"Recent Advancements in Machine Learning and Sentiment Analysis Technologies in Healthcare and Brand Management: A Review"

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Abstract

This paper discusses the application of machine learning technology in the healthcare system, specifically in the context of heart disease detection. The study utilizes various machine learning algorithms, such as the KNN algorithm, decision tree method, and random forest algorithm, to create a predictive model for heart disease detection. The sentiment analysis method is also applied in the healthcare system for risk detection in patients. The study also identifies some of the obstacles faced in the data collection process and proposes solutions to overcome these problems. The findings of this study suggest that the application of machine learning technology and sentiment analysis in healthcare can play a significant role in the early detection and prevention of heart disease, which can help save lives and improve the quality of healthcare services.

Keywords: Machine learning, sentiment analysis, healthcare, brand management, python-based software, wearable devices, IoT systems, quantum-enhanced machine learning, artificial intelligence

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1. Introduction

Heart disease is a major health concern across the world, with a high mortality rate, as reported by the World Health Organization (WHO) (Basiri et al., 2021). The conventional methods of heart disease detection are often limited in their accuracy and are time-consuming. However, with the recent advancements in machine learning and sentiment analysis technologies, healthcare professionals have access to powerful tools for detecting heart disease accurately and in a timely manner. By using machine learning algorithms, large datasets can be analyzed to identify patterns and trends in patient data that can help in early diagnosis and treatment of heart disease. Sentiment analysis can aid in understanding the general characteristics and attitudes of patients towards medical services, brands, and medical products, thus providing valuable insights into patient preferences (Kumar and Jaiswal, 2020).

Python-based application software has emerged as a popular and effective tool in the healthcare industry. With its user-friendly interface and powerful programming language, python has been applied in numerous healthcare domains, including heart disease detection. This approach has provided a significant breakthrough in the development of predictive models for heart disease detection (Mahesh et al., 2022). Therefore, this review focuses on the recent developments in machine learning and sentiment analysis techniques in the healthcare system and

their application in the detection and prevention of heart disease. It also discusses the use of python-based application software as an effective tool for healthcare professionals in this field. The findings of this review can aid in enhancing the quality of healthcare services and improving the overall health of individuals.

2. Literature Review

The advancement of machine learning technology has revolutionized the healthcare system and opened new avenues for improving patient care. This literature review focuses on the application of machine learning technology in the context of heart disease detection. The paper explores the use of various machine learning algorithms, including the KNN algorithm, decision tree method, and random forest algorithm, to develop a predictive model for heart disease detection. Additionally, sentiment analysis is employed to detect the risk of heart disease in patients.

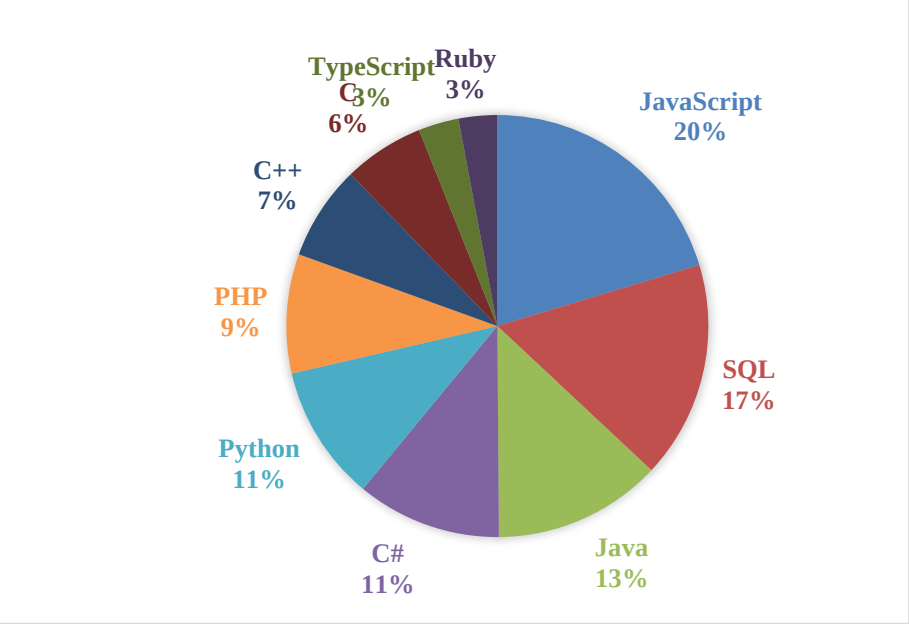

Figure 1: The percentage of the persons who preferred Python programming for the healthcare application.

The paper also discusses the challenges faced during data collection and offers solutions to overcome these obstacles.

Overall, this study suggests that the application of machine learning technology and sentiment analysis in healthcare can play a critical role in detecting and preventing heart disease at an early stage, ultimately enhancing the quality of healthcare services and saving lives.

This review paper evaluates the accuracy of machine learning algorithms in identifying heart disease, specifically using the random forest classifier algorithm, and highlights the importance of building decision trees considering different medical parameters such as age, blood pressure, obesity, etc. The results show a significant improvement in the accuracy of heart disease diagnosis, with an 83% accuracy rate (Ramprakash et al., 2020). The study provides valuable insights into the potential of machine learning and sentiment analysis technology in healthcare, particularly in the detection and treatment of heart diseases. The paper highlights the need for further research in this field to improve patient outcomes (Birjali et al., 2021; Chattu, 2021).

According to a study by Gupta et al. (2020), it helps to track and then establish various types of health monitoring applications for doing sentimental analysis. The authors used Python programming language to present a data processing system that does categorical analysis of the variables and identifies the conversions into categorical columns, which describe the important phase applications with the

development of the performance of logistical regression and with the collection of the database management system to evaluate those attributes of the datasets. The authors also used random forest classifier algorithms to identify heart disease with higher accuracy and achieved an 83% accuracy rate. This experimental value results in a better diagnosis of heart disease. The study also creates insights into patient information with the highlighted selection for sentimental analysis using the random forest classifier data based on the applied dataset and by building the decision tree considering different medical parameters such as age, blood pressure, obesity, etc. The authors conclude that by the application of the Python programming language in the healthcare system, it generates various facilities and helps doctors demonstrate the proposed model to do the treatments with the improvement of the healthcare sector.

The focus of Awotunde et al.'s (2021) research was on automating disease monitoring processes with the use of sentimental analysis. As the global population continues to grow, infectious diseases are also increasing at an alarming rate, and healthcare organizations need to find new ways to monetize disease research, including prediction, diagnosis, and treatment analysis of patients. This study proposes the integration of wearable devices with an IoT system to reform the medical system. The combination of IoT-based wearable sensors with machine learning algorithms helps to collect data, such as heartbeat sensors, glucose sensors, and body temperature sensors, to diagnose and monitor diseases through proper sentimental prediction. By selecting useful features in data capturing and signal analysis of the sensors, this method helps to spread awareness and eliminate faults in the medical field, making it a cost-effective process that increases productivity and patient satisfaction.

Kumar et al.'s (2021) study, heart failure detection in healthcare was analyzed using both the traditional machine learning technique and the quantum-enhanced machine learning approach. Both technologies play an important role in the context of healthcare and have helped in gaining patient information, record management, chronic disease detection, and other aspects of medical research.

To sustain this patient-oriented attention in the healthcare field the author has applied the quantum computation in this research report. Moreover to enhance the present research work here the summarization has been done for the recent progress of the applied research oriented job. The quantum enhanced machine learning with the significance to the heart failure detection, has been done on the basis of 14 attributes. Here by using the min-max approach for the normalization process of the heart failure data has been evaluated here, also the PCA, standard scalar, optimized pipelining technique has been used.

In Zhou et al. 2021, the focus is on the diagnosis of clinical cardiovascular diseases through ultrasound examinations. The paper highlights the challenge of accurate diagnosis due to specific echocardiographic poses, but proposes the use of artificial intelligence for functional evaluation and disease detection. The limitations of this approach are also discussed, but it presents a promising way to improve the accuracy of diagnosis and potentially save lives.

The article by Zhou et al. 2021 highlights the application of AI technology in the heart disease diagnosis process and examines cardiac ultrasounds using sentiment analysis. With AI technology, the diagnosis process is not dependent on the sonographer's experience, and it also promises significant progress in telemedicine services. The author also provides knowledge about the use of AI technology and robotics in robot-assisted minimally invasive cardiac surgery, as well as the gradual incrementation of AI technology in the future to provide assistance in healthcare.

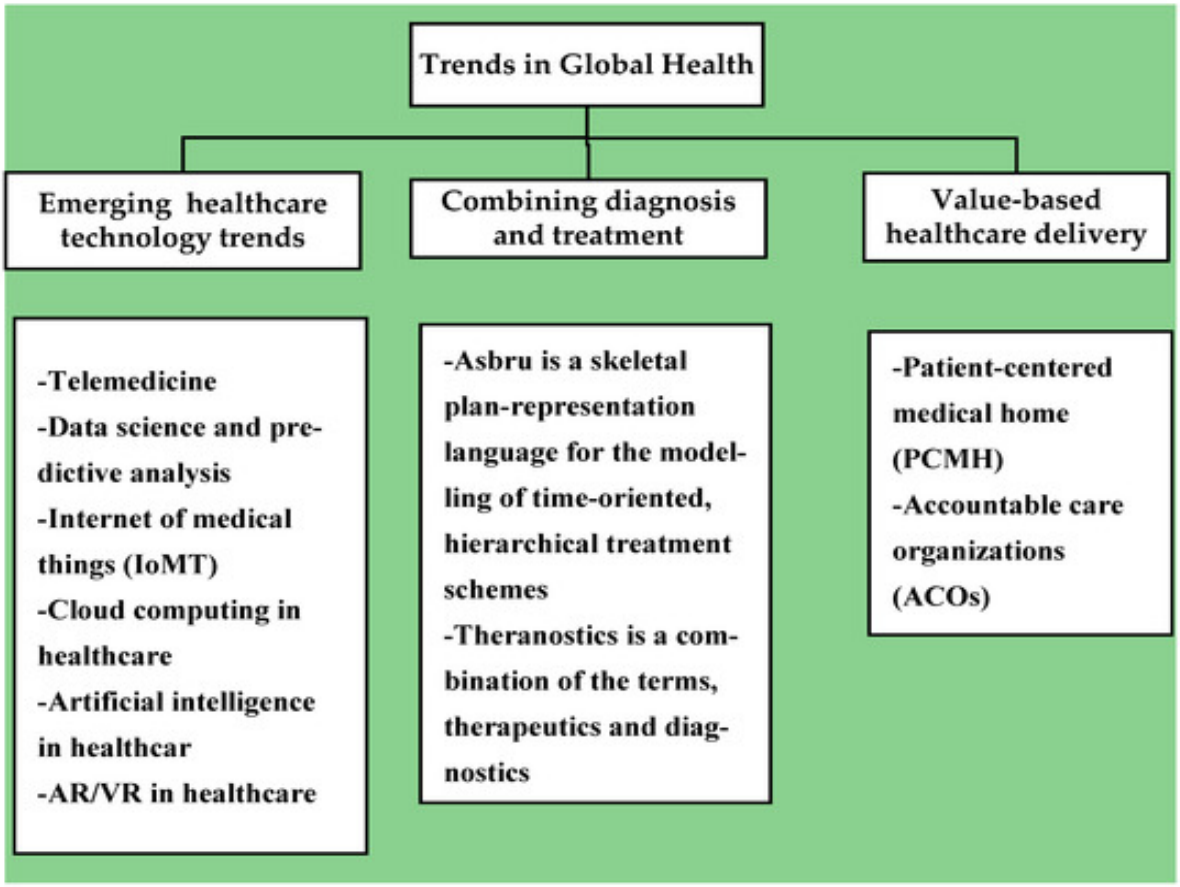

Figure 2: The different trends in global health.

In the article discussing brand management analysis in the corporate sector, the author emphasizes the importance of recognizing multiple stakeholders' perspectives in building brand value. The traditional model is helpful in creating brand recognition and meeting stakeholders' needs, but it has limitations. The article concludes with the research agenda for further exploration in the field of conscientious corporate brands. From this perspective, the management of brands in the healthcare system can be explained in terms of brand monitoring management.

The article by Chattu et al. 2021 emphasizes the application of AI in healthcare for personalized development, drug development, and global health prediction, especially in the context of the COVID-19 pandemic. The author recognizes the need for managing large amounts of patient data, continuous monitoring of individual health status, and the use of wearable medical devices. The use of AI technology improves the analysis of larger amounts of patient data, and the big data analysis method is particularly useful.

In this article, the potential benefits of sophisticated data analysis are explored, with a focus on how machine learning (ML) concepts can be implemented in various technologies, such as big data management and blockchain management. The application of ML technology creates importance in fields like healthcare, medicine, and public health surveillance. ML technology can also play an essential role in predicting global health epidemics, like COVID-19. This paper explores the difficulties faced by medical practitioners in implementing technology and emphasizes the importance of designing futuristic models to improve the quality of human life.

Birjal et al. (2021) analyze the optimum sentimental analysis process with the context of the brand monitoring system. The paper provides

insights on how the implementation of this technology helps patients and customers to influence their opinion regarding medical services. Sentimental analysis is a powerful tool in business management, and it provides governance and research to extract the moods of the public. The brand monitoring process helps to promote the prevention of diseases against people community, making a significant impact on the healthcare system.

Basiri et al. (2021) discuss how sentimental analysis helps in the COVID-19 pandemic situation. By understanding the sentimental analysis, the authors analyze the sentiments of people shared on social media to monitor the disease's spread, control it, and ultimately eradicate it. This paper highlights the impact of social media platforms in creating awareness among people about the importance of the disease, and how it can help promote prevention against the disease in the community.

Ariadne A. Nichol et al. (2022) discuss the considerable effort of artificial intelligence in the healthcare system's development field. The paper explains how machine learning technology, coupled with predictive analysis, provides high-quality responsive organizational benefits that create cost-effective and higher quality policy management in the healthcare system. The systematic database system developed by the authors is relevant to the identification of MLPA in academic research and helps to ensure efficient product service analysis in the organizational products analysis process.

Aniruddha Dutta et al. (2020) discuss the efficient use of the convolutional uses of neural networking with coronary heart disease detection and predictive analysis. The paper explains how machine learning models can recognize curated data to achieve the goal of coronary heart disease detection. The authors provide insights into how the imbalanced data can be rectified with the clinical classified model, and it limits the process of applying efficiency in conventional techniques like data augmentation.

Angraal et al. (2020) focus on the preservation of the ejection fraction by using machine learning technology to predict mortality and hospitalization due to heart failure. The study developed a model for mortality prediction, focusing on the treatment of preserved cardio functional heart failure due to the aldosterone antagonist trial process.

Singh et al. (2022) propose a framework for brand monitoring that leverages machine learning technology for sentiment analysis and complaint identification. The authors emphasize the importance of customer service in healthcare organizations and suggest that timely resolution of customer complaints can lead to increased customer satisfaction and improved healthcare services. The proposed framework includes knowledgeable elements that supervise weak points and leverage an affective space to infuse commonsense into the learning process, resulting in simultaneous sentimental classification and complaint identification tasks. The authors demonstrate that the multitasking feature of the proposed model achieved high cross-validation accuracy and a strong correlation between outperformed sentiment classification tasks and benefits for both customers and organizations. This paper highlights how sentimental analysis can aid in the development of healthcare organizations.

Lin et al. (2021) present a risk assessment model for mortality and hospitalization in patients with heart failure and reduced ejection fraction (HFpEF). The authors apply five methods, including logistic regression with forward selection of variables, logistic regression with lasso regularization for variable selection, random forest method, support vector machine, and gradient descent boosting method, to build the proposed model. The RF model is shown to be effective in predicting mortality using nitrogen level, urea and blood hemoglobin level, and other significant predictors of HF hospitalization. The authors use five-fold cross-validation to validate the model and assess calibration and model discrimination using estimated user receiving operating characteristics curve and Brier scores. This paper provides insight into how predictive modeling can aid in risk assessment for mortality and HF hospitalization in patients with HFpEF and highlights the importance of recording health

status data to determine the prognosis system with cardiac functional analysis.

3. Theories and models

According to the study by Berger et al. (2020), the application of machine learning technology in the healthcare system has brought a significant change in the improvement of healthcare management. The diagnosis process of heart failure in most cardiac centers is based on the ECG, which is a critical healthcare service process.

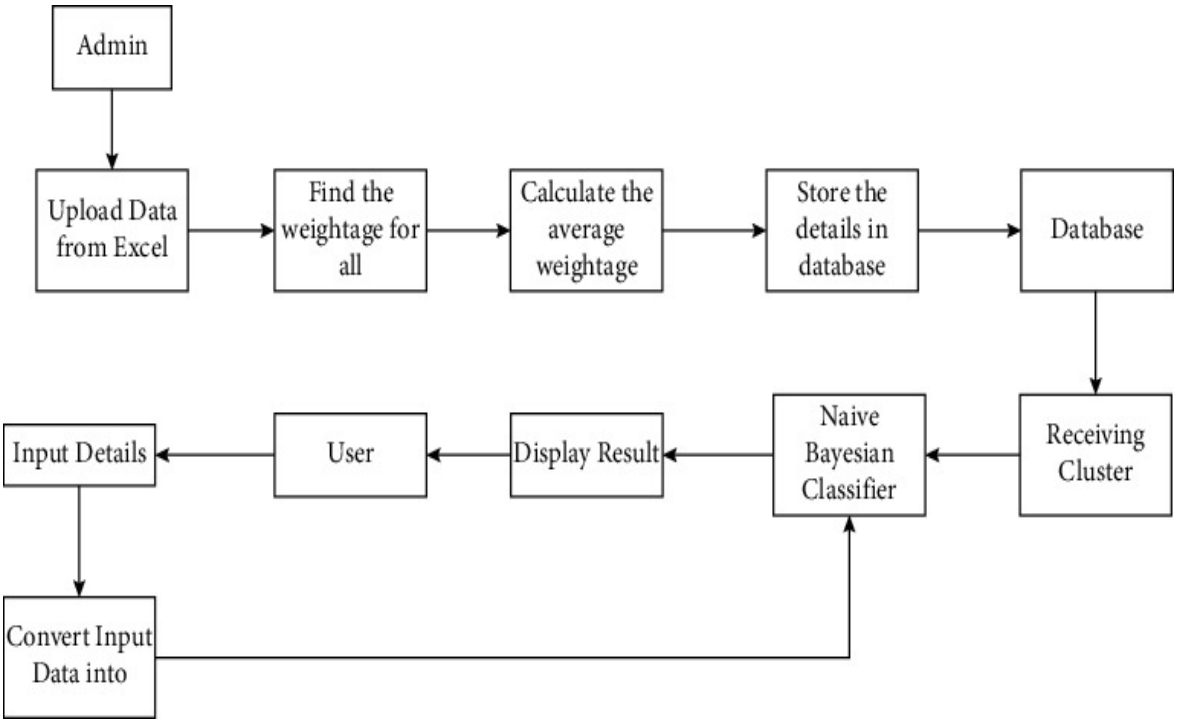

Figure 3: System architecture model of the heart disease detection model using machine learning technology. (Source: www.ncbi.nlm.nih.gov)

Sax et al., (2021) applied machine learning technology, such as the Naive Bayes prediction approach and features of the frequency domain, information theory related and time domain autonomous analysis process with the ischemic heart disease localization process. These two classifiers are based on the support vector machine performance classification process. Another method for automatic identification of heart failure is the improved SVM technique, which builds a clinical decision support system with an effective heart disease prediction model. This model includes the density-based spatial clustering application for the outlier detection and elimination, based on the hybrid synthetic monitoring system analysis over the synthetic minority sampling technique edited to the nearest neighbor for the distribution of the training data, and helps in the heart disease prediction technique (By analyzing the clinical data and risk factors, Ghosh et al. (2021) emphasized the techniques to provide the ultimate service to customers. The sentiment analysis process comes into play for the brand monetization of healthcare organizations. M.E. et al., (2021) utilize the K-nearest neighbor algorithmic method for the prediction of heart disease and to increase the efficiency in the prediction of cardiovascular diseases. The study suggests that machine learning technology can help in the earlier identification of multifaceted clinical diseases and improve the clinical disease identification process, which ultimately leads to better healthcare management.

Khan et al. (2020) proposed loading a minimum number of patient record data in the dataset and removing any missing qualities. The severity of heart disease was diagnosed by applying machine

learning techniques such as random forest, support vector, decision tree methods, and K-nearest neighbor algorithm. After applying the algorithms, the study used the splitting technique to divide the dataset into training and testing data, where binary digits were used to indicate the presence or absence of heart disease. The accuracy of the model depended on the value of 'k' and the measurement of the neighbors. The confusion matrix was used to calculate the true positive, false positive, true negative, and false negative values to measure accuracy, precision, and F-measure. This approach provided accurate proximity and prediction details about the heart disease detection process of the patients.

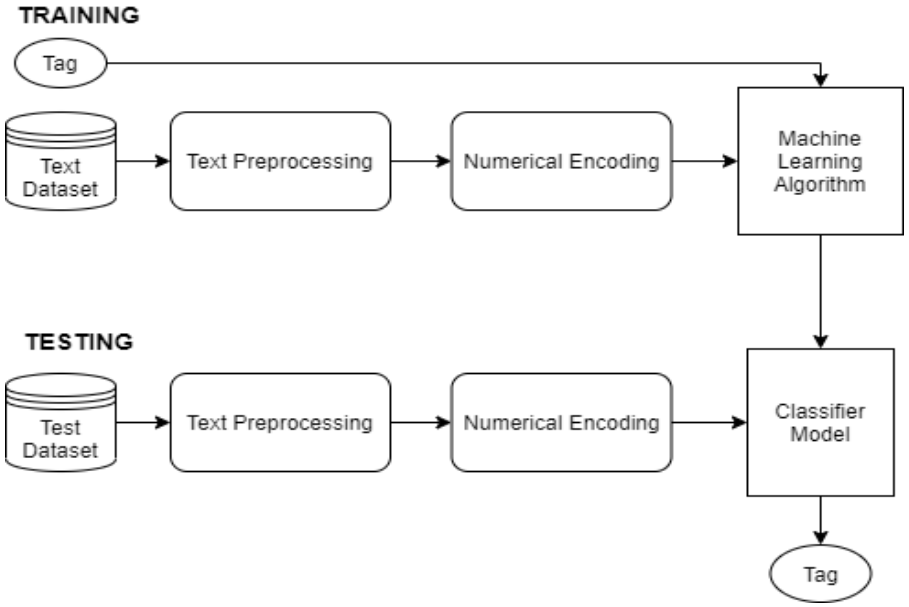

Figure 4: The customized sentimental analysis process.(Source: towardsdatascience.com)

R.S. et al. (2021) explained that it is an application of natural language processing techniques that predict opinions and sentiments by analyzing text. This method involves recognizing negative, positive, and neutral text by extracting meaning and assigning numerical scores to sentimental analysis components. There are various methods available for sentimental analysis, such as customized training of a supervised model, Bert method, Text Blob method, naming entity-based sentimental analysis method, and word dictionary recognition method. In this report, the application of sentimental analysis in the healthcare system is proposed for risk detection in patients. It involves analyzing patient/customer reviews and using social media conversations to make accurate business decisions in a faster and more precise way.

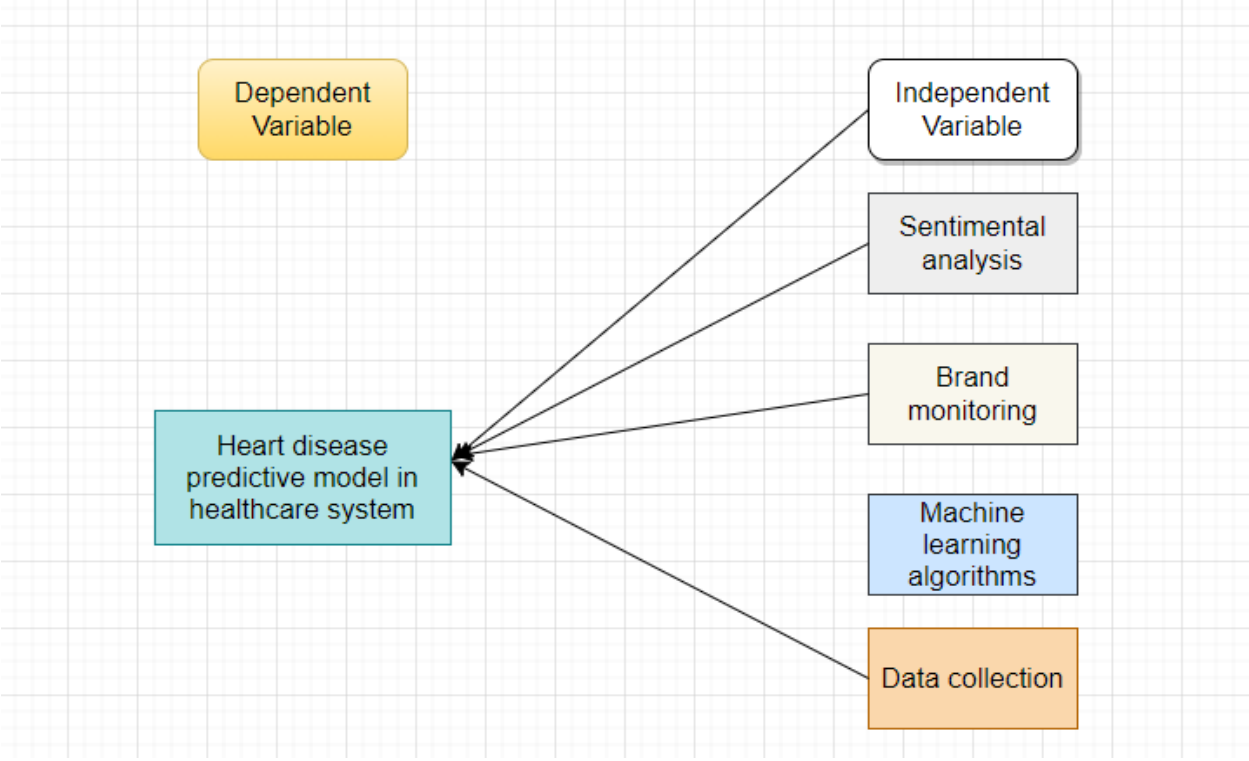

Figure 5: The conceptual framework of the heart disease predictive model in the healthcare system.

Sentiment analysis is a natural language processing technique used to predict opinions and sentiments in text. The process begins by collecting raw labeled datasets and then preprocessing the data before encoding it numerically. Appropriate machine learning algorithms are then applied, followed by hyper tuning and training for predictive analysis.

One popular method for sentiment analysis is the Text Blob method, which involves using various Python libraries to process textual data and APIs for speech tagging, noun extraction, classification, translation, and prediction. This method typically uses pattern analyzer and Naïve-Bayes analyzers.

The Word Dictionary method involves assigning positive scores between 1-0 and negative scores between -1-0 to positive and negative words, respectively. The scores are then classified by taking the division of the total scores.

The Bert method is a state-of-the-art machine learning technique used for NLP tasks. To use this method, the transformer library must be installed, and the Bert classifiers are loaded by creating a processed dataset for training and configuration of hyper parameters for prediction.

The Named-based Entity Sentiment Analyzer method involves finding named entities such as PERSON, GPE, and ORG in the text corpus to perform sentimental analysis on sentences one by one using a top named basis analysis process.

Conclusion

This study has focused on the qualitative analysis of the application of machine learning technology in healthcare, particularly in heart disease detection. The study has utilized various techniques like sentiment analysis and brand monitoring to build a clinical decision support system with an effective heart disease prediction model. However, there were several challenges faced during the process of data collection and analysis.

Key points:

- Machine learning technology plays a crucial role in improving healthcare management systems, particularly in identifying and analyzing complex clinical diseases like heart diseases.
- Sentiment analysis is an essential application of natural language processing in healthcare,

helping to analyze patients' opinions and sentiments for risk detection.

- The heart disease predictive model analysis is challenging due to data collection and accuracy issues. The study has applied various methods to overcome these challenges, such as the KNN algorithm, decision tree, and random forest algorithms.
- The splitting method has been applied to build the model accurately, and the SVM, decision tree, and random forest methods have been used to overcome accuracy problems.
- The ultimate goal is to achieve a reliable model that can directly investigate real-time data analysis and future implementations.

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