CHRONIC KIDNEY DISEASE PREDICTION BASED ON NAIVE BAYES TECHNIQUE

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Abstract – *Data Mining has been a recent trend for obtaining a diagnostic result. Huge amount of unmined data is collected by the healthcare department in order to discover the hidden facts for effective diagnosis and also decision making. Data mining is defined as the process of extracting the huge hidden data from a large dataset, categorizing valid and unique patterns in data. There are lot of DM techniques like clustering, classification, association, analysis, regression etc. The main aim of this paper is to predict a YES or NO for Chronic Kidney Disease (CKD) using the classification technique i.e. Naïve Bayes.*

Key Words: Naive Bayes, Clustering, User Interface (UI), Data Mining (DM), Chronic Kidney Disease (CKD).

1. INTRODUCTION

Data Mining is one among the foremost encouraging areas of analysis with the aim of finding helpful information from voluminous knowledge of datasets. It's been employed in several domains like image mining, opinion mining, web mining, text mining, graph mining etc. Its applications embody anomaly detection, money knowledge analysis, medical knowledge analysis, social network analysis, marketing research etc. It's become common in health department as there's a demand of analytical methodology for predicting and finding unknown patterns and obtaining info in health data. It plays a significant role for locating new trends in aid business.

Data Mining is especially helpful in medical field once no handiness of proof favouring a treatment choice is found. Great deal of advanced knowledge is being generated by aid business regarding patients, diseases, hospitals, medical equipments, claims, treatment price etc. That needs process and analysis for information extraction. Data processing comes up with a group of tools and techniques that once applied to the present processed knowledge, provides information to aid professionals for creating acceptable choices and enhancing the performance of patient management tasks. Patients with similar health problems is sorted along and effective treatment plans may well be recommended supported patient's history, physical examination, designation and former treatment patterns. Chronic Kidney Disease (CKD) has become a world health issue and is a locality of concern. It's a condition wherever kidneys become broken and can't filter nephrotoxic wastes within the body. Our work preponderantly focuses on police work life threatening diseases like chronic nephrosis (CKD) victimization Classification algorithms like Naive Bayes.

2. LITERATURE SURVEY

At present, health care industry is providing several benefits like fraud detection in health insurance, availability of medical facilities to patients at inexpensive prices, identification of smarter treatment methodologies, and construction of effective healthcare policies, effective hospital resource management, better customer relation, improved patient care and hospital infection control. Disease detection is also one of the significant areas of research in medical. Data mining approaches have become essential for healthcare industry in making decisions based on the analysis of the massive clinical data. Data mining is the process of extracting hidden information from massive dataset. Techniques like classification, clustering, regression and association have been used by in medical field to detect and predict disease progression and to make decision regarding patient's treatment. Classification is a supervised learning approach that assigns objects in a collection to target classes. It is the process which classifies the objects or data into groups, the members of which have one or more characteristic in common. The techniques of classification are SVM, decision tree, Naive Bayes, ANN etc.

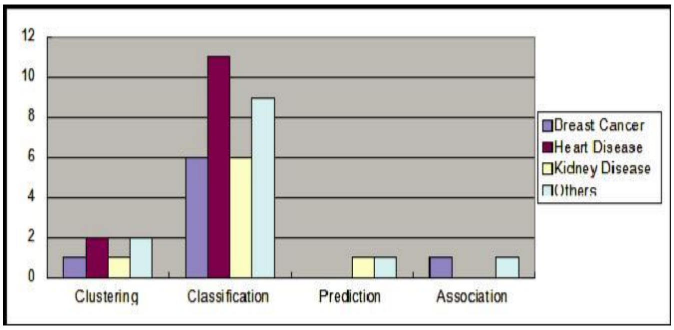


Fig 2.1: potential use of data mining techniques

The feasibleness study of employing a distributed approach for the management of alarms from chronic renal disorder patients. The key problems relating to alarm definition, classification and prioritization consistent with on the market standardization efforts area unit analyzed for the most situations addressed in dialysis. Then, the middleware projected for alarm management is represented, that follows the publish/subscribe pattern, and supports the OMG DDS (Data Distribution Service) customary. This customary facilitates the period of time observation of the changed info, furthermore because the quantifiability and ability of the answer developed relating to the various stakeholders and resources concerned [1].

The study was to work out the connection between the frequency spectrum of the irregular pulses associated with the stages of the CKD particularly from the chi space Information of the irregular pulse were classified into six stages i.e. 1, 2, 3a, 3b, 4, and five of the CKD patients. The information was collected by the activity pressure throughout beat periods or once blood vessels were in relaxed state. During this amount, the instrumentation records reflections of the heartbeat together with info concerning the amplitudes, frequencies, and pulse wave patterns. Observations were targeted on the part of the signal between amplitude from low to high on pulse patterns i.e. systolic period [3].

3. EXISITNG SYSTEM

Nowadays, health care industries are providing several benefits like fraud detection in health insurance, availability of medical facilities to patients at inexpensive prices, identification of smarter treatment methodologies, and construction of effective healthcare policies, effective hospital resource management, better customer relation, improved patient care and hospital infection control. Disease detection is also one of the significant areas of research in medical. There is no automation for chronic kidney disease prediction.

Limitations of Existing System

- Manual Approach
- Requires Medical Equipments
- More Expensive
- Lack of user satisfaction
- Less Efficient
- Less Accurate

4. PROPOSED SYSTEM

Our Aim is to predict the chronic kidney disease using the machine learning algorithm. Chronic kidney disease (CKD) means your kidneys are damaged and can't filter blood the way they should. The disease is called "chronic" because the damage to your kidneys happens slowly over a long period of time. This damage can cause wastes to build up in your body. CKD can also cause other health problems.10% of the population worldwide is affected by chronic kidney disease (CKD), and millions die each year because the doctors are unable diagnose the disease. The system is automation for predicting the CKD. The system is a Real-world web-based application that can be used by many hospitals. Naive Bayes is a probabilistic classifier based on Bayes theorem. It assumes variables are independent of each other. The algorithm is easy to build and works well with huge data sets. It has been used because it makes use of small training data to estimate the parameters important for classification. It performs well in multiple class prediction. When assumption of independence holds a Naive Bayes classifier perform better compare to other models like logistic regression and you need less training data.

5. METHODOLOGIES

Data Mining is one of the most significant stages of the Knowledge Data Discovery process. The process involves data collection from various sources with pre-processing of the chosen data. The data is then transformed into suitable format for further processing. Data mining technique is applied on the data to extract valuable information and evaluation is done at the end.

A. Data Collection

The clinical data of 400 records considered for analysis has taken from UCI Machine Learning Repository. The data obtained after cleaning and removing missing values is 220. There are 25 attributes in the dataset. The numerical attributes include age, blood pressure, blood glucose random, blood urea, serum creatinine, sodium, potassium, hemoglobin, packaged cell volume, WBC count, RBC count. The nominal attributes include specific gravity, albumin and sugar. It also includes RBC, pus cell and pus cell clumps, bacteria, hypertension, diabetes mellitus, coronary artery disease, appetite, pedal edema, anemia and class.

Number of Instances: 400

Number of Attributes: 25

Class: {CKD, NOTCKD}

Missing Attribute Values: yes

Class Distribution: [63% for CKD] [37% for NOTCKD]

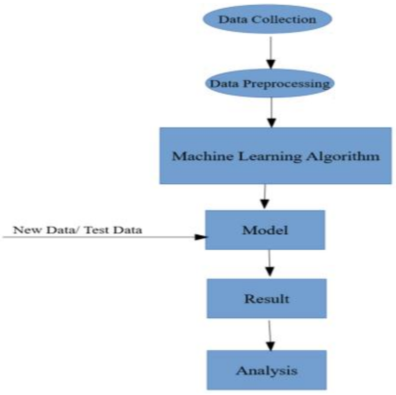


Fig 5.1: Stages of the Knowledge Data Discovery process.

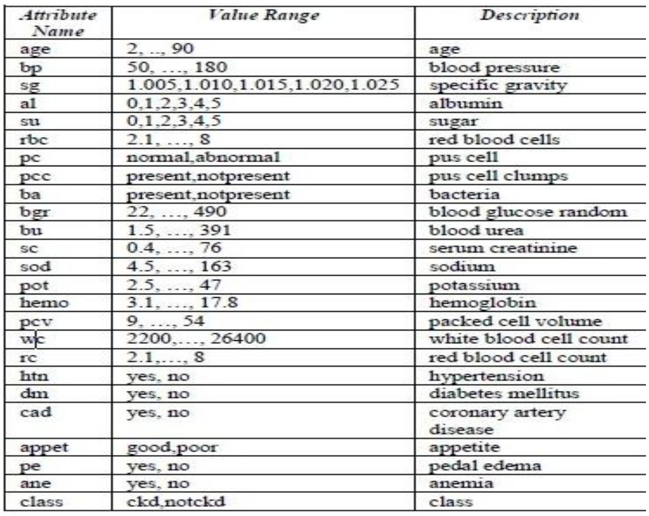
B. Data Pre-processing

Data pre-processing is a data mining technique that involves transforming raw data into an understandable format. The Real-world data is often incomplete, inconsistent, and/or lacking in certain behaviors or trends, and is likely to contain many errors. Data pre-processing is a proven method of resolving such issues. Data reprocessing prepares raw data for further processing. The data from UCI Repository is Pre-processed by removing the noisy data.

C. Machine Learning Algorithm

The machine learning algorithm a basic algorithm that we are using is the naïve Bayes algorithm to predict higher accuracy results and classification will always be accurate.

D. Dataset

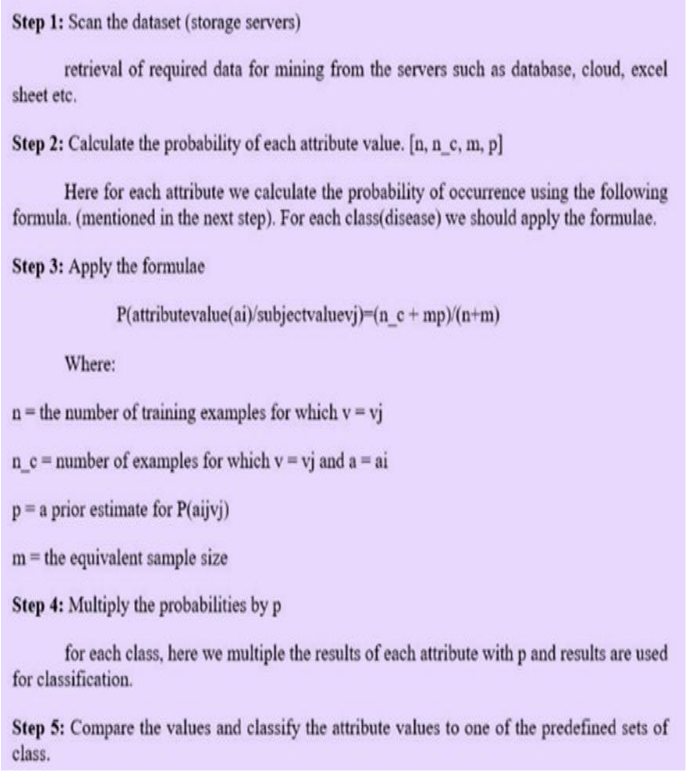


Attribute Name	*Value Range*	*Description*
age	2, .., 90	age
bp	50, …., 180	blood pressure
sg	1.005,1.010,1.015,1.020,1.025	specific gravity
al	0,1,2,3,4,5	albumin
su	0,1,2,3,4,5	sugar
rbc	2.1, …., 8	red blood cells
pc	normal,abnormal	pus cell
pcc	present,notpresent	pus cell clumps
ba	present,notpresent	bacteria
bgr	22, …., 490	blood glucose random
bu	1.5, …., 391	blood urea
sc	0.4, …., 76	serum creatinine
sod	4.5, …., 163	sodium
pot	2.5, …., 47	potassium
hemo	3.1, …., 17.8	hemoglobin
pcv	9, …., 54	packed cell volume
wc	2200,…., 26400	white blood cell count
rc	2.1,…., 8	red blood cell count
htn	yes, no	hypertension
dm	yes, no	diabetes mellitus
cad	yes, no	coronary artery disease
appet	good,poor	appetite
pe	yes, no	pedal edema
ane	yes, no	anemia
class	ckd,notckd	class

Fig: Table Represents the used Data Set.

6. WORKING OF THE SYSTEM

Coming to the working of the proposed system, our main aim is to predict the chronic disease but here we build a web-based application that can be used by hospitals. We have built an application that can be accessed by Admin, Receptionist, Doctor and even the patients. The admin is the person who maintains the entire application and the admin is responsible to add the new parameters or modify the existing parameters for the model. And the receptionist is responsible to add new patients' details and add the data for the new records of new patients and hence helps it to increase the dataset by adding new patient's data. If today we have 400 datasets to train our model next, we will dynamically increase the number of records in the training dataset to train our model; these new datasets of new patients are handled by the receptionist. Next, we have the main aim of our project that is to predict the chronic kidney disease using the naïve Bayes algorithm. Here, the model is trained using the training dataset and the Naïve Bayes algorithm is executed as follows.



Step 1: Scan the dataset (storage servers)

retrieval of required data for mining from the servers such as database, cloud, excel sheet etc.

Step 2: Calculate the probability of each attribute value. [n, n_c, m, p]

Here for each attribute we calculate the probability of occurrence using the following formula. (mentioned in the next step). For each class(disease) we should apply the formulae.

Step 3: Apply the formulae

P(attributevalue(ai)/subjectvaluevj)=(n_c + mp)/(n+m)

Where:

n = the number of training examples for which v = vj

n_c = number of examples for which v = vj and a = ai

p = a prior estimate for P(aijvj)

m = the equivalent sample size

Step 4: Multiply the probabilities by p

for each class, here we multiple the results of each attribute with p and results are used for classification.

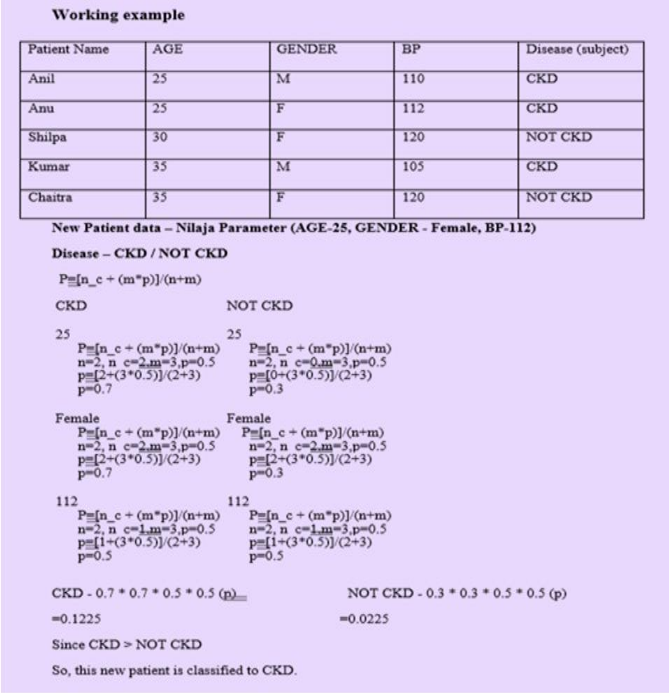
Step 5: Compare the values and classify the attribute values to one of the predefined sets of class.

Fig 6.1: Implementation steps of naïve Bayes

Query Module- We can add the query module as a future enhancement to the application where doctor, receptionist and admin of the application can interact with each other.

Server Deployment- We can deploy this onto the servers for online chronic kidney disease prediction and even create a wellness application for the users for curing or taking care of the disease.

We tested using other algorithms such as KNN (K-Nearest Neighbor Algorithm), SVM (Support Vector Machines), Decision tree and ANN (Artificial Neural Network) but surprisingly Naïve Bayes gave us amazing results and higher accurate results when compared to other algorithms. But using the J48 algorithm we can get similar accuracy rates like that of the Naïve Bayes itself. In future we can even test J48 algorithm to almost similar results. In future we can provide graphical analysis too, which is user friendly to understand.



Working example

Patient Name	AGE	GENDER	BP	Disease (subject)
Anil	25	M	110	CKD
Anu	25	F	112	CKD
Shilpa	30	F	120	NOT CKD
Kumar	35	M	105	CKD
Chaitra	35	F	120	NOT CKD

New Patient data – Nilaja Parameter (AGE-25, GENDER - Female, BP-112)

Disease – CKD / NOT CKD

P=[n_c + (m*p)]/(n+m)

CKD

25
P=[n_c + (m*p)]/(n+m)
n=2, n c=2,m=3,p=0.5
p=[2+(3*0.5)]/(2+3)
p=0.7

Female
P=[n_c + (m*p)]/(n+m)
n=2, n c=2,m=3,p=0.5
p=[2+(3*0.5)]/(2+3)
p=0.7

112
P=[n_c + (m*p)]/(n+m)
n=2, n c=1,m=3,p=0.5
p=[1+(3*0.5)]/(2+3)
p=0.5

NOT CKD

25
P=[n_c + (m*p)]/(n+m)
n=2, n c=0,m=3,p=0.5
p=[0+(3*0.5)]/(2+3)
p=0.3

Female
P=[n_c + (m*p)]/(n+m)
n=2, n c=2,m=3,p=0.5
p=[2+(3*0.5)]/(2+3)
p=0.3

112
P=[n_c + (m*p)]/(n+m)
n=2, n c=1,m=3,p=0.5
p=[1+(3*0.5)]/(2+3)
p=0.5

CKD - 0.7 * 0.7 * 0.5 * 0.5 (p)
=0.1225

NOT CKD - 0.3 * 0.3 * 0.5 * 0.5 (p)
=0.0225

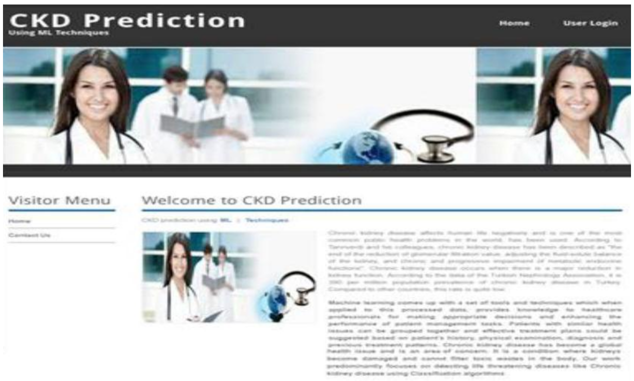
Since CKD > NOT CKD

So, this new patient is classified to CKD.

Fig 6.2: Explanation of Naïve Bayes algorithm

7. EXPECTED RESULTS

It is successfully accomplished by applying the Naïve Bayes algorithm for classification. This classification technique comes under data mining technology.



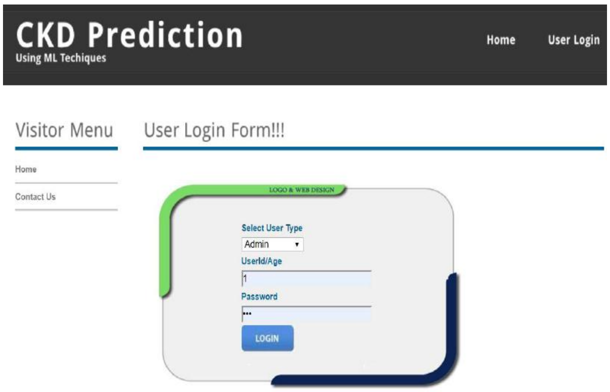
Welcome to CKD Prediction

CKD prediction using ML | Techniques

Chronic kidney disease affects human life negatively and is one of the most common public health problems in the world, has been used. According to Tanrıverdi and his colleagues, chronic kidney disease has been described as "the end of the reduction of glomerular filtration value, adjusting the fluid-solute balance of the kidney, and chronic and progressive impairment of metabolic endocrine functions". Chronic kidney disease occurs when there is a major reduction in kidney function. According to the data of the Turkish Nephrology Association, it is 390 per million population prevalence of chronic kidney disease in Turkey. Compared to other countries, this rate is quite low.

Machine learning comes up with a set of tools and techniques which when applied to this processed data, provides knowledge to healthcare professionals for making appropriate decisions and enhancing the performance of patient management tasks. Patients with similar health issues can be grouped together and effective treatment plans could be suggested based on patient's history, physical examination, diagnosis and previous treatment patterns. Chronic kidney disease has become a global health issue and is an area of concern. It is a condition where kidneys become damaged and cannot filter toxic wastes in the body. Our work predominantly focuses on detecting life threatening diseases like Chronic kidney disease using Classification algorithms.

Fig 7.1: Home Page of the CKD Prediction



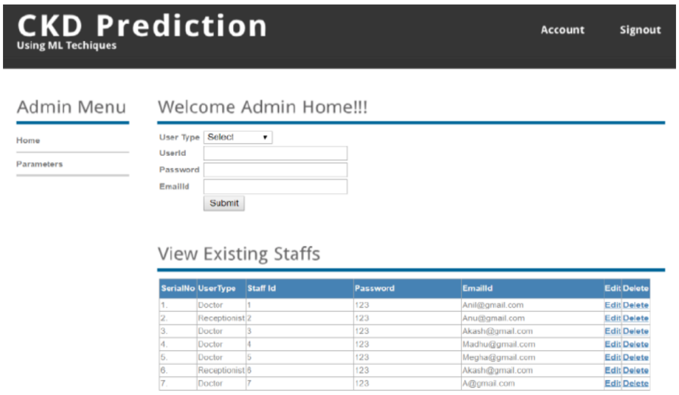
User Login Form!!!

Select User Type: Admin

UserId/Age: 1

Password: •••

Fig 7.2: Admin Login Page of the CKD Prediction



Welcome Admin Home!!!

User Type: Select

UserId:

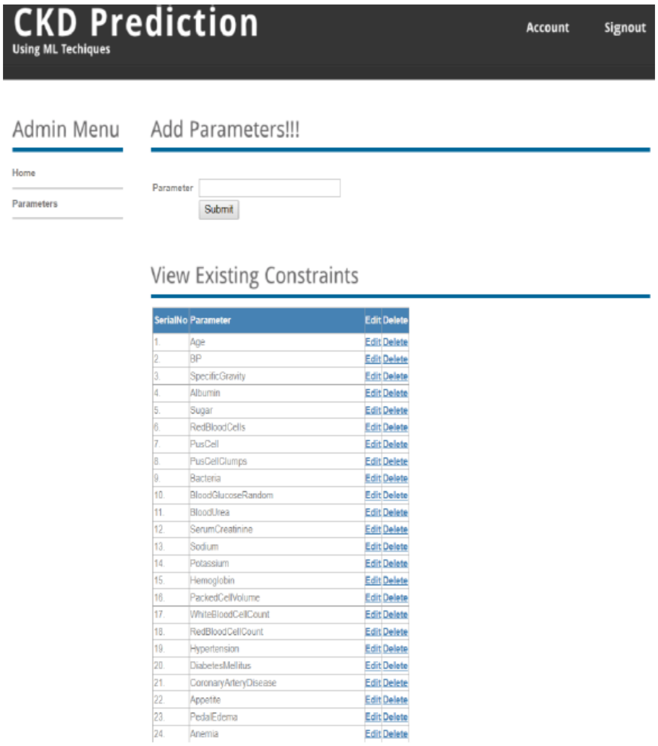
Password:

EmailId:

View Existing Staffs

SerialNo	UserType	Staff Id	Password	EmailId	Edit	Delete
1.	Doctor	1	123	Anil@gmail.com	Edit	Delete
2.	Receptionist	2	123	Anu@gmail.com	Edit	Delete
3.	Doctor	3	123	Akash@gmail.com	Edit	Delete
4.	Doctor	4	123	Madhu@gmail.com	Edit	Delete
5.	Doctor	5	123	Megha@gmail.com	Edit	Delete
6.	Receptionist	6	123	Akash@gmail.com	Edit	Delete
7.	Doctor	7	123	A@gmail.com	Edit	Delete

Fig 7.3: Admin Dashboard



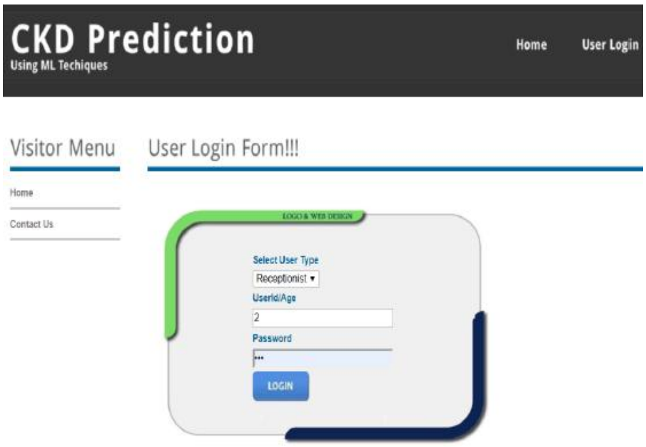
Add Parameters!!!

Parameter:

View Existing Constraints

SerialNo	Parameter	Edit	Delete
1.	Age	Edit	Delete
2.	BP	Edit	Delete
3.	SpecificGravity	Edit	Delete
4.	Albumin	Edit	Delete
5.	Sugar	Edit	Delete
6.	RedBloodCells	Edit	Delete
7.	PusCell	Edit	Delete
8.	PusCellClumps	Edit	Delete
9.	Bacteria	Edit	Delete
10.	BloodGlucoseRandom	Edit	Delete
11.	BloodUrea	Edit	Delete
12.	SerumCreatinine	Edit	Delete
13.	Sodium	Edit	Delete
14.	Potassium	Edit	Delete
15.	Hemoglobin	Edit	Delete
16.	PackedCellVolume	Edit	Delete
17.	WhiteBloodCellCount	Edit	Delete
18.	RedBloodCellCount	Edit	Delete
19.	Hypertension	Edit	Delete
20.	DiabetesMellitus	Edit	Delete
21.	CoronaryArteryDisease	Edit	Delete
22.	Appetite	Edit	Delete
23.	PedalEdema	Edit	Delete
24.	Anemia	Edit	Delete

Fig 7.4: Admin Module- Parameter Addition



User Login Form!!!

Select User Type: Receptionist

UserId/Age: 2

Password: •••

Fig 7.5: Receptionist Login Page of CKD Prediction

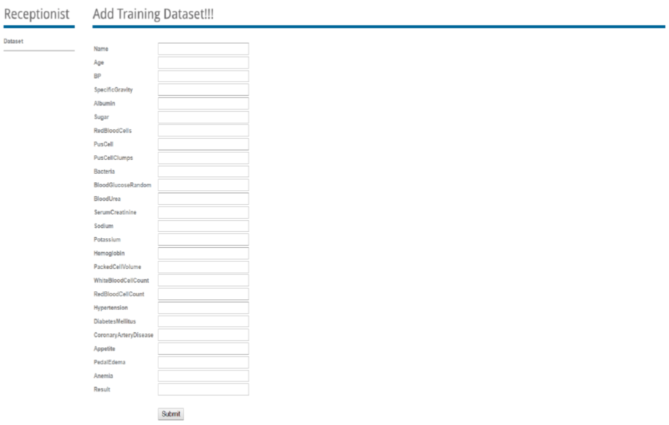
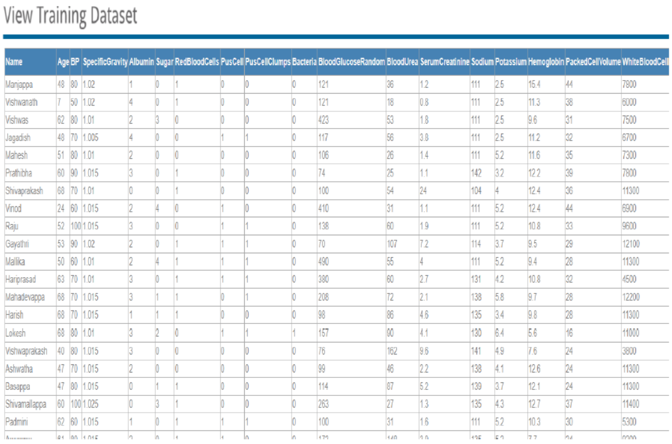


Fig 7.6: Training Dataset submission from Receptionist



View Training Dataset

Name	Age	BP	SpecificGravity	Albumin	Sugar	RedBloodCells	PusCell	PusCellClumps	Bacteria	BloodGlucoseRandom	BloodUrea	SerumCreatinine	Sodium	Potassium	Hemoglobin	PackedCellVolume	WhiteBloodCell
Manjappa	48	80	1.02	1	0	1	0	0	0	121	36	1.2	111	2.5	15.4	44	7800
Vishwanath	7	50	1.02	4	0	1	0	0	0	121	18	0.8	111	2.5	11.3	38	6000
Vishwas	62	80	1.01	2	3	0	0	0	0	423	53	1.8	111	2.5	9.6	31	7500
Jagadish	48	70	1.005	4	0	0	1	1	0	117	56	3.8	111	2.5	11.2	32	6700
Mahesh	51	80	1.01	2	0	0	0	0	0	106	26	1.4	111	5.2	11.6	35	7300
Prathibha	60	90	1.015	3	0	1	0	0	0	74	25	1.1	142	3.2	12.2	39	7800
Shivaprakash	68	70	1.01	0	0	1	0	0	0	100	54	24	104	4	12.4	36	11300
Vinod	24	60	1.015	2	4	0	1	0	0	410	31	1.1	111	5.2	12.4	44	6900
Raju	52	100	1.015	3	0	0	1	1	0	138	60	1.9	111	5.2	10.8	33	9600
Gayathri	53	90	1.02	2	0	1	1	1	0	70	107	7.2	114	3.7	9.5	29	12100
Mallika	50	60	1.01	2	4	1	1	1	0	490	55	4	111	5.2	9.4	28	11300
Hariprasad	63	70	1.01	3	0	1	1	1	0	380	60	2.7	131	4.2	10.8	32	4500
Mahadevappa	68	70	1.015	3	1	1	0	1	0	208	72	2.1	138	5.8	9.7	28	12200
Harish	68	70	1.015	1	1	1	0	0	0	98	86	4.6	135	3.4	9.8	28	11300
Lokesh	68	80	1.01	3	2	0	1	1	1	157	90	4.1	130	6.4	5.6	16	11000
Vishwaprakash	40	80	1.015	3	0	0	0	0	0	76	162	9.6	141	4.9	7.6	24	3800
Ashwatha	47	70	1.015	2	0	0	0	0	0	99	46	2.2	138	4.1	12.6	24	11300
Basappa	47	80	1.015	0	1	1	0	0	0	114	87	5.2	139	3.7	12.1	24	11300
Shivamallappa	60	100	1.025	0	3	1	0	0	0	263	27	1.3	135	4.3	12.7	37	11400
Padmini	62	60	1.015	1	0	1	1	1	0	100	31	1.6	111	5.2	10.3	30	5300

Fig 7.7: Sample View of Training Dataset

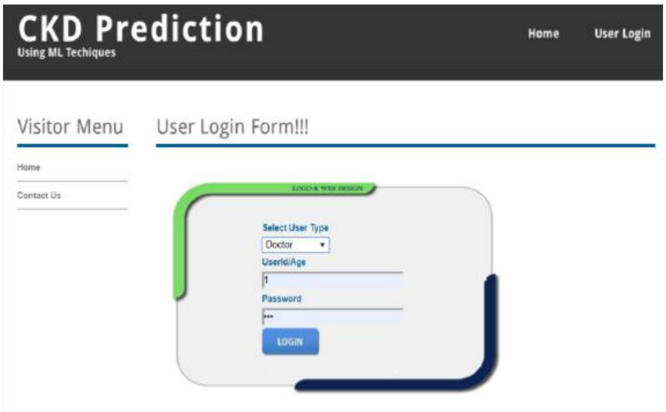


Fig 7.8: Doctor Login Page of CKD Prediction

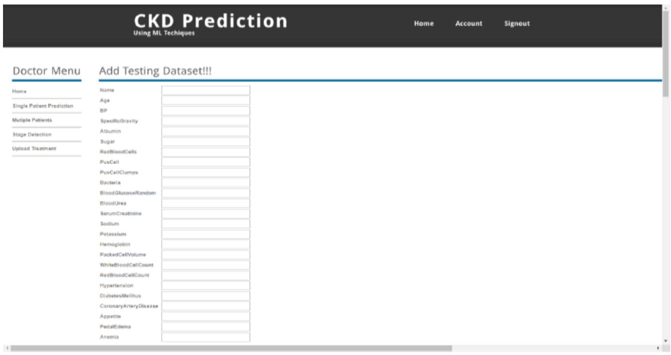


Fig 7.9: Uploading Testing Dataset from Doctor

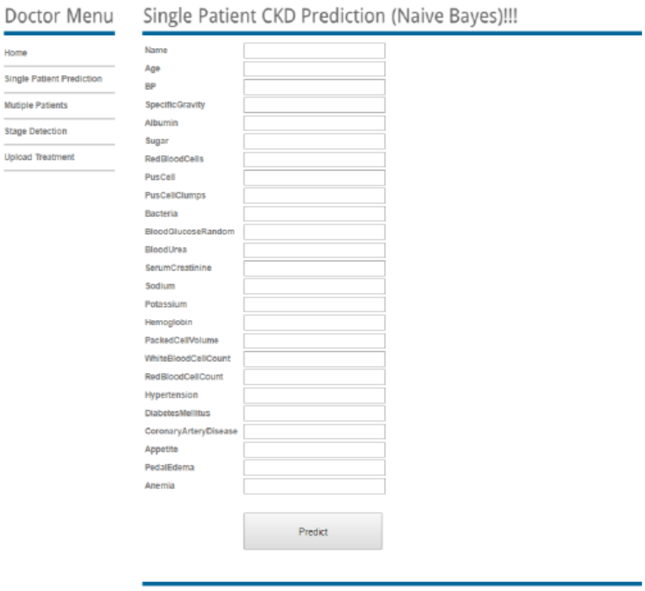
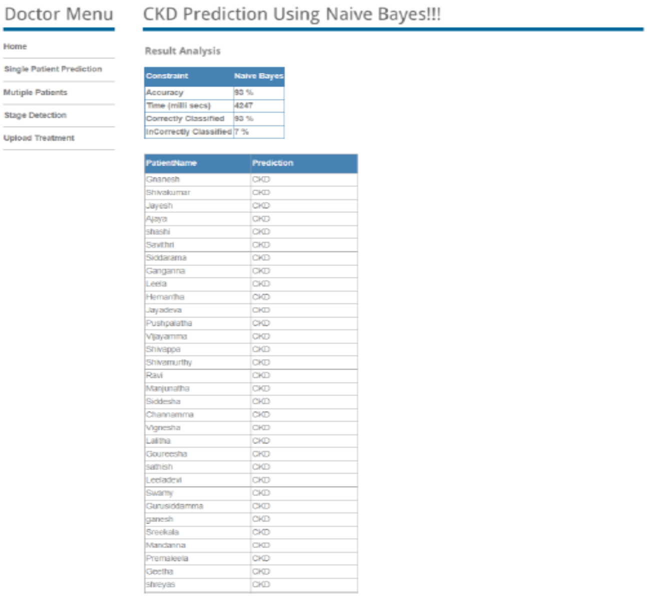


Fig 7.10: Single Patient CKD Prediction from Doctor



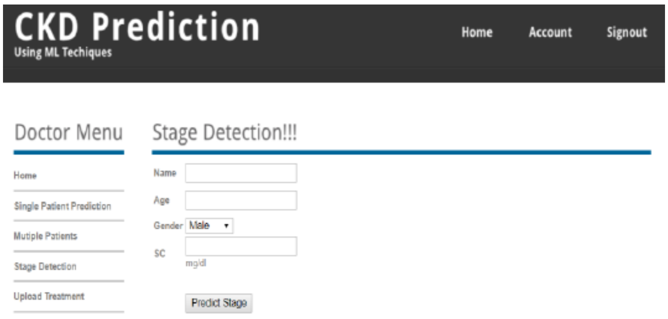
CKD Prediction Using Naive Bayes!!!

Result Analysis

Constraint	Naive Bayes
Accuracy	93 %
Time (milli secs)	4247
Correctly Classified	93 %
InCorrectly Classified	7 %

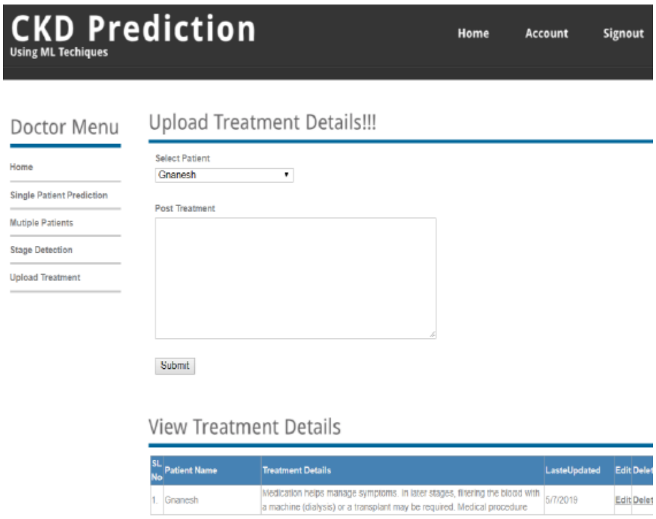
PatientName	Prediction
Gnanesh	CKD
Shivakumar	CKD
Jayesh	CKD
Ajaya	CKD
shashi	CKD
Savithri	CKD
Siddarama	CKD
Ganganna	CKD
Leela	CKD
Hemantha	CKD
Jayadeva	CKD
Pushpalatha	CKD
Vijayamma	CKD
Shivappa	CKD
Shivamurthy	CKD
Ravi	CKD
Manjunatha	CKD
Siddesha	CKD
Channamma	CKD
Vignesha	CKD
Lalitha	CKD
Goureesha	CKD
sathish	CKD
Leeladevi	CKD
Swamy	CKD
Gurusiddamma	CKD
ganesh	CKD
Sreekala	CKD
Mandanna	CKD
Premaleela	CKD
Geetha	CKD
shreyas	CKD

Fig 7.11: Multiple Patient CKD Prediction UI



Name
Age
Gender Male
SC mg/dl

Fig 7.12: Doctor Module – Stage Prediction

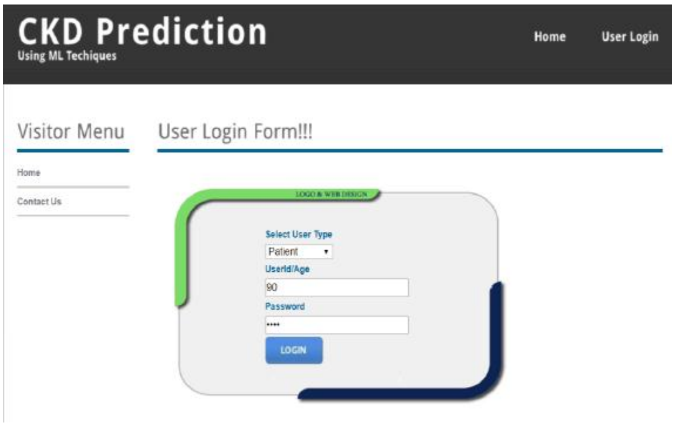


Select Patient Gnanesh

Post Treatment

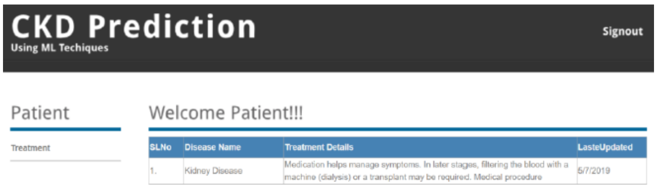
SL No	Patient Name	Treatment Details	LasteUpdated	Edit	Delet
1.	Gnanesh	Medication helps manage symptoms. In later stages, filtering the blood with a machine (dialysis) or a transplant may be required. Medical procedure	5/7/2019	Edit	Delet

Fig 7.13: Doctor Module – Upload the treatment Details



Select User Type Patient
UserId/Age 90
Password ****

Fig 7.14: Patient Login Page

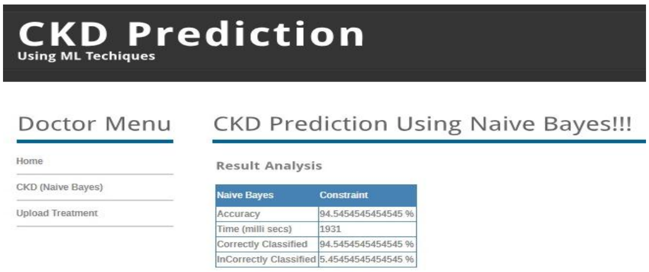


SLNo	Disease Name	Treatment Details	LasteUpdated
1.	Kidney Disease	Medication helps manage symptoms. In later stages, filtering the blood with a machine (dialysis) or a transplant may be required. Medical procedure	5/7/2019

Fig 7.15: Patient Module- View Treatment Details

8. CONCLUSION

This project is a medical sector application which helps the medical practitioners in predicting the CKD based on the CKD parameters. It is automation for CKD disease prediction and it efficiently and economically speedily identifies the disease, its types and complications from the clinical database. The Accuracy obtained is about 94.6%.



Result Analysis

Naive Bayes	Constraint
Accuracy	94.5454545454545 %
Time (milli secs)	1931
Correctly Classified	94.5454545454545 %
InCorrectly Classified	5.45454545454545 %

Fig 8.1: Result analysis

9. FUTURE WORK

We can enhance this problem statement by implementing the below features -

- Graphical analysis
- Feature Extraction
- Stage Prediction

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