A Comparative Study of Speech and Dialed Input Voice Interfaces in Rural India

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The Case for Voice Interaction

Asking a question on Avaaj Otalo

AO: <tune> Welcome to Avaaj Otalo!
You can get to the information by saying a single word.
To ask a question, say ‘question’.
To listen to announcements, say ‘announcements’.
To listen to the radio program, say ‘radio’.

User: I want to ask a question.

AO: Sorry, I didn’t understand. I can only understand single words.
Do you want to ask a question – yes or no?

User: Yes.

AO: OK, you want to ask a question.
To ask a question about agriculture, say ‘agriculture’.
To ask about animal husbandry, say ‘animal’.

Key design choice: input modality

- Application requirements
  - Inexperienced/low literacy users
  - Learnable without training
- Speech is natural
  - But speech recognition requires lots of data

Small- vocabulary, isolated word speech interfaces

Tamil Market

- 27-word vocabulary
- 18 speakers' training data
- 98% accuracy

[Plauché et. al. 2006]

The Experiment

VS.

SPEECH

TOUCHTONE

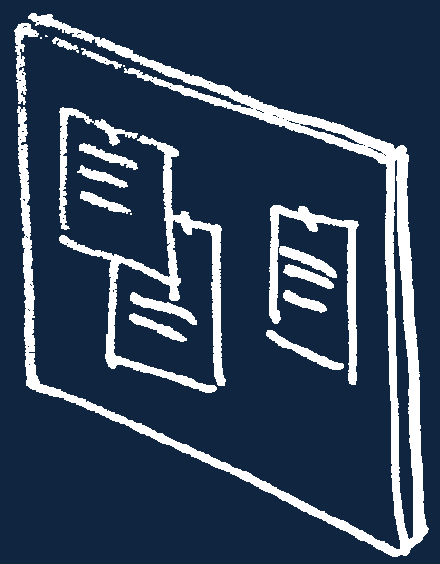
- Previous work for technical professionals in U.S.
- This study: low-literacy, inexperienced users

Sketches courtesy of Bill Verplank

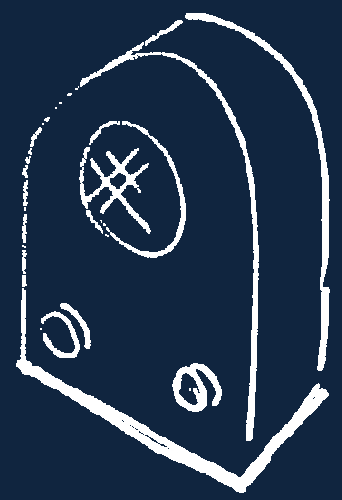
Methodology and Participants

- 45 participants, two treatments, between-subjects
- Small-scale farmers (median 10 acres)
- Native Gujarati, no English
- No experience with voice interfaces
- 73% less than 8th grade education;
  87% never used a PC

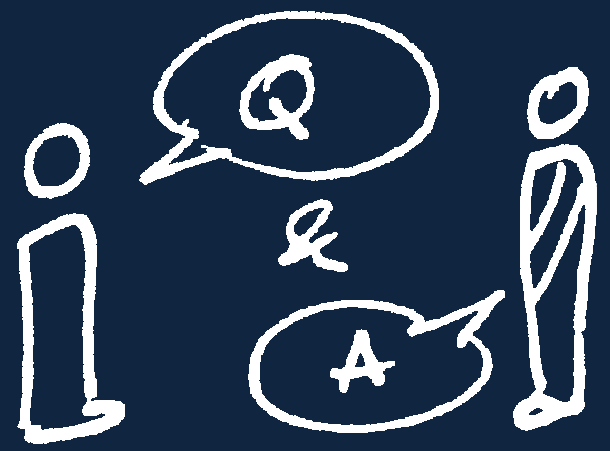
Application Features



ANNOUNCEMENTS



RADIO ARCHIVE



QUESTION AND ANSWER

Sketches courtesy of Bill Verplank

Tasks

1. Listen to announcements (1 step)
   - sequential, 30-60 second audio snippets
2. Listen to a radio program (2 steps)
3. Record a question (9 steps)
   - Categorize question (4 steps)
   - Record question (2 steps)
   - Provide personal contact information (3 steps)

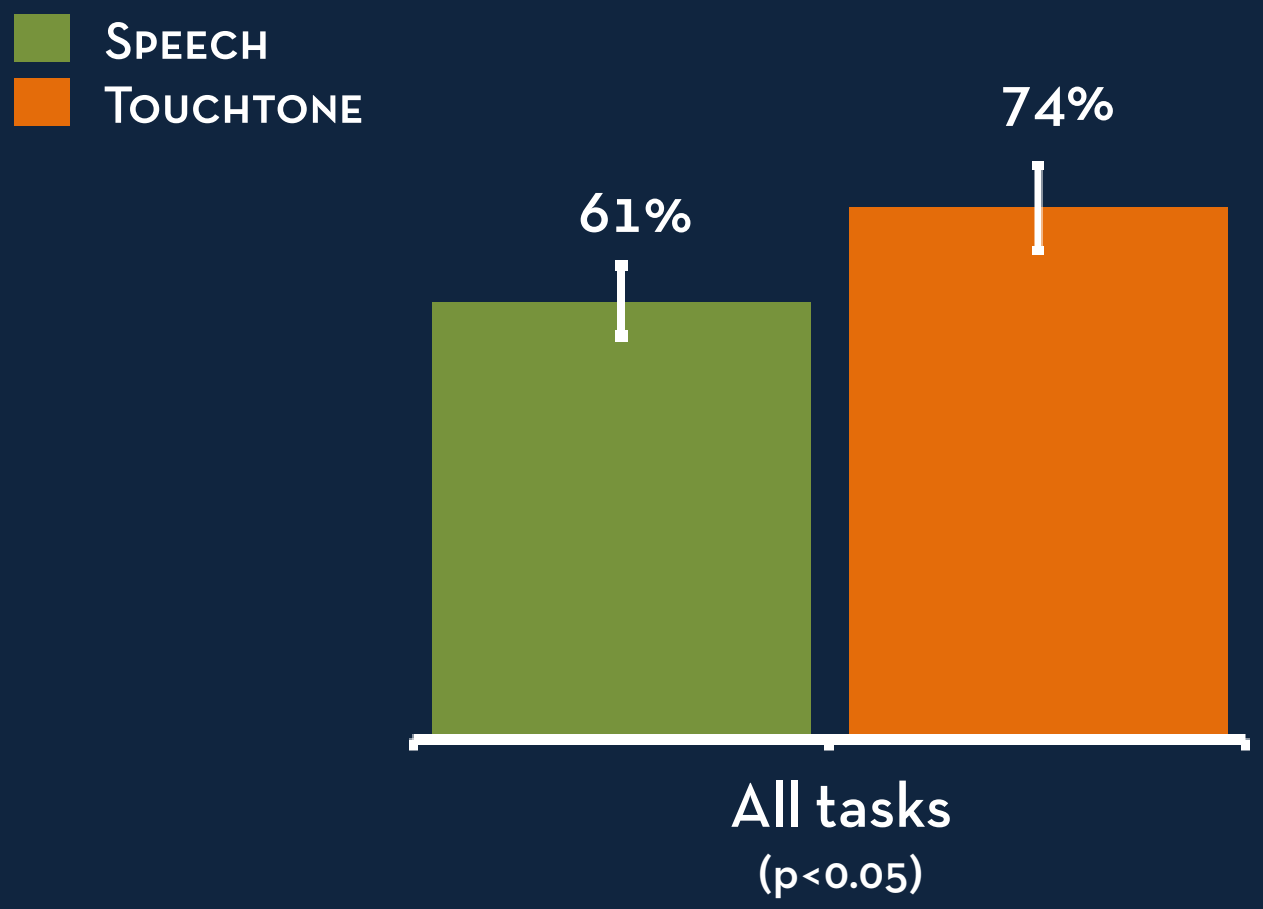
Speech Recognition Accuracy

- Our method: cross-language transfer
  - Apply unmodified acoustic model using transliterated vocabulary
- Accuracy: 94% (commercial systems: ~98%)
- Alternative: model adaptation
  - Linear transformations based on GMM parameters
  - Requires some speech in target language

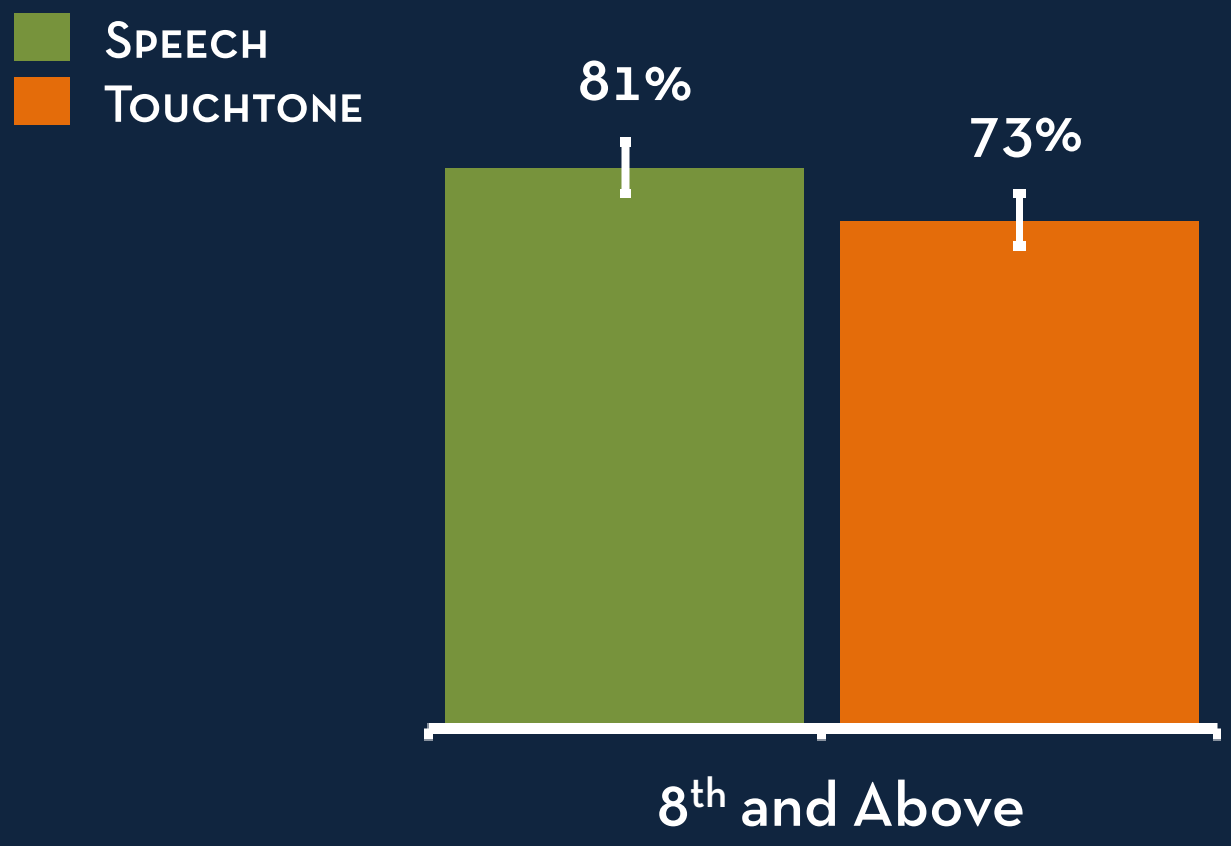
Testing Environment

	OFFICE	VILLAGE
PARTICIPANTS	38 (half speech, half touchtone)	7 (half speech, half touchtone; all women)

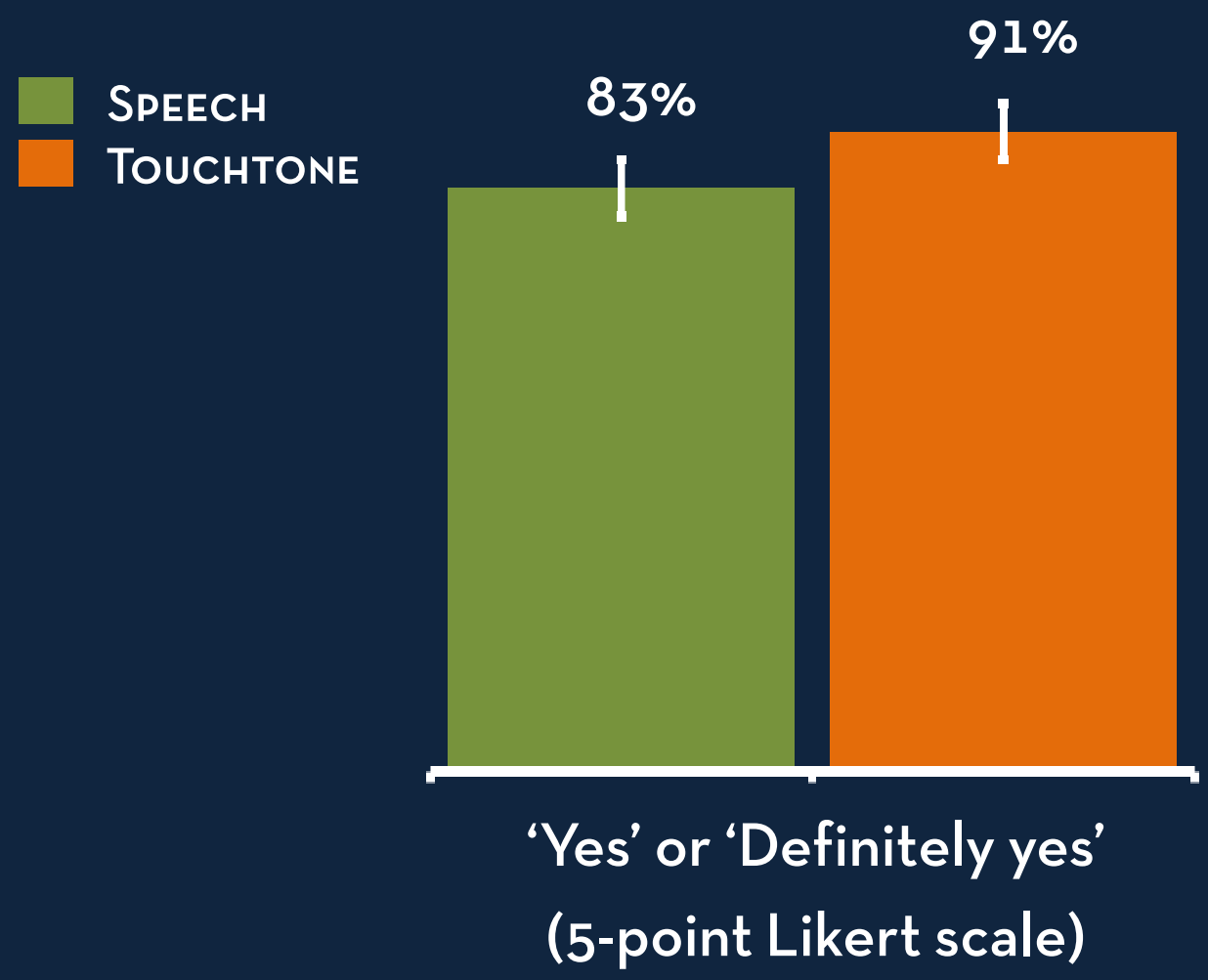
Overall task completion: touchtone higher than speech



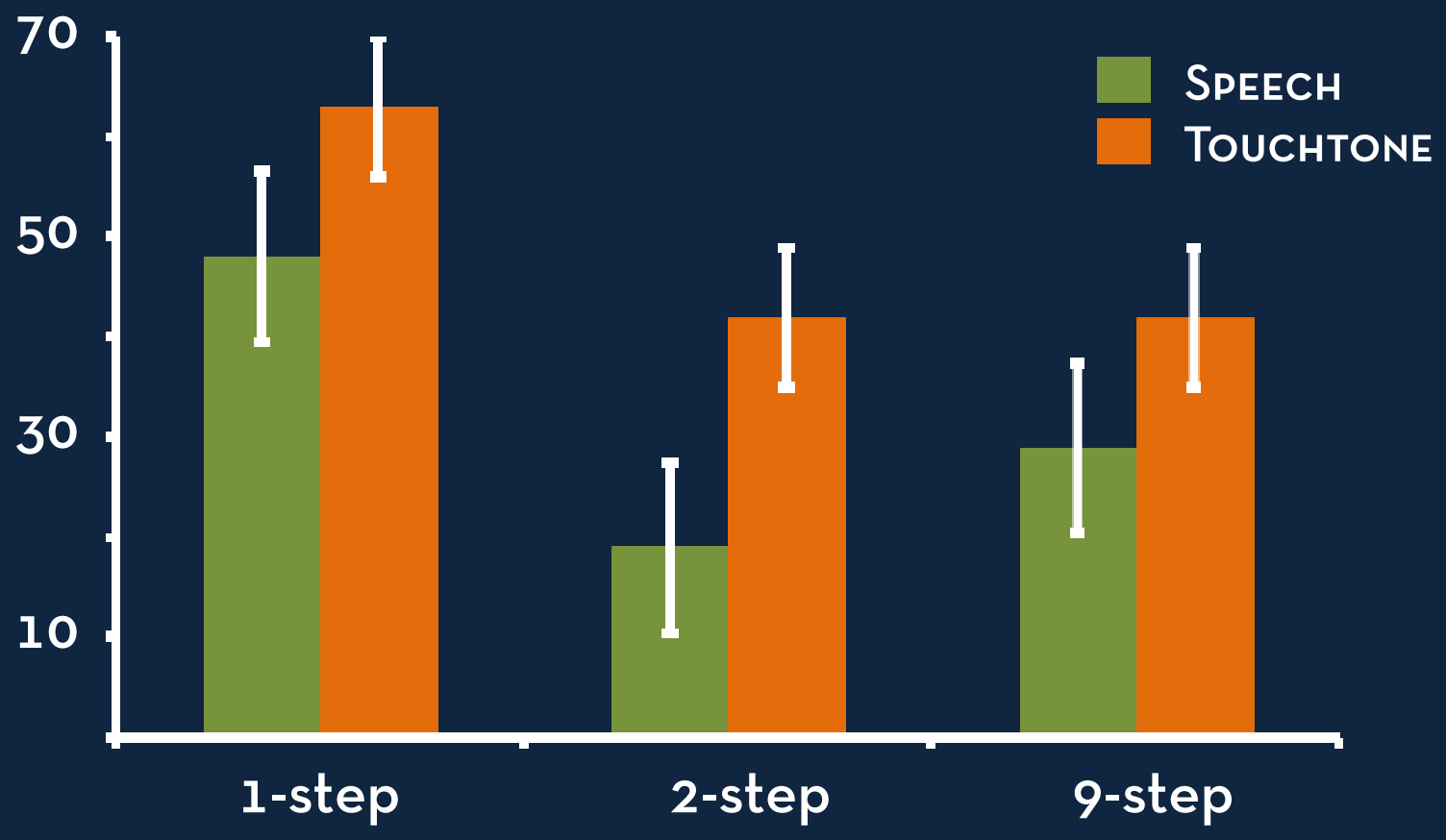
Speech: slightly higher task completion with most educated users



Overall user satisfaction: comparable



Percentage of tasks rated "difficult" or "very difficult"



Across all tasks: 49% (speech) vs. 30% (touch), $p<0.05$

Why was speech less successful?

- Single-word input awkward
- Recognition errors
  - 67% to 42% drop with 1+ errors
- Touchtone benefited from simple, linear tasks

Comparing speech vs. touchtone studies

	TECHNOLOGY	LITERACY	TRAINING	RESULT; USER PREF
IBM staff, U.S *[Lee and Lai, 2005]*	Natural language *~80% accuracy*	High	None	Touchtone; prefer speech
Hospital staff, Botswana *[Sharma et. al., 2009]*	Wizard of Oz *100% accuracy*	Low	Yes	No sig. diff.; prefer touchtone
Community health workers, Pakistan *[Sherwani et. al., 2009]*	Cross-language transfer 93% accuracy	Low	Yes	Speech; no preference
THIS STUDY				
Farmers in India	Cross-language transfer 94% accuracy	Low	None	Touchtone; no preference

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Current Status - Pilot

- Live with 50 farmers; over 3500 hits/month
- 70% of calls in first month used touchtone



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