Motivations for Technology Selection

1. Raspberry Pi for Microcontroller

The Raspberry Pi is employed as the microcontroller in our project due to its versatility, affordability, and computational power. As a single-board computer, the Raspberry Pi provides a robust platform for interfacing with sensors, performing data processing, and running software applications. Its compatibility with various programming languages and libraries allows for flexible development and rapid prototyping. Additionally, the extensive community support and availability of add-ons and accessories further enhance its suitability for embedded systems and IoT applications. The Raspberry Pi's compact size and low power consumption make it a practical choice for integrating advanced technologies into a compact and efficient system.

2. Stereovision for Depth Detection

Stereovision technology is utilized in our project to achieve accurate depth perception. By using two precisely aligned cameras, stereovision mimics human binocular vision, allowing the system to calculate the distance of objects from the cameras based on the disparity between their images. This approach is highly effective for generating three-dimensional spatial data and is particularly valuable in applications requiring precise depth measurement, such as autonomous navigation and robotic manipulation. The use of stereovision ensures robust depth detection even in varying lighting conditions and provides high-resolution depth maps.

3. YOLO (You Only Look Once) for Object Detection

YOLO was selected for object detection in our project primarily due to its exceptional speed and efficiency, which are critical for real-time applications. The YOLO model's ability to process images in a single pass, dividing them into a grid and simultaneously predicting bounding boxes and class probabilities, enables it to deliver rapid object detection results. This speed is particularly crucial when running on a resource-constrained platform like the Raspberry Pi, where computational efficiency is paramount.

To maximize the performance and responsiveness of YOLO on the Raspberry Pi, we have implemented the YOLOv8n model. YOLOv8n is a lightweight and optimized version of the YOLO architecture, specifically designed to enhance speed while maintaining a high level of accuracy. Its reduced computational requirements allow it to operate efficiently within

the processing limits of the Raspberry Pi, making it feasible to perform real-time object detection in a compact and power-efficient setup. This combination of speed and efficiency ensures that our system can rapidly identify and track objects, crucial for applications requiring immediate and dynamic responses.

4. ATAK (Android Tactical Assault Kit) for TAK Client

ATAK is chosen as our TAK client over alternatives such as web TAK due to its superior alignment with real-world operational needs and user requirements. Unlike web TAK, which typically relies on a web browser and is less suited for mobile, on-the-go scenarios, ATAK is specifically designed for use on Android devices, which are more realistic and practical for soldiers and field operators. ATAK offers a range of features tailored to tactical environments, including offline functionality, real-time data sharing, and advanced mapping capabilities.