

ECE 110 Final Report

[Car Navigation Designs]

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INTRODUCTION

The purpose of this project is that by creating circuit model of car that follows white bar on the table track, we know and understand the every parts of circuit, and we adjust basic theory, principles and components from text-notes to experiment. This final report is based on the experiments for last 3weeks, and I try to cover what we have done so far, especially by looking over every trial that we have done, I want to show the improvement and the final model circuit.

IMPLEMENTATION

We started form trial 1 from first week. For the first time, we were using MUX, and PWM module to make car work. The circuit diagram and sensor placement is page 7. Simply, every input starts from 8 sensors, and MUX gets every data from sensors and comparing that logic with comparator in PWM. And, sensor 4 and 8 are for stopping the car. The advantage of this MUX-PWM circuit is that the car goes straight fast, and if the car meets curve, as the number of sensors that show white, its speed is down and make it easier to turn exactly in order not to miss white bar on the track. So, when the car meets curve, one side of sensors has more white than black, so it results that the wheel of the same side is getting slower than the other side. And it makes turn. However, the problem we found is that it usually works in below 60 degrees, but if the degree is greater then it was getting slow and slow, and finally, it stopped.

Therefore, we attempted to achieve greater turning ability by relocating the sensor placement on trial 2. In fact, by making the inner sensors the lowest bit, we thought that

the car would work on corner better than trial 1. We got rid of two sensors from NAND gate, and all inputs are from MUX and the other components are same as trial 1.

But, the same problem exists as before. It didn't turn when it meet over 60 degrees. It was getting slow and finally it stooped.

After that we thought that the problem would depend on how many sensors got white bar when the car is making turn. We rearranged sensors regularly at the front. So we used only one bar and place sensors one by one except middle spaces. The circuit and placement of sensors are on the trial 3. But the circuit was same as before. But in this time, there was definitely improvement. The car has more precision on strait white bar, and more on zig-zag curve, and it even turned over 60 degrees. However, it didn't turn 90 degrees turn, when the car met the right front of 90 degrees point.

On trial 4, we used same circuit as trial 3, and also changed sensor placement. We used two sensor bars and 2 on the front, most out side and others are right next second bar inner side of front 2 sensors. Also we moved around the sensors with the highest bit toward the out side along with the lowest bit. But didn't change a lot. The car was faster when it was turning, but it was stopped again when it was turning in the middle of 90 degrees.

After we haven't gotten any big changes on turning, from the trial 5 on the next week, we started using the type of feedback system. The advantage of this model is that because even though the sensor miss white bar when it turns, the feedback loop still stores last bit pulse, so that the car keep making turning until the other side of sensor hits the white bar. So we used NOR SR latch in order for the car to work simply by connecting from the output of the NOR gate to the input of the other NOR gate. And the

sensors were placed as far as away to making it turn. As a result, it has a great improvement. It was following every path except 90 degrees sometimes. And the circuit was amazingly simple. But there exist some errors when it turn 90 degrees turn. When it turned, the both sensors could detect white bar. Then, the car should stop on the way turning. Because only one motor is running at a time, it doesn't look good when the car goes straight white line either.

So, since this model is almost perfect for all tracks, in order to clear this error that I mentioned, we needed to rearrange sensor replacements. So on trial 6, we added 4 more sensors and put them like diagram on trial 6. We thought more sensors will do good for making turn, but that was wrong. More sensors mean that more chances to get both side white. Consequently, it was stopped in this case, and the result was different how the car goes into the curve. And, the problem occurred when the car reacts to the white tape twice in rapid succession, causing the car to run off the track when the car's center isn't properly situated near the white tape. As a result, on trial 7, we took out 2 sensors out in order to lessen the chances that the sensors of car hit the white bar at the same time.

And finally, on the trial 8 in the last week, we came up the huge circuits in order for the car to work, because we need to correct the few errors and more efficiency on the strait line, rather than trying to continue on a circuit that relied on luck. Since the feed back loop works really good, we keep that model before, and SR latch requires that only one motor be on at a time. But the close spacing of the sensors makes the motors appear to go on at the same time when going strait and allows one motor to be on during a time. And the 2 sensors outside are for stopping the car. It gets signal and connected to AND gate directly, and throughout XOR gate and NOR gate, which is same function as inverter

since one input is ground '0', it makes the motors stop. Because the sensors get '1' both sides after XOR and NOR gates, it is changed to '0' signal. Also, if the track turns to the right, sensors 3, 4 go on and 1, 2 do off. Then SR latch is reset and the output will be '1' to the XOR of the right motor and '0' to the XOR of the left motor. And same thing happens on the left turns. This is what we will use in the contest. But because we haven't tested a lot with this circuit, we are considering either this circuit or the circuit that is using the sequential circuit by building from NOR gate and Current Amplifier on trial 5.

CONCLUSION

Our final circuit is using by the SR latch. In this mechanism, only one motor is on at a time, so that it loses efficiency on a strait line. However, since it shows really good turning at the corner work, we have decided to use this model even though there exist some probability that the errors occur on and off. The one is when the car make turn, there is possibility that both side sensors can have on. And the other is when the car reacts to the white tape twice in rapid succession, causing the car to run off the track.

Since we have built this circuit, personally it was good experience that I can adjust to the basic principle, component, and theory from class. Throughout the whole this kind of experiment, I could know more clearly how things are working especially about sequential circuit. But I regret that we did not try to use CAB module and not know how it works.