

## CONTENTS

<b>FOREWORD.....</b>	<b>i</b>
<b>CONTENTS.....</b>	<b>ii</b>
<b>LIST OF TABLES.....</b>	<b>v</b>
<b>LIST OF FIGURES.....</b>	<b>vi</b>
<b>ABSTRACT .....</b>	<b>viii</b>
<b>INTISARI .....</b>	<b>ix</b>
<b>CHAPTER I .....</b>	<b>1</b>
<b>INTRODUCTION .....</b>	<b>1</b>
1.1 Research Background .....	1
1.2 Research Problem .....	3
1.3 Research Objective .....	4
1.4 Research Scope .....	4
1.5 Research Benefit .....	5
1.6 Research Methodology .....	5
1.7 Writing Systematics .....	6
<b>CHAPTER II.....</b>	<b>8</b>
<b>LITERATURE REVIEW.....</b>	<b>8</b>
<b>CHAPTER III.....</b>	<b>12</b>
<b>FUNDAMENTAL THEORY.....</b>	<b>12</b>
3.1 2D Game .....	12
3.2 Top-Down Perspective Game.....	14
3.3 Simulation Game .....	15
3.4 Unity Game Engine .....	16
3.5 Pathfinding .....	17
3.5.1 A* Algorithm .....	17
3.5.2 Breadth First Search Algorithm .....	19
3.5.3 Dijkstra Algorithm .....	21
3.5.4 Greedy Best First Algorithm .....	22

3.6 NPC (Non-Playable Character) . . . . .	23
3.7 Graph Representation . . . . .	25
3.7.1 Grid Search Graph . . . . .	25
<b>CHAPTER IV. . . . .</b>	<b>27</b>
<b>ANALYSIS AND DESIGN . . . . .</b>	<b>27</b>
4.1 Research Description . . . . .	27
4.2 Research Stages . . . . .	29
4.3 Research Workflow . . . . .	30
4.4 System Planning . . . . .	32
4.4.1 System Requirements. . . . .	32
4.4.2 Use Case Diagram . . . . .	32
4.4.3 Class Diagram . . . . .	35
4.4.4 Activity Diagram . . . . .	36
4.4.5 Pathfinding Algorithm Planning . . . . .	37
4.5 Application and Model Design. . . . .	38
4.6 Implementation . . . . .	38
4.6.1 Tools and Materials . . . . .	38
4.6.2 Implementation of Pathfinding A* Algorithm . . . . .	42
4.6.3 Algorithm Evaluation Planning. . . . .	42
<b>CHAPTER V. . . . .</b>	<b>44</b>
<b>IMPLEMENTATION . . . . .</b>	<b>44</b>
5.1 Tools and Materials . . . . .	44
5.2 System Implementation. . . . .	44
5.2.1 Main Menu . . . . .	45
5.2.2 Scene Transition . . . . .	46
5.2.3 Scene Controller. . . . .	47
5.2.4 Pathfinding Implementation. . . . .	49
5.2.5 Priority Queue . . . . .	55
5.2.6 Map Data . . . . .	58



5.2.7 Graph and Graph View .....	62
5.2.8 Demo Controller .....	64
<b>CHAPTER VI .....</b>	<b>66</b>
<b>RESULT AND EVALUATION .....</b>	<b>66</b>
6.1 Simulation Testing .....	66
<b>CHAPTER VII .....</b>	<b>74</b>
<b>CONCLUSION AND FUTURE WORK .....</b>	<b>74</b>
7.1 Conclusion .....	74
7.2 Future Work .....	74
<b>REFERENCES .....</b>	<b>75</b>

## LIST OF TABLES

Table 2.1: Comparison table of A* pathfinding algorithms implementations. . . . .	11
Table 4.1: Explanation of the Use Case Diagram . . . . .	33
Table 4.2: List of Tools for this Research. . . . .	39
Table 4.3: Hardware Specifications. . . . .	39
Table 4.4: Proposed Evaluation Table . . . . .	70
Table 6.1: Path length of each floor simulation . . . . .	70
Table 6.2: Running time of each floor simulation . . . . .	71
Table 6.3: Average path length and running time of each floor simulation. . . . .	71

## LIST OF FIGURES

Figure 3.1: 2D and 3D Game Axis Comparison . . . . .	12
Figure 3.2: Top-Down and Isometric Grid Comparison . . . . .	14
Figure 3.3: A* Search Algorithm Example. . . . .	19
Figure 3.4: Grid Graph Illustration . . . . .	26
Figure 3.5: Zoomed-in Grid Graph Illustration . . . . .	26
Figure 4.1: Research Stages. . . . .	29
Figure 4.2: Research Workflow . . . . .	31
Figure 4.3: Use Case Diagram . . . . .	33
Figure 4.4: Class Diagram. . . . .	35
Figure 4.5: Activity Diagram. . . . .	36
Figure 4.6: A* Algorithm Flowchart . . . . .	37
Figure 4.7: First floor of the FMIPA UGM building . . . . .	40
Figure 4.8: Second floor of the FMIPA UGM building . . . . .	40
Figure 4.9: Third floor of the FMIPA UGM building . . . . .	41
Figure 4.10: Fourth floor of the FMIPA UGM building . . . . .	41
Figure 4.11: Fifth floor of the FMIPA UGM building . . . . .	42
Figure 5.1: Main Menu Mockup . . . . .	45
Figure 5.2: Scene Transition Script. . . . .	46
Figure 5.3: Scene Controller Script. . . . .	47
Figure 5.4: Class and Variables in Pathfinding Script . . . . .	49
Figure 5.5: Breadth First Search Pathfinding Script . . . . .	51
Figure 5.6: Dijkstra Pathfinding Script . . . . .	52
Figure 5.7: Greedy Best First Pathfinding Script . . . . .	53
Figure 5.8: A* Pathfinding Script . . . . .	55
Figure 5.9: Priority Queue Initialization . . . . .	56
Figure 5.10: Priority Queue Enqueue. . . . .	57
Figure 5.11: Priority Queue Dequeue. . . . .	57

Figure 5.12: Priority Queue Peek, List and Contains Method. ....	58
Figure 5.13: Map Data Initialization . . . . .	59
Figure 5.14: Awake Method . . . . .	60
Figure 5.15: Get Map Text Asset . . . . .	60
Figure 5.16: Get Map Texture 2D . . . . .	61
Figure 5.17: Graph Initialization . . . . .	62
Figure 5.18: Vector Directions . . . . .	63
Figure 5.19: Demo Controller Initialization. . . . .	64
Figure 5.20: Demo Controller Start Method . . . . .	65
Figure 6.1: First Floor of the simulation . . . . .	67
Figure 6.2: First Second of the simulation. . . . .	68
Figure 6.3: Third Floor of the simulation . . . . .	68
Figure 6.4: Fourth Floor of the simulation . . . . .	69
Figure 6.5: Fifth Floor of the simulation. . . . .	70