UB at the NTCIR-12 SpokenQuery&Doc-2: Spoken Content Retrieval Using Multiple ASR Hypotheses and Syllables

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Background and Motivation

- MEI project at Summer 2000 JHU Workshop
  - Query-by-example: English news stories (AP and NYTimes) to retrieve Mandarin news broadcast (VOA)
  - Multi-scale paradigm: use of words, and subwords (Chinese characters and syllables)
- MALACH Project / CLEF-CLSDR track
  - Information access to Holocaust survivor testimonies: multilingual, spontaneous, oral history
- Online programs at UB/GSE/DLIS
  - MS in Information and Library Science, MS in School Librarianship: >90% courses are now online
  - Large volume of recorded lectures

Challenges and Techniques

- Challenges
  - ASR errors, topic boundaries, …
  - Information needs, users, user-system interfaces, …
- Techniques
  - (Most commonly) first converting speech to text and then applying text-based IR
  - Exploring rich features of ASR: words, subwords, time stamps, …

Our Areas of Interest

- Using multiple ASR hypotheses
  - Is it better than using only the "best" hypothesis?
- Using ASR syllables
  - Can it help when coupled with word-based retrieval?
- Comparing ASR engines (Julius and KALDI)
  - Do they result in different retrieval effectiveness?

Test Collection: Documents

98 conference lectures from SDPWS1-7

- Speech audio in wav format, divided into inter pausal units (IPUs)
- Manual transcriptions
- Reference automatic transcriptions, generated by two ASR engines (Julius and KALDI), at both word and syllable level
- Slide transition information
- Slide group segment information
- Slide to IPU alignment information

A “document” is defined as a slide group segment, which may contain one or more contiguous slides corresponding to a topic

Document Processing

- Creating document collections
  - Based on information of slide group segment and slide-to-IPU alignment
  - Multiple collections were created
    - Manual transcription
    - ASRs: word- or syllable-based, top-n hypotheses, Julius or KALDI
  - 2,259 documents per collection
- Segmenting Japanese text
  - Using MeCab Japanese Morphological Analyzer
- Converting into hexadecimal codes
  - For easy handling by the IR system
- Indexing each document collection
  - Multiple ASR hypotheses were treated as independent terms

Query Formulation

- Creating multiple query sets using
  - Manual transcription (verbose)
  - ASR texts: top-n words or syllables generated by the two ASR engines
- Segmenting
- Converting to hexadecimal codes

Average Document/Query Length

Term	Document	Query
Words of manual transcription	194	140
1-best ASR words by Julius	171	136
5-best ASR words by Julius	860	699
1-best ASR syllables by Julius	295	226
1-best ASR words by KALDI	174	180

IR System

Perl Search Engine (PSE): a Perl implementation of Okapi BM25 weighting

$$\sum_{w \in q}[\log \frac{(N - df(w) + 0.5)}{(df(w) + 0.5)}][\frac{(k_1 + 1) \times c(w,d)}{k_1((1-b) + b\frac{dl(d)}{avdl} + c(w,d))} \frac{(k_3 + 1) \times c(w,q)}{k_3 + c(w,q)}]$$

Where

k_1 = 1.2, b = 0.75, k_3 = 7

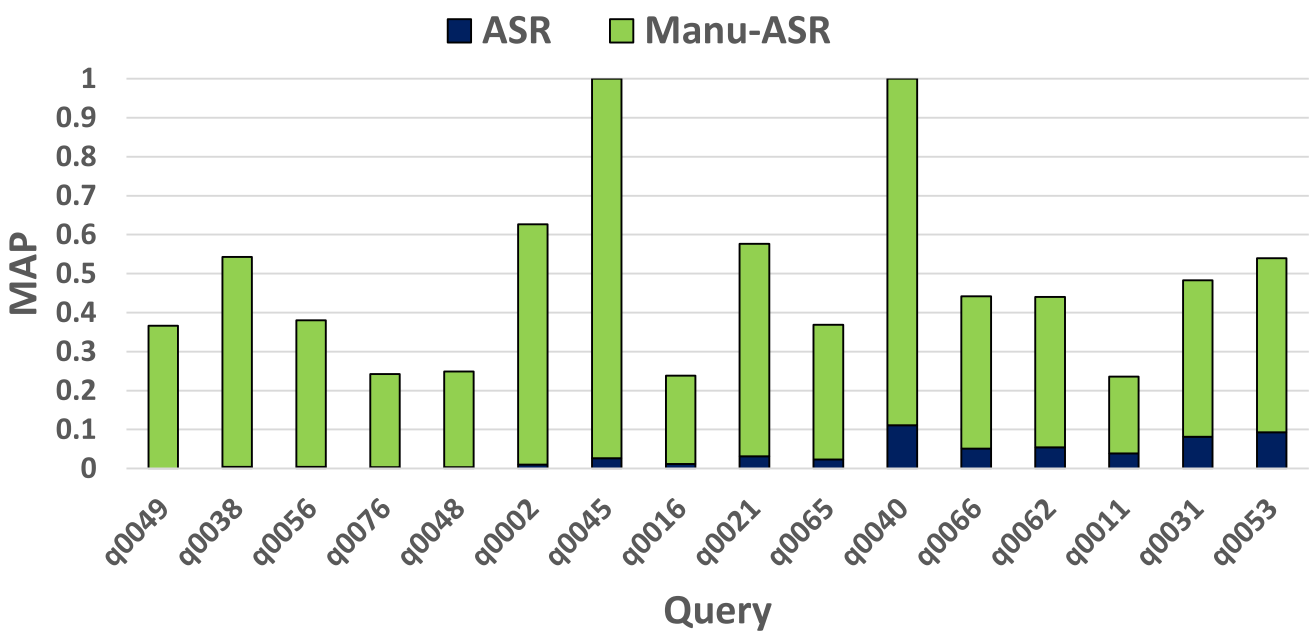
Official Runs and Results

Run id	Document term	Query term	MAP	Relative MAP
SQSCR-UB-SGS-TXT-1	Words of manual transcription	Words of manual transcription (verbose)	0.1953	Reference run
SQSCR-UB-SGS-TXT-2	1-best ASR words of Julius	1-best ASR words of Julius	0.1128	57.8%
SQSCR-UB-SGS-TXT-3	5-best ASR words of Julius	1-best ASR words of Julius	0.0994	50.9%
SQSCR-UB-SGS-TXT-4	1-best ASR words of Julius	5-best ASR words of Julius	0.1127	57.7%
SQSCR-UB-SGS-TXT-5	5-best ASR words of Julius	5-best ASR words of Julius	0.0966	49.5%
SQSCR-UB-SGS-TXT-6	1-best ASR syllables of Julius	1-best ASR syllables of Julius	0.0253	13.0%
SQSCR-UB-SGS-TXT-7	1-best ASR words of KALDI	1-best ASR words of KALDI	0.1946	99.7%

Comparison of Runs

- ASR vs manual transcription
  - Julius: significantly lower MAP regardless of index terms
  - KALDI: statistically indistinguishable MAP on 1-best words
- ASR words vs ASR syllables
  - Significantly higher MAP on ASR words
- Multiple ASR hypotheses (words)
  - Not showing improvement of MAP
- Julius vs KALDI
  - Significantly higher MAP on KALDI 1-best words

Query-by-Query Comparison



Runs: 1-best Julius ASR words vs manual transcription

- Among 29 queries that have an AP of >=0.2 on manual transcription (reference run), 16 queries achieved only less than 20% AP of the reference run on 1-best Julius ASR words
- Detailed analysis is needed for these 16 queries/topics

Conclusions and Future Work

- Noisy ASR text degrades the retrieval effectiveness of spontaneous spoken content
  - But systems can produce ASR texts leading to results comparable to those of manual transcriptions
  - Comparative analysis of ASR texts by different systems are needed
- ASR syllables alone are not reliable for SCR
  - Maybe should better be combined with words
- Treating multiple ASR hypotheses as independent terms does not help improve retrieval effectiveness
  - More sophisticated term weighting techniques might work
- Failure analysis on problematic queries shall tell more about both ASR and IR