability and surrounding environment. Taking in consideration the inaccuracy of these sensors we cannot use them for health risk prediction. Also there are algorithms developed which take user medical test data, images and other

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clinical information as input data for their prediction models. First of all this data is very sparse and conditioned which cannot be solely responsible for certain health conditions [6,7]. The algorithms developed on this data are person, disease or case specific, any variation in the real data produces largely different output. Most of the risk prediction systems are static which means they take lot of information from the user first hand and provide with all possible solutions which are not connected to user life style and environment and the results are totally dependent on the users' memory while entering data. All this results in failure of most of the system to be actually be usable.

Therefore Tech-care aims to create a unified system to collect daily routine data, food habits, mood, symptom occurrence and doctor prescription to enhance the system accuracy. It aims to provide an user friendly console for data input requiring minimum time and memory and providing them with various options for accurate and timely data input.

III. TEXT INPAINTING

Exemplar based Inpainting technique is used for inpainting of text regions, which takes structure synthesis and texture synthesis together. The inpainting is done in such a manner, that it fills the damaged region or holes in an image, with surrounding colour and texture. The algorithm is based on patch based filling procedure. First find target region using mask image and then find boundary of target region. For all the boundary points it defined patch and find the priority of these patches. It starts filling the target region from the highest priority patch by finding the best match patch. This procedure is repeated until entire target region is inpainted. The algorithm automatically generates mask image without user interaction that contains only text regions to be inpainted.

System architecture

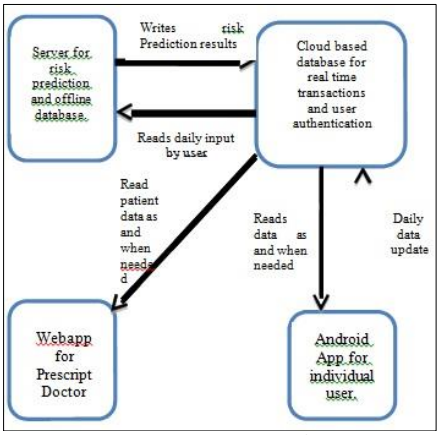

Fig. 1. Android Application for users.

Tech-care is a four tier system with Android Application for users, webapp for doctors, real-time online database and back end server for risk computation. Android Application consists of a handy and easy GUI for users to enter their daily data. It also includes graphical output of daily monitoring and risk prediction description for the user. Firebase is used as the real time database. It is a json database with key value pair format. The doctor's webapp shows detailed analysis of the patients' health and daily routine [8]. The backend is python based which executes the neural network machine learning model and saves the date in textual and graphical format (Fig. 1).

IV. ANDROID APPLICATION

It is a GUI based software application which facilitates user to input his daily routine, food habits, exercise information, water consumption and symptoms seen in him on the day. This data is fed by the user on daily basis. Also

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the application has a facility to track the user activity using accelerometer. This tracking in used to get the calories burnt per day by the user. All this data in uploaded on the real time online database on daily basis using internet.

The user is provided with detailed daily routine analysis as well as health based analysis on his smartphone through the android application. Also the future risk prediction is shown date wise and temperature wise on the phone. Based on this risk prediction user are also suggested possible medication and prevention measures. The App also has facility to search and contact nearby doctors.

The Application can be further linked to any wearable devices the user maybe using to track his daily activity. But major drawback of using automated sensors rather than user input is the inaccuracy and dependency of the sensors on the conditions like availability, user usage and some hardware limitation. The hard-core input just takes one minute a day and it can be user supported but the sensor data values can be denied by the user, which can majorly affect the risk prediction (Fig. 2).

Fig. 2. Inaccuracy and dependency of the sensors.

Neural network

The back end of the system consists of neural network model. It takes input data in the form of symptoms as x data or dependent variables and temperature as predictor variable. The neural network is multilayer, multi perceptron neural network model. Each neuron in the input layer represents each symptom. Then through the inner layers this symptoms are connected to find the risk of disease occurrence and it is linked with temperature changes. This risk is output of the neural network. This risk is then connected with the person's daily routine and daily activity and thus the system helps the user and doctor make proper conclusion with regard to disease risk prediction. The neural network is implemented using R programming language as well as other variation is derived from the scratch in python language. It is flexible model that can find risk of multiple diseases based on the symptom input. The model accuracy totally depends on the number of days and authenticity of the data.

Webapp for doctor

It is a graphical interface which provides risk prediction and daily analysis data of the patient to the doctor. Doctors can only view the data of those users who have granted required permission to them from the android application. In this way security of data is maintained. All this data is accessed from the online database. Also there is an offline database that maintains detailed data. Online database and user authentication service is provided by Google as per their standards. Every user and doctor has their login ID and password to ensure data access security and non-repudiation.

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All three tiers i.e. android app, doctor's app and the online database interact with each other. The risk prediction model is run on a server machine which ensures security of model. The back end downloads the data from online database; goes offline then executes the prediction model. The backend only uploads summarized results on the online data base which are then fetched by user and doctor. None of the users of the system come in contact with the back end server. This guarantees data and model security and result authenticity.

Implementation

The back end server is developed using python and tensor flow for neural network. A parallel model is developed in R language. The front end Doctors application is implemented in python and android application is developed using java and xml in android studio. It is available for android 5 and above with required permissions. The android application has been beta tested for 50 distinct users. Prior to that it has been alpha tested by testing it with team members and other people in different age groups. The testing also done by comparing the application with different similar applications. Also the neural network model is tested by comparing both models as well as comparing the model with in built MLP classifier in tensor flow. The results showed that the MLP model has maximum 70% accuracy and the developed model is dependent on the number of input data solely. More the user uses the model, it becomes more accurate.

V. CONCLUSION

It is concluded that tech-care is a complete system that can be used for daily health risk monitoring and prediction. The system successfully relates the symptoms of disease occurrence with climatic changes and daily health habits. It can be used by person of any age group and any health status. It is totally GUI based and fully available. It is easy to use and mostly automated; it cannot be further automated without making data erroneous. The security standards have been applied based on the standard security parameters.

VI. FUTURE SCOPE

The current implementation of the system is limited to personal health prediction of the diseases which are affected by climatic changes and daily routine, but can be expanded to other diseases by studying the affecting parameters. These parameters can be readily input to the model. Also the same data can be used for grouped analysis like state wise, climate wise etc. This can help many medical researchers to find useful insights and governments can use the analysis for betterment of the standard of living of the people by accurately targeting the issues. Public health can be improved. Further this data can be applied to various data exploration techniques and many insights can be found out. This includes certain API's and sensors in the wearable device or smartphone.

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