DIGITAL I/0 AND TIMERS

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Embedded Systems

Introduction:

In this project we will be designing a traffic light sequencer that will do the same functions as a normal traffic light. This project will contain all the system events and their responses. I will then draw a state chart on the system events. I will then choose the write GPIO connections to use on a XMC board. These connections will be used for the Led outputs and the switch input. I will then choose between polling and interrupts. The Red light will turn on for 30s and if the pedestrian button is not pressed it will go to green after that 30s. After that 40s seconds it turns off and the yellow light turns on for 10s and after that it check to see if the Pedestrian button is pressed. If the button is not pressed it goes back to red with no change but if the button is pressed, then it goes back to red with 90s on the timer instead of 30s.

1. System events and responses

Red Light:

1. Turns on for 30s.
2. Turns on for 90s if pedestrian Light (Blue Light) is pressed.
3. Turns off after reaches the timer.
4. Gives permission for the Green light to turn on.

Green Light:

1. Green Light is on for 40s.
2. Green light is activated after the Red light.
3. Turns off after it reaches the timer.
4. Gives permission for the Yellow light to turn on.

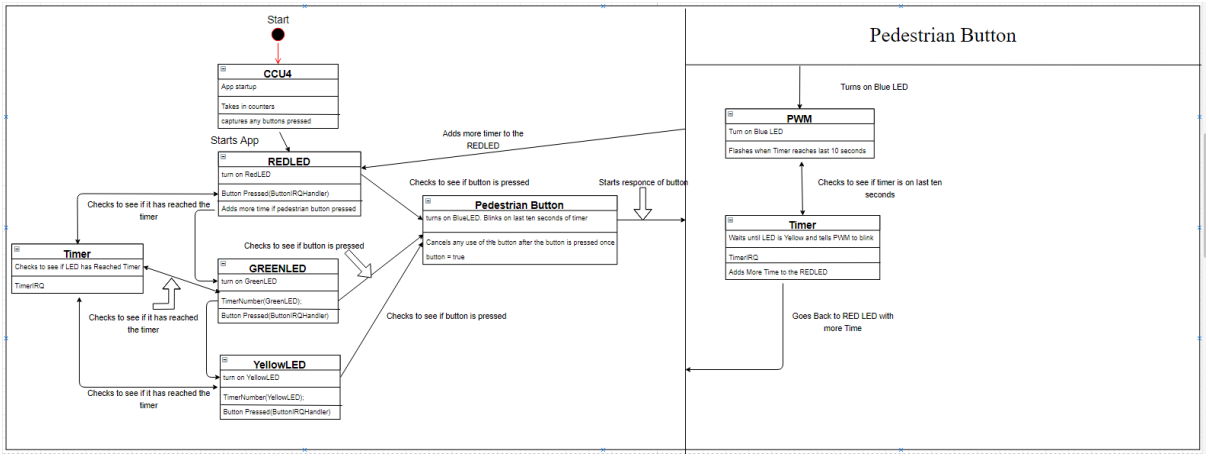
Yellow Light:

1. Turns on for 10s.
2. Turns on once the green light turns off.
3. Turns off after timer and goes back to the red light.

Blue Light:

1. When the button is pressed it waits for the next red light.
2. Extends the time of red light to 90s.
3. Light blinks at 1Hz every half second for the last 10 seconds.
4. Signals pedestrians to pass.

2. **State Chart**



3. **GPIO connections.**

For the Digital I/O I used multiple Digital I/O to represent each different PIN. The Green Pin is represented by pin P0.0. The REDLED pin is on P0.5. The Yellow pin is represented by the pin P0.6. The Pin interrupt is represented by the by the Pin P2.0. The Pin Pedestrian LED which is a PWM is represented by the pin P0.7.

4. **Interrupts vs Polling.**

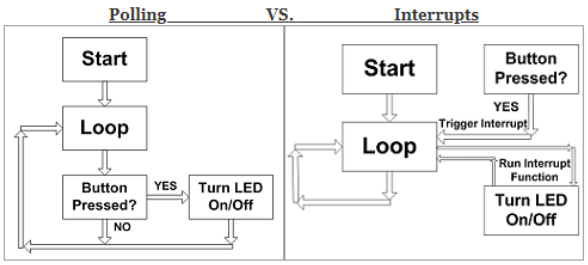
Interrupts is when a device needs something to be processed it will send it to the microcontroller. There are many advantages of interrupts over polling. Polling is used for non-time-critical responsibilities.

The benefits of interrupts are that you maximise the amount of time your program does work. This minimises the amount of latency in responding to an event.

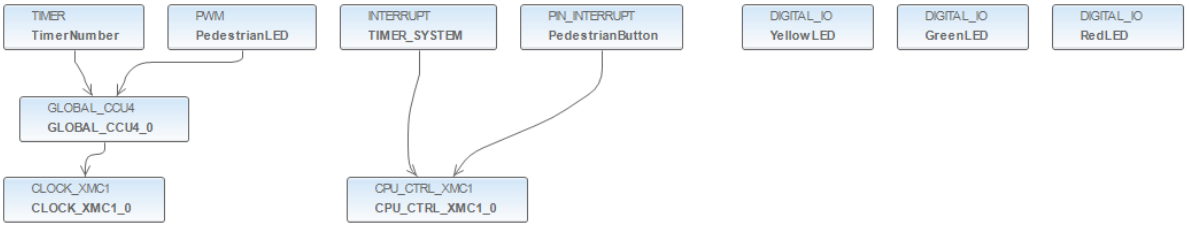
Interrupts are better with the interests of Asynchronous, Urgent, Infrequent. This would make Interrupts better. But when using polling Synchronous, Not urgent and frequent.

Polling uses a lot of CPU cycles. You would only use it when you are polling for a short period of time. Using up the CPU cycles is bad for performance perspective and for power consumption which will use up more battery.

This is the reason why I used interrupts as a traffic light system will require timing. And will be running for a long period of time.



5. DAVE GRAPH



Other Points:

App Instance Name	Resource	Mapped Resource
CLOCK_XMC1_0	CLOCK CONTROL UNIT	scu/0/ccu/config
CLOCK_XMC1_0	DCO CLOCK	scu/0/dco/2
CPU_CTRL_XMC1_0	hardfault_exception	cpu/0/exception/hardfault
CPU_CTRL_XMC1_0	swd0_pin0	p/0/pad/14
CPU_CTRL_XMC1_0	swd0_pin1	p/0/pad/15
GLOBAL_CCU4_0	CCU4 sync start	scu/0/gcu/ccu4_global_enable/0
GLOBAL_CCU4_0	Global	ccu4/0/global
GreenLED	pin	p/0/pad/0
PedestrianButton	External Event	cpu/0/nvic/interrupt/3
PedestrianButton	Pin	p/2/pad/0
PedestrianButton	ers_etl	eru/0/ers_etl/0
PedestrianButton	ogu	eru/0/ogu/0
PedestrianLED	CC4 Slice	ccu4/0/cc4/1
PedestrianLED	PWM Output Pin	p/0/pad/7
RedLED	pin	p/0/pad/5
TIMER_SYSTEM	NVIC Node	cpu/0/nvic/interrupt/0
TimerNumber	CC4 Timer	ccu4/0/cc4/0
YellowLED	pin	p/0/pad/6

Connections:

APP Instance Name	Signal	Connected To	APP Instance Name	Signal
CLOCK_XMC1_0	clk_dco2_output		CLOCK_XMC1_0	clk_rtc
GLOBAL_CCU4_0	ccu4_global		TimerNumber	global_enable
GLOBAL_CCU4_0	ccu4_global		PedestrianLED	global_signal
GreenLED	pin		GreenLED	pin_signal
GreenLED	pin_signal		GreenLED	pin
PedestrianButton	external_event_pin		PedestrianButton	signal_a_b
PedestrianButton	external_event_pin		PedestrianButton	Pin_signal
PedestrianButton	iout		PedestrianButton	sr_node
PedestrianButton	Pin_signal		PedestrianButton	external_event_pin
PedestrianButton	trigger_out		PedestrianButton	trigger_in
PedestrianLED	PWM Output Pin_signal		PedestrianLED	pwm_pad
PedestrianLED	pwm_output		PedestrianLED	pwm_pad
PedestrianLED	pwm_pad		PedestrianLED	PWM Output Pin_signal
RedLED	pin		RedLED	pin_signal
RedLED	pin_signal		RedLED	pin
TimerNumber	event_time_interval		TIMER_SYSTEM	sr_irq
YellowLED	pin		YellowLED	pin_signal
YellowLED	pin_signal		YellowLED	pin