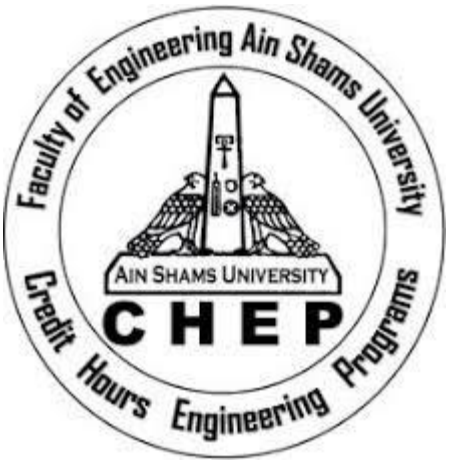

CSE345 - Real-Time and Embedded Systems Design

Project (1) : Multi-junction traffic light controller

Submitted to: Prof. Dr. Omer Alkelany
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Team Name: Titans

Team Members:

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First Part

System Design Part:

1) Project Specifications and Description:

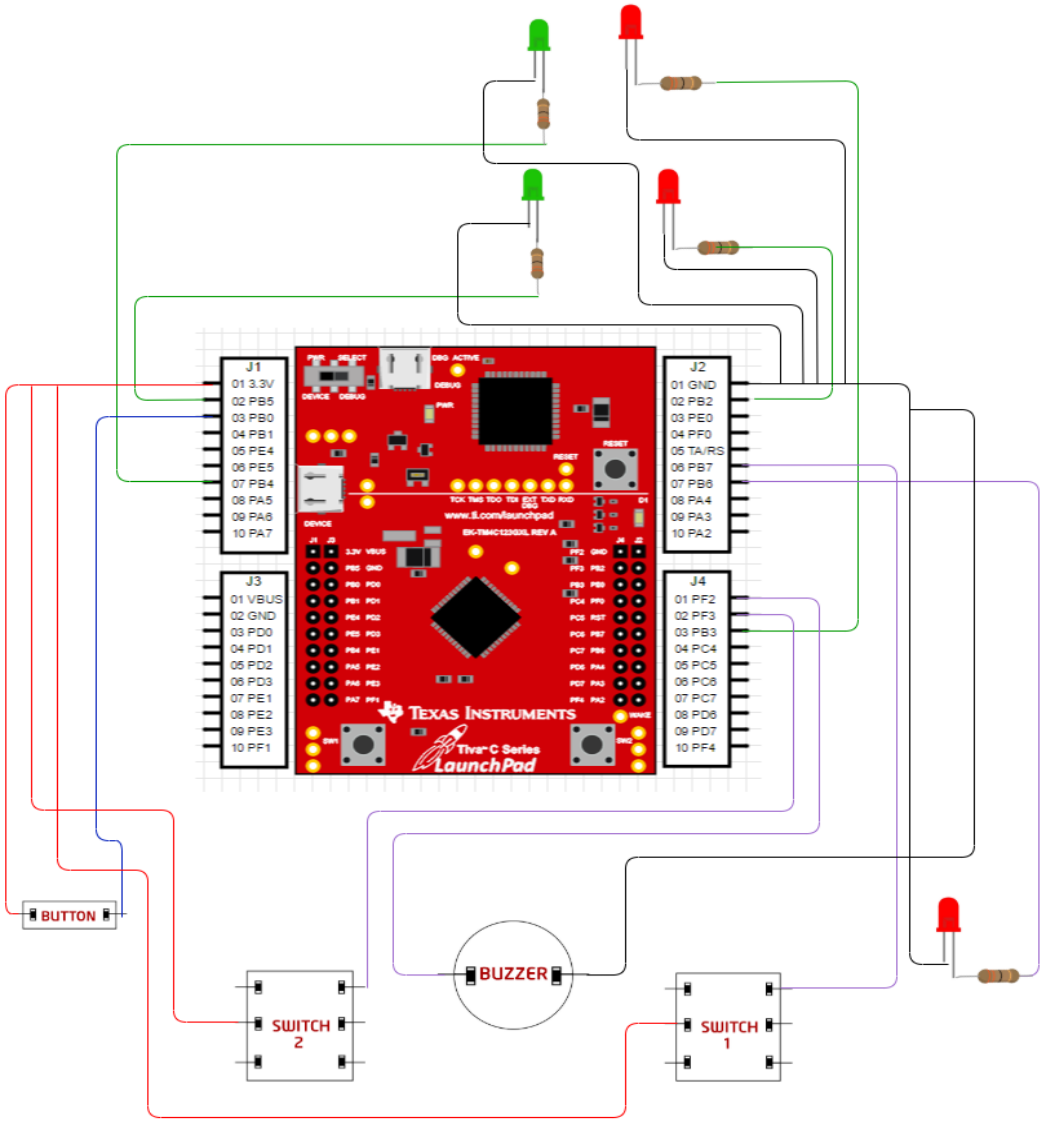
Is to design a Traffic Light controller with four road junctions of different priorities, with parallel railroad crossing. The railroad goes east/west and has the highest priority. The north/south road junctions have higher priority than the east/west road. Single lane railroad crossing has a gate, which is vertical by default, and closes before the train approaches. Once the gate is about to close, all four red lights go flashing, a siren sounds is turned on until the train passes. Pedestrians can also provide requests to cross, at any of the four corners. System can operate at various modes as specified.

2) Design Choices:

- **Normal mode:**
  - For each street we used 2 LEDs (1 green and 1 red) with parametric times given at compile time: the Go times for the North/South will be 5sec , and the Go times for the East/West will be 2.5sec.
- **Pedestrian crossing/Hazard mode:**
  - We used a button when pressed all the red LEDs will be turned on for a certain time = 10sec.
- **Train approaching:**

  We used 2 switches one for when the train is approaching and the other one is used to indicate that the train has left. When the first switch1 is on **all red LEDs(2 red LEDs for the two roads and one for the train gate) and the buzzer turns on** for 30sec.When the second switch is on **all red LEDs and the buzzer turns off.**

3) Detailed block diagram:



- **Block Diagram connections:**
  - 2 road red leds are connected to PB2 & PB3
  - 2 road green leds are connected to PB4 & PB5
  - 1 Button is connected to PB0
  - 2 Switches are connected to PB7 & PF3
  - 1 Buzzer is connected to PF2
  - 1 Railway red led is connected to PB6

4) Team member responsibilities:

All the team members worked at the same rate in face-to-face meetings, but after the quarantine only one member had the equipment and we had to make online meetings to finish the project.

5) Plan of timeline:

Date	Work
1 March	Reading the specifications and making the design plan
8 March	Normal mode
15 March	Pedestrian crossing/Hazard mode and Train approaching mode
23 March	Integration between modes and testing
30 March	Report writing session

Second Part

Technical Details Part:

1) Design details, operation manual, test cases:

- **Demo video link: Demo Video**

Test Cases:

- **Test case 1:** (The normal mode) we let the two roads swap after 5 , 2.5 sec.

  Observe 1: At the beginning the green light of N-S, red light of E-W turn on for 5 sec, the red light of N-S road and the green light of E-W road turn off .Then it switches automatically the red light of N-S road, the green light of E-W road turn on and the green light of N-S road, the red light of E-W road turn off.

- **Test case 2:** (Pedestrian mode) while the light of the two roads are turned on and switch between them, a pedestrian presses the button to cross a road.

  Observe 2: All the red lights of the two roads turn on and all the green lights of the two roads turn off.

- **Test case 3:** (Train mode at the normal mode) while the light of the two roads are turned on and switch between them , the first train switch(sensor) turns on and after the train passes completely the second switch turns on.

  Observe 3: When the first switch(sensor) is pressed, all the red lights of the two roads, the red light of the train, **the buzzer** turn on and all the green lights of the two roads turn off for 30 sec.After the second switch(sensor) is pressed the buzzer and all red LEDs turn off to return to the normal mode.

- **Test case 4:** (Train mode at the pedestrian mode) while all the red lights of the two roads are red because of pedestrians the first switch(sensor) of the train is pressed.

  Observe 4: When the first switch(sensor) is pressed, all the red lights of the two roads, the red light of the train, **the buzzer** turn on and all the green lights of the two roads turn off for 30 sec.After the second switch(sensor) is pressed the buzzer and all red LEDs turn off to return to the normal mode.

- **Test case 5:** (pedestrian mode while the train is passing), the pedestrian button is pressed while the train is passing, all the red lights, **buzzer** are turned on and all the green lights are turned off.

  Observe 5: No change because the train mode has higher priority than the pedestrian mode.

2) Code listings:

- **void PortB_Init(void) :**

  → All PortB initializations are declared in this function

- **void PortF_Init(void) :**

  → All PortF initializations are declared in this function

- **void SysTime (void) :**

  → SysTick initializations are declared in this function

- **VTask1:**

  → Turn on green lights for N-S road for 5 seconds at the same time the red light of E-W is lit for 5 seconds then switch to 2.5 seconds green lights for E-W road and 2.5 seconds of red N-S road lights, check if pedestrian button pressed then proceed to VTask2 (Pedestrian mode) and also check if switch 1 of train is pressed then proceed to VTask 3 (Train mode).

- **VTask2:**

  → If the pedestrian button is pressed then all red lights of N-S & E-W roads are turned on while the green lights are turned off, and check if switch 1 of the train is pressed then proceed to VTask3.

- **VTask3:**

  → If switch 1 of the train is pressed in any mode it automatically proceed to VTask3 (Train mode) as it has the highest priority, all road red lights are turned on, green lights are turned off and the railway red light and **buzzer** are turned on for 30 sec, then switch 1 is switched off to indicate that the train has passed and reached switch 2 which is switched on (must be after 30 safety second) which leads to turning off the railway **buzzer,** red light and it returns to normal mode.

3) Lessons learned:

We learned how to deal with FreeRTOS and we learned how to work as a team using online meetings.We learned how to make 3 different tasks work together independently with different priorities.

4) Problems faced:

We had a problem working on this project due to the coronavirus pandemic that didn't give us the chance to have face-to-face scheduled meetings and we had to make most of the meetings over virtual apps (zoom).