Intersection Control System Specifications

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The traffic lights control system will control an intersection, which is depicted in figure 1.

States

The system must function as a state machine. Under normal daytime operation, there are the following five states:

- State 1 (default): cars travelling on the main road (road 1) can go straight and turn both ways.
- State 2: dedicated left turn signal for cars turning from the main road onto the secondary road (road 3).
- State 3: cars on secondary road can go straight or turn onto main road.
- State 4: only activated if a pedestrian wants to cross road 3. Like state 1, but pedestrian are able to cross on crosswalkP3
- State 5: only activated if a car is waiting at road 2. Allows traffic from roads 2 and 3 to cross the main road.

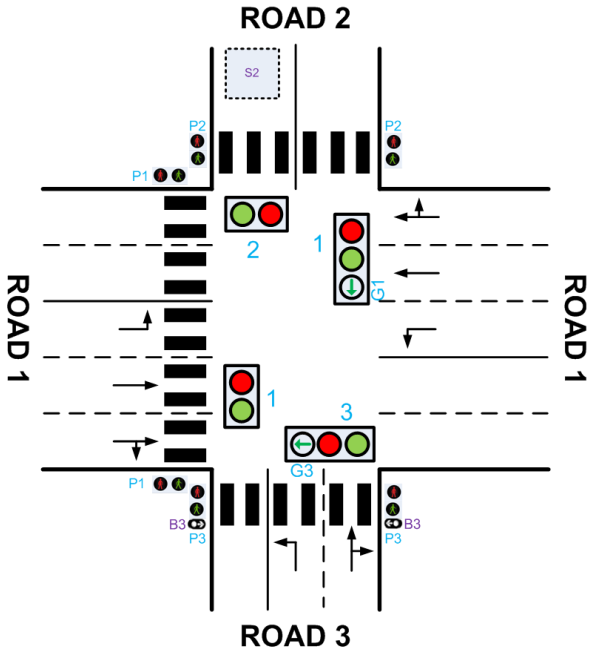

Figure 1: illustration of the intersection

Additionally:

- At night (10:00 pm - 6:00 am), the traffic lights directing the main road will blink green and those directing the other roads will blink red. All pedestrian control lights will turn off completely.
- In event of a hardware failure, the system will enter a special emergency mode that emulates night-time behaviour.

The above are rough state descriptions. The precise effects of each of these states on the various lights are tabulated in table 1 below:

State	**1**	**2**	**3**	**G1**	**G3**	**P1**	**P2**	**P3**	**Timer**
1	Green	Red	Red	Off	Off	Stop	Go	Stop	T1
2	Red	Red	Red	On	Off	Go	Stop	Stop	T2
3	Red	Red	Green	Off	On	Stop	Stop	Stop	T2
4	Green	Red	Red	Off	Off	Stop	Go	Go	T2
5	Red	Green	Green	Off	Off	Stop	Stop	Stop	T2
Emergency / Night	*Green	*Red	*Red	Off	Off	Off	Off	Off	

Table 1: state specifications (denotes a blinking light)*

State transitions

State transitions occur either when the associated timer runs out (for states associated with a timer) or when a certain condition occurs (for all others). The exceptions are the *malfunction* signal, which immediately transitions from any state to *emergency*, and the *reset* signal, which immediately transitions from any state to *state 1*. The system begins operation in the *emergency* state.
Roughly speaking, during the day, the system cycles between states 1 to 5, omitting 4 if the button B3 has not been pressed and omitting 5 if the sensor S2 does not register a car. During the night, the system remains in the night state until daytime. The exact state transitions are illustrated in the following diagram, except malfunction and reset transitions, which for simplicity are not shown.

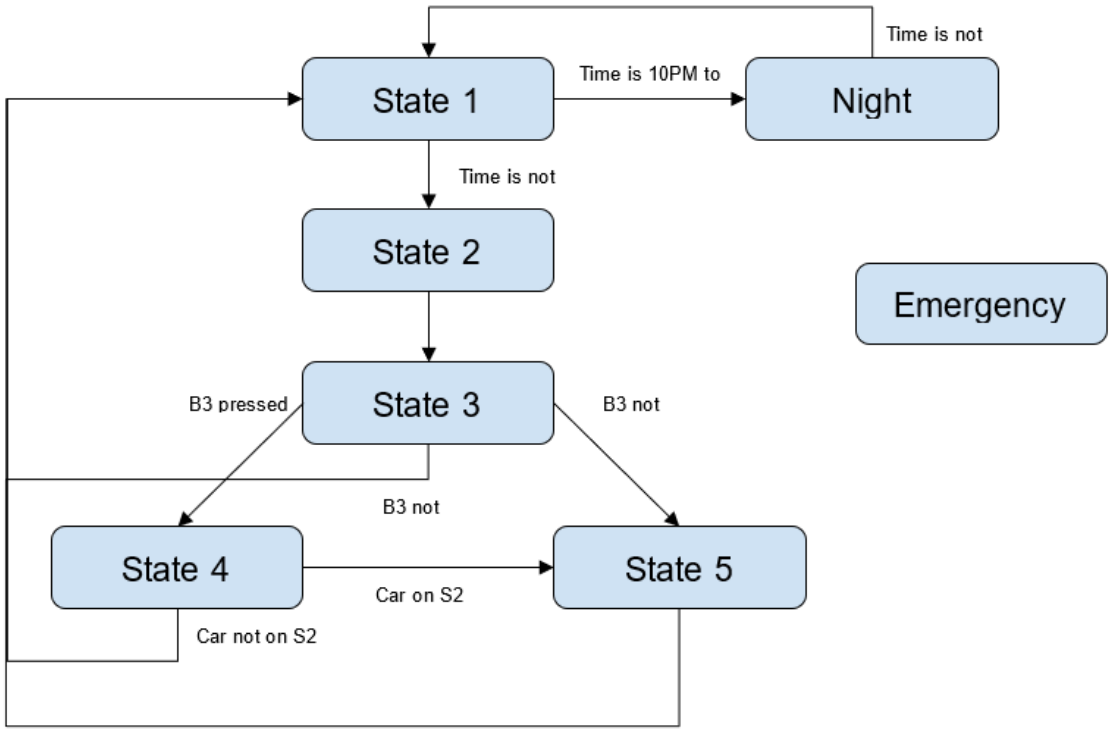

Figure 2: state transitions

Additional specifications:

- Road 1 is the main road and should be given priority (i.e. longer time green).
- The S2 sensor should respond to all vehicles including motorcycles.
- Additional sensors may be added to the system.
- The system must be correct and reliable. It should be void of software bugs.
- The software should ensure that each state correctly displays the corresponding lights.

Comments:

- Typically, left turn light flashes before the lights go green at an intersection. It would seem more typical if the state transitions in the order of 2, 1, 3 instead of 1, 2, 3.
- P1 for state 5 can be green. Cars will have to yield to pedestrians.