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Development of E-ACTIVETRANS for Young Professional Planners/Engineers

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ABSTRACT

This paper presents a development of an expert system to be used as an advisory in finding the solution to problems which are normally solved by human experts. The E-ACTIVETRANS is developed to help young engineers/planners in designing a new cycle lane in urban areas and also to help in reallocation of an existing roadway space for cycle lanes. This system has three sub-systems: Planning on Strategies to Shift from Passive Transportation to Active Transportation, Design on Bicycle Facilities and Examples of Successful Implementation. This paper focuses on the design of bicycle facilities whereby the prototype was developed based on data acquired from the domain experts who are involved in bicycle facility module design, as well as the initial text analysis obtained during the domain familiarisation stage. The validation of the system was performed through a comparison of knowledge content in E-ACTIVETRANS based on expert opinion. The average level of acceptance is 91 percent which validates the system and knowledge of the experts.

Keywords: Bicycle facilities, E-ACTIVETRANS, expert system, human experts

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INTRODUCTION

E-ACTIVETRANS is developed as an advisory system to provide guidance to users on solutions to problems which are normally solved by experts (Forslund, 1995). Both expert and advisory systems play the role of problem-solving packages that mimic experts (Mansyur, 2011). E-ACTIVETRANS was developed using knowledge from experts in the transportation field, and information obtained from guidelines, encyclopaedia and research publications.

DEVELOPMENT OF E-ACTIVETRANS

The E-ACTIVETRANS is developed using Visual Basic.NET and MY SQL. VB is an event language designed to interact with the user on a running system. The most widely used type of representation consists of collection of facts, while rules are used to represent IF-THEN reasoning. These rules have the form of "IF 'condition' THEN 'action'." According to Pauziah et al. (2009), if the condition part is true within the scope of the knowledge base, then the condition would store the facts portion of the system knowledge engine. Therefore, the condition part is performed.

The E-ACTIVETRANS begins by outlining some key guiding principles to help in the selection and identification of available types of bicycle facilities. This guide classifies bicycle facilities into four (4) types. There are no fast and hard rules in determining the most appropriate type of bicycle facility for a certain location (Mansyur, 2011b).

The knowledge extracted during the acquisition process is grouped together in 5 segments in this design module. For the development of knowledge modules, each module solves a specific aspect of the problem within the domain even though some inter-dependency exists between the component tasks. Figures 1, 2 and 3 show the flowchart for the development of E-ACTIVETRANS advisory system, beginning from the first step. This paper focuses on the design of bicycle facilities; it outlines TWO (2) suggestions based on the new design of cycle lane and reallocation of roadway space.

New Design for Cycle Lane

There are several types of cycle lane in E-ACTIVETRANS. Choice is influenced by the vision of the route itself and the surrounding area in the context of delivering travel patterns. In this module, the user needs to know how to select the density area, type of user and other factors influencing the selection of bicycle facilities (VTPI, 2012). The E-ACTIVETRANS will advise the user on how to design the cycle lane according to the flowchart shown Figure 1.

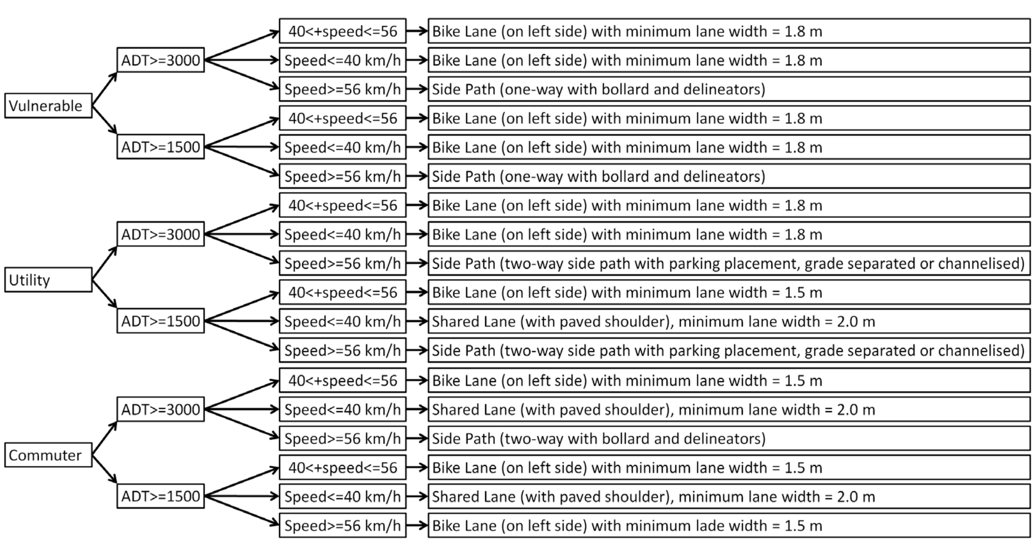

Figure 1. Advisory expert system for new design for cycle lane

Reallocation of Road Way Space

This section describes how roadway design practices can encourage development of more efficient transportation system through reallocation of road space, such as shifting the road space from automobile traffic to other active transport modes such as bike lanes and sidewalks. Reallocation of roadway is particularly appropriate on congested streets (VTPI, 2014). The knowledge extracted during the knowledge acquisition process is grouped together into specific modules based on the objective of the users. Figure 2 and Figure 3 show the flowchart for the development of the reallocation of the existing roadway space for cycle lane's diagnostic from the first step.

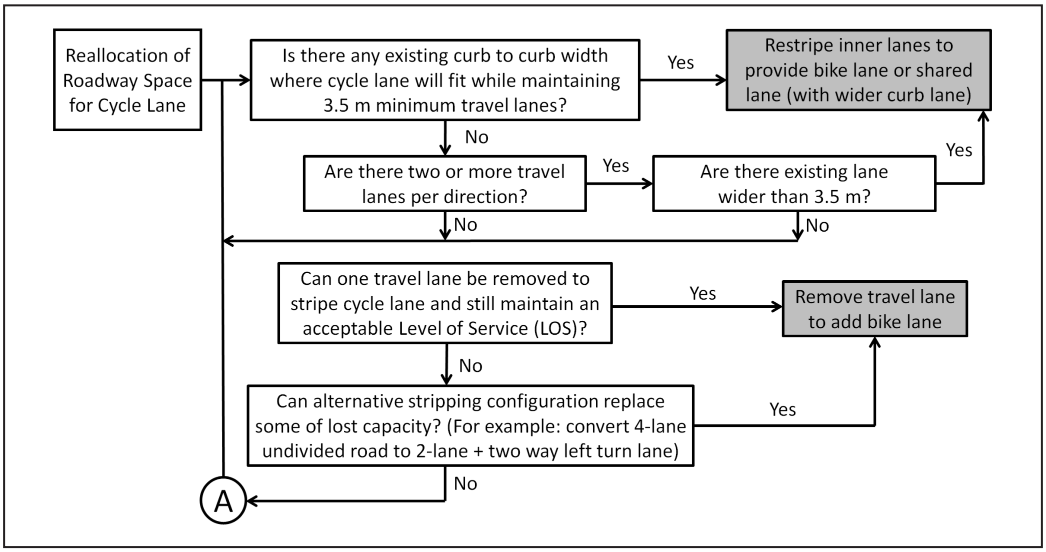

Figure 2. Advisory expert system for the reallocation of roadway space for cycle lane

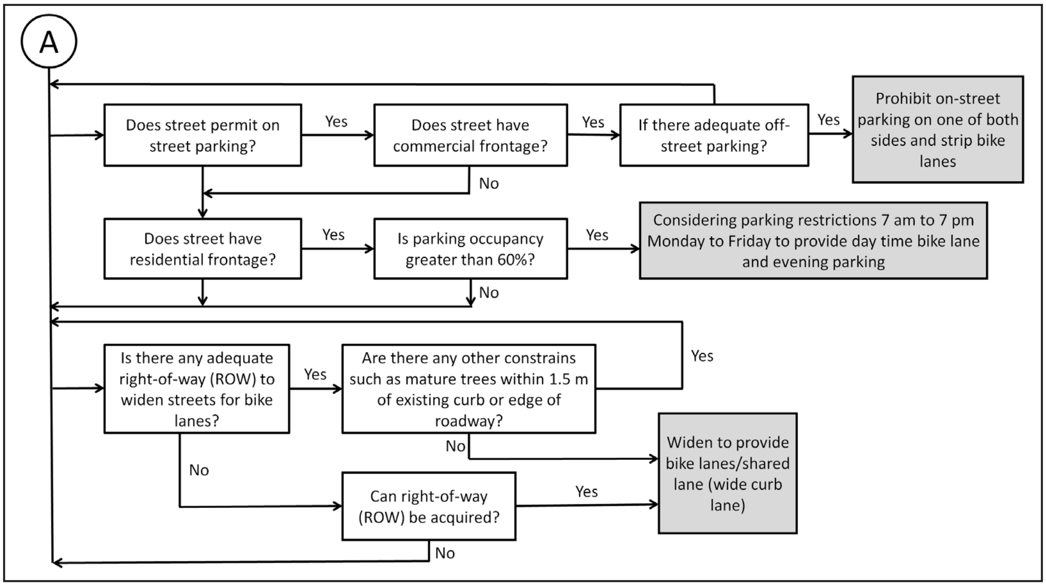

Figure 3. Advisory expert system for the reallocation of roadway space for cycle lane (continued)

E-ACTIVETRANS REASONING VALIDATION

The reasoning rules of E-ACTIVETRANS were verified during system testing to ensure the validity of the system. A number of rules including the logical errors is summarized in Table 1.

Table 1
Number of rules used in the E-ACTIVETRANS

Single Rules					Conclusion (THEN-Part)	
N	Condition (IF-Part					
1	If there is any existing curb to curb width where cycle lane will fit while maintaining 3.5m minimum travel lanes				Restripe inner lanes to provide a bike lane or a shared lane (with a wider curb lane)	
2	If one travel lane can be removed to stripe cycle lane and still maintain the acceptable Level of Service (LOS)				Remove the travel lane to add a bike lane	
Two Combined Rules						
N	Master Rules	Condition (IF-Part) Operator	Sub-Rule		Conclusion (THEN-Part)	
3	If there is no one travel lane can be removed to stripe the cycle lane and cannot maintain an acceptable Level of Service (LOS)	AND	If an alternative stripping configuration replaces some of the lost capacity (for example: convert a 4-lane undivided road to 2-lane + two way left, turn lane).		Remove the travel lane to add a bike lane	
4	If there is an adequate right-of-way (ROW) to widen streets for bike lanes	AND	If there are no other constraints such as mature trees within 1.5m of the existing curb or edge of roadway		Widen to provide bike lanes/shared lane (wide curb lane)	
5	If there is no adequate right-of-way (ROW) to widen streets for bike lanes	AND	If right-of-way (ROW) is acquired	Widen to provide bike lanes/ shared lane (wide curb lane)		
Three Combine Rules						
Condition (IF-Part)						(THEN-Part)
N	Master Rules	Operator	Sub-Rule	Operator	Sub-Rule	Conclusion
6	If there is no existing curb to curb width where cycle lane will fit while maintaining 3.5m minimum travel lanes	AND	If there are two or more travel lanes per direction	AND	If there is an existing lane wider than 3.5m	Restripe the inner lanes to provide a bike lane/shared lane (with wider curb lane)
7	If there is a permit on street parking		If street have commercial frontage		If there is an adequate off-street parking	Prohibit on-street parking on one or both sides & strip a bike lane
8	If there is no permit on street parking		If street have residential frontage		There is a parking occupancy greater than 60%	Consider parking restrictions from 7am to 7 pm (Monday to Friday) to provide day time bike lane and evening parking

E-ACTIVETRANS INTERFACE WINDOW

The prototype of E-ACTIVETRANS was developed according to the knowledge acquisition derived from the expert domains. The example of data output is shown in Figure 4.

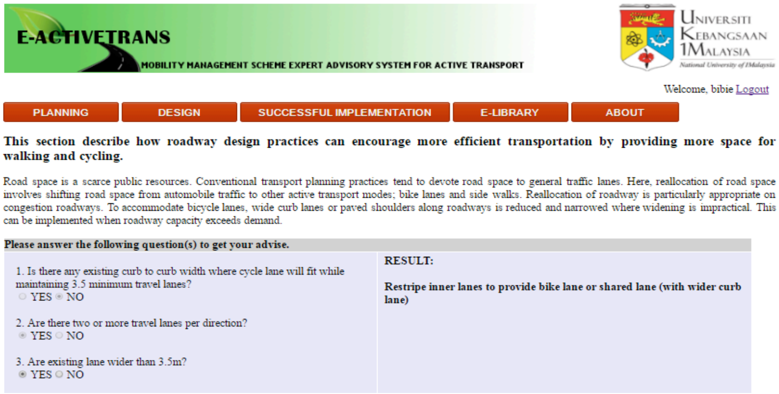

Figure 4. User interface for the decision of reallocation of roadway space

COMPARISON OF E-ACTIVETRANS RESULTS AND DOMAIN EXPERTS

The system validation was performed through a comparison of knowledge contained in E-ACTIVETRANS with the opinion of FOUR (4) domain experts as shown in Table 2 .

Table 1
Evaluation of domain experts for knowledge contained in E-ACTIVETRANS

Module	EXP 1	EXP 2	EXP 3	EXP 4
Module 1	88	100	93	98
Module 2	96	93	92	95
Module 3	93	90	96	87
Module 4	92	88	90	91
Module 5	82	84	90	88
Overall	90	91	92	92

The overall acceptance levels of experts was 90%, 91%, 92% and 92%. Since an E-ACTIVETRANS is an abstraction of reality, perfect performance cannot be expected (O’Keefe, 1987).

CONCLUSION

This paper presented the development of how knowledge acquisition obtained from expert individuals in the transportation field as the expert domain which has been arranged accordingly with references obtained from guidelines, encyclopaedia and research publications to form the expert system. The level of acceptance was 90%, 91%, 92% and 92% shows that the system is validated and represents the knowledge of experts. Hence, the overall comments, the validation and evaluation results indicated that E-ACTIVETRANS system has a degree of user-friendliness acceptable for most intended users.

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