

# TEST PLAN FOR ANUSHKA: THE HUMANOID ROBOT

## *ChangeLog*

Version	Change Date	By	Description
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# 1 Introduction

The rapid advancements in robotics and artificial intelligence have paved the way for innovative applications in various fields. One such fascinating development is the creation of Anushka, an extraordinary humanoid robot. Anushka represents a significant leap forward in the realm of robotic technology, designed to serve as a receptionist in educational institutions. With its remarkable capabilities and state-of-the-art features, Anushka aims to redefine the receptionist experience and revolutionize the way visitors interact with educational institutions.

The inspiration behind Anushka stems from the need to address the limitations of traditional receptionist systems in educational institutions. While human receptionists play a vital role in welcoming visitors and providing information, they are bound by certain inherent biases and limitations. Anushka, on the other hand, offers a unique solution by combining the best of human-like interactions and cutting-edge technology. At its core, Anushka embodies the principles of unbiased and caring interactions.

Its advanced programming and intelligent algorithms enable it to engage with visitors in a fair and impartial manner, devoid of any preconceived notions or biases. This unbiased nature of the robot ensures that every visitor receives equal attention and a personalized experience.

The design of Anushka encompasses various modules that enable it to perform different tasks seamlessly. From its vision module that allows it to perceive its surroundings and recognize individuals, to its conversation module that facilitates natural language processing and generates appropriate responses, each component is meticulously integrated to create a cohesive and efficient system.

Anushka's intelligent capabilities go beyond mere interactions. It possesses the ability to provide valuable insights and information about the educational institution it represents. With its vast knowledge base, Anushka can offer directions, answer frequently asked questions, and provide relevant details about courses, facilities, and events. This wealth of information empowers visitors to make informed decisions and enhances their overall experience within the institution.

The implementation of Anushka as a receptionist in educational institutions signifies a paradigm shift in the way institutions engage with their visitors. It not only offers a technologically advanced solution but also showcases the institution's commitment to embracing innovation and providing an exceptional visitor experience.

In the following sections of this project report, we will delve deeper into the various aspects of Anushka's design, functionality, and the technologies driving its capabilities. Through meticulous planning, research, and development, Anushka has been crafted to be a game-changer in the field of humanoid robotics. By combining unbiased interactions, caring demeanor, and intelligent features, Anushka sets a new standard for receptionist robots in educational institutions.

## 1.1 Scope

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### 1.1.1 In Scope

#### **Functional Requirement: -**

##### **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.

##### **Speech Recognition and Natural Language Processing:**

- 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 chat log and continuously learn from previous interactions to improve its performance.
- iii. The robot shall be able to understand and respond in multiple languages.

##### **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.

##### **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.

##### **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.

## **Non-Functional Requirements: -**

### **Performance Requirements:**

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

### **Security Requirements:**

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

### **Reliability Requirements:**

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

### **Maintainability Requirements:**

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

### **Compatibility Requirements:**

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

### **Usability Requirements:**

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

## **1.1.2 Out of Scope**

### **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.

**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.

**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.

**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.

## 1.2 Quality Objective

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- Ensure the product Under Test conforms to functional and nonfunctional requirements.
- Ensure the AUT meets the quality specifications defined by the client
- Bugs/issues are identified and fixed before go live
- Ensure that the style transfer process is optimized for efficiency and speed, allowing for rapid transformation of images while maintaining high-quality results.
- Prioritize a user-friendly and intuitive interface to enhance user experience, making it easy for users to upload images and customize style transfer.
- Ensure that the system functions correctly on a variety of devices, browsers, and operating systems to maximize user accessibility.

## 1.3 Roles and Responsibilities

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Detail description of the Roles and responsibilities of different team members like

- **QA Analyst**- Piyush Khanna
- **Test Manager**- Ms. Neha Shukla
- **Configuration Manager**- Prof. Akanksha
- **Developers**- Piyush Khanna
- **Installation Team**- Piyush Khanna

# 2 Test Methodology

## 2.1 Overview

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The model of the robot comprises various systems and their modules working synchronously and interacting with each other to bring human touch to the robot. This ecosystem of modules dives into the field of Embedded Systems using Arduinos and various sensors for perception, Internet of Things for direct communication between the modules, Operating System design to be established as a master program over all the modules and their indirect communication, Multithreading, Artificial Intelligence for Natural Language Processing, Computer Vision and Machine Learning for Semantic Analysis. Also, the robot-server logging system has been designed by full-stack Web Development using MERN (MongoDB, ExpressJS, ReactJS and NodeJS).

Also, the approach for Software Development Life Cycle for the robot has been termed as “Search and Destroy”, which offers a novel way to optimize the development process and bring the robot closer to its final product state. This approach not only streamlines the development timeline but also allows for continuous refinement and enhancement of Anushka's functionalities.

The "Search and Destroy" model introduces a unique approach to the development process, combining elements of traditional scrum techniques with a focus on iterative enhancement of an existing prototype. Its innovative aspect lies in its application within the context of developing Anushka. While scrum techniques are commonly used in software development, the adaptation of scrums specifically for the purpose of iteratively enhancing a prototype is a unique aspect of this model. This inventive approach enables the development team to efficiently address design iterations, implement improvements, and fine-tune the robot's features, ultimately resulting in a more refined and sophisticated end product.

## 2.2 Test Levels

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The testing to be performed is white box testing.

The testing is performed by the developer's team along with QA and Configuration Manager.

### Unit Testing

#### Scope:

- Individual components and functions of Anushka, including her ML-based conversational capabilities, gesture recognition, and integration with the recommendation engine.

#### Objective:

- To verify that each component works as intended, ensuring that functions such as natural language processing, gesture responses, and user interactions produce the expected results.

#### Testing Approach:

- Developers and machine learning engineers conduct unit tests for specific components and functions, ensuring that each unit performs its designated tasks accurately.

## Integration Testing

### Scope:

- The interactions and interfaces between different modules of Anushka, including the connections between her user interface, ML model, recommendation engine, gesture recognition, and ChatGPT integration.

### Objective:

- To ensure that the integration of various components does not introduce errors, bottlenecks, or inconsistencies in Anushka's functionality.

### Testing Approach:

- Developers and testers assess how data flows between components and detect any integration issues that might affect Anushka's overall functionality.

## Functional Testing

### Scope:

- The complete Anushka system, covering the entire user journey from voice interactions to gesture responses, personalized recommendations, and ChatGPT conversations.

### Objective:

- To validate that Anushka functions according to specified requirements, providing accurate responses, relevant recommendations, and engaging user interactions.

### Testing Approach:

- Testers execute functional tests by providing sample inputs and assessing that Anushka delivers correct responses, personalized recommendations, and maintains engaging conversations.

## Performance Testing

### Scope:

- Assessing Anushka's speed and efficiency in processing voice and gesture inputs, delivering responses, and maintaining a seamless interactive experience.

### Objective:

- To measure Anushka's response time, resource utilization, and how well she performs under various user loads and conditions.

### Testing Approach:

- Performance tests evaluate Anushka's responsiveness and resource usage to ensure she can handle multiple concurrent users without significant performance degradation.

## Usability Testing



Scope:

- The user interface and overall user experience of Anushka, including the ease of initiating interactions, understanding responses, and navigating through different capabilities.

Objective:

- To assess the user-friendliness and intuitiveness of Anushka's interface to ensure users can easily interact with her.

Testing Approach:

- Usability tests involve real users interacting with Anushka to evaluate her ease of use, clarity, and overall user experience.

## Security Testing

Scope:

- Anushka's security mechanisms, especially for handling sensitive voice and gesture inputs and maintaining the privacy of user interactions.

Objective:

- To identify and mitigate potential security vulnerabilities, including unauthorized access and data encryption.

Testing Approach:

- Security testing includes penetration testing, encryption checks, and access control assessments to ensure user data and interactions with Anushka are secure.

## Compatibility Testing

Scope:

- Anushka's compatibility with various platforms and devices, including different browsers, operating systems, and mobile devices.

Objective:

- To ensure that Anushka functions correctly and displays properly on a wide range of user devices.

Testing Approach:

- Testers verify that Anushka is compatible with various devices and configurations to provide a seamless experience for all users.

## Regression Testing

Scope:

- The entire Anushka system after updates or changes, including new features or modifications to existing conversational capabilities and interactions.

Objective:

- To confirm that new changes or enhancements do not introduce defects or negatively impact Anushka's existing functionality.

Testing Approach:

- Automated regression tests are executed to validate that previously tested features still work as expected after any updates or changes to Anushka.

## 2.3 Test Completeness

Here you define the criterias that will deem your testing complete.

For instance, a few criteria to check Test Completeness would be

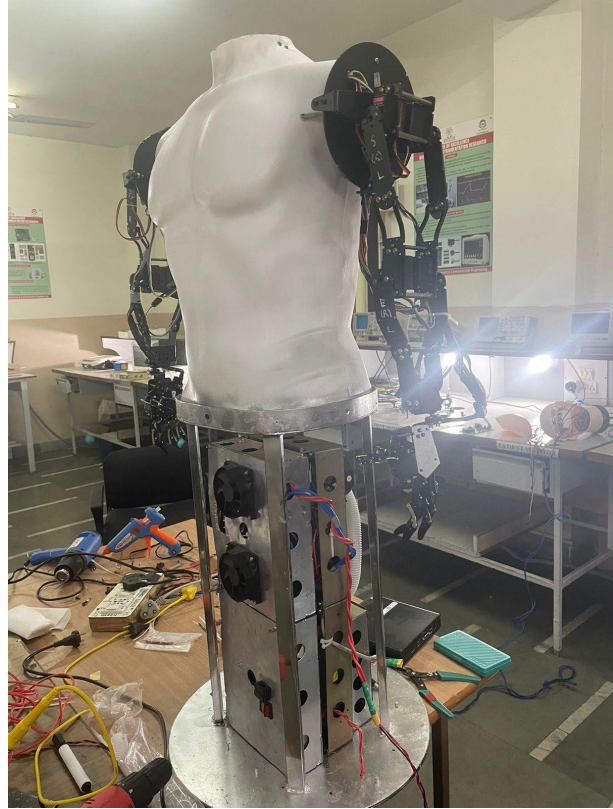
- 100% test coverage
- All Manual & Automated Test cases executed
- All open bugs are fixed or will be fixed in next release
- All content and style transfer tests have been executed, ensuring that various input images have been processed successfully and meet the defined content and style transfer criteria.
- Automated regression tests have been executed, and previously tested features still work as expected after updates or changes.

## 3 Test Deliverables

Test cases: -

Test Case	Test Objective	Test Data	Expected Result		Actual Result	Pass/Fail
1	Voice Recognition	User provides a command	Anushka accurately recognizes and processes the command		Recognition and processing of the command	Pass
2	Facial Recognition	An individual stands in front of Anushka	Anushka recognizes the person through facial recognition		Facial recognition successful	Pass
3	Gesture Recognition	User gestures towards Anushka	Anushka identifies and responds to the gesture appropriately		Appropriate response to the gesture	Pass

4	Information Retrieval	User asks for information	Anushka retrieves and presents accurate information		Accurate information retrieval	Pass
5	Command Execution	User gives a specific command	Anushka executes the command as intended		Successful execution of the command	Pass
6	Multilingual Interaction	User interacts in different languages	Anushka understands and responds appropriately in multiple languages		Appropriate responses in multiple languages	Pass
7	Emotional Response	User expresses emotions	Anushka recognizes and responds empathetically to emotional cues		Empathetic response to emotional cues	Pass
8	Autonomous Navigation	Anushka moves autonomously	Anushka navigates through the environment safely and efficiently		Safe and efficient autonomous navigation	Pass
9	Integration with IoT Devices	Anushka interacts with IoT devices	Anushka successfully communicates and interacts with connected IoT devices		Successful communication with IoT devices	Pass



## 4 Resource & Environment Needs

### 4.1 Testing Tools

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#### 1. Requirements Tracking Tool:

JIRA: JIRA is a versatile tool for tracking requirements, user stories, and project tasks. It can help manage and prioritize project requirements effectively.

#### 2. Bug Tracking Tool:

Bugzilla: Bugzilla is an open-source bug tracking tool that allows teams to efficiently track and manage software defects and issues.

#### 3. Automation Tools:

TensorFlow: TensorFlow provides a framework for automated testing of machine learning models, including those used in neural style transfer. It can be used for automating model testing and validation.

### 4.2 Test Environment

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It mentions the minimum **hardware** requirements that will be used to test the Application.

Following **softwares** are required in addition to client-specific software.

- Windows 10 and above
- Office 2013 and above
- MS Exchange, etc.

## 5 Terms/Acronyms

Make a mention of any terms or acronyms used in the project

TERM/ACRONYM	DEFINITION
API	Application Program Interface
AUT	Application Under Test
BOSS	Bot Operations and Scheduling System
GPU	Graphics Processing Unit

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