

# 373 Projects Overview

## Purpose

Apply the concepts and skills learned over the course of the labs and lecture to an application.

## Lab Topic Categories

Concepts and skills should be representative of the following categories.

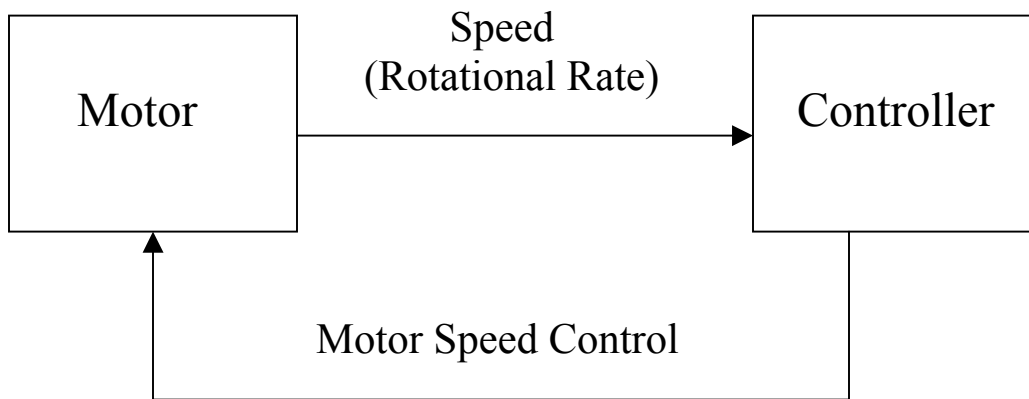
1. Bus Interfacing (Labs 3, 4, 6, 8)
2. Serial Communications, Device Drivers and ABI (Lab 5)
3. Interrupts (Labs 6, 7, 8)
4. Built in MPC823 Devices, i.e. timers (Labs 6, 7, 8)
5. Analog to Digital (ADC) or Digital to Analog (DAC) conversion. (Lab 8)

## Requirements

- The project must demonstrate your fundamental laboratory skill or ability in at least 3 of the lab topic categories.
  - For example, a fundamental bus interfacing skill is demonstrated by developing a simple switch interface as in lab 3.
- The project must also demonstrate advanced skill or ability in one or more of the lab topic categories.
  - For example, an advanced bus skill level can be demonstrated by developing a bus interface to a component that you have not encountered yet, such as an LCD display.
  - You will have to read the specification and understand the timing to develop the LCD interface.

### **Consider Example of Motor Speed Controller**

A feedback control loop can be constructed to control a simple DC computer fan.



## **How can the Motor Speed be measured?**

- **Measurement Concept?**
- **Sensor?**
- **Interface Hardware/Path?**
- **Timing Hardware or Devices?**
- **Software?**
- **What categories are represented to perform the motor speed measurement?**
- **Difficulty components?**

## **How can the Motor Speed be controlled?**

- **Control Concept?**
- **Control Hardware?**
- **Interface Hardware/Path?**
- **Timing Hardware or Devices?**
- **Software?**
- **What categories are represented to perform the motor speed?**
- **Difficulty components?**

**Total difficulty components for project.**

- 2 components: timers and interrupts
- Difficulty components may also count as fundamental skill components.

**Total fundamental skill components.**

- 3 components: timers, interrupts and bus interfacing
- The bus interfacing component does not demonstrate advanced application skill because it is simply an example of lab 3 application.

**Other basic laboratory skill examples.**

- HyperTerminal interface displaying speed and providing input control.
- Provide speed input setting with switches.
- Display output speed on hex display.

**More difficulty or advanced skill level examples.**

- Display motor speed on external LCD. Example of difficult bus interfacing.
- Keypad to enter motor speed. Example of difficult bus interfacing.

## **Grading**

### **50% Fundamental Skill Components.**

- Completion of the three categories at basic laboratory skill level.
- Additional basic categories do not add credit.

### **40% Difficulty Components.**

- Difficulty components earn 10% per component.
- Categories chosen for difficulty components may be shared with categories chosen for basic skill demonstration.
- You may earn more than one-difficulty component per category.
- For groups larger than two, difficulty components are proportionally decreased in value.
  - Three person groups would earn about 8% per difficulty component.
  - Four person groups would earn 7% per difficulty component.

### **10% Final Documentation.**

- Final documentation consists of:
  1. The general specification
  2. Discussion of application issues
  3. A conclusion stating the success of your project.
- You must also submit an electronic file of your Xilinx Foundation project and program source files.

### **Grade Example for Motor Speed Controller**

- 1 category completed at basic skill level
- 2 categories completed at difficulty level (also counts for two basic categories).
- Proper documentation
- Two person group
- Yields:  $50\% + 20\% + 10\% = 80\%$ .

### **Groups**

- Groups are typically composed of the lab group.
- Alternate lab groups are possible, if there is mutual consent among all members.
- Group size may be as large as 4, but consider the value of the difficulty components.

### **Proposal**

The proposal is the general specification for the project. See page four of the project handout for an example of the general specification.

### **Schedule**

See page one of project handout.

### **Other project Examples**

## **Answers to Questions**

### **How can Motor Speed Measured?**

- **Measurement Concept?**

Measure rotational rate by measuring time interval for one rotation.

- **Sensor?**

Use light sensor that is triggered by reflective tape on fan.

- **Interface Hardware/Path?**

Change testpoint output to input by swapping obuf/opad pair for ibuf/ipad pair. Connector TTL compatible sensor output to test point.

- **Timing Hardware or Devices?**

Use sensor output to drive interrupt. Use timers from lab six to measure time interval.

- **Software?**

Program timers, interrupts etc.

- **What categories are represented to perform the motor speed measurement?**

Interrupts, MPC823 devices

- **Difficulty components?**

Difficulty level for both Interrupts and timers.



## **How can the Motor Speed be controlled?**

- **Control concept?**

Modulate DC voltage to motor with pulse width modulation. Ratio of on to off time determines DC level or average, ie Duty Cycle.

- **Control Hardware?**

Switch BJT transistor to modulate motor on and off. BJT used as current buffer. FPGA does not have enough drive to drive a DC motor.

- **Interface Hardware/Path?**

Use testpoint as output to drive transistor. Output register required to drive on/off bit.

- **Timing Hardware or Devices?**

Use timer to determine duty cycle and drive output.

- **Software?**

Timer, interrupt initialization. Some kind of control algorithm to adjust the speed of the motor as the measured speed changes.

- **What categories are represented to perform the motor speed control?**

Bus interfacing, interrupts, timers. Timer drives an interrupt to turn the bit on and off.

- **Difficulty levels?**

As with speed measurement, timers and interrupts earn difficulty level. However, this is similar to speed measurement application so no new difficulty components.

