



FINAL YEAR PROJECT REPORT

**EVALUATION OF HANDWRITTEN DIGITS
USING CNN**

**In fulfillment of the requirement
For degree of
BS (COMPUTER SCIENCES)**

By

HASEEB KHAN

54173 BSCS

NAMRA ALAM

54139 BSCS

SHAHERYAR KAMAL

54167 BSCS

SUPERVISED

BY


MISS SAMEENA JAVED

BAHRIA UNIVERSITY (KARACHI CAMPUS)

FALL-2022

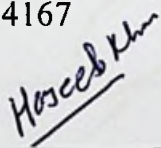
DECLARATION

We hereby declare that this project report is based on our original work except for citations and quotations which have been duly acknowledged. We also declare that it has not been previously and concurrently submitted for any other degree or award at Bahria University or other institutions.

Signature : 

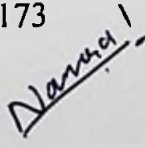
Name : Shaheryar Kamal

Reg No. : 54167

Signature : 

Name : Haseeb khan

Reg No. : 54173

Signature : 

Name : Namra Alam

Reg No. : 54139

Date : 01/02/22

The copyright of this report belongs to Bahria University according to the Intellectual Property Policy of Bahria University BUORIC-P15 amended on April 2019. Due acknowledgement shall always be made of the use of any material contained in, or derived from, this report.

© 2022 Bahria University. All right reserved.

ACKNOWLEDGEMENTS

We would like to thank everyone who had contributed to the successful completion of this project. We would like to express our gratitude to our research supervisor, Ms **Sameena Javaid** for her invaluable advice, guidance and her enormous patience throughout the development of the research.

In addition, we would also like to express my gratitude to our loving parent and friends who had helped and given me encouragement.

EVALUATION OF HANDWRITTEN DIGITS USING CNN

ABSTRACT

The objective of this project is to develop Machine learning algorithm to evaluate handwritten digits of students. This report examines various procedures utilized for the acknowledgment of handwritten digits. Various stages including collection of information, picture handling like the pre-processing stage which includes trimming of images and resizing them and afterward amplification of images and feature extraction will be examined and talked about. At last, the finished result of the calculations will be written in the tool called Jupyter Notebook

This venture utilizes the Deep Learning model to foster the product. The fundamental benefit of utilizing this is a procedure is that it gives image classification and identification that is reasonable for digit recognition. Convolution neural network (CNN) is examined and utilized in light of the fact that it turns out better for data that are addressed as grid structures.

The framework first returns with the assortment of information and pre-interaction of the gathered pictures with expansion and smoothing. Division, resizing and includes extraction are likewise acted simultaneously. Then, the feed forward process through the organization is summoned to yield a result grid. In view of the result network, the perceived person not set in stone. This framework is intended to modify the organization for a singular client. Suggestions for future turn of events and ends are additionally remembered for the report.

TABLE OF CONTENTS

DECLARATION	ii
APPROVAL FOR SUBMISSION	iii
ACKNOWLEDGEMENTS	vi
ABSTRACT	vii
TABLE OF CONTENTS	viii
LIST OF FIGURES	xii
LIST OF SYMBOLS / ABBREVIATIONS	xiii
LIST OF APPENDICES	xiv

CHAPTER

1	INTRODUCTION	1
	1.1 Background	1
	1.2 Problem Statements	1
	1.3 Aims and Objectives	2
	1.4 Scope of Project	2
2	LITERATURE REVIEW	4
	2.0 Previous Work	4
	2.1 Handwritten Digit Recognition with single layer Neural Network	5
	2.2 A Neural Network Approach for Cursive Handwritten character Recognition using Binarization	5
	2.3 Handwritten Character Recognition using CNN-ECOC	6
	2.4 Automated Grading for Handwritten Answer Sheets using CNN	6

2.5	A Comparative study on Handwritten Digit Recognition using Neural Network	6
2.6	Advancements in Image Classification using Convolutional Neural Network	7
3	DESIGN AND METHODOLOGY	9
3.1	Work Flow of the Project	9
3.2	Project Methodology	10
4	IMPLMENTATION	14
4.1	Overview of the Project	14
4.2	Custom Dataset	14
4.3	CNN Model	15
4.4	Merging MNIST Dataset	15
	4.4.1 Model Accuracy with Custom Dataset	16
	4.4.2 Model Accuracy after Merging MNIST Dataset	17
4.5	User Interface	17
4.6	Tinkter	18
5	RESULTS AND DISCUSSIONS	
5.1	Final Result	19
5.1.1	Confusion Matrix and errors evaluation	19
5.2	Graph	20
5.2.1	ROC Curves	21
	5.2.2 Precision and Recall	
	5.2.3 Training and validation graphs	
5.3	Computational time	
5.4	Real time Prediction on Digits	
5.4.1	Prediction from pictures	24
5.5	Failure Results	25
5.6	Discussion	26