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**Embedded Systems Professional Track**

**On-demand Traffic Light control Project**

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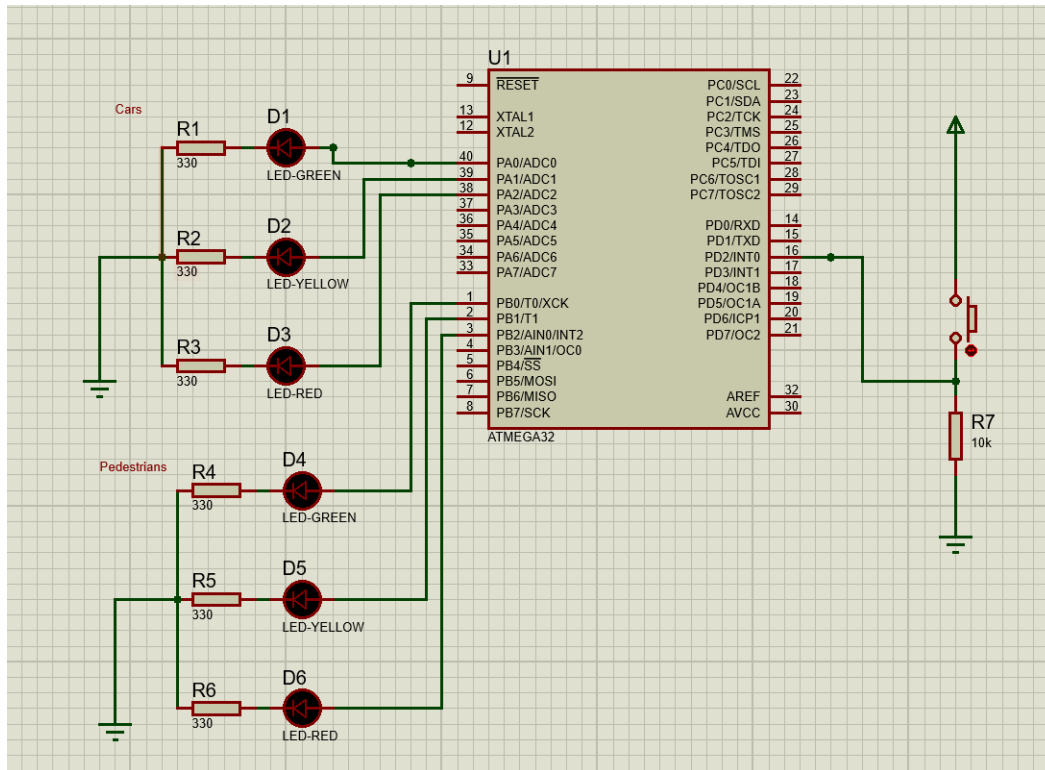
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## System Overview:



Implementation of a traffic lights system with an on-demand crosswalk button. Crosswalk buttons let the signal operations know that someone is planning to cross the street, so the light adjusts, giving the pedestrian enough time to get across.

## System Description:

### Used Hardware:

1. ATmega32 microcontroller
2. One push button connected to INT0 pin for pedestrian
3. Three LEDs for cars - Green, Yellow, and Red, connected on port A, pins 0, 1, and 2
4. Three LEDs for pedestrians - Green, Yellow, and Red, connected on port B, pins 0, 1, and 2
5. Six 330-ohm resistors
6. One 10k ohm resistor.

### 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 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 normal mode again.

### System Inputs:

The only input is a push button for the pedestrian.

### System Outputs:

A traffic light for cars and another one for pedestrians 3 LEDs each.

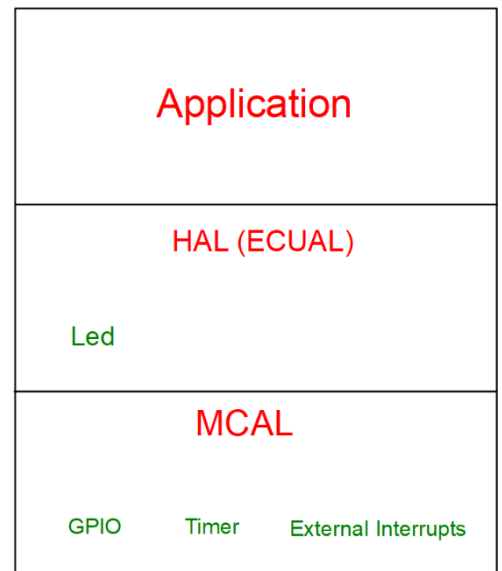
## System Design:

The system is designed as a finite state machine. A state that represents the normal mode and another one that represents the pedestrian mode. The normal mode is the background of the application while the pedestrian mode is the foreground that is executed in an interrupt service routine. The transition from the normal mode to the pedestrian mode occurs when the push button is pressed. The transition from the pedestrian mode to normal mode occurs after the code of the pedestrian mode is fully executed.

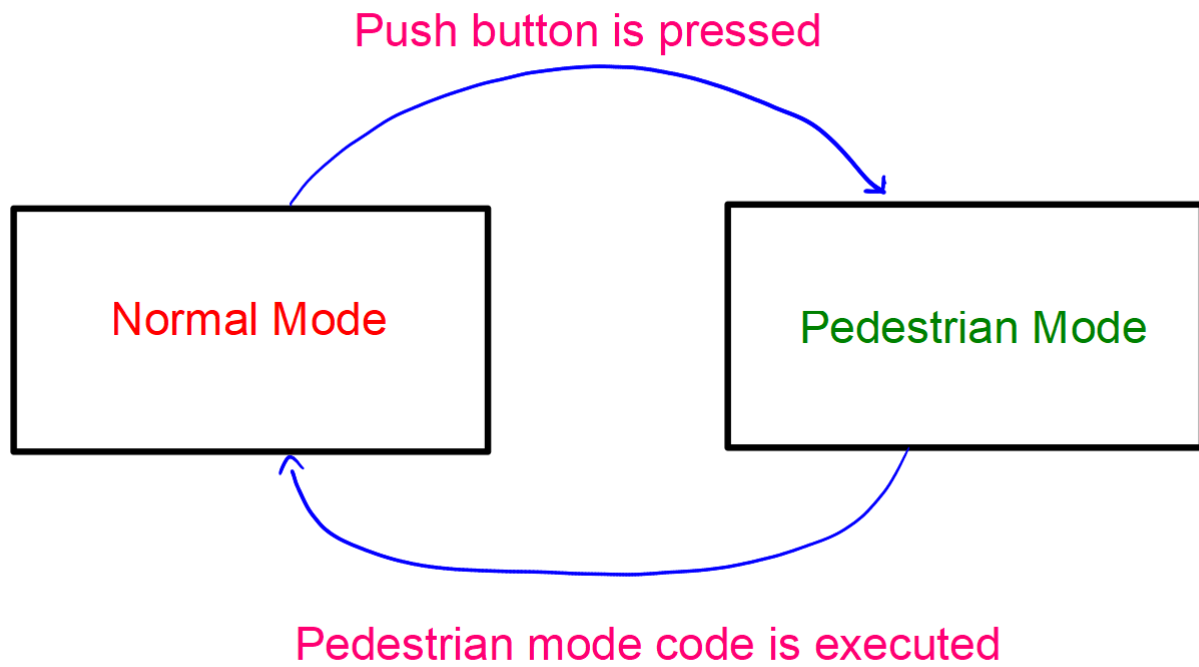
### Software Layered Architecture:

The system is statically designed as layered architecture. It is divided into three layers.

1. Microcontroller Abstraction Layer (MCAL):  
Three modules are included in this layer. GPIO or DIO module to initialize, set and read pins. Timer module to perform needed delays. External interrupts module runs the interrupt server routine that changes the state of the application when the button is pressed, and a rising edge is detected.
2. Hardware Abstraction Layer (HAL) / ECU Abstraction Layer (ECUAL):  
This layer includes the LEDs driver that is used to initialize, turn on, and turn off the LEDs.
3. Application layer:  
This layer includes all the functionality of the application.

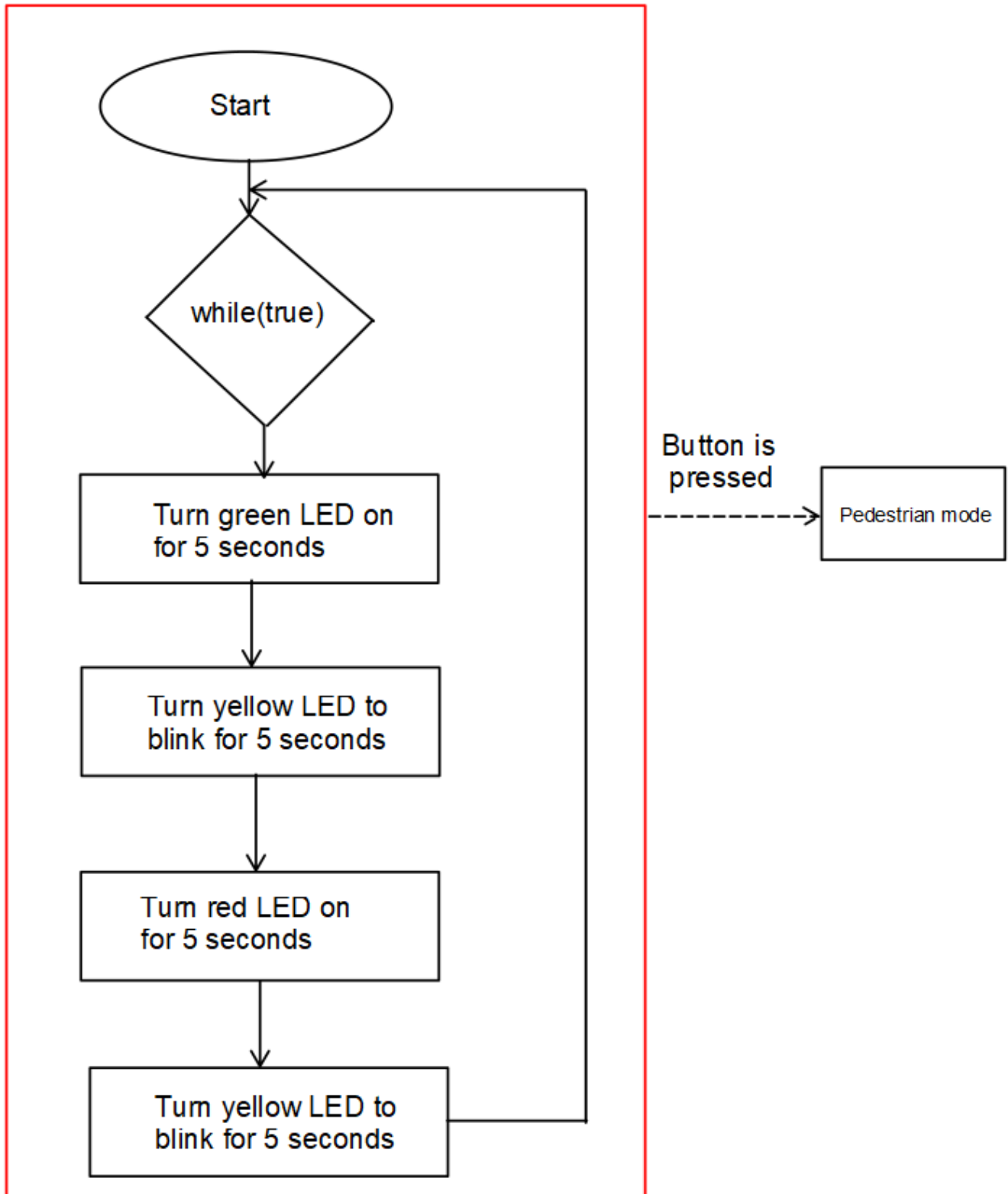


## System State Machine:

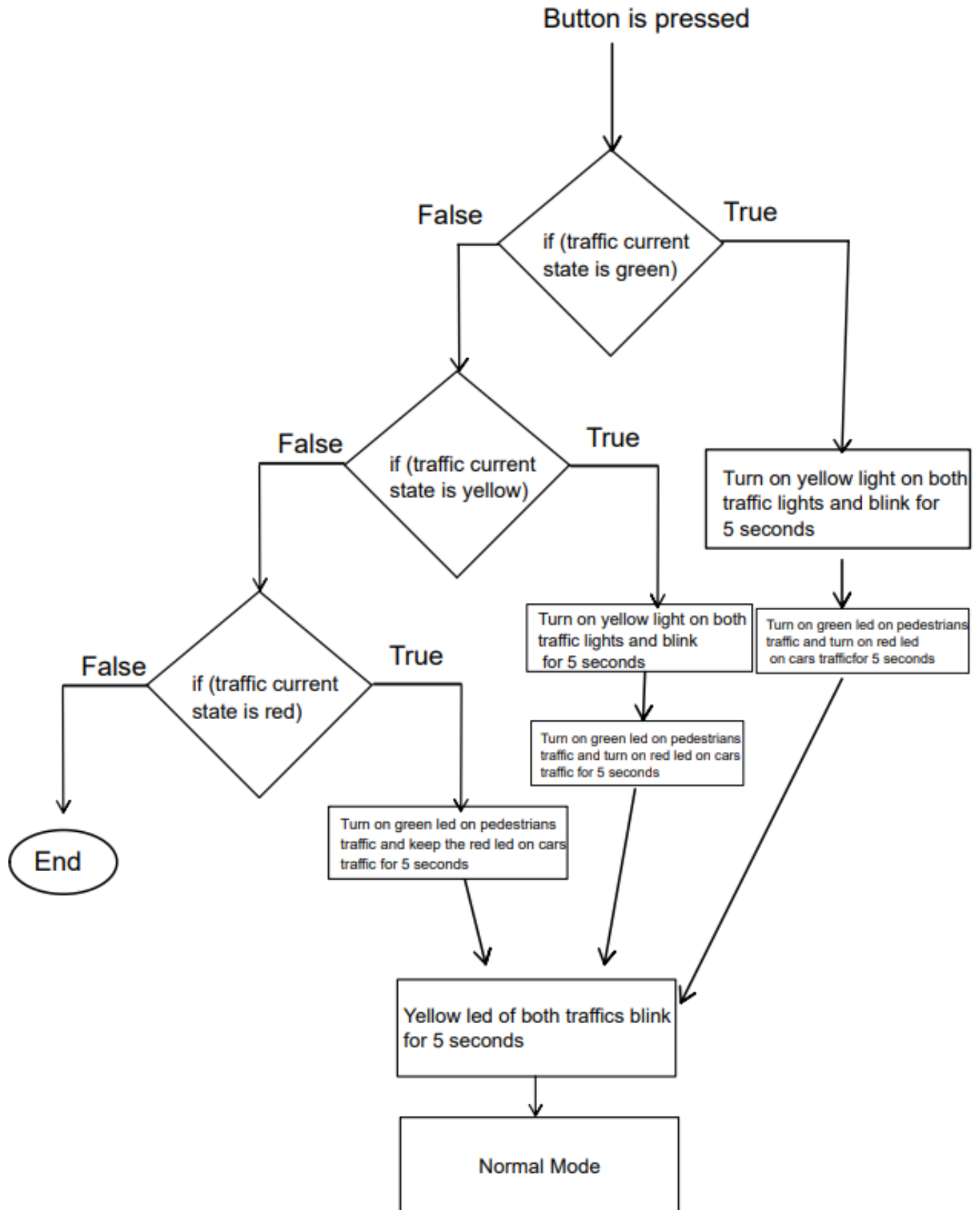


## Flow Chart:

### Normal mode flow chart:



Pedestrian mode flow chart:



## System Constraints:

The system has two constraints.

1. Long Press: It does not matter whether a press is short or long. A long press has the same effect as a short press. They both make a state transition from the normal mode to the pedestrian mode.
2. Double Press: Any press done during the pedestrian mode is neglected. A double press has the same effect as a single press as the second one is neglected.