MTSFB TR 011:2022

TECHNICAL REPORT

THE ADVANCED VEHICLE MONITORING & ASSISTANCE SYSTEM

Preface

Malaysian Technical Standards Forum Bhd (MTSFB) has awarded Heriot-Watt University Malaysia the Industry Promotion and Development Grant (IPDG) to implement the Proof of Concept (PoC) of the Advanced Vehicle Monitoring & Assistance System (AVMS). The duration of this PoC is for 12 months starting September 2019. The PoC is carried out in Putrajaya and Cyberjaya Malaysia.

This Technical Report outlines objective, benefits, scope of work, methodology and result analysis.

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Contents Page

Abbreviations

AVMS	Advanced Vehicle Monitoring System
ECU	Electronic Control Unit
FastCGI	Fast Common Gateway Interface
GDP	Gross Domestic Product
GPIO	General-Purpose Input/Output
GPS	Global Positioning System
GSM	Global System for Mobile Communications
IP	Internet Protocol
JKR	Public Works Department
LCD	Liquid Crystal Display
LTE	Long Term Evolution
MIROS	Malaysian Institute of Road Safety Research
PERCLOS	Percentage of Eye Closures
RSA	Road Safety Audit
SPAD	Land Public Transport Commission
UART	Universal Asynchronous Receiver/Transmitter
UI	User Interface
URL	Uniform Resource Locator
USB	Universal Serial Bus
VPN	Virtual Private Network

ADVANCED VEHICLE MONITORING & ASSISTANCE SYSTEM (AVMS)

Executive Summary

This project aimed to propose and perform Proof of Concept (PoC) of the Advanced Vehicle Monitoring & Assistance System (AVMS). The AVMS is developed to overcome and reduce the accidents due to the behaviour and driving pattern of a driver by adopting the Internet of Things (IoT) and new technologies.

As part of the new innovative approach to reduce road accidents, this project focuses on the usage of IoT concept in which an integrated system is designed to monitor the speed, location and human driving behaviour on the road.

In terms of speed, the threshold speed limit will be set and alerts will be sent to both driver and head office when the threshold is surpassed via Global Positioning System (GPS).

Driving assistance system using the lane tracking method was installed, in which notification will be sent when recklessness is detected, such as driving or manoeuvring out of the lane or not using the indicator when turning to the other lane. All the features will allow data to be fed through the access portal in the head office in real time, therefore increasing the awareness of collective responsibility to drive safely.

The advantages of this project include the obligation of drivers to adhere to speed limit and other regulations, while complying with the optimum number of hours one can drive on the road based on the data from the system.

As the final outcome of this project, a standardisation of guidelines and best practices on transportation system can be developed, not only to monitor but also empower enforcement of laws in reducing accident rates due to human driving behaviour through the applications of IoT technology and data analytics.

1. Background

One of the common causes of road accidents is human driving behaviour. Some of the identified irresponsible human driving behaviours are risky driving, speeding, driving in fatigued condition or drowsiness, etc. The existing control functions available are mostly manufacturers technology in vehicles and via external control through speed trap and enforcement of laws related to driving.

Therefore, the advanced solution of vehicle monitoring system is needed to ensure the likelihood of risky driving is reduced, thus reducing the number of road accidents. On the other hand, it is the obligation of the drivers to adhere to the speed limit and other regulations, while complying with the optimum number of hours one can drive on the road based on the data from the system.

2. Objectives

The objectives of the project are as follows:

a) to develop a speed monitoring feedback control system;

b) to develop a driver's alert awareness feedback control system while driving on the road;

c) to implement driving assistance system using lane tracking method; and

d) to provide real-time information on in-vehicle activities through a dedicated access portal.

3. Scope of work

The scope of work for this project is as follows:

a) Phase 1:

   i) project planning and design; and

   ii) submission of purchase orders.

b) Phase 2:

Software development and testing on the following:

   i) driver's alert awareness feedback control system while driving on the road;

   ii) driving assistance system using lane tracking method; and

   iii) speed monitoring feedback control system.

c) Phase 3:

Software and hardware integration as follows:

   i) connecting the hardware to local microcontroller and cloud server for data collection;

   ii) installation and implementation of AVMS PoC on a vehicle; and

   iii) data collection study: to ensure the values are accurate and within the designated range

The site selected for the testing is located in Cyberjaya. The driving range started from Cyberview building to MCMC Centre of Excellence which is about 3 km. The public road is with two lanes in one direction with slight slope, which allowed the driver to switch lanes during the PoC implementation. The drivers' age ranges from 23 to 43 years old. The condition of the road during the PoC implementation is at normal hours instead of peak hour.

AVMS concepts

In general, there are 4 key objectives in AVMS to be incorporated in the transportation ecosystem to increase the awareness of the employee (driver) and employer (transportation industry) in ensuring the safety of the client (passenger).

The key objectives are to:

a) implement speed monitoring and alert subsystem;

b) implement drivers' awareness monitoring and alert subsystem;

c) implement driver assistance and alert subsystem using lane tracking; and

d) close-loop the first three subsystems using IoT technology for real-time data management so both vehicle and fleet monitoring system are responsible for the safety of the transportation ecosystem.

Having the ecosystem in the transportation may increase the confidence of client towards safety assurance in this transportation system.

Figure 1 shows the overall architecture of AVMS.

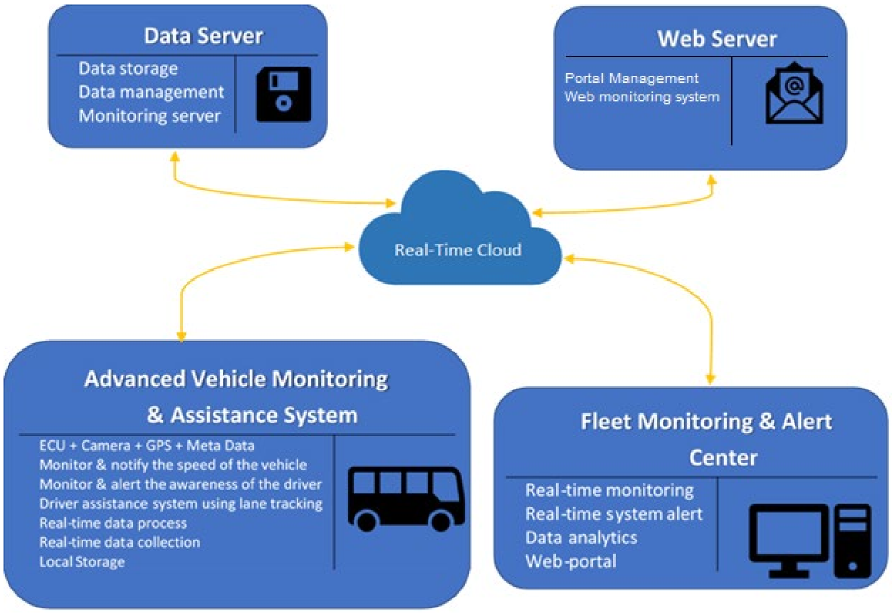


Figure 1. Overall architecture of AVMS

4. Target groups and benefits

The target groups and benefits are shown in Table 1.

Table 1. Target groups and benefits

Target groups	Benefits
Heavy vehicle drivers	• To embrace self-awareness as a responsible driver • The system can enhance their driving experience with more integrated safety features from the AVMS • To reduce the risk of accidents
Public road user and passenger	• To decrease fatal accidents on the road involving heavy vehicles • To provide safe and accident-free public transport system • The road users can provide feedback through the apps system
Government agency	• To propose road safety monitoring and feedback solutions to Malaysian Institute of Road Safety Research (MIROS) as part of their policy and standards • The system can be part of the references to the enforcement authority • The enforcement authority may study and analyse the system to embed in their merit and demerit systems
Social economy (e.g. insurance company, automotive association)	• To reduce the impact on economic and social conditions in terms of health care cost of injuries, disabilities and death • The AVMS can be an evaluation tool for insurance company to classify the insurance premium based on the driving behaviour of the driver

5. Methodology

5.1 Hardware configuration

The overview of the AVMS hardware configuration is as shown in Figure 2.

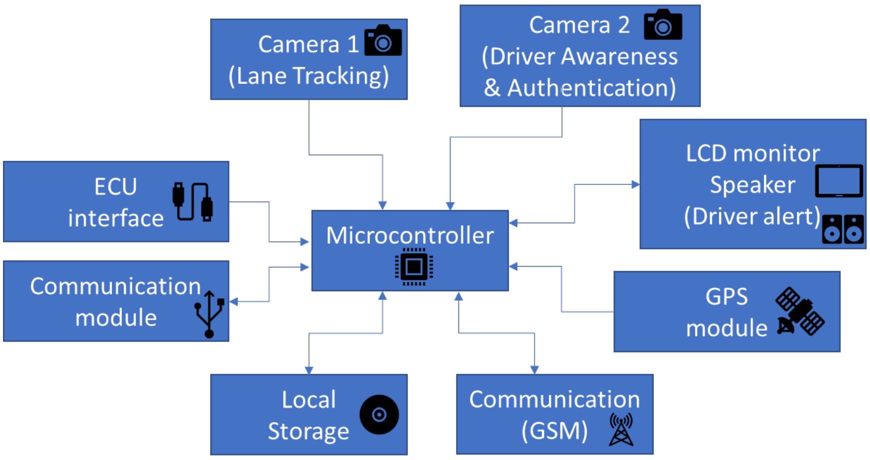


Figure 2. AVMS hardware configuration

The AVMS hardware was installed in the vehicle at the appropriate locations. The microcontroller acts as the master device of the overall system, while the rest of the unit acts as the slave devices. The inputs for the microcontroller are:

a) the images from the Camera 1 for lane tracking picture frame;

b) the images from the Camera 2 for capturing facial activities of the driver;

c) Electronic Control Unit (ECU) interface, a device that connect to an ECU microcontroller directly; and

d) Global Positioning System (GPS) module which contains tiny processors and antennas that directly receive data sent by satellites through dedicated radio frequencies.

These devices conduct simple capturing of the data and provide feed to the microcontroller for data processing.

The local storage keeps temporary data and was also used as a workspace for the microcontroller. The Global System for Mobile Communications (GSM) was used as a medium for communication between the vehicle and the fleet centre via the cloud. It transmitted and received key information between the fleet centre and the vehicle.

The LCD monitor (with touchscreen input) was used to display the status and/or notification when necessary. In addition, it is also used to acknowledge the request from the fleet centre when required. The speaker is used to assist this acknowledgement process so that the driver is aware of the alert or notification, if any.

The communication module is password-protected and used for programming and diagnosing the AVMS system. This ensures only the authorised person can update or modify the algorithm. In addition, any history of access and updates can be tracked and stored in the data centre by the authorised person.

The functions of each of the devices in the respective categories are explained in Table 2.

Table 2. AVMS devices and functions

Category	Component	Function
Hardware	Microcontroller/Edge node (Raspberry Pi 4 Model B)	It processes the data received from the edge device and manages the synchronisation with the server side. Following are the logic modules on the edge node: a) Collect local data and synchronise with the cloud server All the data received from the edge device, together with login information received were transmitted at interval of 5 seconds to the server. The edge device is also capable of storing the data locally if the internet connection was unavailable and shall attempt to synchronise. b) Lane detection logic Lane detection logic module received partially processed data from the edge device related to lane detection, sent corresponding statuses to the dashboard and play the warning sound to warn the driver. c) Drowsiness logic Drowsiness logic module received partially processed data from the edge device related to drowsiness detection, sent corresponding statuses to the dashboard and play the warning sound to warn the driver.

Table 2. AVMS devices and functions (*continued*)

Category	Component	Function
	Edge device (NVIDIA Jetson Xavier NX Developer Kit)	It receives the lane departure camera feed and front camera feed. It runs the following image processing logic: a) lane departure detection; b) drowsiness detection; and c) facial recognition. The partially processed information from the image processing logic were sent to the edge node for further processing and decision making. The current specification is capable of storing around an hour's worth of images in its micro-Secure Digital (micro-SD) storage before it gets deleted.
	Touch screen display Raspberry Pi 7-inch)	Display panel to show the status and/or notification when necessary and connected to the Display Serial Interface (DSI) port using a ribbon cable. Specifications: a) Screen dimensions: 194 mm x 110 mm x 20 mm (including standoffs) b) Viewable screen size: 155 mm x 86 mm c) Screen resolution 800 x 480 pixels d) 10 finger capacitive touch
	Camera 1 stereo camera (ZED 2)	It provides high-definition 3D video and neural depth perception of the environment. It has been designed for the most challenging applications, from autonomous navigation and mapping to augmented reality and 3D analytics. It can detect and track object with spatial context. By combining Artificial Intelligence (AI) and 3D capabilities, the ZED 2 localises the objects in space and provides the tools to create the next-generation spatial awareness. This camera is used for lane tracking system.

Table 2. AVMS devices and functions (*concluded*)

Category	Component	Function
	Camera 2 Hikvision RGB Camera	It is a high-quality device that can be used in a variety of applications, including electronic semiconductor fabrication, factory automation, quality inspection. This camera is used to detect the iris of a driver while driving on road.
	SIM7600E-H 4G HAT	4G/3G/2G communication and GNSS positioning module, which supports LTE CAT4 up to 150Mbps for downlink data transfer. it is pretty low power consumption. By attaching it onto Raspberry Pi to enable functions like 4G high speed connection, wireless communication, sending SMS, global positioning, etc.
	On-premises cloud server (HP IDS Z1 tower G5 entry WKS)	Cloud webserver and database. The modules residing on the cloud servers HPZ1 tower are: a) Webserver; This component shall receive all incoming traffic from the outside world and redirects to other relevant internal modules. b) Database; This module stores all permanent data consisting of profiles, references and also historical transactions. c) redis; This module acts as the memory runtime storage to speed up information passing by eliminating the need to read/write to the hard disk. d) Database admin; This module provides the web-based database client that is accessible via browser. This allows database administration to be carried out remotely. e) PHP application server; and This module serves the web pages for public and authorised users. f) Node-RED. This module provides the web services calls.

5.2 Software configuration

The overview of the developed closed-looped AVMS software architecture is shown in Figure 3.

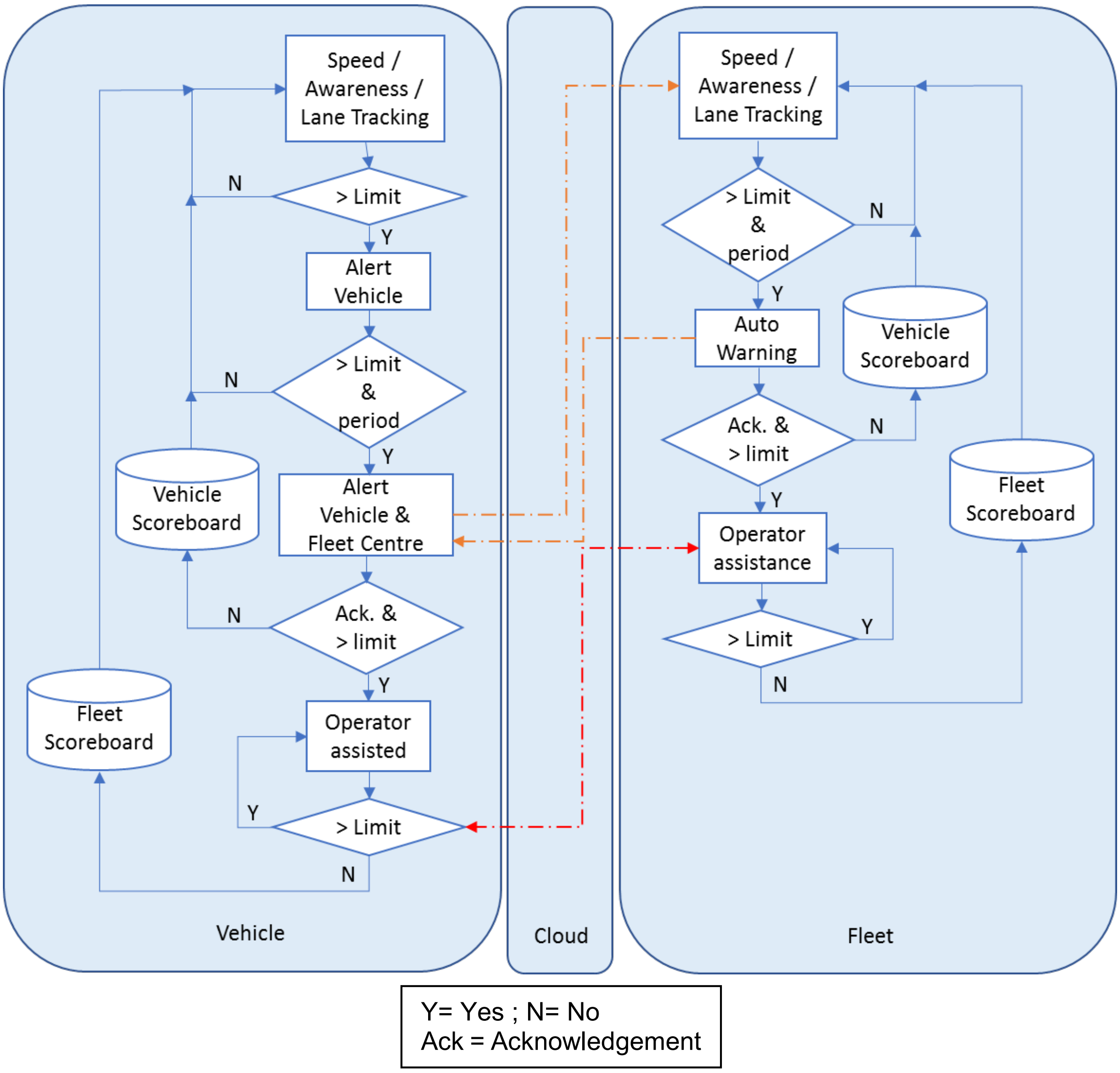


Figure 3. The software architecture of AVMS system.

There are 3 main indicators are measured in AVMS , namely speed, awareness and lane tracking, which utilised modular based software architecture where each subsystem is executed in parallel. The software also consists of scoreboards where it captured the number of times the driver breaks the regulation, namely vehicle scoreboard and fleet centre scoreboard, for example, speed monitoring and alert subsystem.

Technically, this subsystem contains a GPS sensor, GSM and LCD monitor. The GPS system senses the location of the vehicle and sent the data to the data server via GSM. The data server monitors the location of the vehicle and returns with respective road speed in real-time. The AVMS system receives this information and determines if the vehicle is obeying the speed regulation and displays this to the driver via an LCD monitor that is installed at the driver's location. If the speed of the vehicle is beyond the regulation, this subsystem will alert the driver. In addition to speed estimation using GPS, the vehicle speed can also be obtained from the ECU interface. This speed information is useful in case of slow response from the GPS signal, which rarely happens and usually for a short period of time. Also, since the travelling location is not expected to change in such a short period of time, therefore, this information can be used as a secondary speed monitoring system. All the data is processed using the microcontroller and a temporary storage system is provided to ensure there are no data lost due to unavailability of the GSM signal. This subsystem also ensures that the data is synced back to the cloud (data server).

If the vehicle exceeds the speed limit, the AVMS system alerts the driver. The driver is expected to reduce the speed. However, if the driver exceeds the speed limit for a period of within 5 seconds (to have a buffer time when the car is speeding to overtake other vehicles), in addition to the vehicle alert, this subsystem also alerts the fleet centre via cloud and returns with an auto-generated warning to the driver. The driver is expected acknowledge the auto-generated warning and reduce the vehicle speed via touchscreen of the LCD monitor. The Malaysian standard on speed limit regulation for each route is to be strictly followed in this implementation.

The vehicle scoreboard captures the number of times the driver exceeds the limit but may be considered appropriate. For example, it is possible for the driver to exceed the speed limit when overtaking a vehicle.

In the case of no response from the driver, the fleet centre is to be alerted for manual operator assistance to the driver. The fleet monitoring and alert centre sends a warning to the driver via monitor until the driver obeys the speed limit. The fleet centre scoreboard is used to capture the number of times the driver exceeds the speed limit and at the same time being reminded by the fleet centre to follow the speed limit.

The fleet centre should consider serious action to be taken against such drivers. These 2 scoreboards can also be used for data analytics to study the behaviour of the driver.

A similar approach is implemented for drivers' awareness and lane tracking subsystem. The novelty of the method is the closed-loop monitoring and alert system where both vehicle drivers and fleet centre are well informed on the status of the transportation ecosystem, specifically on safety.

5.3 System integration

There are a few systems integration under AVMS, namely cloud server and edge node integration and edge node and edge device integration in vehicle.

5.3.1 Cloud server and edge node integration

There are 2 types of integration channel between cloud server and edge node shown in Figure 4. The details are as follows:

a) web services via public cloud, using the 4G to access the internet. This is sufficient to cater for web services; and

b) web services via Virtual Private Network (VPN). This is necessary to stream video feed out from the edge node.

    i. VPN server is installed in the same container for the web server.

    ii. Web server is configured to redirect traffic that is from the edge node to the web server for image streaming and web services. This is necessary because mobile data line does not provide public Internet Protocol (IP).

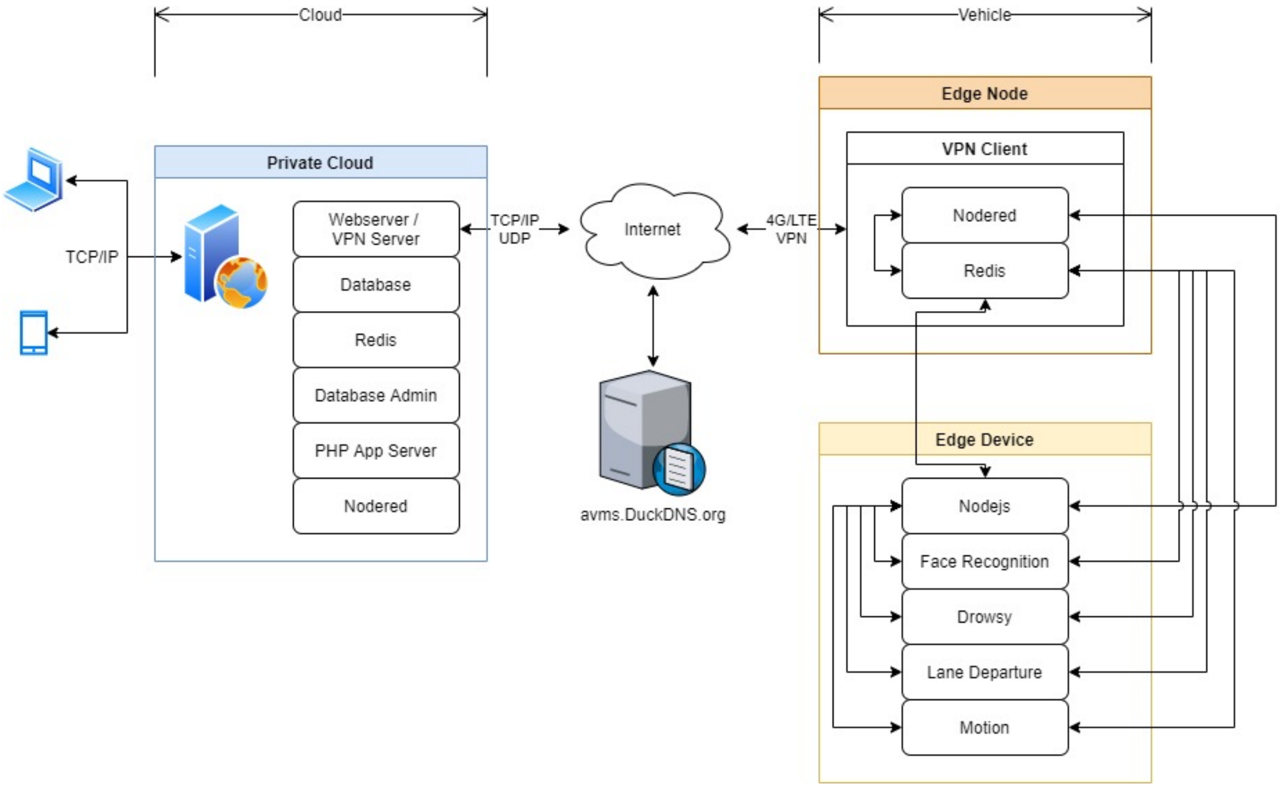


Figure 4. High level integration (software architecture)

5.3.2 Edge node and edge device integration in vehicle

Another integration in the AVMS system is edge node and edge device integration in vehicle as shown in Figure 4.

5.3.2.1 Edge device modules

The edge device modules are shown in Figure 5.

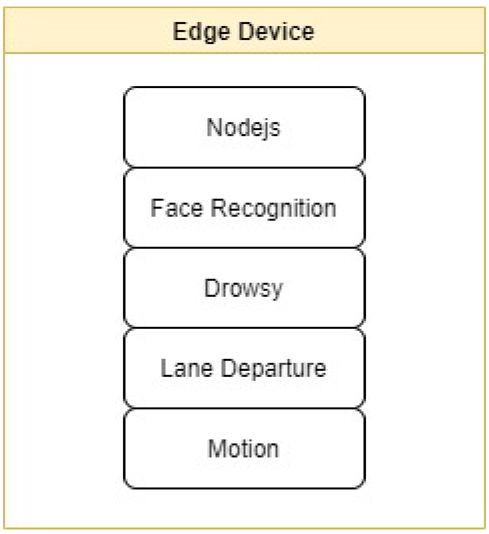


Figure 5. Edge device modules

The modules carry out the functions as described in Table 3.

Table 3. The edge device modules and its functions

Module	Function
nodejs	Provides the web services
Face recognition	Provides the ability to recognise an authorised driver
Drowsy detection	Provides the ability to detect drowsiness
Lane departure	Provides the ability to detect lane deviation
Motion	Provides the streamed images to be published on Hypertext Transfer Protocol (HTTP)

The integration between the edge node and edge device requires physical fitting of the hardware resources as illustrated in Figure 6.

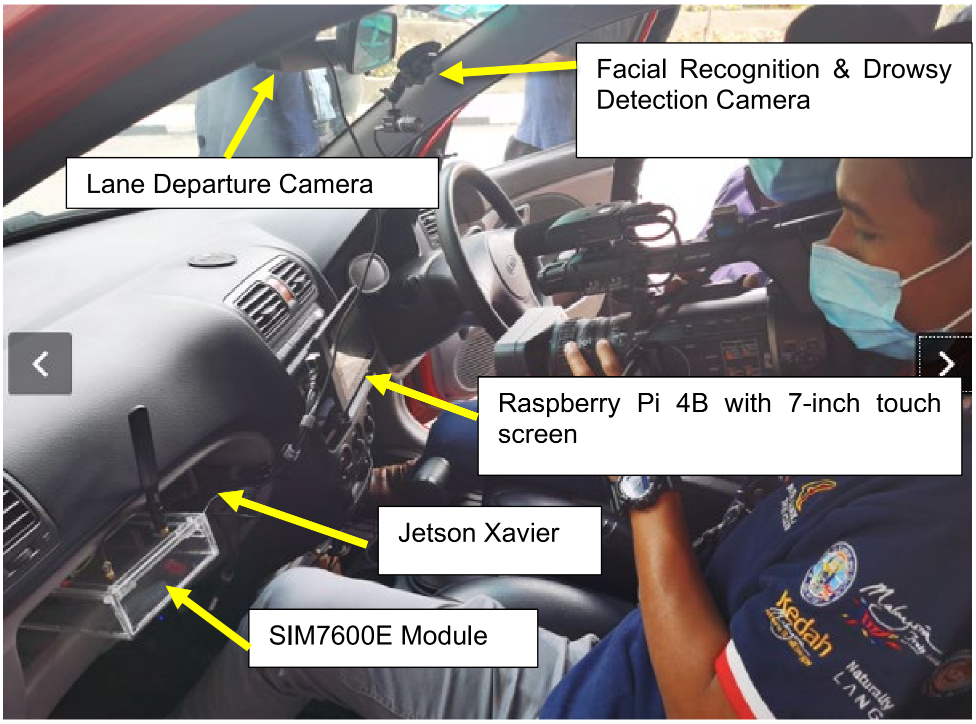


Figure 6. Physical installation inside the vehicle

5.3.2.2 Camera Integration

Figure 7 shows the camera integration of stereo camera and the front camera.

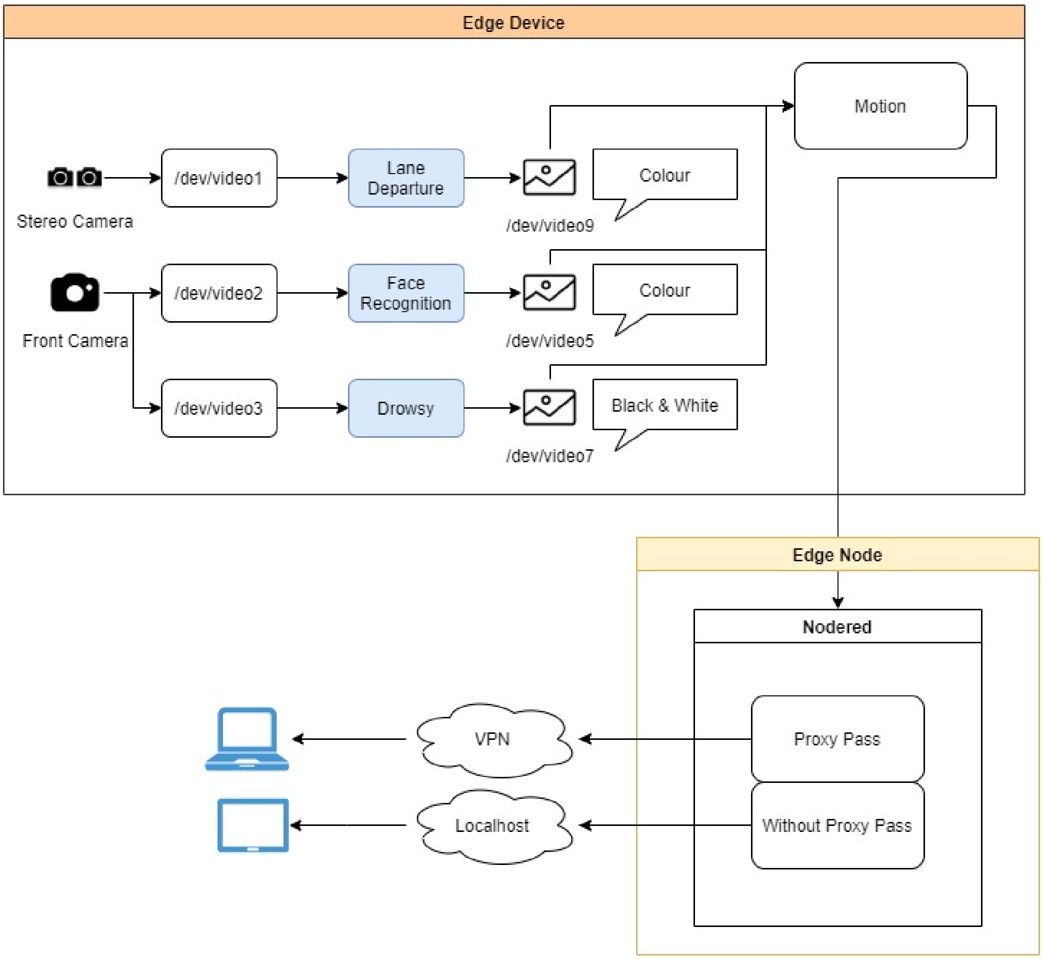


Figure 7. Camera integration (high level)

a) Stereo camera

The feed from the stereo camera is consumed by the lane departure program directly and the output are processed images to a virtual device. This virtual device shall be read by a program that publishes the feed on a specific Uniform Resource Locator (URL) which can be opened on a browser to display the video images.

b) Front camera

The feed from the front camera is duplicated into 2 separate virtual devices. Each of the virtual devices will be read by the different programs i.e. facial recognition program or drowsy program. These programs will read from one of the virtual devices and output to another virtual device. Subsequently, another program will read the output and publish the feed on a specific URL which can be opened on a browser to display the video images.

5.3.3 Node-RED

This module contains the sub-modules as described in Table 4.

Table 4. The sub-modules and its functions

Sub-module	Function
4G & GSM	• To communicate with the Internet Service Provider (ISP) station and acquire access into the 4G network. • To communicate with the satellite to acquire GSM information.
User Interface (UI)	• To provide the touch screen UI widgets and interactions with the user. • To display alerts, status and other relevant information for monitoring purposes. • To provide means to configure the device.
Backend process	• To transfer the data to the require layout. • To process data input based on the given logic state and flow.

5.3.4 Redis

The Redis module shown in Figure 8, acts as the memory runtime storage to speed up information passing by eliminating the need to read/write to the hard disk.

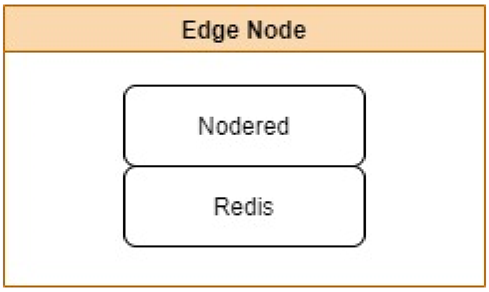


Figure 8. Edge node on Redis

5.4 User Interface (UI) portal development

The AVMS is inclusive of 2 UIs, namely edge node UI (in-vehicle) and cloud server UI.

5.4.1 Edge node UI

The vehicle information is displayed through a dashboard on the 7 inch display as shown in Figure 9. This is developed using Node-RED.

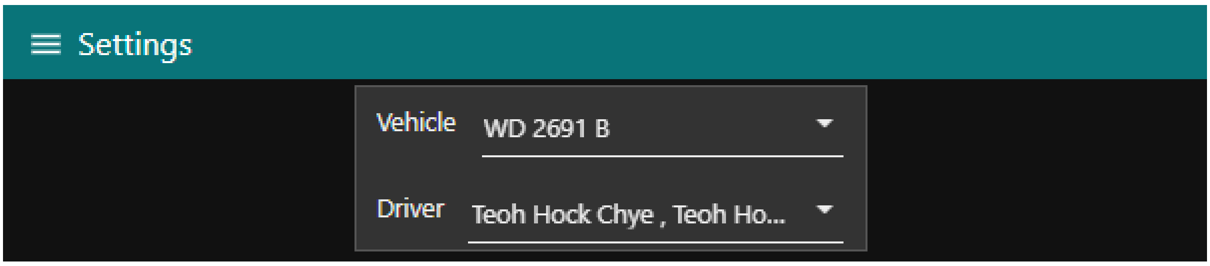


Figure 9. Edge cloud - dashboard for edge node configurations

This UI allows for the following functionalities:

a) Edge node configurations to register the vehicle number and list of allowed drivers. These lists are obtained from the cloud server.

b) Drivers to login via face recognition.

Detection of facial for driver log-in on dashboard is shown in Figure 10.

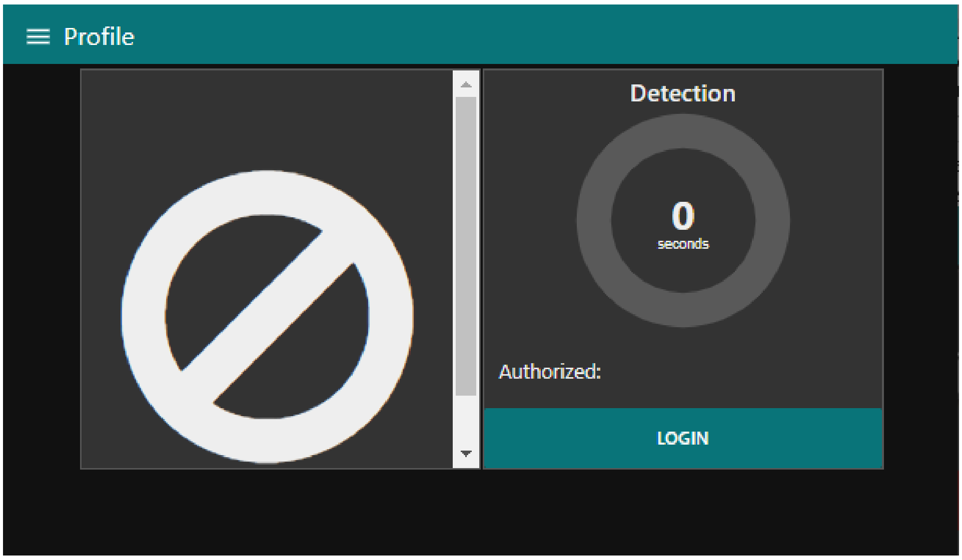


Figure 10. Edge cloud - dashboard for driver login (screen captured during front camera is inactive)

c) Monitoring the edge node system health and administrative control to start/stop processes is shown in Figure 11.

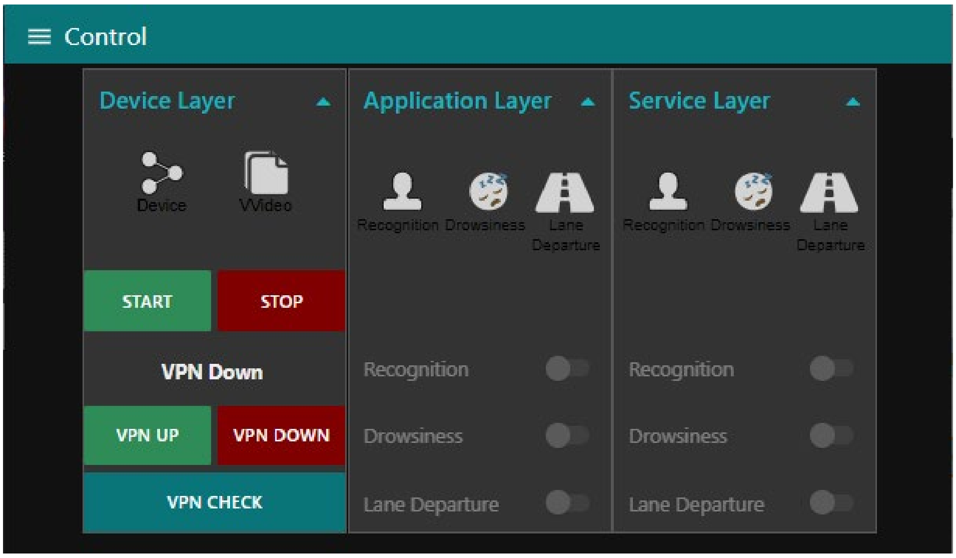


Figure 11. Dashboard for administration of the edge processes

d) Figures 12 and 13 show the real-time status update of:

i. Speed.

ii. Drowsy (awareness).

iii. Lane departure (lane tracking).

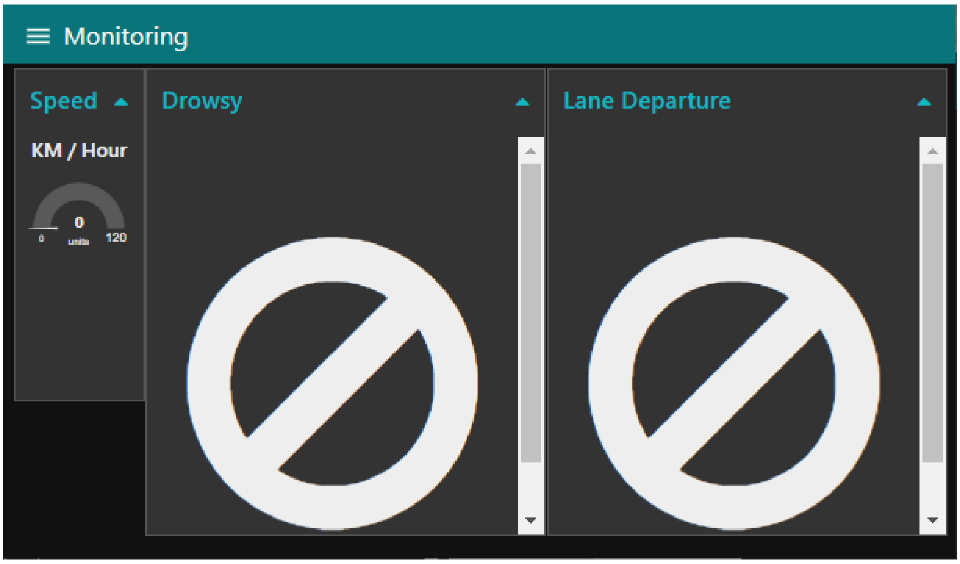


Figure 12. Edge cloud - dashboard to monitor edge devices status and feedback (screen captured during front camera and lane departure camera are both inactive)

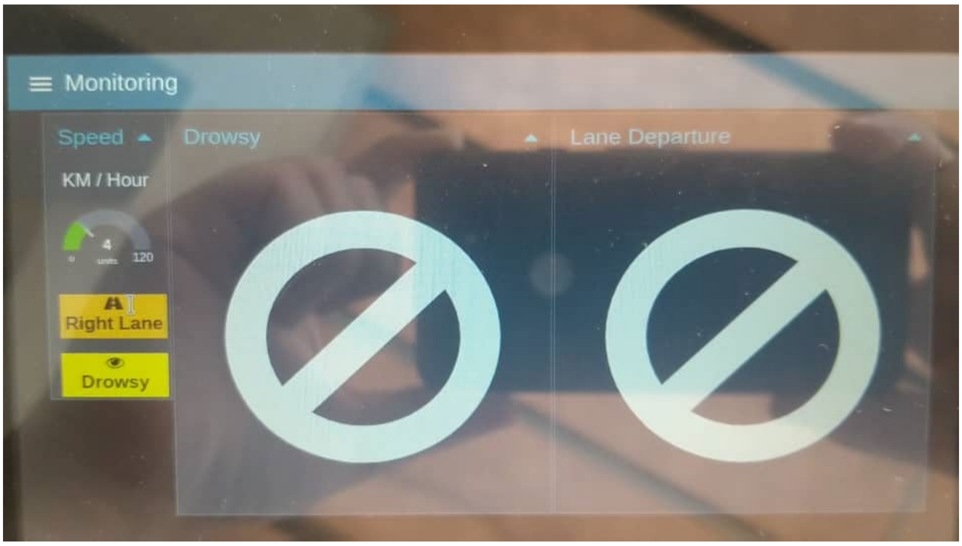


Figure 13. Edge cloud – dashboard (screen captured during front camera and lane departure camera are both inactive and testing of status was conducted)

5.4.2 Cloud server UI

The on-premise cloud server UI can be accessed via internet. Figure 14 shows the site map.

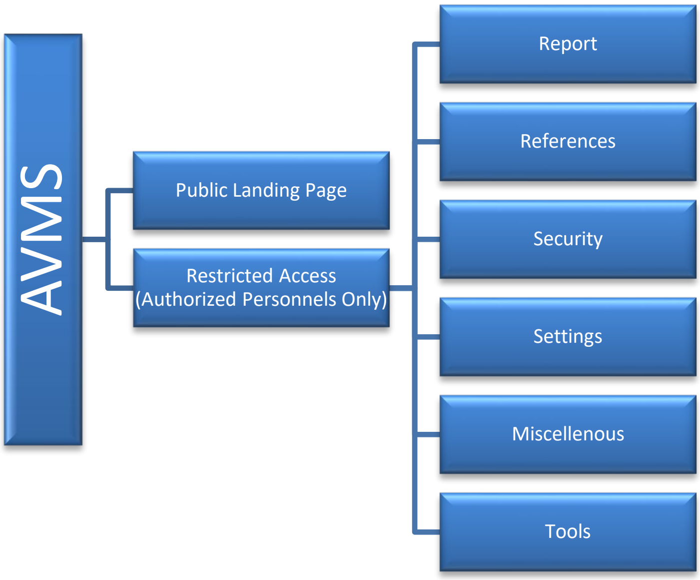


Figure 14. On-premise cloud server - AVMS site map

a) Public landing page

The default landing page shown in Figure 15 which is accessible by public without any access restrictions. It displays in 5 seconds interval of the latest statuses all the AVMS registered vehicles on the map. User can also pick which vehicle to track and follow, resizing the map with zoom.

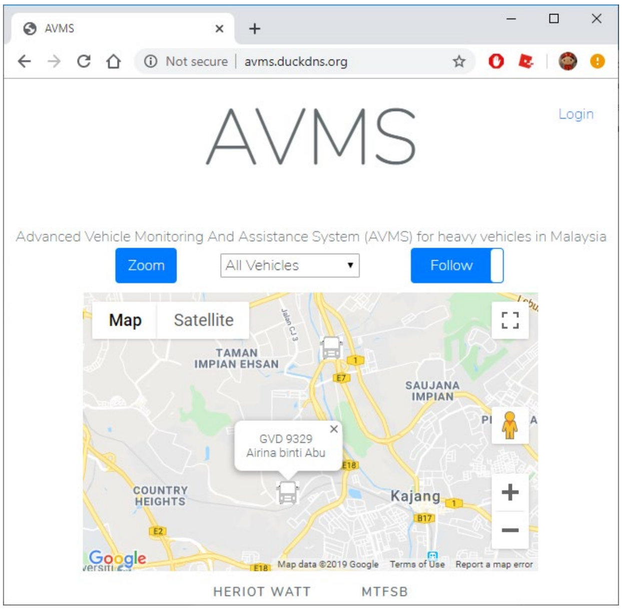


Figure 15. Public landing page

b) Restricted access

The restricted access navigation menu are shown in Figure 16.

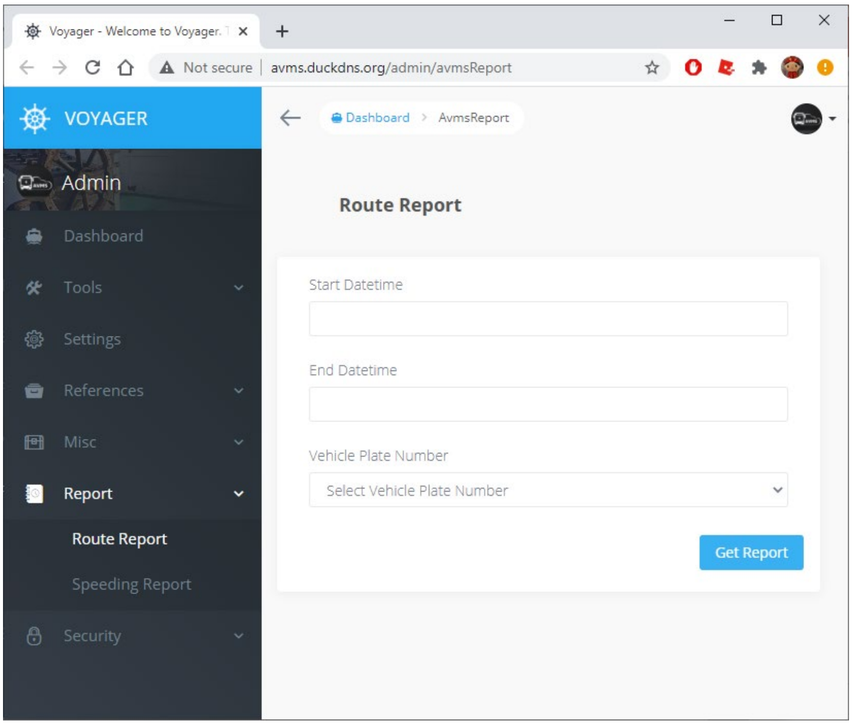


Figure 16. The restricted access navigation menu

6. Finding and result analysis

6.1 Findings

Test drive

Date: 15 September 2020

Time: 10.00 am - 11.30 am

Location: Public roads around Cyberjaya

Speed limit: 50 km/h

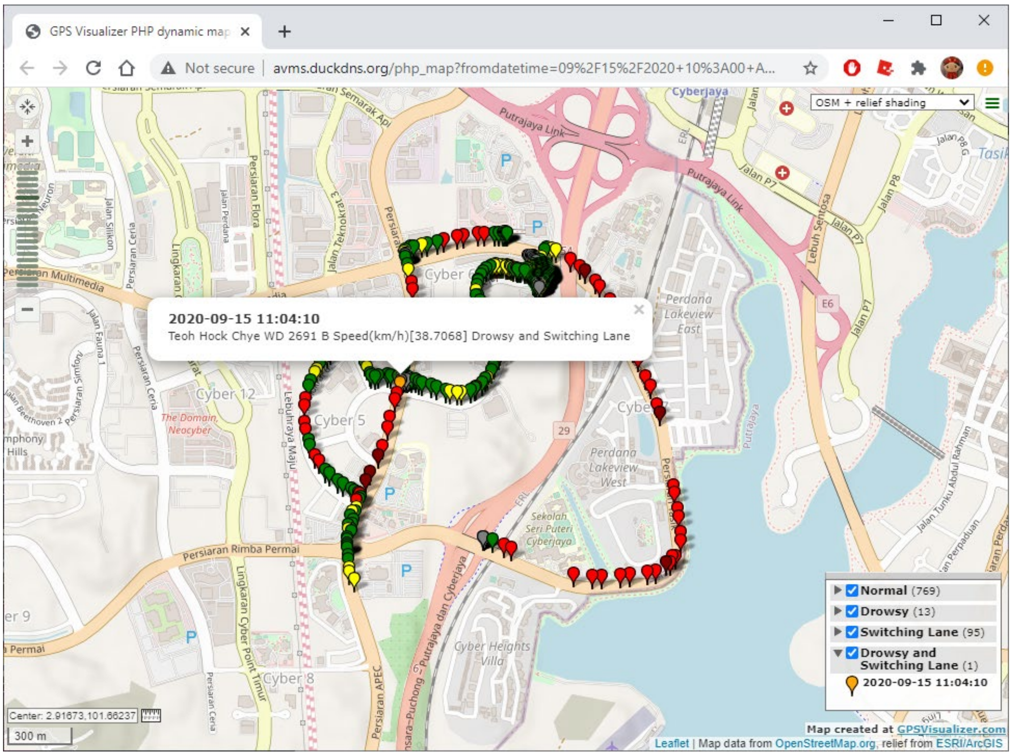


Figure 17. Route report on 15 September 2020

Figure 17 shows the route report of the test drive on 15 September 2020 which displayed the various statuses captured from the edge devices for the duration between 10.00 am to 11.30 am. The green colour pins indicate driving within the set speed limit. Red pins indicate driving above the speed limit and darker red indicates switching lanes or drowsiness detected. Yellow pins indicate switching lanes or drowsiness detected. Orange pins indicate switching lanes and drowsiness detected at the same time. Grey pins indicate the vehicle is at a stop.

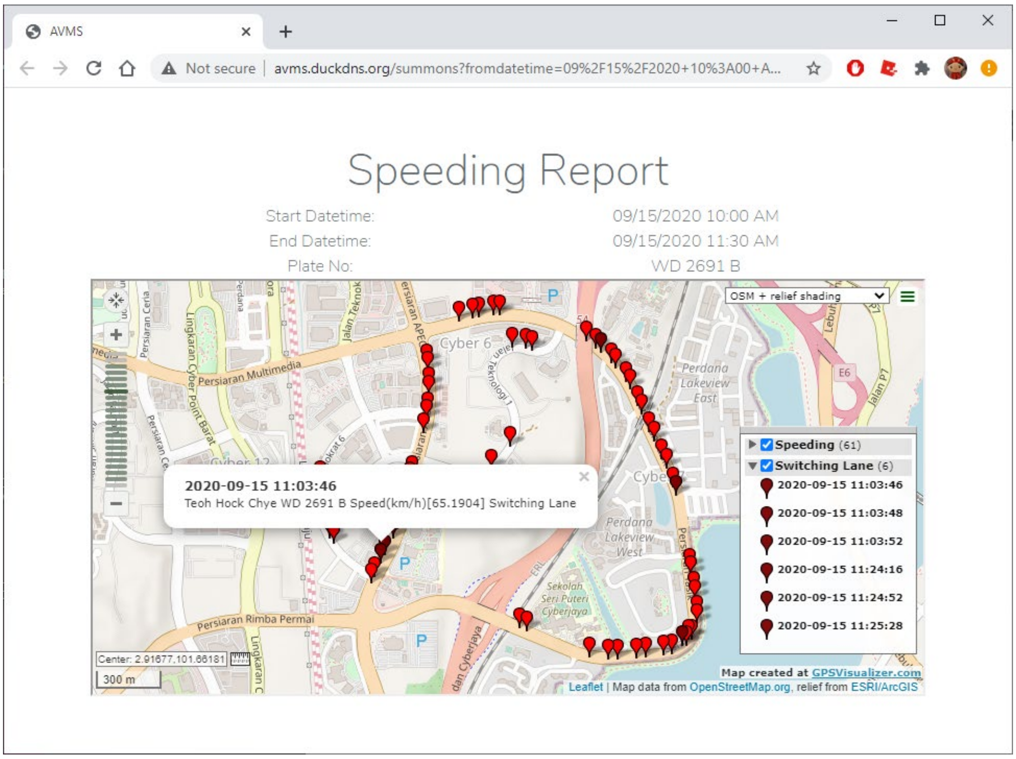


Figure 18. Speeding report on 15 September 2020

Figure 18 shows the speeding report which displayed the various statuses captured from the edge devices for the same test drive. The red pins indicate driving above the set speed limit and darker red indicates switching lanes or drowsiness detected.

Project closure drive demonstration

Date: 17 September 2020

Time: 10.00 am – 11.30 am

Location: Cyberview Sdn Bhd to MCMC Centre of Excellence

Speed limit: 50 km/h

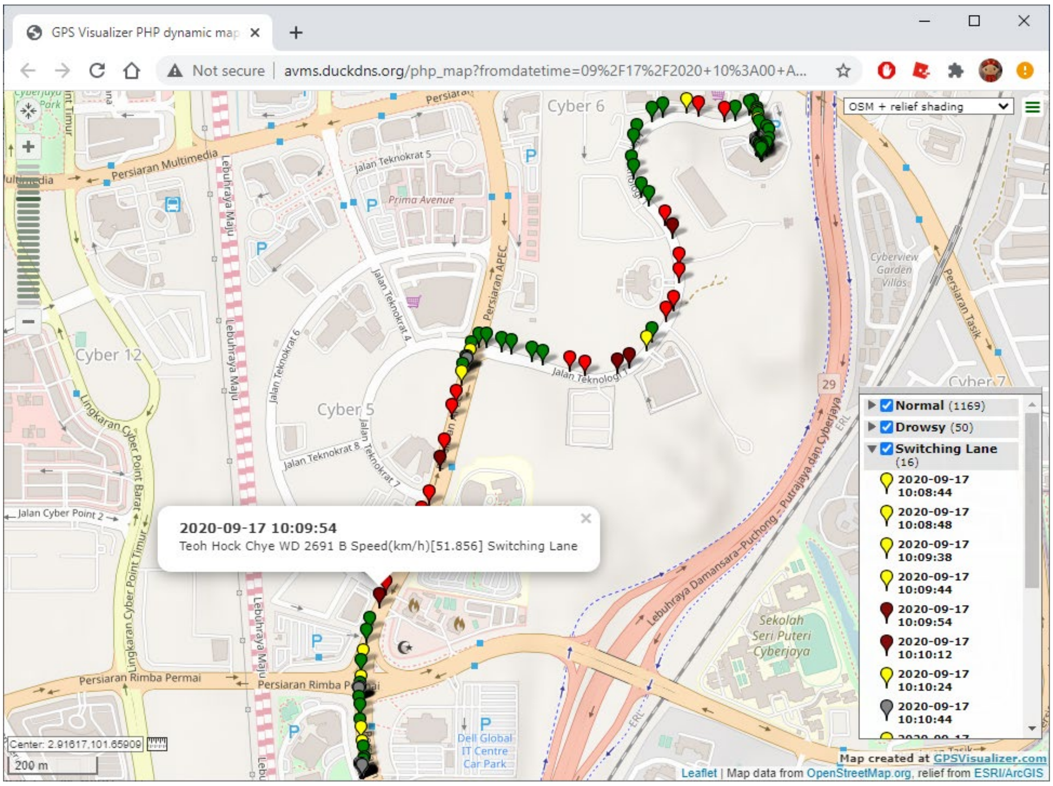


Figure 19. Driving route report on 17 September 2020

The driving route report shown in Figure 19 displayed the various statuses captured from the edge devices for the duration between 10.00 am to 11.30 am of the drive demonstration carried out on 17 September 2020. The green colour pins indicate driving within the set speed limit. Red pins indicate driving above the speed limit and darker red indicates switching lanes or drowsiness detected. Yellow pins indicate switching lanes or drowsiness detected. Orange pins indicating switching lanes and drowsiness detected at the same time. Grey pins indicate the vehicle is at a stop.

Figure 20. The image of the drowsy driver captured in AVMS during the drive demonstration

The driver acted out drowsiness and switching of lanes in a controlled drive demonstration was shown in Figure 20.

The queue size displayed on the frame indicates the speed of frames being processed. To avoid lagging, unprocessed frames are being flushed constantly and processing can continue to the latest captured image.

The result of this is a much more interactive status feedback rather than delayed status due to backlog of unprocessed images.

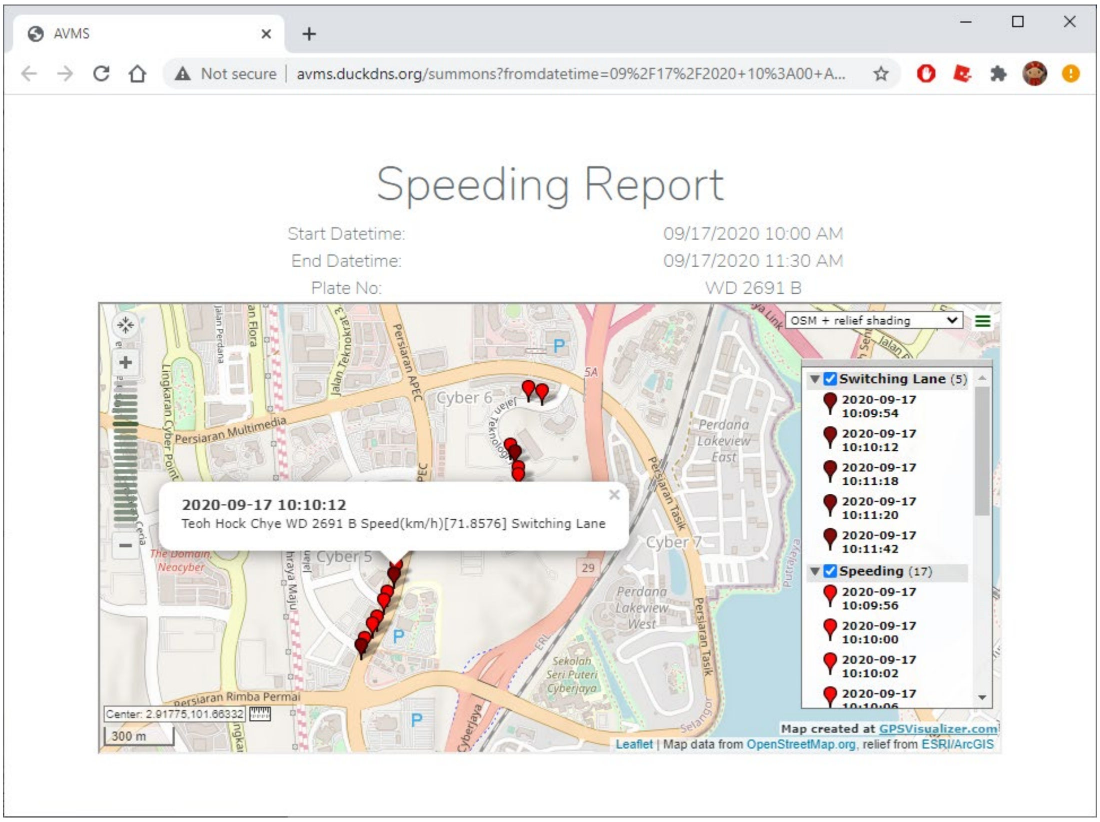


Figure 21. Speeding report on 17 September 2020

Figure 21 shows a speeding report which displayed the various statuses captured from the edge devices for the drive demonstration. The red pins indicate driving above the set speed limit and darker red indicates switching lanes or drowsiness detected.

The drive demonstration has shown that the AVMS system is able to go live online with real cloud broadcast to monitor the driver's behaviours during the drive demonstration. The speeding information such as GPS coordinates, time and speed can be displayed in real time and recorded on the map in the system's database. The coordinates of the locations where the driver changed lanes and drove drowsily can also be recorded into the database with time and date clearly stated in the system. Real time warning is given to the driver when he was speeding, drowsy and keep lane changing during the drive. The outcomes of the project are significantly achieved in fulfilment of the defined project objectives for the PoC.

6.2 Results Analysis

From the development of the system and its integration with the edge node and other devices in the AVMS, it was found that the implementation of container technology on the server side made it easier for the system to move the deployed containers from cloud to an on-premises cloud and vice versa.

In addition, the edge node being implemented for this system has offline capabilities and is able to function without the need for a dedicated connection with the server. However, should it detect internet is available, then it will resume communicating with the server again. It uses Representational State Transfer (REST) web service. To be able to support the high frequency of data transmission, the data at the server side does not get written into the database immediately but resides in the memory and can be immediately consumed especially if it needs to update the latest status to all the web browsers or clients. It will flush at interval of one minute to the database to persist the data to be used for reports.

In terms of lane detection, vision-based lane detection method is susceptible to interference of challenging illumination scenarios such as shadowed environment. To mitigate this, a novel single-image shadow region detection technology known as SAFE was developed. SAFE had been validated on the KITTI (Karlsruhe Institute of Technology and Toyota Technological Institute) road dataset and achieved top-8 ranking for lane estimation evaluation and behaviour evaluation, respectively.

AVMS also aimed to introduce and integrate a contactless drowsiness measuring system in a vehicle to measure the fatigue level of the driver. One of the most effective contactless drowsy indicators is the eye blink duration of the human eyes. Eye blink duration can be measured using Percentage of Eye Closures (PERCLOS) which increases as the person gets drowsier. An eye blink comprises of 2 states which are eye open (presence of iris) and eye close (absence of iris).

This leads to the development of a novel iris centre localisation system which detects and track the iris to identify the driver's eye blinks for drowsiness monitoring. The designed iris centre localisation system has been validated across 4 publicly available face databases which amounts to a total of 11,512 face images. Our system has achieved an iris detection accuracy of 90.21%, 91.24%, 97.82% and 91.48% on the BioID technology (BioID is a unique method to screen for physiologically relevant protein interactions that occur in living cells), MUCT Face Database ,GI4E (Gaze Interaction for Everybody) and Talking Face Video, respectively.

7. Conclusion

In conclusion, the development of AVMS has generated a successful PoC in overcoming and reducing road accidents due to the behaviour and driving pattern of a driver by adopting the Internet of Things (IoT) and new technologies.

The test drive and the drive demonstration conducted had proven that AVMS is successful in providing a real time monitoring of driving conditions being measured, namely speed, drowsiness and lane changing, as well as the corresponding alert system. The learnings from the PoC also led to development of other modules such as SAFE and the novel iris centre localisation system in supporting the overall AVMS.

It is recommended that AVMS and further research on the system to be continued to fully utilise this technology for more applications and other related conditions in preventing road accidents. It can also be a base for a use case in developing standards for IoT in vehicular operations and safety.

Annex A

The specification of 4G HAT

The specification of 4G HAT is shown in Figure A.1.

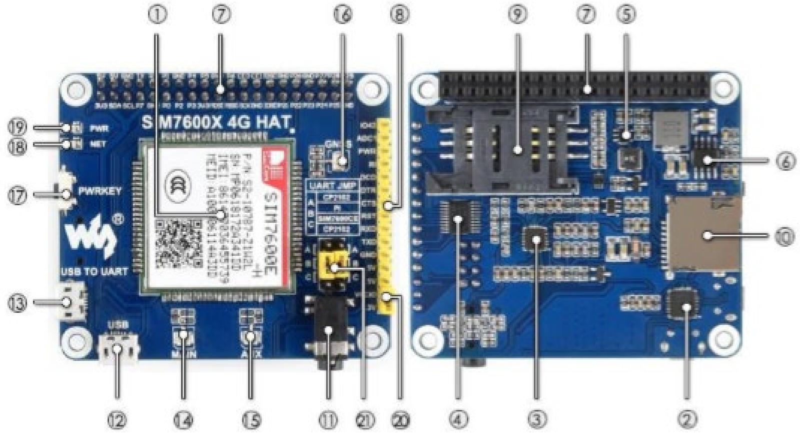


Figure A.1. Specification of 4G/3G/2G/GSM HAT for RPI

1. SIM7600E-H
2. CP2102 USB to UART converter
3. NAU8810 audio decoder
4. TXS0108EPWR voltage translator: translates 3.3V/5V into 1.8V
5. MP212DT power chip
6. MP1482 power chip
7. Raspberry Pi GPIO header: for connecting with Raspberry Pi
8. SIM7600 control interface: for connecting with host boards like Arduino/STM32
9. SIM card slot: supports 1.8V/3V SIM card
10. TF card slot: allows file/SMS/… storage
11. 3.5mm earphone/mic jack
12. USB interface: for testing AT Commands, getting GPS positioning data, etc.
13. USB to UART interface: for serial debugging, or login to Raspberry Pi
14. Main antenna connector
15. AUX antenna connector
16. GNSS antenna connector
17. Power switch
18. Network status indicator
19. Power indicator
20. Operating voltage selection jumper:

VCCIO – 3.3V: set operating voltage as 3.3V

VCCIO – 5V: set operating voltage as 5V

21. UART selection jumper:
    A. access Raspberry Pi via USB to UART
    B. control the SIM7600 by Raspberry Pi
    C. control the SIM7600 via USB to UART

Annex B

Publication / Journal Paper /News/Awards

Driver Awareness Monitoring and Alert System.

http://icipcn.com/

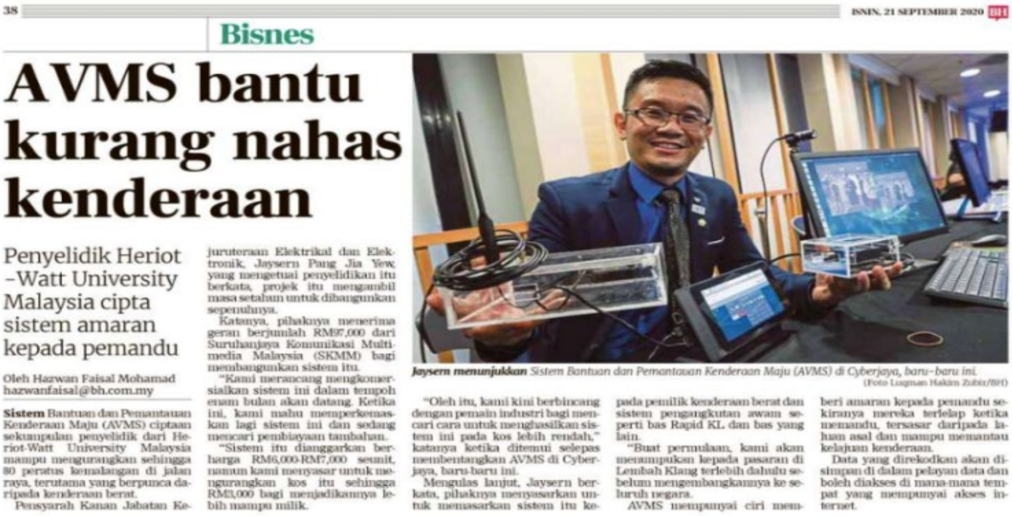
ICIPCN 2020

Scopus Indexed Scopus Source ID: 5100152904 May 6-7, 2020 Contact: +91 8870489968 Proceedings by Springer - Advances in Intelligent Systems and Computing Series

icipcn.com

CAFEO037- Advanced Heavy Vehicle Monitoring and Assistance System Using Industry 4.0 Framework for Future Sustainable Smart Cities. This paper is presented by Ir Dr Bhuven in Conference of ASEAN Federation of Engineering Organizations in Jarkata Indonesia.

https://www.theedgemarkets.com/article/ai-keep-your-eyes-road



38 ISNIN, 21 SEPTEMBER 2020 BH

Bisnes

AVMS bantu kurang nahas kenderaan

Penyelidik Heriot-Watt University Malaysia cipta sistem amaran kepada pemandu

Oleh Hazwan Faisal Mohamad
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Sistem Bantuan dan Pemantauan Kenderaan Maju (AVMS) ciptaan sekumpulan penyelidik dari Heriot-Watt University Malaysia mampu mengurangkan sehingga 80 peratus kemalangan di jalan raya, terutama yang berpunca daripada kenderaan berat.

Pensyarah Kanan Jabatan Kejuruteraan Elektrikal dan Elektronik, Jaysern Pang Jia Yew, yang mengetuai penyelidikan itu berkata, projek itu mengambil masa setahun untuk dibangunkan sepenuhnya.

Katanya, pihaknya menerima geran berjumlah RM97,000 dari Suruhanjaya Komunikasi Multimedia Malaysia (SKMM) bagi membangunkan sistem itu.

"Kami merancang mengkomersialkan sistem ini dalam tempoh enam bulan akan datang. Ketika ini, kami mahu memperkemaskan lagi sistem ini dan sedang mencari pembiayaan tambahan.

"Sistem itu dianggarkan berharga RM6,000-RM7,000 seunit, namun kami menyasar untuk mengurangkan kos itu sehingga RM3,000 bagi menjadikannya lebih mampu milik.

Jaysern menunjukkan Sistem Bantuan dan Pemantauan Kenderaan Maju (AVMS) di Cyberjaya, baru-baru ini.
(Foto Luqman Hakim Zubir/BH)

"Oleh itu, kami kini berbincang dengan pemain industri bagi mencari cara untuk menghasilkan sistem ini pada kos lebih rendah," katanya ketika ditemui selepas membentangkan AVMS di Cyberjaya, baru-baru ini.

Mengulas lanjut, Jaysern berkata, pihaknya menyasarkan untuk memasarkan sistem itu kepada pemilik kenderaan berat dan sistem pengangkutan awam seperti bas Rapid KL dan bas yang lain.

"Buat permulaan, kami akan menumpukan kepada pasaran di Lembah Klang terlebih dahulu sebelum mengembangkannya ke seluruh negara.

AVMS mempunyai ciri memberi amaran kepada pemandu sekiranya mereka terlelap ketika memandu, tersasar daripada laluan asal dan mampu memantau kelajuan kenderaan.

Data yang direkodkan akan disimpan di dalam pelayan data dan boleh diakses di mana-mana tempat yang mempunyai akses internet.

Newspaper article from Berita Harian on 21st September 2020 regarding the AVMS project.

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