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Predictive Diagnosis and Wireless Technologies for Rural Healthcare

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Abstract: As the latest technologies like Internet of Things and Machine Learning are coming up, people are finding their applications in solving real life problems, like rural healthcare. The lack of human skill for medical diagnosis in rural areas is overcome by intelligent systems which do the job of analyzing and diagnosing patients. Big Data Analysis is the field that provides excellent solutions to these problems. The transmission of data is enabled through the recently coming up wireless technologies like Zigbee and LoRa. This paper discusses these concepts and how they individually relate to solving the problem of rural healthcare. Finally, a solution is proposed which involves an intelligent system that addresses and helps overcome the health related issues faced by people living in rural areas.

Keywords: Zigbee, LoRa, Internet of Things, Big Data Analysis.

I. INTRODUCTION

The latest wireless technologies have the potential to provide efficient solutions for serious problems. One of the major problems faced by the world is that of rural healthcare. In developing countries this problem is more significant than in others. An outbreak of an epidemic disease results in the death of thousands of people. Due to the poor medical assistance and facilities provided in rural areas, the quality of life is below standard.

This paper provides an overview on how latest's advances in technology can be used in improving rural healthcare. The following section discusses the wireless technologies that can be used to transmit data from the rural area to hospitals for analysis. In the absence of Wifi, low-power and low-cost technologies like Zigbee and LoRa can be used for communication. This data can then be analysed by performing operations on it. Markov Chain analysis, Neural Networks, Bayesian classification are the various methods that can be used for analysing the data and producing conclusions that can be used for saving lives.

II. WIRELESS TECHNOLOGIES

A. Zigbee

Zigbee/IEEE 802.15.4 is a low cost, low power and short range technology. It can support a large number of nodes, around 65,000. This is the reason it is suitable for a large wireless sensor network that can be deployed in rural villages. It operates in the free band 2.4 GHz. It transmits at a rate of 250kbps. This speed is sufficient for transmitting the data collected from sensors. It has a maximum range of 50m. The standard defines three network topologies- star, tree and mesh. This makes it suitable for a variety of applications. It has two modes- active and sleep. It transmits and receives when in active mode. This dual mode of operation facilitates its low power nature. It consumes significantly less power as compared to Wifi.

The nodes in the network can be configured as either router, coordinator or end device. Every rural household can be provided with a Zigbee module configured as an end device. This will collect all the sensor data of that particular household and transmit it over to a central coordinator. The coordinator device will collect data from all the end devices and further transmit it to a hospital server over the internet.

B. LoRa

This stands for Long Range. It is a new wireless technology used for LPWAN- Low Power Wide Area Network. It is a modulation which is based on spread-spectrum techniques. It transmits at a very low data rate and low power. Also, it operates at a lower frequency of 868/900 MHz. This band is less populated and hence has much lesser interference than the populated band 2.4GHz. These factors also contribute to its excellent Line Of Sight range of 22km. Even with obstacles in between, the range of 2km is much better than most of the other wireless technologies like Zigbee and Bluetooth.

The low-power and long range characteristics of LoRa make it suitable for a rural setting even if the houses are dispersed and have huge farms between them. The data from a cluster of villages can be collected by a gateway LoRa device situated at a central point. The gateway can further transmit the data over the internet to hospitals for analysis.

There are LoRa modules available in the market which can easily be deployed in a network for any application. Due to its long-range, the size of the network reduces as the number of repeaters and concatenators required is less.

The nodes in the network follow a mesh topology. This makes the network highly scalable. This trait is very valuable for an Internet of Things application like rural healthcare.

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III. METHODS OF DATA ANALYSIS FOR PREDICTION

Rural areas lack the well equipped hospitals with specialized staff that are available in urban areas. This makes the people more prone to diseases. As a result of not getting the right treatment at the right time, the condition worsens and more people get affected, in most cases. A solution to this problem is to continuously analyse the data collected from rural households about the health conditions of the people. These analysis techniques can provide diagnosis for the various conditions of the people and thereby the correct treatment can be provided on time. This will help in improving the health of the people living in rural areas.

A. Artificial Neural Networks

A multilayer feed-forward neural network with error backpropagation is an efficient algorithm for classification. This field was originated by psychologists and neurobiologists who wanted to study the computational power of neurons. They involve a long training period in which the accuracy of the output is improved with every iteration. They consist of an input layer, an output layer and multiple hidden layers. The inputs correspond to the values of the attributes for each set of training data. One iteration through the network consists of the forward propagation of the weights of the attributes through the several layers and the backward propagation step, in which, the weights are modified in the best way to minimise the mean-squared error. This error is the deviation of the output from the correct output expected.

Artificial Neural Networks have some prominent advantages. They have a high tolerance for noisy data, they can classify patterns on which they have not been trained. Due to this they have been proved to be successful on data related to pathology and laboratory medicine. They have been used for colon cancer diagnosis.

Their high tolerance makes them suitable for the analysis and prediction in rural healthcare. The symptoms of the people living in rural areas can be fed to a neural network to determine if a disease can be prevalent in a certain area. Based on this, preventive measures can be taken, which can save many lives.

B. Markov Chains

Markov chain models are also known as stochastic or probabilistic processes. In this, the system changes between states at either regular or irregular intervals. This methodology has been used in the field of medicine over the years to predict the probability of a certain event occurring. This event could be random and uncertain like an area being affected by an epidemic disease. Markov Chains have been used for predicting outcomes of kidney transplants, analysing progression of the disease for breast cancer, liver cancer, Alzheimer's disease. There has been a study conducted on the spread and growth of HIV/AIDS in the United States, based on the racial minority population. This study has given an insight on the causes and effects of racial disparity in HIV/AIDS. Also, it estimates the impact of possible solutions.

C. Data Mining and Big Data Analysis

Data mining is the process of analysing a huge amount of data and drawing meaningful conclusions from it by discovering relationships and patterns. It has been used to analyse medical data for clinical analysis. Through it, we can discover hidden patterns which can be helpful in classifying several diseases. Data Mining essentially involves data pre-processing and then a task to be performed on it - clustering, classification anomaly detection etc.

The pre-processing step is done to filter out the duplicate data, normalize the values etc. Clustering algorithms categorize the data into various groups. For example, there can be different clusters representing different diseases like malaria, cholera, mental disorders etc. Depending on the values of the symptoms measured by the sensors, the person is placed under a particular cluster. A person with the symptoms vomiting, leg cramps, dehydration, will be placed in the cluster cholera. The algorithms Naive Bayes, K-NN and Decision trees have been used to analyse a data set for heart disease prediction.

The probability of a person getting a heart disease is estimated based on attributes like age, gender, blood sugar, blood pressure. Clustering and frequent pattern mining have been used to classify common diseases. The clustering is done using the K-means algorithm and the frequent patterns in the relevant data are extracted using the ID3 algorithm. Big Data analysis can help in predicting the cause and outbreak of epidemic diseases. For example, during the Ebola outbreak it was recommended that technologies like Big Data be used so that they can be prepared and send teams on the ground before the outbreak turns into a crisis.

The data that is collected for medical prediction is very vast and varied. The data mining techniques will help in making useful sense out of this data which will benefit everyone. Tangara is an example of a data mining tool which provides various features and a graphical user interface to easily analyse a data set.

IV. PROPOSED SOLUTION

One of the biggest problems with rural healthcare is the absence of good quality services at costs affordable by the locals. Doctors from big cities visit rural area once in a month and conduct health check up camps. These are not always enough to improve the health of the people. In case of emergencies the patients have to be rushed to big hospitals in the city. This turns out to be very inconvenient and expensive for the families living in rural areas. Implementing a smart system can be a feasible and efficient solution to this problem.

The system consists of the following components:

1. A wireless sensor network
2. Predictive Analysis on collected data

The wireless sensor network will include the sensors placed in every household, a transmitting device to continuously record and send data and a central gateway device which will collect all the data in the area and transmit it over the internet to the server of a hospital. The sensors can be simples ones like temperature, glucose level and also complex ones like electrocardiography (ECG), electroencephalography (EEG) etc.

These sensors will be connected to an independent device which will have a Zigbee or LoRa module to transmit the data. Every household will have an end device. The gateway device will be placed in the primary healthcare centre of the rural area. Communication between the end devices and the gateway will happen through the protocol followed by the modules, i.e. Zigbee or LoRa. The hospital can communicate with the people through the primary healthcare centre. This not only helps in looking out for diseases, but also helps in keeping a track of the medicines consumed by the patients.

Next, the data collected by the hospital will be continuously analysed to detect any anomaly in order to notify the doctors regarding a patient. This will give the doctors ample time to travel to the rural area and treat the patient before it is too late. This will also assist in preventing or at least being prepared for the outbreak of an epidemic diseases.

This solution will be appropriate for rural healthcare as it addresses the basic problems faced. Firstly, by using low-power technologies even the areas without electricity can be monitored. Next, the absence of hospital facilities can be overcome by continuously monitoring the patients and also drawing conclusions based on the recorded data.

V. CONCLUSION

As technology advances, improved solutions to real life problems emerge. These solutions are absolutely necessary in overcoming those problems. Rural healthcare is one of those problems which is extremely prominent in developing countries. For example, the village of Hemalkasa in Maharashtra, India, is so isolated from the urban cities that few years back there was no electricity there.

Only after social workers went and settled there, the quality of life of the locals slightly improved. There are many other such places which are in need for improvement with respect to the health of the people. The best solution for this is to implement a smart system. Once the security concerns and probability of major errors is taken care of, these smart systems will be ready to be deployed at a large scale.

REFERENCES

[1] Jiawei Han, Micheline Kamber and Jian Pei, 3rd ed. “Data Mining Concepts and Techniques”

[2] Ciaran Mc Mahon, Mary Aiken, Cyberpsychology Research Center, Royal College of Surgeons in Ireland, Dublin, Ireland “Introducing digital wellness: Bringing cyberpsychology balance to healthcare and information technology” in Proceedings of the 2015 IEEE International Conference on Computer and Information Technology; Ubiquitous Computing and Communications; Dependable, Autonomic and Secure Computing; Pervasive Intelligence and Computing

[3] Ademola Philip Abidoye, Nureni Ayofe Azeez, Ademola Olusola Adesina, Kehinde K. Agbele, Henry O. Nyongesa “Using Wearable Sensors for Remote Healthcare Monitoring System”, Journal of Sensor Technology, 2011, 1, 22-28.

[4] S.Lee, J. Ko, Xi Tan, Isha Patel, R. Balkrishnan and J. Chang “Markov Chain Modelling Analysis of HIV/AIDS Progression: A Race-based Forecast in the United States”, Indian Journal of Pharmaceutical Sciences, 2014 Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4023279/

[5] Matt Wood, “Using technology and big data to predict and prevent the next Ebola outbreak”, Science Life, The University of Chicago, Medicine and Biological Sciences, January 22, 2015 available: https://sciencelife.uchospitals.edu/2015/01/22/using-technology-and-big-data-to-predict-and-prevent-the-next-ebola-outbreak/