Egypt Future Work is Digital – Udacity

Embedded Systems Professional Track

Documentation on On-demand Traffic Light Control

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1. System Description

This section describes the hardware and software requirements of the system, and briefly shows the system's objectives.

1.1 Hardware Requirements

- ATmega32 microcontroller.
- One push button connected to INT0 pin for pedestrian.
- Three LEDs for cars - Green, Yellow, and Red, connected on port A, pins 0, 1, and 2.
- Three LEDs for pedestrians - Green, Yellow, and Red, connected on port B, pins 0, 1, and 2.
- Six 300 Ohm resistors and one 10k Ohm resistor.

1.2 Software Requirements

In normal mode:

1. Cars' LEDs will be changed every five seconds starting from Green then yellow then red then yellow then Green.
2. The Yellow LED will blink for five seconds before moving to Green or Red LEDs.

In pedestrian mode:

1. Change from normal mode to pedestrian mode when the pedestrian button is pressed.
2. If pressed when the cars' Red LED is on, the pedestrian's Green LED and the cars' Red LEDs will be on for five seconds, this means that pedestrians can cross the street while the pedestrian's Green LED is on.
3. If pressed when the cars' Green LED is on or the cars' Yellow LED is blinking, the pedestrian Red LED will be on then both Yellow LEDs start to blink for five seconds, then the cars' Red LED and pedestrian Green LEDs are on for five seconds, this means that pedestrian must wait until the Green LED is on.
4. At the end of the two states, the cars' Red LED will be off and both Yellow LEDs start blinking for 5 seconds and the pedestrian's Green LED is still on.
5. After the five seconds the pedestrian Green LED will be off, and both the pedestrian Red LED and the cars' Green LED will be on.
6. Traffic lights signals are going to the normal mode again.

1.3 System Functionality

2. System Design

This section describes the system overview illustrating the used microcontroller unit, the different electronic units, and connectivity. It also provides the concept of abstracting the

system as a stack of layers. Finally, it presents the followed logic flow in implementing the system.

2.1 System Overview

The following figure depicts the elements of the traffic systems, as mentioned previously in subsection 1.1.

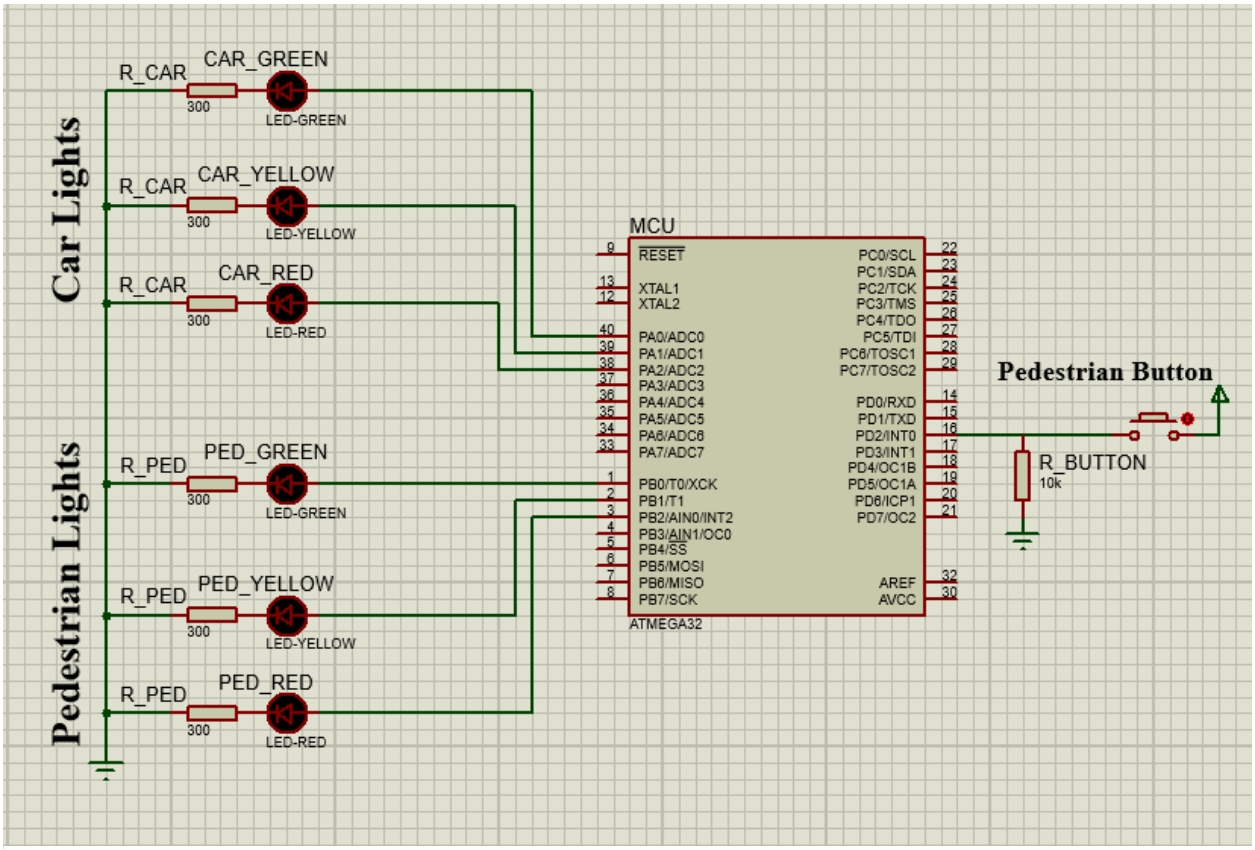


Figure 1 Traffic Light Control Scheme

2.2 System Layers

Figure 2 depicts the abstraction of the traffic system into four interconnected layers, where each layer can invoke one or more methods of its lower layer. Starting from the bottom up, the base layer is the microcontroller unit layer. MCUAL is the layer concerned with the microcontroller's integrated peripherals, such as DIO, Interrupt controller, and Timer module. ECUAL concerns the electronic devices' drivers, such as LEDs and buttons. Finally, the application layer contains the essential APIs, APP_init() and APP_start().

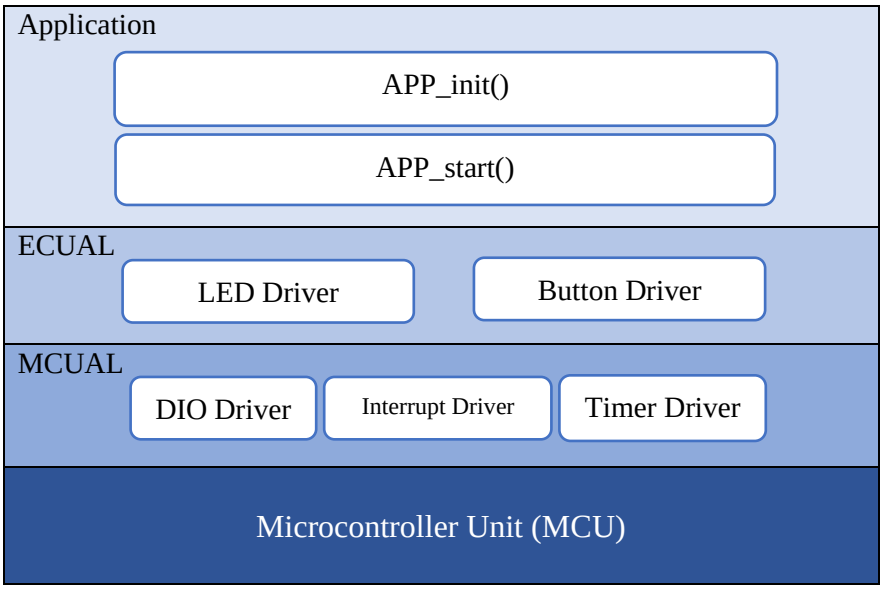


Figure 2 The abstraction layers of on-demand traffic light control system.

2.3 System Flowchart

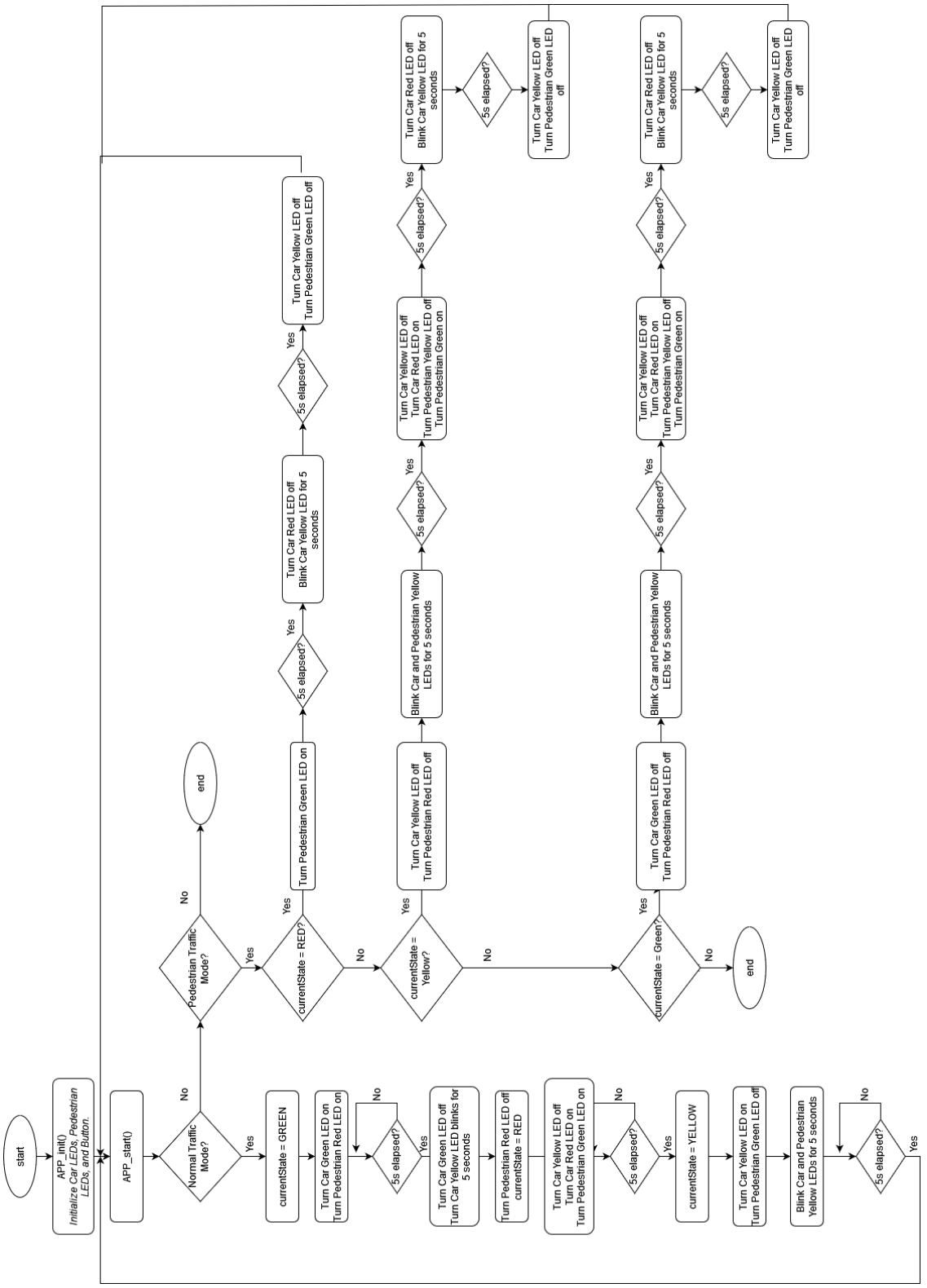
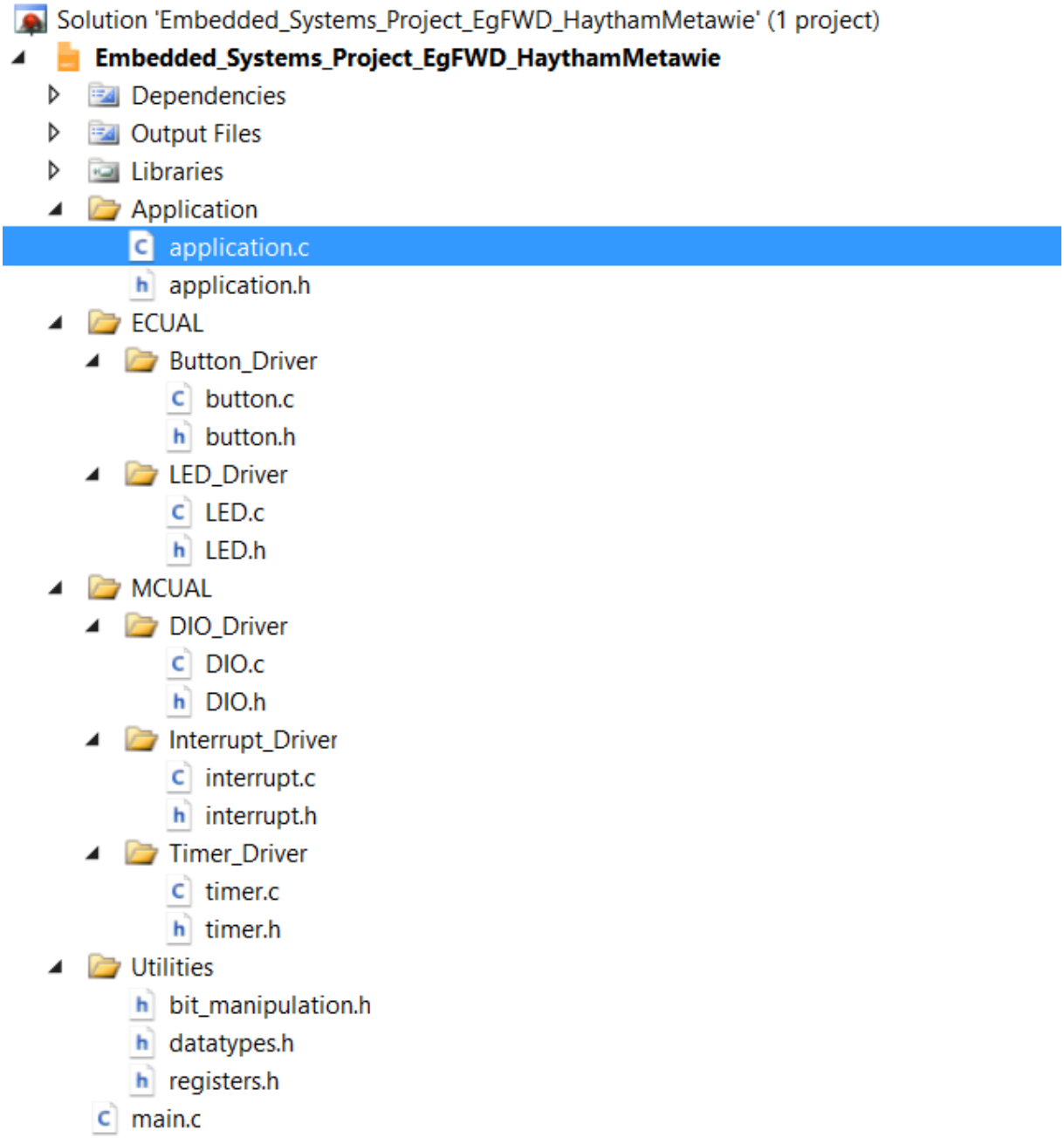


Figure 3 The flowchart of on-demand traffic light control system

3. System Implementation

This section provides an in-depth look at implementing system requirements.



3.1 Software Tools

1. Microchip studio IDE
2. Proteus 8 simulator
3. Diagrams.net (web-based drawing tool)

4. System Testing

This section lists five test case scenarios to ensure that the system can perform the required functionality.

User story 1	As a pedestrian when I will make a short press on the crosswalk button while the cars green light is on and pedestrian red light is off, I will wait for the yellow lights to blink for five seconds then the cars red light is on and pedestrian green light is on for five seconds, so that I can cross the street.
User story 2	As a pedestrian when I will make a short press on the crosswalk button while the cars yellow light is blinking and pedestrian red light is on, I will wait for all yellow lights to blink for five seconds then the cars red light is on and pedestrian green light is on for five seconds, so that I can cross the street.
User story 3	As a pedestrian when I will make a short press on the crosswalk button while the cars red light is on and pedestrian green light is on, I expect nothing to be done.
User story 4	As a pedestrian when I made a long press on the crosswalk button, I expect nothing to be done.
User story 5	As a pedestrian when I made a double press on the crosswalk button, I expect that the first press will do the action and nothing to be done after the second press.