

Mobile and Ubiquitous Information Access: A New Frontier of Information Retrieval Research

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Outline

- From traditional to “modern” information access
- Information Retrieval and the challenges of modern information access
- Some example of these research challenges
- Future, more challenging, directions of work
- Conclusions

Traditional Information Access

Assumptions of “traditional” information access (IA) are:

- Typology of users: librarians, documentalists, trained users, computer literates
- The user: completely devoted to the IA task, interested in high precision and high recall, knows which information source might held sough information
- ...

Traditional Information Access

- The information source: access one source at a time, simple cost function, each source has different modality of interaction
- The IA system: has keyboard, large colour display, graphics
- Bandwidth: large, basically free (i.e. the user does not pay)

“Modern” Information Access

Modern IA should be based on different assumptions

- Typology of users: casual users, computer illiterates, “men of the street”, children, elderly users
- The user: involved in many tasks at the same time, mobile, often interested only in high precision, submits short casual queries, does not know which information resource might held sought information
- ...

“Modern” Information Access

- The information source: access to more than one source at the same time, complex cost function, toward simple and uniform modality of interaction
- The IA system: no keyboard (or very simple one), small screen, low quality graphics, voice recognition, handwriting recognition
- Bandwidth: low, costly (i.e. the user pays for it)

Focus on Information Retrieval

- An important question:

Is Information Retrieval ready to deal with the challenges of modern information access?

The Challenges of Modern Information Retrieval

- There are some areas of research that the IR community should pursue to deal with the challenges of modern IA
- Here are some directions of this research

The Query

- From short written queries to ...
- Spontaneous spoken queries
 - deal with recognition errors
 - use of non verbal information in speech
 - more complex models of uncertainty
- Handwritten or gesture queries
 - deal with recognition errors
 - more complex models of uncertainty
 - more complex models of interaction

Presentation of Results

- From results presented on a large windowed screen to ...
- Synthesised speech
 - vocal dialogue management
 - spoken summarisation
- Small screens
 - new visualisation techniques
 - visual summarisation

Interaction Style

- From “web search engine”-like interaction style to ...
- Simpler and more intuitive style
 - use of spoken dialogue
- Personalised style
 - adaptive style
- Contextualised style
 - put the user, task and information need in context

Information Sources

- From traditional IR to ...
- Transparent Distributed IR from heterogeneous multimedia sources
 - resource discovery and description
 - brokering (unique interface)
 - resource selection
 - data fusion
 - visualisation of fused results

Examples of Research at Strathclyde Univ.

- Sonification of an IR Environment
 - SIRE project (2000-...)
- Mobile access to news
 - WAP-News project (2002), PDA-News project (2003), My-News project (2004-...)
 - PENG project (Personalised News coNtent Programming, 2004-...)
- IR using tangible user interfaces
 - WebKit project (2002-04)
- MIR for the novice user
 - REVEAL-THIS project (REtrieval of Video and ..., 2004-...)

The SIRE (Sonification of an IR Environment) Project

Mobile user



Speech

query
req doc sum
req doc
rel. feedback

Speech

retrieval list
doc sum
doc

Vocal dialogue manager
IR system
Summarisation system



Text



Information resources

Research Challenges

- Some issues to tackle:
 - query recognition (spontaneous speech, background noise, low quality audio, short queries etc.)
 - dealing with errors in the query (robust query indexing model, robust retrieval model, query expansion, etc.)
 - voice dialogue management (application dependent, robust, etc.)
 - speech synthesis for presentation of retrieval results (quality of speech, user cognitive load, effectiveness of relevance feedback, etc.)
- Long term project tackled using a “divide and conquer” approach

Current Status

- Some of the already work carried out includes:
 - Design and implementation of a query biased text summarisation system, adapted to a vocal environment
 - Evaluation of the user's perception of relevance of retrieved documents using spoken document summaries
 - Analysis of the effects of word recognition errors in spoken queries on the performance of an IR system
 - ...

Current Status (cont.)

- ...
- Design of an IR model for spoken queries that takes into consideration the different forms of uncertainty in the retrieval process
- Studied the effectiveness of different relevance feedback models for spoken query retrieval
- Compared the characteristics of spoken vs. written queries
- Studied the use of non-verbal clues (prosodic stress) for topic detection in documents/queries
- See published papers

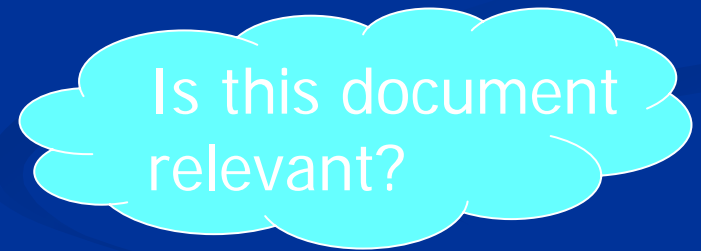
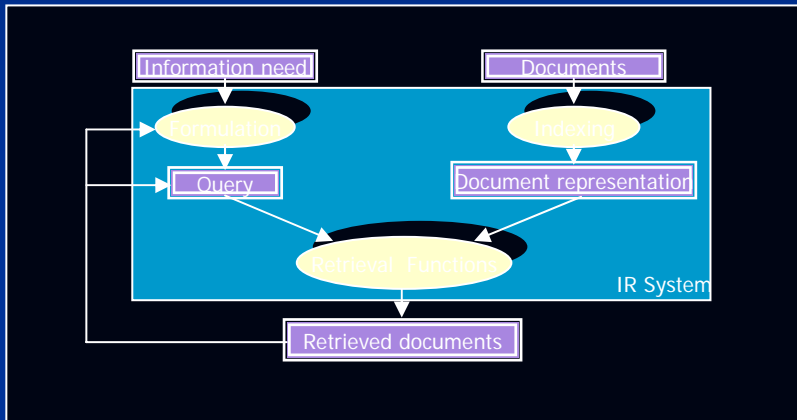
Some Results: a Teaser

- User's perception of relevance of query results presented in spoken form (JASIST 2000)
- Comparison of the characteristics of written and spoken queries (JASIST, in press)
- ...

Results Presentation

- How can we present the results of a search to help the user assess their relevance?
- Different parts of the document
 - Full text
 - Selected parts (e.g. title)
 - Summary (but of what length?)
- Diverse modalities
 - Text
 - Speech (natural or synthesised)

User's Perception of Relevance



Study of User's Perception of Relevance

- Experimental study of the effectiveness of users' assessment of relevance of retrieved documents
 - Do users make correct relevance assessments when presented with document surrogates?
 - Do users make correct relevance assessments when presented with *spoken* document surrogates?
 - Is spoken summarisation effective?
 - Do users make faster assessments?

Query-biased Summarisation

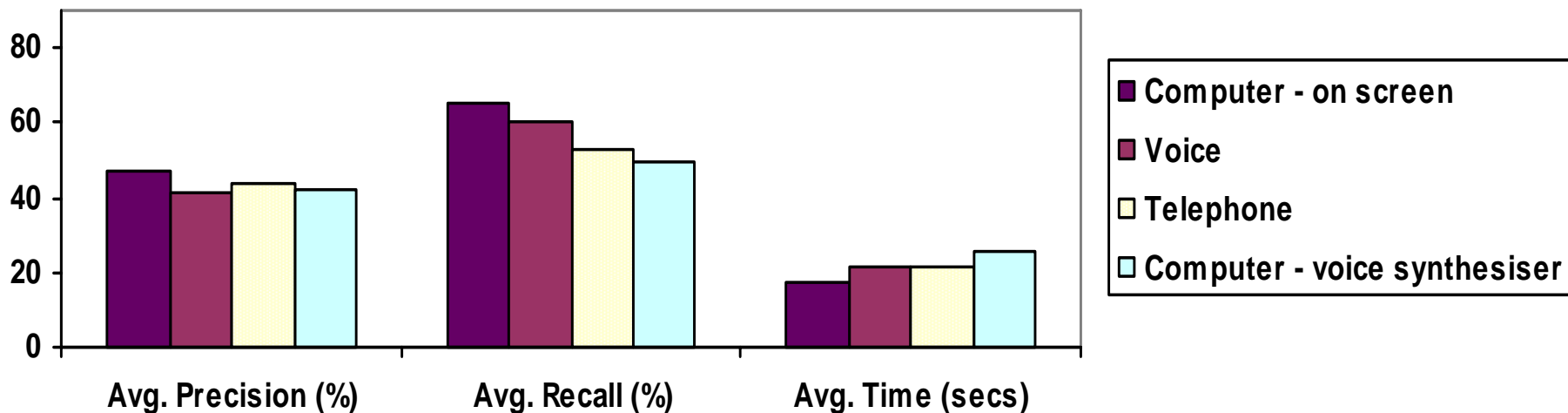
- Technique of automatic text summarisation by sentence extraction
- Sentences are weighted using a combination of evidence from:
 - heuristics (e.g. ~news title and headings)
 - sentence weights based on collection and document statistics (tf-idf)
 - Sentence query score (consider terms in query)
- The effectiveness of this system vs. full text has been already proven

Experimental Settings

- Subjects: 10 native English speakers
- Text collection: summaries of documents results of 50 topics from TREC collection
- Experimental procedure:
 - subject assumed to submit a query
 - a list of relevant document surrogates is produced
 - document surrogates are presented in different modalities
- Take note of effectiveness, speed and ask to fill a questionnaire at the end

Experimental Results

- Average Precision, Recall, and Time for different modalities of document delivery



Conclusions from the Study

- User perception of relevance is influenced by the modality of results presentation
 - P remains almost constant across modalities
 - large across-subjects variations in P, R, S
 - small across-topics variations in P, R, S
 - S decreases with speech
- These findings identify the need for personalised spoken result presentation

More Challenging Work

- Personalised results presentation
- Personalise spoken summaries
- The use of context in result presentation
- Use of speech for highlighting part of the summary
- Use of prosodic stress to identify important part of a spoken query
- We have started working in these directions!

Spoken vs. Written Queries

- Experimental analysis of the characteristics of written and spoken queries
- Are spoken queries the same as written queries?
 - Same length?
 - Same words?
 - Same “information content”?
 - Same level of effectiveness for information access?

Spoken Queries

■ Pros:

- Speech is natural, rapid, more expressive
- Speech has more cues than text (e.g. voice inflection, pitch, tone)

■ Cons:

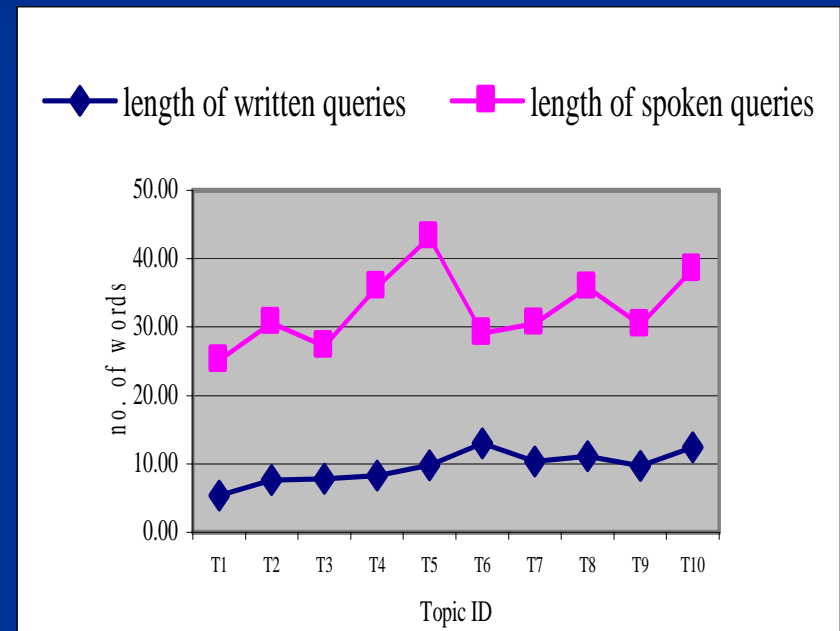
- Automatic speech recognition (ASR) technology is imperfect
- Speech is not always applicable in all situations
- Cognitive load imposed by formulating spoken queries can't be ignored

Experimental Setting

- Subjects: 12 native English speakers
- Text collection: 10 topics were extracted from TREC topic collection
- Experimental procedure: two sessions per participant (written, spoken)
- Data capture: written queries were logged in text format, spoken queries were recorded and saved in wav format, along with the durations of query formulation

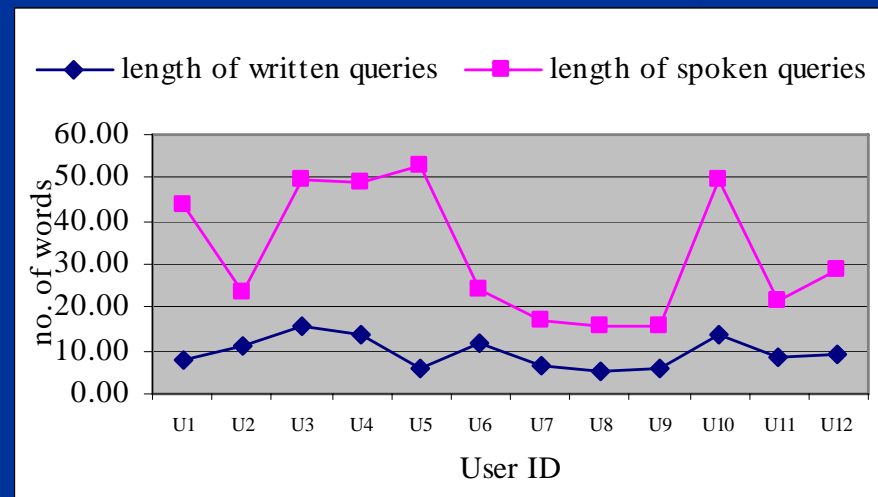
Experimental Results 1: Length of queries across topics

- Spoken queries were longer than written ones for every topic
- The ease of speech encourages participants to use more words



Experimental Results 2: Length of queries across subjects

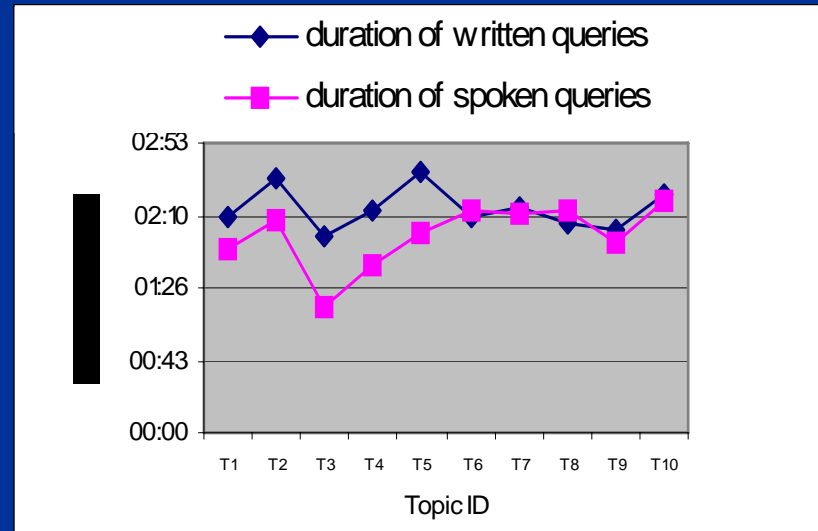
- Spoken queries were longer than written ones for each user
- Length variation related to user's personality
- Length variation for written queries was small
- Length variation for spoken queries was much larger



Experimental Results 3:

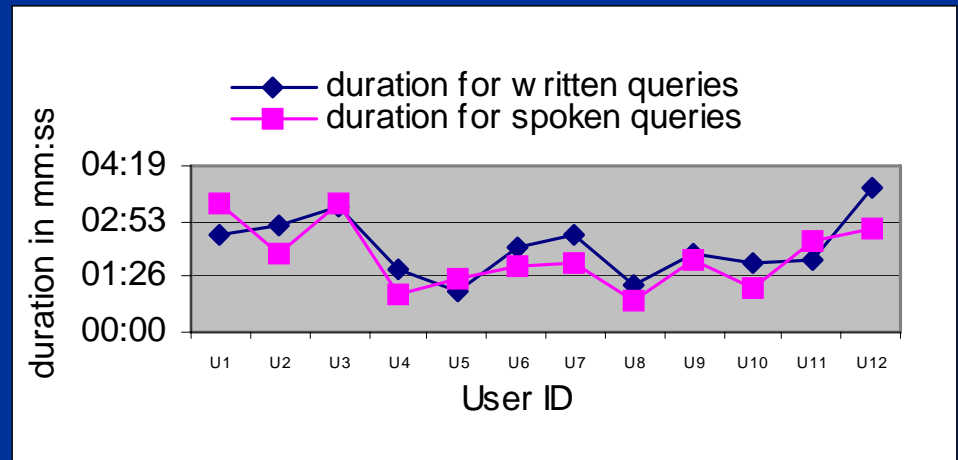
Durations of queries across topics

- On average, more time needed to form the written queries than spoken ones
- Different situation when experience has been acquired
- Hypothesis: cognitive load and lacking of experience in issuing spoken queries pressurised the formulation process



Experimental Results 4: Durations of queries across subjects

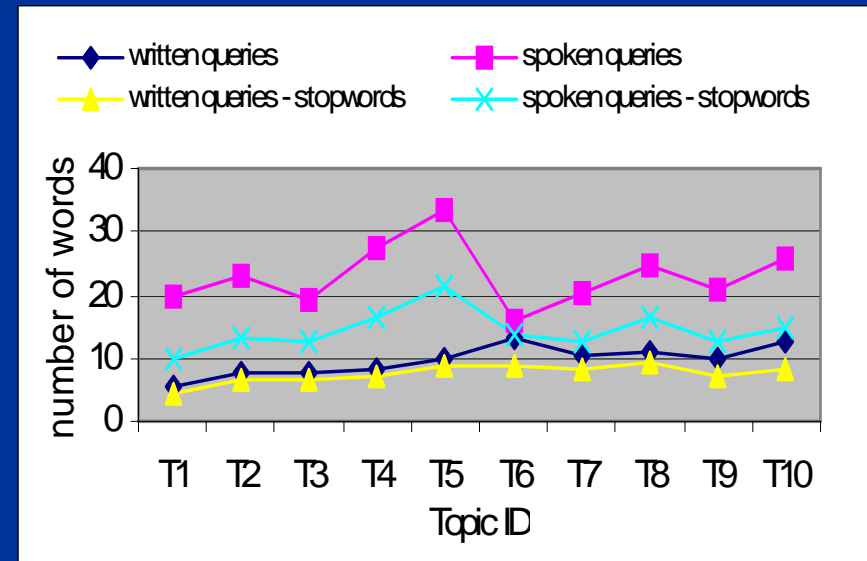
- High variation of durations across participants
- Duration is related to the complexity of the topic
- Two thirds of the participants spent less time on spoken queries than written ones



Experimental Results 5:

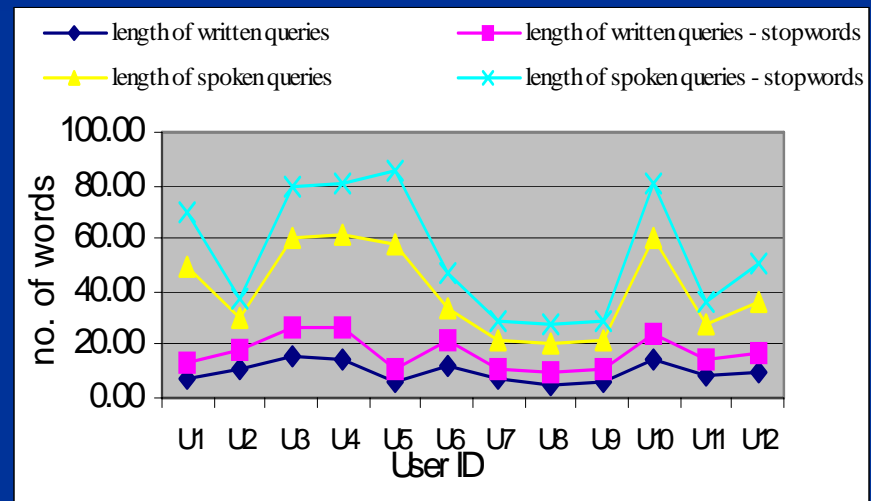
Queries' information content across topic

- More stopwords in spoken queries
- Spoken queries still longer than written ones
- Average length of spoken queries (~14 words) was almost doubled the average length of written queries (~7 words)
- Considering a WER of 50%, spoken queries are as long as written ones



Experimental Results 6: Queries' information content across subjects

- In general, more function words and more content words in spoken queries
- Large personal variations due to querying style
- Experts' spoken queries are very similar to written ones



Conclusions from Study

- Using speech to formulate an information needs not only provides a way to express it in a more natural way, but also encourages longer queries
 - Not just “bla bla”, but more “semantic content”
 - Longer queries = better information access performance (well known result in IR)
- No significant different in the query formulation process (after a short trial period)
- Personal variations are more apparent in spoken than written queries

Conclusions

- Information Access is changing in many aspects (user requirements, system requirements, etc.).
- Research in Information Retrieval should reflect these changes and pursue the challenges that mobile and ubiquitous information access imposes
- Research in these directions requires different expertise and coordination between different research groups

Thank you for your attention!

- Questions?
- More information about my research can be found at <http://www.cis.strath.ac.uk/~fabioc> or Google “Fabio Crestani”