THE CHALLENGE OF DEPENDABLE SYSTEMS – CSC 8201
ASSESSMENT 2022-23
SAFETY ANALYSIS TECHNIQUES

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1. Given that the car in autonomous driving mode comes with a vulnerable road user (VRU) as the top event, it records the causal events related to the top event and the logical relations between them, using logic symbols to represent the relations.

   There are multiple ways an autonomous car comes with a vulnerable road user (VRU) here, using the OR gate, Let's assume bad weather conditions as a basic event and Software system failure, Road users, Road conditions, Hardware system failure, Passenger and vehicle interaction platform and Manual driving are the possible ways

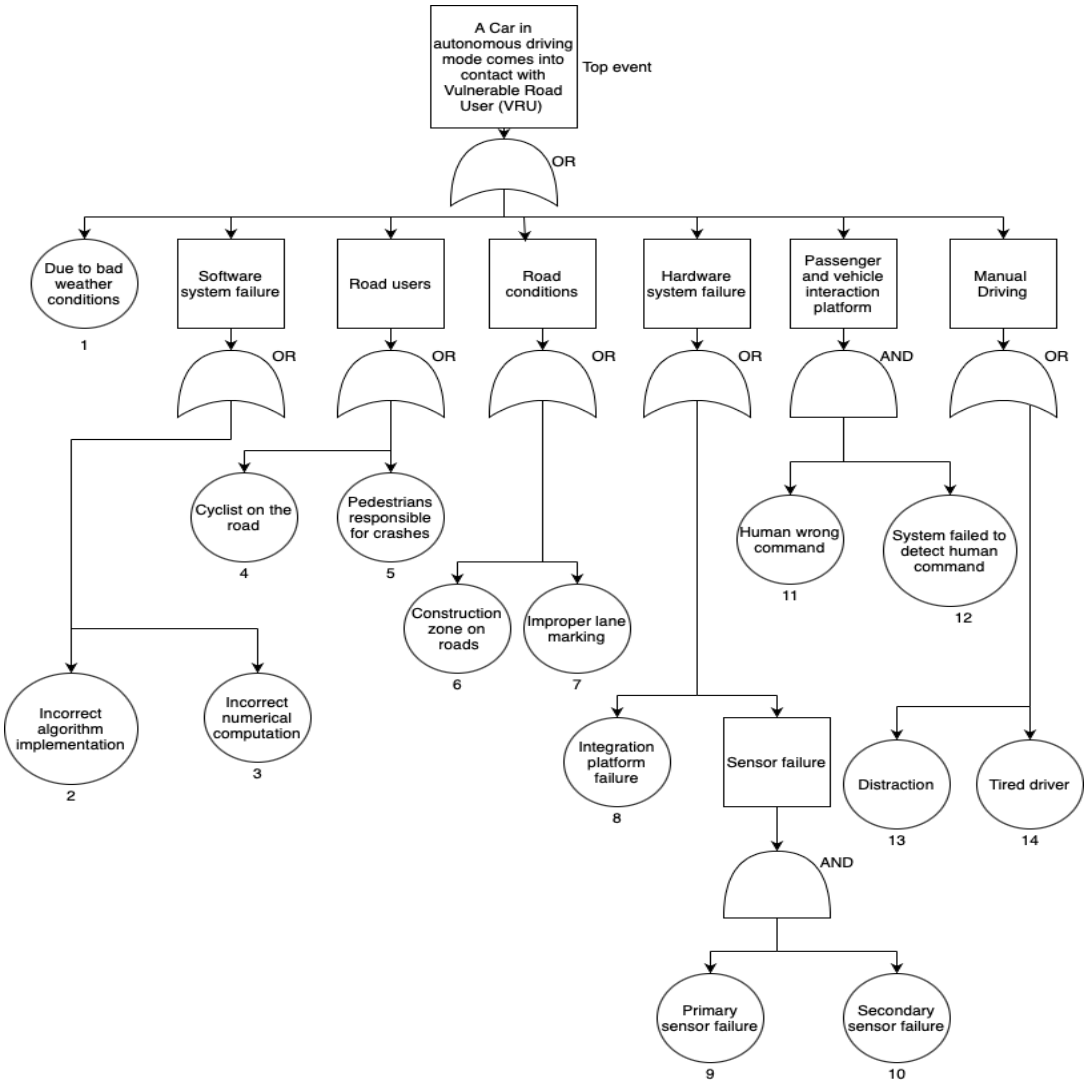

Figure 1

The minimal cut set for the above figure 1 is
C1 = {1}
C2 = {2, 3}
C3 = {4,5}
C4 = {6,7}
C5 = {8, 9, 10}
C6 = {9, 10}
C7 = {11, 12}
C8 = {13, 14}

2. In the given question the loss of a pedestrian's smartwatch can be considered an initial event for event tree analysis

   Event tree analysis for the loss of a pedestrian's smartwatch with the existing steps or barriers that can reduce the risks associated with the outcomes.

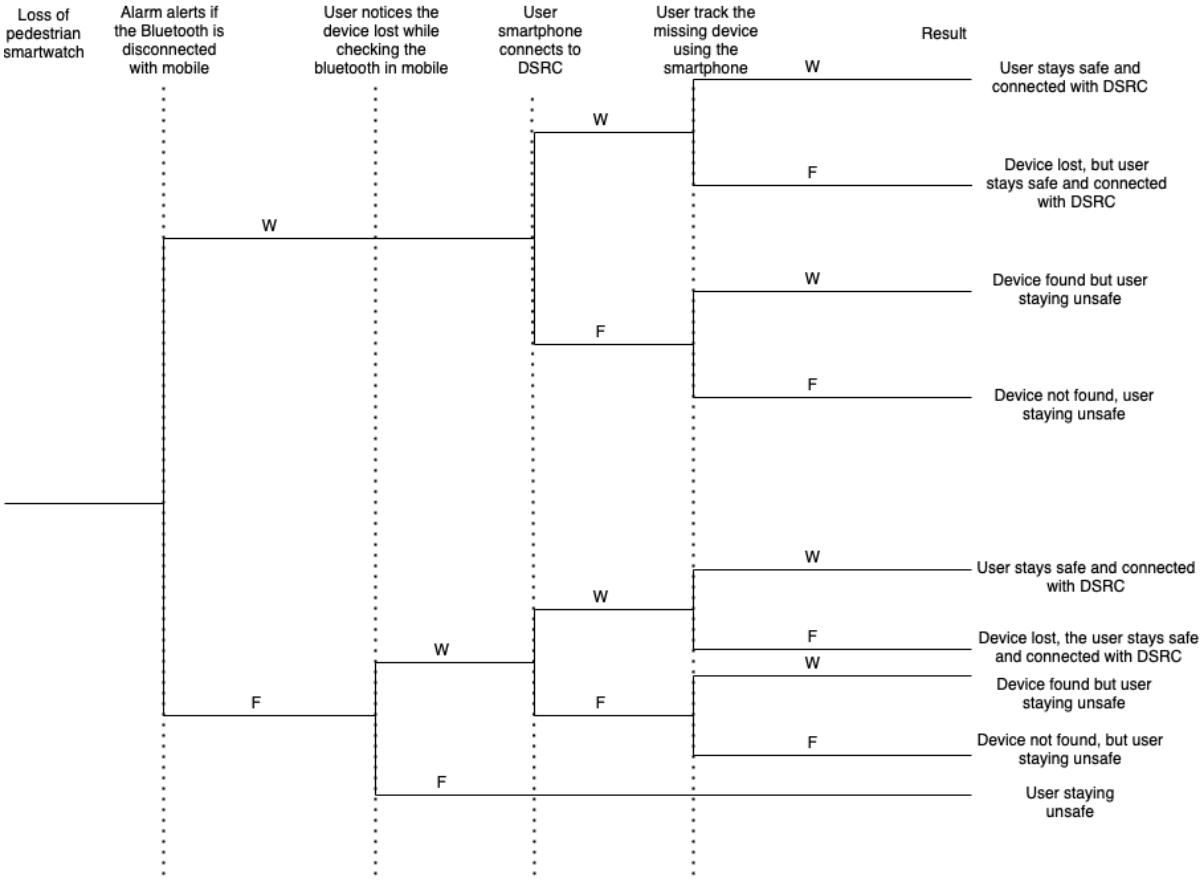

Figure 2

Additional steps or barriers to reduce the risk:

Pedestrians should always connect to DSRC with any two of the smart devices if one goes wrong or missed another can be used as a secondary device it can be either

mobile or any other smart devices to connect with DSRC so that AD can detect the pedestrians, The above figure 2 shows that a pedestrian has two devices smartwatch and a mobile phone which are connected to each other with Bluetooth, after the loss of a pedestrian's smartwatch, the smartphone triggers the alarm once the Bluetooth got disconnected from the smartwatch, and then the pedestrian knows the device was missing so that pedestrian will get connected with DSRC (Dedicated Short Range Communication) using the mobile phone so that the pedestrian stays safe and the pedestrian can track their smartwatch using the mobile application as it is used for the communication gateway for the smart devices, then as per the above event tree process, the pedestrian can find the missing device and then make the connection with DSRC.

3. As per the SHARD technique, the guidewords are to inspire some incorrect behaviours when the bicycle speed sensor is used

   The bicycle speed sensor can be used with any spin bicycle using a compatible mounting option

   The speed sensor is designed to mount on the hub of a bicycle wheel, It measures the rotational speed of the bicycle with the wheel and multipliers it by the wheel size to determine the speed.

   i) Late: The sensor produces the value or message at a later time but not on time so that the bicycle rider doesn't know the actual speed of the bicycle on time whenever he drives fast it can cause some road accidents. It happens only if the battery was low and LED was not working properly, it can be resolved by charging the battery and changing the LED display.

   ii) Omission: The bicycle sensor doesn't produce the expected value or message if the rider rides the bicycle, it can happen only if data can fail to transmit properly, this can be resolved by resetting the sensor or by checking the battery connection.

   iii) Coarse: The bicycle sensor detects the incorrect rotational speed and produces the wrong output to the rider riding the bicycle, if the sensor was producing the improper value then it can also cause road accidents, it happens only if the signal strength degrades as distance increases, so always place the sensor in the right place, so that it produces the correct output.

   iv) Subtle: The bicycle sensor was not working and failed to produce the output to the rider, It can happen only if the battery of the bicycle was dead, the sensor failed and LED was not functioning, by replacing the battery, sensor and LEB we can resolve this issue.