

Project Specification Report: ENGR 3750 Workplace Preparation

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Synopsis:

This project will focus on enhancing the capabilities of the Temi robot at Nanyang Polytechnic (NYP). Temi is a mobile robot equipped with obstacle avoidance systems. It also has a touch display for running applications. The goal is to develop Temi's functionalities to support future projects. It is also to showcase its capabilities during events such as NYP's open evenings.

The key milestones for this project are the following: familiarizing with Temi's existing features, learning Android Studio to develop applications, and integrating the Temi Robot Software Development Kit (SDK) into these applications. The major components of the project are: creating a quiz application, implementing Bluetooth connectivity, and replacing Temi's current text-to-speech system with a more advanced ChatGPT-based plugin. Additionally, an SDK will be developed to create customizable tours. Comprehensive user documentation will be produced to help future developers replicate these steps.

Key stakeholders include:

- **Supervisor:** Oversees the work and ensures that project goals are met.
- **Nanyang Polytechnic:** The organization plans to leverage Temi for future projects and enhance its role in robotics education.
- **Visitors:** The quiz application will engage visitors during events like open evenings.
- **Future Developers:** Successors who will build on the foundation laid by this project.
- **Other Projects:** The documentation will be used to facilitate the integration of Temi into other projects.

The project will expand Temi's utility for NYP. This will allow it to be used in more diverse applications. Thus, enhancing the appeal of the robotics department during showcase events. Additionally, by documenting the development process, future developers will have a solid foundation. Hence, potentially reducing the need to start from scratch and accelerating future progress.

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1. Introduction

This report outlines the plan to enhance the Temi Robot's capabilities. By increasing the number of applications that Temi can support, the project opens up avenues for future development and broader use cases. Additionally, it will provide Nanyang Polytechnic (NYP) with an engaging way to showcase its technology to the community, potentially increasing its appeal and leading to higher enrolment or financial support from the Singaporean government.

To achieve these goals, several features will be developed, including:

- **The creation of a quiz application** that uses Bluetooth connectivity to interact with a dispenser, dispensing chocolates based on quiz results.
- **Replacing Temi's current text-to-speech system** with a more advanced ChatGPT-based plugin.
- **Developing a Software Development Kit (SDK)** to facilitate the creation of customized tours using Temi.
- **Creating detailed documentation and a user manual** to assist future developers in replicating and expanding upon this work.

This report will also include:

- **A background section** that reviews previous research or projects involving the Temi robot, providing context for the current initiative.
- **A project overview** that outlines the objectives and key elements guiding its development.
- **An analysis of assumptions and constraints.**
- **An analysis of stakeholders** to identify their needs and wants, better aligning the deliverables.
- **A work plan** to outline the workflow for the project as well as expected deliverables.
- **Implementation strategies** to ensure the quality and timeliness of deliverables meet standards.
- **Risk management analysis** to identify potential risks within the project and outline steps to prevent or mitigate their effects.

However, a limitation of this report is that it will not document minor deviations that may occur during the project cycle. As familiarity with Temi's capabilities increases, there may be changes to the project's workflow. This may lead to adjustments or removals of certain goals, and the inclusion of others. This dynamic nature of the project may affect the ability to strictly adhere to the initial plan. Additionally, the scope of this project is limited to a 20-week development period, meaning some outlined goals may not be fully achievable within the given timeframe.

2. Project Background

Development surrounding the Temi Robot has occurred previous to this reports project. This included documentation that was provided by the manufactures of Temi. The manufactures will be referred to as Temi Center from this point on. There is also other projects and documentation created by Nanyang Polytechnic (NYP). The background report will have two main section. One will address the documentation provided by Temi Centre and the other from NYP. There will also be background information of the required software to progress though this project. The goal of the project background is to analyze the capabilities of the Temi Robot. This will provide valuable insight when it comes to developing deliverables for this project.



Figure 1 pictures of the Temi Robots from Nanyang Polytechnic (NYP). Left image is version 2 and the right is version 3.

The Temi Robot is one of the products provided by Temi Center. Temi Center is a robotics development company (Temi, 2021). Along with the Temi Robot there are other services provided. These include a mobile application provided from Temi Center that allows greater control of the temi (Temi, 2021). There is also integrated support for introducing external applications into temi (Temi, 2021). This functionality will be utilized for the purposes of achieving the project's goals. For use in this project, there are two different models of the Temi Robot. These include the V2 and V3 models (Temi, 2021). Images of the model from NYP can be seen in Figure 1. Details of the differences between the two version will be addressed later within the Project Background. All Temi Robots come with a home bay. This home bay is used for localization as well as recharging the Temi (Temi, 2021). The Temi Robot has the capability of returning to the home bay when it reaches a certain battery threshold (Temi, 2019)

User Manual

The first material is the Temi User Manual. The manual provides insight on some of the capabilities and limitations of the Temi Robot. The robot has an AI which allows the control of applications within the system (Temi, 2019). By using the microphone array inbuilt into the Temi Robot, it can convert speech to text (Temi, 2019). To start a query with temi, the command "Hey Temi" must be said (Temi, 2019). With this capability it is possible to use verbal queries to operate the AI. From testing, the AI is quite limited in the type of responses it can perform that are outside command type queries. Command type queries are defined as queries that ask the Temi Robot to perform a certain task. By integrating a ChatGPT-plugin the project hopes to solve this limitation. The system also has six-teen sensors for obstacle avoidance and a 3D Depth Camera for obstacle (Temi, 2019). The camera can also be used for facial recognition (Temi, 2019).



Figure 2 image of the Temi Robot from a top down view indicating where the wireless charging surface is (Temi, 2019).

The Temi Robot also has the ability to perform wireless charging of small devices when placed on the spot indicated in Figure 2 (Temi, 2019). This provided the idea of a tethering a mobile device to the Temi Robot. The exact benefit of this is not fully fleshed out. However, it is a feature to keep in mind. Ideas of how it could be used is too have a mobile device that can be used to call tech support in case of an issue with Temi. Although, this could be done by adding a QR code with a link to a report site. Overall, having a system in place to allow reporting on any issues of the Temi is an important feature. This may be another potential path to take the project if needed.

Temi can only operate on dry and flat flooring (Temi, 2019). The system uses a combination of a LIDAR sensor and a user made map (Temi Map) to allow the Temi Robot to navigate around an environment (Temi, 2019). The LIDAR collects data from its surroundings to determine its estimated position on the map. Bumpy terrain disturbs the data collection of the LIDAR. This can result in the delocalization of the Temi Robot (Temi will lose its position on the map). The current system provides no method for the Temi to relocate itself once it has been lost. The Temi robot must be manually placed back onto the home bay so it can relocate itself. This also means if the Temi Robot is picked up and moved to a different location, it will also get lost. Discussion has taken place about features that could be used to address this. The current idea is to attach a module to the Temi Robot that can detect when it has been picked up and to issue a warning. If the Temi Robot is not placed back down, it will then sound an alarm until it is placed down. The warning was recommended as there are situations when the Temi Robot gets stuck. This may lead to a situation when a good Samaritan may pick up the robot to move it with no malicious intent. While this problem is not outlined in the project goals, depending on how the workflow progresses, it may be added on a later date.

Using TemiScript developed by Robocore

Temi has the capability to support applications developed by third parties. One such application is TemiScript developed by Robocore (Robocore). TemiScript is a Software Development Kit (SDK) developed to allow creation of scripts with high order functions. The SDK can be accessed either via an application on the Temi Robot or using a website application. However, using this system is very limited. A script can only be made in a sequential order. While it is possible to delete a command in the middle of a script, it is not possible to add one. This makes creating a script to be a tedious process. The creators of TemiScript have provided an alternate method for uploading scripts which can be found in Source 4. This uses .txt files that can be uploaded to the Temi Robot. Using the .txt files provided a more flexible approach to making script as it allows for easy manipulation of the code. From experimenting with both methods, the usage of .txt files was found to be the most preferable method. Source 4 also provided a detailed list of high order functions that can be used. One major limitation of Robocore is it only allows one person to develop a script for only one Temi robot. It is not possible to seamlessly integrate develop script into other Temi Robots. This greatly reduces its functionality and it is the main reason why a new open SDK for the Temi Robot is desired to be created. With this it was possible to investigate and test out some of the capabilities of Temi.

Setting up Connectivity with Android Studio and the Temi Robot

The main benefits of the Temi Robot are not of the functionalities provided by Temi Center, instead it is capabilities that can be used to create new applications and software. To assist, Temi Center has provided a GitHub repository. Within this repository is a Temi Software Development Kit (SDK) that can be integrated into Android Studio to allow the controlling of temi functions. A link to this can be found in the appendices as Source 1. The source also provides a link to another GitHub repository to access documentation on the Temi robots. Within the documentation is information that can be used set up a connection to the Temi robot via PC. There is also information on what software to use to download applications onto temi.

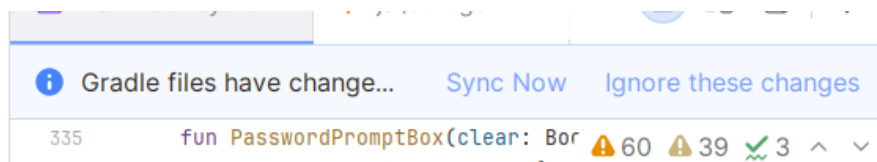


Figure 3 example of the Gradle file syncing issue.

To develop an application on the Temi Robot, the Android Studio is required. There is no special process needed to download Android Studio. However, it is recommended to undergo the beginner training course provided by Android Studio called ‘Android Basics with Compose’. A link to this source has been provided the appendices as Source 2. This tutorial will provide a step-by-step guide needed to install Temi Studio as well as a Tutorial on how to use Android Studio. Please do note that if using the school network at NYP there will be an issue with syncing the Gradle file. This error occurs when first opening a project or changing the Gradle build. To solve this issue, switch to a non-school network and sync the files. Once the files have been synced it is possible to go back to the school network. An example of the issue can be seen in Figure 3. Once Android Studio is set up, the instructions provided by Source 3 can be followed to set up a system to allow Android Studio to connect to the Temi Robot.

To connect Android Studio to the Temi Robot, open up the application that is desired to be uploaded on Android Studio and open up the terminal to connect the daemon. Before attempting to connect the daemon, ensure that the PC that the application is on and Temi are on the same network. If not done, there daemon will not be able to connect. On the Temi Robot, locate the setting and scroll all the way to bottom of the menu to find the ‘Developer Tools’ icon. Select it then select ‘ADB Connection to temi’. Once done, a white button with text saying ‘OPEN PORT’ should be present near the bottom center of the screen. Press it so that the button changes to ‘CLOSE PORT’. Go to the terminal and type ‘./adb connect ####.###.#.#’. Replace the ‘#’ with the port address that can be found on the Temi Robot in green text. Once submitted, on the terminal a confirmation of connection should show up to indicted a successful connection. This should allow the Temi Robot to show up in the device manager. This should allow the creation and implementation of applications onto the Temi Robot.

Previous work to develop a quiz application and setting up Bluetooth Connectivity

One of the project goals is to develop a quiz that will be able to connect via Bluetooth to a device that can dispense chocolate. The goal of this is to have application that can be used in an open evening that can engage with visitors at Nanyang Polytechnic (NYP). However, there is a sub objective. One of the limitations of the Temi Robot is its inability to open doors at NYP. This severely limits its ability to move around to many areas at NYP that are locked behind card readers. Hence, developing a system to connect the Temi to the chocolate dispenser will allow for more developments in the future.

In 2023, a project (Hsiang, 2023) looked at trying to implement Bluetooth on to the Temi Robot to dispense chocolate depending on a developed quiz. This is a similar goal that is desired to be achieved for this report. They used Android Studio to create the questionnaire app and implemented the Bluetooth feature using java (Hsiang, 2023). They used a Bluetooth Low Energy (BLE) system to allow Bluetooth connectivity (Hsiang, 2023). Out of the list of objectives presented by the report (Hsiang, 2023), objectives three and four are of interest. Step three entailed researching on how to develop an application that uses Bluetooth. Step four

entailed developing an application for testing Blue communication between the application and Arduino. The application was present on the Temi Robot and the Arduino on the chocolate dispenser (Hsiang, 2023). To allow for communication, a BLE was wired to the Arduino (Hsiang, 2023). From reading the report, it appears that XML was used to develop the User Interface (UI) and Java to perform the software sides of things. The method they used to implement the questioner is different to the method that will be used in this project. Kotlin will be the language for this project to develop the software and UI features. Therefore, to implement the method for connecting via Bluetooth will require the translation from the reference project (Hsiang, 2023) and this project.

3. Project Overview

3.1 Context Diagram

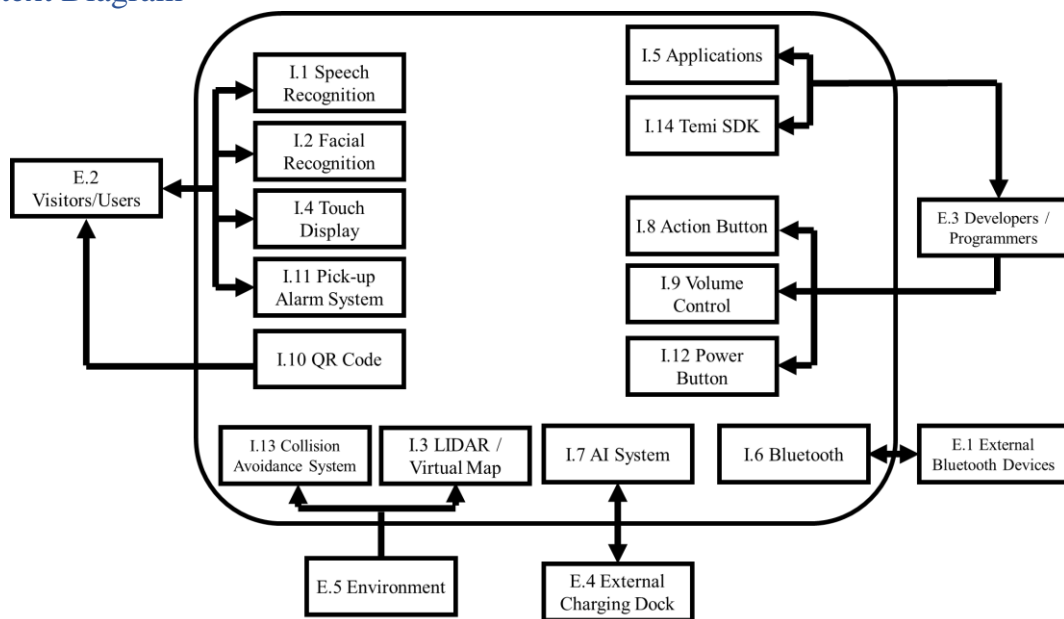


Figure 4 Context Diagram of the Temi Robot with all expected interactions between the external and internal.

This section outlines the context diagram in Figure 4 and its look-up table in Table 1. The **context diagram** visually represents the Temi Robot's interaction with both internal and external components, showing how it communicates with and responds to different systems, users, and devices in its environment. It serves as a high-level overview, highlighting key data flows between Temi's core systems (like speech recognition, navigation, and AI processing) and external entities such as visitors, Bluetooth devices, and developers. By breaking down these interactions, the context diagram helps provide a clear understanding of how Temi operates within the project's scope.

To supplement the diagram, the **look-up table** (Table 1) details the individual elements present in the context diagram, specifying both internal and external components. For each component, the table provides:

- A unique **ID** for easy reference.
- A **description** of its functionality.
- An explanation of its **relation** to the overall system, describing how it interacts with Temi or affects its operation.

The purpose of the look-up table is to offer a concise, structured breakdown of all elements involved in the project, helping developers, stakeholders, and users understand the specific roles and interconnections between Temi's systems and its surrounding environment. Together, the context diagram and look-up table serve as essential tools for identifying and mapping the flow of data, commands, and actions within the project.

Table 1 look up table for elements in context diagram Figure 4.

ID	Internal	Description	Relation
I.1	Speech Recognition	Converts speech from users into a format that the system AI can interpret.	Essential for voice command and interaction with Temi's AI.
I.2	Facial Recognition	Uses the 3D depth perception camera on the touch display to detect and identify user faces.	Enhances personalized interaction and can trigger user-specific actions or greetings.
I.3	LIDAR/Virtual Map	Uses LIDAR and pre-made virtual maps for environmental navigation.	Critical for Temi's autonomous movement and accurate navigation in different environments.
I.4	Touch Display	A touchscreen that allows users to interact with Temi directly.	Main interface for user input and running various applications.
I.5	Applications	Applications and software pre-installed or developed for Temi, including custom apps.	Expands Temi's functionality for different use cases (e.g., quiz app, tours).
I.6	Bluetooth	Communication system enabling the sending and receiving of commands or data between devices.	Facilitates wireless integration with external devices like a chocolate dispenser or door panels.
I.7	AI System	The system used for interpreting data from speech recognition and making decisions.	Powers intelligent responses, dialogue, and interaction using advanced AI like ChatGPT.
I.8	Action Button	Programmable buttons to execute present commands when activated.	Provides quick access to essential commands, useful for demonstrations or simple tasks.
I.9	Volume Control	Allows users to adjust the volume of Temi's speakers.	Regulates audio output for better communication in different environments.
I.10	QR Code	QR codes used to link to contact information or send reports of system faults.	Offers quick troubleshooting and reporting mechanism, reducing maintenance issues.
I.11	Pick-up Alarm System	Detects when Temi is picked up, warns the user, and sounds an alarm to prevent delocalization.	Ensures Temi stays in the correct operational environment without being lifted or displaced.
I.12	Power Button	Turns Temi on or off.	Basic control of the robot's power state, necessary for safe handling.
I.13	Collision Avoidance System	Uses sensors and 3D depth perception to prevent collisions with objects in the environment.	Ensures safe movement and navigation by preventing crashes into obstacles or people.
I.14	Temi SDK	A set of high-level functions that can be used to develop custom applications for Temi.	Provides developers the tools to create new functionalities, such as interactive tours or quizzes.
ID	External	Description	Relation
E.1	External Bluetooth Devices	Devices that communicate with Temi via Bluetooth, such as dispensers, external sensors, or other peripherals.	Facilitates integration with additional hardware (e.g., quiz dispensers), allowing Temi to interact with external systems or trigger actions.
E.2	Visitors/Users	Individuals who interact with Temi during demonstrations or events.	These are the primary end-users during outreach programs, experiencing features like quizzes, tours, and AI-driven interactions.
E.3	Developers/Programmers	Individuals tasked with creating, modifying, or expanding applications for Temi.	Developers will use the SDK and documentation to create new applications, customize interactions, and enhance Temi's functionalities.
E.4	External Charging Dock	The charging station Temi uses for recharging its battery when not in use.	Ensures Temi is adequately powered for continuous operation during outreach programs and demonstrations.
E.5	Environment	The physical space in which Temi operates, including obstacles, lighting, and people.	Affects Temi's navigation, collision avoidance, and overall mobility, requiring its sensors to adapt to various surroundings.

3.2 List of Requirements

Table 2 List of Requirements

Organization: Nanyang Polytechnic Date: 2023.09.23 Revision: 1		List of requirements		Page 1	
Project: Temi Robot for School Outreach					
No.	Importance/ priority	Demand, Wish (W/F)	Requirements	Values - Data	
				Minimum fulfillment	Target Fulfillment
1	High	Demand (F)	Quiz application should be engaging	Simple quiz interface with audio confirmation	Randomized questions with background music, visual integration, and a dynamic scoreboard system
2	High	Demand (F)	Include a broad range of question types	Flexible multiple-choice question framework	Support for input, drag-and-drop, and ranking-type questions
3	Medium	Wish (W)	Quiz application should be intuitive	Basic feedback on answer submission	Immediate feedback on results, progress indicators, and warnings for unsubmitted or incomplete quizzes
4	Medium	Wish (W)	Provide clear feedback for submitted answers	Text-based response to correct or incorrect answers	Visual and audio feedback with language support (multiple languages)
5	High	Demand (F)	Quiz application should be easy to change	Hardcoded blacklist and questions	External .txt file for blacklisted words and questions, documentation on how to update the file
6	High	Demand (F)	Add documentation and comments in code	Basic documentation and comments	Complete manual with detailed code comments and explanations for easy modification
7	High	Demand (F)	Implement Bluetooth Connectivity	Bluetooth system connects to one device	Flexible system that supports multiple devices and is well-documented for easy replication
8	Medium	Wish (W)	Ensure flexible Bluetooth connectivity	Connect to limited range of devices	Customizable connection for specific devices, depending on user needs
9	High	Demand (F)	Replace Temi's AI with ChatGPT Plugin	Basic ChatGPT-based text-to-speech integration	Full integration of ChatGPT for more complex, natural interactions
10	Medium	Wish (W)	Create user guide and manual	Simple guide on programming with Temi	Detailed manual on setting up a PC, running applications, and creating a development environment for Temi
11	High	Demand (F)	Provide a tutorial for setting up the Temi SDK	Basic SDK setup tutorial	Step-by-step tutorial with common issues addressed, and best practices for SDK usage
12	Medium	Wish (W)	Include detailed documentation for software	Minimal documentation	Complete documentation with in-depth explanations and areas for improvement
13	High	Demand (F)	Ensure quiz application integrates smoothly with Temi's hardware	Basic interaction with Temi's display and buttons	Full use of Temi's touch display and voice commands for quiz interaction
14	High	Demand (F)	Quiz application should handle multiple users	Supports one user per session	Ability to save and display scores for multiple users, allowing for competition or group engagement
15	Medium	Wish (W)	Quiz application should be customizable for different outreach events	Pre-defined quizzes for specific events	Ability to upload new quiz questions for each event or user group
16	High	Demand (F)	Ensure system stability during use	Temi should not crash during interactions	Robust error handling for unexpected user input or device malfunctions
17	Medium	Wish (W)	Integrate Temi's camera for user interaction during quizzes	No camera usage	Camera detects user engagement and provides feedback (e.g., pauses quiz when no one is in front of the robot)
18	High	Demand (F)	Ensure the system meets data privacy requirements	No sensitive data collected	Anonymized data collection and compliance with local privacy laws for quiz answers or other interactions

19	Medium	Wish (W)	Support for real-time data analytics	No data analytics	Provide insights on user interaction during outreach events (e.g., quiz results, interaction duration) to guide future improvements
20	High	Demand (F)	Ensure full integration with Temi's movement capabilities	Basic movement while interacting	Quiz or other outreach applications trigger movement (e.g., guide user to a location, move during interaction) to enhance engagement
21	Medium	Wish (W)	Provide multilingual support	Supports one language	System should be easily customizable to add additional languages for international students or events
22	Medium	Wish (W)	Quiz scoring system linked to prizes	Manual connection between quiz and prize	Automatic reward system (e.g., Temi dispenses a reward based on quiz score or completion)

3.3 Project Scope Statement (Including Organizational Vision and Project Scope)

Table 3 Project Scope Statement

Project Scope Statement			
Title:	Temi Robot for School Outreach	Date	23/09/2024
Project Manager	Edwin Foo		
Organizational Vision	Nanyang Polytechnic (NYP) strives to be a leader in innovative education by integrating advanced technologies into its teaching and outreach efforts. The institution envisions a future where robotics and AI play a crucial role in engaging with students, enhancing learning experiences. This demonstrating its forward-thinking approach to education. Through the Temi Robot for School Outreach project, NYP aims to inspire potential students by showcasing its commitment to technological innovation and its dedication to providing cutting-edge educational tools. This initiative supports the institution's broader goal of fostering creativity, critical thinking, and technological literacy in the next generation of students.		
Project Scope Description	The Temi Robot for School Outreach project has a flexible scope focused on creating systems that promote Nanyang Polytechnic as an educational institution. The main requirements include developing engaging applications and functionalities for the Temi robot to interact with potential students and families. Additionally, the project focuses on ensuring that the systems and documentation allow for future development and enhancements. The scope may grow or shrink based on the project's five-month timeline and the capabilities of the team.		
Project Objective	This project aims to leverage the temi robot to enhance school outreach activities. By integrating Temi's mobility, interactive capabilities, and AI functionalities, we can create an engaging platform to connect with potential students and their families, showcase school programs, and provide informative content.		
High-Level Requirements	<ul style="list-style-type: none"> • Development of a quiz application with multiple question types. • Integration of Bluetooth connectivity for interactive devices. • Replacement of Temi's current text-to-speech system with a ChatGPT-based plugin. • Creation of a Software Development Kit (SDK) for creating tours. • Comprehensive user documentation and a manual for developers. 		
In Scope	<ul style="list-style-type: none"> • Development of the quiz application and related features. • Integration of AI functionalities and Bluetooth capabilities. • Documentation of the development process for future reference. • User training and support materials. 		
Out Scope	<ul style="list-style-type: none"> • Hardware modifications to the Temi robot. • Development of external applications not related to school outreach. • Long-term maintenance or support after project completion. 		
Deliverables	<p>Main:</p> <ul style="list-style-type: none"> • A fully functional quiz application on the Temi robot. • Detailed documentation of the development process, including user manuals and guides. • Integration of Bluetooth connectivity with a user-friendly interface. • A working ChatGPT plugin for enhanced interaction. • SDK for creating tour guides. <p>Assessment:</p> <ul style="list-style-type: none"> • Project Specification Report • Final Report • Log Book • Showcase Presentation 		

3.4 Project SWOT Analysis

Table 4 SWOT Analysis

	Internal	External
Positive	Strength	Opportunities
	<ul style="list-style-type: none"> • Previous projects have successfully utilized the Temi robot, providing a strong foundation of knowledge and resources. • Other members at NYP have previous experience with Temi. • The team possesses coding skills necessary for application development. • NYP has access to multiple Temi versions and PCs. • Connections with the Temi Center provides additional learning sources. • NYP has allocated resources for learning and developing with Temi, including training materials. • The institution's willingness to allow flexible development encourages creativity and innovation in the final product. • A pool of potential trial testers at NYP can provide valuable feedback during the development process. 	<ul style="list-style-type: none"> • Developing a robust system for the Temi can enhance NYP's capabilities and attract future developers interested in leveraging the technology. • Successfully creating an engaging outreach platform could serve as a compelling draw for prospective students and families, enhancing NYP's visibility and appeal. • By developing a flexible SDK and integrating AI features, new opportunities for Temi's application can emerge, such as campus tours, interactive learning modules, or event assistance. • Demonstrating innovative tech applications in education can increase the likelihood of receiving additional government funding or subsidies for further technological investments. • Engaging with potential students and their families through this technology can foster a lasting positive impression, leading to stronger enrollment rates over time.
Negative	Weakness	Threats
	<ul style="list-style-type: none"> • The team lacks extensive experience in creating software applications, which may slow progress. • The project is constrained to a 5-month timeline, which could limit feature development. • Adding additional members to the team is not possible. • The developed functionalities may cater to niche applications, potentially limiting broader appeal. 	<ul style="list-style-type: none"> • If the Temi does not function as intended during demonstrations, it could negatively impact NYP's reputation and appeal. • Inadequate documentation could hinder future development efforts, potentially resulting in a failure to meet one of the project's primary aims. • If the objectives achieved in the product do not align with stakeholder desires due to the open nature of the project, it could lead to dissatisfaction. • Integrating Bluetooth devices or complex AI functions may encounter technical challenges, such as compatibility issues or latency, which could impact the user experience.

4. Assumptions and Constraints

4.1 Critical Assumptions

Critical assumptions are factors believed to be true for the project's success. If these assumptions do not hold, the project may face significant challenges or fail to meet its objectives. The following assumptions have been identified as crucial:

- **Functionality of Temi's core systems:** It is assumed that Temi's existing systems, such as mobility, speech recognition, and display functions, will work as intended throughout the development and outreach activities.
- **Availability of Resources:** It is assumed that necessary resources, including hardware, software, and personnel, will be available throughout the project's 5-month timeline.
- **Stakeholder Engagement:** Stakeholders, including developers, educators, and school outreach coordinators, will actively participate in providing feedback and supporting the project's development.
- **Technical Skills:** It is assumed that the team's current skills in coding and working with the Temi robot will be sufficient, with the capability to learn and adapt quickly to new challenges.
- **Temi SDK Stability:** The stability and reliability of the Temi SDK are assumed to remain constant, allowing for seamless integration of new features without significant compatibility issues.
- **External Support:** It is assumed that support from the Temi Center, if needed, will be readily available for troubleshooting and guidance.

4.2 Critical Constraints

Critical constraints are limitations or restrictions that may affect the project's success, limiting the scope or creating potential challenges. The following constraints have been identified:

- **Timeframe:** The project is limited to a strict 5-month timeline, restricting the ability to address unforeseen challenges or add additional features.
- **Budget:** There is no assigned project budget.
- **Team Size:** The number of team members is fixed, and no additional personnel can be added to assist with the workload. This could constrain the team's ability to meet all project objectives.
- **Technical Limitations:** The capabilities of the Temi robot may limit the complexity of applications that can be developed, such as integration with high-end AI systems or multi-device Bluetooth connectivity.
- **Niche Application:** The functionalities developed for the Temi may be highly specialized, limiting the broader application or appeal of the final product.
- **Documentation Requirements:** Comprehensive documentation is required for future developers to build on this project, placing additional time pressure on the team to not only develop the product but also ensure it is well-documented.
- **Testing Environment:** Access to testing environments may be limited to specific locations or times, potentially delaying necessary trial runs and debugging.

5. Analysis of Options

The Analysis of Options section is designed to outline and evaluate different solutions, strategies or approaches to achieve the project goals. In terms of this project, the main goals and the methods to achieve them have already been outlined prior to the start of this project. These goals look at increasing the capabilities of the Temi Robot or creating a foundation for other developers to continue the project/s. What has not been decided is the priority the goals should be given. This is important due to the time limited nature of the project. Once five months has passed, no further development will be done by this team's project. As such, the analysis of options will look at the approach that will be taken when deciding between short term and long-term goals. Based on the assessment done in Table 5, option 3 has been chosen. This option allows the balancing between developing engaging applications while considering the needs of future developers; both of these are essential components of the project scope.

Table 5 Analysis of Options for Best Goal Prioritisation Approach

Options	Option 1: Prioritize Increasing the Capabilities of the Temi Robot (Short-Term Focus)	Option 2: Focus on Creating a Foundation for Future Developers (Long-Term Focus)	Option 3: Balanced Approach (Hybrid Focus)
Description	Focus primarily on enhancing the robot's current capabilities, such as adding new features for better engagement, interaction, or outreach functions. This approach would aim to deliver a tangible, functional result by the end of the five-month period.	Concentrate on building a solid framework, documentation, and scalable code, ensuring future developers can easily continue the work and add further functionality to the Temi robot.	Attempt to achieve both immediate improvements in the Temi robot's capabilities while simultaneously developing a foundation for future developers. This would involve setting realistic, high-impact goals for both immediate functionality and creating scalable documentation.
Option Outline (Priority level of Deliverables; Top Highest)	<ul style="list-style-type: none"> A fully functional quiz application on the Temi robot. SDK for creating tour guides. Integration of Bluetooth connectivity with a user-friendly interface. A working ChatGPT plugin for enhanced interaction. Detailed documentation of the development process, including user manuals and guides. 	<ul style="list-style-type: none"> Detailed documentation of the development process, including user manuals and guides. A working ChatGPT plugin for enhanced interaction. Integration of Bluetooth connectivity with a user-friendly interface. SDK for creating tour guides. A fully functional quiz application on the Temi robot. 	<ul style="list-style-type: none"> A fully functional quiz application on the Temi robot. *Detailed documentation of the development process, including user manuals and guides. Integration of Bluetooth connectivity with a user-friendly interface. SDK for creating tour guides. A working ChatGPT plugin for enhanced interaction.
Pros	<ul style="list-style-type: none"> Provides a clear, demonstrable outcome to showcase at the end of the project. Aligns with immediate stakeholder expectations, especially those interested in seeing how Temi can improve outreach activities. Easier to manage within the given timeframe. 	<ul style="list-style-type: none"> Ensures the project has long-term viability and scalability. Can position NYP as a leader in Temi development by enabling other developers to continue enhancing the robot's capabilities. Creates an enduring legacy that can be used for future educational outreach and tech innovation projects. 	<ul style="list-style-type: none"> Provides immediate results while laying the groundwork for future improvements. Can satisfy both short-term stakeholder expectations and the long-term need for scalability. Ensures the project has a lasting impact while still delivering a functional product within the five-month period.
Cons	<ul style="list-style-type: none"> May not leave enough time to build robust documentation for future developers. Potentially limits long-term impact if the foundational work for future development is not addressed. 	<ul style="list-style-type: none"> Less visible short-term impact. The robot's functionality may remain limited in the current project phase, with future benefits reliant on follow-up work. 	<ul style="list-style-type: none"> Balancing both tasks may lead to a trade-off, where neither the immediate functionality nor the foundation is as fully realized as it could be. Requires careful project management to ensure no

		<ul style="list-style-type: none"> Stakeholders may perceive the project as incomplete if no immediate functionality is demonstrated. 	significant aspect is neglected.
Risk/Dependencies	There may be a risk that the project time limit will run out before any documentation can be done. This can lead to difficulties for future developers to expand upon developed systems. It may also lead to situations where new developer may not be able to use created systems at all, making the project's achievements null.	When going into this project, the team will have limited knowledge on how to develop software application for the Temi Robot. Hence, focusing on creating documentation first may not be the most productive approach. Also, deliverables with long-term benefits are more difficult to implement which may lead to significant delays.	This method relies on getting a deliverable done before creating documentation. It also prioritizes deliverables that complement previous deliverables. For example, the Bluetooth deliverable directly benefits the quiz application while the ChatGPT benefits the tour guide feature. Hence, there may be a situation where development on only one system is done
Recommendation	This approach is ideal if the immediate impact on stakeholders (NYP, educators, outreach coordinators) is of primary concern.	This is ideal if the goal is to establish a long-term impact and encourage further innovation beyond the current project's timeframe.	This approach is ideal if desired to deliver immediate functionality to stakeholders while ensuring that future developers can continue improving the Temi robot.

*** For the Balanced Hybrid Approach, the documentation process is done intermittently between deliverable.**

6. Stakeholders

6.1 Stakeholder

Table 6 List of Stakeholder

Stakeholder	Category	Impact	Interest	Expectation	Power Level	Interest Level	PSC*
NYP (Nanyang Polytechnic)	Organization	High	High	Expect innovative and functional technology that enhances outreach efforts	High	High	Manage closely
Educators/Outreach Coordinators	Internal	Medium	High	Expect engaging, easy-to-use applications for outreach activities	Medium	High	Manage closely
Potential Students and Families	External	Medium	High	Expect interactive and informative experiences during outreach events	Low	High	Monitor
Test Users (NYP students/staff)	Internal	Medium	Medium	Expect to provide feedback and trial experiences	Low	Medium	Monitor
NYP Management	Internal	High	High	Expect the project to align with NYP's vision for tech integration in education	High	High	Manage closely
Government or Funding Bodies	External	Low	Low	Interested in the successful application of technology in education	Low	Low	Monitor
Future Developers	Internal	Low	Medium	Expect well-documented, scalable code for further development	Low	Medium	Keep satisfied
Industry Supervisor	Internal	High	High	Expect timely project progress and comprehensive updates	High	High	Manage closely
Academic Supervisor	External	Assesses performance during placement	High	Expect successful completion of project and demonstration	High	High	Manage closely

6.2 Level of Stakeholder Engagement

Table 7 Level of Stakeholder Engagement

Stakeholder Level of Engagement	Aware of Project and Potential Impacts	Action or Reaction
Leading	Yes	Actively working for project success
Supportive	Yes	Supports the change to be caused by the impact
Resistive	Yes	Resists the change to be caused by the impact
Neutral	Yes	Neither supportive nor resistant
Unaware	No	No intentional reaction to project

6.3 Stakeholders' Engagement Assessment Matrix

Table 8 Stakeholders' Engagement Assessment Matrix

Stakeholder	Leading	Supportive	Resistant	Neutral	Unaware
NYP (Nanyang Polytechnic)		Current, Desired			
Educators/Outreach Coordinators		Desired			Current
Potential Students and Families		Desired			Current
Test Users (NYP students/staff)		Desired		Current	
NYP Management		Current, Desired			
Government or Funding Bodies		Desired		Current	
Future Developers				Desired	Current
Industry Supervisor	Current, Desired				
Academic Supervisor				Current, Desired	

6.4 Stakeholder Engagement Plan

Table 9 Stakeholder Engagement Plan

Role	Stakeholder	Expectation	Communication Approach
NYP (Nanyang Polytechnic)	NYP Management	Achieve the goals outlined in the project	Through NYP Manager or Industry Supervisor
Educators/Outreach Coordinators	Internal Staff	Ensure that the Potential Students' and Families' expectations are met	Through NYP Manager or Industry Supervisor
Potential Students and Families	External Audience	Ensure that the applications they interact with are intuitive and engaging	N/A (No direct communication needed during development)
Test Users (NYP students/staff)	End Users	Ensure that feedback given is applied or considered	Through Industry Supervisor and/or in-person sessions
NYP Management	Mohamad Pauzi (Manager)	Ensure all tasks are done as specified by the Industry Supervisor	Email
Government or Funding Bodies	External Oversight	Address completion of the New Colombo Plan and related factors	Reports through NYP Management or Flinders Team.
Future Developers	N/A	Documentation and manuals are to be of an adequate standard	N/A (Documentation will be available for future reference)
Industry Supervisor	Edwin Foo (Supervisor)	Ensure all project goals outlined are achieved	WhatsApp, email, or in-person meetings
Academic Supervisor	Nassar Asgari (Assessor)	Ensure all assessable content has been submitted	Email and Flinders Canvas

Stakeholder Communication Plan

Description	Frequency	Channel	Audience	Involved
Project Status Updates	Weekly	WhatsApp + In Person	All Internal Stakeholders and Project Team	Industry Supervisor
Project Team Meeting	As Needed	In Person	All project team	Industry Supervisor
External Stakeholder Updates	End of Project	Email	Project Managers and all Stakeholders	Academic Supervisor
Testing and Quality Assurance reports	As Needed	Email + In Person	R&D, Quality Assurance, Regulatory Bodies Teams	Industry Supervisor + Future Developers
Collect Customer Input	As Needed	In person + Quiz Survey	Customer Support, Sales and Marketing Teams	Test Users + Industry Supervisor

Figure 5 Stakeholder Communication Plan

7. Work Plan

7.1 Work Breakdown Structure (WBS)

****NOTE****

Lookup table can be found in the appendices under Table 20.

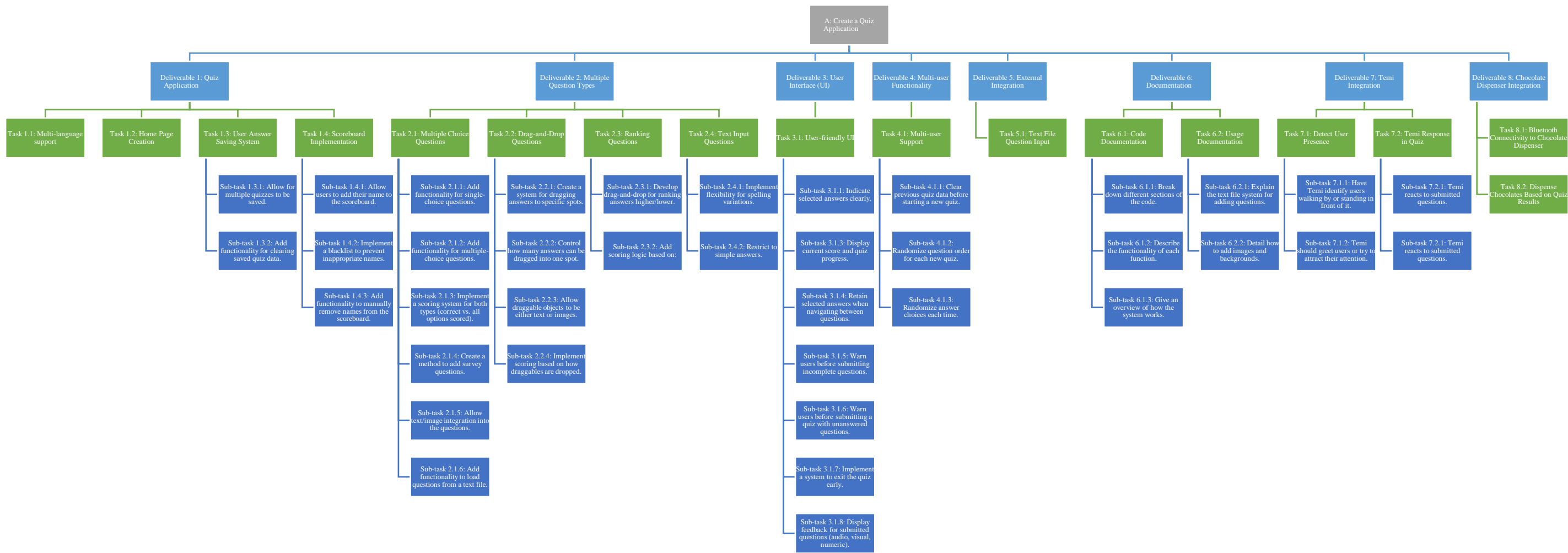


Figure 6 WBS for Project Goal A: Create A Quiz Application

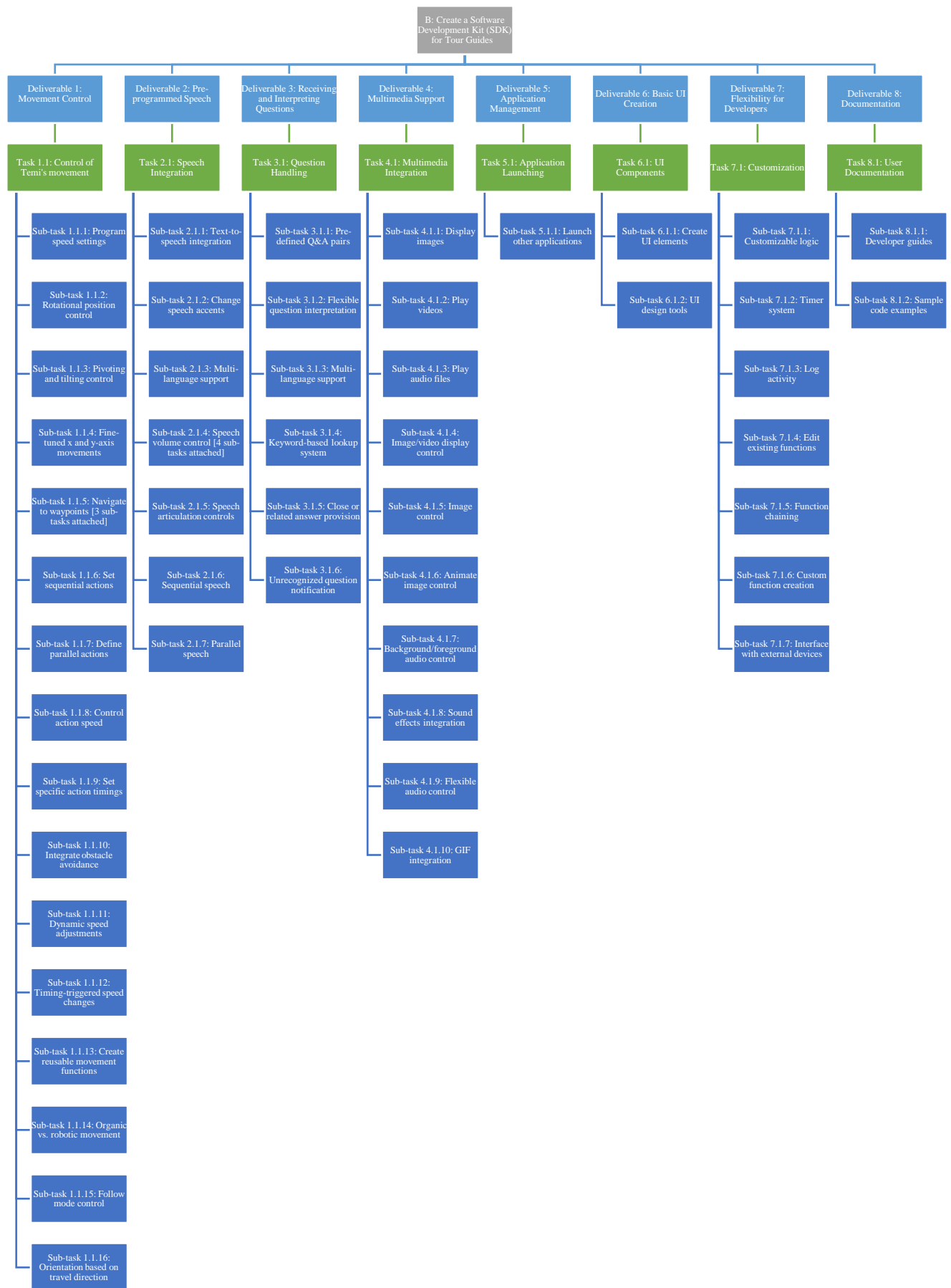


Figure 7 WBS for Project Goal B: Create a Software Development Kit (SDK) for Tour Guides

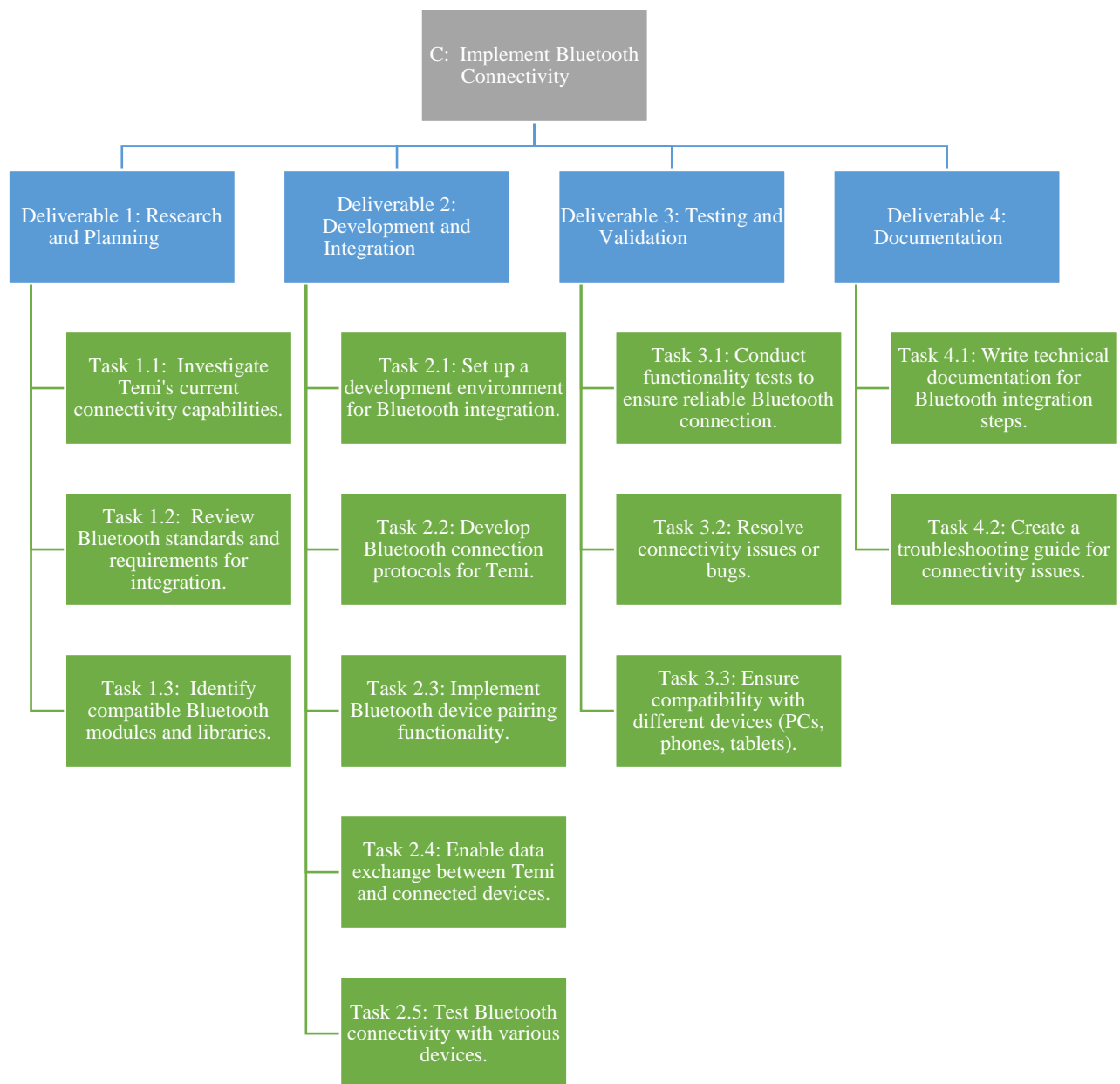


Figure 8 WBS for Project Goal C: Implement Bluetooth Connectivity

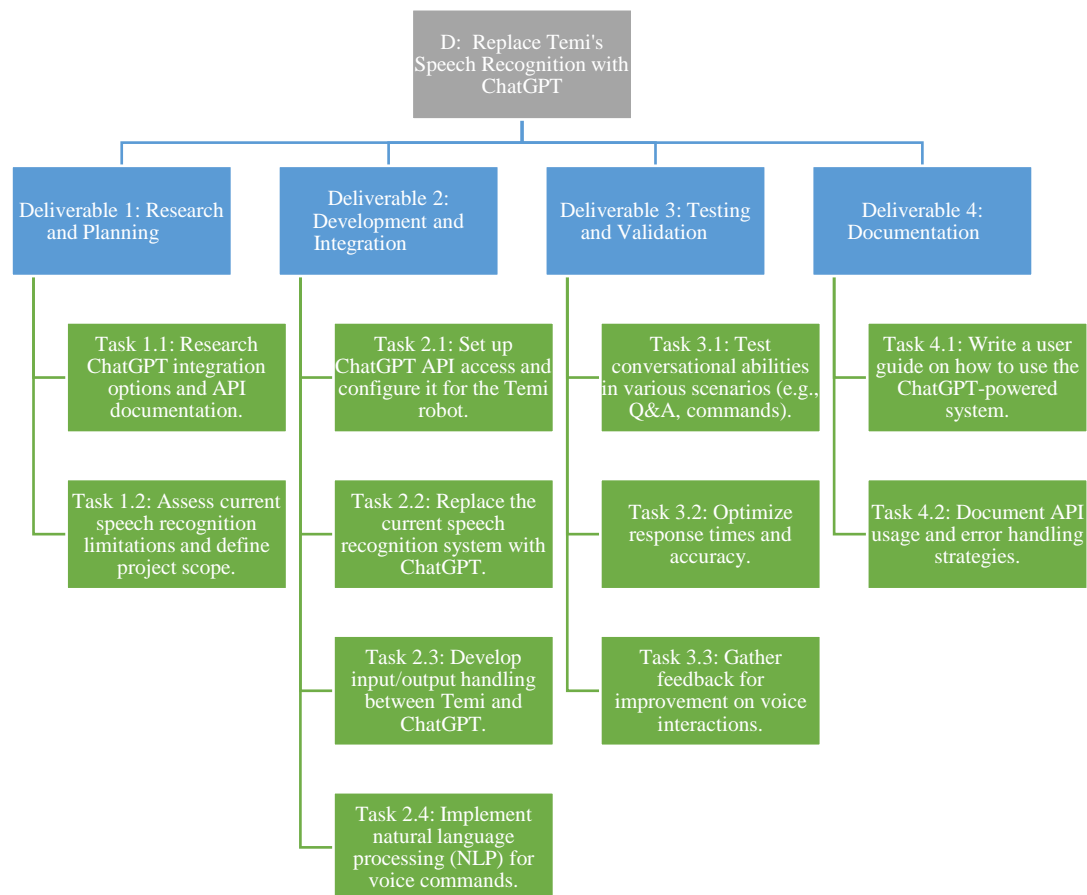


Figure 9 WBS for Project Goal D: Replace Temi's Speech Recognition with ChatGPT

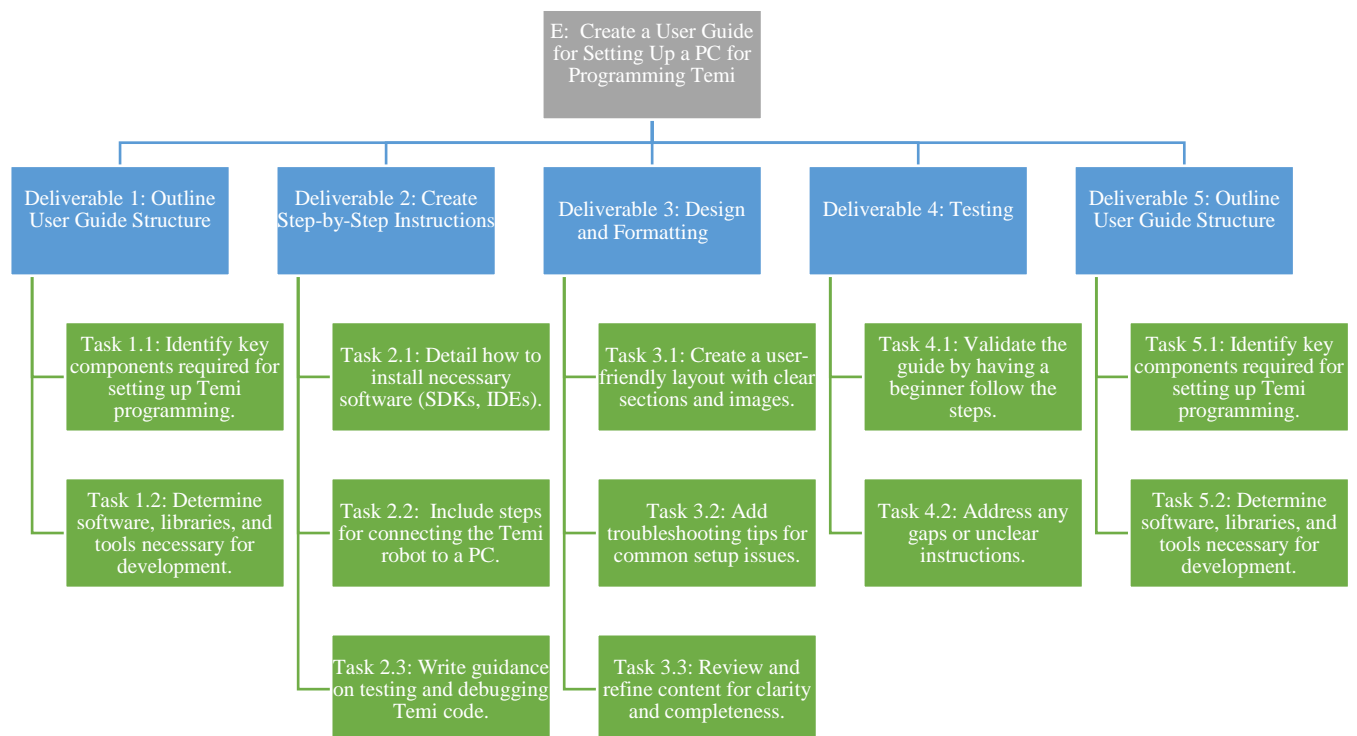


Figure 10 WBS for Project Goal E: Create a User Guide for Setting Up a PC for Programming Temi

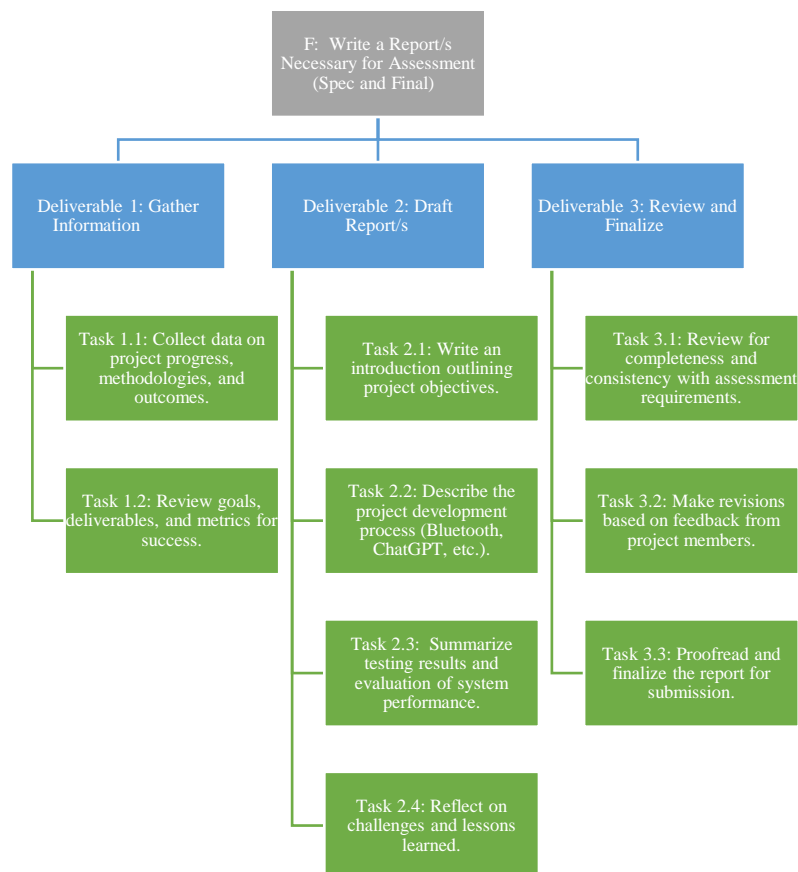


Figure 11 WBS for Project Goal F: Write a Report/s Necessary for Assessment (Spec and Final)

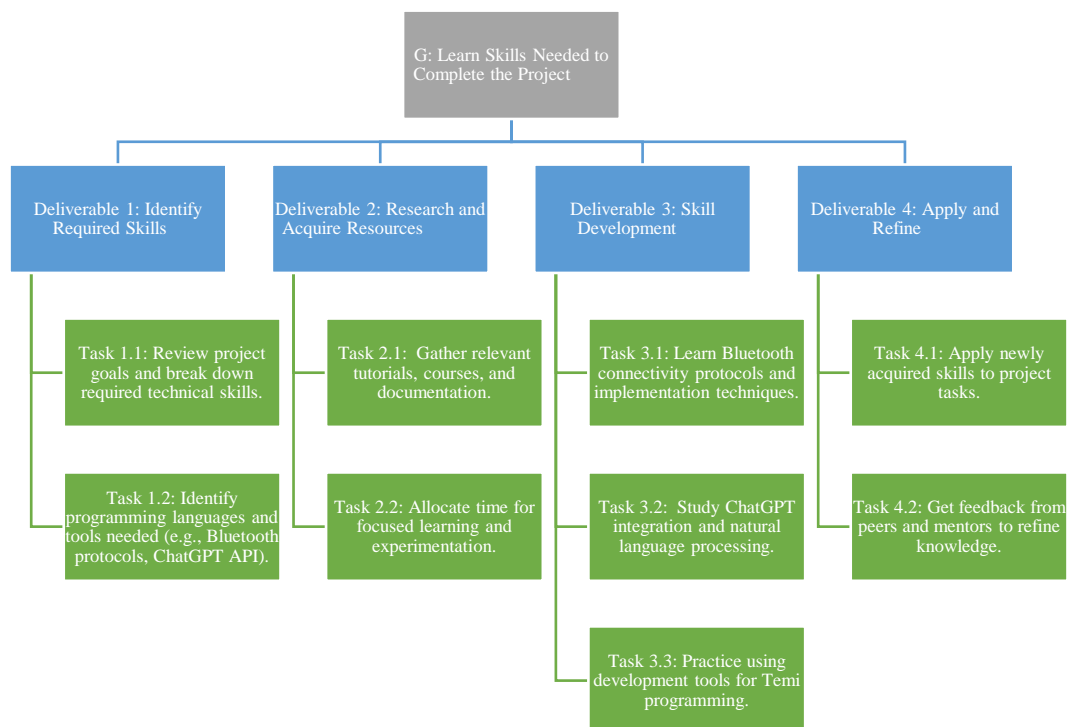


Figure 12 WBS for Project Goal G: Learn Skills Needed to Complete the Project

7.2 Deliverables & Timeline Description

****NOTE****

A day is defined as eight hours in one working day. One week has five working days.

Table 10 Beta Probability Distribution Table

Project Goal	Deliverable Name	Predecessor	Time Estimates (In Days)			Expected Time (T_E)	Total
			Optimistic (O)	Normal (M)	Pessimistic (P)		
A: Create a Quiz Application	Deliverable 1: User Interface (UI)	E D5	0.5	1.25	2	1.2	10
	Deliverable 2: External Integration	A D1	0.75	1.2	2	1.2	
	Deliverable 3: Quiz Application	A D2	0.75	1.3	2	1.3	
	Deliverable 4: Multiple Question Types	A D3	0.75	1.3	2	1.3	
	Deliverable 5: Multi-user Functionality	A D4	0.75	1.3	2	1.3	
	Deliverable 6: Documentation	A D5	1	1.6	2	1.5	
	Deliverable 7: Temi Integration	A D6	0.5	1	2	1	
	Deliverable 8: Chocolate Dispenser Integration	A D7	0.5	1	2	1	
B: Create a Software Development Kit (SDK) for Tour Guides	Deliverable 1: Movement Control	C D4	1	1.8	3	1.8	15
	Deliverable 2: Pre-programmed Speech	B D1	1	2	3	2	
	Deliverable 3: Receiving and Interpreting Questions	B D2	1	2	3	2	
	Deliverable 4: Multimedia Support	B D3	1	2	3	2	
	Deliverable 5: Application Management	B D4	3	2.4	4	2.7	
	Deliverable 6: Basic UI Creation	B D5	1	1.6	2	1.5	
	Deliverable 7: Flexibility for Developers	B D6	1	1.5	2	1.5	
	Deliverable 8: Documentation	B D7	1	1.5	2	1.5	
C: Implement Bluetooth Connectivity	Deliverable 1: Research and Planning	F D2	1	2	4	2.1	10
	Deliverable 2: Development and Integration	C D1	2	4	5	3.8	
	Deliverable 3: Testing and Validation	C D2	1	2.5	3	2.3	
	Deliverable 4: Documentation	C D3	0.75	1.5	2	1.4	
D: Replace Temi's Speech Recognition with ChatGPT	Deliverable 1: Research and Planning	B D8	1	2	4	2.1	10
	Deliverable 2: Development and Integration	D D1	2	4	5	3.8	
	Deliverable 3: Testing and Validation	D D2	1	2.5	3	2.3	
	Deliverable 4: Documentation	D D3	0.75	1.5	2	1.4	
E: Create a User Guide for Setting Up a PC for Programming Temi	Deliverable 1: Outline User Guide Structure	G D3	0.2	1	2	1	10
	Deliverable 2: Create Step-by-Step Instructions	E D1	2	3	4	3	
	Deliverable 3: Design and Formatting	E D2	1	3	4	2.8	
	Deliverable 4: Testing	E D3	1	1.5	2	1.5	
	Deliverable 5: Outline User Guide Structure	E D4	1	1.5	2	1.5	
F: Write a Report/s Necessary for Assessment (Spec and Final)	Deliverable 1: Gather Information	A D	5	6	8	6.1	20
	Deliverable 2: Draft Report/s	A D8	7	10	14	10.1	
	Deliverable 3: Review and Finalize	F D1	2	4	5	3.8	
G: Learn Skills Needed to Complete the Project	Deliverable 1: Identify Required Skills	-	0.7	1	2	1.1	5
	Deliverable 2: Research and Acquire Resources	G D1	0.5	1	1.6	1	
	Deliverable 3: Skill Development	G D2	2	3	3.5	2.9	

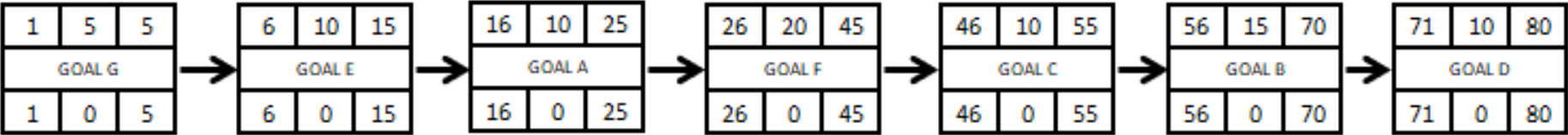


Figure 13 Precedence Diagram

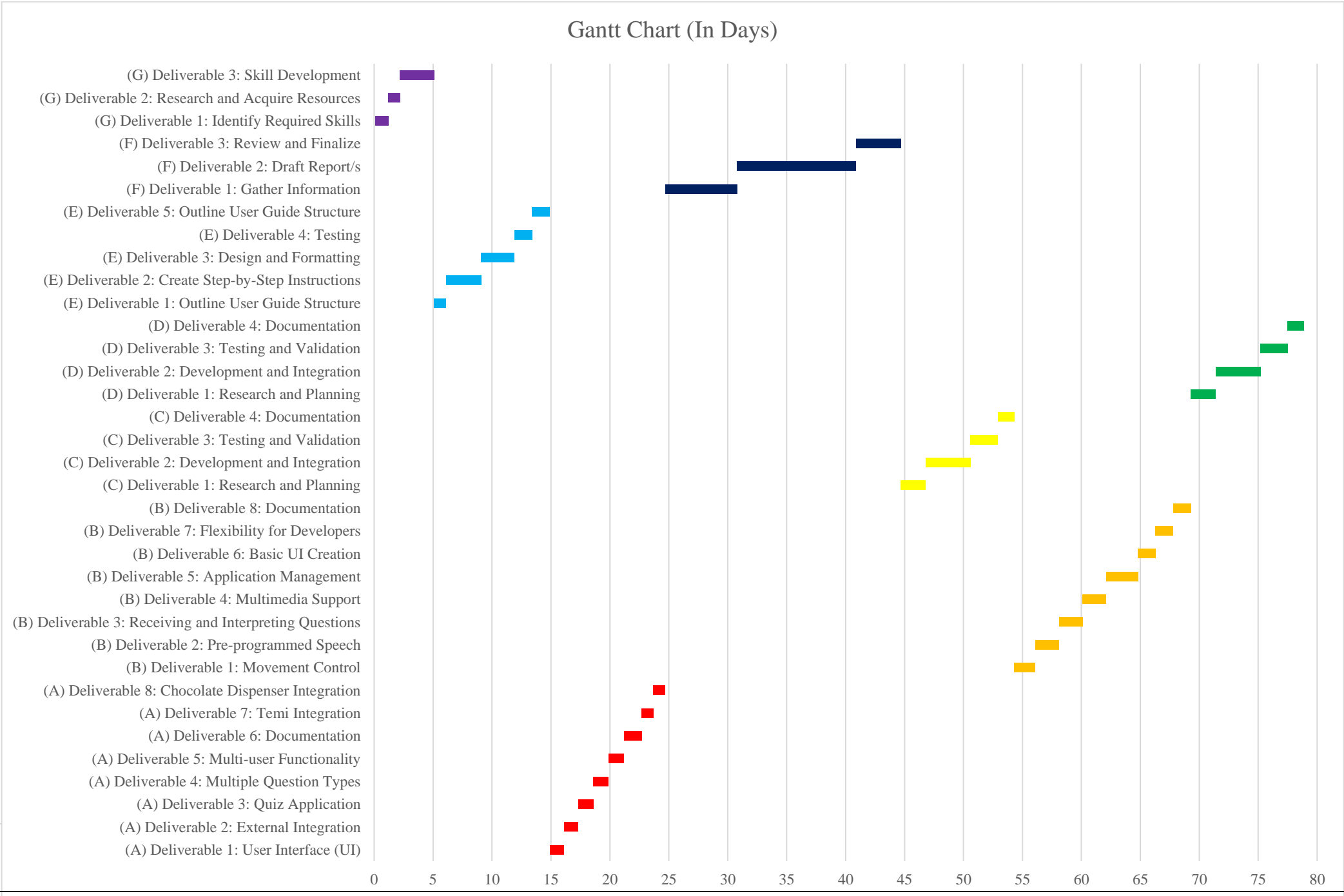


Table 11 Precedence Diagram Lookup Table

Project Goal	Deliverable	Descriptor	Duration (in Days)	Start Date	Start Date	Predecessor	Successor
A: Create a Quiz Application	Deliverable 1: User Interface (UI)	Design an intuitive UI for users to interact with the quiz.	1.2	14.9	16.0	E D5	A D2
	Deliverable 2: External Integration	Create system for adding questions with Text Files.	1.2	16.1	17.2	A D1	A D3
	Deliverable 3: Quiz Application	Develop a functioning framework for a quiz application.	1.3	17.3	18.5	A D2	A D4
	Deliverable 4: Multiple Question Types	Implement support for various types of questions (MCQs, true/false, etc.).	1.3	18.6	19.8	A D3	A D5
	Deliverable 5: Multi-user Functionality	Allow the quiz to be repeated multiple times from different users and save results.	1.3	19.9	21.1	A D4	A D6
	Deliverable 6: Documentation	Create documentation for users and developers.	1.5	21.2	22.6	A D5	A D7
	Deliverable 7: Temi Integration	Integrate the Temi SDK into the application.	1	22.7	23.6	A D6	A D8
	Deliverable 8: Chocolate Dispenser Integration	Integrate a chocolate dispenser that dispenses treats based on quiz results.	1	23.7	24.6	A D7	F D1
B: Create a Software Development Kit (SDK) for Tour Guides	Deliverable 1: Movement Control	Develop functions to control the movement of the robot.	1.8	54.3	56.0	C D4	B D2
	Deliverable 2: Pre-programmed Speech	Create a system to use Temi's speech-to-text.	2	56.1	58.0	B D1	B D3
	Deliverable 3: Receiving and Interpreting Questions	Implement the ability to receive and respond to user questions.	2	58.1	60.0	B D2	B D4
	Deliverable 4: Multimedia Support	Integrate support for multimedia content (audio, video).	2	60.1	62.0	B D3	B D5
	Deliverable 5: Application Management	Develop features for managing the SDK and applications created with it.	2.7	62.1	64.7	B D4	B D6
	Deliverable 6: Basic UI Creation	Create a basic user interface for the SDK.	1.5	64.8	66.2	B D5	B D7
	Deliverable 7: Flexibility for Developers	Ensure that the SDK is flexible and easy to use for developers.	1.5	66.3	67.7	B D6	B D8
	Deliverable 8: Documentation	Write comprehensive documentation for using the SDK.	1.5	67.8	69.2	B D7	D D1
C: Implement Bluetooth Connectivity	Deliverable 1: Research and Planning	Investigate current Bluetooth capabilities and integration options.	2.1	44.7	46.7	F D2	C D2
	Deliverable 2: Development and Integration	Develop and integrate Bluetooth functionality with Temi.	3.8	46.8	50.5	C D1	C D3
	Deliverable 3: Testing and Validation	Conduct tests to ensure Bluetooth connectivity works reliably.	2.3	50.6	52.8	C D2	C D4
	Deliverable 4: Documentation	Document the Bluetooth integration process and usage.	1.4	52.9	54.2	C D3	B D1
D: Replace Temi's Speech Recognition with ChatGPT	Deliverable 1: Research and Planning	Explore ChatGPT integration options and assess current capabilities.	2.1	69.3	71.3	B D8	D D2
	Deliverable 2: Development and Integration	Implement ChatGPT in place of the current speech recognition system.	3.8	71.4	75.1	D D1	D D3
	Deliverable 3: Testing and Validation	Test the functionality and accuracy of ChatGPT in various scenarios.	2.3	75.2	77.4	D D2	D D4
	Deliverable 4: Documentation	Create documentation for the new speech recognition system.	1.4	77.5	78.8	D D3	-
E: Create a User Guide for Setting Up a PC for Programming Temi	Deliverable 1: Outline User Guide Structure	Create an outline for the user guide, defining main topics and sections.	1	5.1	6.0	G D3	E D2
	Deliverable 2: Create Step-by-Step Instructions	Develop clear, step-by-step instructions for setting up Temi.	3	6.1	9.0	E D1	E D3
	Deliverable 3: Design and Formatting	Design the user guide layout, including visuals and formatting.	2.8	9.1	11.8	E D2	E D4
	Deliverable 4: Testing	Validate the guide by having users follow the instructions.	1.5	11.9	13.3	E D3	E D5
	Deliverable 5: Outline User Guide Structure	Revise the user guide based on feedback to ensure clarity.	1.5	13.4	14.8	E D4	A D1
F: Write a Report/s Necessary for Assessment (Spec and Final)	Deliverable 1: Gather Information	Collect relevant data and information for the assessment reports.	6.1	24.7	30.7	A D	F D
	Deliverable 2: Draft Report/s	Create initial drafts of the specification and final reports.	10.1	30.8	40.8	A D8	F D2
	Deliverable 3: Review and Finalize	Review and finalize the reports for submission.	3.8	40.9	44.6	F D1	C D1
G: Learn Skills Needed to Complete the Project	Deliverable 1: Identify Required Skills	Determine the skills necessary for completing the project.	1.1	0.1	1.1	-	G D2
	Deliverable 2: Research and Acquire Resources	Gather resources for learning required skills (tutorials, courses).	1	1.2	2.1	G D1	G D3
	Deliverable 3: Skill Development	Engage in activities to develop the identified skills.	2.9	2.2	5.0	G D2	E D1

8. Implementation Strategies

8.1 Project Phases

The project will be structured into seven distinct phases to ensure targeted progress and risk management. The entire project will span 5 months (approximately 20 weeks). Below is a breakdown of the key activities and deliverables for each phase:

Phase 1: Research and Skill Development (1 Week)

- **Objective:** Equip the team with the necessary knowledge and skills to begin development.
- **Key Activities:**
 - Research Temi robot's SDK and functionality.
 - Familiarize the team with Bluetooth integration and Temi's capabilities.
 - Identify necessary libraries or APIs for the ChatGPT plugin and Quiz system.
 - Develop a preliminary project timeline and prepare tools/software for development.
- **Deliverables:** The team will have a set of knowledge resources, including a thorough understanding of Temi's SDK, ChatGPT integration, and Bluetooth capabilities. A final project timeline will be established, and all tools and frameworks necessary for development will be identified. All of these will be consolidated into a **Specification Report** and **User Handbook**.

Phase 2: Development of Quiz and Bluetooth Systems (4 Weeks)

- **Objective:** Build the core systems for the interactive quiz and establish Bluetooth connectivity.
- **Key Activities:**
 - Develop the interactive quiz application for Temi.
 - Integrate Bluetooth connectivity for external device interaction (e.g., chocolate dispenser).
 - Conduct initial testing of the quiz app and Bluetooth functionalities.
- **Deliverables:** A functional quiz app and fully integrated Bluetooth system will be developed. Initial testing results will help ensure that both systems are working properly and identify any adjustments needed.

Phase 3: Documentation and Development of User Guide (3 Weeks)

- **Objective:** Create comprehensive documentation for end-users and technical support.
- **Key Activities:**
 - Develop step-by-step user guides for installing and using the quiz and Bluetooth systems.
 - Provide troubleshooting tips based on testing feedback.
 - Document technical aspects for future reference.
 - Produce the **Specification Report**.
- **Deliverables:** The team will complete detailed user guides for both the quiz and Bluetooth systems, including troubleshooting advice and FAQs. Additionally, the technical aspects of the systems will be thoroughly documented for future use, and the **Specification Report** will be finalized.

Phase 4: Development of SDK Kit for Tour Guides (3 Weeks)

- **Objective:** Build an SDK kit to simplify Temi's use as a tour guide, showcasing the robot's capabilities.
- **Key Activities:**
 - Develop features for easy programming of Temi's movement and speech for tours.
 - Integrate multimedia capabilities to enhance the tour experience.
 - Test the SDK for compatibility with Temi's navigation and display functions.

- **Deliverables:** A functional SDK kit will be produced, allowing for easy programming of Temi's tour guide features. Initial testing feedback will inform adjustments, ensuring the SDK is compatible with Temi's full range of capabilities.

Phase 5: Development of ChatGPT Plug-in (2 Weeks)

- **Objective:** Integrate the ChatGPT plug-in for advanced speech interaction.
- **Key Activities:**
 - Build and test a ChatGPT plug-in for conversational interactions with Temi.
 - Ensure seamless communication between the ChatGPT API and Temi's speech system.
 - Conduct response testing under various scenarios.
- **Deliverables:** The ChatGPT plug-in will be fully integrated into Temi, allowing for advanced speech interactions. The team will conduct functionality tests and provide API documentation to support future development or adjustments.

Phase 6: Documentation and Development of User Guide for SDK and ChatGPT (3 Weeks)

- **Objective:** Document the functionality of the SDK kit and ChatGPT plug-in.
- **Key Activities:**
 - Develop user guides for the SDK kit and ChatGPT plug-in.
 - Provide technical documentation for future updates or modifications.
 - Collect stakeholder and user feedback to refine guides.
 - Consolidate findings into the **Final Report**.
- **Deliverables:** Comprehensive user guides for the SDK kit and ChatGPT plug-in will be produced, alongside technical documentation for future updates. All findings will be consolidated into the **Final Report**.

Phase 7: Accounting for Project Delays or Researching and Implementing New Project Plans (4 Weeks)

- **Objective:** Allocate time for handling delays or exploring new features.
- **Key Activities:**
 - Review and address any delays or obstacles encountered in previous phases.
 - Conduct additional research if needed for new features or system improvements.
 - Adjust the project plan to incorporate new findings.
- **Deliverables:** The project plan will be reviewed and revised if necessary, accounting for any delays or additional research. Any newly integrated features or improvements will be finalized, and the final round of testing will be completed to ensure all systems are functioning optimally.

8.2 Resource Allocation

The following resources are necessary to ensure the successful implementation of the project. Resources have been categorized into hardware, software, and human resources, with a focus on the single team member who will manage all tasks.

1. Hardware Resources

- **Workstation (PC and WiFi network):** Provided by NYP. A reliable workstation with internet access is essential for development, testing, and documentation throughout the project.
- **Temi Robot:** Provided by NYP. The Temi robot will be the primary hardware platform used to test and implement the interactive quiz, SDK kit, and ChatGPT plug-in.

2. Software Resources

- **Android Studio:** Available for free online. This integrated development environment (IDE) will be used for building the Android applications, including the quiz system and Bluetooth integration.
- **Android Debug Bridge (ADB):** Available for free online. ADB will assist in testing and debugging applications directly on the Temi robot, ensuring smooth functionality and compatibility.
- **Temi SDK:** Provided for free by the Temi Developer Center. This toolkit provides the necessary tools and APIs to develop the tour guide functionalities and other interactive features.
- **Documentation Software (e.g., Microsoft Word, PowerPoint, and Excel):** Provided by NYP. These tools will be used to create the user guides, technical documentation, and project reports.

3. Training Resources

- **Training Materials:** Online resources will be used to learn about Android development, Bluetooth integration, and API interaction with ChatGPT. While the resources are freely available, time will be dedicated to gaining proficiency.
- **Research Time:** The individual will spend time researching how to implement various Temi functionalities and integrating third-party systems like ChatGPT and Bluetooth.

4. Human Resources

- **Single Team Member:** As there is a sole person responsible for all tasks in the project, they will take on multiple roles, including:
 - **Project Manager:** Responsible for planning, scheduling, and managing the overall progress of the project.
 - **Developer:** Handles all technical development, including building the quiz app, integrating Bluetooth, developing the SDK kit, and adding the ChatGPT plug-in.
 - **Documenter:** Prepares user guides, technical documentation, and project reports for end users and future developers.

8.3 Success Metrics

Quality Checklist

Table 12 Quality Table

Quality Checklist					
Project: Temi Robot for School Outreach					Date: 30/09/2024
Quality Item	Verification				
	Yes	No	N/A	Date	Comments
Bluetooth connectivity tested					
Stable communication via Bluetooth					
Quiz app displays questions correctly					
Quiz system records responses accurately					
SDK kit includes navigation features					
SDK speech integration functional					
ChatGPT plug-in responds accurately					
ChatGPT plug-in integrated with Temi's speech					
User guide developed and complete					
Technical documentation complete					
Final product tested for user experience					
Chocolate dispenser integration functional					
Quiz app is responsive and runs smoothly					
All API integrations tested for compatibility					
Navigation commands tested in various settings					
Speech recognition accuracy tested					
Temi's display functions tested with multimedia					
SDK allows easy tour guide customization					
Bluetooth connection stability at long range					
ChatGPT integration tested for response time					
Safety protocols tested (e.g., Temi avoiding obstacles)					
Quiz app tested for different answer formats					
User guide tested for clarity by target users					
Temi's voice output is clear and understandable					
SDK integration allows easy update of tour routes					
Final product evaluated for compliance with school event requirements					

Quality Metric

Table 13 Quality Metric

Metric	Standard	Frequency	Report
Bluetooth Connectivity	95% success rate in establishing connections	After Implementation	Final Report
Quiz App Functionality	100% accuracy in displaying questions	After Each Change/Adjustment to System	Final Report
Response Accuracy (ChatGPT)	90% accuracy in understanding queries	After Implementation	Final Report
User Satisfaction	85% of users rating the experience as positive	After each event/testing phase	Final Report
Documentation Completeness	100% of necessary documentation created	At project end	Final Report
Integration Stability	100% successful integration tests	After Each Change/Adjustment to System	Final Report
Safety Compliance	100% compliance with safety protocols	After Each Change/Adjustment that effects Safety	Final Report
User Guide Clarity	90% of users finding the guide easy to follow	After each event/testing phase	Final Report
Performance Efficiency	Response time under 2 seconds for interactions	As required	Final Report

9. Project Management Framework

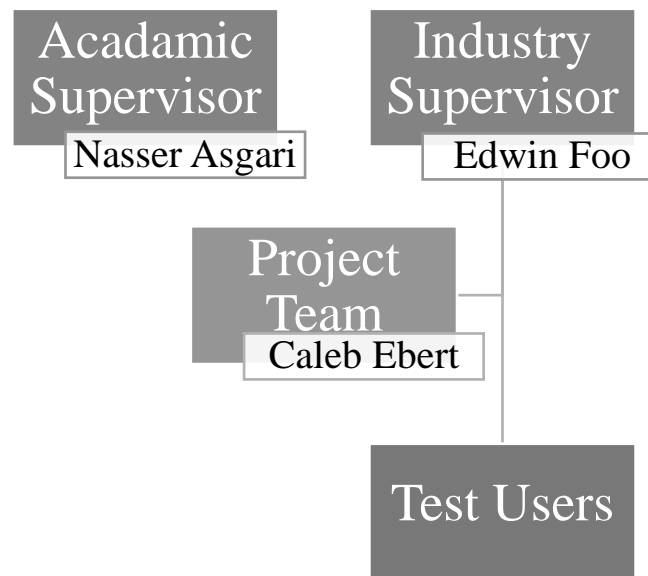


Figure 14 Project Organisational Chart

For this project, the organizational structure is relatively simple, consisting of four primary roles: The Academic Supervisor, the Industry Supervisor, the Project Team (comprising one member), and the Test Users. A visual representation of this structure is shown in Figure 14.

Academic Supervisor: The Academic Supervisor is responsible for evaluating the quality of the reports generated by the Project Team. These reports include the Project Specification Report and the Final Report. The Academic Supervisor must possess a strong understanding of the report requirements and ensure the grading is fair and objective. Their authority heavily influences the overall success of the project, as their evaluations will contribute significantly to the project's final outcome.

Industry Supervisor: The Industry Supervisor's role is to monitor and guide the Project Team to ensure that deliverables and project progress align with industry expectations and requirements. This role requires extensive experience in the relevant field, in this case, robotics. The Industry Supervisor holds the authority to adjust the project workflow and scope as needed, and their assessment on the Project Teams performance directly impacts the project's success.

Project Team: The Project Team is responsible for producing the necessary documentation and deliverables. These deliverables must meet the requirements set forth by the Academic Supervisor and align with the needs and expectations of the Industry Supervisor. The Project Team requires at least three to four years of academic experience in the relevant field to carry out these tasks effectively. The Project Team holds authority over how the project is executed to fulfil the needs and wishes of the Industry Supervisor.

Test Users: The role of the Test Users is to evaluate certain deliverables produced by the Project Team and provide feedback. Test Users must represent the target audience for the deliverables being created, and their feedback is crucial for refining the product. They hold the authority to suggest changes based on their experience, which can lead to further iterations and improvements in the project.

9.1 RACI Chart

Table 14 RACI Chart showing Roles Assigned to Team Members for Various Deliverables

Project Goal	Deliverable	Academic Supervisor	Industry Supervisor	Project Team	Test Users
A: Create a Quiz Application	Deliverable 1: User Interface (UI)	-	C	R	I
	Deliverable 2: External Integration	-	C	R	I
	Deliverable 3: Quiz Application	-	C	R	I
	Deliverable 4: Multiple Question Types	-	C	R	I
	Deliverable 5: Multi-user Functionality	-	C	R	I
	Deliverable 6: Documentation	-	C	R	C
	Deliverable 7: Temi Integration	-	C	R	I
	Deliverable 8: Chocolate Dispenser Integration	-	C	R	I
B: Create a Software Development Kit (SDK) for Tour Guides	Deliverable 1: Movement Control	-	C	R	I
	Deliverable 2: Pre-programmed Speech	-	C	R	I
	Deliverable 3: Receiving and Interpreting Questions	-	C	R	I
	Deliverable 4: Multimedia Support	-	C	R	I
	Deliverable 5: Application Management	-	C	R	I
	Deliverable 6: Basic UI Creation	-	C	R	I
	Deliverable 7: Flexibility for Developers	-	C	R	I
	Deliverable 8: Documentation	-	C	R	C
C: Implement Bluetooth Connectivity	Deliverable 1: Research and Planning	-	C	R	I
	Deliverable 2: Development and Integration	-	C	R	I
	Deliverable 3: Testing and Validation	-	C	R	I
	Deliverable 4: Documentation	-	C	R	C
D: Replace Temi's Speech Recognition with ChatGPT	Deliverable 1: Research and Planning	-	C	R	I
	Deliverable 2: Development and Integration	-	C	R	I
	Deliverable 3: Testing and Validation	-	C	R	I
	Deliverable 4: Documentation	-	C	R	C
E: Create a User Guide for Setting Up a PC for Programming Temi	Deliverable 1: Outline User Guide Structure	-	C	R	C
	Deliverable 2: Create Step-by-Step Instructions	-	C	R	C
	Deliverable 3: Design and Formatting	-	C	R	C
	Deliverable 4: Testing	-	C	R	C
	Deliverable 5: Outline User Guide Structure	-	C	R	C
F: Write a Report/s Necessary for Assessment (Spec and Final)	Deliverable 1: Gather Information	-	C	R	-
	Deliverable 2: Draft Report/s	A	C	R	-
	Deliverable 3: Review and Finalize	A	C	R	-
G: Learn Skills Needed to Complete the Project	Deliverable 1: Identify Required Skills	-	C	R	-
	Deliverable 2: Research and Acquire Resources	-	C	R	-
	Deliverable 3: Skill Development	-	C	R	-

R (Responsible): Does the work

A (Accountable): Owns the work

C (Consulted): Is consulted as needed as the work is performed

I (Informed): Is kept in the loop throughout the task

- (Not Required): Is not required to know

10. Risk Management

10.1 Risk Chart

Table 15 Risk Chart

Risk Factor	Consequence Category	Implications	Likelihood	Impact	Overall Risk	Mitigation Strategy	New Likelihood	New Impact	New Risk
Bluetooth connectivity failure	Technical	Inability to connect Temi via Bluetooth	C	4	Medium	Test Bluetooth module thoroughly, have a backup protocol	D	2	Low
Integration with Chocolate Dispenser fails	Functional	Chocolate dispenser integration breaks user flow	D	3	Medium	Ensure proper testing and fallback functionality	E	2	Low
Temi fails to navigate during tour guide demo	Operational	Delays demo and frustrates users	B	4	High	Test movement module thoroughly, pre-plan demo routes	C	3	Medium
Legal non-compliance with data privacy	Compliance/Legal	Potential fines and legal implications	D	5	Medium	Unsure no personal or private data is passed through Temi.	E	2	Low
Integration of ChatGPT with Temi fails	Technical	ChatGPT fails to respond, breaking voice interaction	B	3	High	Conduct comprehensive testing of API integration	C	2	Medium
Documentation is unclear for end users	User Experience	Users struggle to understand how to use features	C	3	Medium	Create clear, step-by-step guides, test documentation	D	2	Low
Temi gets damaged during operation	Financial	Repair or replacement costs for Temi	D	3	Medium	Unsure careful handling of Temi and only use Temi as is intended.	E	2	Low
Temi fails to function during live events	Reputation	Negative perception from users, loss of credibility	C	3	High	Conduct thorough pre-event testing, have technical support on standby	D	2	Medium

10.2 Probability/Impact Matrix

Table 16 Five Point Scale for Measuring Consequence

Category	1 - Insignificant	2 - Minor	3 - Moderate	4 - Major	5 - Catastrophic
Technical	Minor issue, easy to resolve.	Small delays or problems, requiring minimal resources.	Moderate issues, may cause some delays and rework.	Significant technical problems, major delays or rework.	Project jeopardized due to serious technical failure.
Functional	Feature non-essential, minor impact on user experience.	Small inconvenience in functionality, but workaround available.	Moderate inconvenience, some features underperform.	Major function failure, core aspects of system impacted.	Critical system failure, renders major functions unusable.
User Experience	Negligible impact on user satisfaction.	Minor inconvenience for a few users.	Noticeable inconvenience affecting many users.	Major dissatisfaction or confusion among users.	System is unusable, widespread negative feedback.
Security	No sensitive data affected.	Minor security concern, unlikely to be exploited.	Moderate risk, possible exploitation but contained.	Major breach, exposing critical data, affecting user trust.	Catastrophic breach, major data leak, severe legal consequences.
Financial	No measurable financial impact.	Small, unplanned costs that can be absorbed.	Moderate financial impact, budget adjustments required.	Major cost overrun, may affect other project areas.	Catastrophic financial loss, project may be cancelled.
Operational	Minor operational impact, easy to work around.	Small inefficiencies, does not impact deadlines.	Moderate inefficiencies, some delays in schedule.	Major operational impact, project timeline compromised.	Critical operational failure, halts project progress.
Compliance/Legal	Fully compliant, no legal issues.	Minor compliance issues, easy to address.	Moderate legal risk, may require significant changes.	Major legal issues, requires external intervention.	Severe non-compliance, potential lawsuits, and penalties.
Reputation	No damage to reputation.	Small reputational risk, unlikely to be noticed.	Moderate reputational risk, requires active management.	Major damage to reputation, negative media coverage.	Catastrophic reputational damage, loss of public trust.

Table 17 Likelihood Scale

Likelihood Level	Rating	Description	Time Frame Definition (5 Months)
(E) Very Unlikely	1	Highly improbable; may only happen in exceptional circumstances.	Occurs only once throughout the entire project.
(D) Unlikely	2	Uncommon; could happen, but not expected.	Occurs once every month.
(C) Possible	3	Could happen occasionally but not frequently.	Occurs at least once every week.
(B) Likely	4	Will probably happens at some point.	Occurs once every day.
(A) Almost Certain	5	Expected to happen frequently or is inevitable.	Occurs several times daily.

Table 18 Priorities for Attention

Level of Risk	Suggested Action	Suggested Timing
Low	Maintain oversight; review during regular project updates.	Review as needed
Medium	Monitor the situation closely; implement mitigation strategies as necessary.	Within 2-4 weeks of identification
High	Immediate attention required; address issues promptly to mitigate risks.	Within 1 week of identification

Table 19 Probability/Impact Matrix

Likelihood	A	Medium	Medium	Medium	High	High
	B	Medium	Medium	Medium	High	High
	C	Low	Medium	Medium	Medium	High
	D	Low	Low	Medium	Medium	High
	E	Low	Low	Medium	Medium	Medium
		1	2	3	4	5
		Consequence Rating				

11. References

References

Hsiang, C. C. (2023). *Overseas Internship Programme Report: TemiChoco Questionnaire App*. Singapore: Nanyang Polytechnic.

Robocore. (n.d.). *TemiScript: Unlock the full potential of temi*. Robocore Technology Ltd.

Temi. (8 February, 2019). *User Manual – 08022019_v4*. Retrieved from Temi:
https://www.robotemi.com/helpdesk/user-manual-08022019_v4/

Temi. (2021). *temi Control Center*. Retrieved from Temi Center: <https://center.robotemi.com/>

12. Appendices

<https://github.com/robotemi/sdk>

Source 1 link to the Temi Software Development Kit (SDK) provided by Temi Centre

<https://developer.android.com/courses>

Source 2 link to Android Studio Training course

<https://github.com/robotemi/sdk/wiki/Installing-and-Uninstalling-temi-Applications>

Source 3 link to the instructions for installing temi applications provided by Temi Centre

[file:///C:/Users/nypro/OneDrive/Documents/Temp%20Folder/Temiscrypt%20Tutorial%20v4.0%20\(1\).pdf](file:///C:/Users/nypro/OneDrive/Documents/Temp%20Folder/Temiscrypt%20Tutorial%20v4.0%20(1).pdf)

Source 4 user manual for using TemiScript

Table 20 Work Breakdown Structure (WBS) look Up Table

Project Goal	Deliverable	Task/Sub-Task	Description
A: Create a Quiz Application	Deliverable 1: User Interface (UI)	Task 1.1: User-friendly UI	Design an intuitive user interface that enhances the quiz-taking experience.
		Sub-task 1.1.1: Indicate selected answers clearly.	Indicate selected answers clearly to help users keep track of their choices.
		Sub-task 1.1.3: Display current score and quiz progress.	Display current score and quiz progress to motivate and inform users throughout the quiz.
		Sub-task 1.1.4: Retain selected answers when navigating between questions.	Retain selected answers when navigating between questions to improve usability and experience.
		Sub-task 1.1.5: Warn users before submitting incomplete questions.	Warn users before submitting incomplete questions to prevent accidental errors.
		Sub-task 1.1.6: Warn users before submitting a quiz with unanswered questions.	Warn users before submitting a quiz with unanswered questions to ensure complete responses.
		Sub-task 1.1.7: Implement a system to exit the quiz early.	Implement a system to exit the quiz early, giving users flexibility based on their needs.
		Sub-task 1.1.8: Display feedback for submitted questions (audio, visual, numeric).	Display feedback for submitted questions in various formats (audio, visual, numeric) to enhance learning.
	Deliverable 2: External Integration	Task 2.1: Text File Question Input	Allow the addition of questions via a text file system for streamlined management.
	Deliverable 3: Quiz Application	Task 3.1: Multi-language support	Implement support for multiple languages in the quiz UI.
		Task 3.2: Home Page Creation	Develop a home page to serve as the starting point for the quiz.
		Task 3.3: User Answer Saving System	Implement a system to save user answers during the quiz.
		Sub-task 3.3.1: Allow for multiple quizzes to be saved.	Allow for multiple quizzes to be saved allowing to collect quiz results from multiple users.
		Sub-task 3.3.2: Add functionality for clearing saved quiz data.	Add functionality for clearing saved quiz data to allow system to be reset for a new quiz type.
		Task 3.4: Scoreboard Implementation	Create a scoreboard to track user performance across quizzes.
		Sub-task 3.4.1: Allow users to add their name to the scoreboard.	Allow users to add their name to the scoreboard for personalized tracking of their performance.
		Sub-task 3.4.2: Implement a blacklist to prevent inappropriate names.	Implement a blacklist to prevent inappropriate names from being displayed on the scoreboard.
		Sub-task 3.4.3: Add functionality to manually remove names from the scoreboard.	Add functionality to manually remove names from the scoreboard to maintain a respectful environment.
	Deliverable 4: Multiple Question Types	Task 4.1: Multiple Choice Questions	Create systems for single and multiple-choice questions within the quiz.
		Sub-task 4.1.1: Add functionality for single-choice questions.	Add functionality for single-choice questions to allow users to select one option.
		Sub-task 4.1.2: Add functionality for multiple-choice questions.	Add functionality for multiple-choice questions to enable users to select multiple options.
		Sub-task 4.1.3: Implement a scoring system for both types (correct vs. all options scored).	Implement a scoring system for both types, distinguishing between correct and incorrect answers.
		Sub-task 4.1.4: Create a method to add survey questions.	Create a method to add survey questions for collecting user feedback within the quiz framework.

		Sub-task 4.1.5: Allow text/image integration into the questions.	Allow text/image integration into the questions to enhance engagement and comprehension.
		Sub-task 4.1.6: Add functionality to load questions from a text file.	Add functionality to load questions from a text file for easier question management.
		Task 4.2: Drag-and-Drop Questions	Implement drag-and-drop style questions for interactive learning.
		Sub-task 4.2.1: Create a system for dragging answers to specific spots.	Create a system for dragging answers to specific spots, making it intuitive for users to engage with content.
		Sub-task 4.2.2: Control how many answers can be dragged into one spot.	Control how many answers can be dragged into one spot to manage question complexity.
		Sub-task 4.2.3: Allow draggable objects to be either text or images.	Allow draggable objects to be either text or images, providing varied interaction options.
		Sub-task 4.2.4: Implement scoring based on how draggables are dropped.	Implement scoring based on how draggables are dropped, with rules for correct placement and “trick questions.” (trick question is a answer that has no correct placement spot)
		Task 4.3: Ranking Questions	Implement ranking-style questions where users rank answers according to their preference.
		Sub-task 4.3.1: Develop drag-and-drop for ranking answers higher/lower.	Develop drag-and-drop functionality for users to rank answers higher or lower based on their choice.
		Sub-task 4.3.2: Add scoring logic based on:	Add scoring logic based on the correct positioning of answers and overall order correctness.
		Task 4.4: Text Input Questions	Develop questions that require text input for user responses.
		Sub-task 4.4.1: Implement flexibility for spelling variations.	Implement flexibility for spelling variations, allowing for partial correctness in responses.
		Sub-task 4.4.2: Restrict to simple answers.	Restrict to simple answers to ensure clarity and ease of use for the quiz interface.
	Deliverable 5: Multi-user Functionality	Task 5.1: Multi-user Support	Ensure the system allows multiple users to take the quiz independently.
		Sub-task 5.1.1: Clear previous quiz data before starting a new quiz.	Clear previous quiz data before starting a new quiz to maintain data integrity for users.
		Sub-task 5.1.2: Randomize question order for each new quiz.	Randomize question order for each new quiz to enhance fairness and prevent memorization.
		Sub-task 5.1.3: Randomize answer choices each time.	Randomize answer choices each time to maintain engagement and prevent guessing based on patterns.
	Deliverable 6: Documentation	Task 6.1: Code Documentation	Provide detailed documentation of the quiz application's code for future reference.
		Sub-task 6.1.1: Break down different sections of the code.	Break down different sections of the code to facilitate understanding and maintenance.
		Sub-task 6.1.2: Describe the functionality of each function.	Describe the functionality of each function to ensure clarity for future developers.
		Sub-task 6.1.3: Give an overview of how the system works.	Give an overview of how the system works to assist new team members in getting up to speed.
		Task 6.2: Usage Documentation	Provide a guide for adding questions, images, and backgrounds to the quiz.
		Sub-task 6.2.1: Explain the text file system for adding questions.	Explain the text file system for adding questions to assist users in managing quiz content.
		Sub-task 6.2.2: Detail how to add images and backgrounds.	Detail how to add images and backgrounds to enrich the quiz's visual appeal.
	Deliverable 7: Temi Integration	Task 7.1: Detect User Presence	Integrate Temi's face recognition to detect users engaging with the quiz.
		Sub-task 7.1.1: Have Temi identify users walking by or standing in front of it.	Have Temi identify users walking by or standing in front of it, allowing for context-aware responses.

		Sub-task 7.1.2: Temi should greet users or try to attract their attention.	Temi should greet users or try to attract their attention to encourage interaction.
		Task 7.2: Temi Response in Quiz	Ensure Temi provides interactive responses during quiz activities.
		Sub-task 7.2.1: Temi reacts to submitted questions.	Temi reacts to submitted questions, enhancing user engagement and interaction.
		Sub-task 7.2.1: Temi reacts to submitted questions.	Implement support for multiple languages in the quiz UI.
	Deliverable 8: Chocolate Dispenser Integration	Task 8.1: Bluetooth Connectivity to Chocolate Dispenser	Implement Bluetooth connectivity with an external chocolate dispenser.
		Task 8.2: Dispense Chocolates Based on Quiz Results	Temi dispenses chocolates based on quiz results.
B: Create a Software Development Kit (SDK) for Tour Guides	Deliverable 1: Movement Control	Task 1.1: Control of Temi's movement	Allow for control of Temi's movement.
		Sub-task 1.1.1: Program speed settings	Program speed settings for Temi (low, medium, high).
		Sub-task 1.1.2: Rotational position control	Allow rotational position control of Temi.
		Sub-task 1.1.3: Pivoting and tilting control	Enable control of pivoting and tilting the display screen for better interaction with users.
		Sub-task 1.1.4: Fine-tuned x and y-axis movements	Provide fine-tuned control of Temi's x and y-axis movements in its current position.
		Sub-task 1.1.5: Navigate to waypoints	Enable Temi to navigate to pre-defined waypoints.
		Sub-task 1.1.5.1: Specify waypoint orientation	Allow the user to specify the exact orientation and location Temi should be in at each waypoint.
		Sub-task 1.1.5.2: Arrival distance control	Control how close Temi needs to be to a destination before it is considered to have "arrived."
		Sub-task 1.1.5.3: Pre-set waypoint configuration	Allow pre-set waypoint configuration and editing.
		Sub-task 1.1.6: Set sequential actions	Enable users to set sequential actions (e.g., move to location A, pause, then turn).
		Sub-task 1.1.7: Define parallel actions	Enable users to define parallel actions (e.g., move while speaking or displaying content).
		Sub-task 1.1.8: Control action speed	Allow control over the speed of any given action (faster or slower).
		Sub-task 1.1.9: Set specific action timings	Set specific times for actions to occur (e.g., move for 10 seconds or turn at specific intervals).
		Sub-task 1.1.10: Integrate obstacle avoidance	Integrate Temi's obstacle avoidance system into movement control and allow changing its sensitivity.
		Sub-task 1.1.11: Dynamic speed adjustments	Allow for dynamic speed adjustments during movement.
		Sub-task 1.1.12: Timing-triggered speed changes	Add functionality to alter speed based on timing triggers.
		Sub-task 1.1.13: Create reusable movement functions	Allow users to create reusable movement actions or "movement functions."
		Sub-task 1.1.14: Organic vs. robotic movement	Provide an option to switch between organic movement (natural, human-like behavior) and robotic movement (precise, mechanical movements).
		Sub-task 1.1.15: Follow mode control	Control Temi's follow mode behavior (e.g., distance from the person).
		Sub-task 1.1.16: Orientation based on travel direction	Control Temi's orientation based on travel direction (e.g., face the user while moving backward).
	Deliverable 2: Pre-programmed Speech	Task 2.1: Speech Integration	Allow for pre-programmed speech.
		Sub-task 2.1.1: Text-to-speech integration	Integrate text-to-speech functionality for pre-defined phrases or responses.

		Sub-task 2.1.2: Change speech accents	Provide options to change speech accents.
		Sub-task 2.1.3: Multi-language support	Allow multiple language support for speech.
		Sub-task 2.1.4: Speech volume control	Provide control over speech volume.
		Sub-task 2.1.4.1: Fixed volume	Set a fixed volume.
		Sub-task 2.1.4.2: Dynamic volume adjustment	Adjust volume dynamically based on environmental noise levels.
		Sub-task 2.1.4.3: Change volume during speech	Change volume over the duration of speech.
		Sub-task 2.1.4.4: Real-time volume adjustment	Allow real-time volume adjustment during ongoing speech.
		Sub-task 2.1.5: Speech articulation controls	Implement speech articulation controls to alter pronunciation for clarity or accentuation.
		Sub-task 2.1.6: Sequential speech	Enable sequential speech where speech must finish before performing another action.
		Sub-task 2.1.7: Parallel speech	Enable parallel speech, allowing Temi to speak while performing other actions simultaneously.
	Deliverable 3: Receiving and Interpreting Questions	Task 3.1: Question Handling	Allow for receiving and interpreting questions.
		Sub-task 3.1.1: Pre-defined Q&A pairs	Enable pre-defined question-and-answer pairs in the system.
		Sub-task 3.1.2: Flexible question interpretation	Provide flexible question interpretation, recognizing variants of questions even if phrased differently.
		Sub-task 3.1.3: Multi-language support	Support for multiple languages and accents to ensure broad accessibility.
		Sub-task 3.1.4: Keyword-based lookup system	Implement a keyword-based lookup system to match questions with predefined answers.
		Sub-task 3.1.5: Close or related answer provision	If the system cannot find an exact match, it should provide a close or related answer.
	Deliverable 4: Multimedia Support	Sub-task 3.1.6: Unrecognized question notification	Notify the user if a question is unrecognized, and prompt for rephrasing or suggest related queries.
		Task 4.1: Multimedia Integration	Allow for multimedia support.
		Sub-task 4.1.1: Display images	Display images.
		Sub-task 4.1.2: Play videos	Play videos.
		Sub-task 4.1.3: Play audio files	Play audio files.
		Sub-task 4.1.4: Image/video display control	Allow changing the opacity, size, and display level (foreground/background) of images or videos.
		Sub-task 4.1.5: Image control	Allow controlling the size, rotation, and position of images.
		Sub-task 4.1.6: Animate image control	Enable changes to the size, rotation, opacity, and position of images over time.
		Sub-task 4.1.7: Background/foreground audio control	Allow controlling whether audio plays in the background or foreground.
		Sub-task 4.1.8: Sound effects integration	Support adding sound effects as a separate audio layer.
		Sub-task 4.1.9: Flexible audio control	Provide flexible audio control.
		Sub-task 4.1.10: GIF integration	Support the integration of GIFs into the multimedia system.
	Deliverable 5: Application Management	Task 5.1: Application Launching	Enable application management.
		Sub-task 5.1.1: Launch other applications	Allow for launching other applications from within the SDK (e.g., Temi integration with external apps for enhanced functionality).
	Deliverable 6: Basic UI Creation	Task 6.1: UI Components	Enable basic UI creation.
		Sub-task 6.1.1: Create UI elements	Allow for buttons, text boxes, and shapes.

		Sub-task 6.1.2: UI design tools	Provide tools for designing simple user interfaces within the tour guide system, such as buttons, prompts, and interactive screens.
	Deliverable 7: Flexibility for Developers	Task 7.1: Customization	Ensure flexibility for developers.
		Sub-task 7.1.1: Customizable logic	Enable the SDK to be customizable with additional logic, such as conditional behaviors (e.g., if X happens, do Y).
		Sub-task 7.1.2: Timer system	Implement a timer system for scheduled tasks or actions.
		Sub-task 7.1.3: Log activity	Allow developers to log the activity of the application for debugging purposes.
		Sub-task 7.1.4: Edit existing functions	Provide the ability to edit existing functions.
		Sub-task 7.1.5: Function chaining	Allow chaining of functions (e.g., execute this function after that function finishes).
		Sub-task 7.1.6: Custom function creation	Allow developers to create custom functions to extend the SDK's capabilities.
		Sub-task 7.1.7: Interface with external devices	Enable interfacing with external devices or APIs as needed.
	Deliverable 8: Documentation	Task 8.1: User Documentation	Create documentation for users.
		Sub-task 8.1.1: Developer guides	Provide guides and tutorials for developers on using the SDK effectively.
		Sub-task 8.1.2: Sample code examples	Provide sample code examples for developers to understand SDK usage.
C: Implement Bluetooth Connectivity	Deliverable 1: Research and Planning	Task 1.1: Investigate Temi's current connectivity capabilities.	Analyse Temi's existing hardware and software to understand its current connectivity features, including any available Bluetooth functions.
		Task 1.2: Review Bluetooth standards and requirements for integration.	Study relevant Bluetooth standards (e.g., Bluetooth 4.0, 5.0) and requirements to ensure Temi's integration is compliant and up to date.
		Task 1.3: Identify compatible Bluetooth modules and libraries.	Research available Bluetooth modules and libraries that are compatible with Temi's system and can facilitate seamless Bluetooth communication.
	Deliverable 2: Development and Integration	Task 2.1: Set up a development environment for Bluetooth integration.	Establish a proper development environment, including necessary tools and dependencies, to enable smooth Bluetooth integration.
		Task 2.2: Develop Bluetooth connection protocols for Temi.	Create and implement the protocols for initiating and maintaining Bluetooth connections between Temi and external devices.
		Task 2.3: Implement Bluetooth device pairing functionality.	Enable Temi to pair with various Bluetooth devices by implementing a user-friendly device-pairing system.
		Task 2.4: Enable data exchange between Temi and connected devices.	Develop functionality that allows data to be transferred between Temi and paired devices, facilitating communication for various use cases.
		Task 2.5: Test Bluetooth connectivity with various devices.	Test Temi's Bluetooth connectivity by pairing it with a range of devices (e.g., phones, PCs, tablets) to ensure proper functionality.
	Deliverable 3: Testing and Validation	Task 3.1: Conduct functionality tests to ensure reliable Bluetooth connection.	Perform a series of functionality tests to ensure that the Bluetooth connection remains stable and reliable under various conditions.
		Task 3.2: Resolve connectivity issues or bugs.	Identify and troubleshoot any connectivity issues or bugs that arise during testing, ensuring consistent performance across different scenarios.
		Task 3.3: Ensure compatibility with different devices (PCs, phones, tablets).	Test and validate Bluetooth compatibility with a range of devices, making sure Temi can communicate effectively with each one.

D: Replace Temi's Speech Recognition with ChatGPT	Deliverable 4: Documentation	Task 4.1: Write technical documentation for Bluetooth integration steps.	Document the steps taken to integrate Bluetooth connectivity into Temi, providing technical guidelines for future reference and maintenance.
		Task 4.2: Create a troubleshooting guide for connectivity issues.	Develop a troubleshooting guide that details common Bluetooth connectivity issues and provides step-by-step instructions for resolving them.
	Deliverable 1: Research and Planning	Task 1.1: Research ChatGPT integration options and API documentation.	Research available options for integrating ChatGPT, review OpenAI's API documentation, and identify necessary API features for integration with the Temi robot.
		Task 1.2: Assess current speech recognition limitations and define project scope.	Analyze Temi's current speech recognition system to understand its limitations and use findings to define the project scope for replacing it with ChatGPT.
	Deliverable 2: Development and Integration	Task 2.1: Set up ChatGPT API access and configure it for the Temi robot.	Configure and test ChatGPT's API on the Temi robot by setting up proper access credentials and connection protocols.
		Task 2.2: Replace the current speech recognition system with ChatGPT.	Overhaul Temi's existing speech recognition module by integrating ChatGPT for more advanced natural language processing capabilities.
		Task 2.3: Develop input/output handling between Temi and ChatGPT.	Ensure smooth communication between Temi's hardware and ChatGPT by developing input/output data handling mechanisms.
		Task 2.4: Implement natural language processing (NLP) for voice commands.	Utilize ChatGPT's NLP capabilities to interpret and execute voice commands from users.
	Deliverable 3: Testing and Validation	Task 3.1: Test conversational abilities in various scenarios (e.g., Q&A, commands).	Run tests to validate ChatGPT's conversational abilities across different use cases such as answering questions or executing commands.
		Task 3.2: Optimize response times and accuracy.	Refine ChatGPT's response times and accuracy by adjusting settings and making performance improvements.
E: Create a User Guide for Setting Up a PC for Programming Temi		Task 3.3: Gather feedback for improvement on voice interactions.	Collect user feedback to identify areas where ChatGPT's voice interactions can be improved.
	Deliverable 4: Documentation	Task 4.1: Write a user guide on how to use the ChatGPT-powered system.	Create an easy-to-follow user manual detailing how to interact with the Temi robot's new ChatGPT-powered system.
		Task 4.2: Document API usage and error handling strategies.	Write technical documentation covering how to use the ChatGPT API, including error handling techniques.
	Deliverable 1: Outline User Guide Structure	Task 1.1: Identify key components required for setting up Temi programming.	Determine the hardware components and accessories required to program the Temi robot effectively.
		Task 1.2: Determine software, libraries, and tools necessary for development.	Identify which software development kits (SDKs), libraries, and development environments are needed to begin programming for Temi.
	Deliverable 2: Create Step-by-Step Instructions	Task 2.1: Detail how to install necessary software (SDKs, IDEs).	Provide step-by-step instructions for installing essential SDKs and integrated development environments (IDEs) for programming Temi.
		Task 2.2: Include steps for connecting the Temi robot to a PC.	Outline the steps required to connect Temi to a PC for programming and testing purposes.
		Task 2.3: Write guidance on testing and debugging Temi code.	Create detailed guidance on how to run tests on the Temi robot and troubleshoot common coding errors or issues.
	Deliverable 3: Design and Formatting	Task 3.1: Create a user-friendly layout with clear sections and images.	Design the programming guide with clear sections and visuals to assist users in understanding each step.

		Task 3.2: Add troubleshooting tips for common setup issues.	Include troubleshooting advice for common challenges users might face while setting up Temi for programming.
		Task 3.3: Review and refine content for clarity and completeness.	Proofread and improve the content to ensure clarity and that no key information is missing.
	Deliverable 4: Testing	Task 4.1: Validate the guide by having a beginner follow the steps.	Test the guide by having someone with minimal experience follow it to verify ease of use.
		Task 4.2: Address any gaps or unclear instructions.	Identify and resolve any unclear steps or gaps based on the validation process.
	Deliverable 5: Outline User Guide Structure	Task 5.1: Identify key components required for setting up Temi programming.	Gather all necessary data on the methods used, project progress, and the overall outcomes.
		Task 5.2: Determine software, libraries, and tools necessary for development.	Evaluate the project's goals, deliverables, and how successful it has been in meeting these metrics.
	F: Write a Report/s Necessary for Assessment (Spec and Final)	Deliverable 1: Gather Information	Task 1.1: Collect data on project progress, methodologies, and outcomes.
			Task 1.2: Review goals, deliverables, and metrics for success.
	Deliverable 2: Draft Report/s	Task 2.1: Write an introduction outlining project objectives.	Draft an introduction that clearly presents the objectives and goals of the project.
			Summarize how the Bluetooth and ChatGPT integrations, along with other major components, were developed throughout the project.
			Provide a detailed summary of testing results and evaluate the system's overall performance during development.
			Discuss the challenges faced during development and highlight key lessons learned from the process.
	Deliverable 2: Draft Report/s	Task 2.2: Describe the project development process (Bluetooth, ChatGPT, etc.).	Ensure the final report is complete and aligns with the project's assessment criteria and deliverables.
		Task 2.3: Summarize testing results and evaluation of system performance.	Revise the report based on feedback received from project team members or stakeholders.
		Task 2.4: Reflect on challenges and lessons learned.	Conduct a final proofreading of the project report and make necessary edits before submitting the final version.
		Task 3.1: Review for completeness and consistency with assessment requirements.	Identify the necessary technical skills needed to complete the project, including any programming languages, tools, and protocols required.
	Deliverable 3: Review and Finalize	Task 3.2: Make revisions based on feedback from project members.	List the specific programming languages, libraries, and tools that are required to implement Bluetooth protocols and integrate ChatGPT.
		Task 3.3: Proofread and finalize the report for submission.	Collect resources like tutorials, online courses, and documentation that will help with understanding and implementing key aspects of the project.
		Task 1.1: Review project goals and break down required technical skills.	Schedule dedicated time to study, experiment, and practice the new skills necessary for the project.
	Deliverable 1: Identify Required Skills	Task 1.2: Identify programming languages and tools needed (e.g., Bluetooth protocols, ChatGPT API).	Study the specific techniques needed for implementing Bluetooth connectivity in the project.
		Task 2.1: Gather relevant tutorials, courses, and documentation.	Learn about how to integrate ChatGPT and utilize its natural language processing features for the project.
	Deliverable 2: Research and Acquire Resources	Task 2.2: Allocate time for focused learning and experimentation.	Apply knowledge by practicing with the development tools and SDKs required to program the Temi robot.
		Task 3.1: Learn Bluetooth connectivity protocols and implementation techniques.	Use the knowledge gained from learning sessions to actively work on project tasks.
	G: Learn Skills Needed to Complete the Project	Task 3.2: Study ChatGPT integration and natural language processing.	

		Task 3.3: Practice using development tools for Temi programming.	Seek feedback from team members or mentors to further refine understanding and implementation of project tasks.
		Task 4.1: Apply newly acquired skills to project tasks.	Research available options for integrating ChatGPT, review OpenAI's API documentation, and identify necessary API features for integration with the Temi robot.
		Task 4.2: Get feedback from peers and mentors to refine knowledge.	Analyze Temi's current speech recognition system to understand its limitations and use findings to define the project scope for replacing it with ChatGPT.