



## **PROJECT REPORT**

### **POTATO AND TOMATO DISEASES DETECTION USING CONVOLUTIONAL NEURAL NETWORK**

**NICHOLAS AUDREY SATYA**  
**18.K1.0069**

**Faculty of Computer Science  
Soegijapranata Catholic University  
2022**

## HALAMAN PENGESAHAN



Judul Tugas Akhir: : Potato and Tomato Diseases Detection using Convolutional Neural Network

Diajukan oleh : NICHOLAS AUDREY SATYA

NIM : 18.K1.0069

Tanggal disetujui : 30 Januari 2023

Telah setuju oleh

Pembimbing : Yulianto Tejo Putranto S.T., M.T.

Penguji 1 : Yonathan Purbo Santosa S.Kom., M.Sc

Penguji 2 : Hironimus Leong S.Kom., M.Kom.

Penguji 3 : R. Setiawan Aji Nugroho S.T., MCompIT., Ph.D

Penguji 4 : Rosita Herawati S.T., M.I.T.

Penguji 5 : Y.b. Dwi Setianto S.T., M.Cs.

Penguji 6 : Yulianto Tejo Putranto S.T., M.T.

Ketua Program Studi : Rosita Herawati S.T., M.I.T.

Dekan : Dr. Bernardinus Harnadi S.T., M.T.

Halaman ini merupakan halaman yang sah dan dapat diverifikasi melalui alamat di bawah ini.

[sintak.unika.ac.id/skripsi/verifikasi/?id=18.K1.0069](http://sintak.unika.ac.id/skripsi/verifikasi/?id=18.K1.0069)

## DECLARATION OF AUTHORSHIP

I, the undersigned:

Name : NICHOLAS AUDREY SATYA

ID : 18.K1.0069

declare that this work, titled "POTATO AND TOMATO DISEASES DETECTION USING CONVOLUTIONAL NEURAL NETWORK", and the work presented in it is my own. I confirm that:

1. This work was done wholly or mainly while in candidature for a research degree at Soegijapranata Catholic University
2. Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated.
3. Where I have consulted the published work of others, this is always clearly attributed.
4. Where I have quoted from the work of others, the source is always given.
5. Except for such quotations, this work is entirely my own work.
6. I have acknowledged all main sources of help.
7. Where the work is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself.

Semarang, January, 31, 2023



NICHOLAS AUDREY SATYA

18.K1.0069

## HALAMAN PERNYATAAN PUBLIKASI KARYA ILMIAH UNTUK KEPENTINGAN AKADEMIS

Yang bertanda tangan dibawah ini:

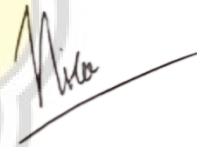
Nama : Nicholas Audrey Satya  
Program Studi : Teknik Informatika  
Fakultas : Ilmu Komputer  
Jenis Karya : Skripsi

Menyetujui untuk memberikan kepada Universitas Katolik Soegijapranata Semarang Hak Bebas Royalti Noneksklusif atas karya ilmiah yang berjudul "POTATO AND TOMATO DISEASES DETECTION USING CONVOLUTIONAL NEURAL NETWORK". Dengan Hak Bebas Royalti Noneksklusif ini Universitas Katolik Soegijapranata berhak menyimpan, mengalihkan media/formatkan, mengelola dalam bentuk pangkalan data (database), merawat, dan mempublikasikan tugas akhir ini selama tetap mencantumkan nama saya sebagai penulis / pencipta dan sebagai pemilik Hak Cipta.

Demikian pernyataan ini saya buat dengan sebenarnya.

Semarang, 31 Januari 2023

Yang menyatakan



NICHOLAS AUDREY SATYA

18.K1.0069

## ACKNOWLEDGMENT

First of all, I would like to express my praise and gratitude to the presence of God Almighty for His blessings and gifts, so that I can complete thesis successfully. This thesis is intended as a graduation requirement of the Bachelor of Computer Science in the Informatics Engineering Study Program, Soegijapranata Catholic University, Semarang.

Of course, in working on the thesis, I can not be separated from the people who support me to achieve my goals and success. With all respect and humility, I would like to thank :

1. My father and mother who always support and pray for me during the completion of this thesis.
2. Yulianto Tejo Putranto, S.T., M.T. as my supervisor who has provided guidance and advice to me, so that this thesis can be completed properly.
3. To all my friends and environment who have supported and shaped me to this day and the big family of Unika Soegijapranata, especially the Faculty of Computer Science, that has facilitated and prepared all the college needs that I need so that I can study comfortably and complete my studies.

Hopefully , this thesis can be accepted and also it can be further developed to be even better.

Semarang, January, 31, 2023



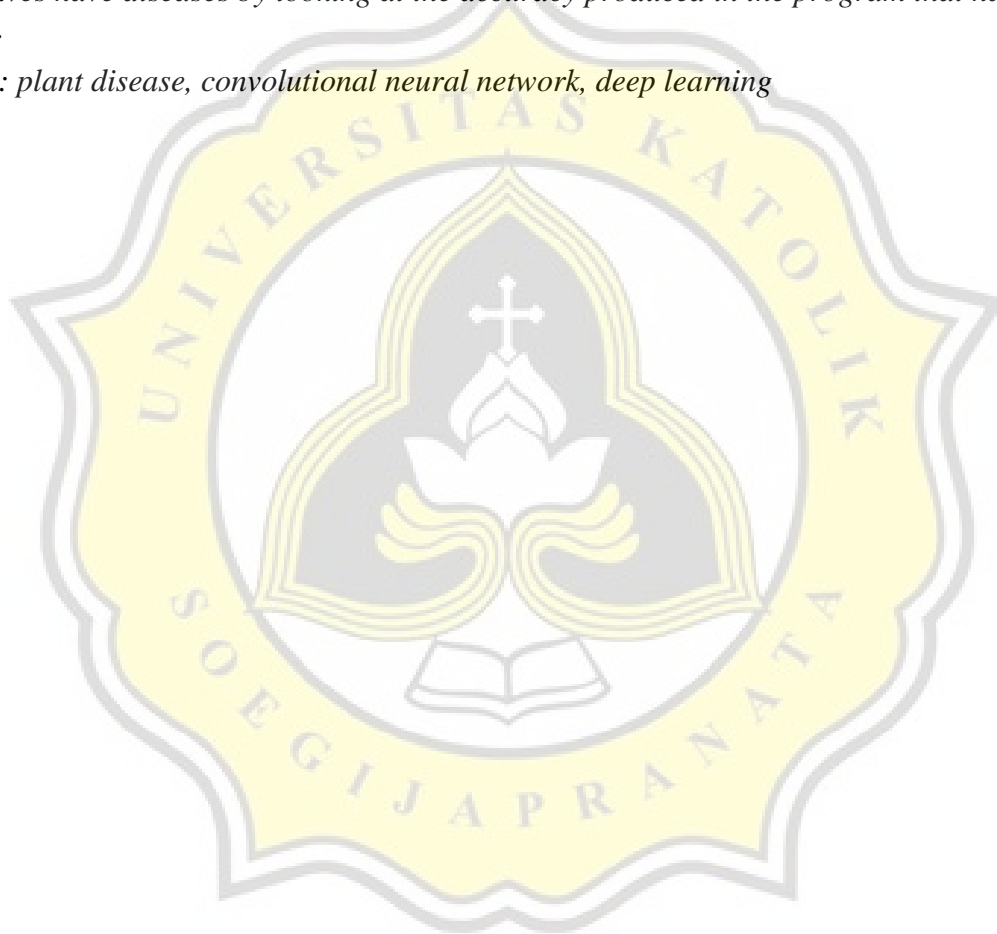
NICHOLAS AUDREY SATYA

18.K1.0069

## **ABSTRACT (ABSTRACT TITLE)**

*Potatoes and tomatoes are important raw materials used by humans in everyday life. In managing the two plants, they certainly experience obstacles, including diseases that attack potato leaves and tomatoes which if left unchecked will produce production a bad one or even a crop failure. Late blight and early blight are frequent diseases found on potato leaves and tomatoes. By utilizing technology, namely in the form of digital image processing, this can be overcome, so in this study will propose appropriate methods of detecting diseases of potato leaves and tomatoes. Classification will be done with three classes in the form of healthy leaves, early blight, and late blight using the Deep Learning method uses a Convolutional Neural Network (CNN) architecture. In this research, it will be detected which leaves are healthy and which leaves have diseases by looking at the accuracy produced in the program that has been designed.*

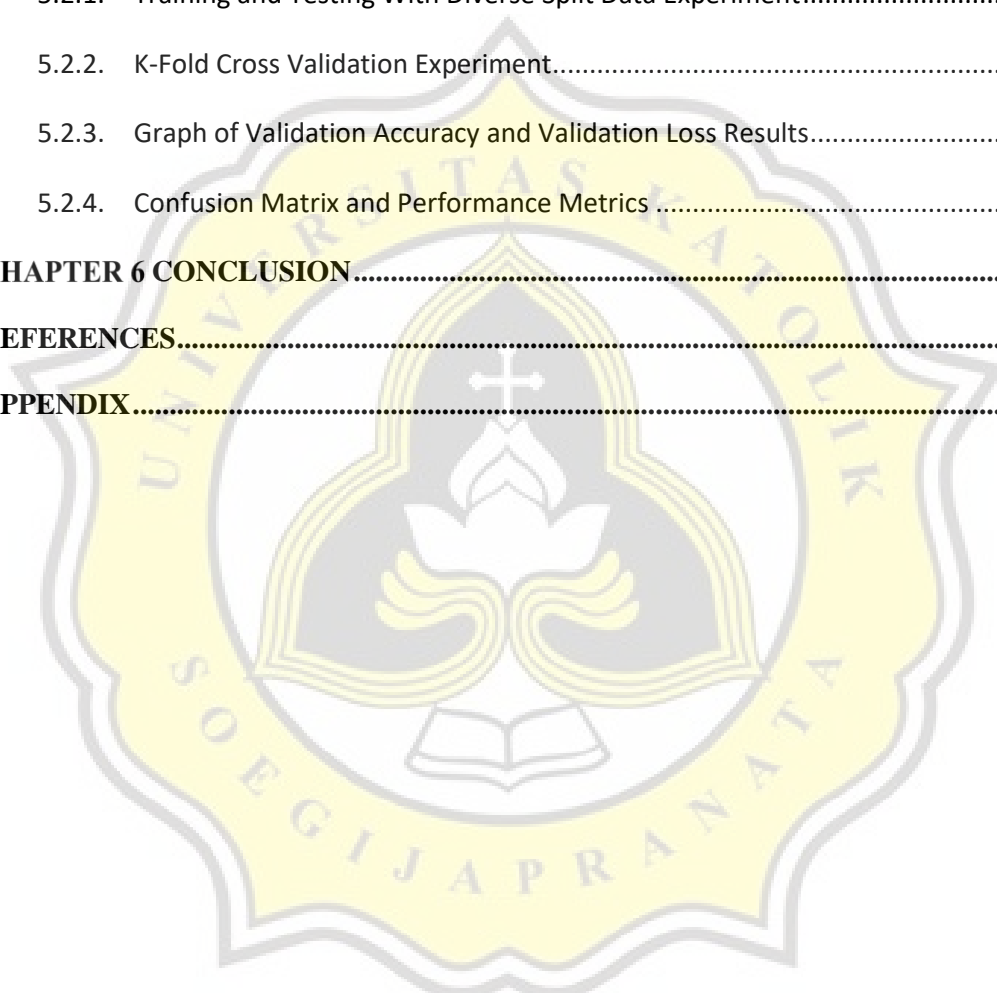
*Keyword: plant disease, convolutional neural network, deep learning*



# TABLE OF CONTENTS

<b>COVER</b> .....	<b>i</b>
<b>DECLARATION OF AUTHORSHIP</b> .....	<b>iii</b>
<b>HALAMAN PERNYATAAN PUBLIKASI KARYA ILMIAH UNTUK KEPENTINGAN AKADEMIS</b> .....	<b>iv</b>
<b>ACKNOWLEDGMENT</b> .....	<b>v</b>
<b>TABLE OF CONTENTS</b> .....	<b>vii</b>
<b>LIST OF FIGURE</b> .....	<b>ix</b>
<b>LIST OF TABLE</b> .....	<b>xi</b>
<b>CHAPTER 1 INTRODUCTION</b> .....	<b>12</b>
1.1. Background.....	12
1.2. Problem Formulation .....	13
1.3. Scope.....	13
1.4. Objective.....	13
<b>CHAPTER 2 LITERATURE STUDY</b> .....	<b>14</b>
<b>CHAPTER 3 RESEARCH METHODOLOGY</b> .....	<b>18</b>
3.1. Research Process.....	18
3.2. Collecting Datasets .....	18
3.3. Base of Convolutional Neural Network.....	19
3.3.1 Convolution Layer .....	19
3.3.2. Pooling Layer.....	20
3.3.3. Fully Connected Layer.....	21
3.4. MobileNet Architecture of Convolutional Neural Network .....	21
3.5. Splitting Data Into 80% Data Training and 20% Data Testing.....	22
3.6. K-Fold Cross Validation .....	24
<b>CHAPTER 4 ANALYSIS AND DESIGN</b> .....	<b>26</b>

4.1. Analysis.....	26
4.2. Design .....	28
<b>CHAPTER 5 IMPLEMENTATION AND RESULTS .....</b>	<b>31</b>
5.1. Implementation .....	31
5.2. Results.....	38
5.2.1. Training and Testing With Diverse Split Data Experiment.....	38
5.2.2. K-Fold Cross Validation Experiment.....	41
5.2.3. Graph of Validation Accuracy and Validation Loss Results.....	42
5.2.4. Confusion Matrix and Performance Metrics .....	42
<b>CHAPTER 6 CONCLUSION.....</b>	<b>45</b>
<b>REFERENCES.....</b>	<b>46</b>
<b>APPENDIX.....</b>	<b>a</b>





## LIST OF FIGURE

<b>Figure 3.1</b> : CNN Architecture.....	19
<b>Figure 3.2</b> : Convolution Layer.....	20
<b>Figure 3.3</b> : Pooling Layer .....	20
<b>Figure 3.4</b> : Fully Connected Layer .....	21
<b>Figure 3.1</b> : MobileNet Architecture.....	22
<b>Figure 3.1</b> Dataset Split Chart.....	23
<b>Figure 3.1</b> : 10 Fold-Cross Validation Illustration.....	24
<b>Figure 4.1</b> : Flowchart Design of the Program.....	29
<b>Figure 5.1</b> : Import libraries and packages .....	31
<b>Figure 5.2</b> : Convert image to array .....	32
<b>Figure 5.3</b> : Load the dataset.....	33
<b>Figure 5.4</b> : Convert the image labels to binary .....	33
<b>Figure 5.5</b> : Pre-process input data.....	33
<b>Figure 5.6</b> : Split data to train, test.....	34
<b>Figure 5.7</b> : Create image generator.....	34
<b>Figure 5.8</b> : Create the MobileNet Model.....	35
<b>Figure 5.9</b> : Training the model .....	36
<b>Figure 5.10</b> : Plotted a graph.....	36
<b>Figure 5.11</b> : Calculated the accuracy .....	37
<b>Figure 5.12</b> : Predict the results .....	37
<b>Figure 5.13</b> : Confusion Matrix.....	37
<b>Figure 5.14</b> : Performance Metrics .....	38
<b>Figure 5.1</b> : (a) Cross Validation with k=5 and (b) Cross Validation with k=10 .....	41

**Figure 5.1** : (a) Graph of Validation Accuracy and (b) Graph of Validation Loss ..... 42

**Figure 5.1** : Confusion Matrix Results ..... 43

**Figure 5.2** : Performance Metrics Results ..... 44



## LIST OF TABLE

<b>Table 3.1.</b> Samples of Dataset.....	19
<b>Table 4.1.</b> Parameters used in the CNN model .....	28
<b>Table 5.1.</b> First Experiments .....	39
<b>Table 5.2.</b> Second Experiments.....	39
<b>Table 5.3.</b> Third Experiments.....	39
<b>Table 5.4.</b> Fourth Experiments.....	40
<b>Table 5.5.</b> Fifth Experiments.....	40

