Software Requirements Specification

for

Anushka: KIET's Social-Humanoid Robot

Version 1.0 approved

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1. Introduction

1.1 Purpose

The Humanoid Robot Project is being developed for KIET Group of Institutions with the goal of creating a social humanoid robot that can serve as a receptionist for the college. The robot will be designed to interact with visitors in a friendly and professional manner and assist them in finding their way around the college. The robot will be equipped with computer vision, speech recognition, and natural language processing capabilities, enabling it to recognize faces, remember and recall people, and converse with visitors in a variety of languages.
The robot's primary role will be to greet visitors, provide them with information about the college, and direct them to their desired destination. By combining cutting-edge technology with friendly and professional interactions, the robot will create a welcoming and memorable experience for all who enter the college.The robot will also be equipped with hand movements for gestures as well as eye, jaw, and neck movements to simulate natural expressions and movements, and the ability to move around the reception area according to speech commands. It can also follow people through computer vision and object detection to avoid collisions, ensuring a safe and efficient navigation experience for both the robot and visitors.
The robot's development is a significant step towards providing a technologically advanced and modernized reception experience for visitors to the KIET Group of Institutions. The robot's intelligent capabilities and friendly demeanor will help create a positive and welcoming environment for all visitors, while also showcasing the college's commitment to innovation and technology.

1.2 Document Conventions

i. *The SRS follows the IEEE Standard for Software Requirements Specification (IEEE Std 830-1998).*

ii. *All requirements are numbered using a hierarchical structure with a unique identifier for each requirement.*

iii. *Bold text is used to highlight important terms or concepts.*

iv. *"Shall" is used to indicate mandatory requirements, while "should" is used to indicate desirable but optional features.*

v. *Use of diagrams, tables, and figures are used throughout the document to aid in understanding and clarification of requirements.*

1.3 Intended Audience and Reading Suggestions

This SRS is intended for the following audience:

i. *Joint Director of KIET Group of Institutions: This document will provide an overview of the Humanoid Robot Project and its specifications, requirements, and limitations. It will*

serve as a reference document for the Joint Director to understand the project's objectives and capabilities.

ii. *Future developers: This document will serve as a reference document for future teams of students who will work on advancing the robot's capabilities.*

To use this document effectively, readers should review the Introduction, Functional and Non-Functional Requirements, Use Cases, and Glossary sections. This will provide a comprehensive understanding of the project's objectives, specific capabilities, performance requirements, and key terms and definitions.

1.4 Product Scope

The Humanoid Robot Project is a social humanoid robot designed to operate as a receptionist at KIET Group of Institutions. The robot's main objective is to perform tasks related to the receptionist role, including greeting visitors, answering questions, and providing directions. The product scope includes the necessary hardware and software components, with specific capabilities including computer vision, speech recognition, and hand movements for gestures. The robot will be designed to operate in the reception area of KIET Group of Institutions, with the potential for future expansion and adaptation. The project is being developed by a team of students at KIET Group of Institutions, with the support of faculty advisors and the Joint Director of the college.

1.5 References

i. J. L. Wyatt, M. Mataric, and G. S. Sukhatme, "Autonomous robots for the service industry," IEEE Robotics & Automation Magazine, vol. 14, no. 1, pp. 91-103, 2007.
ii. Y. Liu, X. Li, and X. Wang, "Speech Recognition in Humanoid Robots: A Review," International Journal of Advanced Robotic Systems, vol. 14, no. 4, 2017.
iii. S. W. Oh, M. H. Park, J. Y. Lee, J. H. Kim, and J. W. Lee, "A Study on the Development of a Socially Interactive Robot for a Hotel Receptionist," International Journal of Control, Automation and Systems, vol. 13, no. 2, pp. 381-388, 2015.

2. Overall Description

2.1 Product Perspective

The Humanoid Robot Project will serve as an important part of the college's reception area, providing assistance to visitors and students. It will be situated in the reception area and will interact with people as they arrive. The robot will be designed to fit seamlessly into the reception process and provide a positive experience for all users.

2.2 Product Functions

The Humanoid Robot Project will have several functions, including computer vision for face recognition, face remembering and recalling, speech recognition with NLP and support for all the languages worldwide and ability to maintain a chat log and continuously learn from chats. It will also include hand movements for gestures, eye movements, jaw movements, neck movements, and the ability to move according to speech commands as well as Follow Me mode with computer vision. The robot will be able to move around the reception area and follow people through computer vision and object detection.

2.3 User Classes and Characteristics

The Humanoid Robot Project will interact with various user classes, including visitors, students, and staff members. Visitors may have limited knowledge of the college's facilities, while students and staff members will be more familiar with the area. Each user group may have different levels of technological proficiency, language preferences, and accessibility requirements that would need to be considered when designing the robot's user interface and functionality. Understanding these user characteristics would be important for ensuring that the robot is user-friendly and accessible to all potential users.

2.4 Operating Environment

The Humanoid Robot Project will operate in an indoor environment, specifically in the college's reception area. It will be exposed to various lighting conditions, noise levels, and temperature ranges. The robot will be designed to operate in these conditions without any issues.

2.5 Design and Implementation Constraints

The Humanoid Robot Project will have design and implementation constraints, including hardware and software limitations. The robot will need to be designed to operate within these constraints while still providing the necessary functions.

2.6 Working Documentation

The Humanoid Robot Project will require documentation, including user manuals and technical documents. These documents will be essential for maintaining and troubleshooting the robot.

2.7 Assumptions and Dependencies

The Humanoid Robot Project assumes that the college's reception area will remain relatively stable, without major renovations or changes. Additionally, the robot will depend on a reliable power supply to recharge its battery and network connection to function properly.

3. Functional Requirements

3.1 Computer Vision

i. *The robot shall be able to detect and recognize faces using computer vision.*
ii. *The robot shall be able to remember faces and recall them when needed.*
iii. *The robot shall be able to perform face tracking to maintain interaction with a person.*
iv. *The robot shall be able to detect and avoid obstacles in its path using computer vision.*

3.2 Speech Recognition and Natural Language Processing (NLP)

i. *The robot shall be able to recognize speech and interpret the meaning of the spoken words using NLP techniques.*
ii. *The robot shall be able to maintain a chatlog and continuously learn from previous interactions to improve its performance.*
iii. *The robot shall be able to understand and respond in multiple languages.*

3.3 Hand and Body Movements

i. *The robot shall be able to perform hand gestures to express emotions and convey messages.*
ii. *The robot shall be able to move its eyes, neck, and jaw to simulate human-like expressions.*
iii. *The robot shall be able to move according to speech commands as well as follow a person in Follow Me mode.*

3.4 Autonomous Operation

i. *The robot shall be able to operate autonomously for extended periods without human intervention.*
ii. *The robot shall be able to recharge itself when its batteries are low.*
iii. *The robot shall be able to detect and report errors or malfunctions to its monitoring system.*

3.5 Integration

i. *The robot shall be able to integrate with the monitoring system to provide real-time updates and status information.*
ii. *The robot shall be able to communicate with other devices using standard communication protocols.*
iii. *The robot shall be able to operate in different environments with varying levels of ambient light and noise.*

4. Non-Functional Requirements

4.1 Performance Requirements

The robot should respond to speech commands and user interactions within 2-3 seconds. The computer vision system should be able to recognize and track faces in real-time with a minimum accuracy rate of 90%.

4.2 Security Requirements

The robot should not be able to access any unauthorized data or systems. User data collected by the robot should be stored securely and only accessible by authorized personnel. The robot should also have the ability to detect and alert security personnel of any potential security breaches.

4.3 Reliability Requirements

The robot should be able to operate continuously for at least 12 hours without any major maintenance or repairs. It should also be able to withstand minor physical impacts without malfunctioning.

4.4 Maintainability Requirements

The robot should be designed in a modular fashion to allow for easy replacement and repair of individual components. The software should also be designed in a modular fashion to allow for easy updates and modifications.

4.5 Compatibility Requirements

The robot should be compatible with various hardware and software systems commonly used in the industry. It should also be designed to support various languages and dialects to accommodate a diverse user base.

4.6 Usability Requirements

The robot's interface should be intuitive and easy to use for both technical and non-technical users. The robot should also have a user manual and documentation readily available for reference.

5. External Interface Requirements

5.1 User Interfaces

There will be no user interface for the humanoid robot. Instead, a remote server will be developed to monitor the robot's activities and provide data log and chat logs for analysis. The server will provide a monitoring system for the robot's batteries or errors.

5.2 Hardware Interfaces

The humanoid robot will have multiple hardware interfaces, including USB and Ethernet ports, to allow for external devices to be connected. The robot will also have camera and microphone interfaces for computer vision and speech recognition. It will also use a ZigBee transmitter module for communication with the moving mechanism.

5.3 Software Interfaces

The software interfaces for the humanoid robot will include APIs for computer vision and speech recognition. These interfaces will be used to integrate the robot's functionality with other software applications.

5.4 Communications Interface

The humanoid robot will require a stable and secure communication interface to connect to the remote server. This can be achieved through wireless communication protocols. The communication interface should be reliable and fast to ensure that data is transmitted in real-time between the robot and the remote server.

6. Conclusion

The development of this humanoid robot project aims to create a social robot that can interact with humans in a natural and intuitive way. The robot is designed to have computer vision and speech recognition capabilities, allowing it to recognize faces, understand and respond to speech commands in different languages, and maintain chat logs. Additionally, it has hand, eye, jaw, and neck movements, as well as the ability to move around and follow people through computer vision and object detection.

The SRS provides a comprehensive documentation of the project's requirements and specifications, including product perspective, functions, user classes and characteristics, operating environment, design and implementation constraints, working documentation, and assumptions and dependencies. It also outlines the external interface requirements for user interfaces, hardware interfaces, software interfaces, and communications interfaces.

Overall, this SRS will serve as a foundation for the development team and future students who will work on advancing this project. It will ensure that the project meets the requirements and expectations of the stakeholders and is developed in a structured and efficient manner.