Paul Beglin

Hardware Design

Project 4: Car key controller Finite State Machine

1. State diagram

Diagram

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1. Code explanation

The Finite States Machine has an idle state that we always return to; this is where the “logic” is done (except for the trunk case), the state is then changed to whatever we’re trying to do (door\_unlocking, lighton etc.) and the respective variables are changed within those states.

This project was similar to project 3, however the trunk was an added level of difficulty.

There are several options for the trunk:

1. BR is pressed and trunk is up (TRUNKD=0)
   1. Wait 5 seconds and pull down the trunk and lock it
   2. If the button is pressed less than 5 seconds nothing happens as we cannot lock the trunk while it is opened. Therefore we send it back to the idle state with the same values
2. BR is pressed and trunk is down (TRUNKD=1)
   1. Wait 5 seconds, unlock and push up the trunk
   2. If T<5 seconds
      1. If the trunk is locked (TRUNKLOCK=1), unlock it
      2. If the trunk is unlocked (TRUNKLOCK=0), lock it

We cannot deal with the time counter in the “idle” state, because we need to look for the “NONE” keypress to know the final amount of time the key was pressed, therefore, we deal with the “nothing happens” case within the door locking…

Since we cannot assess the time spent before going to the state “trunk\_locking” or “trunk\_unlocking”, we do a simple check by adding a new signal: “TRUNKLOCK”, and we go to the locking or unlocking states depending on that signal. Once in those states, we test the time spent and then take the respective actions according to the instructions.

Other than that, we use a logic vector for the key inputs so we have fewer variables.

(Side note: I changed the waiting time from seconds to ms to be more visible when taking the screenshot, otherwise the variable changes are just small red lines (since the Clock is 200MHz which is too quick)

As explained within the code, the sequence taken is as follows:

﻿We are on the morning of a trip to the airport, going towards the car.

We first turn on the lights so we can see better

We unlock the trunk (t<5) and then open it manually

After putting our suitcase in we press BR (t>5) to close the trunk automatically

We then open the doors to get in the car

We drive, once at the airport we

Open the trunk automatically (t>5) close the trunk manually

Close the doors and turn the light off.

Screenshots:

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Beginning of test bench sequence

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Seeing one value in particular, after the unlocking of the trunk (with manual movement of the trunk)

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