appearing signs; If a red sign (X) shows up, they will need to slow down as fast as possible without leaving the center lane and if a green sign (arrow) shows up, they will need to steer the car to the indicated lane as fast as possible without getting any slower. Total time for completing each driving task is about 4.5 minutes and a total of 10 trials for each subject.

Fig. 2. Sign (X) appears on the screen indicated for braking

Fig. 3. Sign (arrow) appears on the screen indicated for lane changing

C. Data Validation

Data validation is commonly performed when developing EEG database to discover whether the acquired data from nominally different tasks are statistically different. There are various methods available for data validation, however, simple and coherent methods of validating data are considered desirable. In this research works, two EEG database (AD database and FD database) were developed using 10 normal subjects with each subject database comprises of 20 EEG signals (2 driving tasks x 10 trials) and validated using Karolinska Sleepiness Scale (KSS). The following hypotheses were formulated.

- Null hypothesis (H_0): The observed data does not have any significant difference between the driving tasks.
- Research hypothesis (H_r): The observed data has a significant difference between the driving tasks.
- Null hypothesis (H_0): The alertness level is lower in the AD compared with the FD.
- Research hypothesis (H_r): The alertness level is abbreviated in the FD.

Karolinska Sleepiness Scale (KSS) is a subjective nine-point scale; ranging from extremely alert (1-point), very alert (2-point), alert (3-point), rather alert (4-point), neither alert nor sleepy (5-point), some sign of sleepiness (6-point), sleepy but no effort to keep awake (7-point), sleepy and some effort to keep awake (8-point), and very sleepy with great effort to keep awake (9-point). The scale was rated after each driving task is completed with the time taken for each completion of driving task is approximately 4.5 minutes. Data validation using KSS rating involves four steps:

- Determine the KSS_{alert} scale for alert (summation of value from KSS-1 to KSS-5; 15-value).
- Determine the $KSS_{fatigue}$ scale for fatigue (summation of value from KSS-6 to KSS-9; 30-value).
- Calculate the alert index using

$$I_{alert} = KSS_i / KSS_{alert+fatigue} \quad (1)$$

with KSS_i is the rating scale at a number of trials, *i*, and KSS_{alert} is the summation of KSS_{alert} scale.

- Calculate the fatigue index using

$$I_{fatigue} = KSS_i / KSS_{alert+fatigue} \quad (2)$$

with KSS_i is the rating scale at a number of trials, *i*, and $KSS_{fatigue}$ is the summation of $KSS_{fatigue}$ scale.

If I_{alert} is less than or equal to $I_{fatigue}$, then reject the H_0.
If I_{alert} is greater than $I_{fatigue}$, then do not reject the H_0.

TABLE I. MEAN KSS RATING RESULTS FOR AD AND FD TASKS

Subject (S)	Alert Index (I_{alert})	Fatigue Index ($I_{fatigue}$)
S1	**0.06**	**0.15**
S2	0.10	0.14
S3	0.09	0.13
S4	0.09	0.12
S5	**0.06**	0.07
S6	0.08	0.07
S7	**0.06**	0.13
S8	0.10	0.14
S9	0.12	0.13
S10	**0.06**	0.09

From Table I, it is observed that subjects S1, S5, S7, and S10 have a minimum I_{alert} value of 0.06, while only subject S1 has the maximum $I_{fatigue}$ value of 0.15. This strongly supports hypothesis H_r and these values (minimum I_{alert} and maximum $I_{fatigue}$) lead to indication against H_0 and in support of H_r. As the I_{alert} value is less than or equal to $I_{fatigue}$, H_0 is rejected. The rejected H_0 concludes that the data has a significant difference between the driving tasks (AD and FD).