

**UNIVERSITI TEKNOLOGI MARA**

**PREDICTION ON WEATHER  
FORECAST BASED ON CLOUD  
SHAPES USING CNN**

**MUHAMMAD ASHRAFF BIN NOOR AZMI**

**BACHELOR OF COMPUTER SCIENCE (Hons.)**

**FEBRUARY 2024**

## ACKNOWLEDGEMENT

Alhamdulillah, with gratitude and thanks to Allah for His Almighty and abundant blessings, I am pleased to acknowledge the essential contributors to the successful completion of this research endeavor. Foremost, my deepest appreciation goes to my supervisor, Madam Siti 'Aisyah, whose unwavering support and guidance were instrumental in bringing this project to fruition. Without her expertise and encouragement, this accomplishment would not have been possible. Additionally, I am thankful to Madam Ummu Fatimah, my lecturer for CSP 600/CSP650, for sharing her knowledge, providing support, and being a source of inspiration throughout the entire semester.

I reserve a special expression of gratitude for my beloved family members, whose love and support have been the cornerstone of my journey. My parents, in particular, deserve heartfelt recognition for their enduring encouragement, both emotionally and through their unwavering presence. Their sacrifices, understanding, and financial support during challenging times have been the bedrock upon which this achievement stands. In their love and support, I find not only the motivation to persevere but also a profound source of strength that has propelled me forward. Finally, I wish to convey deep appreciation to my friends who accompanied me throughout my academic journey. Their relentless support and continuous encouragement have proven invaluable, and I extend my gratitude for their active involvement in realizing both this project and my academic journey.

## ABSTRACT

This thesis aims to address the challenges in weather forecasting, particularly the reliance on hardware-intensive methods and the limited coverage of weather stations in inhabited regions by analyzing clouds, with their diverse shapes and colors, serve as vital indicators for predicting atmospheric conditions. Recognizing the impact of cloud shapes on temperature regulation, meteorologists traditionally rely on large computer systems for weather prediction. To overcome the limitations of traditional methods, this research proposes a system utilizing Convolutional Neural Networks (CNN) for accurate weather prediction based on cloud shapes. The CNN model is designed to process visual information, identify cloud patterns, and forecast weather conditions with improved accuracy, speed, and reduced model size. Remote weather stations are recommended to broaden weather monitoring coverage, especially in isolated regions where dependence on inhabited-area stations can lead to delayed or incomplete information, posing risks to agriculture and resource management. The development phase focuses on implementing the CNN algorithm specifically for weather prediction based on cloud shapes. The results demonstrate the model's effectiveness, emphasizing the importance of balancing training and testing datasets with an accuracy of 93.59%. Evaluation results indicate that the Customized Xception Model with Intermediate Dense Layer outperforms the Simplified Xception Model, with an average accuracy of 0.915 compared to 0.88. This notable accuracy difference highlights the superiority of the Customized Xception Model with an Intermediate Dense Layer. Consequently, this model is selected as the system of choice. In conclusion, this project successfully achieves its objectives by proposing a CNN-based approach for accurate weather prediction, addressing the limitations of traditional methods. The research highlights the potential of remote weather stations to enhance coverage and reduce risks associated with incomplete information. While acknowledging limitations, this work serves as a foundation for future system improvements, emphasizing the positive contributions made in advancing weather prediction methodologies.

# TABLE OF CONTENT

<b>CONTENT</b>	<b>PAGE</b>
<b>SUPERVISOR APPROVAL</b>	<b>i</b>
<b>STUDENT DECLARATION</b>	<b>ii</b>
<b>ACKNOWLEDGEMENT</b>	<b>iii</b>
<b>ABSTRACT</b>	<b>iv</b>
<b>TABLE OF CONTENT</b>	<b>v</b>
<b>LIST OF FIGURE</b>	<b>viii</b>
<b>LIST OF TABLES</b>	<b>xi</b>
<b>CHAPTER 1</b>	<b>1</b>
1.1 Background Study	1
1.2 Problem Statement	2
1.3 Research Objectives	4
1.4 Scopes	5
1.5 Significance	6
1.6 Overview of Research Framework	7
1.7 Conclusion	9
<b>CHAPTER 2</b>	<b>11</b>
2.1 Introduction	11
2.2 Related Research on Prediction on Weather Forecast	12
2.2.1 Definition and Characteristics of Cloud Shapes	13
2.2.2 Techniques for Prediction On Weather Forecast	14
2.3 Convolutional Neural Network (CNNs)	17
2.3.1 Definition of CNNs and How Does CNNs Works	17
2.3.2 Recent Advancement in CNNs	19
2.3.3 General Application of CNNs	20
2.3.4 Applications of CNNs in Image Processing	21

2.4	Implementation of CNNs in Image Prediction	22
2.5	Similar Works	36
2.6	Implication of Literature Review	46
2.7	Conclusion	48
	<b>CHAPTER 3</b>	<b>50</b>
3.1	Overview of Research Framework Methodology	50
3.1.1	Detailed Content of Research Framework	50
3.2	Preliminary Study	53
3.2.1	Literature Study	53
3.2.2	Data Collection	54
3.2.3	Data Pre-Processing	56
3.3	Design	59
3.3.1	Prototype Architecture	59
3.3.3	Prototype Pseudocode	60
3.3.4	User Interface of Prototype	61
3.4	Development	62
3.5	Performance Evaluation	64
3.5.1	Confusion Matrix	64
3.5.2	Application Evaluation	65
3.6	Gantt Chart	66
3.7	Conclusion	66
	<b>CHAPTER 4</b>	<b>67</b>
4.1	Conceptual Framework	67
4.2	Results for Objective 1	69
4.2.1	Analysis of Literature Review on CNN	69
4.2.2	Library and Packages Used	71
4.3	Results for Objective 2	72
4.3.1	Input Representation	72