CymSTAR Capstone Joystick Controller

Hardware User Manual and Documentation

Clark Shannon, Connor Redington, Gracen Ownby,

Matthew Crawford, and Michael Fergusen

Overview of the Hardware Solution

The hardware for our solution is built around the Arduino Mega 2560 Rev3 microcontroller. It functions as an IO controller capable of communicating with the Host PC using serial communication over the USB 2.0 type C cable that also functions as its power source. With it, we can accurately monitor each analog and digital input we have connected and control the digital outputs based on the selections made by the user running the GUI program. The primary reasons for selecting this device were its expanded I/O capacity, plug and play capability, inexpensive price point, and extensiveness of the references available online. Selection of the testing components followed a similar rationale as these components are used to demonstrate I/O capabilities instead of being destined to be used in the final product produced by CymSTAR. As such, we selected readily available and relatively inexpensive options that demonstrate the ability for the Arduino device running our firmware to accurately monitor inputs and control outputs. Each input and output is connected to and controlled by a single pin on the Arduino. The technical specifications for the Arduino and the testing components:

Arduino Mega Rev3:

- Power: can be powered via the USB connection or with an external power supply
    - I/O Voltage: 5 V
    - Input voltage (nominal): 7-12 V
    - DC current per I/O pin: 20 mA
    - Supported battery: 9V
    - Operate on an external supply of 6 to 20 V
- Clock Speed:
    - Main processor: ATmega2560 16 MHz
    - USB-Serial Processor: ATmega16U2 16 MHz
- Memory:
    - 256 KB of flash memory for storing code
    - 8 KB of SRAM
    - 4 KB of EEPROM
- Input & Output:
    - 54 digital pins used for input or output operating at 5V
    - 16 Analog inputs providing 10 bits of resolution
        - By default operate from 0 to 5V
    - 20 mA recommended operating current; 40 mA maximum current
- Communication:
    - 4 Hardware UARTs
    - I2C – not used
    - SPI – not used
- Reference documents:
    - Full Pinout: Pinout

- Datasheet: Datasheet Rev3
- Schematic: Schematic

KY-O23 Joystick Modules (XY-Axis):

X and Y positions of the joystick can be measured as an analog voltage at the output pin. The x-axis and y-axis have their own potentiometers, together building a voltage divider. We have two joysticks connected to the Arduino, combining to make up 4 of the 8 analog inputs of the system. These were chosen to replicate some of the controls that would be typical in a flight simulator controller.

Datasheet: XY Joysticks

Pushbutton Switches:

These switches were selected for our 32 digital inputs being read into the device and being displayed in the GUI. They were chosen due to as they are controls that would be expected in any flight simulator.

- Circuit configuration: Push-On momentary, 1 pole 1 through
- Power rating: MAX 50 mA 24 VDC
- contact resistance: MAX 100
- Dielectric withstanding voltage: 250 VAC for 1 minute

Datasheet: Switches

Linear Slide Potentiometer:

The linear slide potentiometer is an analog input sensor used to represent a throttle on a flight simulator controller.

- Resistance: 10 kOhm
- Voltage: 3.3-5 V
- Size 90mm * 20mm

Datasheet: Linear Slide Potentiometer

Knob potentiometer:

The 3 knob potentiometers are analog input sensors used to represent different dials/knobs on an aircraft flight simulator.

- Resistance: 10kOhm
- Voltage: 3.3-5V
- Size: 6mm * 12mm
- Weight: 1.6g

Datasheet: Knob Potentiometer