

**Final Year Project Report
Tour Guide Robot**



Project Advisor:

Dr.Muhammad Umar Suleman

Submitted By:

Farseen Ashraf (14024020176)

Maria Ahsan (14024020173)

Naima (14024020104)

Session: 2014-2018

**University of Management and Technology
C-II Johar Town Lahore Pakistan**

Dedication

We dedicate our project to our parents whose endless support and unconditional love enabled us to be at this stage today and our teacher Mr. Umar Suleman, whose continuous guidance helped us to complete this task.

Supervisor's Approval

I have carefully examined the documentation of the Final Year Project titled "*Project Title*"; and I endorse that this documentation complies with the standards of an undergraduate level Final Year Project report.

Moreover, I have also checked for the plagiarism beyond Turnitin in the documentation and I am convinced that this documentation is not plagiarized.

Signature: _____

Date: _____

Thesis Similarity Report

Turnitin Originality Report

Tour Guide Robot by Farseen Ashraf, Maria Ahsan and Naima

From Learning resource development (LRD)

- Processed on 27-Sep-2018 12:10 PKT
- ID: 1009312332
- Word Count: 23394

Similarity Index

12%

Similarity by Source

Internet Sources:

7%

Publications:

3%

Student Papers:

7%

Sources:

2% match (Internet from 30-May-2018)

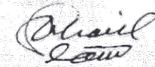
<https://medium.com/@ageitgey/machine-learning-is-fun-part-4-modern-face-recognition-with-deep-learning-c3cffc121d78>

2% match (Internet from 05-Apr-2018)

<https://stackoverflow.com/questions/1332466/how-does-dijkstras-algorithm-and-a-star-compare>



Checked by



Verified by CLO

Note:

- Sometimes the overall similarity index may be a smaller than the repository percentages combined. This would be due to overlapping text within the repositories.
- It is a system generated report.

Final Approval

Panel of Examiners

- **Head of Department**
Department of Computer Science
UMT Lahore

- **Program Director (Final Year Projects)**
Department of Computer Science
UMT Lahore

- **Supervisor**
Department of Computer Science
UMT Lahore

- **Co-Supervisor**

Project Title Tour Guide Robot

Undertaken by Dr. Umar Suleman

Supervised by Dr. Umar Suleman

Starting Date 20 September 2017

Completion Date 25 July2018

Tools Used

- IP webcam
- Android Studio
- Java
- Opencv
- Openface
- Python
- Pycharm

Operating System Ubuntu, windows

Acknowledgement

We would like to thank Almighty Allah who helped us a lot throughout our journey to complete our project. We are very grateful to our faculty members who have worked so hard in order to make us learn new technologies and knowledge. We are extremely blessed to have great teachers Dr. Umar Suleman and Dr. Adnan Shahzada as our supervisors who has guided us so competently throughout our project and actuate us to accomplish our tasks. In the success of our project they hold a specific place. Their technical advices and recommendations were the key factor behind the completion of our project.

Abstract

As technology developed, artificial intelligence has been used to make machines more capable of serving people in much more diverse areas and better than ever before. In recent years, artificial intelligence has become more and more applicable in our society due to its functionalities and utility. One of the major field where artificial intelligence has great impact is robotics. In the beginning, robots were automated machines and they only performed a limited number of tasks, but with the passage of time, their usefulness has increased. Throughout these years, engineers and scientists are trying to improve robotic capabilities to the point that they are comparable to human abilities in several aspects.

One application where human and robot interaction is rising is the tour guide robot. The lack of tourist guide is common therefore to fulfill the requirements of guide many autonomous tour guide robots have been built to ease the process of tourists guides. These robots have replaced the current human guide. In order to properly guide the tourists there are guides provided to help them. The lack of tourist guide is common therefore to fulfill the requirements of guide many autonomous tour guide robots have been built to ease the process of tourist guides. These robots have replaced the current human guide.

Hence, we decided to work on a tour guide robot which will be helpful for its organization saving the manpower and giving the tour to the tourists by itself. Tour guide autonomous Robot specifically design for tourists, and it will provide them information about places they are seeing for the first time. It will move on the dynamic paths based on predefined map fed in it. It will provide information to the tourists about all the persons whose facial information has been stored in the system. It will move between any two coordinates given by the user and we demand it to take the shortest route in order to move between two coordinates. We also want the robot to provide information to the tourists about places around it upon reaching specific coordinates.

In this paper we describe the complete architecture of “Tour Guide Robot”. We use Histogram of Oriented Gradients algorithm for face detection. As our Robot has to recognize the specific persons so, for recognition of face we use deep learning algorithm called “Convolutional Neural Networks”. We use many computer vision techniques in our project. Tour guide robot enabled to navigate at high speed through crowds and also capable to reliably avoiding collisions with obstacles. For voice synthesis we use “espeak” library.

For hurdle detection we used triangle similarity. First of all, we calibrated the system for the calculation of focal length and for that we gave an image containing objects whose distance from the camera was known. On the basis of this calculation we substituted the values in our equation and are capable of finding the distances of unknown images from the camera. Several laser light spots are used as the object in the image from which the distance to the camera is to be calculated

For navigation, we manually made the map of the area in which we want to operate our robot. Then we specified the directions for the map i.e. east, west, north and south. We found the path between two specific coordinates by using the A steric algorithm. Then on the basis of on which direction our robot is facing we moved the robot from a specific coordinate to another coordinate.

Revision Chart

Version	Primary Author(s)	Description of Version	Date Completed
1.0	Naima	Initial draft created for distribution and review comments	01-02-2018
1.1	Maria	Second draft incorporating initial review comments, distributed for final review	03-02-2018
1.2	Maria	First complete draft, which is placed under change control	05-02-2018
1.3	Farseen	Revised draft, revised according to the change control process and maintained under change control	06-02-2018
1.4	Naima	Revised draft, revised according to the change control process and maintained under change control	11-02-2018
1.5	Farseen	Testing	20-05-2018
1.6	Naima	Module Updating	01-07-2018
1.7	Maria	Uses Cases and Updated decision tables	15-07-2018
Final	Maria	Final version	25-07-2018

CONTENTS

CONTENTS	1
DEFINITIONS AND ACRONYMS	4
LIST OF FIGURES	5
LIST OF TABLES	6
1. INTRODUCTION	8
1.1 MOTIVATIONS.....	8
1.2 PROJECT OVERVIEW	ERROR! BOOKMARK NOT DEFINED.
1.2.1 <i>Target Users:</i>	<i>Error! Bookmark not defined.</i>
1.3 PROBLEM STATEMENT.....	ERROR! BOOKMARK NOT DEFINED.
1.4 OBJECTIVES	ERROR! BOOKMARK NOT DEFINED.
1.4.1 <i>Face Detection</i>	<i>Error! Bookmark not defined.</i>
1.4.2 <i>Posing and Projecting Faces:</i>	<i>Error! Bookmark not defined.</i>
1.4.3 <i>Encoding faces:</i>	<i>Error! Bookmark not defined.</i>
1.4.4 <i>Face Recognition:</i>	<i>Error! Bookmark not defined.</i>
1.4.5 <i>Hurdle Detection:</i>	<i>Error! Bookmark not defined.</i>
1.4.6 <i>Path Finding:</i>	<i>Error! Bookmark not defined.</i>
1.4.7 <i>Robot Movement:</i>	<i>Error! Bookmark not defined.</i>
1.4.8 <i>Voice Synthesis upon Face Recognition:</i>	<i>Error! Bookmark not defined.</i>
1.4.9 <i>Voice Synthesis for Pointing Location:</i>	<i>Error! Bookmark not defined.</i>
2. DOMAIN ANALYSIS.....	ERROR! BOOKMARK NOT DEFINED.
2.1 CUSTOMERS	ERROR! BOOKMARK NOT DEFINED.
2.2 STAKEHOLDERS	ERROR! BOOKMARK NOT DEFINED.
2.3 AFFECTED GROUPS WITH SOCIAL OR ECONOMIC IMPACT	ERROR! BOOKMARK NOT DEFINED.
2.3.1 <i>Affected factors regarding social/economic impacts:</i>	<i>Error! Bookmark not defined.</i>
2.4 DEPENDENCIES/ EXTERNAL SYSTEMS.....	ERROR! BOOKMARK NOT DEFINED.
2.4.1 <i>Hardware components:</i>	<i>Error! Bookmark not defined.</i>
2.4.2 <i>Applications/software components:</i>	<i>Error! Bookmark not defined.</i>
2.5 REFERENCE DOCUMENTS.....	ERROR! BOOKMARK NOT DEFINED.
2.5.1 <i>Related Projects</i>	<i>Error! Bookmark not defined.</i>
2.5.2 <i>Feature Comparison:</i>	<i>Error! Bookmark not defined.</i>
3. REQUIREMENTS ANALYSIS	ERROR! BOOKMARK NOT DEFINED.
3.1 REQUIREMENTS	ERROR! BOOKMARK NOT DEFINED.
3.1.1 <i>Functional Requirements:</i>	<i>Error! Bookmark not defined.</i>
3.1.2 <i>Non-Functional Requirements:</i>	<i>Error! Bookmark not defined.</i>
3.1.3 <i>Data Requirements:</i>	<i>Error! Bookmark not defined.</i>
3.1.4 <i>External Interface Requirements:</i>	<i>Error! Bookmark not defined.</i>
3.1.5 <i>RID</i>	<i>Error! Bookmark not defined.</i>
3.2 LIST OF ACTORS.....	ERROR! BOOKMARK NOT DEFINED.
3.2.1 <i>List of use cases</i>	<i>Error! Bookmark not defined.</i>
3.3 SYSTEM USE-CASES:	ERROR! BOOKMARK NOT DEFINED.
3.3.1 <i>Send image from robot</i>	<i>Error! Bookmark not defined.</i>
3.3.2 <i>Receive images on system</i>	<i>Error! Bookmark not defined.</i>
3.3.3 <i>Face Detection:</i>	<i>Error! Bookmark not defined.</i>
3.3.4 <i>Posing and Projecting Faces:</i>	<i>Error! Bookmark not defined.</i>
3.3.5 <i>Encoding faces:</i>	<i>Error! Bookmark not defined.</i>

3.3.6	Face Recognition:	<i>Error! Bookmark not defined.</i>
3.3.7	Hurdle Detection:	<i>Error! Bookmark not defined.</i>
3.3.8	Path Finding:	<i>Error! Bookmark not defined.</i>
3.3.9	Robot Movement:	<i>Error! Bookmark not defined.</i>
3.3.10	Voice Synthesis upon Face Recognition:	<i>Error! Bookmark not defined.</i>
3.3.11	Voice Synthesis for Pointing Location:	<i>Error! Bookmark not defined.</i>
3.4	SYSTEM USE CASE DIAGRAM	ERROR! BOOKMARK NOT DEFINED.
3.5	EXTENDED USE CASES:	ERROR! BOOKMARK NOT DEFINED.
3.5.1	Use Case 1: Send image from robot:	<i>Error! Bookmark not defined.</i>
3.5.2	Use Case 2: Receive images on the system:	<i>Error! Bookmark not defined.</i>
3.5.3	Use Case 3: Face Detection	<i>Error! Bookmark not defined.</i>
3.5.4	Use Case 4: Posing and projection of Face	<i>Error! Bookmark not defined.</i>
3.5.5	Use Case 5: Encoding Faces	<i>Error! Bookmark not defined.</i>
3.5.6	Use Case 6: Face Recognition	<i>Error! Bookmark not defined.</i>
3.5.7	Use Case 7: Hurdle Detection	<i>Error! Bookmark not defined.</i>
3.5.8	Use Case 8: Robot Movement	<i>Error! Bookmark not defined.</i>
3.5.9	Use Case 9: Path Finding	<i>Error! Bookmark not defined.</i>
3.5.10	Use Case 10: Speech Synthesis on Face Recognition	<i>Error! Bookmark not defined.</i>
3.5.11	Use Case 11: Speech Synthesis on Reaching specific places ...	<i>Error! Bookmark not defined.</i>
3.6	USER INTERFACES (MOCK SCREENS)	ERROR! BOOKMARK NOT DEFINED.
3.6.1	Module 1: Face Detection:	<i>Error! Bookmark not defined.</i>
3.6.2	Module 2: Posing and Projecting of Faces	<i>Error! Bookmark not defined.</i>
3.6.3	Module 3: Encoding Face:	<i>Error! Bookmark not defined.</i>
3.6.4	Module 4: Face Recognition:	<i>Error! Bookmark not defined.</i>
3.6.5	Module 5. Distance Measurements:	<i>Error! Bookmark not defined.</i>
3.6.6	Module 6. Path Finding:	<i>Error! Bookmark not defined.</i>
3.6.7	Module 7. Robot Movement	<i>Error! Bookmark not defined.</i>
3.6.8	Module 8. Voice Synthesis upon Face Recognition:...	<i>Error! Bookmark not defined.</i>
3.6.9	Module 9. Voice Synthesis for pointing locations:	<i>Error! Bookmark not defined.</i>
4.	SYSTEM DESIGN	ERROR! BOOKMARK NOT DEFINED.
4.1	SYSTEM ARCHITECTURE DIAGRAM	ERROR! BOOKMARK NOT DEFINED.
4.2	MODULE INTERACTION:	ERROR! BOOKMARK NOT DEFINED.
4.3	COLLABORATION DIAGRAM:	ERROR! BOOKMARK NOT DEFINED.
4.4	SEQUENCE DIAGRAMS	ERROR! BOOKMARK NOT DEFINED.
5.	IMPLEMENTATION DETAILS	ERROR! BOOKMARK NOT DEFINED.
5.1	DEVELOPMENT SETUP:	ERROR! BOOKMARK NOT DEFINED.
5.1.1	Tools:	<i>Error! Bookmark not defined.</i>
5.1.2	Technologies:	<i>Error! Bookmark not defined.</i>
5.2	DEPLOYMENT SETUP	ERROR! BOOKMARK NOT DEFINED.
5.2.1	Milestones overcome:	<i>Error! Bookmark not defined.</i>
5.3	ALGORITHMS	ERROR! BOOKMARK NOT DEFINED.
5.3.1	Face Detection using dlib & python:	<i>Error! Bookmark not defined.</i>
5.3.2	Posing and Projecting of Faces:	<i>Error! Bookmark not defined.</i>
5.3.3	Encoding Face:	<i>Error! Bookmark not defined.</i>
5.3.4	Face Recognition:	<i>Error! Bookmark not defined.</i>
5.3.5	Hurdle Detection:	<i>Error! Bookmark not defined.</i>
5.3.6	Voice synthesis:	<i>Error! Bookmark not defined.</i>
5.3.7	Path Finding:	<i>Error! Bookmark not defined.</i>

5.3.8	<i>Robot Movement:</i>	<i>Error! Bookmark not defined.</i>
5.3.9	<i>Voice Synthesis upon Face Recognition:</i>	<i>Error! Bookmark not defined.</i>
5.3.10	<i>Voice Synthesis for pointing locations:</i>	<i>Error! Bookmark not defined.</i>
5.4	CONSTRAINTS	ERROR! BOOKMARK NOT DEFINED.
5.4.1	<i>Assumptions</i>	<i>Error! Bookmark not defined.</i>
5.4.2	<i>System constraints:</i>	<i>Error! Bookmark not defined.</i>
5.4.3	<i>Restrictions</i>	<i>Error! Bookmark not defined.</i>
5.4.4	<i>Limitations</i>	<i>Error! Bookmark not defined.</i>
6.	TESTING	ERROR! BOOKMARK NOT DEFINED.
6.1	EXTENDED TEST CASES	ERROR! BOOKMARK NOT DEFINED.
6.1.1	<i>IP webcam verification:</i>	<i>Error! Bookmark not defined.</i>
6.1.2	<i>Face Detection verification:</i>	<i>Error! Bookmark not defined.</i>
6.1.3	<i>Face posing and projection:</i>	<i>Error! Bookmark not defined.</i>
6.1.4	<i>Encoding faces verification</i>	<i>Error! Bookmark not defined.</i>
6.1.5	<i>Face recognition verification:</i>	<i>Error! Bookmark not defined.</i>
6.1.6	<i>Input image containing laser light dot in ideal lighting:</i>	<i>Error! Bookmark not defined.</i>
6.1.7	<i>Verify the functionality of speech synthesis on face recognition</i>	<i>Error! Bookmark not defined.</i>
6.1.8	<i>Verify the functionality of speech synthesis on desired coordinates</i>	<i>Error! Bookmark not defined.</i>
6.2	DECISION TABLE.....	ERROR! BOOKMARK NOT DEFINED.
6.2.1	<i>Code snippet</i>	<i>Error! Bookmark not defined.</i>
6.2.2	<i>Decision coverage table</i>	<i>Error! Bookmark not defined.</i>
6.2.3	<i>Traceability Matrix</i>	<i>Error! Bookmark not defined.</i>
7.	CONCLUSION	ERROR! BOOKMARK NOT DEFINED.
8.	FUTURE WORK	ERROR! BOOKMARK NOT DEFINED.
9.	BIBLIOGRAPHY	ERROR! BOOKMARK NOT DEFINED.
9.1	ARTICLES.....	ERROR! BOOKMARK NOT DEFINED.
9.2	RESEARCH PAPERS	ERROR! BOOKMARK NOT DEFINED.
9.3	OTHER REFERENCES	ERROR! BOOKMARK NOT DEFINED.
10.	APPENDIX	ERROR! BOOKMARK NOT DEFINED.
10.1	GLOSSARY OF TERMS	ERROR! BOOKMARK NOT DEFINED.

Definitions and Acronyms

Acronym	Definition
UMT	University of Management and Technology
HOG	Histogram of Oriented Gradients
SVM	Support Vector Machine
CNN	Convolutional Neural Networks

Table 1: Definitions and Acronyms

List of Figures

Figure 1: An educational Humanoid Tour Guide Robot	Error! Bookmark not defined.
Figure 2: Autonomous Tour Guide Robot.....	Error! Bookmark not defined.
Figure 3: Museum Tour Guide Robot	Error! Bookmark not defined.
Figure 4: Use case	Error! Bookmark not defined.
Figure 5: Opencv configuration in Android Studio.....	Error! Bookmark not defined.
Figure 6: Working with Camera in Opencv and Android Studio...	Error! Bookmark not defined.
Figure 7: Converting Image into Grey Scale.....	Error! Bookmark not defined.
Figure 8: Face Detection	Error! Bookmark not defined.
Figure 9: Detection using dlib & python.....	Error! Bookmark not defined.
Figure 10: Face Detection along with Landmarks.....	Error! Bookmark not defined.
Figure 11: Measurements generated from image	Error! Bookmark not defined.
Figure 12: Face Recognition of known person along with confidence (existing in database)	Error! Bookmark not defined.
Bookmark not defined.	
Figure 13: Face Recognition of unknown person (not existing in database)	Error! Bookmark not defined.
defined.	
Figure 14: laser light detection for distance measurement	Error! Bookmark not defined.
Figure 15: Path Finding.....	Error! Bookmark not defined.
Figure 16: Robot Movement	Error! Bookmark not defined.
Figure 17: Voice Synthesis upon Face Recognition.....	Error! Bookmark not defined.
Figure 18: Voice Synthesis for pointing locations	Error! Bookmark not defined.
Figure 19: System Architecture Diagram.....	Error! Bookmark not defined.
Figure 20: Module Interaction.....	Error! Bookmark not defined.
Figure 21: Collaboration Diagram (1).....	Error! Bookmark not defined.
Figure 22: Collaboration Diagram (2).....	Error! Bookmark not defined.
Figure 23: Sequence Diagram	Error! Bookmark not defined.
Figure 24: Laptop	Error! Bookmark not defined.
Figure 25: Laser light	Error! Bookmark not defined.
Figure 26: Tablet	Error! Bookmark not defined.

List of tables

Table 1: Definitions and Acronyms	4
Table 2: Stakeholders along with their role in system.....	Error! Bookmark not defined.
Table 3: Feature Comparison	Error! Bookmark not defined.
Table 4: Functional Requirements.....	Error! Bookmark not defined.
Table 5: Data Requirements	Error! Bookmark not defined.
Table 6: External Interface Requirements	Error! Bookmark not defined.
Table 7: RID description along with details & boundary constrains	Error! Bookmark not defined.
Table 8: IP webcam verification.....	Error! Bookmark not defined.
Table 9: Face Detection verification	Error! Bookmark not defined.
Table 10: Face posing and projection.....	Error! Bookmark not defined.
Table 11: Encoding faces verification.....	Error! Bookmark not defined.
Table 12: Face recognition verification.....	Error! Bookmark not defined.
Table 13: Input image containing laser light dot in ideal lighting..	Error! Bookmark not defined.
Table 14: Speech synthesis on face recognition.....	Error! Bookmark not defined.
Table 15: Speech synthesis on face recognition.....	Error! Bookmark not defined.
Table 16: Code snippet.....	Error! Bookmark not defined.
Table 17: Decision coverage table	Error! Bookmark not defined.
Table 18: RID vs UCID.....	Error! Bookmark not defined.
Table 19: RID vs TID.....	Error! Bookmark not defined.
Table 20: Coverage	Error! Bookmark not defined.
Table 21: Glossary of terms	Error! Bookmark not defined.

1. INTRODUCTION

1.1 Motivations

Many advancements in the discipline of robotics has taken place in recent years. The main focus of developers is towards the interaction of human beings and robots. Robots are being used to decrease the man power. Manpower is required giving a tour to tourists and providing them information about the places they are seeing for the first time.

Hence, we decided to work on a tour guide robot which will be helpful for its organization saving the manpower and giving the tour to the tourists by itself. The robot will move on a predefined map which has been fed in it. This robot will go to specific places along with the tourist and upon reaching those coordinates will provide information to the visitor about places around it. During this tour, this robot will also be taking pictures after a specific period of time on runtime and sending them to the system.

System will receive these pictures on runtime and apply face recognition and hurdle detection on these pictures one by one. Robot will also provide some information about the recognized persons to the visitor.