VISVESVARAYA TECHNOLOGICAL UNIVERSITY

Jnana Sangama, Belagavi - 590018

Internship Report

on

"ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING"

Submitted in partial fulfillment for the award of the degree of

BACHELOR OF ENGINEERING
in
COMPUTER SCIENCE AND ENGINEERING
by

TEJASWINI PEERU GOUDA
4MT20CS170

Internship Carried out
at
DLITHE CONSULTANCY SERVICES PVT. LTD.

Internship Guide

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CSE, MITE

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(*Accredited by NBA*)

MANGALORE INSTITUTE OF TECHNOLOGY & ENGINEERING

(A Unit of Rajalaxmi Education Trust ®, Mangalore)

Autonomous Institute Affiliated to V.T.U, Belagavi, Approved by AICTE, New Delhi

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2023-24

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CERTIFICATE

This is to certify that the Internship report entitled by **Artificial Intelligence and Machine Learning** submitted by **TEJASWINI PEERU GOUDA 4MT20CS170** is work done by her in partial fulfillment for the award of Bachelor of Engineering in Computer Science and Engineering of the **Visvesvaraya Technological University, Belagavi** during the year **2023-24**. Carried out under the supervision of **MR. VIJAYANANDA V MADLUR** during August 21, 2023 to September 21, 2023. It is certified that all corrections/suggestions indicated for Internal Assessment have been incorporated in the report and deposited in the departmental library. The Internship report has been approved as it satisfies the academic requirements prescribed for the said degree.

Mr. Vijayananda V Madlur	**Dr. Ravinarayana B.**	**Dr. Prashanth C M**
Internship Guide	**Head of the Department, CSE**	**Principal MITE**

External Viva

External Viva	Name of the Examiners	Signature with Date
1.		
2.		

Dlithe Consultancy Services Pvt. Ltd.

CIN: U72900KA2019PTC121035

21 September 2023

TO WHOMSOEVER IT MAY CONCERN

This is to certify **Tejaswini**, bearing USN No: **4MT20CS170** from **Mangalore Institute of Technology and Engineering, Moodabidre** has successfully completed one-month internship starting from **21-08-2023 to 21-09-2023** under the mentorship of DLithe's development team. **Tejaswini** has worked on Fundamentals of Artificial Intelligence and Machine Learning in Data Science, Deep Learning, and Natural Language Processing to Model building and deployment.

The domain & agile development process exposure was given along with usage of GitHub tool.

During the internship, **Tejaswini** demonstrated good coding skills with good design thoughts.

We wish all the best for future endeavours!

DLITHE CONSULTANCY SERVICES PVT. LTD. Bengaluru

For Dlithe Consultancy Services Pvt Ltd

Director

Certificate ID: SEP2023AIML6338978

ACKNOWLEDGEMENT

First and foremost, we thank our parents for what we are and where we are today, withoutwhose hard work and sacrifice we would not be here today.

We deem it a privilege to place on record the deep sense of gratitude to our supervisor **Mr. Vijayananda V Madlur,** Assistant Professor, Computer Science and Engineering, whostood behind us and supported in each and every step of the internship work.

We are grateful to **Dr. Ravinarayana B.**, Head of the Department, Computer Science and Engineering for their support and encouragement.

We would like to thank our Principal **Dr. Prashanth C M**, for encouraging us and giving us an opportunity to accomplish the internship work.

We also thank our management who helped us directly and indirectly in the completion ofthis work.

Our special thanks to faculty members and others for their constant help and support.

Above all, we extend our sincere gratitude to our parents and friends for their constant encouragement with moral support.

TEJASWINI PEERU GOUDA
4MT20CS170

ABSTRACT

DLithe is a technology-based product company that has been serving IT companies and academic institutions since the year 2018. The company is led by industry professionals with two decades of experience. For IT companies, DLithe offers services such as technology consultancy, project development, IT recruitment, staffing, competency development, and content development. On the other hand, the company serves academic institutions by providing competency development services in niche technologies like artificial intelligence, internet of things, robotics, cybersecurity, augmented reality, and more. DLithe has also developed the arm-based Cortex M3 series microcontroller and the ioCube product in the embedded and IoT domain.

During my enriching internship with the Artificial Intelligence and Machine Learning domain, I had the privilege of being a part of an exceptional program under the guidance of this renowned organization. Throughout the internship, I gained comprehensive insights into diverse industry verticals, spanning from understanding project requirements to the final deployment phase.

DLithe's internship program provided me with a valuable opportunity to immerse myself in real-world scenarios, gaining exposure to industry best practices and learning how to implement AI and ML solutions within an agile project life cycle.

The supportive environment and dedicated mentors at the organization ensured that I could explore practical use cases for AI and ML implementation, enabling me to grow and learn during insightful post-mentoring sessions.

Overall, this AI and ML internship has been a transformative experience, equipping me with not only technical skills but also a deeper understanding of how AI and ML technologies play a vital role across various industries.

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The objectives of this internship are as follows:

- The internship provided a thorough understanding of Python programming, covering syntax, data structures, and essential libraries crucial for AI and ML development.
- Participants gained insights into fundamental ML algorithms like Linear Regression, Binary Classification, and Decision Trees, laying the groundwork for advanced techniques in supervised learning.
- Delving into Neural Networks, participants learned about their architecture, functioning resembling the human brain, and essential concepts like Activation Functions and Forward Propagation.
- The internship stressed the significance of maintaining active profiles on GitHub and LinkedIn, encouraging participants to showcase their projects, contributions, skills, and accomplishments online.
- Participants applied AI and ML techniques to develop a CNN model for Handwritten Digit Recognition, bridging theory with practical application, and gaining hands-on experience in solving real-world problems.

WEEKLY OVERVIEW OF INTERNSHIP ACTIVITIES

	DATE	DAY	NAME OF THE TOPIC/MODULE COMPLETED
1st Week	21-08-2023	MONDAY	Introduction to Python Fundamentals for AI & ML.
	22-08-2023	TUESDAY	worked on basic python programming exercises and projects.
	23-08-2023	WEDNESDAY	
	24-08-2023	THURSDAY	Created a structured flow of activities.
	25-08-2023	FRIDAY	
	26-08-2023	SATURDAY	

	DATE	DAY	NAME OF THE TOPIC/MODULE COMPLETED
2nd Week	28-08-2023	MONDAY	Hands-on implementation of binary classification algorithms
	29-08-2023	TUESDAY	Worked on linear regression
	30-08-2023	WEDNESDAY	
	31-08-2023	THURSDAY	Explored decision tree and their practical application
	01-09-2023	FRIDAY	
	02-09-2023	SATURDAY	

	DATE	DAY	NAME OF THE TOPIC/MODULE COMPLETED
3rd Week	04-09-2023	MONDAY	Gathered and formed dataset
	05-09-2023	TUESDAY	
	06-09-2023	WEDNESDAY	Data preprocessing
	07-09-2023	THURSDAY	
	08-09-2023	FRIDAY	Feature extraction
	09-09-2023	SATURDAY	Model architecture

	DATE	DAY	NAME OF THE TOPIC/MODULE COMPLETED
4thWeek	11-09-2023	MONDAY	Model training
	12-09-2023	TUESDAY	
	13-09-2023	WEDNESDAY	Model Evaluation
	14-09-2023	THURSDAY	
	15-09-2023	FRIDAY	Web application development and deployment
	16-09-2023	SATURDAY	

CHAPTER 1

INTRODUCTION

During my internship with DLithe, a leading technology-based product company, I had the privilege of delving into the realms of Artificial Intelligence and Machine Learning (AI/ML). Under the guidance of seasoned industry professionals, I embarked on a transformative journey, gaining invaluable insights into various industry verticals. DLithe's internship program provided a nurturing environment where I could explore real-world scenarios and implement AI/ML solutions within agile project frameworks.

One such project I had the opportunity to contribute to is the Handwritten Digit Recognition system. In today's digital age, handwriting recognition plays a pivotal role in efficiently processing information across diverse applications. Leveraging cutting-edge machine learning techniques, particularly Convolutional Neural Networks (CNNs), our project aims to accurately recognize handwritten digits, catering to the demands of large databases while ensuring low computational complexity and consistent performance.

Throughout this internship, I not only honed my technical skills but also gained a deeper understanding of how AI/ML technologies drive innovation across various sectors. This report encapsulates the culmination of my enriching experience, highlighting the significance of AI/ML in solving real-world challenges and paving the way for future advancements.

CHAPTER 2

LITERATURE REVIEW

Artificial Intelligence

Artificial intelligence (AI) represents the emulation of human intelligence by machines, enabling them to perform tasks typically requiring human cognitive functions such as learning, problem-solving, and decision-making. This transformative technology encompasses a spectrum of applications, from virtual assistants and autonomous vehicles to predictive analytics and medical diagnosis. At its core, AI relies on algorithms and data to enable machines to perceive, reason, and act autonomously, revolutionizing industries and driving innovation across various sectors. As AI continues to evolve, its potential to augment human capabilities and address complex challenges remains unparalleled, heralding a future defined by intelligent automation and enhanced efficiency.

Machine Learning

Machine learning is a subset of artificial intelligence that empowers computers to learn from data and make predictions or decisions without being explicitly programmed. It enables systems to identify patterns, extract insights, and improve performance over time through iterative learning processes. By leveraging algorithms and statistical models, machine learning algorithms analyze vast datasets to uncover trends and patterns, enabling organizations to make informed decisions and automate tasks. From recommendation systems and image recognition to language translation and predictive analytics, machine learning finds applications across diverse industries, revolutionizing how businesses operate and innovate in the digital age**.**

Python

Python is a high-level programming language known for its simplicity, versatility, and readability. With its clean syntax and extensive libraries, Python facilitates rapid development and prototyping across various domains, including web development, data science, artificial intelligence, and automation. Its dynamic typing and interpreted nature make it beginner-friendly, enabling users to write concise and elegant code while emphasizing readability and maintainability. Python's vast ecosystem of third-party modules and frameworks, such as Django for web development and TensorFlow for machine learning, further enhances its capabilities.

CHAPTER 3

INTERNSHIP WORK AND DISCUSSION

3.1 WEEK 1

During the initial week of the internship, emphasis was placed on introducing interns to the organization and acquainting them with the diverse range of services it offers. first week of the Internship focused on introduction to the organization and the various services provided by the organization. Additionally, the agenda for the entire internship was outlined, and a structured flow of activities was established. In the first we were introduced to the Python Fundamentals for AI & ML providing insights into the various fields where Engineers can contribute their expertise. Trainers explained how the code forms in Python, covered Python syntax and data structures. We explored essential libraries used in AIML and worked on basic python programming exercises and projects.

3.1.1 STRUCTURE

Some of the most common Python data structures:

List: A list is an ordered collection of items, which can be of different types. Lists are mutable, meaning that their elements can be changed after they are created.

Tuple: A tuple is an ordered collection of items, which can be of different types. Tuples are immutable, meaning that their elements cannot be changed after they are created.

Set: A set is an unordered collection of unique items. Sets are mutable, meaning that their elements can be added or removed after they are created.

Dictionary: A dictionary is a collection of key-value pairs. Keys are unique identifiers, and values can be of any type. Dictionaries are mutable, meaning that their elements can be added, removed, or changed after they are created.

3.1.2 LIBRARIES

NumPy: is an open-source Python library for arrays processing. It can execute algebraic, logical, and statistical operations over matrices and multidimensional arrays.

Pandas: is the best option for handling tabular data and time series. This open-source library has a comprehensive list of built-in commands that save ML developers the need to write code specifically for certain mathematical operations.

Matplotlib: is a Python open-source plotting library used to create a variety of plots and charts and primarily serves as a tool for developing static, animated, and simple interactive visualizations.

TensorFlow: is an open-source software library for numerical computations using data flow graphs.
OpenCV: enables comprehending visual information as simple as calling the proper function and specifying the correct details, from detecting/recognizing faces to classifying human behaviors.
Scikit-learns: a Python AI package that allows the development of machine learning algorithms easier utilizing the popular NumPy, SciPy, and matplotlib libraries.

3.1.3 BASIC PYTHON PROGRAMMING EXCERCISE

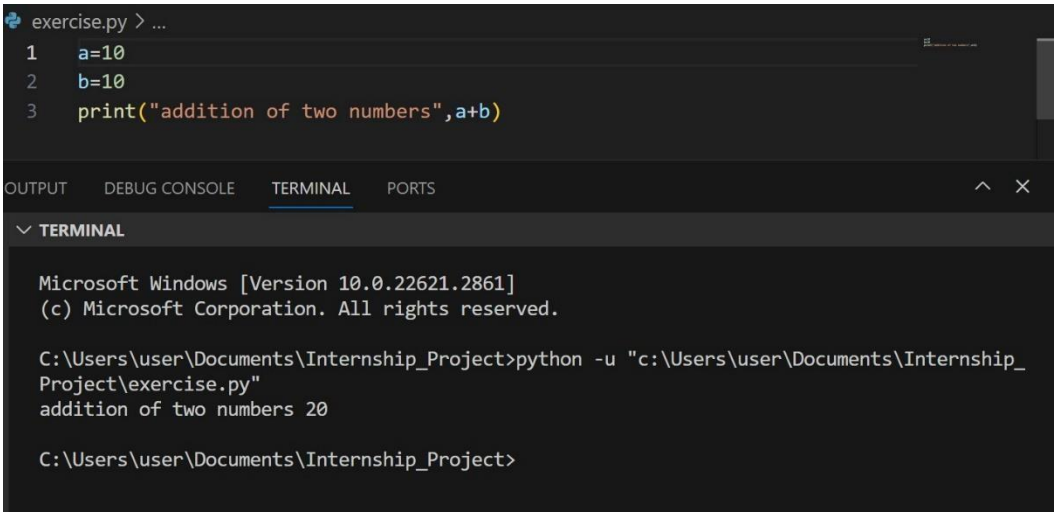

Fig 3.1.1: Exercise Program

3.2 WEEK 2

The second week interns were introduced to various Machine Learning Algorithms and Implementation in Python.

3.2.1 HANDS-ON IMPLEMENTATION OF BINARY CLASSIFICATION ALGORITHMS

Binary classification is the task of classifying the elements of a set into one of two groups (each called *class*) on the basis of a classification rule.

Typical binary classification problems include:

- Medical testing to determine if a patient has certain disease or not;
- Quality control in industry, deciding whether a specification has been met;
- In information retrieval, deciding whether a page should be in the result set of a search or not. Binary classification is dichotomization applied to a practical situation. In many practical binary classification

problems, the two groups are not symmetric, and rather than overall accuracy, the relative proportion of different types of errors is of interest. For example, in medical testing, detecting a disease when it is not present (a *false positive*) is considered differently from not
detecting a disease when it is present (a *false negative*). Below figure Fig 3.2.1 shows the sample binary classification consisting of two classes A and B.

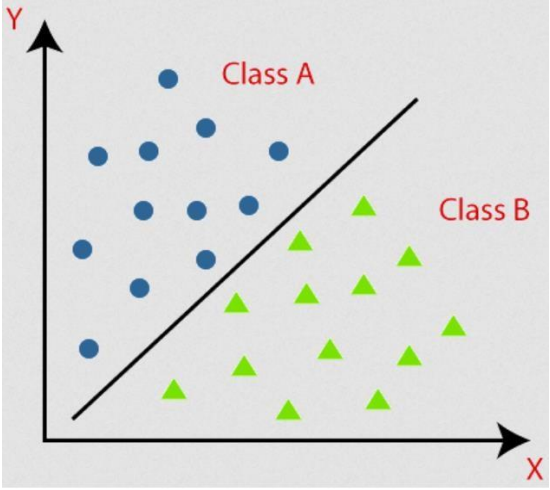

Fig 3.2.1: Binary Classification

3.2.2 EXPLORED DECISION TREE AND THEIR PRACTICAL APPLICATION

A decision tree is a non-parametric supervised learning algorithm, which is utilized for both classification and regression tasks. It has a hierarchical, tree structure, which consists of a root node, branches, internal nodes and leaf nodes.

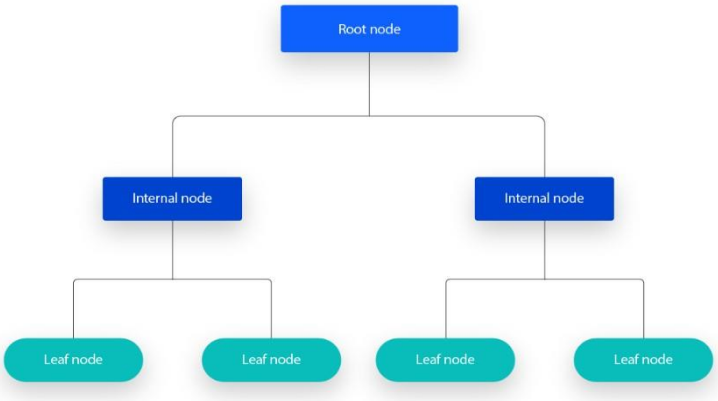

Fig 3.2.2: Decision Tree

Some practical applications:

1. **Health Care**: In healthcare, decision trees can help medical professionals with diagnoses. For example, based on symptoms (decision nodes), a doctor can narrow down the possible conditions (leaf nodes).
2. **Financial Analysis**: In the financial sector, decision trees are used in options pricing and strategy development. They can model possible future price movements based on different market conditions to help investors make informed decisions.
3. **Customer Relationship Management (CRM):** Companies use decision trees to predict customer behavior, such as whether a customer will churn or respond positively to a marketing campaign. Based on different characteristics (e.g., age, purchase history, browsing behavior), a company can categorize customers and tailor their marketing strategies accordingly.
4. **Quality Control:** In manufacturing and quality control, decision trees can be used to predict whether a product will fail a quality assurance test based on different measurements and conditions during the manufacturing process.
5. **Fraud Detection**: Decision trees can help detect fraud by identifying patterns in transactions. Based on parameters like transaction frequency, amount, and location, a decision tree model can flag suspicious activities for further investigation.

3.2.3 WORKED ON LINEAR REGRESSION

Linear regression is a type of supervised machine learning algorithm that computes the linear relationship between a dependent variable and one or more independent features shown in Fig 3.2.3. When the number of the independent feature, is 1 then it is known as Univariate Linear regression, and in the case of more than one feature, it is known as multivariate linear regression.

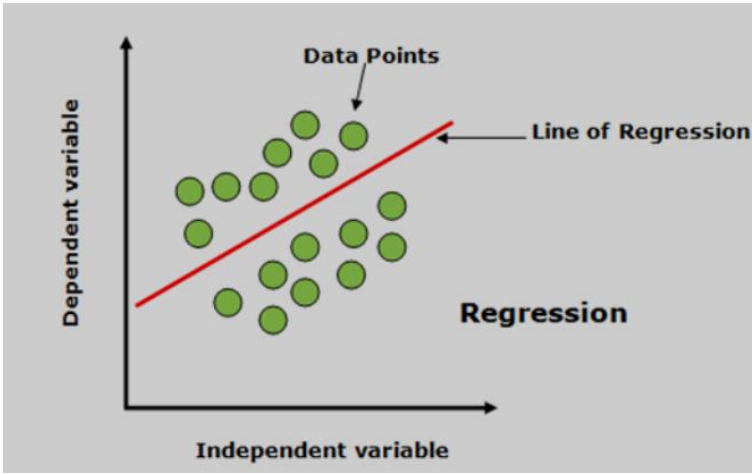

Fig 3.2.3: Linear Regression

3.3 WEEK 3

In the Week 3 of the Internship, we had to select a use case and had to work on it.

The use case that we selected was Handwritten Digit Recognition using AIML.

3.3.1 GATHERED AND FORMED DATASET

Created a dataset of 1000 handwritten digit images. Fig 3.3.1 shows the sample datasets.

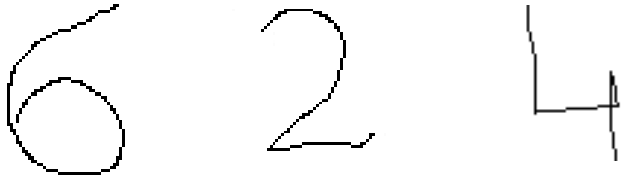

Figure 3.3.1: Sample Datasets

3.3.2 DATA PREPROCESSING

The collection of images will be preprocessed and converted into binary matrix which represents the corresponding image. Preprocessing includes resizing the images to ensure consistent format, resolution, and orientation and splitting the dataset into training, validation, and test sets. The dataset consists of 1000 rows and 2 columns. The first column contains binary matrix, while the second column contains corresponding labels/digits. Each column has a significant number of unique values. Preprocessed the images by resizing them to a consistent size (64x64), converting them to grayscale, and normalizing the pixel values.

3.3.3 FEATURE EXTRACTION

Extracted HOG features from the preprocessed images. HOG features are a type of feature extraction technique that is well-suited for image classification tasks.

3.34 MODEL ARCHITECTURE

Designed a CNN architecture for handwritten digit recognition. The CNN architecture includes the following layers as shown in the Fig 3.3.2.

Convolutional layer(s): This layer extracts low-level features from the input image.

Max pooling layer(s): This layer reduces the dimensionality of the feature maps while preserving important information. Flatten layer: This layer converts the feature maps from a 2D to 1D format.

Dense layer(s): This layer combines the high-level features extracted from the previous layers and outputs a probability **distribution over the 10-digit classes.**

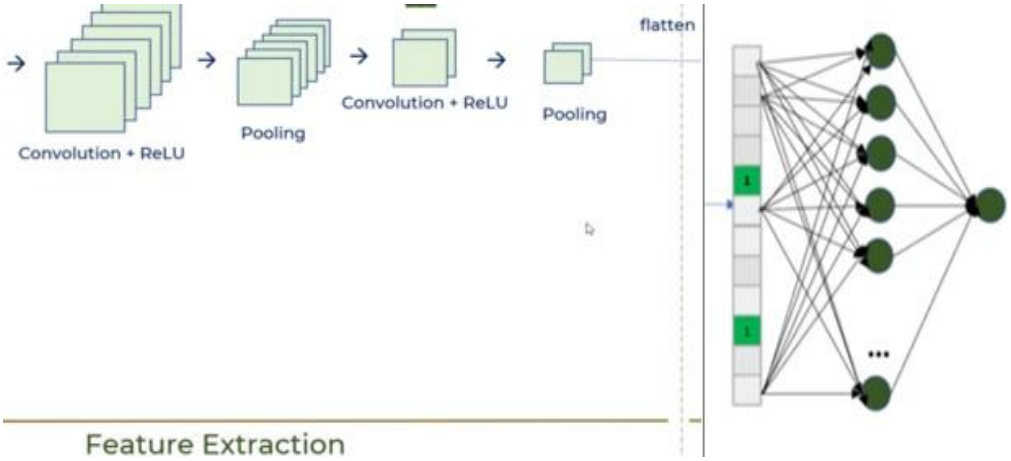

Fig 3.3.2: Model Architecture

3.4 WEEK 4

In the Week 4 of the Internship, testing and validation of our proposed model.

3.4.1 MODEL TRAINING

We are training the model using 2 dense layers, which combines to form a full connected layer. The 2 dense layers take 128,10. We flatten the pixels of the greyscale image in the input layer. Then we apply the activation functions to the weights in the hidden layer. The output layer gives the result as a prediction.

```
In [11]: model.fit(X_train, Y_train, epochs=10, validation_data=(X_test, Y_test)) #epoch => cycles; each cycle our models learns whole dat

Epoch 1/10
24/24 [==============================] - 4s 119ms/step - loss: 2.4633 - accuracy: 0.3724 - val_loss: 1.0604 - val_accuracy: 0.7
917
Epoch 2/10
24/24 [==============================] - 3s 112ms/step - loss: 0.5708 - accuracy: 0.9323 - val_loss: 0.3473 - val_accuracy: 0.9
323
Epoch 3/10
24/24 [==============================] - 3s 115ms/step - loss: 0.1651 - accuracy: 0.9857 - val_loss: 0.1727 - val_accuracy: 0.9
688
Epoch 4/10
24/24 [==============================] - 3s 111ms/step - loss: 0.0712 - accuracy: 0.9961 - val_loss: 0.1161 - val_accuracy: 0.9
844
Epoch 5/10
24/24 [==============================] - 3s 109ms/step - loss: 0.0390 - accuracy: 1.0000 - val_loss: 0.0925 - val_accuracy: 0.9
844
Epoch 6/10
24/24 [==============================] - 3s 107ms/step - loss: 0.0247 - accuracy: 1.0000 - val_loss: 0.0811 - val_accuracy: 0.9
844
Epoch 7/10
24/24 [==============================] - 3s 106ms/step - loss: 0.0179 - accuracy: 1.0000 - val_loss: 0.0709 - val_accuracy: 0.9
844
Epoch 8/10
24/24 [==============================] - 3s 107ms/step - loss: 0.0133 - accuracy: 1.0000 - val_loss: 0.0627 - val_accuracy: 0.9
896
Epoch 9/10
24/24 [==============================] - 3s 107ms/step - loss: 0.0105 - accuracy: 1.0000 - val_loss: 0.0592 - val_accuracy: 0.9
844
Epoch 10/10
24/24 [==============================] - 3s 107ms/step - loss: 0.0085 - accuracy: 1.0000 - val_loss: 0.0546 - val_accuracy: 0.9
896

Out[11]: <keras.src.callbacks.History at 0x21b61036550>

In [12]: test_loss, test_acc = model.evaluate(X_test, Y_test)

         print(f"Test Loss: {test_loss*100}")
         print(f"Test accuracy: {test_acc*100}")

         6/6 [==============================] - 0s 19ms/step - loss: 0.0546 - accuracy: 0.9896
         Test Loss: 5.462175607681274
         Test accuracy: 98.95833134651184
```

Fig 3.4.1: Training

3.4.2 MODEL EVALUTION

Model Evaluation consists of evaluating the trained model on the test set to assess its performance, calculating metrics such as accuracy and precision. The model will also will evaluated on real-world data of handwritten digit image.

Evaluated the model on a held-out test set to assess its performance on unseen data. The model achieved a test accuracy of above 98%.

```
In [13]: test_image_path = "img/6/65.png"
         test_image = Image.open(test_image_path)
         test_image.show()

         test_image = test_image.resize((64, 64))
         test_image = test_image.convert("L")
         test_image = np.array(test_image) / 255.0

         test_image = np.expand_dims(test_image, 0)

         # Make predictions
         predictions = model.predict(test_image)
         print(predictions)
         predicted_digit = np.argmax(predictions)


         print("Predicted Digit:", predicted_digit)

         1/1 [==============================] - 0s 131ms/step
         [[1.69910036e-05 1.13708675e-05 2.61833009e-07 2.13417536e-07
           6.33905483e-06 2.33112087e-06 9.99945283e-01 1.64560754e-09
           1.54182544e-05 1.77115669e-06]]
         Predicted Digit: 6
```

Fig 3.4.2: Validation

3.4.2 WEB APPLICATION DEVELOPMENT AND DEPLOYMENT

Saved the trained CNN model to a file. Developed a web application that allows users to upload handwritten digit images and receive predictions from the model.

By utilizing Streamlit, the model was successfully integrated with the web application. It provided seamless and user-friendly interface for users to upload images, and the model provides real-time predictions, showcasing the practical application of machine learning in a web-based environment. The deployed link is:

https://digit-recognition-cnn.streamlit.app

In our digit recognition project, we achieved remarkable results by leveraging Convolutional Neural Networks (CNNs) as our primary model architecture. By employing CNNs, we harnessed their ability to automatically learn and extract intricate features from images.

Fig 3.4.3: Web application

In our digit recognition project, we achieved remarkable results by leveraging Convolutional Neural Networks (CNNs) as our primary model architecture. By employing CNNs, we harnessed their ability to automatically learn and extract intricate features from images.

This proved instrumental in accurately classifying handwritten digits in our custom dataset, yielding impressive classification accuracy. Moreover, a pivotal aspect of our project was the creation of a bespoke dataset. This dataset was meticulously crafted to suit our specific needs and challenges, ensuring that it contained a diverse range of handwritten digits that mirrored real-world scenarios.

CHAPTER 4

CONCLUSION AND FUTURE WORK

Conclusion:

From this implementation, we are able to identify the handwritten digits as input given to the code, analyze it and predict the probability output. With the code we are able to show that written data in MS paint application can be saved. Where the saved file is now loaded into the program and will run. With a while loop, we check each image and predict the value if multiple data set files are present. With this the image is analyzed by the already learnt neural connections and the grayscale pixels. It will now provide us with a prediction of the accurate output of recognized data. So, we can successfully recognize and digitalize our data. We are successfully able to understand and use Sequential Model, ReLU, SoftMax, adam, Cross-Entropy, Accuracy functions for image recognition.

Future Work:

The future scope of digit recognition using Deep learning techniques is promising, with several exciting possibilities. Firstly, DL-based digit recognition can be extended to incorporate multiple data modalities, enabling more robust recognition systems that combine image, audio, or even sensor data. Additionally, there is significant potential for real-time applications, such as signature verification in banking, touchless payment systems, and gesture recognition in human-computer interaction, as CNNs are known for their efficiency in image pattern recognition during inference. In the medical field, DL models can play a crucial role in recognizing handwritten prescriptions and interpreting numeric data in patient records, contributing to improved healthcare. Exploring enhanced feature engineering techniques and scalability options for large datasets will further optimize CNN model performance. Moreover, continual learning methods can be implemented to adapt CNN models to evolving handwriting styles and challenges over time. Overall, DL-based digit recognition remains a relevant and adaptable technology, poised for growth in various domains, from healthcare to finance and beyond.

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