2. Requirements, Constraints, And Standards

2.1. Requirements & Constraints

Functional Requirements

1. **Algorithm Integration:** Successfully integrate and concurrently run the three specified algorithms (image preprocessing, blink detection, and eye tracking) on the Xilinx Kria K26 board.
2. **System Throughput:** Achieve a system throughput of less than 5 ms per frame. This metric is crucial to ensure real-time processing and analysis capabilities, which are imperative for the system to function effectively in its intended applications.

User Interface (UI) Requirements

1. **Command Line Interface (CLI):** Design a user-friendly CLI for both technical and non-technical users.
    a. Outline clear commands to allow the user to interact and control configurations within the system.
    b. Help commands to assist the user and provide descriptions for different commands.
2. **Command Feedback:** Provide immediate and clear feedback based on each command, displaying the results or errors encountered during execution. Helping the user identify their input's impact on the system's state.
3. **Error Handling:** Provide detailed error handling and logging mechanisms. Errors will be clearly communicated to the user to assist with fixes, and logs will be detailed to assist the user in debugging and adjusting the system for expected performance.

Physical and Economic Requirements

1. **Hardware Compatibility:** All components for the time being will be compatible with the Xilinx Kria K26 board, keeping hardware adjustments minimal for current costs.
2. **Cost-Effectiveness:** Design a system that is economical in its investment and for future maintenance and updates.

System Constraints

1. **Memory Limitations:** The Xilinx Kria K26 board has 5GB of DDR memory. This finite resource must be allocated among the three algorithms.
2. **FPGA Resource Allocation:** The available FPGA space for deploying our Deep Learning Processing Unit (DPU) is limited. Efficient use of FPGA resources is essential to accommodate the computational demands of our algorithms without exceeding the board's capacity.
3. **Single DPU Utilization:** Given that the board houses only one DPU, there is a need for a strategy that allows the blink detection and eye-tracking algorithms to share the DPU effectively.

Additional Considerations

1. **Deployment Options:** During current development, deployment will be limited to a portable device, the Xilinx Kria K26 board.
2. **Data Handling and Privacy:** Implement strict measures to protect user data privacy and security within the system.

2.2. Engineering Standards

- IEEE 3129-2023 - IEEE Standard for Robustness Testing and Evaluation of Artificial Intelligence (AI)-based Image Recognition Service
  - This standard is essential as it provides guidelines for testing the robustness of AI-based image recognition services. Robustness testing ensures that these systems perform reliably under various conditions and can handle unexpected inputs or scenarios, which is critical for their real-world deployment.
- IEEE 2802-2022 - IEEE Standard for Performance and Safety Evaluation of Artificial Intelligence Based Medical Devices: Terminology
  - With the increasing use of AI in medical devices, ensuring their performance and safety is paramount. This standard establishes terminology for evaluating the performance and safety of AI-based medical devices, providing clarity and consistency in assessing their effectiveness and reliability in clinical settings.
- IEEE 7002-2022 - IEEE Standard for Data Privacy Process
  - In an era of increasing data breaches and privacy concerns, this standard sets forth processes for safeguarding data privacy. It outlines best practices and procedures for handling sensitive information, ensuring compliance with regulations and fostering trust among users and stakeholders in data-driven applications and services.
- IEEE 3156-2023 - IEEE Standard for Requirements of Privacy-Preserving Computation Integrated Platforms
  - Privacy-preserving computation is crucial for protecting sensitive data while still enabling useful computations. This standard defines requirements for platforms that facilitate privacy-preserving computation, ensuring that such systems adhere to established principles and practices for safeguarding privacy in data processing and analysis.
- IEEE 2842-2021 - IEEE Recommended Practice for Secure Multi-Party Computation
  - Secure multi-party computation enables parties to jointly compute a function over their inputs while keeping those inputs private. This recommended practice provides guidance for implementing secure multi-party computation protocols, promoting the development of robust and trustworthy systems for collaborative computing in sensitive applications such as finance, healthcare, and privacy-preserving analytics.
- IEEE 2952-2023 - IEEE Standard for Secure Computing Based on Trusted Execution Environment
  - Trusted execution environments (TEEs) play a crucial role in securing sensitive computations and data on computing platforms. This standard defines requirements for secure computing based on TEEs, ensuring that systems leveraging these technologies adhere to established security principles and practices, thereby mitigating the risk of unauthorized access and tampering.
- IEEE 1484.1-2003 - IEEE Standard for Learning Technology - Learning Technology Systems Architecture (LTSA)
  - As learning technology continues to evolve, having a standardized architecture is essential for interoperability and scalability. This standard defines the architecture for learning technology systems, providing a framework for designing, implementing, and integrating educational software and systems, thereby facilitating collaboration and innovation in the field of online learning and digital education.