



# Spoken and Multimodal Bus Timetable Systems: Design, Development and Evaluation

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We have developed multiple bus timetable systems in various research projects. User tests have shown that open user-initiative dialogue strategy based on human-human interaction is not an optimal starting point for interactive systems. We have addressed the problem in various ways.

## Towards truly mixed-initiative interaction - the Busman system

Welcome to Busman, the Tampere bus information service! How may I help you?

*I'm leaving from Central Square, and I'm going to Hervanta.*

Sorry, I didn't recognize that. Please tell me where you are leaving from.

*"From Central Square."*

Where are you going to?

*"to Hervanta."*

From Central Square to Hervanta use lines 13 and 20. Do you want to hear timetables?

*"Yes."*

From Central Square to Hervanta on weekdays at 11:15 bus in line 23. (list continues)...

## Human - human interaction as the basis - the Interact system

Welcome to the Helsinki automatic bus timetable service. How may I help you?

*"When does bus number 6 leave from Hakaniemi to Hietalahti?"*

At 10:59.

*"When is the next bus from downtown to Munkkiniemi which leaves after 10:58?"*

Unfortunately bus 44 does not go from downtown to Munkkiniemi.

*"When does leave the next - what lines go from downtown to Munkkiniemi?"*

Sorry, I don't understand.

*"What lines go from downtown to Munkkiniemi?"*

At 10:57.

## Task-oriented system-initiative dialogues - the Stopman system

Welcome to the Stopman timetable service. You can ask help by saying "tell instructions". Please tell the name of the bus stop, for example "Main Square".

*"Alexander Church"*

Do you want to retrieve timetable for stop Alexander Church?

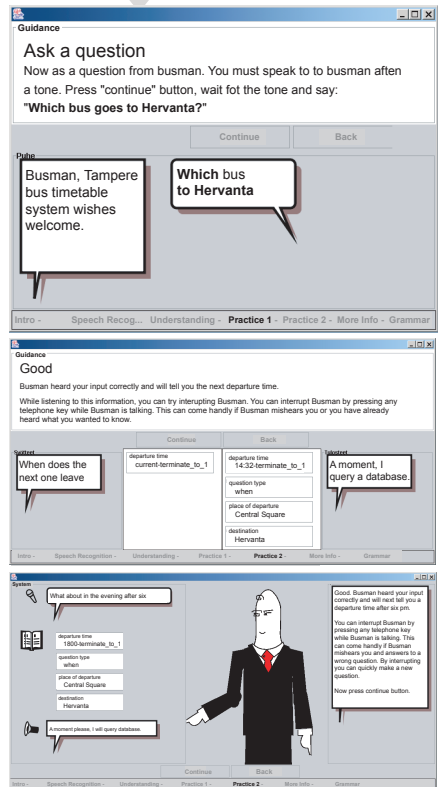
*"Yes"*

Wait while the time table for Alexander Church is retrieved. The time is 10:10. Today, the next buses leaving from bus stop Alexander Church are to Vehmainen number 5, now (list continues)... Give your command, for example tell instructions.

*"Select a line"*

Please tell the line number. You can a list the lines by saying "list lines".

*"Thirteen."*



Busman	1. Initiative	Stopman
In addition to asking for missing information Busman is capable of taking the initiative in other situations as well. Most importantly, the initiative is modeled in a way which allows adaptive, truly mixed-initiative dialogues to take place.	Most users can be satisfied with a robust, system-initiative interface. The Stopman system provides a task-oriented, system-initiated interface. The aim of the system is to satisfy most of the callers with the first timetable listing.	
Implicit confirmations are used to help the users to follow the dialogue. Furthermore, the Busman system is able to change dialogue strategy in flexible ways if problems occur.	System-initiative user interface guides the user through the Stopman system. Errors are prevented by providing examples of valid inputs. The system also uses explicit confirmations in low confidence score, high cost situations.	
Users quickly bypass general help prompts. In addition to traditional help functionality, integrated tutoring is used to familiarize the users with the Busman system. We have found that integrated tutoring is a good way to familiarize the user to the rhythm of the interaction.	In order to provide help and guidance for novice users, Stopman supports universal commands that adapt to the interaction and can be used across applications. For example, "what next?" gives relevant guidance to the user, taking into account the current dialog situation and history.	
In the Busman application the tutor is implemented as a multimodal application to make the capabilities of the system visible and help the user to learn how to use speech-only systems.	We have extended the Stopman system to use smartphone displays to make listings and menus more pleasant and efficient. Menus for item selection are presented also in graphical form. All system outputs feature a small menu where global commands, such as "Quit" and "Cancel" are always presented.	



## Conclusions

We have presented three timetable systems with different interaction management approaches. Concluding from the tests with the Interact system we found that it is not preferable to use human-human data, as such, to design spoken dialogue systems. This was shown in the inefficiency of the initial design of Interact. The system-initiative Stopman system is able to serve most users with a single prompt and usage changes towards even briefer interaction, which is shown in the shortening of call durations over time. The Busman system, on the other hand, solves the inefficiency by using software tutors that familiarize users to the system and by using a truly mixed-initiative user interface. Multimodality is used in both applications to support speech-based interaction.