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Artificial Intelligence-based Prediction of Depression, Anxiety and Stress

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Abstract:- In today's fast-paced world, mental health concerns that include anxiety, depression, and stress have become quite frequent among individuals of all ages. One of the major reasons behind this problem is the lack of awareness among the masses. Mental health refers to one's psychological, emotional, and social well-being, and it is essential at all stages of life, from childhood and adolescence to maturity. In this study, machine learning algorithms were used to predict anxiety, Depression, and stress. To apply the machine learning algorithms, information was gathered from people of different ages, occupations, sexes, and lifestyles through a questionnaire with questions psychologists frequently use to comprehend their patients' issues in specifics. The results reveal that the model has a high level of accuracy in predicting mental health outcomes.

Our aim with this paper is to raise awareness and make people aware that they may be suffering from mental health disorders like Anxiety, Depression, and Stress. The model developed in this study can assist healthcare providers in identifying patients at high risk of developing Mental issues and can enable early intervention and prevention strategies. We believe establishing such a system into effect could help us avoid a future "Mental health epidemic" and make diagnosis easier for people.

Keywords:- *Anxiety, Depression, Decision Tree Algorithm, Mental Health Prediction, Machine Learning, Stress.*

I. INTRODUCTION

Artificial Intelligence (AI) is rapidly transforming diverse sectors, the development of artificial intelligence in terms of medicine has made a significant contribution to the simplification of clinical procedures and decision-making in the healthcare industry [1]. Currently, the healthcare sector is gathering data from several hospitals and patients. Through the best possible application of this data, physicians may readily predict more effective treatment approaches and improve the healthcare industry's entire service delivery. The Python framework has several applications, prominent among them being the ability to facilitate the understanding of data across the healthcare sectors and to support computational facilities in the collection of useful information. Additionally, Python is regarded as one of the most well-known programming languages worldwide [2]. This research paper explores the multifaceted contributions of AI to the life sciences, showcasing its ability to accelerate discoveries, improve patient outcomes, and address critical challenges within the field. We examine the current state of AI applications in life sciences, ongoing research trends, and the potential for AI to reshape the future of healthcare. The development of AI depends on the idea of machine learning (ML). The definition of machine learning (ML) is the capacity of a machine to learn tasks from a huge amount of previous data along with the ability to predict the same for future occurrences. Machine Learning (ML) is an application of Artificial Intelligence (AI) that provides systems with the ability to automatically learn and improve from experience without being explicitly programmed [3].

Mental health issues aren’t new to mankind. References to mental illness can be seen throughout history, as early as the 5th century BC. But in the modern world, the problem is more common. Many people are experiencing various forms of psychological health issues as a result of their modern lifestyles. Anxiety, depression, and stress are psychological conditions that share certain characteristics. For instance, feeling depressed and alone is a common trait among all three. According to authorities statistics out of the entire populace of India, one hundred thirty million human beings may be tormented by a few types of mental illness. The main reason behind such a huge number of people suffering from mental illness is our crumbled healthcare system and inadequate government support. In India, the topic of mental health is still considered taboo which is why only 8 to 10 percent of people can get some kind of treatment for their problems and the rest go unnoticed which could be a possible reason for the high suicide rates. Doctors have found out that almost 35 per cent of the people who seek medical help could be suffering from depression, stress, anxiety etc. [4].

According to World Health Organization data India has 0.75 psychologists and psychiatrists per 100,000 people. To triumph over this capability epidemic of mental illness, the authorities have to take a few robust and essential steps in the direction of healthcare, offering enough finances in the direction of intellectual health. A healthcare professional may ask a patient to complete a questionnaire to diagnose their condition. These inquiries may be objective and situational. We aim to forecast the following issues in our study.

- Depression: This condition affects a person's emotions directly and makes it harder for them to go about their daily lives normally.
- Anxiety- is described as a feeling of nervousness along with a sense of excessive worry towards a future scenario.

In some serious cases, it can also cause rapid heart rate and shortness of breath.

- Stress- severe nervousness brought on by a challenging circumstance, or something that triggers this state: under pressure High levels of stress can cause headaches, minor aches, and trouble sleeping. [4]

Since patients with anxiety, depression, and stress are frequently reluctant to discuss their thoughts with medical professionals, friends, or family, psychiatrists typically utilize questionnaires like the DASS42 to evaluate these conditions. Then, machine learning algorithms were applied.

In Figure 1. how data is traversed can be visualized with the help of a simple diagram commonly known as a diagram of data flow.

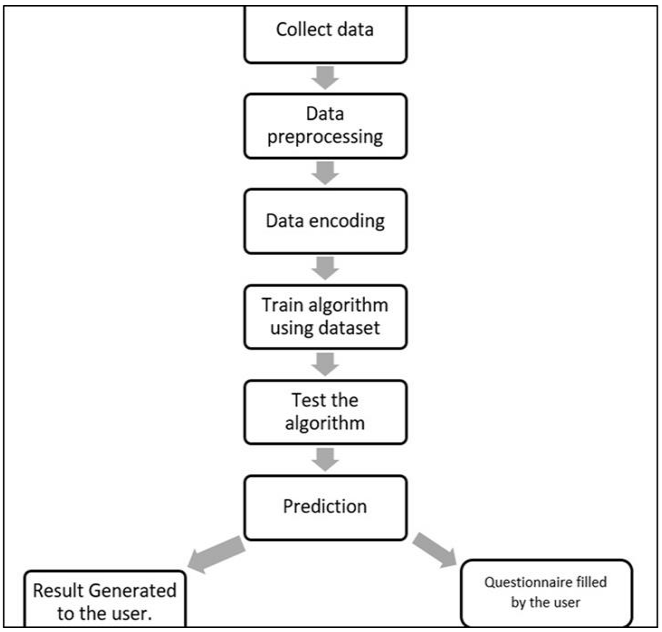

Fig 1 Block Diagram Showing the Work Flow of Application

II. MATERIALS AND METHOD

Working with several important parameters is essential to achieve the best potential performance of machine learning algorithms. Once the appropriate parameters have been decided, we will proceed to apply machine learning algorithms to our acquired dataset of depression, anxiety, and stress. For both classification and regression applications, supervised machine learning algorithms like as decision trees are employed. It is a graphical representation of a decision-making process that recursively splits data into subsets based on the most significant attributes or features.

➢ *Parameters*

The dataset consists of 200 records of patients' data. Table 1 gives a detailed explanation of the parameters. I considered factors such as age, gender, marital status, and family history, as well as their Depression, Anxiety, and Stress Conditions.

Table 1 Selected Attributes Showing Dataset Feature's Information

Parameters	Description
Age	18 - 60
Gender	Value 1 = Male, Value 0 = Female
Marital Status	alue 0 = Single, Value 1 = Married, Value 2 = Divorced.
Family History	Value 0 - no, Value 1 = Yes

Table 2 Questions Associated with Anxiety

Q	**Description**
Q2	I was aware of the dryness of my mouth
Q4	I experienced breathing difficulty (e.g., excessively rapid breathing, breathlessness in the absence of physical exertion).
Q7	I had a feeling of shakiness (e.g., legs going to give way).
Q9	I found myself in situations that made me so anxious I was most relieved when they ended.
Q15	I had a feeling of faintness.
Q19	I perspired noticeably (e.g., hands sweaty) in the absence of high temperatures or physical exertion.
Q20	I felt scared without any good reason.
Q23	I had difficulty swallowing.
Q25	I was aware of the action of my heart in the absence of physical exertion (e.g., sense of heart rate increase, heart missing a beat).
Q28	I felt I was close to panic.
Q30	I feared that I would be by some trivial but unfamiliar task.
Q36	I felt terrified.
Q40	I was worried about situations in which I might panic and make a fool of myself.
Q41	I experienced trembling (e.g., in the hands).

Table 3 Questions Associated with Depression

Q	Description
Q3	I couldn't seem to experience any positive feelings at all.
Q5	I just couldn't seem to get going.
Q10	I felt that I had nothing to look forward to.
Q13	I felt sad and depressed.
Q16	I felt that I had lost interest in just about everything.
Q17	I felt I wasn't worth much as a person.
Q21	I felt that life wasn't worthwhile.
Q24	I couldn't seem to get any enjoyment out of the things I did.
Q26	I felt down-hearted and blue.
Q31	I was unable to become enthusiastic about anything.
Q34	I felt I was pretty worthless.
Q37	I could see nothing in the future to be hopeful about.
Q38	I felt that life was meaningless.
Q42	I found it difficult to work up the initiative to do things.

Table 4 Questions Associated with Stress

Q	Description
Q1	I found myself getting upset by quite trivial things.
Q6	I tended to overreact to situations.
Q8	I found it difficult to relax.
Q11	I found myself getting upset rather easily
Q12	I felt that I was using a lot of nervous energy.
Q14	I found myself getting impatient when I was delayed in any way.
Q18	I felt that I was rather touchy.
Q22	I found it hard to wind down.
Q27	I found that I was very irritable.
Q29	I found it hard to calm down after something upset me.
Q32	I found it difficult to tolerate interruptions to what I was doing.
Q33	I was in a state of nervous tension.
Q35	I was intolerant of anything that kept me from getting on with what I was doing.
Q39	I found myself getting agitated.

Table 2,3,4 displays the 14 queries each chosen for the anxiety, stress, and depression disorder set. [5]

III. DATA COLLECTION

The first stage is to collect data. The Questionnaire has been taken from https://openpsychometrics.org/_rawdata/, and collected by online questionnaires. In total 200 cases were collected [6]. Questions were objective and situational. There are no right or wrong responses in it. 42 questions from the DASS42 standard form the basis of the dataset. The user's response is transformed using numeric values ranging from 0 to 3, and occasionally 0 to 4, once data gathering is complete [6].

Of these 42 questions, 14 questions relate to each of anxiety, depression and stress [7]. Then the data for pre-processing is moved to feature extraction thenceforth prediction of mental illness.

The numbers corresponding to the responses to every question in the specific class were added to determine the scores for stress, anxiety, and depression. After calculating the final scores, they were categorized according to the severity, i.e. Extremely Severe, Severe, Moderate, Mild, and Normal. The extremely severe class for anxiety, depression and stress was given a score of 20+, 28+ and 33+ respectively.

The three received scores in the severe class of 15 to 19, 21 to 27, and 26 to 33, in that order. The moderate class was assigned scores of 10 to 14 for anxiety, 14 to 20 for depression and 19 to 25 for stress. For anxiety, the range is 8 to 9, for depression, it is 10 to 13, and for stress, it is 15 to 18. Data falling below these scores comes under the normal category for all three conditions [6].

IV. IMPLEMENTATION

The experiment was carried out using the online interactive tool Jupyter Notebook running on the Anaconda environment manager. which was used for data processing and modelling evaluation. Extreme gradient boosting, or "XGBoost," is a technique that applies to gradient-boosted trees. Supervised machine learning algorithm XGBoost is regarded as one of the most popular ML methods. This is because of how user-friendly and accurate its predictions are.

XGBoost can be applied to issues involving regression and classification, much as other machine learning algorithms. [8]. The XGBoost model relied on the "XGBClassifier" package and was dependent on the "DecisionTreeClassifier," package, which can be accessed from the sklearn library in the public Python software [9].

➢ *Decision Tree Coding using Python Program*

Python language is the most appropriate language for detecting patients suffering from Mental Issues. It is one of the robust languages that foster computational capabilities in gaining valuable insights from the information of the patients suffering from Mental problems. Thus, it is apt for the healthcare sector, However, attempts have been made to employ decision tree approaches in life science to anticipate suicide attempts, neuroticism levels, life quality, and late life. In this experiment, we will be using a decision tree algorithm in the field of medical diagnosis to predict Mental health using the Python programming language. Where the data is stored as a record in the database, it is stored as a CSV file that has comma-separated values. Finally, the new patients are rated in one of the categories.

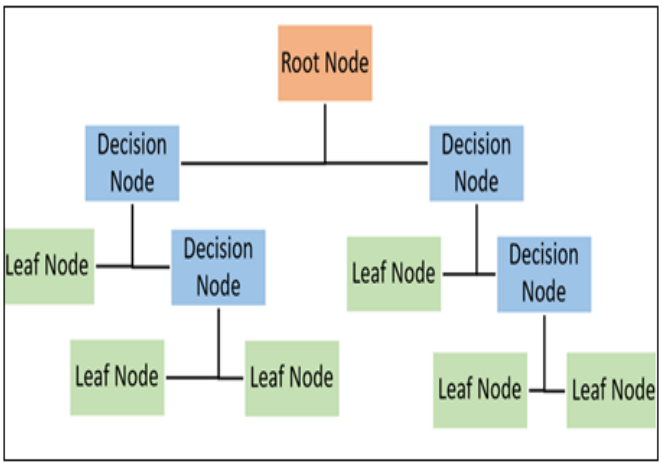

Fig 2 Pattern of Decision Tree

➢ *Algorithm of the Code*

- Import the necessary libraries, including pandas, scikit-learn, and XGBoost.
- Load the CVD patient data from a CSV file into a Panda DataFrame.
- Divide the data into the target variable (y) and features (X).
- Split the data into training and testing sets using train_test_split from scikit-learn.
- Create an instance of the XGBoost classifier.
- Train the XGBoost classifier using the training data.
- Calculate the accuracy of the trained model using the score method.
- Prompt the user to input patient data.
- Parse the patient data and use the trained model to predict the patient's CVD risk.
- Classify the predicted output into one of five categories based on its numerical value.
- Print the predicted CVD risk to the console.
- Print the accuracy of the model to the console.

V. RESULT

➢ *Software Requirement*

- Operating System: Windows family - Linux
- Technology: Anaconda- anaconda PowerShell prompt
- IDE: Jupiter notebook

➢ *Sample Code*

```
import pandas as pd
from sklearn.model_selection import train_test_split

df = pd.read_csv("csv_Mental_Health.csv")
X = df.drop('Result', axis='columns')
y = df['Result']
ycpy = df['Result']
X_train, X_test, y_train, y_test = train_test_split(X.values, y.values, test_size=0.1)
#-------------------------Accuracy Calculation-------------------------
from xgboost import XGBClassifier
model = XGBClassifier()
model.fit(X_train, y_train)
accuracy= model.score(X_test, y_test)
#-------------------------Predict value---------------------------------
patient_data = input("Enter the patients data: ")
arr = patient_data.split(",")
arr = [int(x) for x in arr]
predicted_output=model.predict([arr])

array_value = predicted_output[0]
if array_value == 0:
   print('This person has Mild Anxiety and Extremely severe Depression and Severe Stress')
elif array_value == 1:
   print('This person has Extremely severe Anxiety and Moderate Depression and Moderate Stress')
elif array_value == 2:
   print('This person has Mild Anxiety and Mild Depression and Mild Stress')
else:
   print('Invalid data')

print('Accuracy level of this model:', accuracy)
```

Fig 3 Samle Code

VI. DATASET DETAILS

A total of 200 cases were collected. The 42 questions in the collection were selected from the DASS42 standard form.

Table 5 Anxiety Score Calculation

Sr.no	Age	Gender	Martial status	Family History	Q1	Q6	Q8	Q11	Q12	Q14	Q18	Q22	Q27	Q29	Q32	Q33	Q35	Q39	Total Score	Result
1	32	1	1	0	2	2	1	0	2	3	0	2	1	1	3	1	1	3	54	2
2	78	0	2	0	3	1	1	3	3	1	1	3	0	1	1	0	2	2	78	2
3	31	0	0	0	0	3	0	3	2	0	0	0	0	2	2	0	1	0	25	0
4	57	0	0	1	2	1	0	0	1	2	0	0	0	2	1	0	2	0	25	0
5	45	0	2	0	0	1	0	0	0	1	0	0	0	0	0	0	3	0	31	1
6	32	0	0	1	1	2	2	3	3	3	2	0	1	1	1	0	1	2	67	2
7	33	1	0	1	3	0	3	3	1	3	3	0	1	0	3	3	3	1	79	2
8	37	0	1	0	0	3	0	3	2	0	0	0	0	2	2	0	1	0	25	0
9	36	1	2	1	0	0	3	2	1	0	3	2	2	3	0	3	0	0	55	1

Table 6 Stress Score Calculation

Sr.no	Age	Gender	Martial status	Family History	Q2	Q4	Q7	Q9	Q15	Q19	Q20	Q23	Q25	Q28	Q30	Q36	Q40	Q41	Total Score	Result
1	32	1	1	0	3	3	0	0	1	1	0	1	0	2	3	0	0	0	54	2
2	78	0	2	0	3	3	3	1	3	2	3	3	3	3	3	2	1	2	78	2
3	31	0	0	0	0	0	3	1	0	0	0	0	0	0	0	2	0	2	25	0
4	57	0	0	1	0	2	0	0	0	0	1	0	0	0	0	0	0	1	25	0
5	45	0	2	0	3	1	0	0	0	3	0	0	1	1	0	0	2	2	31	1
6	32	0	0	1	3	0	2	2	3	2	2	1	3	3	0	1	0	2	67	2
7	33	1	0	1	2	3	1	3	2	2	1	3	2	2	3	3	0	1	79	2
8	37	0	1	0	0	0	3	1	0	0	0	0	0	0	0	2	0	2	25	0
9	36	1	2	1	1	0	0	3	2	3	0	3	1	0	2	0	3	1	55	1

Table 7 Depression Score Calculation

Sr.no	Age	Gender	Martial status	Family History	Q3	Q5	Q10	Q13	Q16	Q17	Q21	Q24	Q26	Q31	Q34	Q37	Q38	Q42	Total Score	Result
1	32	1	1	0	0	2	3	1	1	2	0	3	1	1	3	1	0	0	54	2
2	78	0	2	0	1	2	1	0	0	0	3	3	1	3	0	1	3	3	78	2
3	31	0	0	0	0	0	0	1	0	0	0	0	0	2	0	0	1	0	25	0
4	57	0	0	1	0	1	2	1	0	0	1	1	0	0	0	3	1	0	25	0
5	45	0	2	0	0	2	2	0	0	0	2	0	0	3	0	2	2	0	31	1
6	32	0	0	1	3	3	2	3	1	0	3	2	1	0	1	1	1	0	67	2
7	33	1	0	1	0	3	1	2	2	3	0	3	3	2	1	1	0	3	79	2
8	37	0	1	0	0	0	0	1	0	0	0	0	0	2	0	0	1	0	25	0
9	36	1	2	1	0	1	2	0	1	1	0	3	1	0	2	2	2	2	55	1

From Table 5,6,7, The columns for age, gender, marital status, and family history were included after the new feature "condition" was created, and these were helpful in the model's construction. Later, "Total score" and "Result," two more features, were added. To make the outcome binary, I made a result column that returns '1' for moderate or severe conditions, '2' for 'very severe' conditions, and '0' for normal and mild conditions. Because moderate mental problems can progress to severe and extremely severe levels, they must be taken into account alongside those with severe and highly severe mental disorders.

VII. RESULTS OBTAINED

```
Enter the patients data: 9,36,1,2,1,0,1,0,0,1,0,0,3,3,2,2,1,0,0,2,1,1,3,3,0,0,2,3,3,1,1,2,0,3,2,0,0,3,2,0,0,2,2,0,3,1,2,55
This person has Extremely severe Anxiety and Moderate Depression and Moderate Stress
Accuracy level of this model: 1.0
```

Fig 4 Snapshot of Result (Mental Health – Anxiety)

```
Enter the patients data: 57,0,0,1,2,0,0,2,1,1,0,0,0,2,0,1,1,2,0,0,0,0,0,1,1,0,0,1,0,0,0,0,2,0,0,1,0,0,2,0,3,1,0,0,1,0,25,0
This person has Mild Anxiety and Extremely severe Depression and Severe Stress
Accuracy level of this model: 0.9
```

Fig 5 Snapshot of Result (Mental Health – Depression)

```
Enter the patients data: 1,32,1,1,0,2,3,0,3,2,2,0,1,0,3,0,2,1,3,1,1,2,0,1,0,0,2,1,3,0,1,1,2,1,3,1,3,1,3,1,0,1,0,3,0,0,0,54
This person has Mild Anxiety and Mild Depression and Mild Stress
Accuracy level of this model: 1.0
```

Fig 6 Snapshot of Result (Mental Health – Normal)

VIII. DISCUSSION

A significant number of researchers used machine learning (ML) to predict diabetes. However, since diabetes has just two varieties of outcomes, it is easier to classify than psychological health. whereas each mental disorder has a varied predicted level of anxiety, depression, and stress. The dataset taken here is from online questionnaires.

In this section, the results are summarised and discussed. A description is given of how decision tree models are executed using the DASS42 dataset. Comparing the results with other algorithms' performance is crucial. As we know decision tree algorithm provides the highest accuracy of all algorithms. This is acquired from different papers which are described below. The researchers indicated below did not consider demographic factors such as age, gender, marital status, and family history. For example, for scenario 2, we turned "normal" and "mild" to 0 and "moderate," "severe," and "extremely severe" to 1. In doing so, we transformed five output classes into a binary output. Furthermore, we found that eight personality factors and fourteen generic parameters significantly influence DASS prediction, increasing prediction accuracy. This work has made a significant addition to the field of stress, anxiety, and depression prediction. The model's accuracy can aid in enhancing the psychological domain's ability to predict mental disease with accuracy.

The following topics will include methods used by researchers to identify mental diseases using a variety of methodologies, as well as approaches made to detect mental illness using machine learning algorithms. The research and innovative methods that were created are described in depth in the paragraphs that follow [11], evaluating the accuracy of prediction of machine learning algorithms for stress, anxiety, and depression. The Stress, Anxiety, and Depression Scale is a collection of a set of questionnaires, that assesses the level of stress, anxiety, and depression (DASS42). This work improved the functionality of Logistic Regression and Support Vector Machines and compared their classification accuracy to other methods. After adjusting for parameters, SVM obtains 97.35%, 97.49%, and 97.20% classification accuracy for depression, anxiety, and stress, respectively. LR attains 98.15%, 98.05%, and 98.45% classification accuracy for the Depression, Anxiety, and Stress datasets, in that order. The outcomes showed that LR outperformed SVM in terms of accuracy. Deep learning models, which have the potential to achieve more accuracy than logistic regression, were not taken into account in this study.

(Priya et al. 2020) used machine learning algorithms to predict stress, anxiety, and depression using an online questionnaire. They used KNN, Naive Bayes, SVM, and Decision Tree, but found unbalanced classes in the confusion matrix. Random Forest was chosen as the most accurate model, but the dataset was small.

(Singh and Kumar, 2021) used the DASS-21 questionnaire to classify anxiety and depression using machine learning algorithms. They found SVM outperforms all other techniques, but the study only considered depression and stress, causing issues. In this work, trained eight machine learning algorithms to predict psychological problems like anxiety, depression, and stress using data from the DASS42 application. Neural networks performed best, with RBFN outperforming other networks in depression. The random forest result for DASS21 anxiety was 100%.

(Satvik Gurjar et.al; 2022), To achieve high accuracy, data needs proper cleaning and preprocessing using Python libraries like NumPy, pandas, and matplotlib. Multiple ML algorithms like logistic regression, SVM, random forest, and k-neighbors were used to pass datasets. The system achieved 97.27%, 94%, 81%, and 80% accuracy for anxiety and other diseases.

(Robert Wernigg, Márton, 2022), ML decision trees on healthcare databases are effective in focusing quality audit efforts, with narrative analysis for clinical contexts being indispensable.

(Yunpeng Huang, et.al, 2022), The study utilized a decision tree-based analysis of a questionnaire to analyze

academic performance, leave patterns, medical history, medication history, school bullying, dietary patterns, sleep quality, and psychological crisis problems among college students. A psychological problem prediction model was developed, identifying 48 students with potential issues. This model aims to improve early warning and prevent tragedies due to a lack of mental health intervention.

(Xiuyan Liu, et.al 2022), The decision tree model effectively predicts disorders' occurrence, development, and prognosis in data-limited situations. A study using logistic regression, decision tree algorithm, and XG Boost found it best for identifying blood transfusion needs, with time advantages.

(Konda Vaishnavi et.al 2022), This study compares five machine learning techniques for classifying mental health datasets. Results show that all five techniques provide more accurate results, with accuracy above 79%. The minimal data set used in the research suggests that larger datasets could improve accuracy in future research. This is crucial for accurate disease prediction in the medical field.

IX. CONCLUSION

This study concentrated on applying a machine learning model to predict stress, anxiety, and depression. To foresee the outcome, we have utilized decision tree algorithms on the patient's data. All the algorithms are applied to patients' data comprised of major risk factors like depression, anxiety, and stress. The predictions obtained from this type of system can help doctors identify mental health performance or different diseases. The decision tree technique provides greater accuracy and efficiency compared to other algorithms, making it the best choice for classification and regression problems involving small datasets.

Low classification accuracy when there is a huge amount of training data is the primary drawback of the decision tree approach. However, all of these are limited to tiny datasets and require the permanent storage of all or part of the dataset in memory. Their use for mining over big databases is thus limited. Decision tree techniques are used to overcome this issue. It is still necessary to create efficient decision tree algorithms. This model can be further expanded for the prediction of different diseases and other medical fields.

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