

Nephrology Advisory system

An Expert System for Diagnosing Kidney Diseases

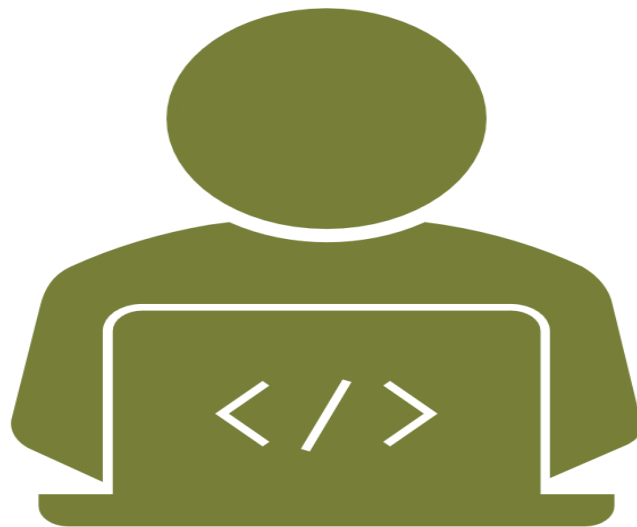
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Course : U18IS4004 - Artificial Intelligence

Language used : Prolog



1.Project abstract :

The system mainly contains two modules one is Information System and the other is Expert Advisory system. The Information System contains the static information about different diseases in the field of Nephrology. This information system helps the patients /users to know about the problems related to kidneys. The Nephrology Advisory system helps the Patients /users to get the required and suitable advice depending on their queries. This research describes how the expert system designed to support the medical decision process using medical databases and creating the optimal systems for ministry of the health to help the physician to making the correct decision with high certainty.

The main aim of the proposed system is the ability to diagnose of the kidney disease by questionnaire and clinical data of the patient. The proposed system makes a differential diagnosis among the main kidney diseases. The diagnosis is made considering the clinical exam (the symptoms that can be seen or felt) and the preclinical exam (the results of laboratory tests). This system is designed to give help to the patients(users) in making the approximate diagnosis of a patient. The kidney diseases have a lot of common symptoms and many of them are very much alike, and that makes it very difficult even for a kidney doctor (specialist) to put a right diagnosis.

So the main operation of the proposed system is ability to diagnosis kidney disease by using the medical expert's knowledge inherited into a computer system and friendly user interface and also has ability to explain the result and the answer of most two questions how the proposed system reaches to the results and why the proposed system reaches to this results.

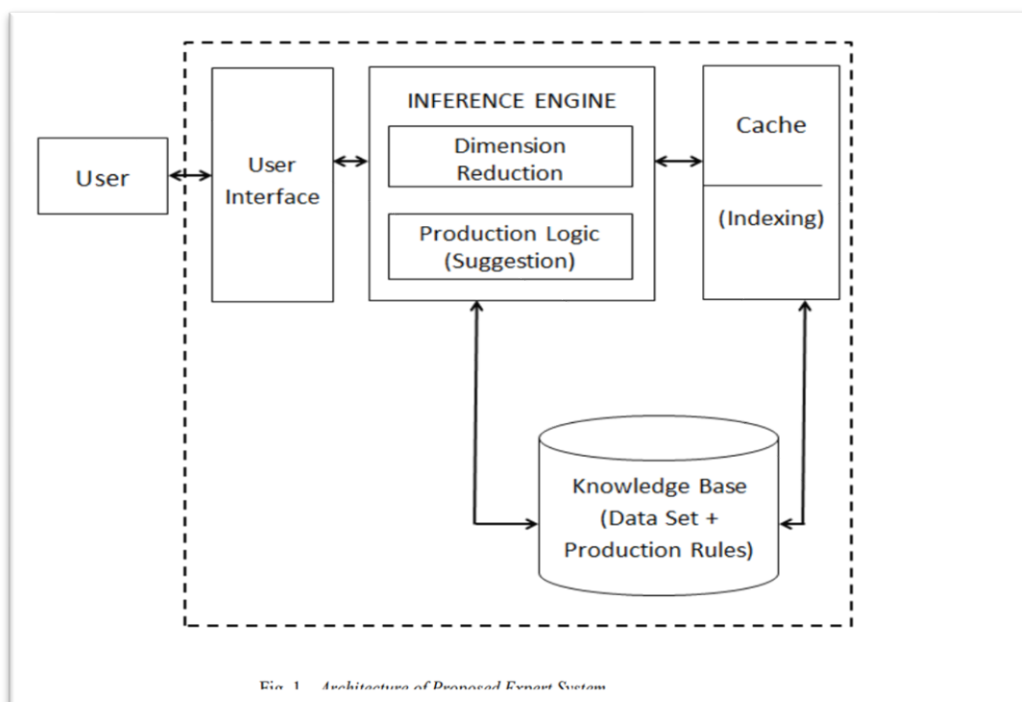
2. Expert system :

An expert system is computer software that attempts to act like a human expert on a particular subject area.

Expert systems are often used to advise non experts in situations where a human expert is unavailable (for example it may be too expensive to employ a human expert, or it might be a difficult to reach the location).

An expert system is made up of four parts:

- *A user interface*
- *A knowledge base*
- *A rules base*
- *An inference engine*

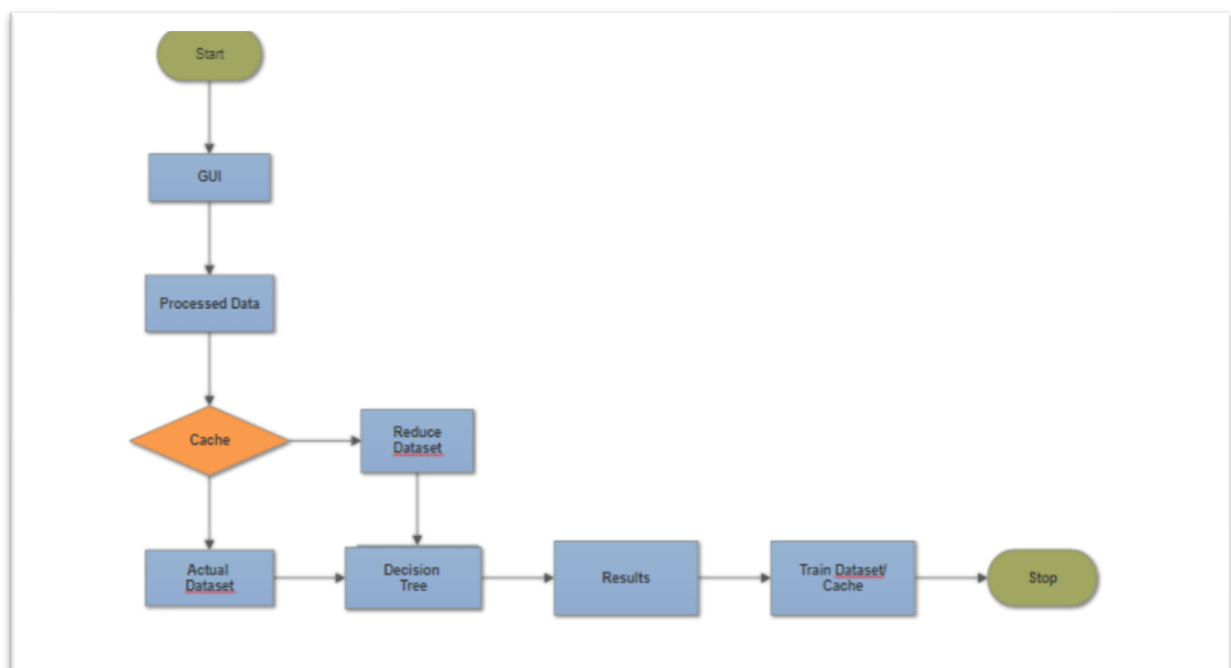


3.Algorithm :

Decision Tree algorithm

The system workflow starts when user interacts with system through GUI. The user gives symptoms of a disease as input to the system. The data input is firstly processed, and the processed data is sent to Cache. In Cache, the parameters are checked if they exist previously or not. If the parameters are found in Cache, it will go to Reduce Dataset then it will form Decision tree. If all the parameters were not found in Cache then it will move to next stage known as Actual Dataset.

Actual Dataset is the Data set of this System which is already refined by ETL process. The parameters which user enters are thus matched with all possible symptoms present in dataset and all possible diseases from dataset are obtained. Next step is to feed the reduced dataset into Decision Tree Algorithm which will help us to identify most likely the diseases which can be result of these symptoms. Decision Tree also help to trace all the possible diseases which can be result of these symptom.



4. Working of system :

Firstly, this system gathers or takes the input from the user in the form of one or more symptoms. After the user inputs the symptom, the Expert System will fetch all the diseases which are related to those symptoms in our data set or database i.e. those diseases whose symptoms are not present in the user's entered symptom(s) list will be removed for that particular case.

After the data fetching phase, the data cleansing takes place which results in the removal of non-usable data. Then the Cache provides indexing and priorities to the diseases whose symptom(s) occur the most which have been selected for a particular case. After all this process, when all the diseases are prioritized and ready for classification, finally the Decision Tree Algorithm is applied which starts from the root or starting index and goes on to ending index and results in the fetching of the final disease to be predicted by the Expert System.

So the User Interface will provide the results about that particular case to the user which is in form of diseases. This system makes it easier for users to work upon their health . This system in future will be able to give proper reports to the doctors as well as patients about the particular disease and its origin, symptoms and how to cure that disease by proper intake of medicines preferred by the system.

5. Dataset used :

	A	B	C	D	E	F
1	Diseases	Symptoms	Test/scans	Tests-scans	Food to eat	Food to avoid
2	Kidneystone	pain in abdomen,blood in urine,pain in lowerback,fever,nauses,frequent urination.		Blood test,urine test,X ray,Ct scan,Ulra sound	Food rich in sodium,oxalate,avoid animal meats	calcium rich foods
3	acutekidneyinjury	swelling of body parts,fatigue,loss of appetite,nausea,chest pain		kidney Function test,Kidney Biopsis,Ultrasonic	Moderate level of potassium foods	Salty foods,Food rich in phosphorous
4	kidneycancer	blood in urine,sudden weightloss,lumps in abdomen,fever,pain in lowerback,loss of appetite		Blood test,Kidney biopsy,MRI,CT scan,	Food high in calories	Food rich in oxalate and avoid animal meats
5	kidneycysts	abdominal pain,abdominal swelling,fever,frequent urination,backpain,high BP		Ultrasound test,MRI,Ctscan	Food high in calories	Food rich in oxalate,avoid animal meat
6	chronickidneydisease	nausea,loss of appetite,swelling of body,hypertension,urate more,decreased mental sharpness		Kidney Function test,Urine test,Ultrasound,Hormone test,Kidney Biopsy Low potassium food,Low protien food		High Potassium food,High protien food
7						
8						
9						
10						
11						
12						

6.Source code :

```
go:-
hypothesis(Disease),
write('-----'),
nl,
write('The person may have : '),
write(Disease),
nl,
write('-----'),
nl,
write('Its Better to consult a Nephrologists or Oncologists'),
undo.
```

```
hypothesis(chronickidneydisease) :- chronickidneydisease,!.  
hypothesis(kidneystone) :- kidneystone,!.  
hypothesis(acutekidneyinjury) :- acutekidneyinjury,!.  
hypothesis(kidneycancer) :- kidneycancer,!.  
hypothesis(kidneycysts) :- kidneycysts,!.  
hypothesis(unknown).
```

```
kidneystone:-
verify(pain_in_the_abdomen),
verify(pain_in_the_lowerback),
verify(blood_in_urine),
verify(fever),
verify(nausea),
verify(frequent_urination),
write('KIDNEYSTONE'),
```

```
nl,
write('Presence of stones in the kidney due to a decrease in urine
volume or excess of stone-forming substances in the urine'),
nl,
write('TESTS AND SCANS'),
nl,
write('1:Blood Test'),
nl,
write('2:Urine Test'),
nl,
write('3:X-ray'),
nl,
write('4:CT scan'),
nl,
write('5:Ultrasound'),
nl,
write('COMPLICATIONS OF KIDNEY STONE'),
nl,
write('1.Recurrence - the most common complication is that the
kidney stones can occur again'),
nl,
write('2.Obstruction and infection - Blockage of the urinary tract
can cause kidney damage and also can make the urinary tract
susceptible to infection.'),
nl,
write('ADVICES AND SUGGESTIONS:'),
nl,
write('Consult doctor and take medication'),
nl,
write('The medicine includes:'),
nl,
write('1.Analgesic-Helps to relieve pain'),
nl,
write('2.Antiemetic: Injected to treat nausea (feeling of sickness)
or vomiting.'),
nl,
write('3.Alpha blockers/calcium channel blockers: Used as part of
medical expulsive therapy to facilitate the passage of stones.'),
nl,
write('FOOD TO AVOID'),
nl,
write('1:Food rich in sodium'),
nl,
write('2:Food rich in oxalate'),
nl,
write('3.Avoid animal meat'),
nl,
write('FOOD TO EAT :calcium rich foods'),
nl,
write('Drink plenty of water'),
nl.
```

```
acutekidneyinjury:-
verify(swelling_of_bodyparts),
verify(fatigue),
verify(loss_of_appetite),
```

```

verify(nausea),
verify(chest_pain),
write('A condition when an abrupt reduction in kidneys ability to
filter waste products occurs within a few hours or a few days'),
nl,
write('COMPLICATION OF ACUTEKIDNEYINJURY'),
nl,
write('1.Shortness of breath'),
nl,
write('2.Loss of kidney function'),
nl,
write('3.Muscle weakness'),
nl,
write('TESTS AND SCANS TO TAKE:'),
nl,
write('1:Kidney Function Test'),
nl,
write('2:Kidney Biopsy'),
nl,
write('3:Ultrasound'),
nl,
write('ADVICES AND SUGGESTIONS:'),
nl,
write('Consult doctor and take medication'),
nl,
write('Take Intravenous Therapy'),
nl,
write('The medicines are:'),
nl,
write('1.Diuretics: To minimise the swelling for AKI caused by fluid
buildup'),
nl,
write('2.Potassium lowering drugs: Prevent the accumulation of
potassium in the blood'),
nl,
write('3.Dietary supplements: Calcium is given when the levels
drop'),
nl,
write('FOOD TO AVOID:'),
nl,
write('1:Salty foods'),
nl,
write('2:Food rich in phosphorous'),
nl,
write('FOOD TO EAT:Moderate level of potassium foods'),
nl,
write('Drink plenty of water'),
nl.

```

kidneycancer:-

```

verify(blood_in_urine),
verify(sudden_weightloss),
verify(lumps_in_abdomen),
verify(fever),
verify(pain_in_lowerback),
verify(loss_of_appetite),

```



```
write('A disease caused by development of cancerous (malignant)
cells in the kidney'),
nl,
write('COMPLICATIONS OF KIDNEY CANCER'),
nl,
write('1.Metastasis'),
nl,
write('2.Liver dysfunction'),
nl,
write('3.Elevated levels of red blood cells'),
nl,
write('TESTS AND SCANS:'),
nl,
write('1:Blood Test'),
nl,
write('2:Kidney Biopsy'),
nl,
write('3:MRI'),
nl,
write('4:CT scan'),
nl,
write('ADVICES AND SUGGESTIONS:'),
nl,
write('Consult doctor and take medication'),
nl,
write('Take Radiation therapy'),
nl,
write('The medicine include:'),
nl,
write('1.Immunotherapy: This is a biological therapy, which uses the
immune system to fight against cancer.
'),
nl,
write('2.Targeted therapy: These medications identify and control
the abnormal multiplication of cancer cells.
'),
nl,
write('FOOD TO AVOID'),
nl,
write('1:Food rich in oxalate'),
nl,
write('2.Avoid animal meat'),
nl,
write('FOOD TO EAT:Foods high in calories'),
nl,
write('Drink plenty of water'),
nl.
```

```
kidneycysts:-
verify(abdominal_pain),
verify(abdominal_swelling),
verify(fever),
verify(frequent_urination),
verify(backpain),
verify(high_blood_pressure),
```

```
write('A condition characterised by small, oval or round thin-walled
sacs with watery fluid in the kidney'),
nl,
write('COMPLICATIONS OF KIDNEY CYSTS'),
nl,
write('1.Cyst infection.'),
nl,
write('2.A ruptured cyst causing severe pain.'),
nl,
write('3.Hydronephrosis - urine obstruction causes kidney
swelling'),
nl,
write('TESTS AND SCANS:'),
nl,
write('1:Ultrasound Test'),
nl,
write('2:MRI'),
nl,
write('3:CT scan'),
nl,
write('ADVICES AND SUGGESTIONS:'),
nl,
write('Consult doctor and take medication'),
nl,
write('Take Radiation therapy'),
nl,
write('FOOD TO AVOID'),
nl,
write('1:Food rich in oxalate'),
nl,
write('2:Avoid animal meat'),
nl,
write('FOOD TO EAT :Foods high in calories'),
nl,
write('Drink plenty of water'),
nl.
```

```
chronickidneydisease :-
verify(nausea),
verify(loss_of_appetite),
verify(swelling),
verify(hypertension),
verify(urinate_more),
verify(decreased_mental_sharpness),
verify(sleepingproblems),
verify(blood_in_urine),
verify(chestpain),
verify(shortness_of_breath),
verify(persistent_itching),
write('A condition characterised by a gradual loss of kidney
function. Early stage'),
nl,
write('COMPLICATIONS OF CHRONIC KIDNEY DISEASE'),
nl,
write('1.Fluid retention: Kidney failure leads to fluid retention
causing swelling in the arms and feet'),
```

```

nl,
write('2.Cardiovascular disease - Heart and blood vessels are
affected due to kidney failure'),
nl,
write('3.Imbalance in potassium levels: This can be life-
threatening'),
nl,
write('4.Decreased immune response'),
nl,
write('5.Impairing central nervous system'),
nl,
write('6.Complications in pregnancy'),
nl,
write('7.Complete loss of kidney function in the late stage'),
nl,
write('8.Imbalance in potassium levels: This can be life-
threatening'),
nl,
write('TESTS AND SCANS:'),
nl,
write('1:Kidney Function Test'),
nl,
write('2:Urine Test'),
nl,
write('3:Ultrasound'),
nl,
write('4:Hormone Test'),
nl,
write('5:Kidney Biopsy'),
nl,
write('6:Renal flow scan'),
nl,
write('ADVICES AND SUGGESTIONS:'),
nl,
write('Visit doctor and take medications'),
nl,
write('FOOD TO EAT:'),
nl,
write('1:Consume low potassium foods like apples,cabbage,green
beans,carrot and so on'),
nl,
write('3:Limit protien content.Eat low protien foods.'),
nl,
write('FOOD TO AVOID :'),
nl,
write('1:High Potassium foods'),
nl,
write('2: High protien foods'),
nl.

```

```

ask(Question):-
write('Does the patient have following symptom:'),
write(Question),
write('?'),
read(Response),
nl,

```

```
        ((Response == yes; Response == y)
->
assert(yes(Question));
assert(no(Question),fail).

:- dynamic yes/1,no/1.

verify(S):-
  (yes(S)
->
  true;
  (no(S)
->
  fail;
  ask(S))).

undo:-retract(yes(_)),fail.
undo:-retract(no(_)),fail.
undo.
```

7.Outputs:

7.1.Kidney stone:

Does the patient have following symptom:nausea?yes.

Does the patient have following symptom:loss_of_appetite? | , no.

Does the patient have following symptom:pain_in_the_abdomen? | , y.

Does the patient have following symptom:pain_in_the_lowerback? | ,Does the patient have following symptom:pain_in_the_lowerback? | , y.

Does the patient have following symptom:blood_in_urine? | , yes.

Does the patient have following symptom:fever? | , yes.

Does the patient have following symptom:frequent_urination? | , y.

KIDNEYSTONE

Presence of stones in the kidney due to a decrease in urine volume or excess of stone-forming substances in the urine

TESTS AND SCANS

1.Blood Test

2.Urine Test

3.X-ray

4.CT scan

5.Ultrasound

COMPLICATIONS OF KIDNEY STONE

1.Recurrence - the most common complication is that the kidney stones can occur again

2.Obstruction and infection - Blockage of the urinary tract can cause kidney damage and also can make the urinary tract susceptible to infection.

ADVICES AND SUGGESTIONS.

Consult doctor and take medication

The medicine includes.

1.Analgesic-Helps to relieve pain

2.Antiemetic. Injected to treat nausea (feeling of sickness) or vomiting.

3.Alpha blockers/calcium channel blockers. Used as part of medical expulsive therapy to facilitate the passage of stones.

FOOD TO AVOID

1.Food rich in sodium

2.Food rich in oxalate

3.Avoid animal meat

FOOD TO EAT :calcium rich foods

7.2.Acute Kidney injury:

Does the patient have following symptom.loss_of_appetite? | , yes.

Does the patient have following symptom.swelling? | , no.

Does the patient have following symptom.pain_in_the_abdomen? | , no.

Does the patient have following symptom.swelling_of_bodyparts? | , yes.

Does the patient have following symptom.fatigue? | , y.

Does the patient have following symptom.chest_pain? | , yes.

A condition when an abrupt reduction in kidneys ability to filter waste products occurs within a few hours or a few days

COMPLICATION OF ACUTEKIDNEYINJURY

- 1.Shortness of breath
- 2.Loss of kidney function
- 3.Muscle weakness

TESTS AND SCANS TO TAKE:

- 1.Kidney Function Test
- 2.Kidney Biopsy
- 3.Ultrasound

ADVICES AND SUGGESTIONS:

Consult doctor and take medication

Take Intravenous Therapy

The medicines are:

- 1.Diuretics. To minimise the swelling for AKI caused by fluid buildup
- 2.Potassium lowering drugs. Prevent the accumulation of potassium in the blood
- 3.Dietary supplements. Calcium is given when the levels drop

FOOD TO AVOID:

- 1.Salty foods
- 2.Food rich in phosphorous

FOOD TO EAT.Moderate level of potassium foods

Drink plenty of water

The person may have , acutekidneyinjury

Its Better to consult a Nephrologists or Oncologists

true

7.3.Kidney cysts:

Does the patient have following symptom.blood_in_urine? | , no.

Does the patient have following symptom.abdominal_pain? | , y.

Does the patient have following symptom.abdominal_swelling? | , y.

Does the patient have following symptom.fever? | , y.

Does the patient have following symptom.frequent_urination? | , yes.

Does the patient have following symptom.backpain? | , yes.

Does the patient have following symptom.high_blood_pressure? | , yes.

A condition characterised by small, oval or round thin-walled sacs with watery fluid in the kidney

COMPLICATIONS OF KIDNEY CYSTS

- 1.Cyst infection.
- 2.A ruptured cyst causing severe pain.
- 3.Hydronephrosis – urine obstruction causes kidney swelling

TESTS AND SCANS.

- 1.Ultrasound Test
- 2.MRI
- 3.CT scan

ADVICES AND SUGGESTIONS.

Consult doctor and take medication

Take Radiation therapy

FOOD TO AVOID

- 1.Food rich in oxalate
- 2.Avoid animal meat

FOOD TO EAT .Foods high in calories

Drink plenty of water

The person may have , kidneycysts

Its Better to consult a Nephrologists or Oncologists

true.

7.4.Kidney cancer :

Does the patient have following symptom.blood_in_urine? | , y.

Does the patient have following symptom.sudden_weightloss? | , y.

Does the patient have following symptom.lumps_in_abdomen? | , y.

Does the patient have following symptom.fever? | , y.

Does the patient have following symptom.pain_in_lowerback? | , y.

Does the patient have following symptom.loss_of_appetite? | , y.

A disease caused by development of cancerous (malignant) cells in the kidney

COMPLICATIONS OF KIDNEY CANCER

- 1.Metastasis
- 2.Liver dysfunction
- 3.Elevated levels of red blood cells

TESTS AND SCANS:

- 1.Blood Test
- 2.Kidney Biopsy
- 3.MRI
- 4.CT scan

ADVICES AND SUGGESTIONS:

Consult doctor and take medication

Take Radiation therapy

The medicine include:

- 1.Immunotherapy: This is a biological therapy, which uses the immune system to fight against cancer.
- 2.Targeted therapy: These medications identify and control the abnormal multiplication of cancer cells.

FOOD TO AVOID

- 1.Food rich in oxalate
- 2.Avoid animal meat

FOOD TO EAT:Foods high in calories

Drink plenty of water

7.5.Chronic Kidney disease:

Does the patient have following symptom.chestpain? | , y.

Does the patient have following symptom.shortness_of_breath? | , y.

Does the patient have following symptom.persistent_itching? | , y.

A condition characterised by a gradual loss of kidney function. Early stage

COMPLICATIONS OF CHRONIC KIDNEY DISEASE

- 1.Fluid retention: Kidney failure leads to fluid retention causing swelling in the arms and feet
- 2.Cardiovascular disease – Heart and blood vessels are affected due to kidney failure
- 3.Imbalance in potassium levels: This can be life-threatening
- 4.Decreased immune response
- 5.Impairing central nervous system
- 6.Complications in pregnancy
- 7.Complete loss of kidney function in the late stage
- 8.Imbalance in potassium levels: This can be life-threatening

TESTS AND SCANS,

- 1.Kidney Function Test
- 2.Urine Test
- 3.Ultrasound
- 4.Hormone Test
- 5.Kidney Biopsy
- 6.Renal flow scan

ADVICES AND SUGGESTIONS,

Visit doctor and take medications

FOOD TO EAT,

- 1.Consume low potassium foods like apples,cabbage,green beans,carrot and so on
- 3.Limit protien content.Eat low protien foods.

FOOD TO AVOID ,

- 1.High Potassium foods
2. High protien foods

The person may have , chronickidneydisease

Its Better to consult a Nephrologists or Oncologists

true.

?-

7.6.unknown:

?-

| go.

Does the patient have following symptom:nausea?no.

Does the patient have following symptom:pain_in_the_abdomen?|, no.

Does the patient have following symptom:swelling_of_bodyparts?|, no.
|, no.

Does the patient have following symptom:blood_in_urine?|, no.

Does the patient have following symptom:abdominal_pain?|, no.

The person may have , unknown

Its Better to consult a Nephrologists or Oncologists

true.

~

8.Conclusion:

In this project, we have proposed an expert system based on decision tree algorithm for medical diagnosis. The proposed system understands, learns, and trains the data provided in the data set and apply rules and algorithms to calculate the best possible results. It takes symptoms of diseases as input and predicts the disease. It is implemented using a standard dataset and achieves an accuracy of nearly 90 percent. In future, these systems can be very useful as they can predict the disease faster than the existing systems and can also achieve higher accuracy.