IBM Prague R&D lab

Role of Speech User Interface

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It is more than 65 years ago when US Department of defense begun funding the first speech processing project

- What are the reasons for “slow” progress?
- Is the speech really as big thing in UI as originally expected?
- What are the current trends and techniques?

Why speech

- Speech is fast (large lists, dates, times)
- Speech is natural and intuitive
- Speech input device is small
- Capturing emotional state
- Determining speaker identity

Speech interfaces can be just a burden if not designed properly!

Problems with speech

- Speech is transient (no history on the screen)
- Speech is “serial”.
- Limited short term memory of the user
- Real time apps (speech is slow)
- Problems with noisy environment
- Other modalities can be more effective in some cases
- Privacy

Application areas

- Large list selections, dates and times.
- Hands busy situations
- Embedded systems with no keyboard or screen
- Telephony
- Pervasive systems – Car, Home environments

Speech recognition is not the same as speech understanding!

NLP Technologies

- TTS (Text To Speech)
- ASR (Automatic Speech Recognition)
- NLU (Natural Language Understanding)
- Dialog management

- Speaker ID, speaker verification
- Voice detection and location
- Language detection

ASR

- **Where it is done?**
  - Remote (on server)
  - Local (on a client device)
  - Hybrid (both)
- **Output**
  - Recognized sentence, N-best or lattice
  - Confidence
  - Annotation

ASR – Automatic Speech Recognition

- **Who can speak?**

Speaker independent
Speaker dependent
Speaker adaptation

- **What can I say?**

List of phrases
Grammar
Dictation
  unlimited vocabulary or domain specific

ASR

- **When to speak?**

PTS – Push To Speak
PTA – Push To Activate, Silence detection
Always Speak Mode, Trigger words
Barge in

- **How does it work?**

Acoustic models
Language models

NLU Natural Language Understanding

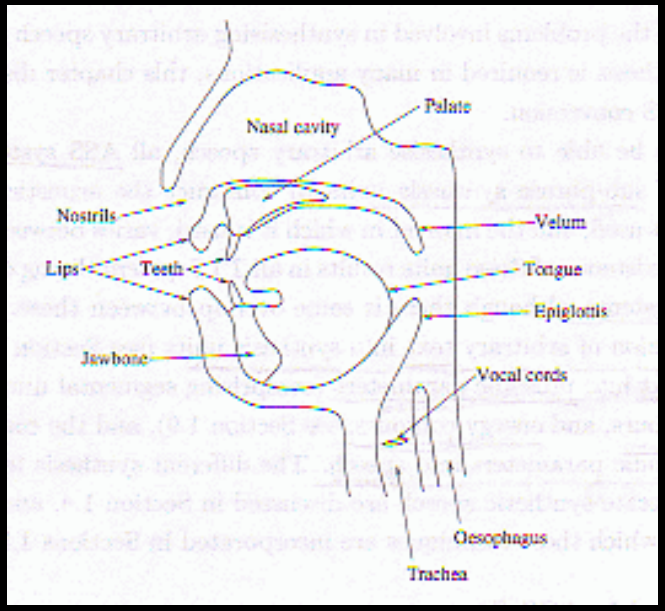
- **Rule based, silent word based**
- **Statistical**

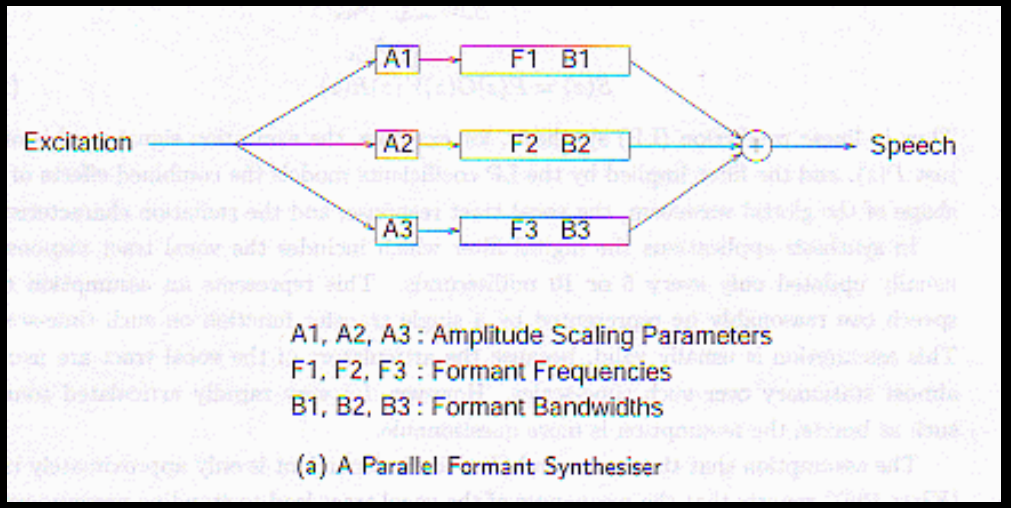
- **Input – recognized phrase or N-best**
- **Output – action and attributes**

TTS-Text To Speech

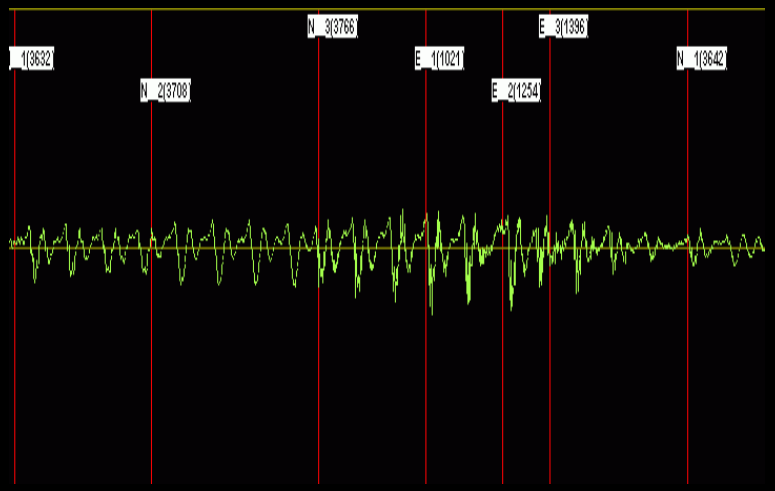
Formant synthesis

Small size
Low quality





Concatenate synthesis



- Connecting PCM
- High processing power and memory requirements
- Prosody
- Coarticulation
- Emotions
- Voice morphing

Dialog

- Directed dialog
- Mixed initiative
- Believe state modeling
- POMDP (Partially Observable Markov Decision processes)

Trends

- Multimodal systems
- Pervasive systems
- Natural Dialog
- Audio-Visual speech recognition
- Domain knowledge utilization

Some hints how to write the speech application

- Indicate that user speaks to the machine
- Keep in mind short term memory of the user.
- Provide “what can I say” option through the app.
- Provide “go back” option throughout the app.
- Build in an error correction mechanism

Pervasive systems - Paradigm Shift

- Applications started to reach out of PC boxes, they blend and become part of the environment, the users will be living in applications.
- This process started already in automotive industry, the home is the next.
- Interaction model needs new interaction means, mouse and keyboards will no longer suffice.
- Speech recognition and computer vision can help.

Standards

- Open source engines

  TTS, ASR, NLU
- Markup languages

  VoiceXML,

  SSML

  X+V, SALT
- JSAPI, SMAPI

VoiceXML

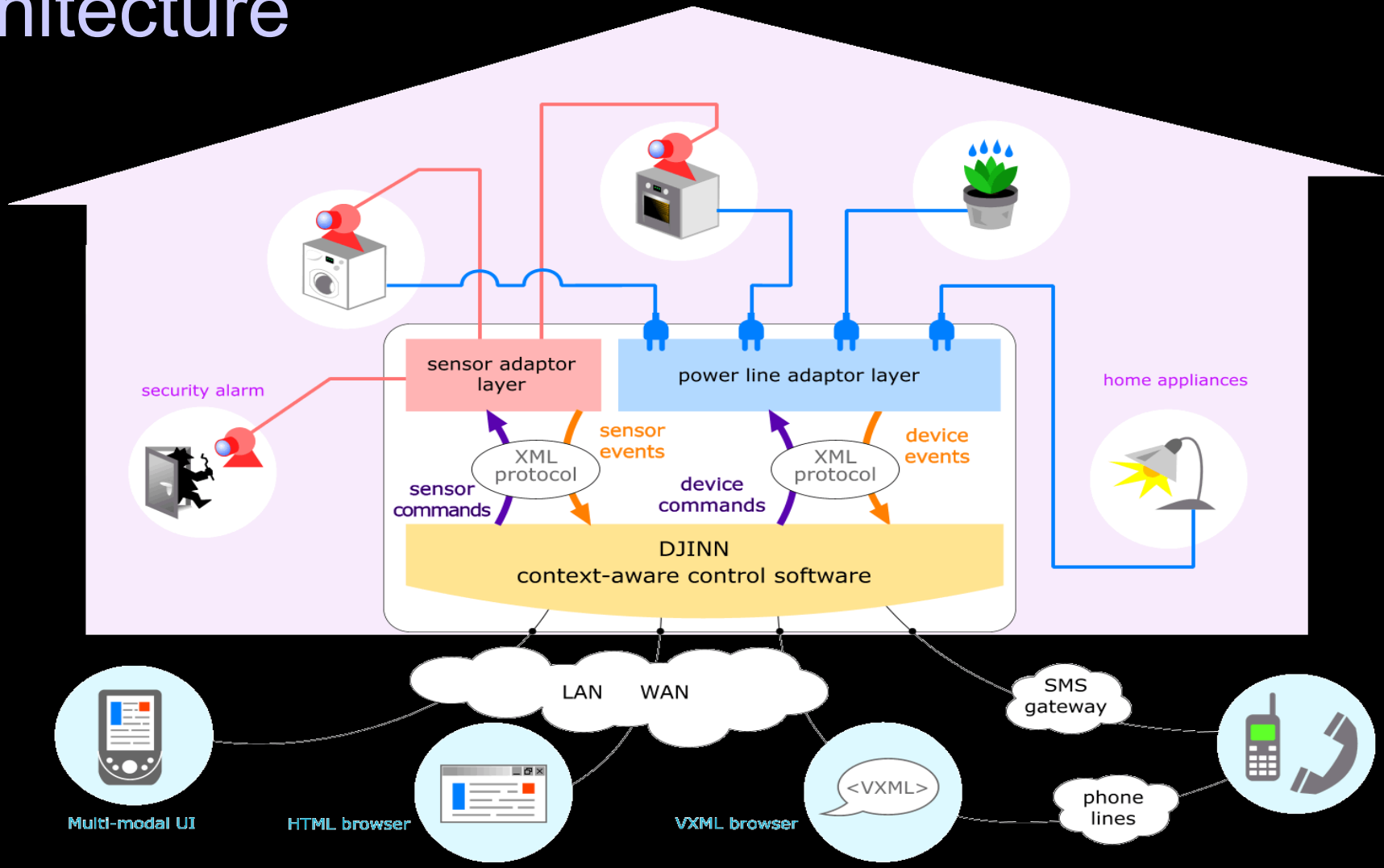
```
<?xml version="1.0" encoding="UTF-8"?> <vxml xmlns="http://
   www.w3.org/2001/vxml" version="2.1">
<form id="get_address">
   <field name="citystate">
      <grammar type="application/srgs+xml" src="citystate.grxml"/>
      <prompt> Say a city and state.</prompt>
   </field>
    <field name="street">
      <grammar type="application/srgs+xml" src="citystate.grxml '/>
      <prompt> What street are you looking for? </prompt>
   </field>
   <filled>
            <prompt> You chose <value expr="street"/>
                     in <value expr="citystate"/> </prompt>
    </filled>
</form>
</vxml>
```

SSML

```
<?xml version="1.0"?>
<speak version="1.0" xmlns="http://www.w3.org/2001/10/synthesis"
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:schemaLocation="http://www.w3.org/2001/10/synthesis http://
   www.w3.org/TR/speech-synthesis/synthesis.xsd" xml:lang="en-US">

  <voice gender="female">Mary had a little lamb,</voice>
  <!-- now request a different female child's voice -->
  <voice gender="female" variant="2">
     Its fleece was white as snow.
  </voice>
  <!-- processor-specific voice selection -->
   <voice name="Mike">I want to be like Mike.</voice>
</speak>
```

Architecture



In car UI

Some trends

- Intelligent room
- Audio-visual recognition
- Taking notes
- Person tracking, person recognition
- Situation modeling
- Question answering

Thank you!

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