Full Design of Arduino System

The following outlines the full design of the EMG-Data Acquisition System

Hardware Components

- MyoWare EMG Sensor
- Arduino R3
- DC Motors
- Current Sensors
- 5V Battery

Public Methods

- ***void setup()***
  - Function:
    - Called at runtime, setting initial Serial port and attaching Servos to their specified ports
- ***void loop()***
  - Function:
    - Looped indefinitely
    - Has complete algorithm
- ***int ReadInput(int pinNumber)***
  - Function:
    - Calls the private ***_TryReadInput*** method
    - Only returns a value if ***_TryReadInput*** was successful
  - Arguments:
    - pinNumber (int): the specific input pin that is read from
  - Returns:
    - int: digital value from pin
- ***float Filter(int data)***
  - Function:
    - Public method for filtering the digital data. Calls the private filtering method.
    - Ensures that the data is properly filtered, even if errors occur.
  - Arguments:
    - data (int): the digital data passed which needs to be filtered
  - Returns:

- float value of filtered data
- **_void ControlMotors(float filteredSignal, int sensorReadings[])_**
  - Function:
    - Full control algorithm for motors
  - Arguments:
    - filteredSignal (float): Filtered EMG data
    - sensorReadings (ints): Current sensor readings

Private Methods

- **_Pair _TryFilter(int data)_**
  - Function:
    - Attempts to filter the given data using a specific voltage threshold.
  - Arguments:
    - data (int): The raw EMG data
  - Returns:
    - Returns a boolean indicating if filtering was successful, and the filtered value.
- **_Pair _TryReadInput(int pinNumber)_**
  - Function:
    - Reads the analog input value at a specified pin
  - Arguments:
    - pinNumber(int): the specific pin that is read from
  - Returns:
    - bool: whether or not the read was sucessful
    - float: the value read from the pin as a float

Design Components

- Digital Filter
- Control Algorithm

Algorithm

```cpp
const int EMG_PIN = A0;

struct Pair {
    bool success;
    float data;

    Pair(bool s, float d) : success(s), data(d) {}
};

void setup() {

    .

    .

    .


}

.
.
.


void loop() {

    .

    .

    .

    float rawSignal = ReadInput(EMG_PIN);

    /* Filter signal */

    /* Control Algorithm */

    delay (100);    // 100 ms delay
}

float ReadInput(int pinNumber) {
    /*
    - Function:
        - Calls the private ***_TryReadInput*** method
```

```
            - Only returns a value if ***_TryReadInput*** was successful
        - Arguments:
            - pinNumber (int): the specific input pin that is read from
        - Returns:
            - int: digital value from pin
        */


        Pair input = _TryReadInput(pinNumber);
        if (!input.success) {
            Serial.println("Error reading input from pin" + String(pinNumber));
            return 0.0;
        }


        return int(input.data);
    }


    Pair _TryReadInput(int pinNumber) {
        /*
        - Function:
            - Reads the analog input value at a specified pin
        - Arguments:
            - pinNumber(int): the specific pin that is read from
        - Returns:
            - bool: whether or not the read was sucessful
            - float: the value read from the pin as a float
        */


        Pair input(false, 0.0); // Instantiate bad input value in case an error occurs


        float value = (analogRead(pinNumber) / 1023.0) * 5.0; // Input value in Volts


        input.success = true;
        input.data = value;


        return input;
    }
```

Full Design

Hand

DC Motors

DC Current

Current Sensor

MyoWare EMG Sensor

EMG Data

Current Reading

Arduino

Input Pins

Digital Control Signal

ADC

Digital EMG Signal

Digital Filter

Filtered EMG Data

Control Algorithm

Output Pins