Plans for Sprint 2,3

1. Present collected requirements for the client and ask for further clarification
2. Develop following requirements

User Story ID	Requirements to Develop	Sprint
CV.1	As an Operator, I want to see the tracking status of items on the GUI so that I can check whether the item is recognized.	2
CV.2	As an Operator, I want to see the tracking status of human anatomy on the GUI so that I can check whether the human anatomy is recognized.	2
CV.3	As Tech Support, I want to see the tracking status of items on the GUI so that I can debug when objects cannot be recognized.	2
CV.4	As Tech Support, I want to see the tracking status of human anatomy on the GUI so that I can debug when human anatomy cannot be recognized.	2
CV.5	As an Operator, I want to place the required items in the field of view of the robot camera so that I can ensure the vision system can detect the items.	3
CV.6	As an Operator, I want to receive feedback that the item could not be found so that I can identify the cause of the failure.	3
VR.1	As an Operator, I want to speak commands through the microphone so that I can give voice commands to the robotic arm.	2
VR.2	As an Operator, I want to see or hear the command I have given so that I can check whether the robot understands my command.	2
VR.3	As an Operator, I want to input the action commands that the robot can perform into the system so that I can command the robot to move.	3
VR.4	As an Operator, I want to see the tracking situation of various objects from the robot's vision so that I can check if the vision system is working properly.	3
VR.5	As an Operator, I want to receive feedback on command completion so that I can know the action is ended and check if it is correct.	3
VR.6	As an Operator, I want to receive feedback on command failure so that I can identify the cause of the failure.	3
DM.1	As an Operator, I want to integrate visual and audio sensory abilities into the robotic arm so that the robotic arm can act autonomously without the need for manual input.	3
RC.1	As an Operator, I want to see the robot's action as soon as possible after issuing the command so that I can know whether the system has received my command and is running normally.	3
RC.2	As an Operator, I want to create new actions for the robot so that I can design new actions and new commands.	3
RC.3	As an Operator, I want to receive feedback that the action could not be found so that I can identify the cause of the failure.	3
SS.1	As Tech Support, I want to reboot the entire system so that I can reset the configurations and parameters.	3
SS.2	As Tech Support, I want to receive notifications when a subroutine encounters a problem so that I can know where the problem specifically occurred and investigate it.	3
SS.3	As an Operator, I want to restore the robotic arm to its initial state after the command is completed so that I can make it execute other commands.	3

Sprint 2: Computer Vision Development & Speech Interface Development

Object Detection and Recognition

1. **Azure Kinect Integration:** Integrate the Azure Kinect sensor with ROS2 to capture RGB-D data.
2. **YOLO Model Integration:** Implement YOLO-based object detection using pre-trained models. Consider fine-tuning the model for novel objects in your application.
3. **ROS2 Integration:** Develop ROS2 nodes to process sensor data and publish object detection results.

People Detection and Tracking

1. **MediaPipe Integration:** Integrate MediaPipe or another suitable library for people detection and tracking.
2. **ROS2 Nodes:** Create ROS2 nodes to process camera data, detect and track people, and publish the tracking results.

Gesture Recognition

1. **MediaPipe Gesture Module:** Integrate MediaPipe's gesture recognition module or similar libraries.

2. **Gesture Labeling:** Develop a system to capture and label gestures for training.
3. **ROS2 Integration:** Implement ROS2 nodes to recognize and interpret gestures from camera data.

Speech Recognition System

1. **Google Speech API:** Integrate the Google Speech-to-Text API for accurate speech recognition.
2. **Voice Data Collection:** Gather voice data to fine-tune the model for domain-specific commands.

Natural Language Processing

1. **OpenAI GPT-4:** Utilize the OpenAI GPT-4 API for natural language understanding and command interpretation.
2. **Command Categorization:** Define a set of command categories for the robot to understand.
3. **ROS2 Integration:** Develop ROS2 nodes to process interpreted commands.

Sprint 3: Robotic Arm Control Integration

1. **ROS2 Arm Control:** Utilize the ROS2 Franka Emika package to control the robotic arm.
2. **Command Execution:** Map-interpreted commands to robotic arm actions (e.g., pick-and-place).
3. **Safety Measures:** Implement collision avoidance and safety protocols to ensure safe movements.

Integration and Testing

1. **Combine Software Components:**
    - Integrate the computer vision, speech interface, and robotic arm control components.
    - Develop ROS2 nodes to manage communication between these components.
2. **Unified Software System:**
    - Ensure seamless interaction and coordination between the different modules.
    - Handle synchronization of data and commands.
3. **I Spy + Pick and Place Demo:**
    - Create a demo scenario where the robot responds to "I spy" commands and performs pick-and-place actions.

Infrastructure and Deployment

Hardware Setup

1. **Franka Emika Arm:** Ensure the robotic arm is properly connected and calibrated.
2. **Azure Kinect:** Set up the Azure Kinect sensor and ensure it's properly calibrated with the robot.

Simulation Environment

1. **Gazebo Setup:** Set up the Gazebo simulator to test and debug the robotic arm control and vision modules.
2. **Simulation Integration:** Integrate ROS2 nodes with the Gazebo simulation environment.