EARLY DETECTION OF ALZHEIMER'S USING DEEP LEARNING

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ABSTRACT

There are many different causes of dementia, but Alzheimer's Disease is the most usual form. As the condition progresses, it limits one's ability to perform any task without aid, and the diagnosis timeline and aging population are expected to cause its prevalence to increase. The conventional ways of detecting Alzheimer's is tiring for both patients, doctors where it involves retrieving the past medical records and having Magnetic Resonance Imaging scans and even neurophysical testing which can be inconvenient for patients. An early diagnosis of brain diseases makes a big difference when it comes to attempting to cure them. Our work has used deep learning (neural networks) to detect Alzheimer's disease earlier than usual by combining it with deep learning. As the obtained dataset from Kaggle is heavily imbalanced, we evenly distributed the data between the categories using SMOTE. Then the model is trained and tested with the categorized MRI data i.e. very mild, mild, moderate and severe AD and finally extract features to examine the results. The results we achieved are compared with the previous attempts on detection of Alzheimer's and came out to be significantly greater in terms of precision and accuracy.

Keyword Alzheimer's Disease**:** *MRI scans , CNN technique, Deep Neural Networks (DNNs)*

1. INTRODUCTION

A person with Alzheimer's Disease (AD) suffers from a developing neurobiological disorder that affects brain cells to die & atrophy. AD is the prevalent cause of dementia, which causes memory loss and impaired reasoning abilities. Around 6 million people in the U.S of age 65 and above are caused with Alzheimer's disease. Of those 80 percent are above 75 years old. In India it is calculated around 5.3 million people live with dementia of which Alzheimer is the common cause. Alzheimer's is not a curable disease, but an early diagnosis can help prevent the patient from suffering from the later stages. In order to diagnose AD manual detection systems for example: Positron Emission Tomography (PET) were used to track the progression of the various stages of AD, MRI scans and genotype sequencing results were taken for diagnosis. Among the most popular fields of research in recent years has been brain-computer interface (BCI), thanks to its applications in areas such as brain fingerprinting, detecting neurological illnesses, tiredness, adaptive e-learning and more. By extracting the most significant characteristics, BCI creates an effective link to interact between the brain and the device. A complex brain structure varying with age and pathology makes it very difficult to detect neurodegenerative diseases in their early stages. Computer-assisted techniques are more successful in detecting these disorders than traditional approaches. A timely diagnosis and identifying of Alzheimer's disease is essential to reducing medical expenses, improving treatment, and preventing brain cell degeneration.Some of the methods included in an early examination include Positron Emission

Tomography (PET), digital imaging methods and genotyping-by-sequencing. It is difficult to take decisions by analyzing different methods. Furthermore, the patients will have to undergo radioactive effects during PET medical procedure. According to our findings, MRIs can provide valuable information on the brain, because they provide flexible imaging, superior tissue contrast, and do not expose the brain to ionizing radiation. It is crucial to develop a model that can take MR images as input and detect whether patients are normal or not. By utilizing a dataset, machine learning can extract knowledge. Computer science, artificial intelligence, and statistics combine to make up this field.. The ML is done through training a computer to produce the output based on its past experience to solve a given problem. Machine learning can be applied in a variety of fields in order to solve problems quicker than humans, and therefore be more efficient, and reduce time spent on repetitive tasks. Nowadays, because of the reduction in the cost of computing power and memory. This allows processing and analyzing huge amounts of data to generate insights. Additionally, Deep Learning is a subset of ML and an advanced mode of analyzing and learning information from raw data that computers are able to replicate, much like how humans are able to do, with a computer. Deep learning is becoming increasingly popular for diagnosing diseases. Several Machine learning approaches have been proposed recently to aid in this diagnosis, providing doctors with more information to make informed decisions. We use C for feature extraction using deep learning techniques in the proposed model. A solution to underfitting is to use sampling techniques especially oversampling to resolve class imbalance. DL performs classification on given MR images using the cortical surface of the brain as input.Using a dementia-specific (Alzheimer's) dataset, the models are evaluated by NonDemeneted, Moderate Dementia, Mild Dementia and Very Mild Dementia obtained from Kaggle. Utilizing the CNN technique, we extract discriminating features for AD classification by improving the accuracy. By using this model, we can accurately classify the stages of AD.

2. EXISTING SYSTEM

Early detection of this disorder is being researched to slow down the abnormal degeneration of the brain, reduce medical care cost reduction, and ensure improved treatment. In Existing system machine learning algorithms are used to predict the Alzheimer disease using psychological parameters like age, number of visit, MMSE and education. Different modalities are used for AD study include MRI, Positron Emission Tomography (PET), and genotype sequencing results. It is time-consuming to analyze different modalities to take a decision. Furthermore, the patients can encounter radioactive effects in the modalities like PET. Previously researchers performed 3D tissue segmentation of white matter, gray matter, and cerebrospinal fluid from MR images after skull striping using FSL tool, calculate the surface fractal dimension from segmented brain tissue.From the survey , Numerous techniques exist for AD classification using machine and deep learning. However, the high model parameter and class imbalance in the multiclass AD classification is still an issue.

2.1 Disadvantages in existing system

The existing model shows significant accuracy only when MMSE score, education, etc., is given. The patients can encounter radioactive effects in the modalities like PET. 3D MRI scan is hard to train and time consuming process

3. PROPOSED SYSTEM

It is considered important to develop a better computer-aided diagnostic system that can interpret MRI imaging and determine whether patients are healthy or have Alzheimer's disease. Conventional deep learning systems use the cortical surface to input the CNN to perform AD classification on raw MRI images. In this proposed work, We believe that the MRI modality benefits from its greater imaging flexibility, excellent tissue contrast, lack of ionizing radiation, and ability to provide useful information on human brain anatomy. This paper proposes a model that uses the convolutional neural network to extract the discriminative features. Class imbalance is addressed using the Synthetic Minority Oversampling Technique (SMOTE) technique. The model is developed from scratch to classify the stages of AD more accurately by reducing its parameters and computation cost. The models are evaluated by training them over the MRI dataset from the Kaggle. The dataset comprises four types of dementia such as Mild Dementia (MID), Moderate Dementia (MOD), Non-Demented (ND) and Very Mild Dementia (VMD). A new convolutional neural network architecture is proposed with relatively small parameters to detect the types of

dementia which is suitable for training a smaller dataset SMOTE technique is used to address the class imbalance problem in the dataset is by randomly duplicating the minority class of images in the dataset to minimize the overfitting problem. We created the generalized model that learns from the smaller dataset with reduced parameters and computation cost, which still performs better for AD diagnosis. We also compared the proposed model with deep features and hand-crafted features to detect AD stages in terms of Accuracy, AUC and Cohen's kappa score.

3.1 Prerequisites:

- **Google co-lab:** Google Colab is a free cloud-based platform by Google for collaborative Python coding. It offers a Jupyter notebook interface, runs entirely in the cloud, and provides access to powerful computing resources like GPUs and TPUs. Users can seamlessly save and share their work via integration with Google Drive.
- **Anaconda:** Anaconda is a distribution of Python and R languages tailored for data science and machine learning. It comes with pre-installed packages like Jupyter notebooks and Spyder IDE, simplifying setup and management. Anaconda streamlines workflows for developers and data scientists, providing a robust platform for building data-driven applications.
- **Spyder Notebook:** Spyder Notebook is an integrated development environment (IDE) bundled with the Anaconda distribution. It provides a convenient interface for interactive Python coding and data analysis, combining the features of a Jupyter notebook with the capabilities of Spyder IDE. With Spyder Notebook, users can write and execute Python code in cells, visualize data, and document their work using markdown cells. It offers a flexible and user-friendly environment for scientific computing and data exploration within the Anaconda ecosystem.

3.2 Libraries:

- **Scikit-learn (sklearn)**: Sklearn is one of the most popular machine learning libraries in Python. It provides simple and efficient tools for data mining and data analysis, including various algorithms for classification, regression, clustering, dimensionality reduction, and more. It's built on top of other scientific libraries like NumPy, SciPy, and matplotlib.

- **Pandas**: Pandas is a powerful data manipulation and analysis library. It offers data structures and functions to efficiently manipulate and analyze structured data, such as tables and time series. With pandas, you can easily load, clean, transform, and analyze data before feeding it into machine learning algorithms.

- **NumPy**: NumPy is the fundamental package for scientific computing in Python. It provides support for multi-dimensional arrays and matrices, along with a collection of mathematical functions to operate on these arrays. Many other scientific and data analysis libraries in Python are built on top of NumPy.

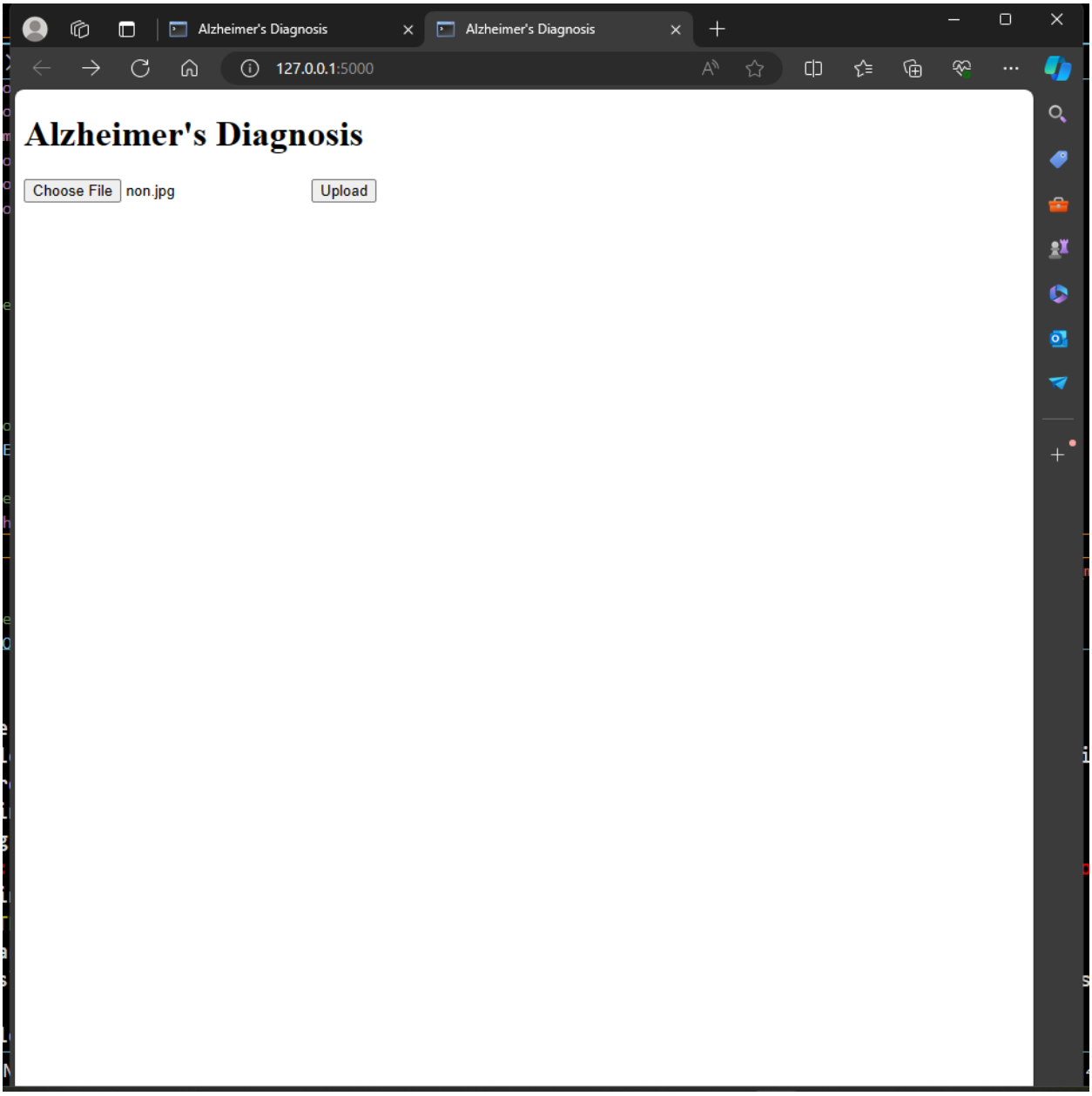
- **Matplotlib (matplotlib.pyplot)**: Matplotlib is a plotting library for creating static, animated, and interactive visualizations in Python. It provides a MATLAB-like interface and supports various types of plots, including line plots, scatter plots, bar plots, histograms, and more. It's widely used for data visualization tasks in data science and scientific computing.

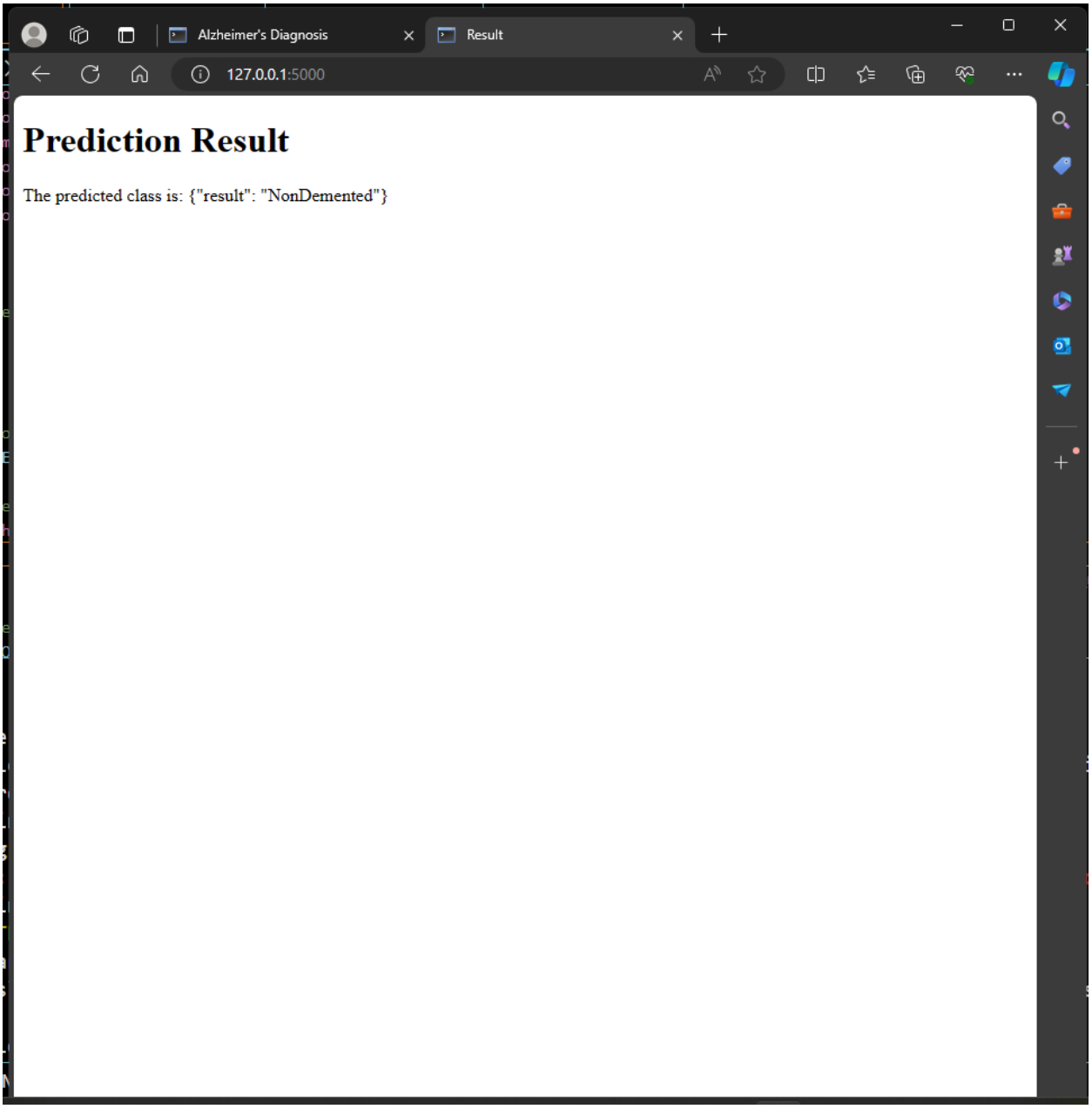
- **TensorFlow** is a popular open-source library for building and deploying machine learning models. It provides tools for defining and training neural networks, high-level APIs like Keras for easier model building, visualization tools like TensorBoard, and deployment options like TensorFlow Serving and TensorFlow Lite for mobile and embedded devices. It's widely used for a variety of machine learning tasks and is known for its flexibility, performance, and extensive ecosystem.

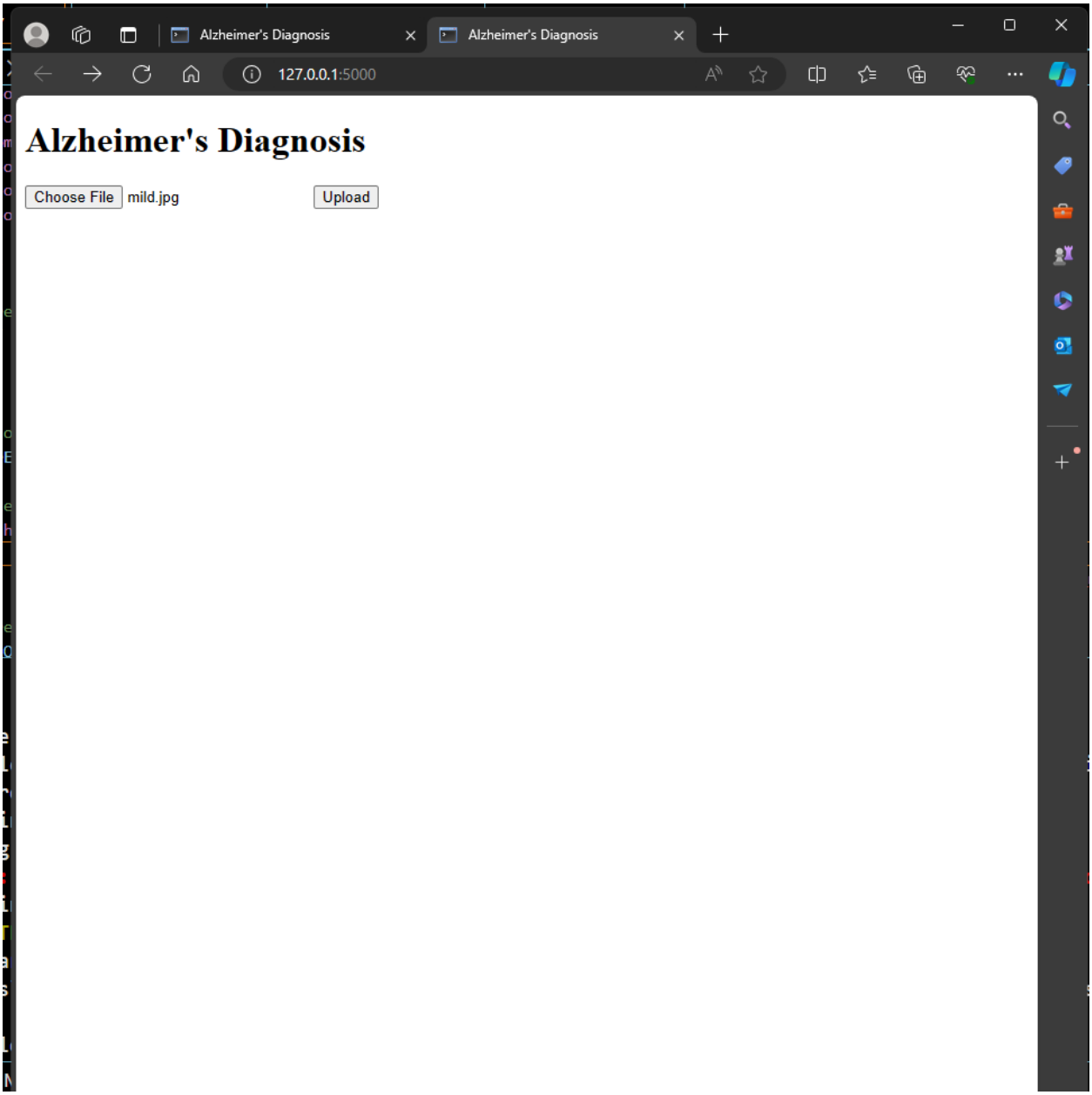
3.3 Algorithms used:

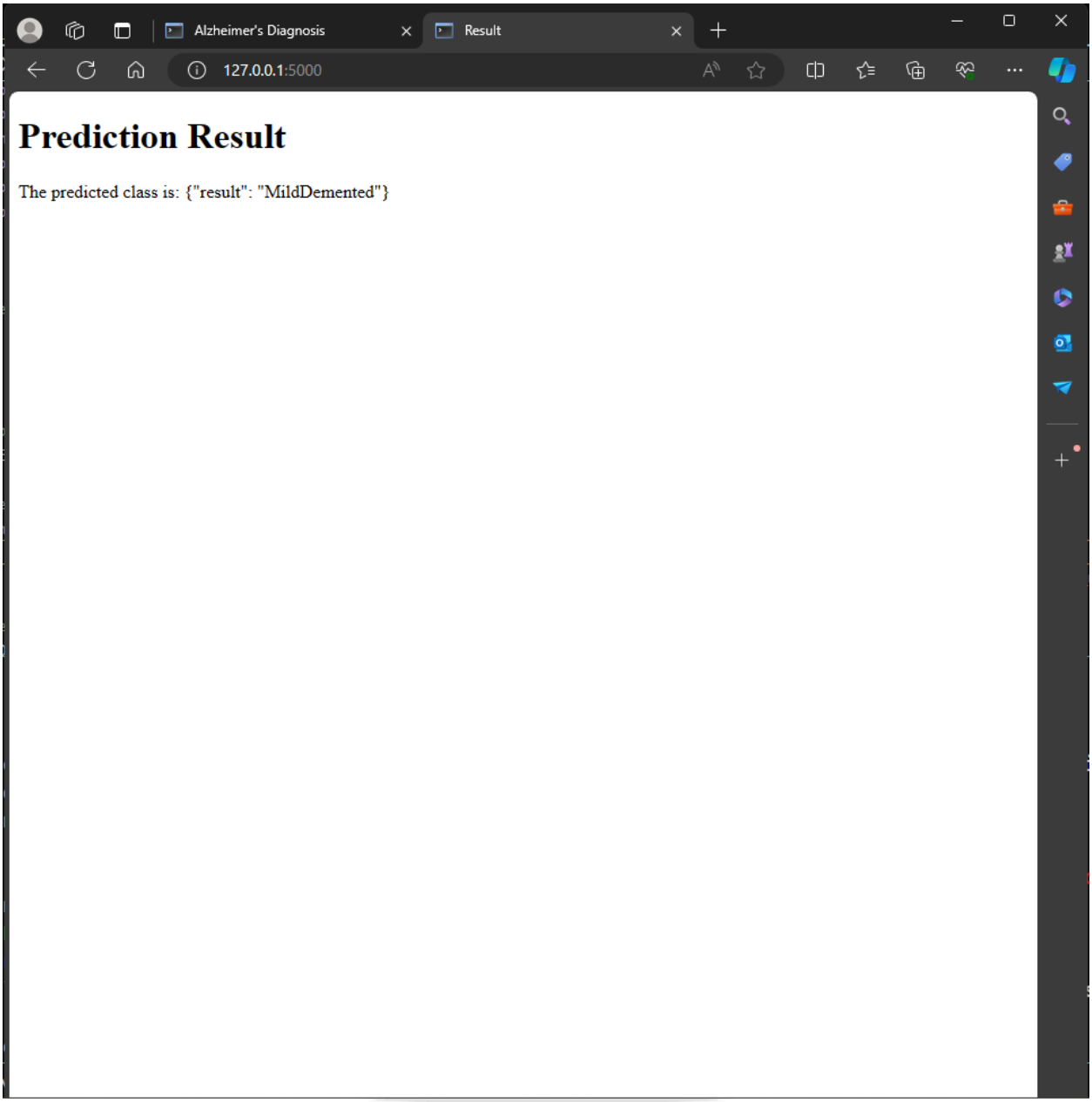
A Convolutional Neural Network (CNN) is a type of deep learning algorithm commonly used for image recognition. It's designed to automatically learn patterns and features from images. It does this by using layers of convolutional filters to extract features like edges and textures. These features are then passed through additional layers to make predictions, such as identifying objects in images. CNNs are particularly effective for tasks involving visual data due to their ability to capture spatial hierarchies of features.

4. RESULT




Alzheimer's Diagnosis
Result
127.0.0.1:5000
Prediction Result
The predicted class is: {"result": "NonDemented"}


Alzheimer's Diagnosis
Alzheimer's Diagnosis
127.0.0.1:5000
Alzheimer's Diagnosis
Choose File
mild.jpg
Upload


Alzheimer's Diagnosis
Result
127.0.0.1:5000
Prediction Result
The predicted class is: {"result": "MildDemented"}

5. CONCLUSIONS

In this paper, a custom CNN model is proposed to predict the class of Alzheimer disease among the given classified images. The proposed model has been tested with testing data consisting of four classes and accomplish a 93.59% accuracy. The dataset has a major disadvantage - a class disparity, the SMOTE method is employed to resolve this issue. In this way, it is well suited to identify brain areas often associated with AD and can facilitate physicians' decision making by helping them determine each patient's AD severity level according to the level of dementia.

6. REFERENCES

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