Abstract

Intelligent Speed Adaptation (ISA) is a system which informs, warns and discourages the driver to exceed the statutory local speed limit. The in-vehicle speed limit is set automatically as a function of speed limit indicated on the road. GPS allied to digital speed limit maps allows ISA technology to continuously update the vehicle speed limit to the road speed limit. The main purpose of this study is to investigate the effect of Intelligent Speed Adaptation (ISA) to University Teknologi MARA (UiTM)’s bus drivers. This study is focusing on speed profile and the effect on driver’s psychology before and after the intervention of ISA technology. To achieve this objective, one experiment was conducted on GPS-ISA instrument involving about 10 respondents from various backgrounds. The instruments used in order to collect data are GPS-ISA device and a set of questionnaire. The data obtained from GPS-ISA device is speed profile. Speed profile is used to indicate the speeding and speed variation. On the other hand, the data obtained from the questionnaire are frustration level, attention level and ISA acceptance level. These data are used to evaluate driver’s psychology on ISA. The expected result is the UiTM’s bus drivers are tended to reduce the speed during implementation of ISA, and they felt comfortable with the device. It is important to reduce speed, especially in a campus zone like UiTM to avoid an accident from occur because there is high density of vehicles on the road as well as the pedestrians.

Keywords: Speed Limit; Speed management; Road Safety; Intelligent Speed Adaptation
However, Speed humps effect is limited to certain time and certain location. They may be able to reduce speed at specific spot, but inappropriate for a larger scale implementation. In order to overcome these limitations and deficiencies utilization of technology such as Intelligent Speed Adaptation (ISA) is indeed another possible intervention to decrease the speeding problem among road users due to its “anytime, anywhere” characteristic as long as the driver does not turn the system off.

Intelligent Speed Adaptation is a system which informs, warns and discourages the driver to exceed the statutory local speed limit. The in-vehicle speed limit is set automatically as a function of the speed limits indicated on the road. Global Positioning System (GPS) allied to digital speed limit maps allows Intelligent Speed Adaptation technology to continuously update the vehicle speed limit to the road speed limit. This technology has been implemented in some countries in United Kingdom. In the other word, ISA is a generic name for any system that provides support to driver on vehicle speed control. This system varies from advisory type that produce only audio and/or visual warning to the driver up to mandatory type, where it intervenes to the system of a vehicle.

Not only ISA is time and location independent, GPS oriented ISA requires no additional infrastructure to be developed along the road network. This reduces financial implications relating to the installation and maintenance that is always an issue of traditional speed control signage and measure. Unlike other engineering measures such as speed humps which effect all road users even if they are travelling at appropriate design speed, ISA intrudes only when the driver exceed the statutory local speed limit. Thus, ISA only punishes those who are law-non-abiding users [3].

Many other countries are considering about implementing ISA by conducting studies to understand its effectiveness to solve speeding problem. Advisory ISA is predicted to be able to produces a 10% reduction in injury accidents and an 18% reduction in fatal accidents based on simulation study conducted in United Kingdom [3].

It is important to conduct this study on the effect of ISA in order to reduce speeding problem among Malaysian road users especially in campus zone because there is highly density of vehicles on the road as well as the pedestrians. As we all known, speed kills. Speeding problem is the highest cause of death among Malaysian road users. Hopefully, the output from this study will increase the awareness among Malaysian road users on how important to reduce speed and care about their life and others people surrounding.

2. Objective

Based on related researches, speeding is a problem which contributes to dangerous situation [4-5]. One of the solutions for the speeding problems is to implement Intelligent Speed Adaptation (ISA) in Malaysia. However, the effect of ISA remained unknown. The main purpose of this study is to investigate the effect of Intelligent Speed Adaptation (ISA) to UiTM’s bus drivers. This study was focused on the effects of followings:

i. Speed profile
ii. Driver’s psychology:
   - Stress level
   - Attention level
   - ISA acceptance level

In order to achieve these objectives, an experimental approach has been set up on ISA based GPS instrument involving 10 respondents from various demographic backgrounds.

3. Research Methodology

The main purpose of this research is to investigate the effect of Intelligent Speed Adaptation (ISA) to UiTM bus drivers. To achieve this objective, one experiment was conducted on GPS-ISA instrument involving about 10 respondents (UiTM bus drivers) from various backgrounds.

This research utilizes both quantitative and qualitative research methodology. The instruments used in order to collect data are GPS-ISA device and a set of questionnaire. The quantitative data for this research is come from the experiment itself which is obtained using GPS-ISA device. Meanwhile, the qualitative data for the research come from the questionnaire.

The data obtained from GPS-ISA device is speed profile. Speed profile is used to indicate the speeding and speed variation. On the other hand, the data obtained from the questionnaire are stress level, attention level and ISA acceptance
level. These data is used to evaluate driver’s psychology on ISA.

This research involves two period of data collection which is before intervention of ISA during intervention of ISA. A unit of GPS device will be installed in the bus to perform as a voluntary-informative type of ISA.

10 respondents with various backgrounds were given consent and undergo these periods of data collection on a predefined route consisted of numerous speed limit: 25km/h, 35km/h, 60km/h and 70km/h. After exposing the respondents, the expected output variables or dependent, as listed below will be measure using appropriate instruments.

Demographic details that will be acquired are:

1. Age
2. Driving experience

Independent variables involves in this study are as followed:

1. Demographic details
2. ISA system (voluntary-informative type)

Dependent variables that will be collected as the output of this study are listed below:

1. Speed profile (from GPS device)
2. Driver psychology (from questionnaire)
   a. Stress level
   b. Acceptance level of ISA system

4. Result and Discussion

All the data and results obtained from the experiment were recorded and tabulated in tables and visualized in graph form which all the result arranged consecutively section by section as below. These results were obtained from 10 respondents who involves in the experiment of ISA using GPS device.

Other than that, a survey was carried out by giving each respondent a set of questionnaires to answer. To analyse data, we divided into two main sections which are the results from GPS and the results from questionnaire.

The data obtained from GPS-ISA device is speed profile. Speed profile is used to indicate the speeding and speed variation. On the other hand, the data obtained from the questionnaire are frustration level, attention level and ISA acceptance level. These data is used to evaluate driver’s psychology on ISA.

We had summarized the results obtained from ISA-based GPS device which is speed profile and visualized them into graphs:

4.1 Speed Profile

![Graph of averages speed for all respondents before and after intervention of ISA](image-url)
Figure 1 shows a graph of averages speed for all respondents before and after intervention of ISA. As we can see from the graph, before intervention of ISA, the highest average speed was obtained from respondent 8 which are 35.6 km/h. Meanwhile, the lowest average speed was obtained from respondent 9 which are 30.8 km/h. The average speed before intervention of ISA was in range of 30 km/h to 36 km/h. After intervention of ISA, the highest average speed was obtained from respondent 6 which are 35 km/h. Meanwhile, the lowest average speed after intervention of ISA was obtained from respondent 8 which are 29.3 km/h. The average speed after intervention of ISA was in range of 29 km/h to 35 km/h. All respondents show the reduction in average speed except for respondent 6 and 9.

In addition, according to National Speed Limits (Malaysia) general speed limit for school, college and university area is 35 km/h. By comparing the averages speed limit for all respondents with the general speed limit, only one respondent had exceeded this speed limit. The rest of respondents are below the speed limit of 35 km/h.

The graph in figure 2 shows the average of averages speed for all 10 respondents before and after intervention of ISA. As we can see from the graph, the overall average speed before intervention of ISA was 33 km/h. After intervention of ISA the average speed had reduce to 31.5 km/h. The differences between the average speed before and after the intervention of ISA was 1.6 km/h. This result represents the average of averages speed for all respondents. From the result obtained, we can conclude that after intervention of ISA the drivers tend to reduce the speed of the bus.

Table 1. Reduction in speed for all respondents after intervention of ISA.

<table>
<thead>
<tr>
<th>Respondent</th>
<th>Reduction in Speed (Km/h)</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>2.0</td>
</tr>
<tr>
<td>2</td>
<td>4.0</td>
</tr>
<tr>
<td>3</td>
<td>2.1</td>
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<td>4</td>
<td>1.3</td>
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<td>7</td>
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<td>8</td>
<td>2.0</td>
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<tr>
<td>9</td>
<td>4.0</td>
</tr>
<tr>
<td>10</td>
<td>2.1</td>
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</tbody>
</table>

Table 1 shows the reduction in speed for all respondents after intervention of ISA. As we can see from the table, the highest reduction was 6.8 km/h which is come from respondent 8. For respondent 6 and respondent 9, there is no reduction because the speed was increased after intervention of ISA. For respondent 6, the speed was increased about 1.8 km/h. Meanwhile, for respondent 9, the speed was increased about 1.9 km/h. However, from the result obtained, most of respondents tend to reduce the speed while driving with ISA.
4.1 Driver Psychology (Questionnaire)

1. Stress level
   Q: Do you feel any stress while using this ISA system?

   ![Fig. 3. Stress level of respondent](image)

   Pie chart in figure 3 indicated stress level of the respondents. From the data obtained, 80% of the pie chart which is represents 8 respondents did not felt any stress while driving with ISA. Meanwhile, 20% of the chart which is represents 2 respondents was affected by stress while driving with ISA because they felt ISA had restricted their speeding behaviour.

2. Acceptance level of ISA system
   Q: In overall, do you feel comfortable with this ISA system?

   ![Fig. 4. Comfortable level of respondents](image)

   Figure 4 shows the comfortable level of respondents after they drove with ISA system. As we can see from the pie chart, most of respondents which are 80% felt comfortable with ISA system. Meanwhile, 20% of respondents felt not comfortable with ISA system. They felt not comfortable because of distraction and stress occur while they driving with ISA. It is important to investigate the effect of ISA on drivers’ psychology because human factor engineering or ergonomics must be taking into consideration in designing something especially for speed limiter device such as ISA.

5. Conclusion

This study investigated the effect of Intelligent Speed Adaptation (ISA) to UiTM’s bus drivers. Primary data which is speed profile were obtained from ISA-based GPS device. Secondary data were collected by distributing questionnaires to 10 respondents who involve in the experiment of ISA. As mentioned earlier in the introduction, the objective of this study was to investigate the effect of Intelligent Speed Adaptation (ISA) to UiTM’s bus drivers. This study was focused on the effects from speed profile and driver’s psychology aspects. The following conclusions can be drawn based on the findings of the study:

a) Speed Profile:
   This study has shown that most of the respondents are concerned about speed limit while they were driving in UiTM area. This statement is supported with the speed profile data obtained by using ISA-based GPS device. The overall average speed before intervention of ISA was 33 km/h. After intervention of ISA the average speed had reduce to 31.5
km/h. The differences between the average speed before and after the intervention of ISA was 1.6 km/h. From the result obtained, we can conclude that after intervention of ISA the drivers tend to reduce the speed of the bus.

b) Divers’ Psychology:
Most of respondent not felt any stress and distraction while driving with ISA. In overall, most of respondents felt comfortable with ISA system. It is important to investigate the effect of ISA on drivers’ psychology because human factor engineering or ergonomics must be taking into consideration in designing something especially for speed limiter device such as ISA. All respondents agreed that ISA system should be implemented in Malaysia as a solution in order to reduce accident rate. They also satisfied with ISA device and appreciate the effort to reduce accident rate in Malaysia.

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References