International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 12 **Issue:** IV **Month of publication:** April 2024

DOI: https://doi.org/10.22214/ijraset.2024.61185

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 12 Issue IV Apr 2024- Available at www.ijraset.com

Enhancing Coronary Heart Disease Risk Prediction with Machine Learning and Deep Learning

Mrs. P S H R Padmaja[1] , Velpula Sudarshan[2], K Sudheer Babu[3], M M Krishna Lakshman[4], K Akhilandeswari[5,]
[1]Assistant Professor , [2, 3, 4, 5] B.tech Students Department of Information Technology, Pragati Engineering College, Surampalem , Andhra Pradesh, India

Abstract: Coronary artery disease is the world's most common cardiac problem today. Humans face a major situation that must be properly diagnosed. Plaque formation in the coronary arteries, which is largely composed of calcium, fibrin, and cholesterol, produces a partial blockage of blood flow over time, eventually leading to coronary artery disease. Coronary arteries help the heart circulate oxygen-rich blood throughout the body. On the other hand, early detection and precise diagnosis will decrease the likelihood of developing it. This study looks into the possible use of deep learning algorithms to predict cardiac disease in its early stages. The primary goal of this study is to precisely determine whether or not an individual has cardiac abnormalities. Early-stage prediction can be implemented with a range of machine learning algorithms and deep learning techniques. It can be applied to data mining, decision trees, Naive Bayes, and artificial neural networks (ANNs). The ANN Model will be employed in the research.
Keywords: Deep learning, Coronary Heart Disease Prediction, Artificial Neural Networks, Machine Learning

I. INTRODUCTION

Blood arteries enable the human heart, one of the body's most important organs, to circulate blood throughout the body. It contains four compartments. Its primary focus is on the coronary arteries, which branch off the aorta (the body's main artery) and enter the left ventricle of the heart. The coronary arteries are classified into two types: left and right. Plaque formation in blood vessels causes atherosclerosis, the major cause of heart attacks worldwide. Arteries constrict due to a lack of blood supply, impeding blood flow. The most frequent type of illness is heart disease. Heart disease is one of the leading causes of death worldwide, claiming 17.9 million lives each year. A poll suggests that the number of cardiac cases could double. Smoking, hypertension, and lifestyle changes may all contribute to this. Depression and other mental health issues, such as anxiety, might increase your chance of developing heart disease [1]. The main signs and symptoms of coronary artery disease are chest discomfort caused by diminished blood flow. excruciating shoulder discomfort Constriction in respiration. Those with the condition endure a variety of symptoms, including shoulder soreness and chest pain caused by diminished blood flow.

II. LITERATURE SURVEY

The fascinating connection between cardiac disease and mental disorders. Talks on clinical neuroscience." Mental health disorders and coronary heart disease (CHD) are two of the world's leading causes of morbidity and mortality. Numerous, frequently unanticipated connections have been found throughout several decades of research between congenital heart condition (CHD) and psychological disorders. Studies have even proposed a causal relationship between the two disorders. The precise nature of these connections has not yet been identified, though. Therefore, the goal of this research is to present a thorough analysis and dialogue of the most recent pathophysiology and epidemiological facets of the reciprocal relationships between CHD and mental disease. may raise the risk of CHD (coronary artery disease) on its own. Nonetheless, research suggests that these psychological conditions and symptoms are prevalent among individuals with congestive heart failure and could significantly raise the risk of cardiovascular morbidity and death. Lastly, a genetic, behavioral, physiological, and behavioral connection between mental illnesses and chronic heart failure seems to exist.

"Risk of heart disease and economic insecurity." Compared to the general population, patients with heart disease (CVD) experienced food insecurity (FI) far more frequently. FI is defined as having inadequate access to nutrient-dense food. Recent studies suggest that FI may raise the risk of death and cardiovascular disease via a number of behavioral and biological mechanisms. Importantly, FI is more common in low-income households and disproportionately impacts families with children, especially those led by single moms.

Solutions designed specifically for these high-risk subgroups—who have a higher risk of CVD related with FI—are needed to address these inequities. In addition, the expense of treating CVD may make a person more vulnerable to unstable finances. Despite the fact that involvement in federal assistance programs, such as the Nutrition Assistance Program and the specialized nutritional program for Women, Infants, and Children, has been associated with advantages to cardiovascular health, Persistent FI and poorer dietary quality in a large number of households underscore the need for more public assistance programs and better outreach. When it comes to providing people with food and instructional materials as well as FI screening, medical facilities and community groups can be crucial players. The burden of FI and its effects on cardiovascular health can be addressed by policy, healthcare, and community initiatives, even if further study is required to identify the sociodemographic differences in the relationship between FI and CVD.

"All plant foods are not created equal: plant-based diets for the prevention of cardiovascular disease Diets cantered around plants have been suggested as a way to lower the risk of cardiovascular disease. This study explores the many definitions of plant-based diets, highlights the differences between healthy and harmful plant-based diets, and looks into how plant-based diets affect the risk of CVD. The majority of research indicates that plant-based diets are usually good for cardiovascular health, despite notable variations in terminology. Numerous earlier studies categorized plant-based diets as those that completely exclude meat or animal products, even though some studies have taken into account plant-based diets that contain traces of animal nutrients. There isn't many research to evaluate the health benefits of the particular plant foods that make up these dietary patterns. These studies suggest that plant-based diets with an increased intake of heart-healthy foods like fruits and whole grains, Coffee, tea, nuts, legumes, oils, and vegetables all lower the risk of CVD. Conversely, data suggests that plant-based diets are associated with a higher risk. A well-planned plant-based diet rich in high-quality foods can be beneficial to the cardiovascular system and sufficiently nutrient-dense. Contrary to popular belief, plant-based diets do not have to be vegan or vegetarian. Most people cannot and should not completely avoid meat and animal products in order to maintain cardiovascular health. It's crucial to take into account the quality of each component of a plant-based diet as not all meals made from plants are good for the heart. Nutrient-dense plant-based diets can reduce risks to human and environmental health when widely adopted. They may also be modified to reflect cultural and individual tastes.

III. SYSTEM ANALYSIS

A. *Existing System*

The current approach seeks to lower the risk to world health posed by heart disease, which is very common. The method places a strong emphasis on the necessity of an accurate and timely diagnosis so as to provide the optimal course of treatment for a disease. For early prediction, conventional machine learning techniques like mining data, decision trees, and naive Bayes predictions are employed. The potential of machine learning algorithms, in particular artificial neural networks or ANNs, as a helpful tool for the early diagnosis of heart sickness is also examined in this study. The main goal of these procedures is to use them to diagnose cardiac problems in individuals. The approach identifies the role that plaque formation—a combination of cholesterol, fibrin, and calcium plays in partially blocking coronary arteries. The current approach employs deep learning and machine learning to swiftly and correctly identify persons at risk of coronary artery disease, with the goal of reducing that risk. To obtain the needed prediction outputs, the study approach relies on an ANN model as its fundamental component.

DISADVANTAGES OF THE EXISTING SYSTEM

1) Limited Data Diversity: The representativeness and diversity of the training dataset may pose problems for the current system. If the dataset contains only a few demographic and clinical variables, the model's generalizability may suffer.
2) Dependence on Historical Data: The system's reliance on historical data may limit its ability to adjust for patient demographic shifts, rapidly changing medical practices, and technological improvements. This may affect how successfully the system adapts to the current situation of healthcare.
3) Interpretability Issues: One typical critique leveled at deep learning models, such as artificial neural networks, is their lack of interpretability. The model's decision-making process may be difficult to understand, making healthcare professionals less likely to trust and adopt the system.
4) Computational Resource Requirements: Neural networks, in particular, which are employed in deep learning techniques, may demand a significant amount of computing power. The existing system's computing resource limits may have an impact on the prediction model's scalability and real-time applicability in a clinical setting.

5) Ethical and Privacy Concerns: The use of machine learning, especially in healthcare, raises ethical and privacy concerns. The existing technique may not adequately address issues such as patient data privacy, consent, and the proper management of sensitive medical information, preventing widespread implementation and adoption.

B. *Proposed System*

The proposed approach intends to address the limitations of the current technique by enhancing the dataset's diversity and depth, which includes a broader range of demographic and clinical data. We propose combining advanced machine learning approaches to improve the interpretability of the model's predictions. The system will adapt to current medical procedures by combining historical data with regular updates, ensuring its relevance and effectiveness. To address computational constraints, we seek to improve the model's resource usage, resulting in better scalability and real-time clinical application. Furthermore, the proposed strategy prioritizes ethical considerations by establishing strong protections to preserve patient privacy, obtain consent, and ensure that sensitive medical information is handled appropriately. The proposed method intends to provide a more accurate, adaptive, and ethical framework for early detection of coronary artery disease, resulting in improved patient outcomes and healthcare decision-making.

IV. SYSTEM DESIGN

SYSTEM ARCHITECTURE

Below diagram depicts the whole system architecture.

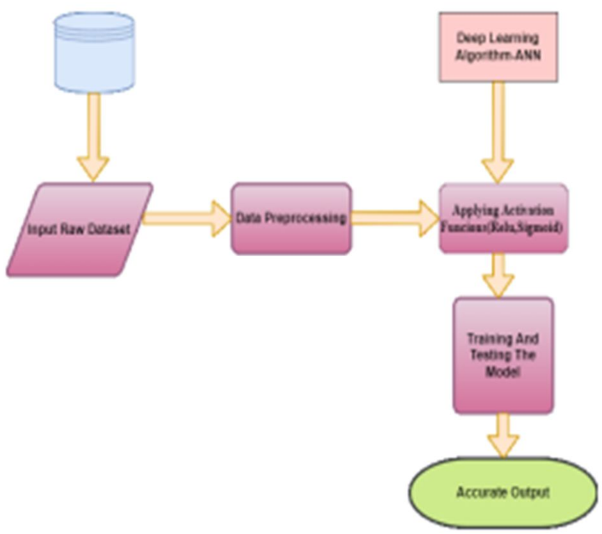


Fig 1. Methodology followed for proposed model

V. SYSTEM IMPLEMENTATION

MODULES

1) *The Data Preprocessing module:* cleans, transforms, and normalizes the incoming dataset. It addresses issues such as outliers and missing data, as well as ensuring that the data is in the proper format for training the machine learning model.
2) *The feature extraction and selection module:* extracts relevant components from the dataset that are most critical for accurate coronary artery disease prediction. Feature extraction strategies can increase the model's performance, while feature selection procedures can reduce its dimensionality.
3) *Machine Learning and Deep Learning Model Training Module:* The proposed system uses sophisticated machine learning algorithms and deep learning methodologies to train the prediction model in this module, with a focus on the Artificial Neural Network (ANN) model. To make exact predictions, the training phase involves identifying patterns and relationships in the data.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 12 Issue IV Apr 2024- Available at www.ijraset.com

4) *Interpretability Module:* This module addresses the interpretability issue by focusing on developing instruments or strategies to help clarify the model's decision-making process. To improve the predictability of the outcomes, tactics such as interpretability-agnostic approaches or feature importance analysis may be employed.
5) *Ethical and Privacy Compliance Module:* This critical module ensures that the system conforms with privacy regulations and ethical standards. It comprises components such as obtaining patient consent, securely keeping data, and implementing protections to protect confidential medical information. This module aims to establish trust and adhere to ethical norms in the healthcare profession.

VI. RESULTS AND DISCUSSION

The system prioritizes ethical issues, implementing strong measures to preserve patient privacy, obtain consent, and ensure proper administration of confidential medical data. With these enhancements, the proposed method aims to provide a more precise, adaptable, and ethically sound framework for early coronary artery disease prediction.

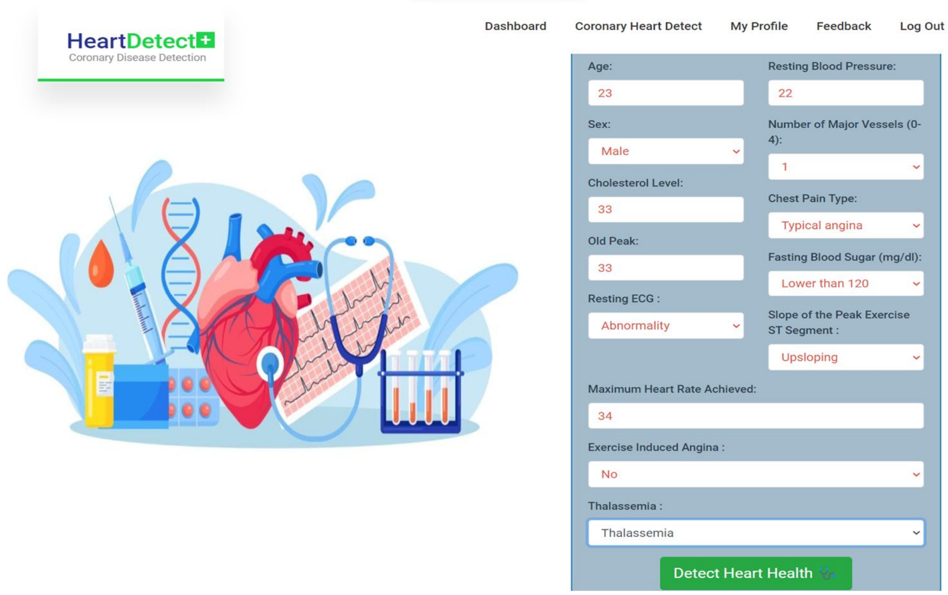


Fig 2. Providing Diagnosis Results for Predicting Heart Disease

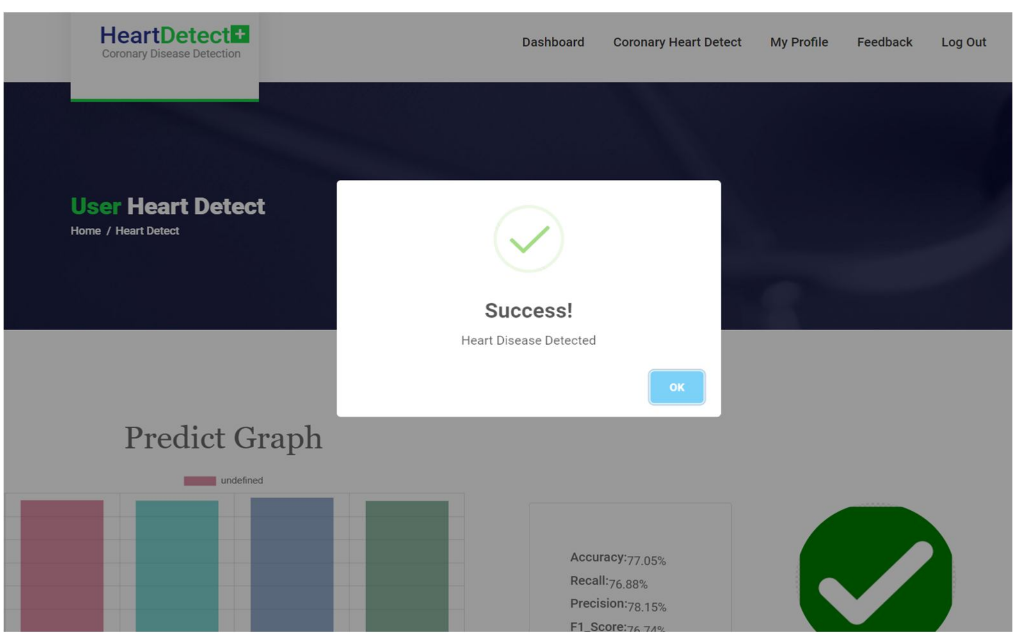


Fig 3. Analysed and Identified the Heart Problem

VII. CONCLUSION AD FUTURE WORK

According to the research findings, ANN outperformed other machine learning models with a maximum accuracy of 84.44%. Decision Tree (73.33%), Random Forest (81.67%), Support Vector Machine (83.33%), and KNN (61.67%).The order is as follows. Random Forest > Decision Tree > ANN > SVM > KNN. Artificial Neural Networks (ANNs) may detect coronary heart disease with varied degrees of accuracy on the Cleveland dataset, depending on the network's specific design, data quality and pre-processing, and assessment criteria used. However, ANNs may generally be utilized to achieve high accuracy on the Cleveland dataset. Recent research have shown that well-designed ANNs can achieve accuracy rates of more than 80% when used to this dataset.

Advanced methods such as ensemble multiple ANN models, fine-tuning hyperparameters, and transfer learning can be utilized to improve accuracy even more. It is critical to remember that, while high accuracy is important, other assessment metrics such as sensitivity, specificity, and precision should also be taken into account when evaluating a model's ability to detect coronary heart disease.

REFERENCES

[1] De Hert, M., Detraux, J. & Vacampfort, D. (2022). The intriguing relationship between coronary heart disease and mental disorders. Dialogues in clinical neuroscience.

[2] Richardson, T. G., Sanderson, E., Palmer, T. M., Ala-Korpela, M., Ference, B. A., Davey Smith, G., & Holmes, M. V. (2020). Evaluating the relationship between circulating lipoprotein lipids and apolipoproteins with risk of coronary heart disease: A multivariable Mendelian randomisation analysis. PLoS medicine, 17(3), e1003062.

[3] Liu, Y., & Eicher-Miller, H. A. (2021). Food insecurity and cardiovascular disease risk. Current Atherosclerosis Reports, 23(6), 1- 12.

[4] Hemler, E. C., & Hu, F. B. (2019). Plant-based diets for cardiovascular disease prevention: all plant foods are not created equal. Current atherosclerosis reports, 21(5), 1-8.

[5] Lao, X. Q., Liu, X., Deng, H. B., Chan, T. C., Ho, K. F., Wang, F., ... & Yeoh, E. K. (2018). Sleep quality, sleep duration, and the risk of coronary heart disease: a prospective cohort study with 60,586 adults. Journal of Clinical Sleep Medicine, 14(1), 109-117.

[6] Chen, X. Fu, Y., Lin, J., Ji, Y., Fang, Y., &Wu, J. (2020). Coronary artery disease detection by machine learning with coronary bifurcation features. Applied Sciences, 10(21), 7656.

[7] Alizadehsani, R., Abdar, M., Roshanzamir, M., Khosravi, A., Kebria, P. M., Khozeimeh, F., ... & Acharya,U. R. (2019). Machine learningbased coronary artery disease diagnosis: A comprehensive review. Computers in biology and medicine, 111, 103346.

[8] Kavitha, M., Gnaneswar, G., Dinesh, R., Sai, Y. R., & Suraj, R. S. (2021, January). Heart disease prediction using hybrid machine learning model. In 2021 6th International Conference on Inventive Computation Technologies (ICICT) (pp. 1329-1333). IEEE.

[9] Dutta, A., Batabyal, T., Basu, M., & Action, S. T. (2020). An efficient convolutional neural network for coronary heart disease prediction. Expert Systems with Applications, 159, 113408.

[10] Shah, D., Patel, S., & Bharti, S. K. (2020). Heart disease prediction using machine learning techniques. SN Computer Science, 1(6), 1-6.

[11] Chen, J. I. Z., & Hengjinda, P. (2021). Early prediction of coronary artery disease (CAD) by machine learning method-a comparative study. Journal of Artificial Intelligence, 3(01), 17-33.

[12] Muhammad, L. J., Al-Shourbaji, I., Haruna, A. A., Mohammed, I. A., Ahmad, A., & Jibrin, M. B. (2021). Machine learning predictive models for coronary artery disease. SN Computer Science, 2(5), 1-11.

[13] Genders, T. S., Steyerberg, E. W., Hunink, M. M., Nieman, K., Galema, T. W., Mollet, N. R., & Laule,M. (2012). Prediction model to estimate presence of coronary artery disease: retrospective pooled analysis of existing cohorts. Bmj, 344.

[14] Nassif, A. B., Mahdi, O., Nasir, Q., Talib, M. A., & Azzeh, M. (2018, November). Machine learning classifications of coronary artery disease. In 2018 International Joint Symposium on Artificial Intelligence and Natural Language Processing (iSAI-NLP) (pp. 1-6). IEEE.

[15] Ayatollahi, H., Gholamhosseini, L., & Salehi, M. (2019). Predicting coronary artery disease: a comparison between two data mining algorithms. BMC public health, 19(1), 1-9.

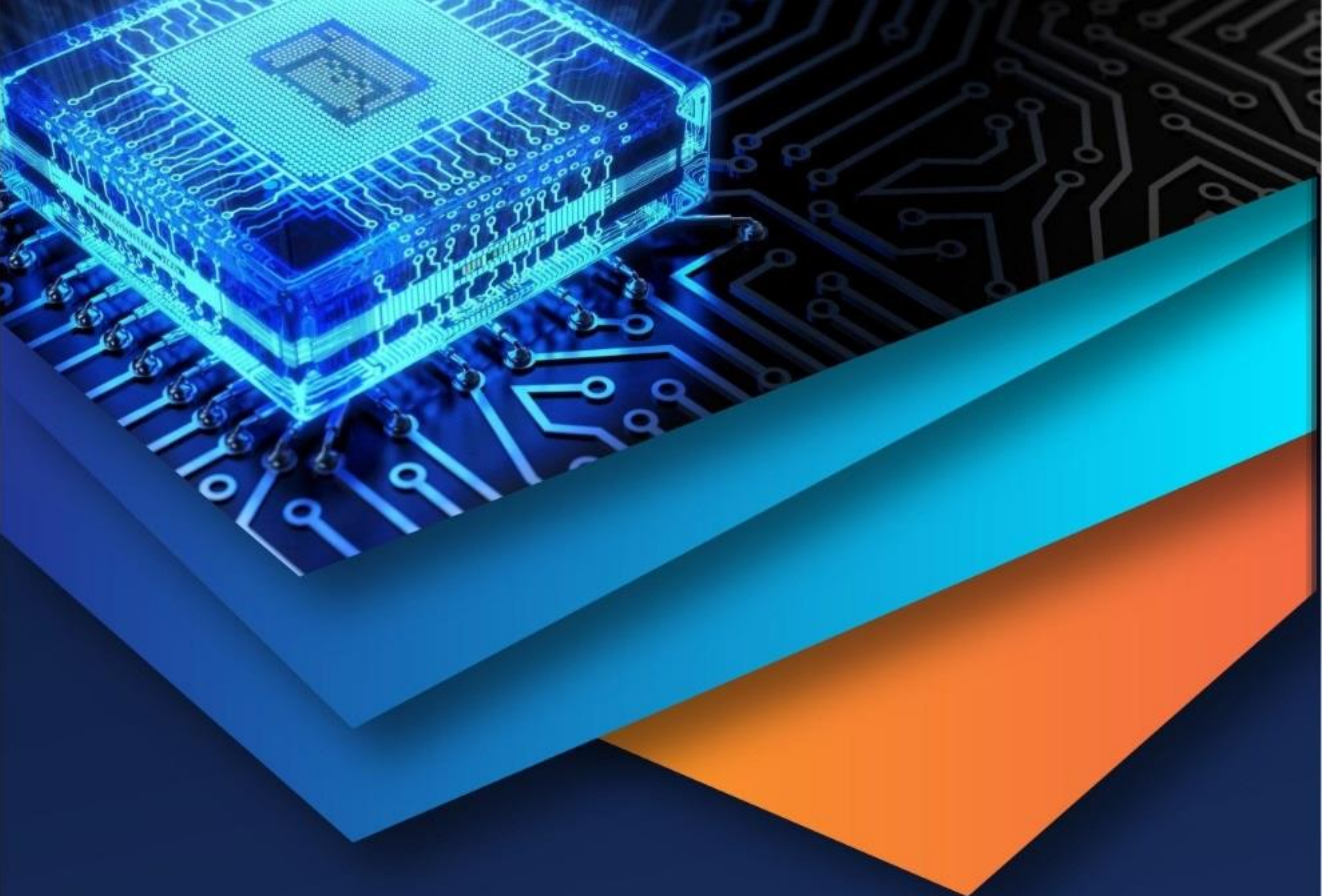
[16] Abdar, M., Książek, W., Acharya, U. R., Tan, R. S., Makarenkov, V., & Pławiak, P. (2019). A new machine learning technique for an accurate diagnosis of coronary artery disease. Computer methods and programs in biomedicine, 179, 104992.

[17] Kim, J. K., & Kang, S. (2017). Neural network-based coronary heart disease risk prediction using feature correlation analysis. Journal of healthcare engineering, 2017..

[18] Miao, K. H., Miao, J. H., & Miao, G. J. (2016). Diagnosing coronary heart disease using ensemble machine learning. International Journal of Advanced Computer Science and Applications, 7(10).

[19] Li, D., Xiong, G., Zeng, H., Zhou, Q., Jiang, J., & Guo, X. (2021). Machine learning-aided risk stratification system for the prediction of coronary artery disease. International Journal of Cardiology, 326, 30- 34.

[20] Krishnani, D., Kumari, A., Dewangan, A., Singh, A., & Naik, N. S. (2019, October). Prediction of coronary heart disease using supervised machine learning algorithms. In TENCON 2019-2019 IEEE Region 10 Conference (TENCON) (pp. 367-372). IEEE.



10.22214/IJRASET

INDEX COPERNICUS
45.98

ISRA JIF
IMPACT FACTOR: 7.129

TOGETHER WE REACH THE GOAL
IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Call : 08813907089 (24*7 Support on Whatsapp)