

An IoT-based Public Transport Collection and Analytics Framework using Bluetooth Proximity Beacons (BLE) Project Meeting and Knowledge Sharing Report/Minutes Form

I. Organizer:

Name:	Prof Sharul Kamal bin Abdul Rahim	
Position:	Project Leader	
Institution:	Universiti Teknologi Malaysia	

II. Program:

Date:	10-11 December 2024
Venue:	Hyatt Place (Johor, Malaysia)

Program Agenda:

DAY 1	L
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09:00 - 09:30	Registration
09:30 - 10:30	 Introductory Session Welcome by Prof Sharul Kamal bin Abdul Rahim (10 mins) Welcome by Dr. Emoto Hiroshi (NICT) (20 mins) Project Introduction: objectives, activities and results by Prof Sharul Kamal bin Abdul Rahim (UTM) and Dr Sye Loong Keoh
	(UGS)
10:30 - 11:00	Morning Coffee Break
11:00 – 12:00	 Overview of the system and deployment architecture IoT Technology for Public Transport AI and Machine Learning for Journey Prediction Deployment in Johor
12:00 - 13:00	Sharing and Discussion with PAJ and City Councils
13:00 - 14:00	Lunch and Networking
14:00 - 17:00	 Showcase of Public Bus Arrival (P411 and T30) Dashboard in the City of Kulai: Larkin Sentral Terminal 'Hospital Kulai' Bus Stop



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	• 'Senai' Bus Stop
17:00	End of Meeting

DAY 2

08:45 - 09:00	Registration
09:00 - 10:30	 Project Team member updates and results discussion (Session 1): UB (Malang Deployment) USM, UTAR, UTB (Data Analytics)
10:00 - 10:30	Morning Coffee Break
10:30 - 12:00	Project Next Steps
12:00 - 13:00	Lunch and Networking
13:00 - 15:00	Visit to Johor Bahru City Council Smart Operation Centre
15:00 - 15:30	Afternoon Coffee Break
15:30 - 16:30	Any Other Matters

III. Participants:

No.	Name	Organization
1	Prof. Ir. Dr. Sharul Kamal Abdul Rahim	UTM
2	Dr Hiew Moi Sim	UTM
3	Mr Leo Ming Wu	UTM
4	Dr Emoto Hiroshi	NICT
5	Mr Shafiq bin Che Soh	UTM
6	Dr. Sye Loong Keoh	UGS
7	Dr. Chee Kiat Seow	UGS
8	Dr. Achmad Basuki	UB
9	Dr. Agung Setia Budi	UB
10	Dr. Noor Farizah Binti Ibrahim	USM
11	Dr. Mohd Najwadi Yusoff	USM
12	Mr Syazwan Jasni	PAJ
13	PAJ Second Representative	PAJ



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14	Mr Ali	МРКи
15	MPKu Second Representative	MPKu
16	Dr. Choo Kok Wah	MBJB
17	MBJB Second Representative	MBJB
18	MBIP First Representative	MBIP
19	MBIP Second Representative	MBIP

IV. Summary of the activities corresponding to the objectives

1. Briefly describe the objectives of the event.

The workshop aims to bring together all project partners, city councils in Johor (Kulai, Iskandar Puteri, Johor Bahru), Johor Public Transport Corporation (Perbadanan Pengangkutan Awam Johor (PAJ)), and NICT to discuss the challenges and solutions for urban mobility. The workshop allows for the project team to share the technical knowhow, IoT technologies used in the project, and the project outcomes from deployment sites in Johor and Malang, Indonesia to the policy makers and government agencies in Malaysia in order to promote adoption. This is important to convince the various stakeholders in the Johor State Government to adopt the technology beyond the project duration, and potentially expand to other service routes in the state

2. Describe the activities corresponding to the objectives.

The project leader Prof. Sharul first welcomed all the participants at Hyatt Place Hotel and this was followed by an overview of NICT and ASEAN IVO presentation by Dr Emoto. Prof Sharul then provided an overview of the project according to the current progress, especially the deployment progress in Johor Malaysia.

- 4 bus routes (P-411,P-211,T30 and T31) involving 15 buses of both PAJ's Bas Muafakat Johor and MyBas's buses are fitted with Bluetooth Low Energy (BLE) Beacons for the Johor trial.
- Raspberry Pi Zero (RPi) is used as the BLE detection device and the team tried to minimize the power consumption.
- 21 RPi have been deployed at 21 locations along the two bus routes.
- Passenger Display Information System (PIDS) have been installed and deployed in 4 locations, namely Senai (2 displays), Kulai (1) and Larkin Sentral Terminal (1).
- A basic machine learning model utilizing XGBoost has been deployed to perform the prediction of ETA based on the location detected by BLE.

Dr Keoh provided technical updates on the software development for Johor deployment and installation of PIDS. UTM Student Mr Leo Ming Wu presented his work on the AI model development and deployment using the data collected in Johor.

Before lunch break, the city council representatives shared their view on the developed system. In particular, Dr Choo from MBJB shared that the JB city council has procured a



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smart surveillance system that can potentially use its AI and camera system to detect the bus plate number to enhance the fleet tracking. The operation centre is located in the MBJB Building. As for PAJ, currently they are working on automatic passenger counting (APC) in order to increase the ridership of their free buses. By February 2025, there is a plan to consolidate myBAS and BMJ services. For the Kulai City Council, there is strategic plan for public transport hub to be developed in Senai area, connecting the airport, train and bus services.

The team then proceeded to visit the sites with PIDS installed. A UTM bus was arranged to ferry the participants to all sites. We first visited the Larkin Sentral Bus Terminal, where the floor-standing LCD screen display is installed. The team had the chance to see the MJ buses arriving and departing from the platform, and we also showered the BLE beacon installed on the buses. Overall, the team was impressed with the display and suggested that UI/UX of the screen can be improved to reduce confusion to the passengers.

The team the visited the Senai PIDS. The display is a LCD 32" monitor and there is a custom-made casing (water proof). As not all buses are equipped with a BLE beacon, hence not bus ETA is available. Instead, the PIDS will display the scheduled arrival time if the live ETA is not available. The team witnessed that the T30 bus was quite on-time and arrived according to the schedule displayed on PIDS.

The last stop was to visit the PIDS Opposite Hospital Kulai. The team waited for the bus at the bus stop and we were impressed with the accuracy of the predicted ETA by the AI model at this bus stop. Overall, the installed PIDSs are robust, water-resistant, and accurate.

The overall feedback for the project was very positive by the team members and representatives from city councils and PAJ.

On the second day, the team focused on the progress updates from USM and UB. Dr Agung from UB presented that the deployment in Malang Indonesia is currently stable, with the RPi 4 running reliably during the school bus operation. However, there was one RPi 4 deployed at Tlogomas which saw a low beacon detection rate. This seems to be too far from the bus route and may need to be re-located. This was followed by Dr Ibrahim from USM presented the data analytics and machine learning on Malang dataset. The CatBoost model with Wrapper Based Optimisation (RFE) has been chosen as the for predicting the ETA for Malang school bus. It achieves an R² of 0.865. This model was further refined with gaussian hyperparameter tuning on wide space of parameters, as well as catboost + hyperparameter tuning focused on L2 regularization. A web application has been developed to show the prediction of ETA. The models were further trained with weather information as one of the featurse, and it turns out that the weather feature did not play a significant role in affecting the ETA or journey duration.



Lastly, Dr Keoh presented the future plan of the project, as this IVO project will end in May 2025, the team hopes to obtain the support from the city councils and PAJ to adopt the projects, so that this will benefit the commuters.

After lunch, the team visited the MBJB Smart City Operation Centre in Johor Bahru.

3. Describe, in detail, if there are changes in the work plan, project schedule, budget allocation, etc. from the initial proposal.

There is no change to the current project schedule or budget allocation.

V. Others

(It is best if you put event pictures here)

1. Pictures



Figure 1: Prof Sharul welcomed the participants



Figure 2: Participants in the meeting





Figure 3: Leo presenting his work on AI prediction



Figure 4: Inspecting the PIDS in Senai Bus Stop



Figure 5: PIDS in Senai Bus Stop





Figure 7: Inspecting PIDS in Opp Hospital Kulai Bus Stop



Figure 8: Inspecting PIDS in Senai Bus Stop



Figure 8: Dr Setia Budi presenting UB updates





Figure 9: Dr Ibrahim presenting USM updates



Figure 10: Group photo at the end of the meeting