Impact Evaluation of Cyber-attacks on Traffic Flow of Connected and Automated Vehicles

Connected and Automated vehicles report their current speed and location details to nearby vehicles with the help of their on board sensors and road side sensors to improve travelling efficiency and to avoid accidents but this advance technologies always comes with challenges such as deployment cost or cyber-attacks. Attackers can launch attacks on vehicles on board sensors to report fake information such as vehicle speed and location to nearby vehicles and based on reported information near vehicles may take action which can cause accidents or traffic jam at road side.

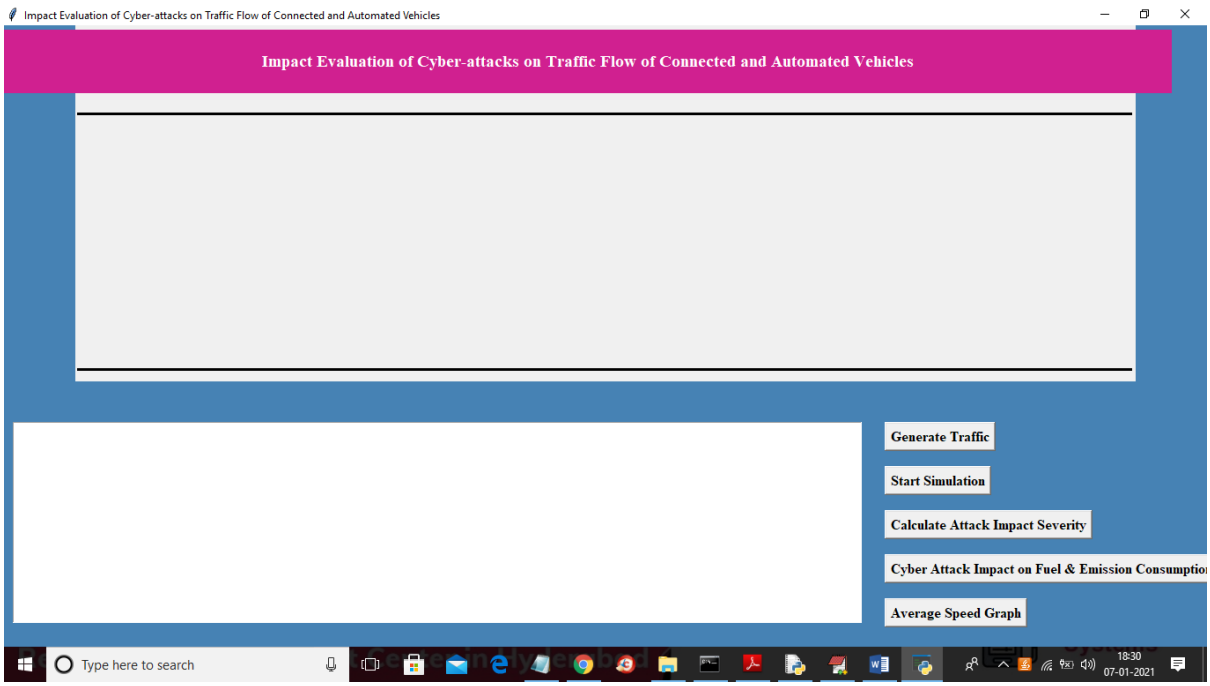
In this paper author is evaluating impact of traffic flow, fuel consumption and emission with the help of simulation and through simulation author has confirm that fake information generated by cyber-attacks sensors can cause accidents and increase fuel consumption and emission. Attackers may report less speed to nearby vehicles and nearby vehicles will also down their vehicles which can cause vehicle to reach destination in more time, consume more fuel and emission.

In simulation author is calculating speed, location with various times and then injecting attackers with less speed and then calculated fuel consumption and emission. To calculate traffic flow we have used SPEED, ACCELARATION and POSITION of the vehicles. When attacker slow down vehicle speed then then the regions or range between attack vehicle and rear vehicle may narrow and then this narrow region will be indicate as INSTABLE region and if both vehicle maintain sufficient range then it will indicate as STABLE region.

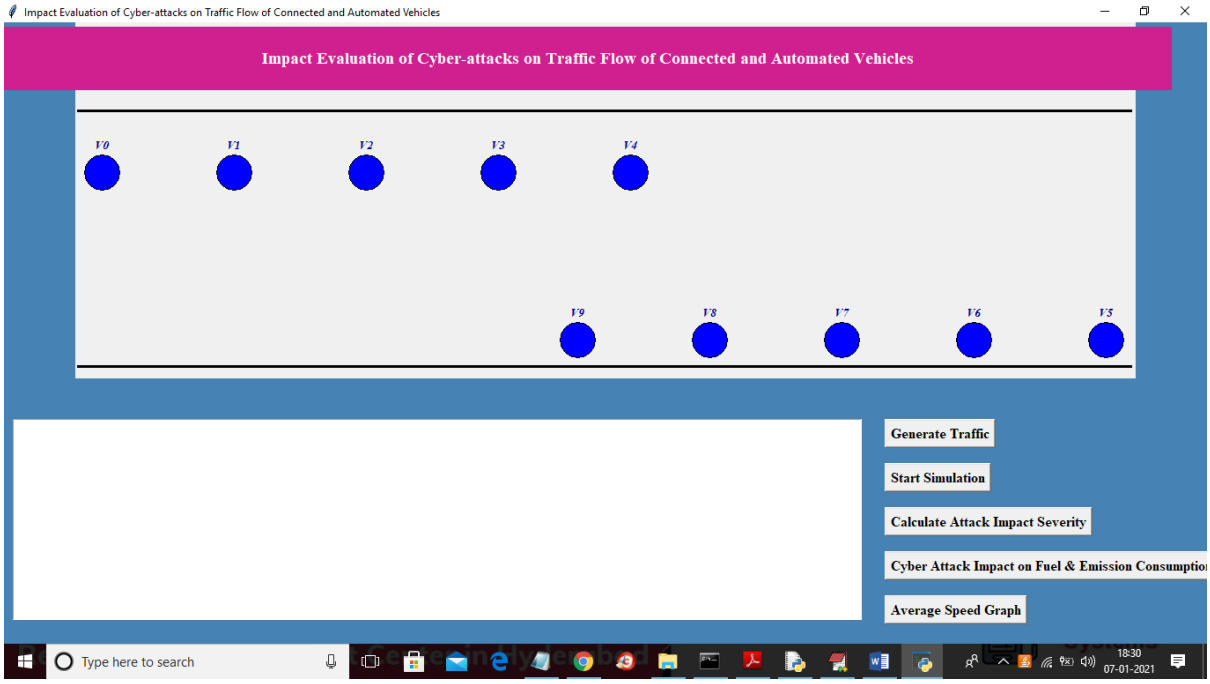
In this project author has done simulation with one side vehicles and in extension work we have added simulation with both side's vehicles and so in our output we are simulating with two sided vehicles.

SCREEN SHOTS

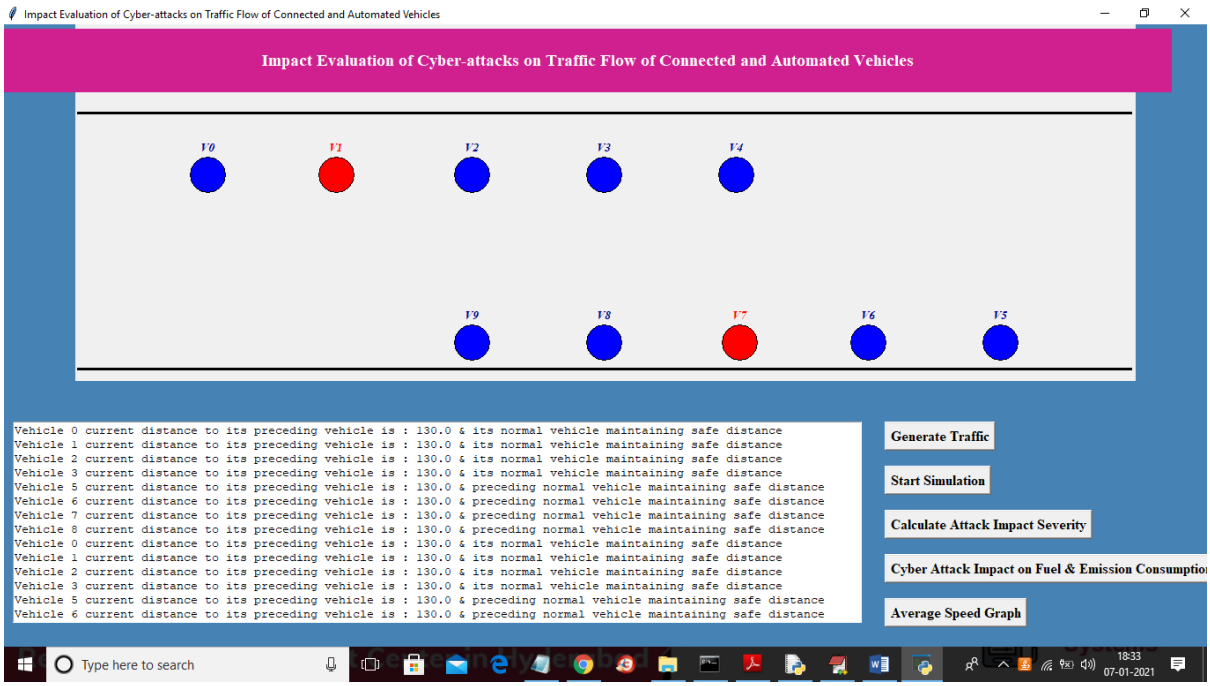
To run project double click on 'run.bat' file to get below screen

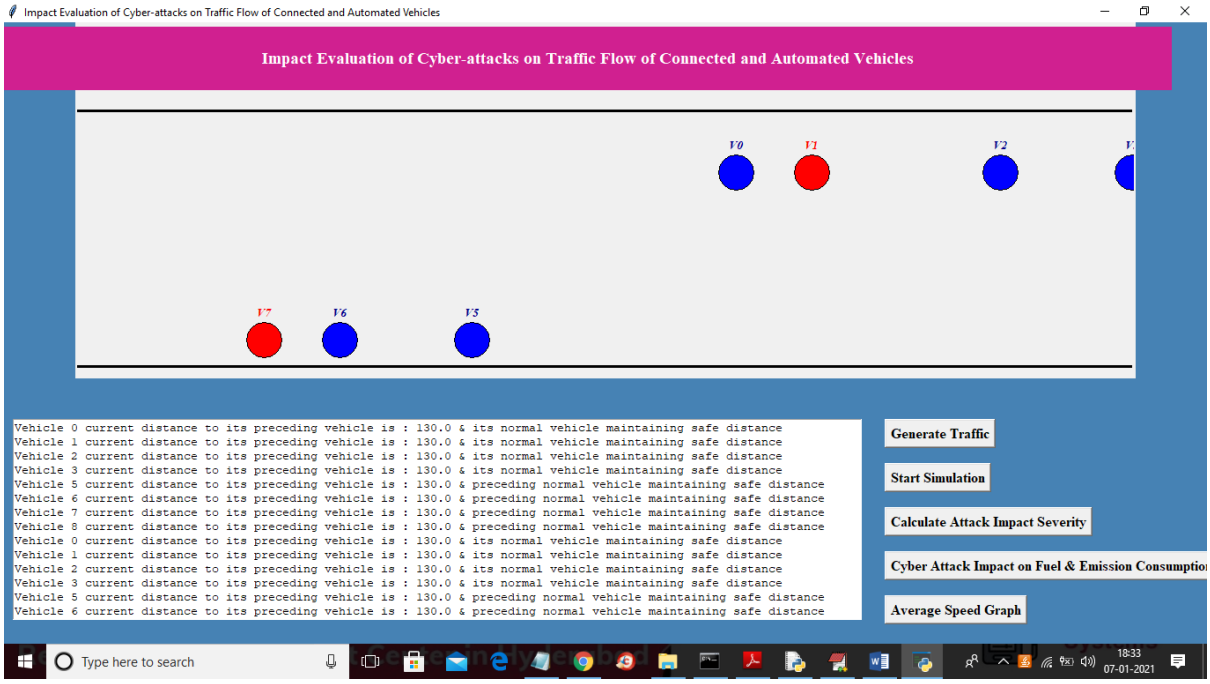


In above screen click on 'Generate Traffic' button to get below screen

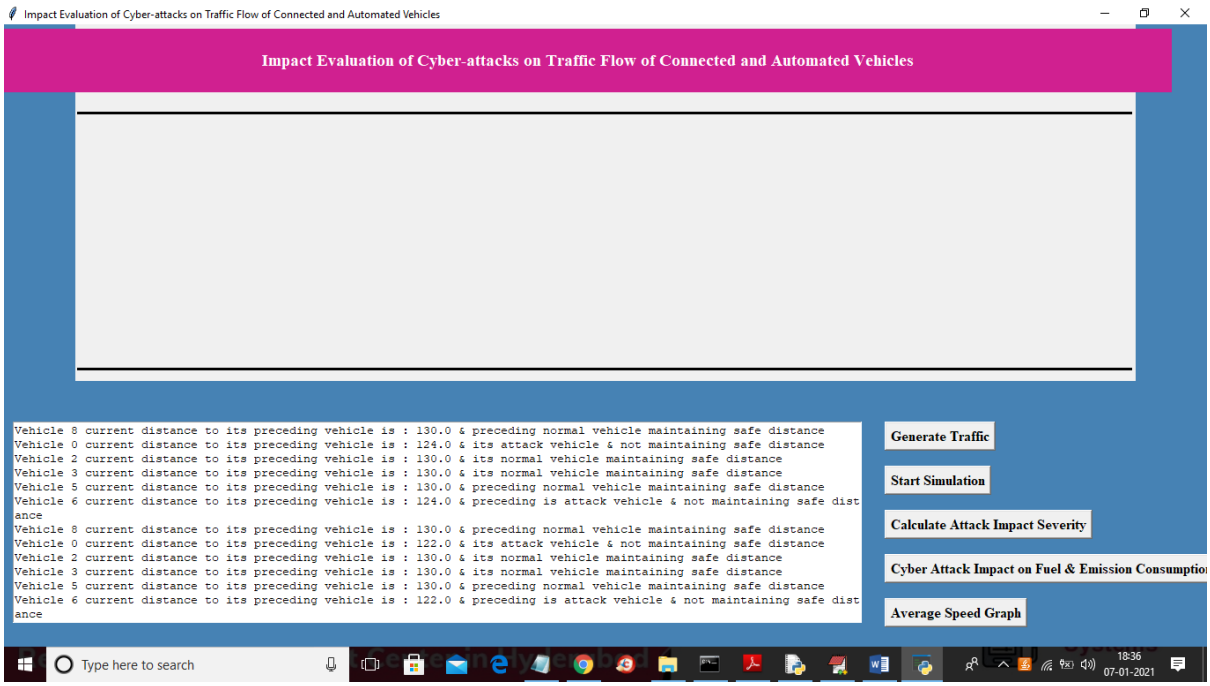


In above screen we have created traffic with 10 vehicles and each circle will represents one vehicle and now click on 'Start Simulation' button to move vehicles and then intentionally we are injecting some attackers which report fake speed information to nearby vehicles and when two vehicles enter into instable region then vehicle colour will change to red colour and while simulation we can see two vehicles comes to close location due to fake speed

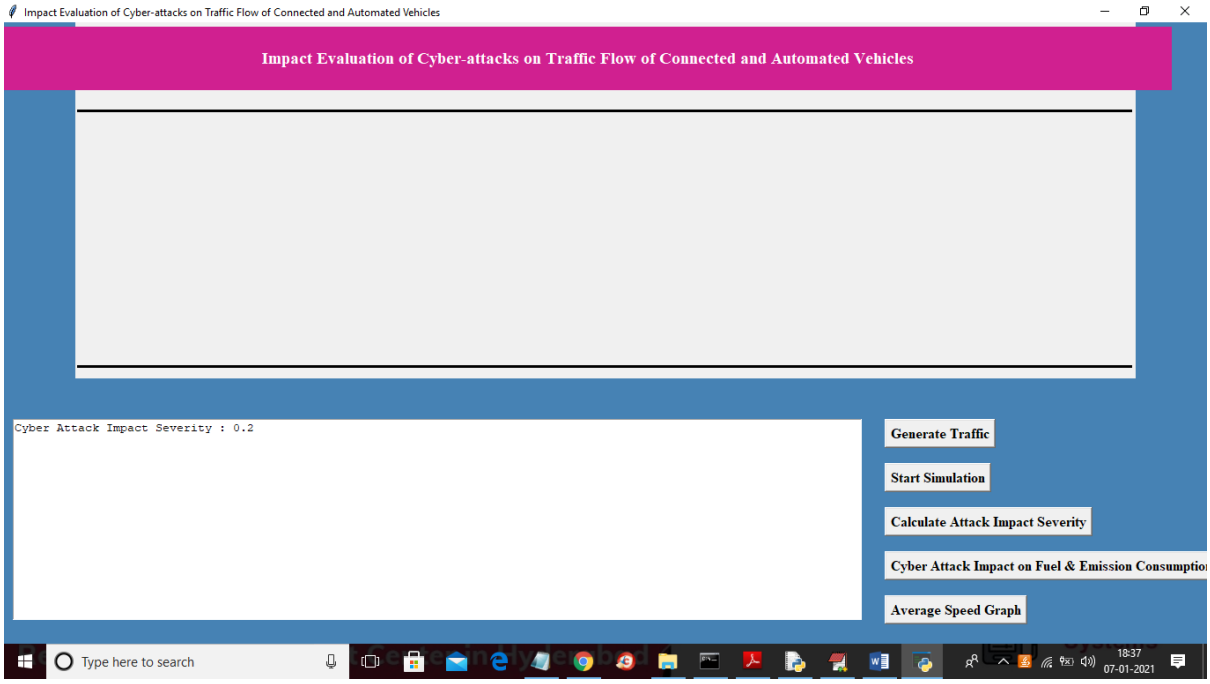




In above screen we can see vehicles start moving in both directions and when vehicle comes too close then it will enter into instable region and red colour preceding vehicle becomes attacker as it report fake speed due to which rear vehicles come too to attack vehicles. In text area also we are displaying distance between current vehicle and its preceding vehicles and also displaying status and once after simulation complete then will get below screen

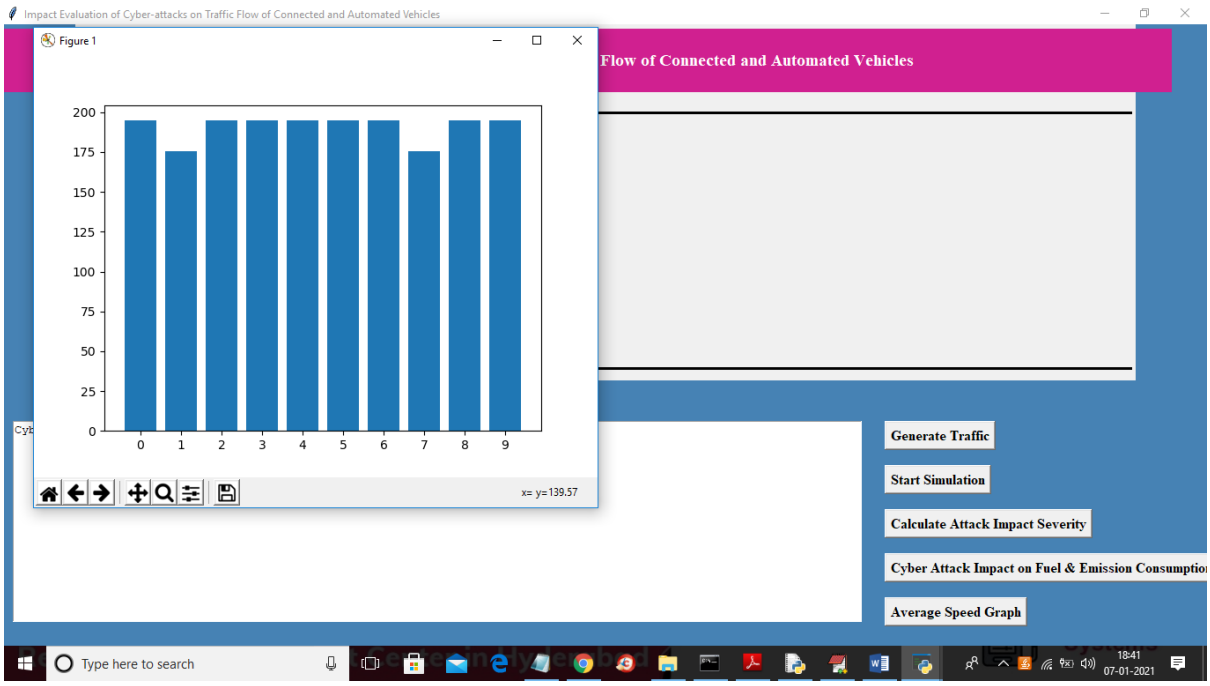


Now click on ‘Calculate Attack Impact Severity’ button to calculate attack severity for this simulation



In above screen attack severity percentage is 0.2% and now click on 'Cyber Attack Impact on Fuel & Emission Consumption Graph' to get fuel and emission consumption between normal and attack vehicles

In above graph x-axis represents number of vehicles and y-axis represents emission or fuel consumption and the vehicle under attack is consuming more fuel and more emission as normal vehicles move in given speed so it's fuel is same for example in above graph vehicle 2, 3, 4, 5, 6, 8 and 9 is consuming less fuel and other are the attack vehicles which consume more fuel. Now click on 'Average Speed Graph' button to get speed graph of all vehicles



In above graph x-axis represents vehicle numbers and y-axis represents speed and then vehicle with less speed consider as attacker as they report fake information and slow down their vehicles which can cause accident to rear vehicles and normal vehicles move with average given speed.

So from above experiment we can conclude that impact of cyber-attack on automated vehicles may consume more fuel, emission and cause accidents