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Multi-Organ Failure Prediction using Machine Learning Approach

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ABSTRACT

Multi-organ failure is one of the most critical conditions in humans that can lead to a high death rate if not detected and treated properly in early ages. In this lifestyle, early diagnosis is very difficult for effective treatment. Machine learning algorithms can aid in the early detection of multi-organ failure by analyzing patient data and identifying patterns indicative of the disease. This project aims to develop a multi-disease predictor system that can identify the likelihood of a patient developing multi-organ failure based on their medical history and current symptoms. The proposed system makes use of a dataset consisting of medical records of patients with liver, kidney, heart, and diabetes diseases. The dataset includes various features such as age, gender, blood pressure, and glucose levels. The machine learning algorithms used in this system is to make analysis of Random Forest, and Decision tree. The proposed system makes use of data collection, data preprocessing, feature extraction, and classification. Data collection involves obtaining the patient's medical records, which are then preprocessed to remove any irrelevant or missing data. Feature extraction involves selecting the nearest features from the dataset and transforming them into a feature vector. The classification stage involves training the machine learning algorithms using the feature vector and predicting the likelihood of multi-organ failure. The system's performance is evaluated using various metrics such as accuracy, precision, recall, and F1-score. The results of the evaluation indicate that the proposed system can accurately predict multi- organ failure with high precision and recall.

Keywords: multi-organ failure, machine learning, early detection, medical history, symptoms, Random Forest, Decision tree, data preprocessing, feature extraction, classification, accuracy, precision, recall, F1-score, evaluation, medical records, dataset, feature vector, likelihood.

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I. INTRODUCTION

Multi-organ failure is a life-threatening condition where more than one organ fails to maintain normal physiological function. The timely diagnosis of such a condition can be crucial for the successful management of patients. The traditional diagnostic methods for multi-organ failure are time- consuming and require a high degree of expertise. Therefore, the development of an automated system that can accurately predict multi-organ failure can greatly enhance the ability of healthcare professionals to make timely and informed decisions. In this regard, machine learning techniques have shown promising results in the field of medical diagnosis. Th e system aims to improve patient care by providing accurate predictions of diseases based on their medical history and symptoms. This can lead to timely and appropriate medical interventions and treatments, thus improving patient outcomes. Moreover, the system can also help reduce the workload of healthcare professionals by automating the disease prediction process, allowing them to focus on other critical aspects of patient care. The goal of this project is to develop a multi-disease predictor using machine learning. Specifically, we aim to train a model that can predict the likelihood of three diseases: heart attack, diabetes, and hypertension. The dataset used in the project is from a Kaggle competition and contains information on patient demographics, medical history, and laboratory results.

A. The Objectives of our Project is as follows:

- To train a feedforward neural network model using the TensorFlow machine learning library that can accurately predict the likelihood of heart attack, diabetes, and hypertension based on patient data.
- To evaluate the performance of our multi-disease predictor by splitting the dataset into training, validation, and testing sets and testing the model's accuracy on the testing set.
- To develop a cross-validation version of the project to further evaluate the performance of our multi-disease predictor.
- To identify the strengths and weaknesses of our multi- disease predictor and provide recommendations for future research to improve the accuracy of the model for predicting the likelihood of all three diseases.
- To demonstrate the potential of machine learning for predicting multiple diseases based on patient data and highlight the importance of using these tools to improve patient outcomes.

Overall, the objective of this project is to develop a tool that can help healthcare professionals make more accurate diagnoses and develop more effective treatment plans based on patient data. By achieving these objectives, we hope to contribute to the growing body of research on machine learning in healthcare and advance our understanding of how these tools can be used to improve patient outcomes.

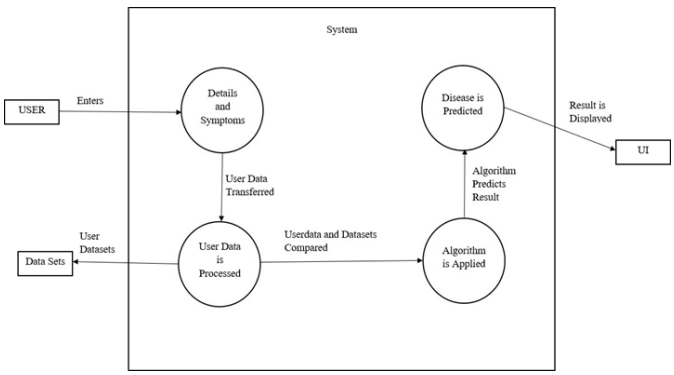

Fig. 1. Data Flow Diagram

II. RELATED WORKS

B.C. Srimedha et al. [1] worked on A Comprehensive Machine Learning Based Pipeline for an Accurate Early Prediction of Sepsis in ICU. The system can classify the model accurately and predict sepsis up to 6 hours before the disease is being diagnosed Chih-chou chiu et al. [2] worked on Applying an Improved Stacking Ensemble Model to Predict the Mortality of ICU Patients with Heart Failure. The proposed project had an accurate and clinically driven framework for detecting death rate in the ICU based on a key characteristic of patients with HF in the ICU. M Yogasundari et al. [3] worked on Future Prediction Using Supervised Machine Learning for COVID-19. This work recognizes extremely critical areas using current network functionalities handover and cell (re)selection used to maintain seamless coverage for mobile end-user equipment (UE). Xinlu Zhang et al. [4] worked on Multiple Organ Failure Prediction with Classifier-Guided Generative Adversarial Imputation Net- works. The Author Proposed an Applying machine learning models to electronic health records (EHRs) is the pervasive- ness of missing values. Yuqing Wang et al. [5] worked on Empirical Analysis of Machine Learning Configurations for Prediction of Multiple Organ Failure in Trauma Patients. The Proposed System was to formulate MOF prediction as a binary classification task. Fumin Xu et al. [6] presented a Prediction of Multiple Organ Failure Complicated by Moderately Severe or Severe Acute Pancreatitis Based on Machine Learning: A Multicentre Cohort Study. In this project, every data model was trained and tested according to cohort of AP patients. Sanjukta N. Bose et al. [7] proposed an Early Prediction of Multiple Organ Dysfunction in the Pediatric Intensive Care Unit. The Proposed System is Risk Group-Based Prediction: Risk- group stratification among positive predicted labels was pivotal in assigning confidence to the model predictions. Robinson Spencer et al. [8] proposes an Exploring feature selection and classification methods for predicting heart disease. The Proposed System is to create a more accurate model for heart- disease prediction by applying feature selection. Mohammad Asim et al. [9] The proposed project is about Multiple organ dysfunction syndrome: This project gives insights on the entire medical spectrum. This model uses certain Machine learning algorithms to get an overview on medical system. Vanya V. Valindria et al. [10] the author presented about the Reverse Classification of the model Accuracy of Predicting Segments and its Performance in the Absence of Truth. This is an attempt to get an objective metrics, such as precision, F1 score and recall with missing GT is proposed by but it is not able to be used for data sets with partial Truth. Noha Ossama El-Ganainy et al. [11] worked on A New Real Time Clinical Decision Support System Using Machine Learning for Critical Care Units The Proposed system works on the theoretical model that mimics different structural and algorithmic principles in the brain's neocortex. Alvaro Silva et al. [12] proposed a Multiple Organ Failure Diagnosis Using Adverse Events and Neural Networks. The Proposed system is mainly focused to fill in the missing value seen in the medical records. Qiu et al. [13] worked on Developing and validating the three machine-learning models for detecting multi organ failure in extremely severe and severe acute liver failure. Meicheng Yang1 et al. [14] has proposed this model for an Early Prediction of disease Using Multi-Feature Fusion Based XGBoost Learning and Bayesian Optimization. This study has boosted to develop a system for accurately detecting the onset of disease in the preceding of six hours. Xianchuan Wang et al. [15] worked on A New Effective Machine Learning Framework for Sepsis Diagnosis. This study proposed the CFOA learning strategy, in which two new mechanisms were introduced into the original FOA: the chaotic population initialization and chaotic local search strategy.

III. PROBLEM STATEMENT

The problem addressed in the Multi Disease Predictor project is the accurate and timely prediction of the presence of various diseases such as diabetes, heart failure, kidney failure and liver failure. This project helps to develop a machine learning model that can predict patient data and predict the likelihood of each disease, helping healthcare, professionals to diagnose more effectively. Our project mainly uses machine learning algorithms such as Random Forest, and Decision Tree for accurate predictions.

IV. EXISTING SYSTEM

Low accuracy in the detection of multiple organ failure. No emergency alerts. No continuous monitoring of real-time data. Implementation failures are more. Practice of traditional approach which leads to rework for computation.

V. PROPOSED SYSTEM

The proposed system is a multi-disease predictor that utilizes machine learning algorithms to predict the likelihood of a patient having multiple diseases. The system is designed to take in various medical test results as input and analyze them using feature extraction techniques. The extracted features are then fed into machine learning models such as Random Forest and Decision tree to predict the likelihood of a patient having one or more diseases. The system also provides insights into the correlation between different diseases and organ systems, which can aid in early detection and treatment. The proposed system has the potential to assist medical professionals in making accurate and timely diagnoses, leading to better patient outcomes.

VI. METHODOLOGY

The methodology of the above project includes several stages. First, the dataset is collected and pre-processed to remove missing or erroneous values. Then, feature selection techniques are applied to select the most relevant features for the prediction of multi-organ failure. The selected features are then used to train machine learning algorithms such as Random Forest, and Decision Tree to build the prediction model. The performance of the models is evaluated using various metrics such as accuracy, precision, recall, and F1-score. The model with the best performance is selected and used for prediction. During the prediction phase, the model takes input data and predicts the probability of multi-organ failure. Finally, the prediction results are visualized using graphs and heatmaps. Overall, the methodology aims to provide an accurate and efficient prediction model for the early detection of multi-organ failure, which can help in providing timely and effective medical intervention.

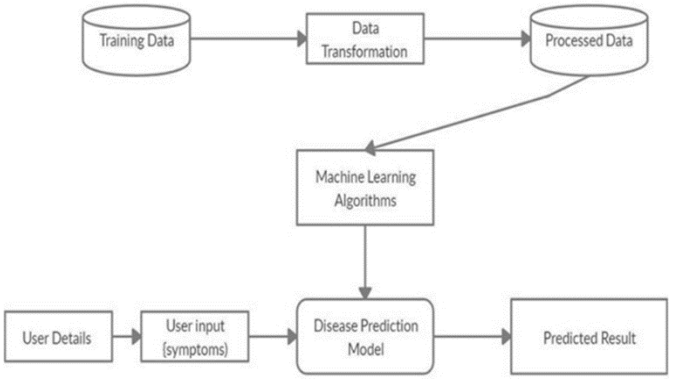

Fig. 2. System Architecture

A. DATASET

1. **Diabetes Dataset:** This dataset contains medical records for Pima Indian patients, including various health measurements such as glucose level, blood pressure, and body mass index (BMI), as well as a binary indicator for diabetes diagnosis. The dataset was collected by the National

Institute of Diabetes and Digestive and Kidney Diseases and is available on Kaggle.

2. **Heart Disease Dataset:** This dataset contains medical records for patients with suspected heart disease, including various health measurements such as age, blood pressure, and cholesterol levels, as well as a binary indicator for heart disease diagnosis. The dataset was collected by the Cleveland Clinic Foundation and is available on Kaggle.

3. **Kidney Disease Dataset:** This dataset contains medical records for patients with chronic kidney disease, including various health measurements such as serum creatinine and blood glucose levels, as well as a binary indicator for kidney disease diagnosis. The dataset was collected from hospitals in India and is available on Kaggle.

4. **Liver Disease Dataset:** This dataset contains medical records for patients with liver disease, including various health measurements such as bilirubin levels and albumin levels, as well as a binary indicator for liver disease diagnosis. The dataset was collected from patients in India and is available on Kaggle.

It's important to note that these datasets contain sensitive information about patients and their medical conditions. Therefore, it's important to use caution when working with such datasets and ensure that any analysis or modeling work performed on them is done with the utmost care for data privacy and ethics.

VII. RESULTS

The results of the Multi Disease Predictor project show that the developed machine learning models can accurately predict the presence of various diseases such as diabetes, heart disease, kidney disease, and liver disease in patients. The Random Forest algorithm showed the highest accuracy in predicting the presence of these diseases, with an accuracy of 90.49% for liver disease, 89.76% for kidney disease, 86.36% for diabetes, and 78.96% for heart disease. The results suggest that the developed models can be useful in assisting healthcare professionals in the early diagnosis and treatment of these diseases, potentially improving patient outcomes.

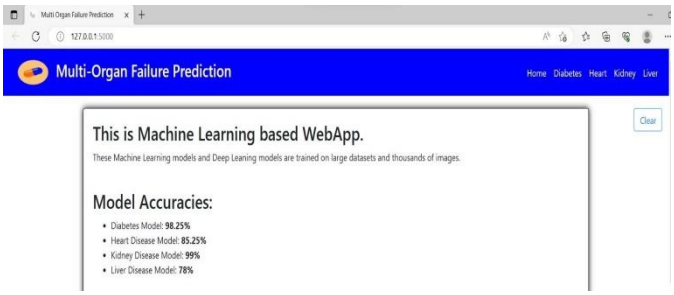

Fig. 3. Home Page

VIII. CONCLUSION

In conclusion, the Multi-Disease Predictor is a comprehensive system that uses machine learning algorithms to predict the occurrence of various diseases based on patient data. The system takes in patient data and processes it through various data pre-processing and feature extraction techniques. The data is then classified using different machine learning algorithms, like Random Forest to predict the occurrence of specific dis- eases. The project aimed to reduce the time taken for disease diagnosis and increase accuracy in the diagnosis of multiple diseases simultaneously. The results obtained from the system are promising, and the accuracy achieved is good, showing that the system has potential in predicting the occurrence of diseases.

IX. REFERENCES

[1]. B. C. Srimedha, R. Naveen Raj and V. Mayya, ”A Comprehensive Machine Learning Based

Pipeline for an Accurate Early Prediction of Sepsis in ICU," in IEEE Access, vol. 10, pp. 105120-105132, 2022, doi: 10.1109/ACCESS.2022.3210575.

[2]. Chiu CC, Wu CM, Chien TN, Kao LJ, Li C, Jiang HL. Applying an Improved Stacking Ensemble Model to Predict the Mortality of ICU Patients with Heart Failure. J Clin Med. 2022 Oct 31;11(21):6460. doi: 10.3390/jcm11216460. PMID: 36362686; PMCID: PMC9659015.

[3]. M.Yogasundari , Dr. N.Mohanapriya , K.Sivapriya. Future Prediction Using Supervised Machine Learning for COVID-19. Volume: 09 Issue: 07 — July 2022. © 2022, IRJET — Impact Factor value: 7.529 — ISO 9001:2008 Certified Journal.

[4]. Xinlu Zhang, Yun Zhao, Rachael Callcut, Linda Petzold Multiple Organ Failure Prediction with Classifier-Guided Generative Adversarial Imputation Networks. [Submitted on 22 Jun 2021].

[5]. Wang, Yuqing, Yun Zhao, Rachael Callcut, and Linda Petzold. "Empiri- cal analysis of machine learning configurations for prediction of multiple organ failure in trauma patients." arXiv preprint arXiv:2103.10929 (2021).

[6]. Xu F, Chen X, Li C, Liu J, Qiu Q, He M, Xiao J, Liu Z, Ji B, Chen D, Liu K. Prediction of Multiple Organ Failure Complicated by Moderately Severe or Severe Acute Pancreatitis Based on Machine Learning: A Mul- ticenter Cohort Study. Mediators Inflamm. 2021 May 3;2021:5525118. doi: 10.1155/2021/5525118. PMID: 34054342; PMCID: PMC8112913.

[7]. Bose SN, Greenstein JL, Fackler JC, Sarma SV, Winslow RL, Bembea MM. Early Prediction of Multiple Organ Dysfunction in the Pedi- atric Intensive Care Unit. Front Pediatr. 2021 Aug 16;9:711104. doi: 10.3389/fped.2021.711104. PMID: 34485201; PMCID: PMC8415553.

[8]. Spencer R, Thabtah F, Abdelhamid N, Thompson M. Exploring feature selection and classification methods for predicting heart disease. DIGI- TAL HEALTH. 2020;6. doi:10.1177/2055207620914777.

[9]. Asim M, Amin F, El-Menyar A. Multiple organ dysfunction syndrome: Contemporary insights on the clinicopathological spectrum. Qatar Med J. 2020 Sep 22;2020(1):22. doi: 10.5339/qmj.2020.22. PMID: 33628712; PMCID: PMC7884906.

[10]. Vanya V. Valindria, Ioannis Lavdas, Wenjia Bai, Konstantinos Kamnit- sas, Eric O. Aboagye, Andrea G. Rockall, Daniel Rueckert, Ben Glocker. Reverse Classification Accuracy: Predicting Segmentation Performance in the Absence of Ground Truth. [Submitted on 11 Feb 2017].

[11]. N. O. El-Ganainy, I. Balasingham, P. S. Halvorsen and L. A. Rosseland, "A New Real Time Clinical Decision Support System Using Machine Learning for Critical Care Units," in IEEE Access, vol. 8, pp. 185676- 185687, 2020, doi: 10.1109/ACCESS.2020.3030031.

[12]. Silva, A´., Cortez, P., Santos, M., Gomes, L., Neves, J. (2006). Multiple Organ Failure Diagnosis Using Adverse Events and Neural Networks. In: Seruca, I., Cordeiro, J., Hammoudi, S., Filipe, J. (eds) Enterprise Information Systems VI. Springer, Dordrecht.

[13]. Qiu, Q., Nian, Yj., Guo, Y. et al. Development and validation of three machine-learning models for predicting multiple organ failure in moderately severe and severe acute pancreatitis. BMC Gastroenterol 19, 118 (2019).

[14]. Yang, Meicheng et al. "Early Prediction of Sepsis Using Multi-Feature Fusion Based XGBoost Learning and Bayesian Optimization." 2019 Computing in Cardiology Conference (CinC) (2019): n. pag.

[15]. X. Wang, Z. Wang, J. Weng, C. Wen, H. Chen and X. Wang, "A New Effective Machine Learning Framework for Sepsis Diagnosis," in

IEEE Access, vol. 6, pp. 48300-48310, 2018, doi: 10.1109/AC- CESS.2018.2867728.

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