Automation of Hospital with Decision Making Ability

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Abstract--**This paper addresses the advance data mining and feasibility of using IVR approach in medical clinics and hospitals. Using the interactive voice response (IVR) technology the existing hospital phones can be configured to act as automated telephone answering machines, which give instructions to the patients to book appointments, provide guidelines etc. The voice files of data demanded are built and played for response through application, TTS (Text to Speech) and IVR server .System automatically sends alert messages about babies' vaccination schedule dates to the parents of new born babies. Also send alert messages about upcoming medical camps and appointments to the patients. System is able to provide automatic functioning in hospital by taking decision about scheduling of patient's appointment and medical diagnosis reports by using stored patient's and medical database. In this system we focus on simple and effective methodology for medical diagnosis. We are using association rules with the apriori algorithm to decide the diagnostic respective to the disease. To perform effective data mining, system performs classification, clustering and association of data used to identify the symptoms, decision and the respective diagnostics. The association rule is used to select the best solution for the patient.**

Keywords—**IVR (Interactive Voice Response); Data Mining; SMS (Short Message Service); Apriori Algorithm; Naive bayas algorithm; K-Means Clustering algorithm**

I. INTRODUCTION

Today's small scale clinics and hospitals are lacking in providing accurate information to the patient's because they based on manual appointment scheduling approach. As today's Healthcare professionals are overwhelmed with a huge amount of information generated from different sources. In this context, preventable medical errors are estimated to be the cause of thousands of deaths and loss of billions of dollars per year in all over the world. To reduce the human related errors, clinical decision support systems have been developed to help physicians and caregivers in practicing medicine. In recent years, many studies in health informatics literature have investigated the effectiveness of the clinical decision support systems and concluded that these systems are indeed helpful. In small scale clinics and hospitals appointments are booked and scheduled on telephone. This requires dedicated human involvement for 24/7 for attending these calls. So in order to overcome these problems in medical sector this paper gives the idea of using IVR technology and Short Message Service that allows the patient's and doctor's to access required information remotely on mobile. All the relevant information is stored on server, which is present at hospital. By using the IVR technology the existing hospital phones are automated which guides patient for taking a new Appointment. Also Doctor can schedule their Appointment by using IVR system. And this atomized approach reduces the human errors. Sometimes it is not possible to make a call in clinic or hospital

for getting answer of any health related question in such situation we can use Short Message Service. SMS resolve the availability problem so that patient can send their query to the server at any time [1].

Medical database is too large, so to retrieve required data efficiently from the database, in this paper we have explained precise approach for Association Mining to decide the diagnostic respective to the disease. Where the classification, clustering and association rules is used to identify the symptoms, decision and the respective diagnostics and the association rule mining is to select the best solution for the patient.

II. LITERATURE SURVEY

Most of small scale clinics and hospitals are based on manual appointment scheduling approach. That makes the system more error prone. To overcome from this problem we are explaining more advance approach of using IVR and SMS technology.

A. IVR:

Interactive voice response (IVR) is an automated telephony system that interacts with callers, gathers information and provides the requested information to the caller. An IVR system accepts a combination of voice input and touch-tone keypad selection and provides appropriate responses in the form of voice, fax, callback, e-mail and perhaps other media. An IVR system interacts with its user according to a pre-defined scenario designed in tree structure.

User is moved to different states according to his/her answer to the questions being asked by the system [3] .Touch tone IVR systems are used where a menu is read for the user and he/she uses the buttons on the phone keypad to interact with the system according to the read menu[2].
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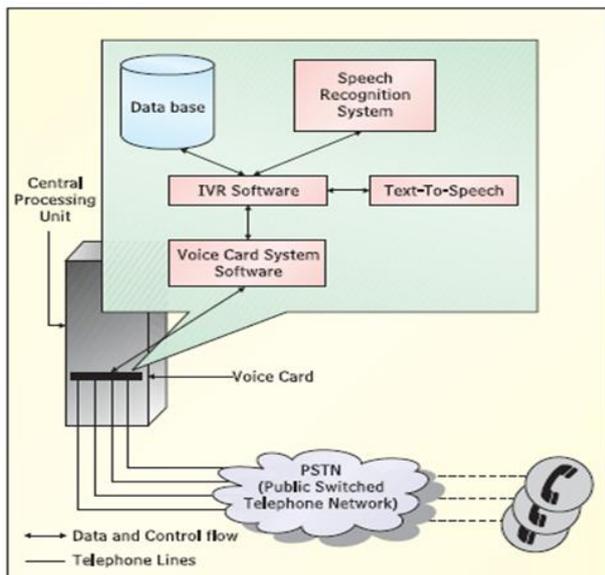
Figure 1: Block diagram of an IVR system

The system consists of software and hardware implementation which senses the number entered and accordingly inputs the response to the IVR system. The IVR software is programmed to respond to a certain option in a predetermined fashion.IVR systems make use of tone dialling. The punched numbers on the telephone are converted into digital format pulses and transferred to the IVR systems via the telephone exchange.

B. Data Mining:

While large-scale information technology has been evolving separate transaction and analytical systems, data mining provides the link between the two. Data mining software analyzes relationships and patterns in stored transaction data based on open-ended user queries.

Sequential patterns: Data is mined to anticipate behaviour patterns and trends. For example, an outdoor equipment retailer could predict the likelihood of a backpack being purchased based on a consumer's purchase of sleeping bags and hiking shoes.

Classes: Stored data is used to locate data in predetermined groups. For example, a restaurant chain could mine customer purchase data to determine when customers visit and what they typically order. This information could be used to increase traffic by having daily specials.

Associations: Data can be mined to identify associations. The beer-diaper example is an example of associative mining.

Clusters: Data items are grouped according to logical relationships or consumer preferences. For example, data can be mined to identify market segments or consumer affinities.

Data mining consists of five major elements:

a) Extract, transform, and load transaction data onto the data warehouse system.
b) Store and manage the data in a multidimensional database system.
c) Provide data access to business analysts and information technology professionals.
d) Analyse the data by application software.
e) Present the data in a useful format, such as a graph or table.[1]
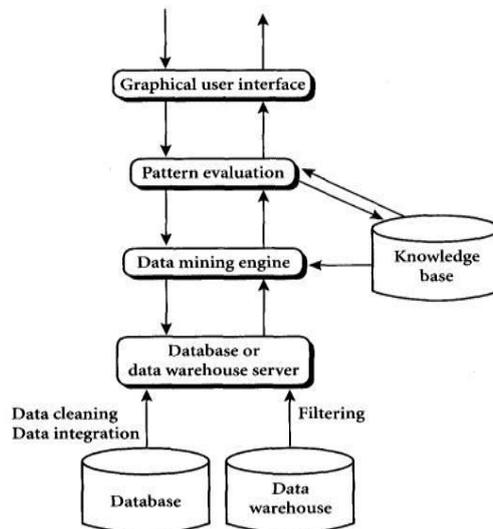
Figure 2: Block diagram of Data Mining

III. SYSTEM DETAILS

This System mainly used by two types of users Doctor's and Patient's. They are using IVR technology and SMS technology as interface for interacting with database. For efficient retrieval of information we are providing three modules with data mining technique. These modules are,

1) Web Portal
2) SMS Module
3) IVR Module
4) Automatic Medical diagnosis

A) System Architecture
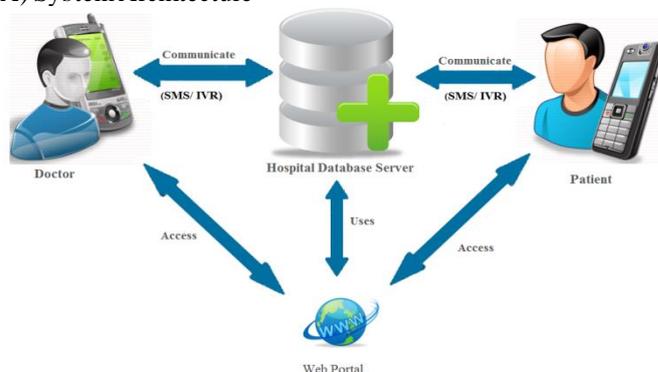
Figure 3: System Architecture

Hospital server automatically attends the call from patient and doctor through voice modem and resolves their queries. GSM modem is connected to hospital server that allows the server to receive the text message. Server automatically analyse message through text recognition technique. We are providing Web Portal another option of interaction with system. So by using the web portal patient and doctor can schedule their Appointments, also patients and doctors can view patient's diagnosis reports.

B) System Specification

1) SMS Module :

i. Take New Appointment:

For taking a new appointment, message send by the patient must be in specific structured format as text recognition is take place at server end. Patient and Doctor book their appointment by sending simple text message to the server. Patients send his name, date of appointment and doctor name to the server. Server automatically extracts the required content from message through text recognition and checks them against the database. Appointment conformation message send to the patient if at specified date and time doctor is available. If the requested time slot is already occupied then server check database and give suggestion to the customer about next most appropriate time slot which is free.

ii. Update Appointment:

This facility mainly concerns about preponing and postponing of scheduled appointments. To make change in the scheduled Appointment patient or doctor simply send the text message to the server containing current Appointment date/time and new Appointment date/time. At server end server interpret the message through text recognition and make changes to the database. For example, Due to some reason if doctor wants to reschedule his appointment of Thursday by postponing them by two hours then, Doctor simply send the text message to the server and server check the appointments scheduled at upcoming Thursday and automatically postpone the Appointments by two hours. Suppose patient 'XYZ' had taken Appointment on Thursday of 12:30 pm server automatically reschedule his appointment to 2:30 pm and changed appointment notification is get delivered to patient 'XYZ'.

iii. Cancel Appointment:

For the cancelation of Appointment Doctor simply send the text message to the server. Patient also cancels his/her booked Appointment. Cancelation message contains patient id, Appointment date and doctor name. After the cancellation message has been processed server send Conformation message to the patient and simultaneously send updating notification to the patient.

iv. SMS Alert:

a) Alerts about vaccination:

In hospital after a particular time period baby is needed to get vaccinated. Such as polio vaccination, so when child is get

born in the hospital all the information regarding the birth of the child is saved on the server. And According to saved information server automatically sends the vaccination alerts to patient.

b) Alerts about Event:

If any medical camp is going to be held in hospital then, information about such camp is send to the patient via text message.

2) IVR Module

Hospitals involve many routine and mundane procedures which are replaced by an intelligent IVR Software quite effectively. In fact, using IVR Software increases the utilization of resources as well and increase efficiency and better output for the hospital. IVR Software works 24 hours a day and that is one of the major advantages of IVRS. The strength of IVR systems lies in the fact that the callers do not have to wait on phone for any idle agent.

i. Appointments Scheduling:
For booking the new Appointment through IVR, patient call on hospital no then call is get transferred to the server. Server automatically attends the call and guides the caller. For example if caller want to book his appointment he has to press '1' on his mobile. Server recognises which key is press through DTMF on based on that it takes the action.

ii. Cancel Appointment:
By calling on hospital phone patient able cancel his appointment.

iii. Asking about specific treatment is available or not.

iv. Schedule or change appointments

v. Ask about the charges about the treatment

vi. Medical billing inquiry or confirm payment receipt.

3) Automatic Medical diagnosis:

Medical diagnosis usually involves careful examination of a patient to check the presence and strength of some features relevant to a suspected disease in order to take a decision whether the patient suffers from that disease or not.

A feature, like a runny nose for instance, may appear to be very strong for one patient but it can be moderate or even very light for another. It is the experience of the physician that tells him how to combine a set of symptoms (features and their strengths) to find out the correct diagnostic decision. By interpreting the patient data using the mined knowledge within the context of the clinical guidelines, the Healthcare personnel will be assisted to make a guided decision about the clinical case

Most hospitals today employ sort of hospital information systems to manage their healthcare or patient data. These systems typically generate huge amounts of data. There is a wealth of hidden information in these data that is largely untapped. How data is turned into useful information that can enable healthcare practitioners to make intelligent clinical decisions. The main objective of this research is to develop a

Decision Support in Disease Prediction System (DSHDPS) using one data mining modelling technique. It can discover and extract hidden knowledge (patterns and relationships) associated with disease from a historical disease database.

4) Web Portal
  i. Accessing Diagnosis Reports:

   We are providing web portal for patient and doctor to access the medical diagnosis reports and other information. Web portal used by both doctor and patient. Doctor upload the patients reports to the server also he updates them through portal. When new report is uploaded patient get alert through SMS and email.

  ii. Appointment Scheduling:

   Also doctor can schedule his appointments through web portal, by entering authentic credentials in the portal doctor can view, update, prepone, postpone his appointment. Patient get information about babies vaccination dates, upcoming medical camps and events. Also Patient take appointment through web portal, as complete scheduling information is available on web qportal, also he/she prepone, postpone or cancel appointment through web portal.

  iii. Health Awareness:

   Web portal gives information about diseases, viral infections and precautions that should be taken. Doctor may upload any video, speech to make awareness about health between patients.

IV. IMPLEMENTATION
A .Web Portal
  1. Administrator Interface:

Figure 4: Patients Registration Process

   Administrator logs in the server and registers the patient information on the server and fixed the Appointment as per schedule. After patient registration is successful, Appointment conformation message is send on patients mobile. Whole days schedule information is also send on corresponding doctors mobile.

  2. Patient Interface:

Figure 5: Patients Appointment Details

   After the registration is successful patient can checks the appointment details by visiting the hospitals web portal or by making a call to hospitals IVR.
  3. Doctor Interface:

Figure 6: Generation of Diagnosis report for patient

   Doctor is able to view his next scheduled appointments, also he can access and generate the patient's diagnosis reports. After the generation of patient's diagnosis reports server sends it on the patient's registered mobile number.

B. SMS:

Figure 7: SMS Module

SMSEngine is a Java API library which can be used to send and/or receive SMS messages through your GSM modem or mobile phone. Patient or doctor sends message to the server. Server processes it, and takes the required action. For this process system uses JSMS Engine.

 C. IVR:

   For booking the new Appointment through IVR, patient call on hospital no then call is get transferred to the server. Server automatically attends the call and guides the caller.

Figure 8:IVR Module

By calling on hospital phone doctor can cancel his appointment. After this the reflection of database is done with respect to cancelled appointment. The message is send to patient for informing that his/her appointment was cancelled.

D. Automatic Medical Diagnosis:

(Classification) > (Clustering) > (Association)
Figure 9: Data Mining Process

Data mining Process involves Classification, Clustering and Association processes for generating medical Diagnosis of the patient. Classification process divides the Data in to the specific classes and previously unseen records get assign a class. Clustering process includes a similar kind of records in to the same cluster. Association Searches for relationships between variables. It determines which frequently diseases can happen together [5].
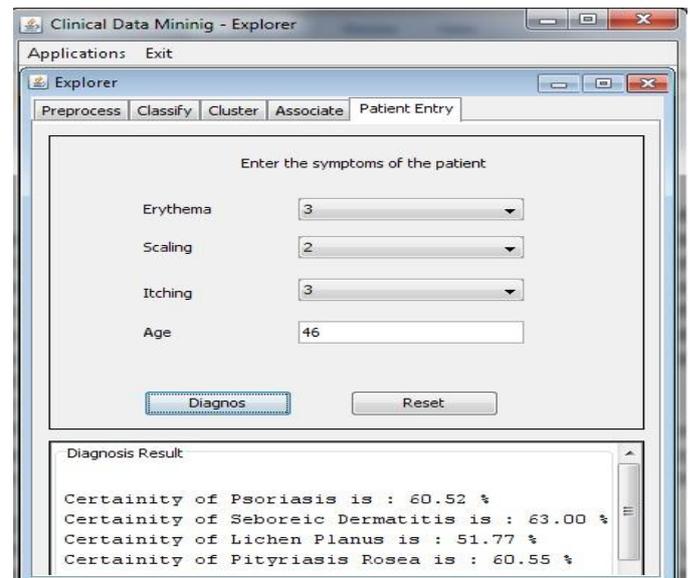
Figure 10: Automatic Medical Diagnosis

Automatic medical diagnosis module produces the Diagnosis report of the patient. For Diagnosis report values of symptoms of the patient as an input are given like Age, scaling (type of skin disease) etc. And System Automatically Produce the Result in terms of percentage that probable percentage of diseases patient may have.

Algorithms used for Implementation:

a. Naive bayas algorithm:

The Naïve Bays Classifier technique is particularly suited when the dimensionality of the inputs is high. Despite its simplicity, Naive Bayes can often outperform more sophisticated classification methods. Naïve Bayes model identifies the characteristics of patients with disease. It shows the probability of each input attribute for the predictable state. It provides new ways of exploring and understanding data.[5]

Advantage of naive bays implementation:
1) When the data is high.
2) When the attributes are independent of each other.
3) When we want more efficient output, as compared to other methods output.

b. K-Means Clustering algorithm:

The k-means algorithm accepts two inputs. The data itself, and "k", the number of clusters. The output is k clusters with input data partitioned among them. The aim of K-means (or clustering) is this: We want to group the items into k clusters such that all items in same cluster are as similar to each other as possible. And items not in same cluster are as different as possible. We use the distance measures to calculate similarity and dissimilarity. One of the important concept in K-means is that of centroid. Each cluster has a centroid. You can consider it as the point that is most representative of the cluster. Equivalently, centroid is point that is the "center" of a cluster.[6]

Algorithm:
1. Randomly choose k items and make them as initial centroids.

2. For each point, find the nearest centroid and assign the point to the cluster associated with the nearest centroid.

3. Update the centroid of each cluster based on the items in that cluster. Typically, the new centroid will be the average of all points in the cluster.

4. Repeats steps 2 and 3, till no point switches clusters.

After some iterations, we will get k-clusters within which each points are similar.

c. Apriori Algorithm:

In computer science and data mining, Apriori is a classic algorithm for learning association rules. Apriori is designed to operate on databases containing transactions (for example, collections of items bought by customers, or details of a website frequentation).The purpose of the Apriori Algorithm is to find associations between different sets of data. It is sometimes referred to as "Market Basket Analysis". Each set of data has a number of items and is called a transaction. The output of Apriori is sets of rules that tell us how often items are contained in sets of data.[6]

Example:

Each line is a set of items

- alpha beta gamma
- alpha beta theta
- alpha beta epsilon
- alpha beta theta

1. 100% of sets with alpha also contain beta

2. 25% of sets with alpha, beta also have gamma

3. 50% of sets with alpha, beta also have theta.

VI. CONCLUSION

The goal of this project is making small scale clinics and hospital atomized. Server works 24/7 without any human involvement. It is well proven that IVRS controls damages and waste due to careless human error and poor management up to 30%. This adds value in terms of direct cut in cost and better utilization of resources.

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