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12th ISCTSC in Portugal (20-25 March 2022)

#86 - IMPUTING TRANSPORTATION MODES FROM GPS DATA IN A MOTORCYCLE-DEPENDENT AREA

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Introduction

Mode detection methods are the key to deploying GPS in travel demand survey.

- Little, however, is known about the potential and barriers to mode imputation from GPS in developing countries.
- This study aims to impute travel modes from GPS data in combination with socio-demographics of respondents in Hanoi (Vietnam) - a motorcycle-dependent city.

Experimental description

- App: TRavelVU
- Time: 18/03 – 15/04/2020
- Place: Hanoi
- After filtering, used GPS data of 63 persons.

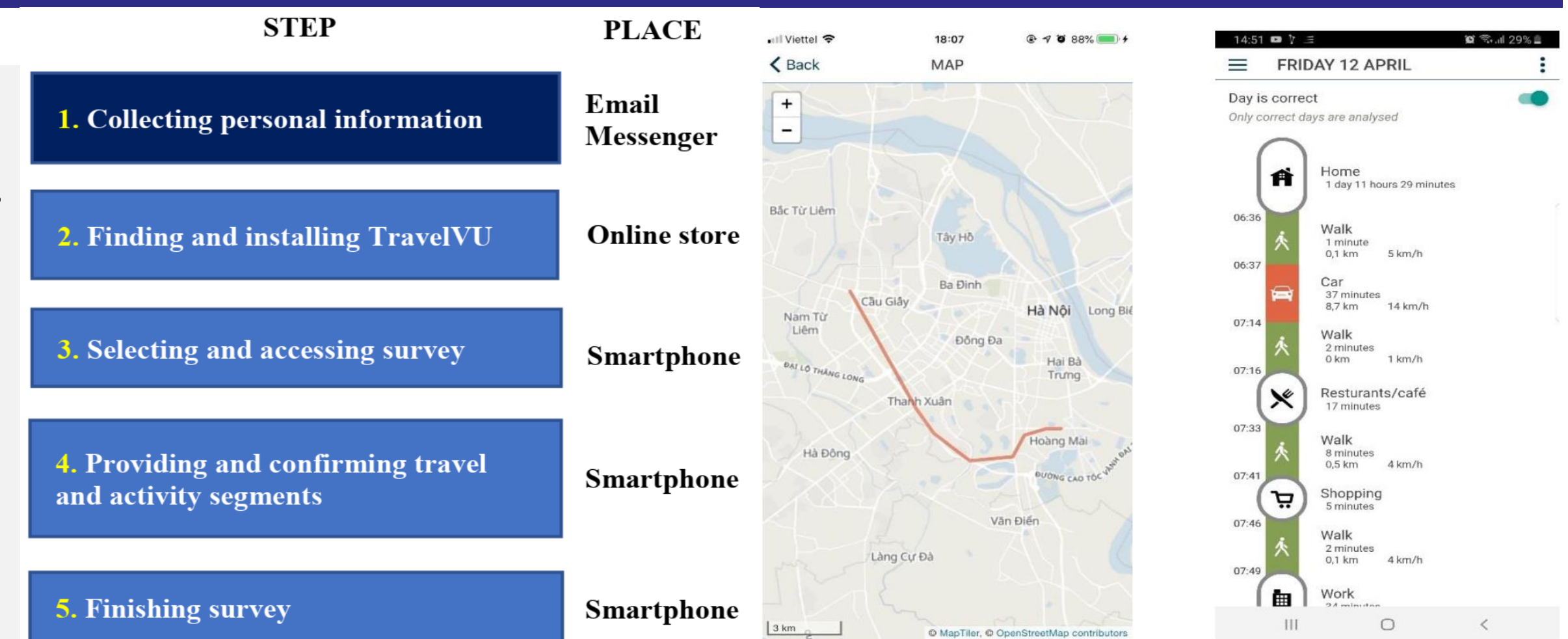


Fig 1. Survey process and app TRavelVU

Methodologies and results

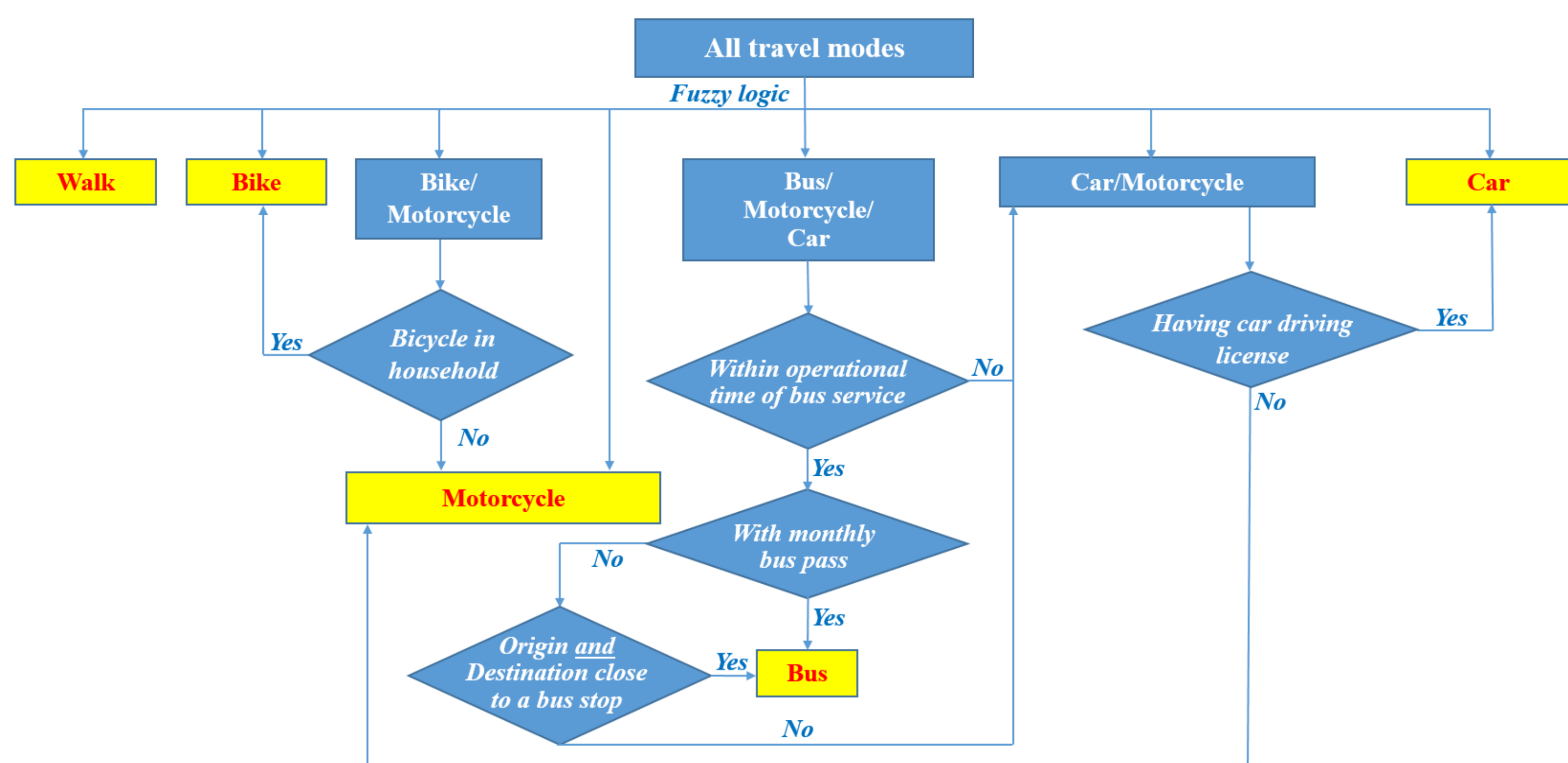


Fig 2. Process of travel mode imputation

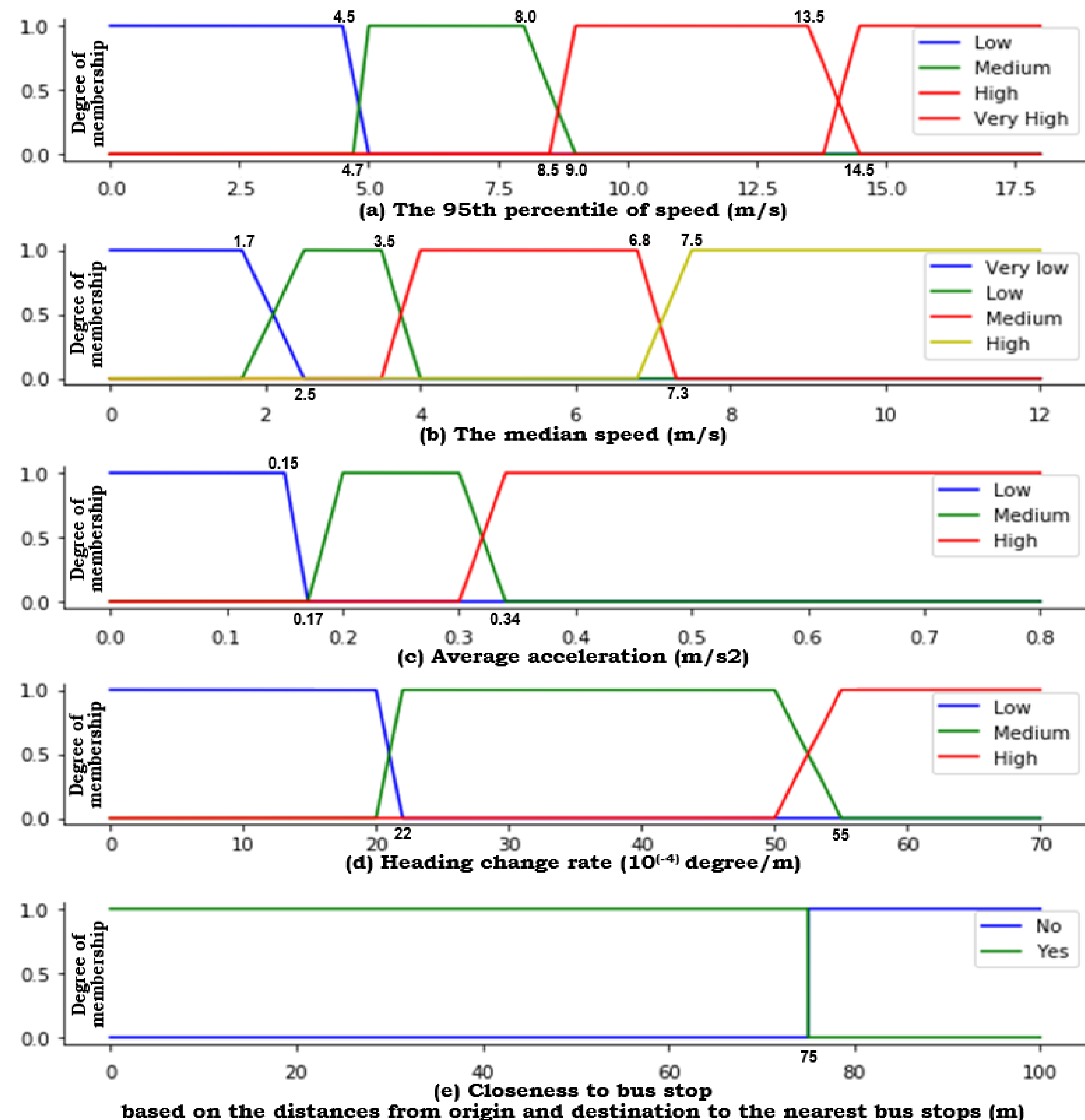


Fig 3. Membership functions of fuzzy variables

Conclusions

- Among first studies of detecting travel modes from GPS data in a motorcycle-dependent city of a developing country.
- Inclusion of motorcycle increases the difficulty of mode detection challenge.

Tab 1. Confusion matrix of imputation results

		Predicted					Total	Recall
		Walk	Bike	Bus	Motorbike	Car		
Actual	Walk	719	9	0	28	2	758	94.9%
	Bike	4	75	0	23	2	104	72.1%
	Bus	0	2	72	21	2	97	74.2%
	Motorbike	48	33	36	1058	70	1245	85.0%
	Car	11	5	10	117	444	587	75.6%
	Total	782	124	118	1247	520	2791	
Precision		91.9%	60.5%	61.0%	84.8%	85.4%	Acc.	84.8%

Process of mode detection (Fig 2.)

- Applying fuzzy logic (Fig 3.) to detect: (1) walk, (2) bike, (3) car, (4) bike/motorcycle, (5) bus/motorcycle/car, (6) car/motorcycle.
- Post-processing to further detect:
 - Bike/motorcycle: A bike/motorcycle segment was classified as a bike one in case the traveler came from a household with at least one bicycle.
 - Car/motorcycle: In case the user had a car driving license, the car/motorcycle segment was labelled as a car segment. If not, it was categorized as a motorcycle one.
 - Bus/motorcycle/car: First, in case both the starting time and ending time of a bus/motorcycle/car segment felt into the operational time of bus services, this segment was then checked by two criteria. In case the user had a monthly pass or both origin and destination of this segment was close to bus stops, it was classified as a bus segment. By contrast, it was next treated as a motorcycle/car segment.

Mode imputation results (Tab 1.)

- Reasonable overall accuracy of 84.8%.
- Motorcycles are the main source of misclassification.
- Imputations of bus and bike are poorer (see precision and recall)

Future direction

- Improving the detection of bus and bike using machine learning

Our related publications

- Nguyen, M.H., Armoogum, J., 2020. Hierarchical process of travel mode imputation from GPS data in a motorcycle-dependent area. *Travel Behav. Soc.* 21, 109–120. <https://doi.org/10.1016/j.tbs.2020.06.006>
- Nguyen, M.H., Armoogum, J., Adell, E., 2021. Feature Selection for Enhancing Purpose Imputation using Global Positioning System Data without Geographic Information System Data. *Transp. Res. Rec.* 2675, 75–87. <https://doi.org/10.1177/0361198120983006>
- Nguyen, M.H., Armoogum, J., Madre, J.-L., Garcia, C., 2020. Reviewing trip purpose imputation in GPS-based travel surveys. *J. Traffic Transp. Eng. Engl. Ed.* 7, 395–412. <https://doi.org/10.1016/j.jtte.2020.05.004>