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AUTOMATED DETECTION OF CARDIOVASCULAR DISEASES USING ECG IMAGES

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ABSTRACT
Global heart disorders, often known as cardiovascular diseases, are the primary cause of major death. More lives can be saved when they are identified and predicted earlier. Cardiovascular disease can be identified with a simple ECG, a simple, low-cost, non-invasive method of detecting the electrical activity of the heart. Using a public dataset of ECG images from cardiac patients, deep learning algorithms were utilized in the study to predict the four main cardiac abnormalities: irregular heartbeat, myocardial infarction, history of myocardial infarction, and normal person classes. First, the pre-trained deep neural networks VGG16, RESNET50, and InceptionV3 were used to study the transfer learning approach. The aforementioned pre-trained models were used as feature extraction tools for traditional machine learning algorithms, namely, Support Vector Machine, K-nearest neighbors, Random Forest, and Naïve Bayes.
Keywords: Random Forest Classifier, ECG Images, Supervised Machine Learning

INTRODUCTION

Cardiovascular diseases (CVDs) continue to be a leading cause of mortality worldwide, emphasizing the urgent need for effective diagnostic tools and predictive models. Electrocardiogram (ECG) imaging is a fundamental diagnostic technique used to monitor the electrical activity of the heart. This project leverages the state-of-the-art machine learning and image processing techniques to develop an automated system for the detection of cardiovascular diseases using ECG images. The proposed project, "Automated Detection of Cardiovascular Diseases using ECG Images," aims to develop an accurate and efficient method for CVD diagnosis based on analyzing ECG images. Motivated by the desire to improve diagnostic accuracy, reduce human error. The system's approach focuses on the accurate feature extraction from the images, which can significantly impact the model's accuracy. The main areas that affect the success of these approaches, i.e., selection of features, extraction techniques, types of classification algorithms, and most importantly, the use of imbalanced data for classification can reduce the recognition accuracy of the minority class. Before applying the classification phase, the machine learning techniques like feature extraction and feature selection have to be performed on the model. Where feature extraction reduces the quantity of features in a data collection by transforming (or projecting) the data into a new and lower dimensional feature space while maintaining the relevant information of the original data.

LITERATURE SURVEY

[1] Damodar Prabhu K; Prathiksha Rao; Varsha Bhat K; Pooja N.S; Priya R Kamath "Detection and Analysis of Cardiovascular Diseases using Machine Learning Techniques" The incorporation of machine learning technologies to forecast onset of cardiovascular diseases and analyzing their progression has shown promising results. This paper demonstrates the machine learning models that can provide near-accurate predictions and help identify the right data set based on accuracy. The choice of the best-fitting algorithm has been made by a comparative study and with the inclusion of K-fold cross-validation. We infer that the Random Forest algorithm is the best algorithm for detection and K-

Nearest Neighbor Algorithm for the analysis of prominent heart diseases like Stable Angina, ST-elevated myocardial infarction, and non-ST elevated myocardial infarction which will serve as a direction to further diagnosis. Overall, the potential for machine learning to improve early detection and treatment of Cardiovascular Diseases, which could ultimately save lives and reduce healthcare costs, has been recognized.

[2] Pradipta Syifa Narfian; Dylan Christiandi Halim; Albert Nathan Sembiring; Renaldy Fredyan; Hady Pranoto "Detection of Cardiovascular Disease Using Machine Learning Algorithms and Principal Component Analysis" Both the support vector machine and the decision tree classifier algorithm were trained with the Cleveland heart disease dataset and a version of the dataset that has undergone dimensionality reduction through the principal component analysis (PCA) algorithm, with a 75:25 ratio of training and testing data. The performance of the two algorithms was then evaluated using the confusion matrix which found that the PCA algorithm enhanced the performance of both algorithms and that the SVM model paired with PCA achieved the highest performance of 86.67% accuracy.

[3] Muhammad Arqam; Majid Hussain; Hina Zafar; Amna Iqbal; Maria Liaqat2023 International Conference on IT and Industrial Technologies (ICIT)"Natural Language Processing for Diagnosis and Risk Assessment of Cardiovascular Disease" Many hybrid systems have been suggested that attempt to integrate knowledge-driven and data-driven approaches, however due to the usage of Machine Learning, rules, and dictionaries, methods, they frequently require substantial human input. Natural language processing and deep learning methods can be used to extract useful information from clinical tales. By using state-of-the-art methods involving stacked word embeddings to the 2014 i2b2 challenge, this article hopes to contribute to the state of the art in this area. The suggested model makes use of a stacking method that combines different embeddings (CHARACTER-BERT Embedding) to better understand the data. The application of this method to the i2b2 cardiovascular risk factors challenges dataset resulted in significant enhancement of our model's performance. An F1 score of 92.65% is an excellent result. When compared to competing models and systems created for the 2014 i2b2 challenge, our proposed model fares exceptionally well.

[4] P. Saikrishna; K. Abdul Basith " An Efficient Application of Hybrid Optimization with Deep Learning Approach in the Prediction of Cardiovascular Disease" Deep Learning (DL) has lately attracted research interest in a variety of fields, especially medical treatment, where it is being used to diagnose the cardiovascular disease early on via image processing. The following phase involves selecting the most crucial features for predicting CVD using a hybrid lion-grey-wolf optimization algorithm, which incorporates the advantages of both techniques. A deep learning model which incorporates a convolutional neural network (CNN) and bidirectional long short-term memory (Bi-LSTM) architecture completes the categorization of CVD. The suggested method is highly accurate at identifying CVD and is a dependable technique for identifying and diagnosing CVD early.

EXISTING SYSTEM

Electrocardiogram (ECG) is a non-invasive diagnostic tool used to evaluate the electrical activity of the heart. The ECG image provides valuable information about the heart's rhythm, rate, and electrical conduction system. The analysis of ECG images is crucial in the detection and diagnosis of various cardiovascular diseases (CVDs) such as myocardial infarction, arrhythmias, and heart failure. The existing system for detection of CVDs using ECG images involves several steps. First, the ECG signal is acquired using electrodes placed on the patient's skin. The signal is then amplified, filtered, and digitized to obtain the ECG image. The ECG image is analyzed visually by a cardiologist or automated algorithms to detect any abnormalities. Automated algorithms for ECG image analysis use various techniques such as machine learning, deep learning, and signal processing. These algorithms can detect and classify different types of CVDs with high accuracy and sensitivity. The use of automated algorithms has several advantages over visual analysis, including faster analysis time, higher accuracy, and reduced inter-observer variability.

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Disadvantages

- Manual analysis of ECG images requires significant expertise and can be slow. Additionally, interpretation can vary between doctors, leading to potential inconsistencies in diagnosis.
- Traditional methods of classifying diseases can be time consuming and they are less accurate .

PROPOSED SCHEME

The power of deep learning and pre-trained networks can be used for feature extraction without having to retrain the whole network, transfer learning, and classification. In this research, the pre-trained networks, i.e., VGG16, RESNET50, and InceptionV3 are used as a transfer learning approach to study their performance in heart disease classification and as feature extraction for traditional machine learning methods for heart disease classification using ECG images. Random Forest (RFC) algorithm is trained on the dataset to identify patterns in cognitive test results that are associated with cardiovascular disease. RFC addresses overfitting, a common issue with decision trees, by training a collection of them, leading to improved accuracy. Pre trained transfer learning networks like VGG16, RESNET50, and InceptionV3 are used for feature extraction.

ADVANTAGES

- This model provides us with more accurate results when compared to results produced by traditional methodologies
- systems provide objective and quantitative analysis of cardiac electrical activity, reducing variability and subjectivity associated with human interpretation. This can lead to more consistent and reliable diagnoses, enhancing patient care and clinical decision-making.

System Block Diagram

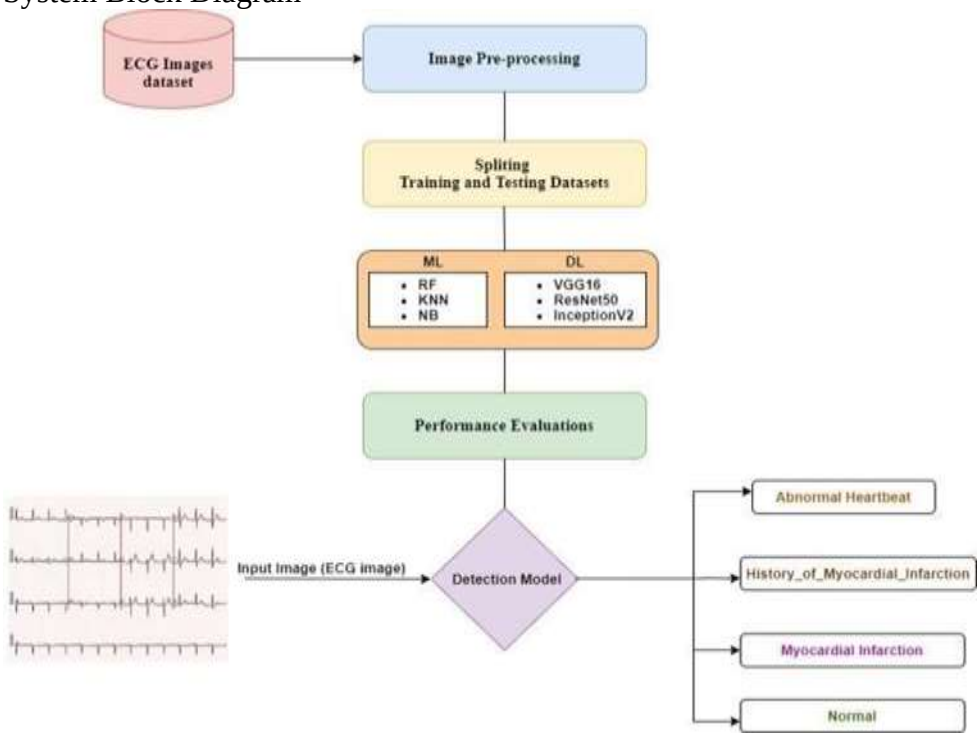

Fig1: System Architecture

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OUTPUT SCREENS

Fig: Home page

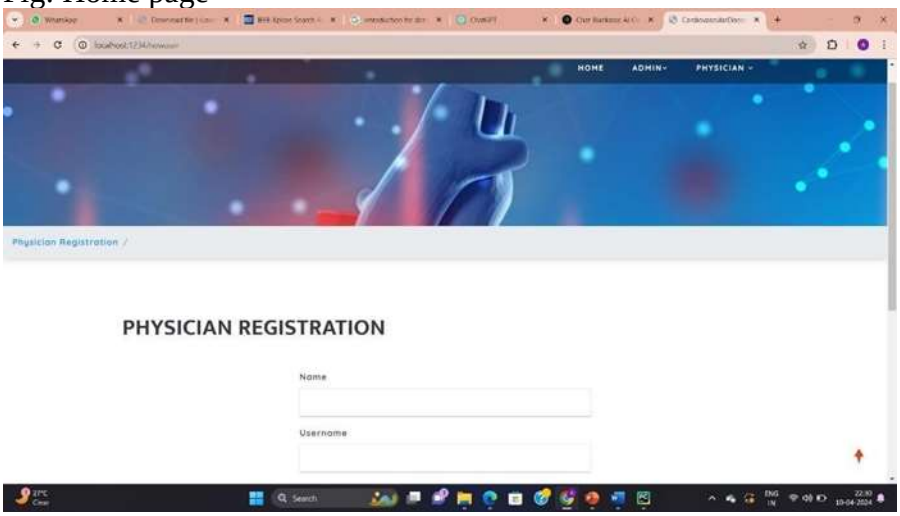


Fig : User Registration page

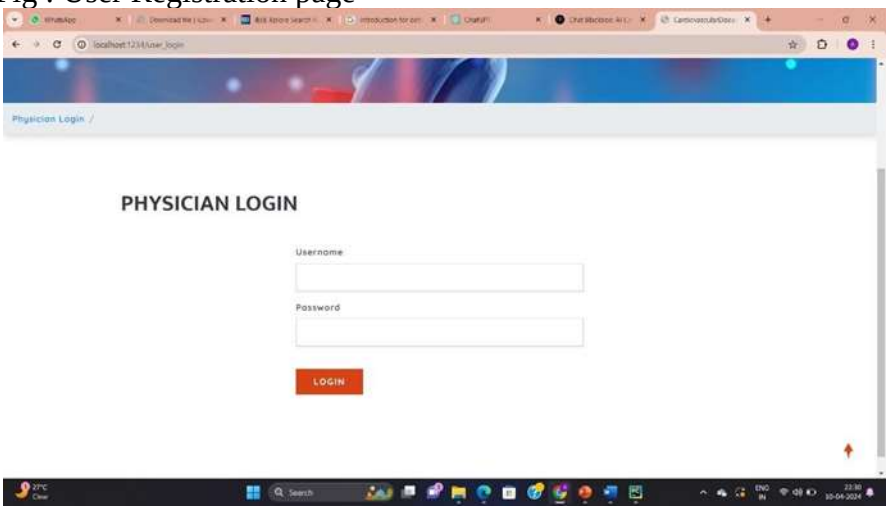


Fig: User Login page

http://doi.org/10.36893/JNAO.2024.V15I1N01.269-275

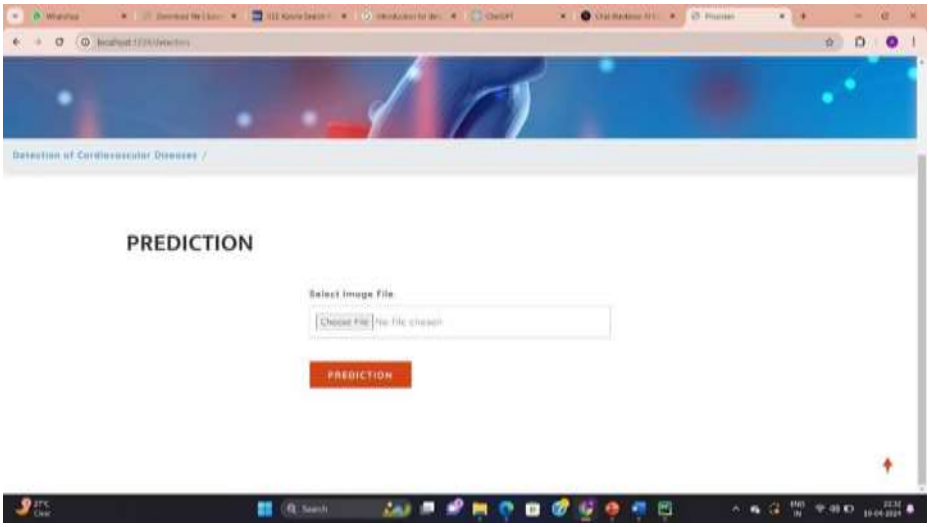
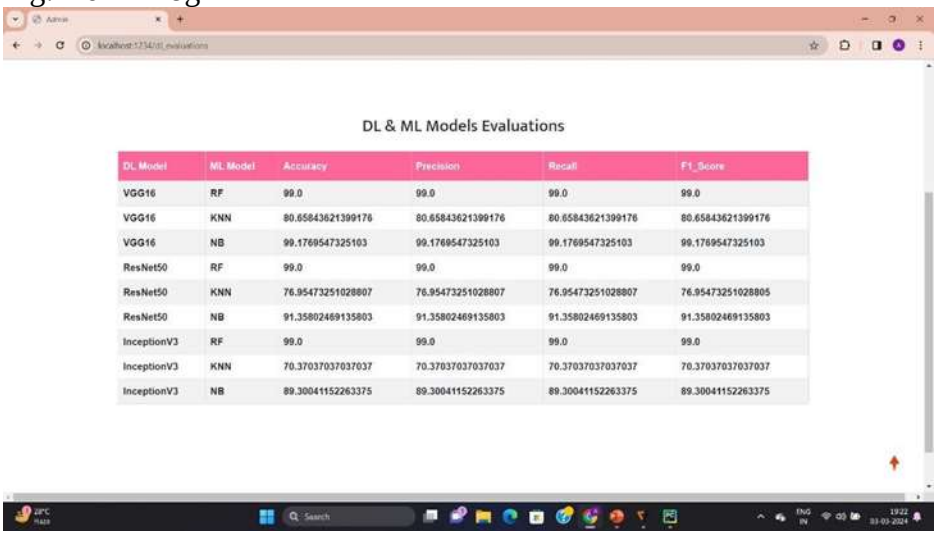


Fig: Admin login



DL Model	ML Model	Accuracy	Precision	Recall	F1_Score
VGG16	RF	99.0	99.0	99.0	99.0
VGG16	KNN	80.65843621399176	80.65843621399176	80.65843621399176	80.65843621399176
VGG16	NB	99.1769547325103	99.1769547325103	99.1769547325103	99.1769547325103
ResNet50	RF	99.0	99.0	99.0	99.0
ResNet50	KNN	76.95473251028807	76.95473251028807	76.95473251028807	76.95473251028805
ResNet50	NB	91.35802469135803	91.35802469135803	91.35802469135803	91.35802469135803
InceptionV3	RF	99.0	99.0	99.0	99.0
InceptionV3	KNN	70.37037037037037	70.37037037037037	70.37037037037037	70.37037037037037
InceptionV3	NB	89.30041152263375	89.30041152263375	89.30041152263375	89.30041152263375

Fig : Evaluations

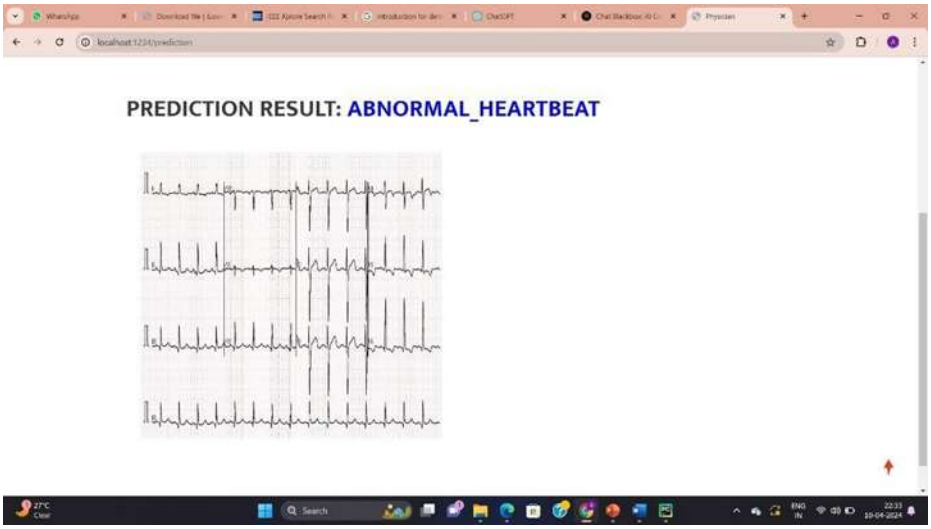


Fig: Disease Classification

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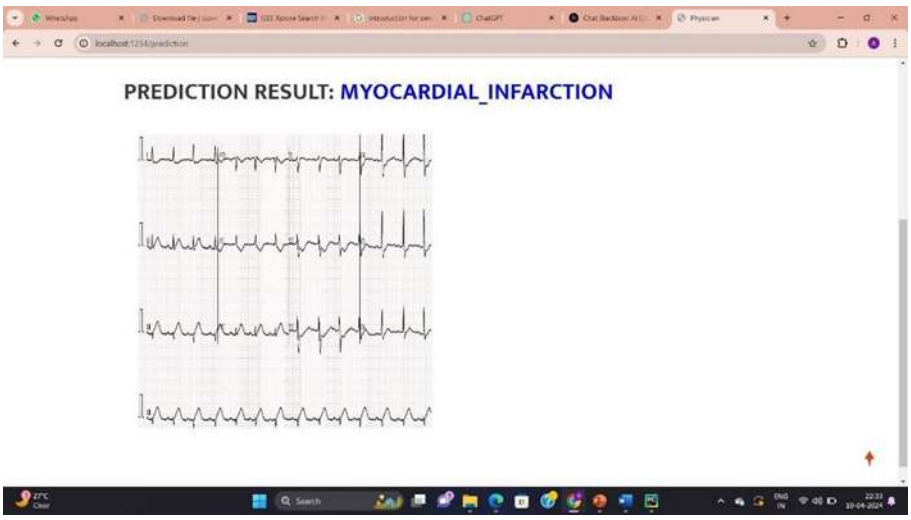

Fig: Disease Classification

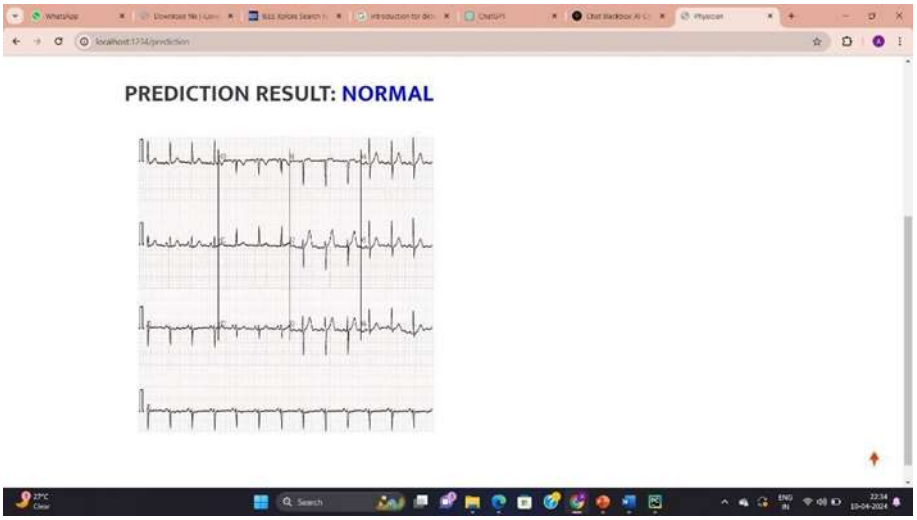

Fig: Disease Classification

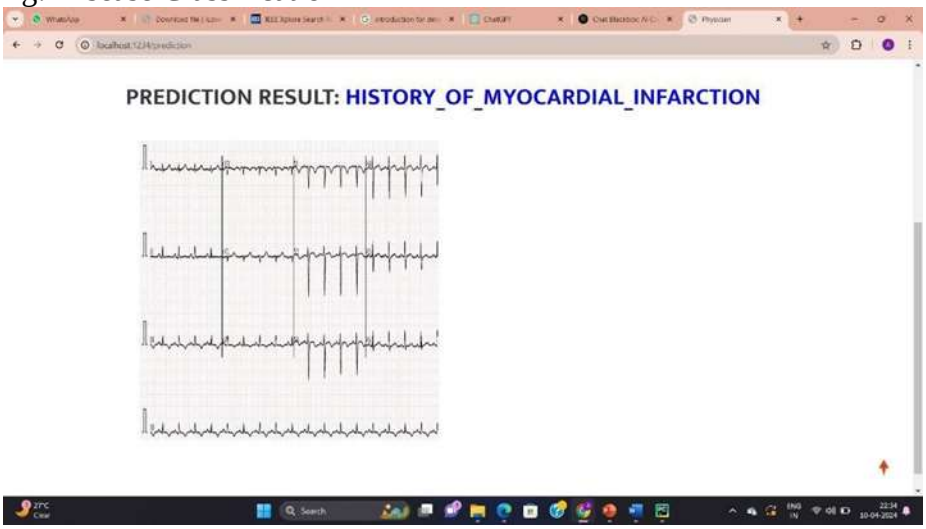

Fig: Disease Classification

CONCLUSION

In this article, we propose a lightweight Transfer learning networks to classify the four major cardiac abnormalities, i.e., AH, MI, H. MI, and NP classes, using public ECG images dataset of cardiac

patients. According to the results of the experiments, the proposed model achieves remarkable results in cardiovascular disease classification and can also be used as a feature extraction tool for the traditional machine learning classifiers. Thus, the proposed model can be used as an assistance tool for clinicians in the medical field to detect cardiac diseases from ECG images and bypass the manual process that leads to inaccurate and time-consuming results. In the future work, optimization techniques can be used to obtain optimized values for the hyperparameters of the proposed model. The proposed model can also be used for predicting other types of problems. Since, the proposed model belongs to the family of low-scale deep learning methods in terms of the number of layers, parameters, and depth. Therefore, a study on using the proposed model in the Industrial Internet of Things domain for classification purposes can be explored.

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