# Architecture Design

Overview

This system provides real-time data acquisition and synchronization of motor position data and experimental signals for analysis in Spike2. Using a multithreaded design, data is independently captured from Harmonic Drive motors and a 1401 ADC/DAC, buffered, synchronized, and output to Spike2. A Master Clock ensures all data aligns accurately in time.

Project Structure
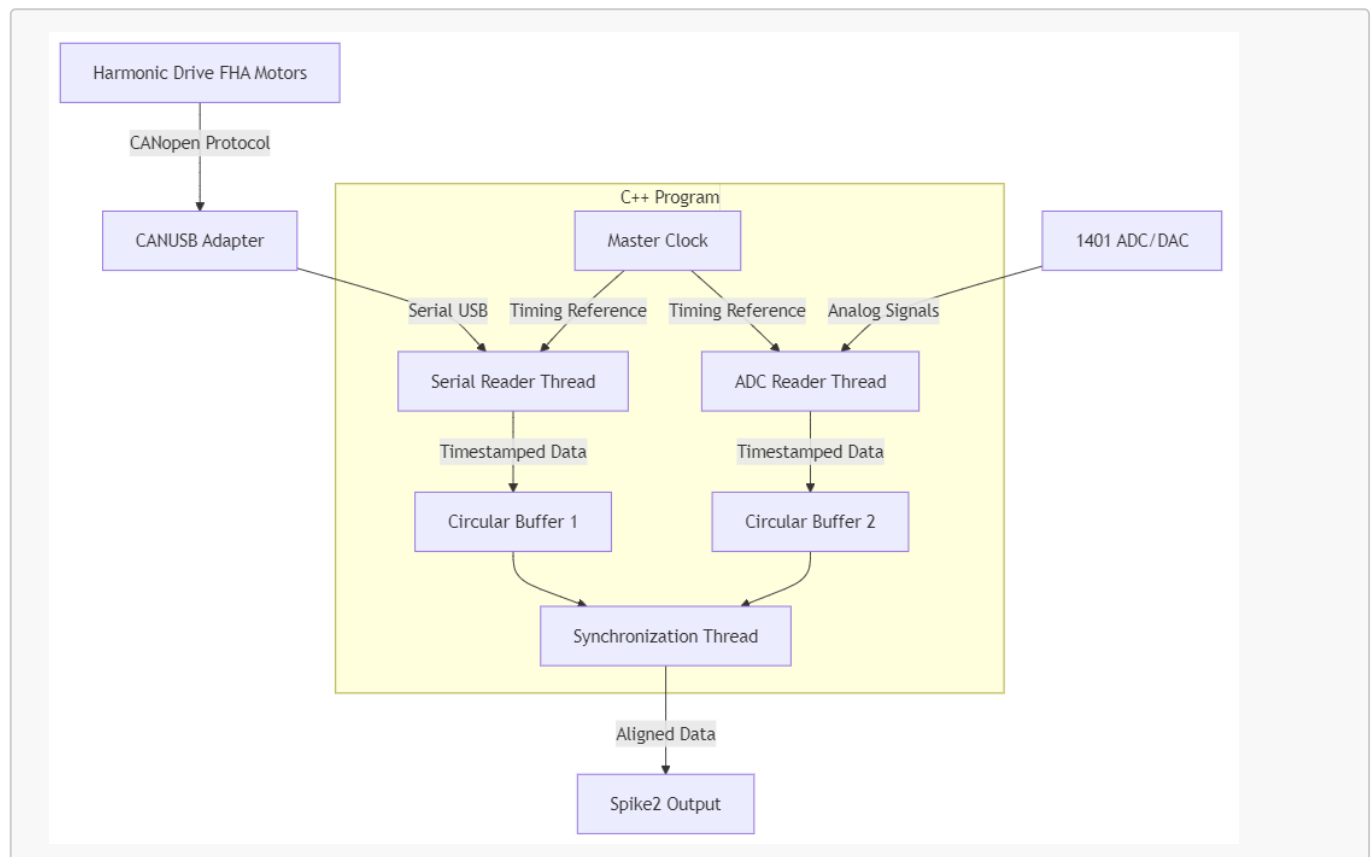
System Components

1. Data Acquisition Threads

- **Serial Reader Thread**:

  - Reads CANopen motor data through the CANUSB adapter.
  - Timestamps each entry with a reference from the Master Clock.
  - Stores data in **Circular Buffer 1**.

- **ADC Reader Thread**:

  - Captures analog signals from the 1401 ADC/DAC.
  - Timestamps each entry with a reference from the Master Clock.
  - Stores data in **Circular Buffer 2**.

2. Circular Buffers

- **Buffer 1 (Motor Data)** and **Buffer 2 (ADC Data)**:
  - Temporary storage for timestamped data.
  - Allows non-blocking access by the Synchronization Thread, enabling continuous, efficient data flow.

3. Master Clock

- Provides a unified timing reference for both data streams, enabling precise synchronization.
- Supports interpolation for aligning data when timestamps do not perfectly match.

4. Synchronization Thread

- Reads data from both buffers and aligns it based on timestamps.
- Outputs synchronized data to Spike2, ensuring real-time, coherent data for analysis.

5. Spike2 Output

- Formats and sends the aligned data to Spike2.
- Conforms to Spike2 SDK requirements for seamless data integration.

Key Considerations

- **Real-Time Performance**: Ensure low latency in data processing and transfer to meet real-time analysis needs.
- **Error Handling**: Implement mechanisms for handling potential timing mismatches or data loss.
- **Modularity**: Design components to be independently maintainable and easily extendable.