Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Section: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Names: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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| PROJECT SIGNOFF | |
| **Early Progress (20%)**  One week before project deadline, some aspects of project have been developed and demonstrated in lab.  **Project Technical Content (30%) (BONUS: up to +10% for outstanding)**  Project uses some detailed technical microcontroller content e.g. things like PWM timer, interrupt, DDR, serial commands, adc or other peripherals inside the microcontroller or even using external sensors or actuators. Lower end of points –e.g. 5 points for code that just responds to an input using digitalRead and digitalWrite. Higher end of points – e.g. micro interfaces to a servo using PWM timer and interfaces to external sensor using adc, serial port or custom commands, or project has other interesting/novel use of microcontroller commands e.g. multiplexing digital lines to read a keypad or drive an LED cube.  **Writeup: Portfolio piece with reflection (30%) (BONUS: up to +10% for outstanding)** Documents the following:  motivation (5%), meaning to you or others (5%),  project is clearly described at a high level (5%),  good use of photos or video (5%), describes testing (5%)  describes challenges and improvement ideas (5%)  **Creativity of Idea or Quality of execution (20%):**  A combination of was it well done, interesting, ambitious (even if it didn’t fully work) | \_\_\_\_\_  \_\_\_\_\_  Bonus:  \_\_\_\_\_  \_\_\_\_\_  Bonus:  \_\_\_\_\_  \_\_\_\_\_ |
| Points | \_\_\_\_ |

What is the learning goal of the project?

During the course of this semester you have gone from not knowing much about how microcontrollers work or what goes on inside them, to where now you can program microcontroller hardware for example, configuring pins to be inputs or outputs, setting up hardware sub-modules such as timers and PWM, and using interrupt subroutines to perform multiple tasks at the same time e.g. reading sensors and driving motors.

However, all of this learning and skill development has gone by quickly – how do you make sense of it and put it all together in your brain?

Well, the project is a chance for you to reflect back on what you’ve learned and try to apply one or more pieces of your new knowledge to building something that you find interesting, useful, or simply amusing.

As instructors, we want to see that you can apply what you’ve learned to build something creative or useful, or both.

We want to see you reflect on what you’ve learned and put that learning in context. For example, you learned about interrupts and measuring time. You might find that capability interesting and try to find a way to measure the speed of sound using a microcontroller timer using interrupts or using the Timer1 capture module. You might try to measure how fast rain drops are falling when they reach the ground by using a timer to measure the time between when a rain drop passes a first infrared reflectance sensor and a second infrared reflectence sensor (eg. think of the QTR sensor in your kit that we used in the ADC experiment).

You might just want to make something artistic or amusing – an LED cube or other novelty item. What we want to see is that you connect the dots between some technical capability you’ve learned and the project that you want to build. What makes your project interesting to you, to some other user, to an observer? Not only what makes it interesting but what makes it useful (art is useful too). This doesn’t have to be anything big or deep, but we do want to you think about and talk about it in your project writeup.

Making your project a reflective portfolio piece

In the next year you will be applying for your first co-op job. That is always stressful as you have to sell yourself and your capabilities even though you haven’t completed all your courses and may feel unsure of your capabilities. What we have heard over and over again from employers and students is that talking about projects you’ve built is a great way to break the ice and to get employers interested in you. Because of that, we require you to create a one page write up of your project, with color pictures or a video link, so that you are ready to attach it to your resume when you start job hunting.

Your project writeup should be focused on an audience that is a potential employer looking to hire you.

The writeup should:

1. Describe what you made.
2. Describe why it had meaning to someone (you or some other user) and what that meaning was.
3. It should be brief and to the point in describing what the system is or does.
4. It should have clear well-lit color pictures to make the project understandable.
5. It should have some technical detail of interest that you can talk about (e.g. a sample of some key part of the code or a list of key libraries used, or a schematic of the hardware you assembled, or a picture of the mechanical/physical system you built around the microcontroller, etc.). This could be the starting point for a conversation with a recruiter about what you did or what your skills, interests, or passions are. It is not a full description of all the technical details.

To help you frame your writeup, take a look at the three step process of reflection given on the next page. Think about these questions as you get started on your project writeup.

We have provided a sample writeup on the next page. Your writeup may take a very different direction depending on what mattered to you or what meaning you made from your experience. For example you may have really found some technical detail to be what you wanted to talk about or maybe you wanted to talk more about the application context and not the technical details e.g. you made an electric piano and really got a kick out of how much your friends liked writing new songs for it.

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From: <https://www.luc.edu/experiential/eportfolio/learningportfolioelements/criticalreflection/>

**Remote control of a light switch using an InfraRed remote.**

*Chris Buckley – 2nd year Electrical Engineering Technology Student at RIT*

**Motivation:** I have always been interested in figuring out how to remote controls work and have wanted to use my TV remote control to control more things in my house. In my microcontrollers lab, I learned how to program a microcontroller to interface with an IR sensor and output devices like an RC servo. Using this knowledge, I built a microcontroller system to remotely control a light switch.

**Project Description:** The system uses a IR receiver (part number TSOP38238) to decode a serial stream of infrared light codes emitted a TV remote. The digital codes are used to control a state machine. When the correct code is received, a RC servo motor is controlled using a PWM Timer to turn a light switch on or off. I found an existing 3D printed light switch controller on Thingiverse and used that to hold the servo. I had to modifiy it to hold the microcontroller board and a battery.

**Testing:** I was able to get the system to work up to 10 feet away using a small IR remote, but with the TV remote, I could get it work up to 20 feet away.

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if (IR\_command\_received.value == OFF) commandState = LIGHT\_OFF;

if (IR\_command\_received.value == ON) commandState = LIGHT\_ON;

**Challenges:** The hard part of the project was figuring out what each pattern of IR light codes meant. I found several websites that decribed the codes for various manufacturers e.g. SONY, Samsung, but in the end I just learned the patterns by pressing the remote button and recording the digital codes on the microcontroller.

**Meaning:** Now that I have built this, I can see applications for elderly people to be able to control lights in their house using a TV remote. This doesn’t required a smart home system like Amazon’s Alex which needs an internet connection to work but rather can be used by anyone with a TV remote.

**Possible improvements:** I found another example of the light switch controller that uses a Attiny85 micro and a lithium polymer battery. This system uses less energy, has a better battery and is a lot smaller making it practical to mount next to the light switch.

