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Drivers Drowsiness Detection with Speed Limiter Integrated Fatigue Anlyzer (SLIFA) on Fuel Tank Truck

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Abstract: Traffic accident is becoming the most serious problem in Indonesia as it happens every day and every time. It was proved by increasing fatalities from 321,301 to 85,596 accident cases. It means that there are 10 road fatalities per day. There are several factors that cause traffic accident, such as external 34%, attitude 24%, fatigue 20%, over speed 17% and technical vehicle 5%. Other factors might be caused by rapid growth of vehicles and industries which increase significantly. The average annual vehicle growth from 1996 to 2006 is 20% , which might take a higher possibility in increasing road fatalities. The method is to pair SLIFA on the fuel tank truck engine to control the driver's physical condition through the heartbeat of the driver with a sensor that has been placed directly in front of the driver and when the driver drowsiness speed will decrease up to 30 km /h. The result of this research is the decrease of accident ignored by sleepy driver from shift of incident data during January-Juny 2016 period there are 51 cases of Shift of incident that is in morning 20%, afternoon 33%, night 25%, daylight 22%, then after the SLIFA pair decreased the case shift of incident to 39 cases, consisting of 13% morning, 59% afternoon, night 23% and daylight 5%, a total decrease in incident shift by 76% in July 2016-January 2017 so SLIFA to be very effective at attach to the fuel tank truck in reducing the drivers drowsiness. What needs to be done in future research is how to get SLIFA integrated with image processing.

Keywords: fuel tank truck engine, sensor, heartbeat, SLIFA.

1. Introduction

The traffic accident in Indonesia based on the report of Indonesia Police Department close to 31.234 fatalities cause by traffic accident. The average annual vehicle growth from 1996 to 2006 of 20%, the data is shown in Table 1.

Table 1. Number of Vehicle growth in Indonesia [1]

Year	Total registered vehicle	Annual growth of total vehicle (%)
1996	14530095	4
1997	16821076	16
1998	17644885	5
1999	18224149	3
2000	18975344	4
2001	21201272	12
2002	24671330	16
2003	32774929	33
2004	41986814	23
2005	47654826	13
2006	50102492	5

This vehicle growth in Table 1 will also increase the percentage of traffic accident. Working hours have been largely responsible for problems in physical health, work performance, safety and accidents. This is well presented by many researchers. Specifically, working long hours have been identified as having an association with fatigue [1]. By observed and research releated, the main reason people becoming fatigued is due to insufficient rests [2]. Other than that the authors noted that fatigue can be caused by other reasons, such as too much, or too little stimulation at work, not enough chance to rest and having insufficient time to recover from fatigue. Lack of sleep as a result of long working hours is also thought to contribute to fatigue. Road accidents that involved commercial trucks and buses are of growing concern in Malaysia. It was reported that the majority of truck and bus accidents involved in a long journey truck and bus service.

The investigations conducted by MIROS found that, all cases were occurred during and after travelling at the few hours. The main cause of commercial bus accidents reported in Malaysia is primarily due to the driver's fault. In Malaysia, most commercial drivers particularly those who involved in long distance travels are required to drive around the clock. Truck and bus drivers work based on rotating shift which affect their sleep patterns causing fatigue. Fatigue and falling asleep while driving have

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been identified as one of the major causes of road accidents. Furthermore, MIROS found that, there are two prominent times of the day when most of the truck and bus accidents occurred (as presented in Figure.1) [3]. This finding was claimed to mirror with other studies conducted.

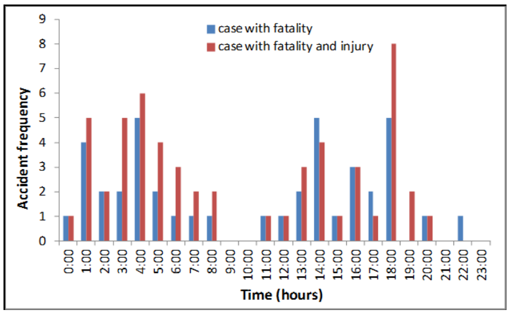

Fig. 1 Distribution of bus accidents in Malaysia investigated by MIROS from 2007 to 2008 [3].

Studied a relationship between career stages, time spent on roads and driver work-related attitudes. This research used career stage and time spent driving on the road as independent variables and truck driver attitudes as dependent variables. The findings showed that, the career stage and time spent on the roads significantly affected the driver behaviour. This can be proven from a research study on taxi driver behaviour, which spent greater time driving than an average driver [4]. The findings from this research can be very useful to relate between bus driver time spent on driving and their ability to work with greater driving performance. Recent study conducted. Found a pattern of an increased propensity of collision involvement with the increased of driving hours. This study was conducted on bus accident involvement histories in Florida. In the journal paper, indicated that a bus driver who is involved in a collision would have driven more than 45 hours in seven days prior to the collision.

In particular, pointed the research out that bus drivers who have driven for more than 50 hours per week have 95% chances of being involved in a collision [5]. Automotive is developing a system called driver alert control, which can alert driver drowsiness before he or she dosez of at the wheel [6,13]. Similar systems can also be found in other vehicles, such as the Driver Monitoring System in Toyota [7, 14] and the Attention Assist System in the Mercedes-Benz [8]. To decimate accident rate that causes the driver fatigue factor, there has been increasing interest in the development Fatigue Warning System (FWSs) over the last two decades [9,10].

To improve the safety system, we propose a system by integrating the speed limiter and the fatigue analyser [11-13]. The system will detect the limit speed from the vehicle and also the fatigue from driver and the control system had succeeded in limiting the engine speed according to the pre-set vehicle speed limits and heart rate detection [13-16].

2. Methodology

To achieve the purpose of this research, we to use a methodology in Figure 2, and the methodology consists of the steps how we develop the system. This figure shows the analytical method and step to determine the lock speed until max. 70 km/h and decrease speed when driver detection fatigue condition max.30 km/h and the equation calculated in the determination when the first step is determining the main input calculation that was obtained from the speed sensor with the condition in 1435 KHz output IC Program then the signal is converted IC into a voltage value.

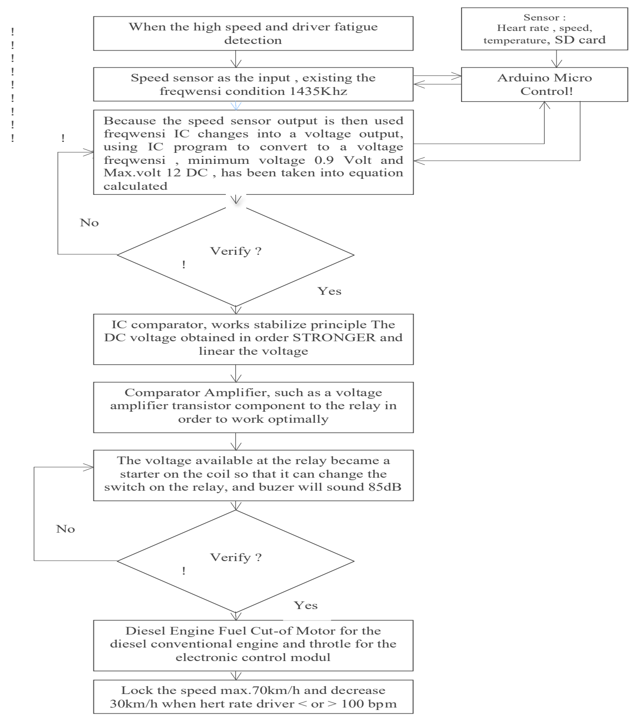

Fig 2. Analytical Method to Determine the drivers drowsiness and Decreased Speed

3. Design and develop SLIFA on fuel tank truck

SLIFA is an electronic device that is designed with the intention to terminate the fuel consumption will enter the combustion chamber by using a relay circuit breaker on the switch solenoid that embedded in the fuel injection pump on diesel engines for truck and bus when the input sensor read speed over speed and heart rate unreadable fatigue, Figure 3.

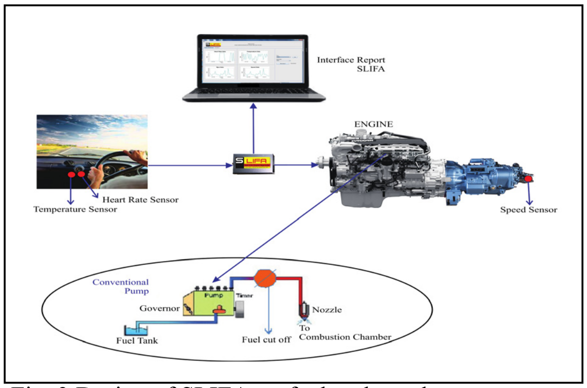

Fig. 3 Design of SLIFA on fuel tank truck

Based on [12], the developed speed limiter will read the speed of the vehicle and also improved with the engine rotation (RPM). These two data will be used as parameters from the speed limiter device. The speed limiter consists of sensor to read these two data from the vehicle and save the data to the storage devices.

The fatigue analyzer system will be equipped with two sensors, the first sensor is temperature sensor, and the second sensor is heart rate sensor. The temperature sensor will sense the temperature from the driver, meanwhile the heart rate sensor will take the heart rate value from the driver.

The main device for SLIFA system is an Arduino UNO, and some the sensors need by the system. All the sensors connected to Arduino board, and the Arduino manage all of the sensor for getting data are needed by SLIFA system. The sensor will be facing the object to be measured, such as the body temperature of driver, and also the heart rate of driver, the sensor will be implemented closed to the object.

3.1 Installation SLIFA on fuel tank truck

There are steps in SLIFA installation on diesel engine of trucks and buses such as speed and fatigue calibration test of modul SLIFA with engine RPM and speed (km/h) Table 4.2. This test will ensure the accuracy of frequency value with a voltage that can change speed value.

3.2 Speed and Fatigue Calibration Test

Before installing in units of truck and bus Speed calibration is necessary to reset the data speed between the speed out of the transmission output via the pulse speed sensor with the value of the voltage available at the speed limiter sensor in circuit SLIFA, by setting up early with the stages of the process as following:

i. Connect the special tool special adjustment to the connector on the speed limiter box. Set the multimeter to volts DC. Attach the (+) probe to port SIG and probe (-) to port 13 GND Fig 14.

ii. Start the engine and raise the vehicle's speed with the gas pedal until the desired speed, eg 55km / h and 60 km / h), will appear voltage / voltage on the multimeter. Record the voltage at 55 km / h (X volt) and 60km / h (Y volts). Remove the gas pedal back. NOTE: If the voltage does not appear, check the cable ties green speed limiter with signal cables in the vehicle speed (blue and white).

iii. Turn off the engine and re-ignition is ON

iv. Then point selector switch on special tool to the down position / BUZZER. Attach the probe multimeter (+) at the port and probe ADJ (-) to port GND.

v. Hold the control box with the bracket on the bottom, the hole on the right side is for adjusting the activation of the buzzer, is the speed at which the buzzer / alarm starts beeping (warning speed, eg 55 km / h) and speed while the engine back to life or when the acceleration pedal mechanism back function (cut-in speed). Perform adjustment by rotating counter-clockwise to increase / increase the speed and rotate clockwise to lower / reduce speed. Set the value to X volt alarm to sound at 55 km / h. NOTE: Setting voltage may not be equal to or lower than 1,9V, because the buzzer / alarm will go off by itself.

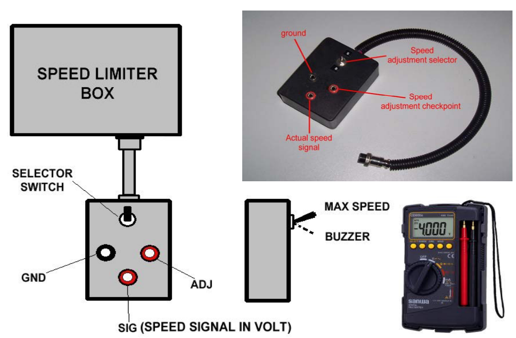

Fig. 4 Speed Calibration Test

Fig. 5 Fuel Tank Truck 16000kl installed SLIFA

4. Effectiveness of SLIFA on Drivers Drowsiness Detection

Effectiveness of SLIFA on Fatigue detection, tested dynamically by way of installing SLIFA in the truck and bus, directly and operated in accordance with the time shift that has been set, so that in this test to get the value of testing the actual to the condition of heart rate and temperature of body driver in regard as fatigue detection on SLIFA features. From the test data is done, the driver with the detection of maximum and minimum heart rate achieve the and the rpm and speed down to 30 km / h as shown in the Figure 6 and Table 2 report the incident.

4.1 Effectiveness Drivers Drowsiness Detection time shift 04:00-06:00

SLIFA testing on this shift has detected significant fatigue at the time of 04:00 to 6:00 time such data fatigue truck and bus, id B 9263 UU driver D-03 and HT 674 driver D-10 heart rate reached 100 bpm, when these conditions SLIFA read driver fatigue condition.

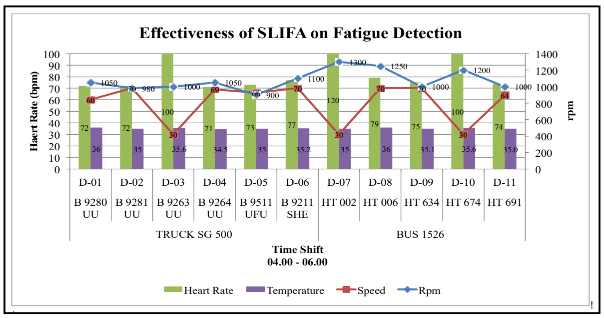

Fig. 6 Effectiveness Drivers Drowsiness Detection

4.2. Report incident after installation SLIFA on the Fuel tank Truck

Table 2. Shows the number of potential incident and incident which recorded by July 2016 – January 2017 two company in Indonesia PT.Pertamina Persero. There are several decreasing incident cases observed such as: shift of incident (morning, afternoon, night, daylight).

Table 2. Shift of Incident period July 2016-January 2017

Shift of Incident				
	Jan-Jun 2016 (%)	UOM	Jul 2016 –Jan 2017 (%)	UOM
Morning	20	10	13	5
Afternoon	33	17	59	23
Night	25	13	23	9
Daylight	22	11	5	2
Total cases	100	51	100	39

5. Summary

SLIFA is designed to fulfil the safety needs of trucks and buses by activating the speed limit and driver fatigue detection. It works to utilize the frequency delivered by speed censor and then changed into voltage to cut the fuel off when the speed limit is over 70 km/h. It also can be detected when the driver's drowsiness. The driver's drowsiness detection can be detected by SLIFA through the minimum and maximum of heartbeat and body temperature of the driver. If the driver does not response or ignores the speed information, it will decrease until 30 km/h. Based on the observation, the buses and trucks, which have been, installed the SLIFA for 6 months, can reduce the accident potential that often occurs on the road.

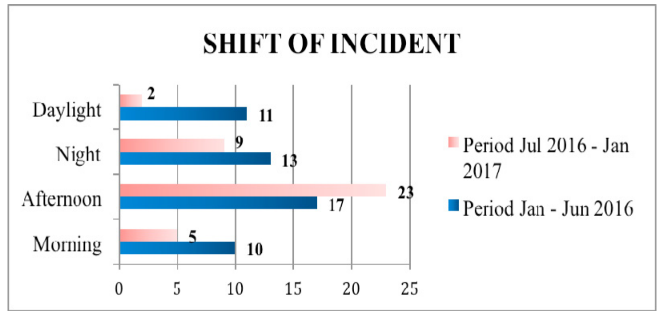

Fig. 7 Shift of Incindent period July 2016-January2017

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