

Bangla Automatic Speech Recognition (ASR)



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Outline

- What is ASR ?
- Status of Bangla ASR.
- How to build ASR for Bangla?
- Conclusion

What is ASR?



- I want to perform my tasks using my voice command.
- I want the computer to generate documents from my voice.

What is ASR?

- Technique to perform automatic recognition.
- Recognizing speech signals.
 - From a microphone.
 - From a telephone.
- set of words
- Two types:
 - Isolated Speech Recognition
 - Continuous Speech Recognition

What is ASR?

- Process of converting an acoustic signal to a set of words.



- Applications:
 - Commands & Control
 - Data Entry
 - Document Preparation

Speech to Text

What is ASR (research perspective)

- ASR problem for researchers:
 - Pattern Recognition.
 - Artificial Intelligent.
 - Speech processing.

- ASR for English: Since 1930

- Commercial ASR available.
 - Dragon, Philips, IBM.

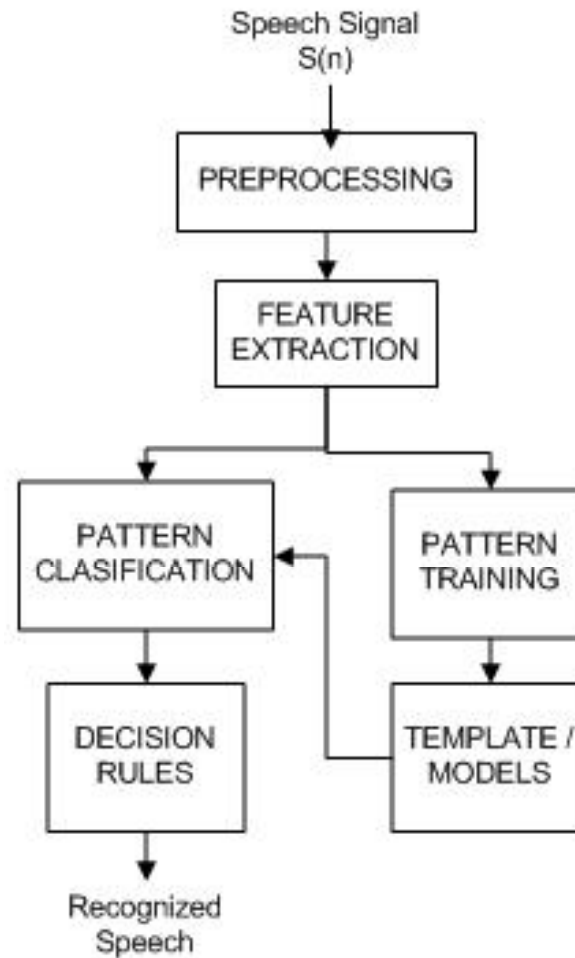
- Tools
 - HTK, JULIUS, Sphinx.

Status of ASR for Bangla

- Limited on research work, experiment and demo.
- Most recent:
 - From CSE Dept., Dhaka University
 - Limited vocabulary ASR
 - From CRBLP (2007)
 - Isolated Speech Recognizer (demo)
 - Continuous Speech Recognizer (research ongoing)

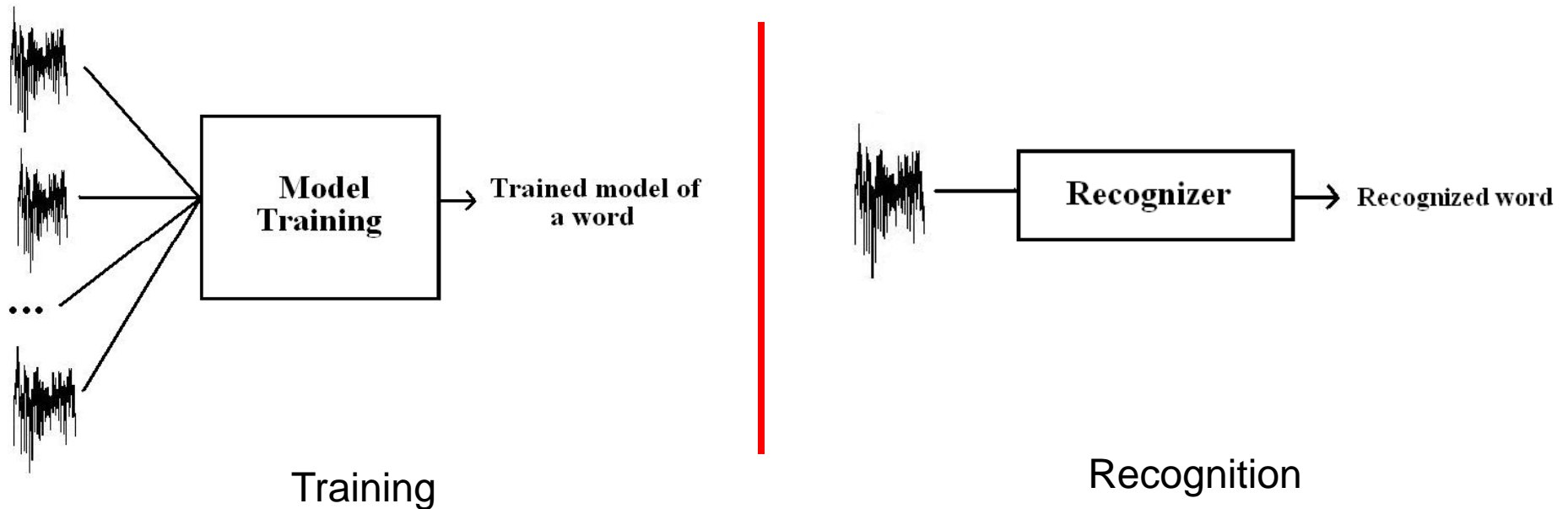
How to build an ASR for Bangla?

- Follow standard procedure to build an ASR.



How to build an ASR for Bangla? (Isolated Speech Recognition)

- ❑ Concentrate on each individual spoken word.
- ❑ Perfect word boundary detection.
- ❑ Speaker enrollment : User must provide samples.
- ❑ Limited vocabulary for Command & Control.



How to build an ASR for Bangla?

(Continuous Speech Recognition)

- Design Phoneme Set.
- Define the task Grammar (Unlimited Vocabulary).
- Pronunciation Dictionary.
- Prepare phonetically balance sentence (Training).
- Use tools to generate models for each unit
 - Monophone
 - Di-phone

How to build an ASR for Bangla?

(Continuous Speech Recognition)

□ Design Phoneme Set

Place		Bilabial		Dental		Alveolar		Post- Alveolar		Palatal	Velar		Glottal
Manner													
Stops	voiceless	প/p/	ফ/p ^h /	ত/t/	থ/t ^h /	ট/t/	ঠ/t ^h /	চ/c/	ছ/c ^h /		ক/k/	খ/k ^h /	
	voiced	ব/b/	ভ/b ^h /	দ/d/	ধ/d ^h /	ড/d/	ঢ/d ^h /	য, জ/j/	ঝ/j ^h /		গ/g/	ঘ/g ^h /	
Nasals		ম/m/				ন, ণ/n/					ঙ, ঞ/ŋ/		
Trill						র/r/							
Flap						ড়, ঢ়/r/							
Fricatives						শ, স/s/				ষ, ষ, স/ʃ/			হ, ঙ/h/
Lateral						ল/l/							
Approximant										য়/j/			

How to build an ASR for Bangla? (Continuous Speech Recognition)

□ Define the task Grammar

sentence = subject object verb

subject = আমি | তুমি | সে

object = ভাত | কাজ | বাড়ি

verb = খাই | খাও | করি | করে | যাই | যায়

Example: Grammar

How to build an ASR for Bangla? (Continuous Speech Recognition)

□ Pronunciation Dictionary

এক ea k
দুই da u i
তিন ta i n
চার c aa r
পাঁচ p aa^ c
ছয় ch a y
সাত sh aa ta
আট aa t
নয় n a y
শূন্য s uu n n a

Example: Dictionary

How to build an ASR for Bangla?

(Continuous Speech Recognition)

- ❑ **Prepare phonetically balance sentence (Training)**
 - ❑ Create/ select a set of sentences
 - ❑ Ensure the presence of each phoneme
 - ❑ Transcribe sentences with appropriate phone label
 - ❑ Record the sentences
 - ❑ Consider variety of environments

- ❑ **In our research**
 - ❑ Total 52 sentences for phonetically balance set
 - ❑ 1814 phonemes

How to build an ASR for Bangla?

(Continuous Speech Recognition)

-	sil	101	খ	k ^h	da	দ	ɖ	33
অ	ɔ	161	গ	g	dah	ধ	ɖ ^h	12
আ	a	217	ঘ	g ^h	p	প	p	39
ই	i	117	ঙ	ŋ	ph	ফ	p ^h	12
ঈ	i:	3	চ	c	b	ব	b	67
উ	u	42	ছ	c ^h	bh	ভ	b ^h	14
ঊ	u:	1	জ	ʃ	m	ম	m	36
এ্যা	æ	1	ঝ	ʃ ^h	z	য	ɖʒ	13
এ	e	165	ঞ	No	r	র	r	135
ও	o	61	ত	t	l	ল	l	52
আঁ	ã	5	থ	t ^h	s	শ	ʃ	30
ইঁ	ĩ	2	দ	ɖ	sh	স	s	23
উঁ	ũ	2	ধ	ɖ ^h	h	হ	h	28
ওঁ	õ	2	ন	n	ra	ঢ়	r	4
এঁ	ẽ	4	ট	t	y	য়	j	22
ক	k	102	ঠ	t ^h	2			

Statistics of phoneme distribution

How to build an ASR for Bangla?

(Continuous Speech Recognition)

- **Use tools to generate models for each unit**
 - Hidden Markov Model Toolkit (HTK)
 - HInit (HMM model initialization)
 - HSLab (labelling word)
 - HRest (Re-estimate the model parameters)
 - HCopy (For feature extraction)
 - HVite (Viterbi decoder : Recognizer)
 - HParse (Create a regular grammar and convert it to an intermediate form of decoding network)

Conclusion

- Concept of ASR.
- Applications of ASR.
- Status of ASR for Bangla script.
- Overview of building an ASR.

Questions

Thank You