MODEL OF A CAR CROSSING A JUNCTION

Considering a car arriving at a junction as shown in figure 1, turning left and continues its movement, there are four major stages involved with different forces acting on the car.
STAGE 1: As the car is coming straight, approaching the junction, you need to apply break (deceleration), potentially coming to a halt:
Assuming we have a car with 4 tires
$F_1 and F_2$ are the forces on the two front and the two rear tires respectively.
$F_f and F_r$ are the frictional forces on the front and rear tires respectively which act against the driving force of the car
h is the distance from the tire to the centre of the car (equidistance to the 4 tires position, ie the centre of gravity)
L is the distance between the two tires (front and back)
w = weight of the car
m = mass

Therefore $\sum F_x = ma = F_f + F_r$......(1) (forces in X-direction)
$m = w/g, a = g/4; therefore ma = w/g * g/4 = w/4$

$\sum F_y = 0 (because along y axis the normal force = W) = F1 + F2w = 0$ ....(2) (forces in Y-direction)

Therefore $F1 + F2 = w; F2 = w - F1$

$h(F_f + F_r)LF_1 + LF_2 = 0$

$w * h/4 + L(F_1F_2) = 0$

$w * h/4 + L(w - F_1)F_1) = 0$.......(3)

STAGE 2: The car start accelerating into the junction: At this stage what we need are the acceleration and frictional force.
The car moves when drive force ¿ friction force

$F = m * a$ ....(4)
The force on the tire = $m * g/4$

Radius of the tire = R, therefore drive force = $F * a * R$

Radius of the axil shaft =r, therefore drive force = $F * a * r$

Coefficient of static friction =μ(0.33 for cars)

The maximum force needed = $Fmax = 2(mg/4 * \mu)$

$= 1/2(mg * \mu)$ .... (5)

STAGE 3: The car make a turn in the junction (curve) keeping the speed; at this stage the centripetal force will be acting on the vehicle tire $\sum F = x/ma$; and $\sum F = y/ma$, depending on the direction of the turning force (x or y direction)

Centripetal force $\sum F_c = mv2/r$ .... (6)

Force of friction $F_f = mv2/r$

The normal formal =$\mu Fn = mv2/r$

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Therefore Fn = Fg

Fn = mg

We have $\mu mg = mv2/r$

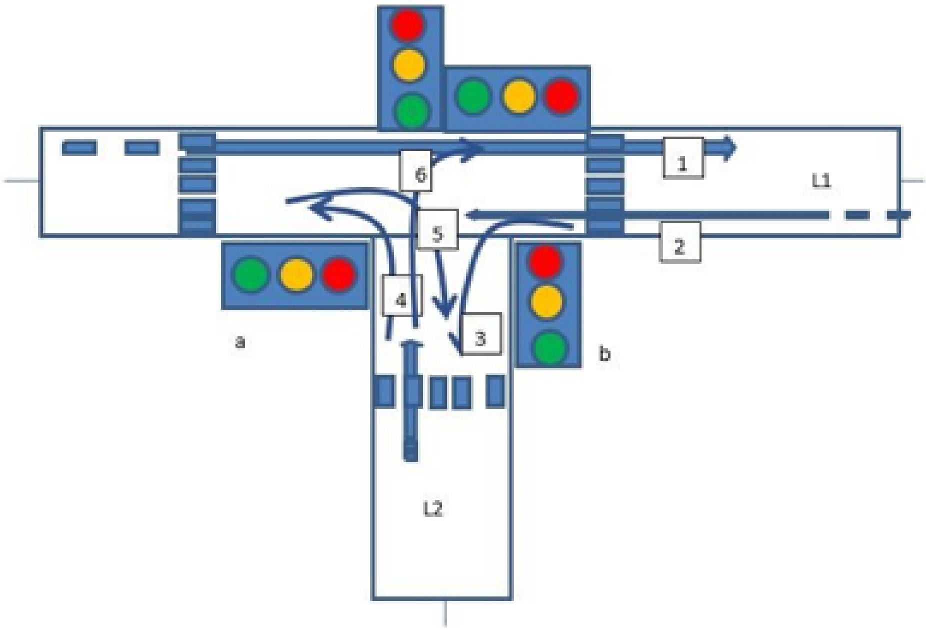
Hence $\mu g = v2/r$

Then $\sqrt{r.g} = v$............................ (7)

Therefore $V_max = r * \mu g$ .... (8)

STAGE 4: The car leaving the junction straight acceleration to increase speed to the acceptable max speed
Here the forces acting on the car are the drag force and the air resistant
The front area of the car A = width of the car multiply by its height from the front view
There the force acting on the car at top speed =
$F = Cd * A * 1/2P * V2$ ....(9)
Where Cd = drag coefficient
A= front area of the car (width * height)
P = air density
V = speed

Figure 1: Three way traffic road intersection



Direction of my thinking

1. Develop function for each stage and then integrate it to the main program?