Universal home appliances controller with memory, timing, knowledge and intelligence

Must be well done, better than last time!

I want to go to Seoul, sweetie...

Draw me a cat
Speech recognition

Speech interpretation

Dialog manager

Text generation

Speech synthesis

Text Input

Text Processing

Text in orthographic form

Function Word Lexicon

Abbreviation Lexicon

Phonetic Rule Base

Exception Lexicon

Grapheme-Phoneme Conversion

Phoneme string

Duration Model

Intonation Model

Prosodic Modelling

Phoneme string with prosodic annotation

Unit Selection

Unit string with prosodic annotation

Speech Units (Diphones)

Acoustic Synthesis

Synthetic speech signal
Intelligent Learning Robot will:

- Answer in Japanese questions asked in Korean
- Answer in English questions asked in Korean
- Answer in Korean questions asked in English
- Answer in English questions asked in English
- Create traditional Confucian poetry and create nonsensical speeches
- Recognize faces and react to them accordingly
- Learn facial movements and emotions by examples
- Communicate with human and other robot by voice and image processing (gestures)
Intelligent Learning Robot will:

- Learn behaviors that link sensor to actuator data
- React with behaviors to sentences, images and sensor information
- Be completely reprogrammable by the user.
- It cannot be confused, it will always do something, and in most cases it will be unexpected.
- Combining logic and probabilistic approaches to robot design is not used in robot toys yet.
Is it possible?

Yes!

How?

By using a general-purpose logic learning architectures based on Data Mining methods that we developed recently at PSU
Examples

1. Face Recognition
2. Behavior control
3. Question answering
4. Learning Gaits
Example 1: Face Recognition

John
Mark
Dave
Jim
Alan
Mate
Nick
Robert
<table>
<thead>
<tr>
<th></th>
<th>A - size of hair</th>
<th>B - size of nose</th>
<th>C - size of beard</th>
<th>D - color of eyes</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Good guys

A' BCD

A' BCD'

A' B'CD

A' B'CD'
<table>
<thead>
<tr>
<th>AB</th>
<th>CD</th>
<th>00</th>
<th>01</th>
<th>11</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>01</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>11</td>
<td>-</td>
<td>-</td>
<td>0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>10</td>
<td>-</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

- **A** - size of hair
- **B** - size of nose
- **C** - size of beard
- **D** - color of eyes

Bad guys: Alan, Mate, Nick, Robert

\[ A' BC'D', AB'C'D, ABCD, A'B'C'D \]

\[ A'C \]
**Generalization 1:**
Bald guys with beards are good

**Generalization 2:**
All other guys are no good

<table>
<thead>
<tr>
<th></th>
<th>A'</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>11</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>10</td>
<td>-</td>
<td>0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>01</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

A - size of hair  
B - size of nose  
C - size of beard  
D - color of eyes  
A’C
This kind of input-output problem description appears in many applications.