Journal of the Society of Automotive Engineers Malaysia
Volume 4, Issue 1, pp 101-105, January 2020
e-ISSN 2550-2239 & ISSN 2600-8092

Initiatives to Increase the Use of Vehicle Turn Signals

M. H. Md Isa[*1,2], S. Abu Bakar[1] and M. S. Mohamad Hashim[1]

[1]Faculty of Mechatronics Engineering, Universiti Malaysia Perlis, 02600 Arau, Perlis, Malaysia
[2]Malaysian Institute of Road Safety Research, 43000 Kajang, Selangor, Malaysia

[*]*Corresponding author: mohdhafzi@miros.gov.my*

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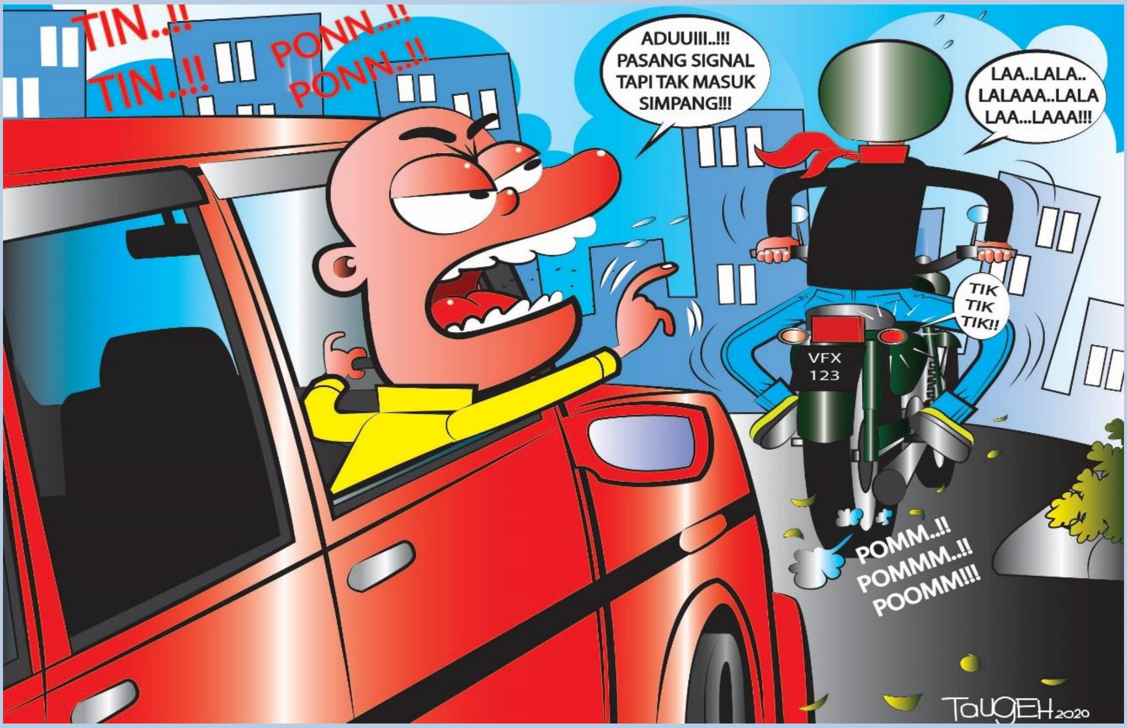

The failure to indicate the movement of a vehicle while turning or changing lanes through signaling may lead to a preventable collision. Due to lack of turning indicator usage among two and four-wheeler drivers, several initiatives, including behavioural modification programs and safety assist technologies, have been developed and implemented.

Taugeh or his real name, Ruslan Ayob, is a legendary cartoon artist (Ujang humour magazine) based in Sungai Besar, Malaysia. His Facebook page is https://www.facebook.com/taugehstudio/.

Keywords: Vehicle turn signal, activation, initiative

Article History:

Received	Received in revised form	Accepted	Available online
2 Aug 2019	*10 Nov 2019*	*11 Nov 2019*	*1 Jan 2020*

Journal homepage: www.jsaem.saemalaysia.org.my

While the use of turn signals is mandatory by law in many countries, the rates of turn signal neglect are still high, not only in developing countries, but also in developed countries. For example, the rates of turn signal neglects among car drivers during lane-changing were reported at 60 % in Beijing, China (Zhang et al., 2006), and 48 % in Ohio, USA (Ponziani, 2012). As for the indicator usage during turning at intersections among the car drivers, the rates vary between 38 % (Abdul Manan & Várhelyi, 2015) to 85 % (Faw, 2013). In addition, the reported activation rates for motorcyclists were lower than the car drivers at intersections, ranging from 0% (Ahmed et al., 2016) to 40 % (Nguyen-Phuoc et al., 2019).

Initiatives to increase the use of vehicle turn signals have been extensively discussed in several studies. Table 1 lists five studies on the implemented interventions and their effectiveness, as well as the intended vehicle type. Generally, there are two main intervention types: (i) behavioural modification programs (BMPs); and (ii) Safety Assist Technologies (SATs). Majority of the proposed and assessed interventions targeted car drivers instead of motorcycle riders.

Out of the five studies, two studies implemented BMPs at the workplace and within the university compound (Clayton & Myers, 2008; Ludwig et al., 2002). Ludwig et al. (2002) investigated the effects of a safe driving competition among pizza deliverers. Within the study period, the performance of targeted and observed safe behaviours (including use of turn signals) was publicly posted in the stores. Weekly rewards and a grand prize were also given to the highest achievers, e.g., vouchers of automotive-related products or services. This approach has tremendously improved the turn signal activations among the deliverers.

Clayton & Myers (2008), on the other hand, implemented a different BMP approach to encourage the use of turn signals among university staff and students. This particular study used textual prompts “Please Signal and Drive Safely” placed at strategic locations within the university area close to the parking garage where drivers could see. The prompts were being communicated to car drivers in two ways; during the first intervention, a stationery poster with a specific dimension (known as passive prompting) was used. For the second intervention, a research assistant held the poster at chest height (known as mediated prompting). Both approaches were found to be effective, resulting in increased turn signal usage from the baseline study.

The remaining three studies (Chen et al., 2015; Md Isa et al., 2018; Ponziani, 2009) introduced or investigated the effectiveness of interventions related to SATs. These technologies can provide support for car drivers or motorcyclists to improve the turn signal usage while performing lane changing or turning at intersections or roundabouts. Ponziani (2009) proposed a system known as Turn Signal Reminder System (TSRS). This concept or prototype, which was designed for cars and only considered turning behaviours, provide drivers with a dashboard message by reminding them to use signals in their next turns if turn signal neglect were recorded. The system monitors the status of turn signal usage by incorporating vehicle dynamics data (e.g., travel distance, speed, yaw and steering wheel angle).

The effectiveness of TSRS was determined based on the estimation of potential crash reduction if the systems were equipped in vehicles. Based on related crash configurations that might be benefitted from using the turn signals, it was estimated that the system can save up to 300 lives. Nevertheless, the aspects of drivers’ acceptance and adoption of the proposed system, which are an essential element of technology commercialization, was not covered in the study. It is also unclear whether this system has already been equipped in any existing vehicle models or not.

Table 1: Studies on the effectiveness of interventions related to vehicle turning indicators

Study	Intended Vehicle		Interventions	Effectiveness of Interventions
	Motorcycle	Car		
Ludwig et al. (2002)	-	√	Behavioural feedback program in the form of safe driver competition; weekly performance of each deliverer in terms of safe behaviours, including turn signal activation, was posted in the stores, and the winners were rewarded.	Use of turn signals increased from baseline study, i.e., without any intervention (35.8 %) to 57.6 % after intervention.
Clayton & Myers (2008)	-	√	Passive and mediated prompts with a message “Please Signal and Drive Safely”.	Use of turn signals increased from baseline study; without any intervention (68.3 %) to a range from 84.5 % to 89.1 %.
Ponziani (2009)	-	√	TSRS; the turn signal activation status is monitored, and a reminder message “USE SIGNAL NEXT TURN” is displayed if turn signal neglect was recorded.	Installation of the systems in vehicles was estimated to save 3000 drivers yearly.
Chen et al. (2015)	√	-	AMTS system; the turn signal in the motorcycle is automatically activated through a mobile application.	The correct detection or functionality of the prototype was estimated at 95.3 % (out of 256 attempts by four volunteers on actual test runs). Additional surveys among 1331 motorcyclists revealed high potential adoption rates.
Md Isa et al. (2018)	-	√	LCAS in Volvo, Toyota, and Mazda models; the system assists driver in providing an audio or visual warning if there is any vehicle in the blind spot zone (first stage) and additional warning if the driver activates the turn signal to change lane (second stage).	35 % of the 276 drivers who owned vehicle models equipped with the LCAS, used their turn signals more often after using the LCAS.

The proposed TSRS has the potential to be applied to motorcycles; however, several considerations need to be taken into accounts. For example, prompting the message on the motorcycle dashboard may not be feasible due to the design constraints. Various aspects of Human-Machine Interface (HMI) should be considered during the design and development stage as cognitive and psychomotor demands for motorcyclists are generally higher than car drivers.

Md Isa et al. (2018) investigated the acceptance and behavioural effects of Lane Change Assistance System (LCAS) among existing owners of Volvo, Toyota, and Mazda models equipped with LCAS. This system provides warning to car drivers if there is any vehicle in the blind spot zone and second-stage warning if drivers activate the turn signals. This study revealed that about 35 % of the car drivers used turn signals more often after they used the system. A similar system has also been recently available in few high-end motorcycle models (Schoenherr et al., 2017) and as after-market products (ADVrider, 2019); nevertheless, studies on the system's effectiveness are still lacking.

Chen et al. (2015) designed and developed a prototype, known as Automatic Motorcycle Turn Signal (AMTS), that can automatically activate the turn signals in motorcycles when performing lane changing or turning by utilising an Android phone. This prototype and standalone system (i.e., not integrated with the motorcycle system) utilizes the gyroscope sensor of the phone to indicate whether turnings have been made or not. Located near the handlebars, the gyroscope sensor of the android phone measures the angular velocity in tri-axial direction (x, y, and z), which indicate the angle velocity of the roll, pitch, and yaw directions, respectively. When the phone app detects that the angular velocity difference exceeds ± 0.5 rad per second, the turn signal is automatically activated through Bluetooth communication.

On-road assessment of the prototype's correct functionality indicated a high accuracy, and additional surveys conducted among the motorcyclists also revealed a high adoption rate (95.9 %). Although the prototype is proven to be able to activate the motorcycle turn signal automatically, several identified limitations, such as false activation at traffic light due to movement of the handlebars and limited number of applicable scenarios for the system to function (Chen et al., 2015), may undermine the intended benefits of the system.

Additional market surveys were also performed to seek for any other after-market products that were related to motorcycle turn signal systems. There is a system, known as Smart Turn System (STS), which is capable of cancelling the signal after each turn, lane change, or roundabout exit (Safer-turn.com, 2019). Whether this system can improve the use of turn signals among motorcyclists is still questionable, as empirical studies evaluating the public acceptance and adoption of the system are still lacking.

In summary, most of the proposed and implemented initiatives were shown to be highly effective. However, the sustainability and intended benefits of the initiatives, in the long run, may not be achieved if the initiatives are conducted for a particular duration or limited to a certain scenario or application only, especially involving motorcyclists. Thus, understanding of the motorcycle-signalling behaviour in various scenarios for the development of a technological system to improve the use of turn signal is needed.

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