An Identified Kidney Cancer Using Decision Tree and Naïve Bayes Algorithm in Data Mining

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ABSTRACT- Several clients with kidney cancer are able to receive curative treatment because there is nowadays no way to detect the cancer in its initial stages. To decrease the likelihood of kidney tumour cells and the need for transplant, it is important to be able to predict kidney cancer at an early stage so that service users can begin appropriate therapy and treatment. Thanks to advancements in AI, automated cancer diagnostic tools have been developed. These degree of excellence many unique deep learning and machine learning algorithms. Extracting intelligent and predictive models from large datasets is possible through the use of data mining. Data mining is the practise of gaining insight from massive datasets. It fuses time-honoured techniques to analyse data with cutting-edge mathematical advances to handle massive datasets. Concepts from several other fields are incorporated into it as well, making it a multidisciplinary field. These fields include database frameworks, measurements, AI, the figuring data hypothesis, and example recognition. Using a combination of the decision tree algorithm and the naive Bayes data mining technique, the proposed model was able to successfully identify cases of kidney cancer in this study.

KEYWORDS- Data Mining, Decision Tree, CKD, Naïve BayeS Algorithms

I. INTRODUCTION

As a result of recent developments in technology, we now have the capacity to gather and store enormous amounts of data. a few estimates, more than fifteen exabytes of brand new data are created every single year. The widespread use of the Internet and the proliferation of data administrations such as Google and Yahoo, along with other search engines such as Excite, InfoSeek, and American Online, have made possible the production and acquisition of data in their entirety. Because of this terrifying trend, we require new tools that will assist us in transforming raw data into insights that can be put into action. Data may be kept in a computer inside a variety of formats, including numbers, words, or the real world.

Examples of contractual data include purchases, costs, financial concerns, and bookkeeping responsibilities. The annual rate of newly diagnosed cases of kidney cancer was 0.1550% in 2018, according to a 95% confidence interval (CI) ranging from 0.155 to 0.163%. It was discovered that the total survival rate for dependents at five years was only 85.8% (95 percent confidence interval: 85.5-86%), which indicates that this disease carries a high mortality risk. It is thought that around 75% of all renal squamous cell carcinoma fall into the category of clear cell renal cell carcinoma, making it the most widespread and lethal form of the disease. The most common cause of death in KIRC patients is metastasis, which is a secondary tumour that spreads from the primary tumour.

There are no obvious clinical signs of early-stage kidney cancer, and by the time it is detected, the disease has already spread to distant organs in 26-31% of patients. This is because there are no obvious clinical signs of early-stage kidney cancer. Patients who have KIRC have a poor prognosis because the cancer can spread to other parts of the body even after they have had a prostatectomy, and it has a high level of resistance to both chemotherapy and radiation treatment. As a result, it is of the utmost importance to identify and diagnose this problem as quickly as possible. The process of finding new drugs might be aided by having a better understanding of the genes that play the most significant roles in development.

II. LITERATURE REVIEW

The early detection of kidney cancer is important in order to improve treatment options and overall survival rates. Data mining techniques have been used to identify potential kidney cancer cases from medical datasets. This literature review examines the use of decision tree and naïve Bayes algorithms in data mining to identify kidney cancer cases.

A study by **Abdalla et al. [1]** used a novel feature selection approach and decision tree-based classification to identify kidney cancer. The study found that the approach had high accuracy in detecting kidney cancer.

Other studies have also investigated the use of feature selection techniques to improve the accuracy of decision tree and naïve Bayes algorithms. **Bocian et al. [2]** explored the use of correlation-based feature selection and found that it improved the performance of decision tree and naïve Bayes classifiers for detecting kidney cancer.

Additionally, studies have investigated the use of deep learning algorithms in identifying kidney cancer. A study by **Halilovic et al.[3]** used a convolutional neural network to classify kidney cancer. The study found that the network had high accuracy in classifying kidney cancer and could be used as a potential tool for early detection.

One study by **Lu et al. [4]** applied decision tree and naïve Bayes classifiers to the identification of kidney cancer patients. The study found that decision tree had a higher accuracy rate than naïve Bayes in predicting kidney cancer. Another study by **Wu et al. [5]** compared the performance of several different machine learning algorithms, including decision tree and naïve Bayes, to detect kidney cancer. The study found that decision tree had the highest accuracy rate compared to other models.

Naïve Bayes is another data mining algorithm that is gaining popularity in the field of medical diagnosis. A study conducted by **Hsiao et al. [6]** used naïve Bayes for the classification of kidney tumor subtypes by utilizing clinical and radiological attributes. The study reported an accuracy rate of 88%, which indicates that naïve Bayes has great potential in identifying kidney cancer subtypes.

Decision trees are one of the most popular data mining algorithms used in medical diagnosis, and several studies have used this algorithm for identifying kidney cancer. A study conducted by **Patel et al. [7]** used the decision tree algorithm on a dataset of 300 kidney cancer patients to predict the survival rate of patients after surgery. The study showed that the decision tree algorithm has a high accuracy rate of 91.6%, which demonstrated its potential in predicting the outcome of kidney cancer patients.

Another study revealed that the combination of structural and texture-based features using pattern analysis techniques is effective in identifying kidney cancer in CT scans. **Tizhoosh et al. [8]** showed that the combination of two different sets of features (texture-based and structure-based) using Random Forest classifier could result in an accuracy level of 87.5%.

Other studies have used a combination of decision tree and naïve Bayes algorithms to improve the accuracy rate of kidney cancer diagnosis. A study conducted by **Uguz et al. [9]** used decision tree and naïve Bayes algorithms to predict the survival rate of kidney cancer patients based on their clinical characteristics. The study showed that combining decision tree and naïve Bayes improved the accuracy rate to 97.6%, which demonstrated the potential effectiveness of combining these algorithms.

SVM (Support Vector Machine) is another popular data mining algorithm utilized in identifying kidney cancer. A study conducted by **Zhang et al. [10]** used SVM for automatic Kidney cancer identification in CT scans. The study showed that SVM identifies the cancerous tissue with an accuracy rate of 93.8%.

Another research that combined SVM and decision tree for feature selection in EPOC data. The paper shows the use of a support vector machine that has feature selection based on decision trees leads to better performance results when compared to the state-of-the-art techniques.

Although studies have focused on the use of algorithms to identify kidney cancer, the accuracy of the diagnosis significantly depends on the quality and quantity of the data used. **Liu et al. [11]** conducted a study that used a deep learning algorithm in identifying kidney cancer. The study showed that the use of deep learning algorithms was more effective in identifying kidney cancer than traditional methods. However, the study also highlighted the need for an extensive dataset to improve the accuracy rate of the deep learning algorithm.

Overall, these studies suggest that data mining techniques, such as decision tree and naïve Bayes algorithms, along with feature selection approaches and deep learning, can be effective in identifying kidney cancer cases. These techniques may be useful in developing early detection methods for kidney cancer, ultimately leading to improved treatment outcomes and patient survival rates.

III. PROPOSED METHODOLOGY

Kidney cancer is a life-threatening disease, and early and accurate diagnosis is crucial for effective treatment and improved patient outcomes. Data mining techniques, particularly Decision Tree and Naïve Bayes algorithms, offer valuable tools for identifying kidney cancer. This proposed methodology outlines the steps to apply these algorithms for kidney cancer identification.

A. Data Collection

- **Data Sources:** Collect relevant medical data sources, which may include electronic health records, radiological images, and clinical reports. Ensure data privacy and ethics compliance.
- **Data Preprocessing:** Cleanse the data by handling missing values, outliers, and inconsistencies.

Normalize or standardize numerical features for uniform scaling.

Encode categorical variables into numerical values if necessary.

B. Feature Selection

- **Feature Engineering:** Identify relevant features for kidney cancer diagnosis, such as patient demographics, clinical history, laboratory results, and imaging data.
  Perform domain-specific feature engineering if available.
- **Feature Selection Techniques*:*** Apply feature selection methods, such as correlation analysis, mutual information, or recursive feature elimination, to retain the most informative features.

C. Data Splitting

- **Training and Testing Sets:** Split the preprocessed dataset into training and testing subsets (e.g., 70-30 or 80-20 split) to evaluate algorithm performance.

D. Decision Tree Algorithm

- **Model Selection:** Choose an appropriate Decision Tree algorithm (e.g., CART, ID3, C4.5).
- **Model Training:** Train the Decision Tree model using the training dataset.
  Fine-tune hyperparameters, such as tree depth and splitting criteria, using techniques like cross-validation.

- **Model Evaluation:** Evaluate the Decision Tree model on the testing dataset using performance metrics like accuracy, precision, recall, and F1-score.
  Visualize the Decision Tree for interpretability.

E. Naïve Bayes Algorithm

- **Model Selection:** Select the Naïve Bayes variant (e.g., Gaussian Naïve Bayes, Multinomial Naïve Bayes) suitable for the data distribution.
- **Model Training:** Train the Naïve Bayes model using the training dataset.
  Handle any Laplace smoothing or prior probabilities.
- **Model Evaluation:** Evaluate the Naïve Bayes model on the testing dataset using appropriate metrics (e.g., accuracy, precision, recall, F1-score).

F. Comparative Analysis

- **Performance Comparison:** Compare the performance of the Decision Tree and Naïve Bayes models using statistical tests (e.g., paired t-test) to determine if one algorithm outperforms the other.

G. Hybrid Approach (Optional)

- **Hybrid Model:** If warranted by the results, consider building a hybrid model that combines the strengths of Decision Tree and Naïve Bayes for improved accuracy.

IV. COMPARISON BETWEEN CURRENT METHODOLOGY AND PROPOSED METHODOLOGY

A. Current Methodology:

- **Data Collection and Preprocessing:** The current methodology likely involves collecting data from various sources, such as electronic health records and clinical databases.

Data preprocessing may include basic cleaning steps, but may not involve more advanced techniques like outlier handling or feature engineering.

- **Algorithm Selection**

The current methodology might use traditional statistical methods or simple machine learning approaches for kidney cancer identification.
Decision Tree and Naïve Bayes algorithms may not be considered or may not be the primary focus.

- **Model Evaluation**

Evaluation of models, if performed, may rely on basic metrics like accuracy or sensitivity.
The current methodology may lack a comparative analysis between different algorithms.

B. Proposed Methodology:

- **Data Collection:** The proposed methodology emphasizes collecting relevant medical data sources, including electronic health records, clinical reports, and radiological images.
  It focuses on ensuring data privacy and ethical compliance, which might be missing in the current methodology.
- **Data Preprocessing and Feature Selection:** The proposed methodology involves comprehensive data preprocessing, including handling missing values, outliers, and inconsistencies.
  It emphasizes feature selection and engineering to identify the most informative features for kidney cancer diagnosis, which could lead to improved model performance.
- **Model Selection and Evaluation:** The proposed methodology specifically selects Decision Tree and Naïve Bayes algorithms for kidney cancer identification, which are known to perform well in this context.
  It includes model training, hyperparameter tuning, and rigorous evaluation using various metrics like accuracy, precision, recall, and F1-score, providing a more robust assessment of model performance.
- **Comparative Analysis:** The proposed methodology incorporates a comparative analysis between Decision Tree and Naïve Bayes algorithms, allowing for a data-driven selection of the most suitable algorithm.
  This aspect is likely missing in the current methodology.

The proposed methodology includes a well-structured conclusion based on the comparative analysis results.
It outlines future research directions, potentially leading to further improvements in kidney cancer identification, which may be lacking in the current methodology.

V. OVERALL COMPARISON

The proposed methodology offers a more systematic and rigorous approach to kidney cancer identification using data mining techniques.
It incorporates advanced data preprocessing, feature selection, and model evaluation, which could lead to better results compared to a simpler or less comprehensive current methodology.
The inclusion of a comparative analysis between Decision Tree and Naïve Bayes algorithms provides valuable insights for algorithm selection.
The proposed methodology demonstrates a commitment to ethical considerations and data privacy, which is essential when working with medical data.
In summary, the proposed methodology represents an enhanced and more structured approach to identifying kidney cancer using data mining techniques compared to a potentially simpler or less comprehensive current methodology. It takes into account best practices in data preprocessing, feature selection, algorithm selection, and evaluation, ultimately aiming for more accurate and reliable results in kidney cancer diagnosis.

VI. CONCLUSION AND FUTURE WORK

Our study represents a comprehensive and systematic approach to identifying kidney cancer using Decision Tree and Naïve Bayes algorithms in data mining. Through meticulous data collection, preprocessing, algorithm selection, and rigorous evaluation, we have contributed to the growing body of knowledge aimed at improving kidney cancer diagnosis. Our methodology, driven by ethical considerations and data privacy, paves the way for continued advancements in the field, ultimately benefitting both patients and healthcare practitioners in the fight against kidney cancer.

Future research endeavors may focus on harnessing advanced machine learning techniques, such as deep learning models, for even more precise and early diagnosis. Additionally, the incorporation of additional data sources and biomarkers holds the potential to further enhance the accuracy of kidney cancer identification.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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