Motor Controlled Pendulum Arm

Objective: To design and build a motor controlled oscillating pendulum that will be able to start and stop at a user command, as well as achieve various heights as selected by the user.

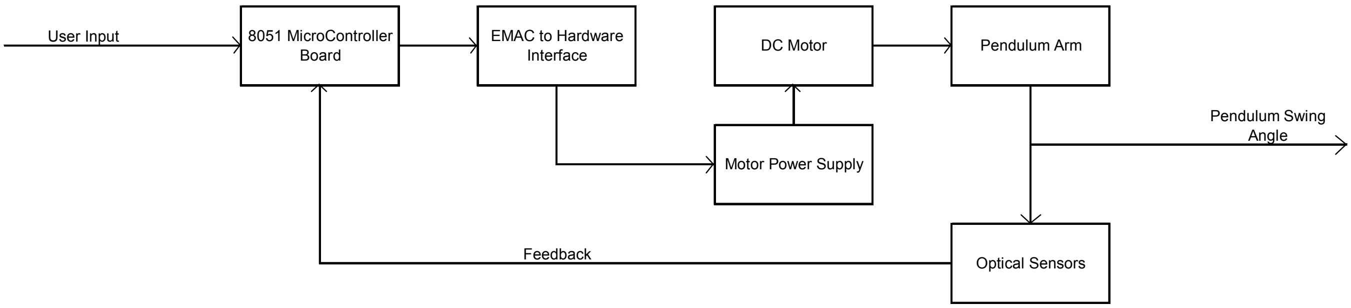


Figure 1. High Level Block Diagram

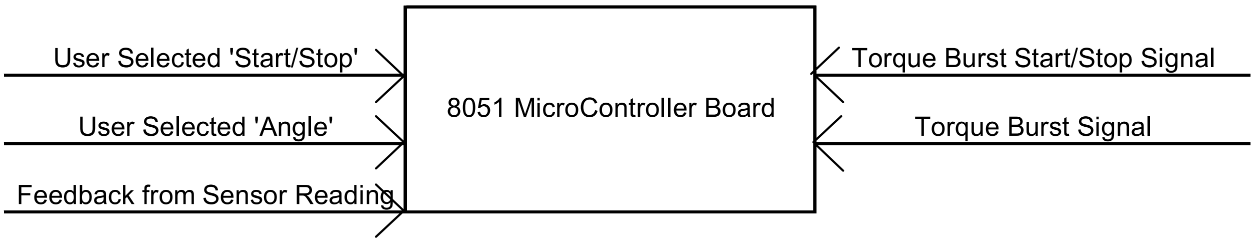
Figure 1 shows the high-level block diagram for the previously described system. The user will input a desired height and instruct the motor to begin. The user's inputs are given through the EMAC microcontroller keypad, which then sends the desired angle, and start command. The microcontroller outputs must then travel through a hardware interface that will convert the EMAC signals to an appropriate motor control signal.

The motor, draws power from a DC power supply that will produce a torque pulse for a limited period. The burst length will be determined by both the microcontroller according to desired height, and the power available to the motor from its supply.

The torque bursts will then propel the pendulum arm. Further research and testing will determine the point in the pendulum's oscillation at which the torque burst will take place. Optical sensors will be monitoring the angle at which the pendulum is swinging, and will be providing feedback to the microcontroller. The motor will continue to provide bursts until the sensors report that the pendulum has reached the appropriate height.

Once the pendulum has reached the desired height, the sensors will continue to provide feedback pertaining to the height of the pendulum. If the pendulum falls below the sensor level, another motor burst will be required to return the pendulum to the appropriate height. The user will have the ability to end the oscillation at any point by selecting the 'Stop' option on the microcontroller keypad.

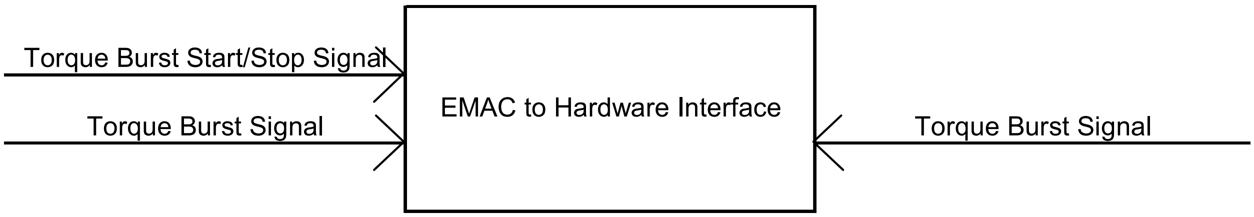
I. Microcontroller Subsystem



The microcontroller subsystem is contained on the EMAC microcontroller kit. The microcontroller's keypad and LCD will be used for user interface ability. The inputs to the microcontroller will be the user selected 'Start' and 'Stop', which will be entered through the microcontroller keypad and the feedback signal from the optical sensors.

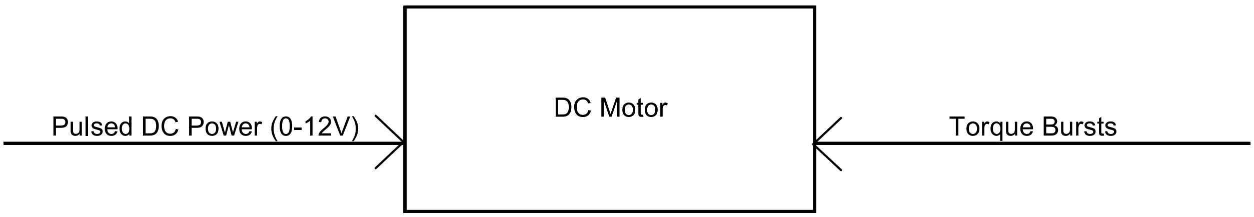
The microcontroller will send a high level signal to begin the torque bursts upon accepting a 'Start' command from the user. This motor burst signal will be sent to the hardware used to interface the microcontroller and the motor. The burst signals will continue until feedback from the sensors indicates that the pendulum has reached the desired angle. The sensors will continue to send feedback so that when the pendulum arm falls below the desired angle, the microcontroller will begin to send the burst signal again.

II. MicroController to Motor Interface Hardware Subsystem



The purpose of the microcontroller to motor interface hardware subsystem will be to convert the microcontroller's output signal to a signal that is at the appropriate levels to be usable by the motor power supply. The interface hardware will also serve as protection for both the EMAC kit as well as the motor. The interface hardware will be designed to be minimal.

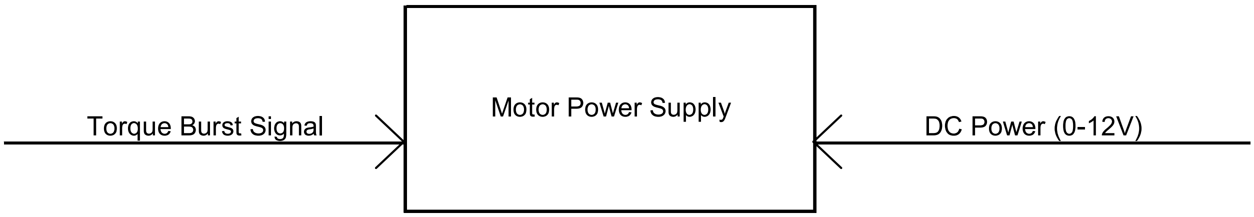
III. DC Motor Subsystem



The DC Motor subsystem will comprise of a small (< 1lb.) Pittman DC motor. The motor is rated at 12VDC, which will be able to run at supplies as low as 1VDC. A non-geared motor is more suitable for this application, so that it will be able to turn freely when the motor is not powered. This is important so that the oscillation of the pendulum is not hindered.

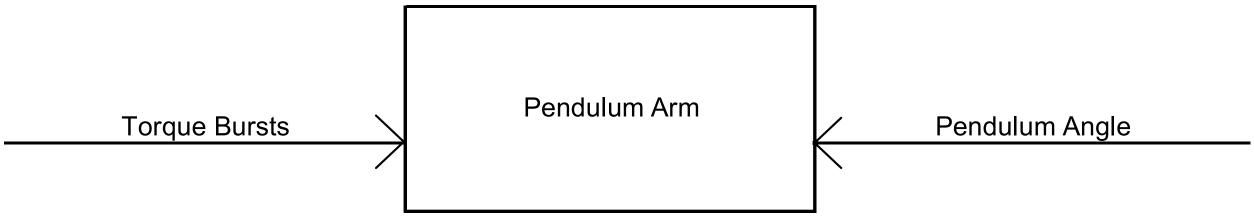
The motor will accept its input through a transistor switch. This switch will allow the power supply to send a pulse to the motor to create a torque burst. Additional H-bridge circuitry may later be added so that the motor will be able to be pulsed on both the rising and falling oscillations.

IV. Motor Power Supply Subsystem



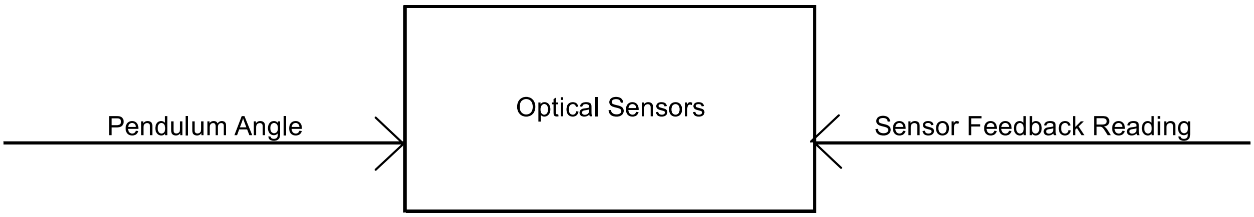
The motor power supply will be a DC power supply less than 12V. The power supply will be designed to have minimal reserve power and for economical purposes will not be able to drive the motor continuously. Testing will be done to determine the lowest supply voltage necessary for the motor to still function at a high enough level to still raise the pendulum arm. Supplies such as 9V batteries will also be explored as alternatives.

V. Pendulum Arm Subsystem



The pendulum arm will be the mass that is oscillated by the motor. The pendulum will be directly attached to the shaft of the motor, and it will extend to the sensors. Multiple designs for the pendulum will be explored. The most common design would be a clock-type pendulum arm, while an alternate design that will be researched is a complete circle mass with the lower section weighted. The pendulum must have an area that will be able to trigger the sensors, because the angle output provided by the pendulum is recorded by the optical sensors. The pendulum will also have to be of an appropriate weight for the DC motor.

VI. Optical Sensor Subsystem



The optical sensors will at all times be recording the height level that the pendulum is reaching. This height will be sent back to the microcontroller as feedback. The number of sensors to be used is still to be determined. Multiple sensors will allow for a larger variance in angle that would be able to be selected by the user.