

Fall 2022 ECET279 Embedded Digital Systems

Lab12 - 13: Crane Controller

Sign up online for your check off time [here](#)

Instructions:

- Any code print out **MUST** be presented in a legible fashion **WITHOUT** any wrap-around of text. **Avoid** using Notepad.
- Two lab periods are allocated to this project, specifically Labs #12 - #13. (Total 100 points, both labs will receive the same score) Anything above that are extra credits.
- All check offs for this project can **ONLY be done by the course instructors.**
- Each team should reserve a check off time online, each slot is 30 minutes.
- You must produce your own code.
- All parts provided to you must be returned after the check off. (points will be deducted for parts not returned for all members in the team)

Team Rules:

- Work with your team to complete the tasks assigned.
- Only member of the team who's present for the check off receives points for the check off. One check off time per team.
- Only member of the team who can answer questions will receive points for the check off.
- Check off can only be obtained at the signed up check off time. You may change your check off time as your project progress.
- Each member of the team are assigned responsibilities. Instructor reserve the right to change team member's responsibility should the need arise. Total score of each member will depend on the success of the project (total score) and that their performance during check off time. i.e. not every member will have the same score for the project. Depends on their performance, they work within the team, and how well they answer the questions during check off time.

Notes:

1. Points are allocated for successfully demonstrating the cumulative operation of any of the defined stages in the overall development, and the final overall successful operation.
2. Points allocations vary according to the degree of difficulty.
3. The final project code is to be in multi-modular form during the development
4. Points are also awarded for submitting your final code listing, required information include:
 - a) Properly and thoroughly commented code
 - b) Descriptions of operation associated with specific functions and ISRs.
 - c) Any calculations associated with the setup of any peripherals used.

Introduction:

This project involves developing a multi-module C program in stages in order to use the Arduino MEGA with ATmega2560, to control a crane to move a weight from one location to another, from one height to another. Height and location to be assigned during check off. Location and height information will be assigned at time of check off. To move the crane, there are two servo motors and one stepper motor to control the crane's movement. Crane action is initiated by either a phone (bonus) or by serial terminal from the computer.

With a push of a button, the crane move a weight from one location to another (identified by the instructor). This route can be changed by entering the “Recording” mode using the phone app or the terminal. In the Record mode, user records a new route. Once the route is recorded, upon pressing the start pushbutton (either hardware, serial terminal, or the phone), the new route is used to move the weight. This new route is saved in EEPROM, so that it can be used even after removing power to the controller.

During the Record mode, operator can use potentiometers to move the crane manually and use a pushbutton to record its locations. User must be provided some kind of feedback on the next step during this mode and when the Record mode has been successful.

There is a switch located at the base of the crane. This can be used to locate the home position. At startup, crane must move to the identified home position (identified by the team).

Program requirements:

In your program, you must utilize at least

- One interrupt service routine.
- You must use the controller to produce the PWM signal
- you must write your own USART code
- your own timer delay code
- your own EEPROM code
- Incorporate ADC as part of your project

Tips

- The Arduino may have enough power to drive one of the servo motor, but it won't have enough power to drive both motors and the stepper motor. Use an external power supply to drive all three motors
- Build your project piece by piece. Make sure you can drive the servo motor manually.
- If in doubt, test the hardware. Use the test code to test the hardware.
- Place a little time between each step of the route.
- First determine all the IO requirements, then determine the major steps required for the normal operation.
- Give your team enough time to incorporate the modules into a project and to troubleshoot the final project. If you wait until the last week to put everything together, you will run out of time.

Start up:

1. At start up, servo motor positions for each step should be retrieved from EEPROM
2. Press start pushbutton to move a weight from one location to another
3. When the crane is moving, feedback to operator at the phone or serial terminal that the crane is moving

Record mode

1. A text **string** “Calibrate” from the phone to enter the Record mode
2. Controller should return a message, indicating entering of the Recode mode
3. Use potentiometer / s to control the servo motors positions, or you can choose to use other method
4. A roller mini switch is installed at the base of the crane, this is to locate the horizontal position of the crane.
5. Press a record pushbutton to save servo motors and stepper motor positions for each step
6. Provide feedback serially to operator on which step they have recorded
7. Upon completing all the steps, feedback to operator serially that Record mode completed
8. Save all data to EEPROM
9. To test that the route has been recorded successfully, press the start pushbutton to demonstrate moving the weight from one location to the next using the new recorded route.
10. The crane must complete its operations at least three times successfully.

Check-offs: Only member who's present will receive the check off.

Name: _____

You are free to develop a solution in any order you choose but the code development must be cumulative.

For full functionalities, check off at #6 to receive total score.

For partial functionalities, check off using #1 to #5. There is no partial credit on any of the stages.

Functionalities	Points	Checkoff
1. Manually control one servo motor using a potentiometer	20	
2. Manually control stepper motors movements using two push buttons	20	
3. Move a weight from one location to another (location = weight drop into different circle locations), start the operation by one pushbutton or use the phone app	30	
4. Demonstrate Record mode by recording the various servo motors positions, from entering the Record mode to exiting this mode. May simulate servo positions by typing through serial terminals or use the phone app. This must be your own code. Team must determine how to demonstrate Record mode.	30	
5. Demonstrate saving the route to EEPROM and reading the saved values from EEPROM. Reading the EEPROM should be performed once at the start of the program. May demonstrate the servo positions and the stepper position by typing through serial terminals. Values should be typed as numbers. You may not use printf to print the values read from EEPROM. Must be your own code.	30	
6. Complete all operations and completed project worksheet. Crane must move object from one designated location to another designated location as specified by the instructor successfully and repeatedly (more than five times).	180	
7. Deduct if don't have <ul style="list-style-type: none"> a. Own code for PWM b. Own code for timer c. Own code for USART d. Interrupt e. Own code Compare string, and math operations f. Maximum of 6 modules (primary + secondary) 	-20 -10 -20 -10 -20 -10	
8. Commented code (submit online)	20	
Total		

Extra credit

If completed #6 and with full score, you are eligible to obtain extra credit, added to your lab's total score. Showing extra credit before normal function above is not permitted.

1. Functionality to perform multiple routes (3). Use either Serial terminal or push buttons to select routes. 10 pts
2. Identify each location (6 locations), instructor determines pick up and drop off locations using serial terminal. Then start the operation by either pressing the start push button or a command from serial terminal. (for either stepper motors or servo motor set up) 10 pts
3. Use own phone (select at the beginning of the project and did not receive phone from instructor) 20 pts