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Understanding on Train Driver Behaviors using On-Train Data Recorder (OTDR)

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Abstract: The rail transportation has been an important role in providing alternative transport to connect to work, families and social activities. In Malaysia, the largest rail company is Keretapi Tanah Melayu (KTMB) that provides plenty type of services which are ETS, KTM Intercity, KTM Komuter etc. This study focuses on the train driver behaviours using On-Train Data Recorder (OTDR). At first, OTDR are used for train fault and management only but based on the previous research, it also stated that it may have the application on monitoring the train driver activities. Train driver's behaviour is the actions of a train driver to ensure safety in driving the train. Too many actions will lead to human error that will affect the safety and efficiency of the train services. The objectives of this study are to pre-process the raw data and to understand the train driver behaviours. This study focuses on the analysis of the train driver behaviour using OTDR given by ETS KTMB services (Coach 105). The method used was by using the MATLAB software to present the data into the understandable form. Overall, this study can be concluded that train driver behaviours correlated with their actions.

Keywords: Train Driver Behaviors, OTDR, Electric Train Service (ETS)

1. Introduction

Malaysia has been introduced about the rail transport since the late 19th century. The aim of having the rail transportation since the past decades is to speed up transportation of the tin mining areas to ports along the coast. Now, rail transport is one of the country's most important transport mode. As in many other modes of passenger transport, rail safety relies on one person's actions and vigilance to safely transport the passengers [1]. In train management applications such as train safety control and driving operation regularisation, train driver operation monitoring is becoming increasingly important [2]. In railway transportation, train drivers are responsible in transporting both passengers and freight to its desire location. Train driver behaviour is the set of actions that performed to ensure the safety of people and compliance to the driving regulations. Thus, the train driver behaviours are the actions that need to be performed in their daily working routine.

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Recently, in train management applications such as train safety control and driving regularisation, train driver operation monitoring is increasingly important [2]. It is believed that railway automation technology would gradually shorten the headway between consecutive trains and increase the amount of rolling stock on a given infrastructure [3]. However, there is also another modern train system which is on-train data recorder (OTDR). OTMR is used to gather information about how trains are driven and the condition of various train systems during the journey [4].

1.1 Problem Statement

In any rail company, the most important element in safety policy is the fitting of train data recorders. The basic form of train data recorders is capable of monitoring and recording all the operational functions on board the train. In Malaysia, the train data recorders have been used for data transmission purposes in every rail company. At first, OTDR are used for train fault and management only but based on the previous research, it stated that as the train drivers log each input in the cab there also may have application on monitoring the train driver activities which more accurately called as task loads. Train driver's behaviour is the actions by the train driver to ensure safety in driving the train. Too many actions will lead to human error that will affect the safety and efficiency of the train services.

1.2 Train Driver's Action

The role of train driving is mainly a visual-spatial task requiring continuous observation and information processing, and most physical acts of train drivers are driven by information obtained. For instance, responded to a change in the speedometer by moving the traction handle [5]. the most important duties for train drivers are to steer the train and manage the panel (controlling all buttons and switches, including controlling the speed, tracking speed and air-pressure meters, controlling the emergency brake, configuring the driver direction and opening and closing the doors [6].

2. Materials and Methods

2.1 Methods

Firstly, this study is about the understanding on train driver behaviors using OTDR. OTDR given by KTMB was in huge excel files and in binary code. Therefore, the OTDR data should be shown into an understandable form such a bar chart or histogram to achieve objectives of this study.

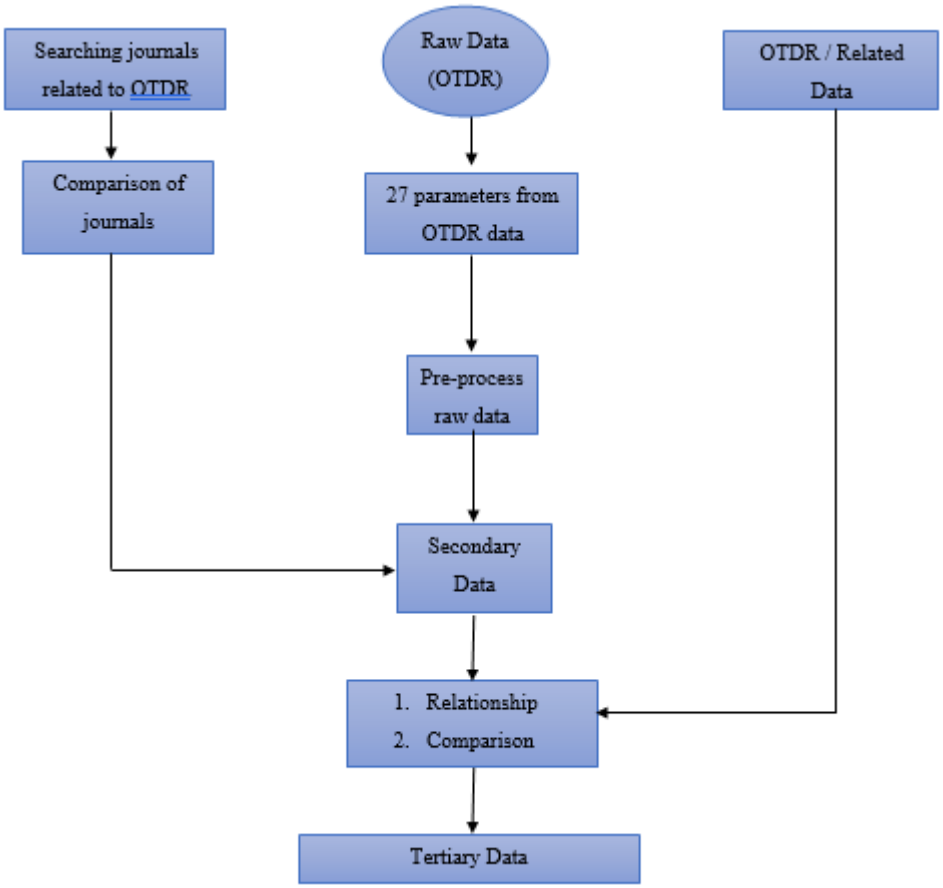

Figure 1: Methodology chart of this study

Data pre-processing is a data mining approach that entails converting raw data into a format that can be understood. Real-world data is frequently inadequate, inconsistent, and/or lacking in specific behaviours or trends, as well as including numerous inaccuracies. Pre-processing data is a tried-and-true means of resolving such problems.

Secondary data is information that has previously been gathered from primary sources and made available to researchers for use in their own studies. It is a type of information that has previously been gathered. Books, personal sources, journals, newspapers, websites, and articles are examples of secondary data sources. Secondary data for this study also describes as a moderately done data to make a framework for the train journey analysis.

Tertiary data in this study is the raw data can be converted into the understandable form. It will show the action of the train drivers when running the train. From the tertiary data, this study will give more understanding about the train driver behaviours towards the train.

3. Results and Discussion

3.1 Analysis of Secondary Data

The secondary data will provide the framework of train journey analysis for this study. This analysis will describe the four main phases repeated throughout the journey.

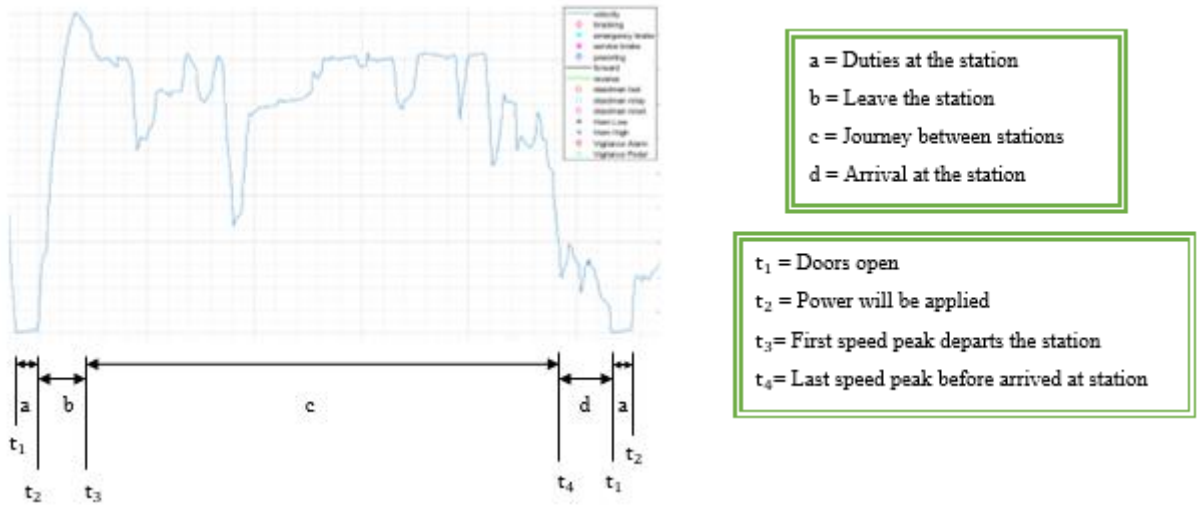

Figure 2: Train journey analysis framework

Station duties are defined as the time between the doors opening at the stop station (t_1) and the power being applied to leave the station (t_2). Depart station defined as the time between the application of power (t_2) and the first speed peak obtained when leaving the station (t_3) is designated as depart station. Journey between station is the period between the initial speed peak on leaving the station (t_3) and the application of the brakes on approaching the next station (t_4). Arrival station is the time between the commencement of the brake application (t_4) and the station doors opening (t_1) is denoted as arrival at station.

3.2 Results for Tertiary Data

The result for tertiary data will shows histogram describing the number of actions in each 5 minutes of the train journey. The result only focused on few actions done by the train drivers which lead to their behaviour patterns. In other word, their behaviours are based on their actions. From the results, the behaviour patterns can be seen clearly.

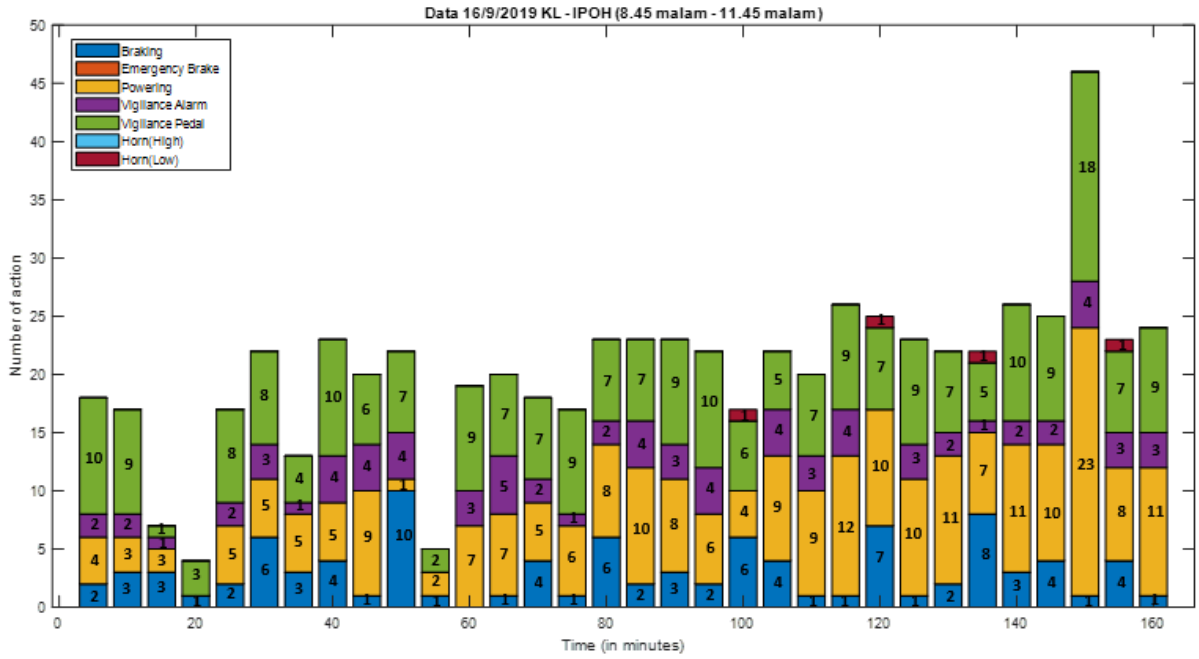

Figure 3: Histogram 1

It can be concluded that each 5 minutes of journey experienced the acknowledging of vigilance alarm and need to toggle the vigilance pedal to avoid the emergency brake automatically being applied. Besides, another action that influenced the train driver behaviours is powering being applied in each 5 minutes of journey. Powering functioned as to increase the speed of the train by getting enough electrical energy to run the train.

4. Conclusion

In conclusion, this study has achieved its objective which is to pre-process the raw data and to understand the train driver behaviours. The raw data given by KTMB is in binary code and huge excel files can be presented into a histogram that much easier to understand. It can be concluded that the train driver behaviours and habits are due to their actions. Thus, the train driver behaviours are the actions that need to be performed in their daily working routine. The behaviours of train drivers are in applying braking to make a stop at its desired locations, applying powering to supply more electrical energy to increase the speed of the train, acknowledge of vigilance alarm to avoid emergency brake automatically being applied etc.

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References

[1] A. J. Filtness and A. Naweed, "Causes, consequences and countermeasures to driver fatigue in the rail industry: The train driver perspective," *Appl. Ergon.*, vol. 60, pp. 12–21, 2017,

[2] M. Xu, H. Fang, P. Lv, L. Cui, S. Zhang, and B. Zhou, "D-STC: Deep learning with spatio-temporal constraints for train drivers detection from videos," *Pattern Recognit. Lett.*, vol. 119, pp. 222–228, 2019,

[3] N. Brandenburger and A. Naumann, "On Track: A Series of Research about the Effects of Increasing Railway Automation on the Train Driver," *IFAC-PapersOnLine*, vol. 52, no. 19, pp. 288–293, 2019,

[4] E. L. Rashidy *et al.*, "University of Huddersfield Repository DRIVER COMPETENCE PERFORMANCE INDICATORS," 2016.

[5] N. Balfe, K. Crowley, B. Smith, and L. Longo, "Estimation of train driver workload: Extracting taskload measures from on-train-data-recorders," *Commun. Comput. Inf. Sci.*, vol. 726, no. December 2019, pp. 106–119, 2017,

[6] I. Zoer, J. K. Sluiter, and M. H. W. Frings-Dresen, "Psychological work characteristics, psychological workload and associated psychological and cognitive requirements of train drivers," *Ergonomics*, vol. 57, no. 10, pp. 1473–1487, 2014