KF6010 Mini Project

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1 Introduction

This mini project runs at the end of the first semester, and can be viewed as a formative exercise to get feedback ready for the final assessment at the end of the module.

> Do treat this as seriously as if it were an assignment. Because this isn't assessed, we can give you much more help and feedback than we can with the final assignment. We will review your solution with you individually in the first lab session of semester 2.
>
> *Take this opportunity to build up your knowledge and confidence.*

2 Scenario

You are tasked with writing a *robust* low power controller for a pedestrian crossing. The crossing has standard light sequences for the traffic and pedestrians. In addition to the light signals there is an audible crossing tone. The system should be event driven.

The crossing is subject to various legislation and standards set out by the Department for Transport. Behaviour of the traffic signals is principally covered in the "The Traffic Signs Regulations and General Directions" [UK , 2016]. The sequences and timings for use in pedestrian crossings are given in "The Design of Pedestrian Crossings" [DfT]. The specifications for the audible signal are in "Performance Specifications for Audible Equipment for use at Pedestrian Crossings"[HA]

2.1 Features

A pedestrian crossing has the following features:

- Traffic lights to control traffic on the road
- Pedestrian lights to control the flow of pedestrians across the road
- A push button for pedestrians to signal that they want to cross

The safety constraints are:

- Traffic and pedestrians should not be permitted in the crossing at the same time
- When a pedestrian signals that they want to cross, that request must be satisfied
- Timing constraints (see 3.2) and light sequences (see 3.1) must be followed.

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3 Requirements

3.1 Light sequences

The lights in the crossing follow prescribed sequences, which must be adhered to.

Traffic light The traffic lights have Red, Amber , and Green lights. These show in a fixed sequence [UK , 2016, Schedule 14, para 4.2];

use the blue led for the amber light

1. Red only
2. Red and Amber
3. Green
4. Amber
5. Red

Pedestrian lights The lights signalling to pedestrians consist of a Red and Green light. The sequence for these is

1. Red
2. Green
3. Red

3.2 Timings

The light sequences are subject to time constraints between transitions. The timings are summarised in table 1 taken from [DfT, Table 6, page 19]

Table 1: Timing sequence for crossing in seconds

Phase	pedestrians	vehicles	timings min	timings max	
1	Red	Green			
2	Red	Amber	3		*mandatory*
3	Red	Red	1	3	
4	Green	Red	4	9	with audible tone
5	Red	Red	1	5	
6	Red	Red and Amber	2		*mandatory*

Red and Amber The "Red and Amber" lights must show together for 2 seconds [UK , 2016, Schedule 14, para 4.3]

Amber The single "Amber" light must show for 3 seconds [UK , 2016, Schedule 14, para 4.4]

4 Audible signal

The green light indicating pedestrians may cross is accompanied by an audible signal. This has a frequency between 2kHz and 3.5kHz, pulsed at 240 pulses per minute, with a mark space ratio of 1.5:1 [HA, para 2.5]

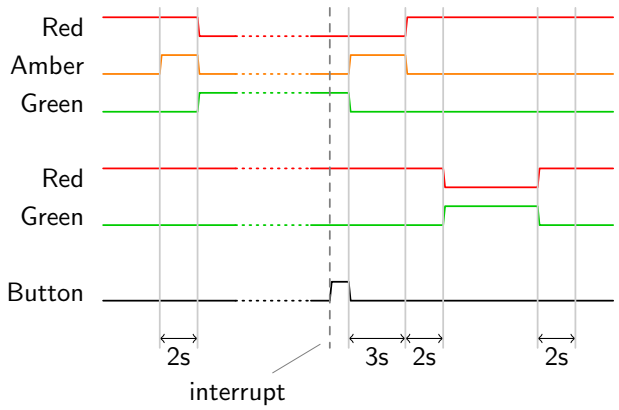

Figure 1: Timing diagram

5 Implementation

A suggested solution may include

- Threads to handle
  - Traffic signals
  - Pedestrian signals
- Interrupt handlers to respond to the button pushes.
- Mutexes for safety critical code
- Semaphores for internal signalling and messaging

My sample solution has *3 threads, 2 interrupt handlers, 1 mutex, and 2 semaphores*

6 Implementation notes

More detailed notes on implementation issues will be released as an appendix in the second week of the mini project.

References

DfT. *The Design of Pedestrian Crossings*. Department for Transport, lts 2/95 edition, April 1995. URL `https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/330214/ltn-2-95_pedestrian-crossings.pdf`.

HA. *Performance Specification for Audible Equipment for use at Pedestrian Crossings*. Highways Agency, Department for Transport, July 2005. URL `http://www.ukroads.org/webfiles/TR%202509%20A.pdf`.

The Traffic Signs Regulations and General Directions. UK Government, 2016. URL `http://www.legislation.gov.uk/uksi/2016/362/contents/made`.