Model-based Software Design

Assignment Report

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Part1.Simulink project work-logic

Introduction

In the assignment we have to implement a level indicator. In order to achieve this system logic, I built the model according to the following structure.
In the overall structure model is include a "CONTROL" and a "PLANT".

Working Logic

The following is the working logic of the model.
Since this is an emulator, we will initially give the distance data to the plant by the knob distance from 2cm-400cm. When the model start to working the trig we setting inside the "CONTROL" will send a Trig-Signal to the PLANT. The trig-signal is crated by a stateflow. We use a "BLINKER" and set the high level time with 10us & the low level time is 60ms because of the Triggering pulses shall be distant at least 60ms to prevent echos. Such that we can get a continuous squeal trig signal.

Logic of plant

Then the PLANT get the trig signal and the PLANT start to produce the echo signal by the distance wo give from the knob . the Echo signal is also produce by the stateflow the logic is : At start block echo signal is 0 in a STAND_BY condition. When the stateflow check the trig signal is equal to 1 then the block is blink from 1 to 0 after a time "58*distance" us. Then the block go back to the STAND_BY condition, when the trig signal is continuous send the echo signal is continuous produce from the plant , next the Echo signal will be send to the controller to analysis and output as a level indicator.

Logic of controller

When the Echo signal is received by the controller. We will process the obtained signal. I set a two indicates "TIMER" & "COUNTER", "TIMER" is used to count 4 times of high level time of the echo signal , because we produce a continuous Echo signal (for accuracy we would taking 4 consecutive and computing the average).And the "COUNTER" is used to count the distance . Above all we setting the step size as "1.00E-6". Because in the staeflow the minimun time is "us".In the first block I set a "initiation" the " TIMER" &"COUNTER" are all equal to 0, then the logic between the second and the fourth block is: First we should let the "TIMER=TIMER+1"because the "TIMER" is used to count the measure time it must be 4 times. When the stateflow check the Echo=1, then the COUNTER=COUNTER+1, it means: In a signal pulse of the Echo signal, once the high level voltage is detected, the "COUNTER" will count follow the step time, every step time the counter will be superimposed by one. When the Echo=0 is detected , the counter will suspend, then the cycle will be run 4 time. So at last the counter output is "4*signal high level time".

Output logic inside controller

Now we have the date of 4 times signal high level time, we need to transform it into centimeter, and then we set 3 stateflow to distinguish what the data belongs to.If the date is belong to the first condition "distance>=10 & distance <100" this block will output "1" , if is belong to the second condition "distance >0&distance <10||distance >100" the block will output "1" ,the second condition means the model is closed . To implement the blinks with duty cycle depending on the measurement, I decided to produce a waveform corresponding to the measured value first, because I found that I couldn't identify the distance and implement the corresponding level output at the same time.

What I do is counter the high level time "A" and low level time "B" and let them be the time of a "BLINKER" then I get the level output corresponding the date I get. At last I just need to product this level with the first condition block. But at the beginning of the measurement, there will always be 0.5 seconds of noise. Because the output of the counter is trapezoidal, it will measure 4 times. This takes time, and during this period of time, it is impossible to distinguish and give an output. So I set a time delay for every stateflow of 3 conditions.

Part2. Google Test

To using the Google Test . First I do the the Simulink Test on the subsystem of "CONTROLLER" . In order to consider all the situations as much as possible, I have selected 6 different distance, and performed them in the Simulink Test separately. The distances which I choose are "echo_closed,5,10,50,100,200". Why I choose these distance because I should do the test in each region and test the limited boundary of the region. And I use the APP: "Coverage Analyzer" to the coverage report and the input and the out dates of the Simulink Test these data will be used in the Google test. In the Simulink Test after multiple tests, I finally got 100% coverage. Then I did my Google Test by the data I get .

In the Google test, due to computer limit and data issues, I finally chose 1 case, 2 cases and 3 cases for testing. I found that more data can achieve more coverage. Even so, I have 450,000 lines of waveform data. So I only used the test results of 3 cases here "echo_closed, 50cm ,200cm" .

In the file because the function I use is not generated by the model so the coverage is not so good .Is only 37.5%.

In the file "Controller_CalDistance0.c' I got the branch coverage 75.9%.
The first branch in row.141 I didn't covered is the branch of trig signal ,but the data I get from the Simulink test is not including the trig signal so the branch is not covered. Even I did all the 6 tests here.
The next is at row.199. Here I didn't cover the branch is because of the "TIMER" is not been used here , because in this test I give the input and output signal data , so the "TIMER" will not be used to count 4 times measurement. Also in this branch the test time is not useful here because I input the wave data so the "TIMER" will not be used in these condition.
The other rows are not been covered are because of only 3 tests here it is impossible to cover all the branches, So the coverage is not perfect.