

Initially  
*Light0* = Red  
*Light1* = Green Counter = 20

Light *i*  
0 : *while*(*True*){  
1 :    *if*(*counter*  $\hat{=}$  0){  
2 :     *flip color of Light i*  
3 :     *Set Counter to 20*  
4 :    }  
5 :    *else*{  
6 :     *decrement counter*  
7 :    }  
8 : }

Check if light 0 has color green and light 1 has color green can ever occur in the synchronous composition of these systems

In your model assume that if there is a slog (stutter), both lights stutter together (By default, such a transition is assumed in TLA+)

EXTENDS *Integers*  
VARIABLES *pc0*, *pc1*, *l0*, *l1*, *counter*

0 denotes red and 1 denotes green for lights

variables for LIGHT 0 is *pc0*, *l1*, *counter* ; variables for LIGHT 1 is *pc1*, *l2*, *counter*

possible transitions

01  
12  
16  
23  
38  
68  
80

*Init0*  $\hat{=}$  (*pc0* = 0)  $\wedge$  (*l0* = 0)

*Init1*  $\hat{=}$  (*pc1* = 0)  $\wedge$  (*l1* = 1)

*Init*  $\hat{=}$  *Init0*  $\wedge$  *Init1*  $\wedge$  (*counter* = 20)

*L01*  $\hat{=}$

$\wedge$  *pc0* = 0

$\wedge$  *pc0'* = 1

$\wedge$  UNCHANGED  $\langle$ *l0*, *counter* $\rangle$

*L12*  $\hat{=}$

$\wedge$  *pc0* = 1

$\wedge$  *pc0'* = 2

$\wedge$  *counter* = 0

$\wedge \text{UNCHANGED } \langle l0, counter \rangle$

$L16 \triangleq$   
 $\wedge pc0 = 1$   
 $\wedge pc0' = 6$   
 $\wedge counter \neq 0$   
 $\wedge \text{UNCHANGED } \langle l0, counter \rangle$

$L23 \triangleq$   
 $\wedge pc0 = 2$   
 $\wedge pc0' = 3$   
 $\wedge l0' = 1 - l0$   
 $\wedge \text{UNCHANGED } \langle counter \rangle$

$L38 \triangleq$   
 $\wedge pc0 = 2$   
 $\wedge pc0' = 3$   
 $\wedge counter' = 20$   
 $\wedge \text{UNCHANGED } \langle l0 \rangle$

$L68 \triangleq$   
 $\wedge pc0 = 6$   
 $\wedge pc0' = 8$   
 $\wedge counter' = counter - 1$   
 $\wedge \text{UNCHANGED } \langle l0 \rangle$

$L80 \triangleq$   
 $\wedge pc0 = 8$   
 $\wedge pc0' = 0$   
 $\wedge \text{UNCHANGED } \langle l0, counter \rangle$

$Next0 \triangleq$   
 $\vee L01$   
 $\vee L12$   
 $\vee L16$   
 $\vee L23$   
 $\vee L38$   
 $\vee L68$   
 $\vee L80$

$M01 \triangleq$   
 $\wedge pc1 = 0$   
 $\wedge pc1' = 1$   
 $\wedge \text{UNCHANGED } \langle l1, counter \rangle$

$M12 \triangleq$   
 $\wedge pc1 = 1$

$$\begin{aligned}
&\wedge pc1' = 2 \\
&\wedge counter = 0 \\
&\wedge \text{UNCHANGED } \langle l1, counter \rangle
\end{aligned}$$

$$\begin{aligned}
M16 &\triangleq \\
&\wedge pc1 = 1 \\
&\wedge pc1' = 6 \\
&\wedge counter \neq 0 \\
&\wedge \text{UNCHANGED } \langle l1, counter \rangle
\end{aligned}$$

$$\begin{aligned}
M23 &\triangleq \\
&\wedge pc1 = 2 \\
&\wedge pc1' = 3 \\
&\wedge l1' = 1 - l1 \\
&\wedge \text{UNCHANGED } \langle counter \rangle
\end{aligned}$$

$$\begin{aligned}
M38 &\triangleq \\
&\wedge pc1 = 2 \\
&\wedge pc1' = 3 \\
&\wedge counter' = 20 \\
&\wedge \text{UNCHANGED } \langle l1 \rangle
\end{aligned}$$

$$\begin{aligned}
M68 &\triangleq \\
&\wedge pc1 = 6 \\
&\wedge pc1' = 8 \\
&\wedge counter' = counter - 1 \\
&\wedge \text{UNCHANGED } \langle l1 \rangle
\end{aligned}$$

$$\begin{aligned}
M80 &\triangleq \\
&\wedge pc1 = 8 \\
&\wedge pc1' = 0 \\
&\wedge \text{UNCHANGED } \langle l1, counter \rangle
\end{aligned}$$

$$\begin{aligned}
Next1 &\triangleq \\
&\vee M01 \\
&\vee M12 \\
&\vee M16 \\
&\vee M23 \\
&\vee M38 \\
&\vee M68 \\
&\vee M80
\end{aligned}$$

$$SLOG\_TOGETHER \triangleq \text{UNCHANGED } \langle pc0, pc1, l0, l1, counter \rangle$$

$$Next \triangleq (Next0 \wedge Next1) \vee SLOG\_TOGETHER$$

$$Both\_Not\_Green \triangleq \neg((l0 = 1) \wedge (l1 = 1))$$

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