



SCHOOL OF INTERACTIVE  
ARTS + TECHNOLOGY



SIMON FRASER UNIVERSITY  
ENGAGING THE WORLD

# Interactive, Socially Intelligent Systems

Ö. Nilay Yalçın, PhD.  
SIAT, SFU  
[oyalcin@sfu.ca](mailto:oyalcin@sfu.ca)

For SFU CMPT419 / CMPT983 with Dr. Angelica Lim



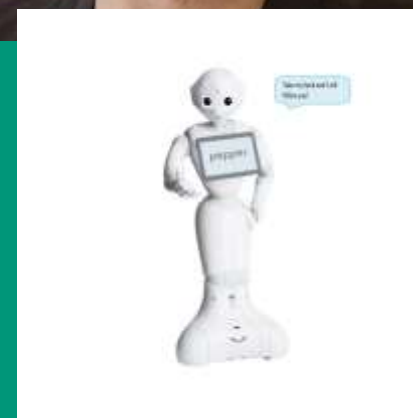
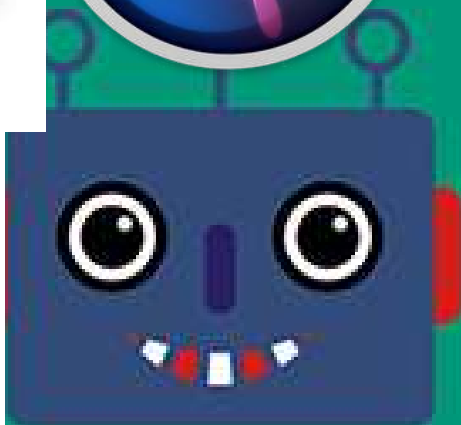
digital health circle



iVizLab  
EXPRESSION BASED INTELLIGENT  
VISUALS AND VISUALIZATION LAB

# Outline

- Computers as Social Actors
  - Background
  - Examples of Use
- Embodied Conversational Agent Framework
  - System Overview
  - System Components
  - Evaluation
  - Challenges
- Discussion



Hello everybody, I'm Merlin.  
I'll guide you through the  
application windows.



# Computers as Social Actors

- Easier interaction
  - Natural interaction methods: conversation, gestures, gaze, emotions
  - Personalization
- People respond to agents similar to how they respond to people (Reeves & Nass, 1996)
  - 4/5 hurling abuse at their PCs, 3/4 swear at their computers. (MORI survey in UK, 1250 users)
  - Assigning personality, gender, stereotypical traits

How can we utilize this?

- Use of socio-emotional cues
  - Likable, trustworthy, engaging, persuasive, collaborative

# Usability and Long Term Interaction

## Exercise Advisor

MIT FitTrack  
Exercise Advisor

Log your activity for Tuesday, April 30

Sleep

Went to bed at: [1] [00:00]

Got out of bed at: [1] [00:00]

Morning Activity

Moderate [0] [00:00] Hours Minutes

Hard [0] [00:00] Hours Minutes

Very Hard [0] [00:00] Hours Minutes

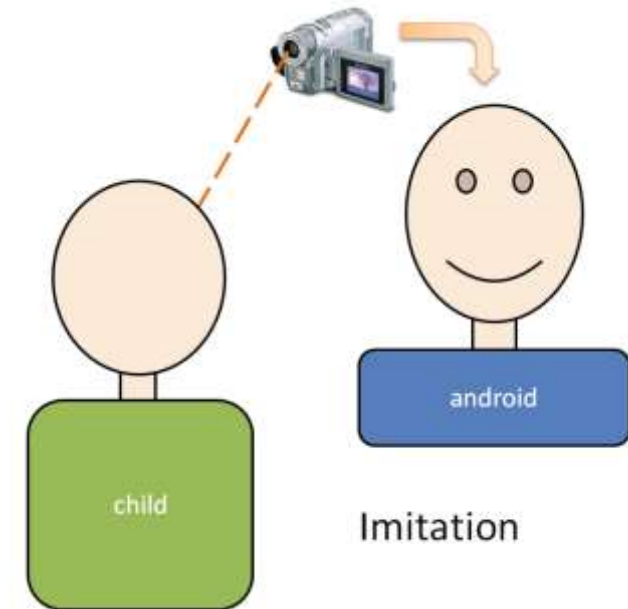
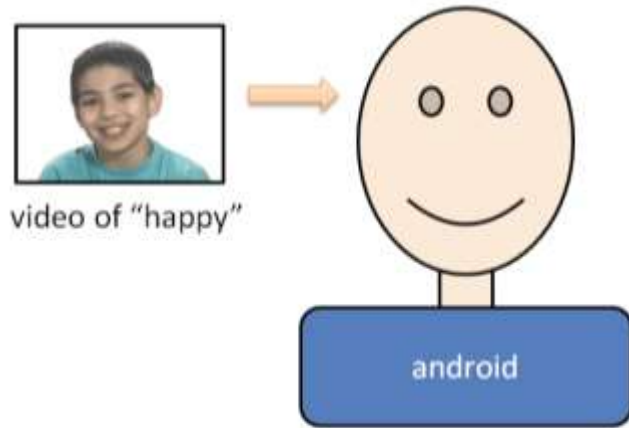
No. no problems this week.  
Yes. I had a few problems exercising this week.  
Yes. I had some significant problems exercising this week.

Health exercise domain:

- "Laura and I **respect** each other." ( $p < .001$ )
- "Laura and I **trust** one another." ( $p < .001$ )
- "I feel Laura **cares** about me..." ( $p < .001$ )
- "I feel Laura **appreciates** me." ( $p = .009$ )
- "I believe Laura **likes** me." ( $p < .001$ )
- **Liking** of Laura. ( $p = .007$ )
- Desire to continue working with Laura. ( $p = .001$ )

Bickmore, T. W., & Picard, R. W. (2005). Establishing and maintaining long-term human-computer relationships. *ACM Transactions on Computer-Human Interaction (TOCHI)*, 12(2), 293-327.

# Autism Research – Teaching Social Skills



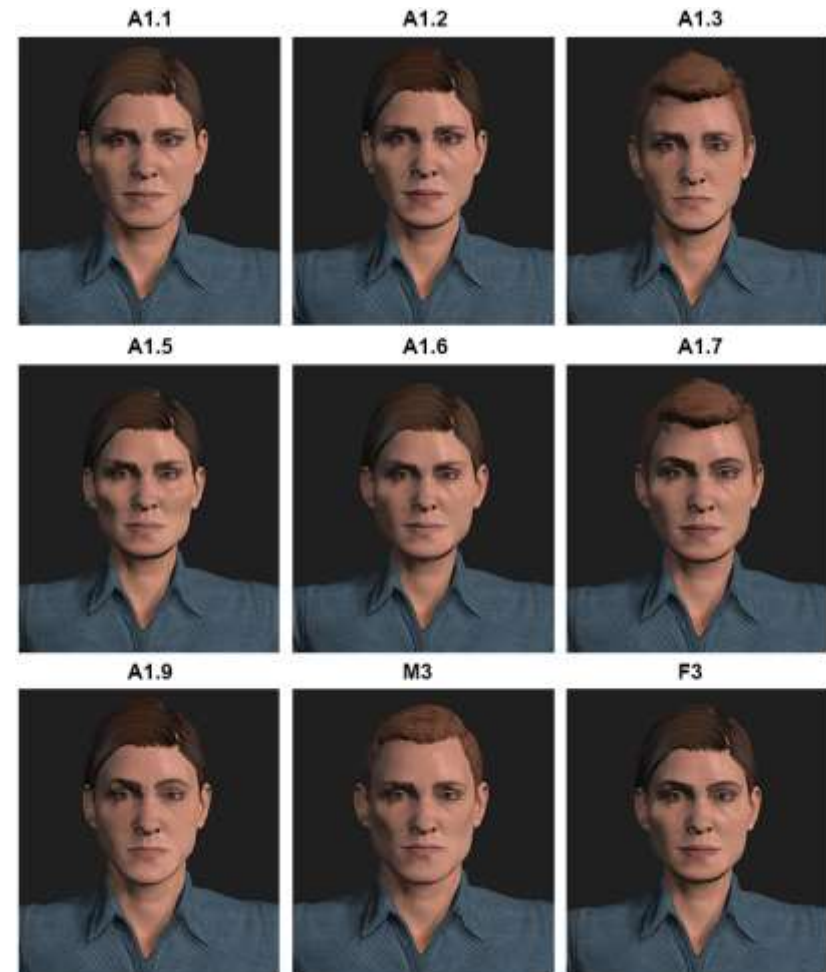
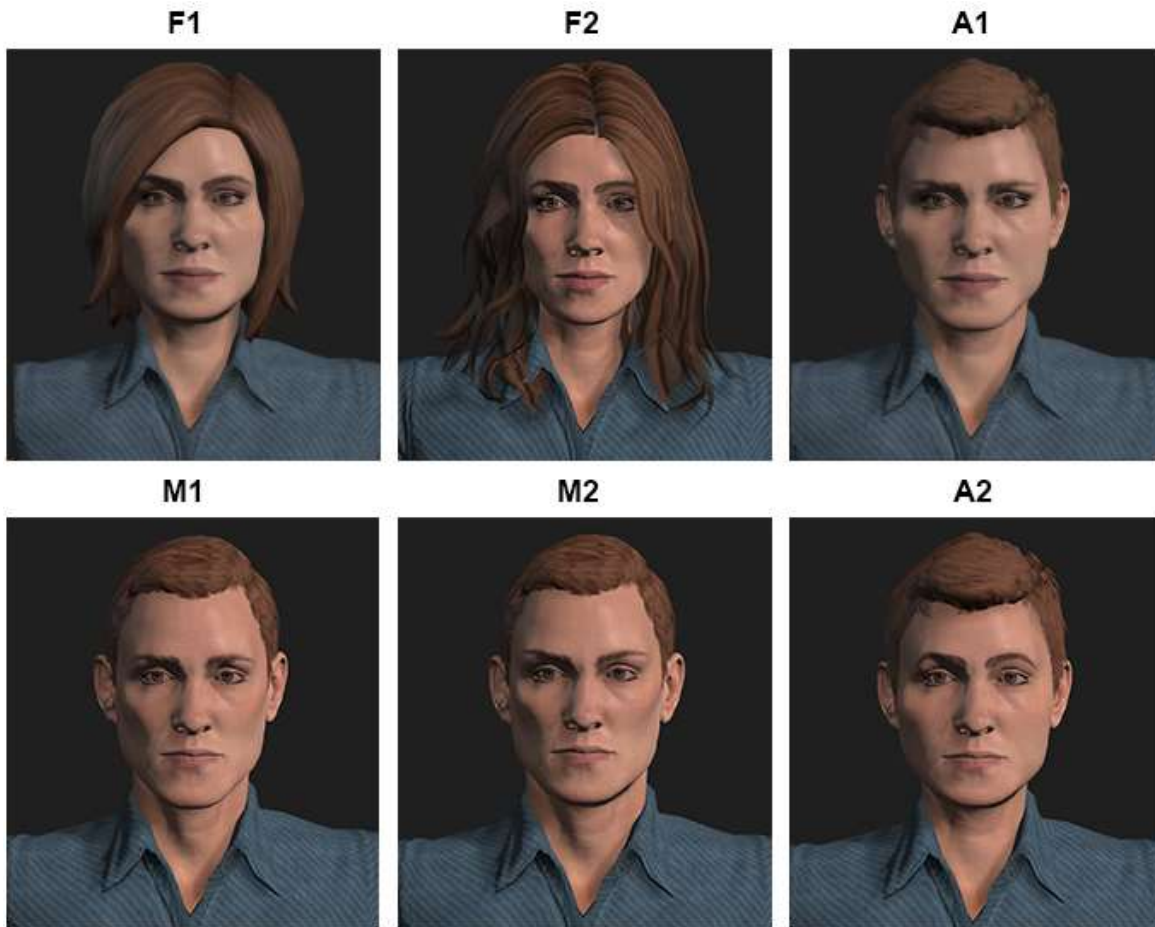
Rudovic, O., Lee, J., Mascarell-Maricic, L., Schuller, B. W., & Picard, R. W. (2017). Measuring engagement in robot-assisted autism therapy: A cross-cultural study. *Frontiers in Robotics and AI*, 4, 36.

Tanaka, H., Negoro, H., Iwasaka, H., & Nakamura, S. (2017). Embodied conversational agents for multimodal automated social skills training in people with autism spectrum disorders. *PloS one*, 12(8), e0182151.

Pictures retrieved from: <https://www.cl.cam.ac.uk/research/rainbow/emotions/robotsASC.html>, <http://robots4autism.com/>

# Studying Human Social Behaviors

- Gender Stereotypes in Virtual Agents. (submitted) Nag, P. & Yalcin, N.



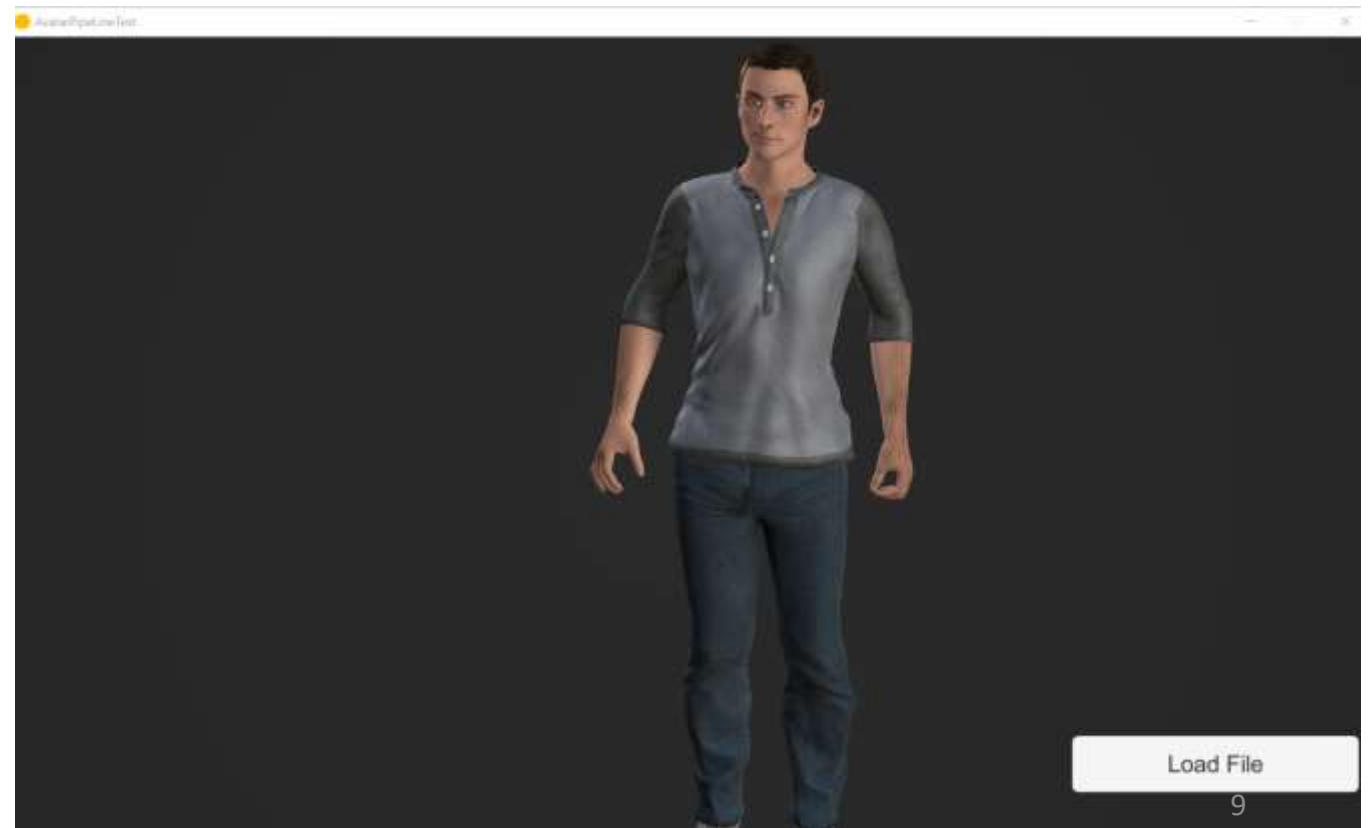
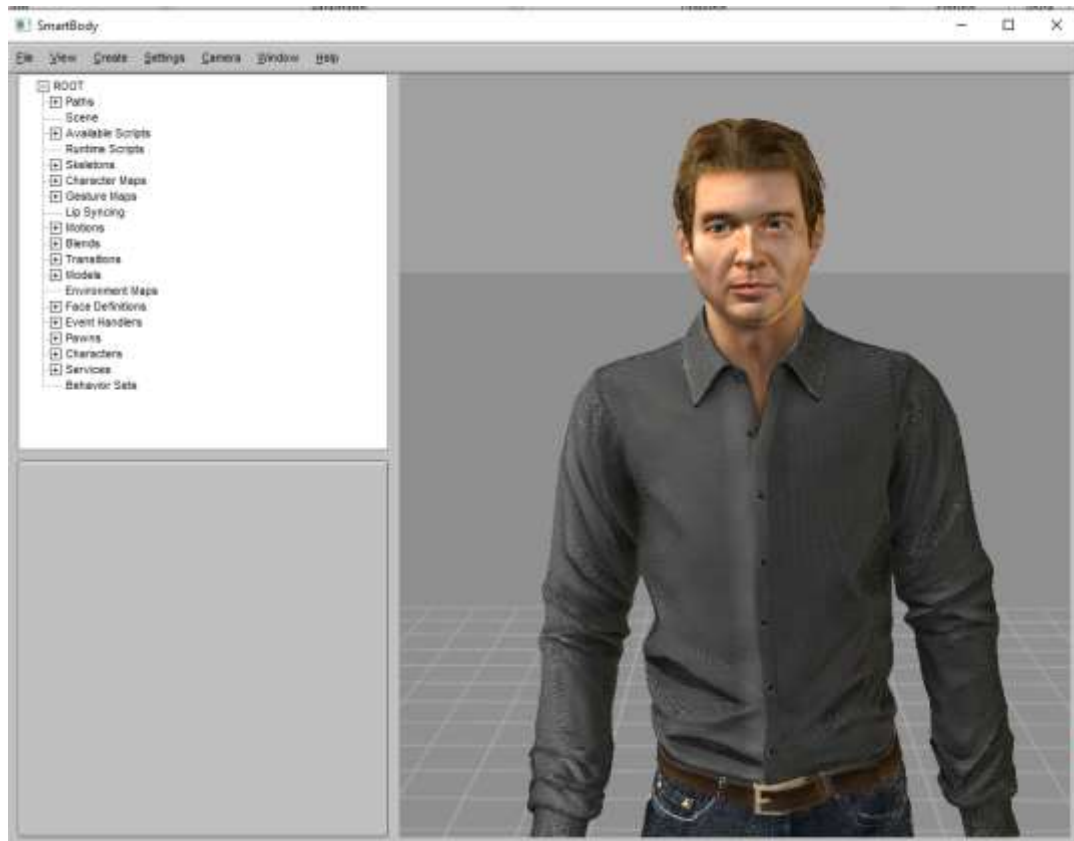
# What do you need for an Embodied Conversational Agents?



# Behavior Realizer

SMARTBODY : <http://smartbody.ict.usc.edu/>

iVizLab Unity Behavior Realizer: [https://drive.google.com/file/d/1ec-D4QNn0VDoC\\_VCNxlaB-Rrd3UBKofZ/view?usp=sharing](https://drive.google.com/file/d/1ec-D4QNn0VDoC_VCNxlaB-Rrd3UBKofZ/view?usp=sharing) \*\*more avatars available for this version



# BML - Behavior Markup Language

<http://www.mindmakers.org/projects/bml-1-0/wiki>

A Standard Markup Language for Behavior Realizers. An example:

```
<bml>
  <speech id="speech0" type="application/ssml+xml">
    <mark name="T0" />My <mark name="T1" />morning<mark name="T2" />started
    <mark name="T3" />off<mark name="T4" />amazing <mark name="T5" />
  </speech>
  <gesture name="ChrBrad@Idle01_BeatLowLf02" stroke="speech0:T4" />
  <face amount="0.7" au="102" ready="speech0:T0" relax="speech0:T5" type="facs"/>
</bml>
```

Behaviors

Behavior Block

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**</bml>**

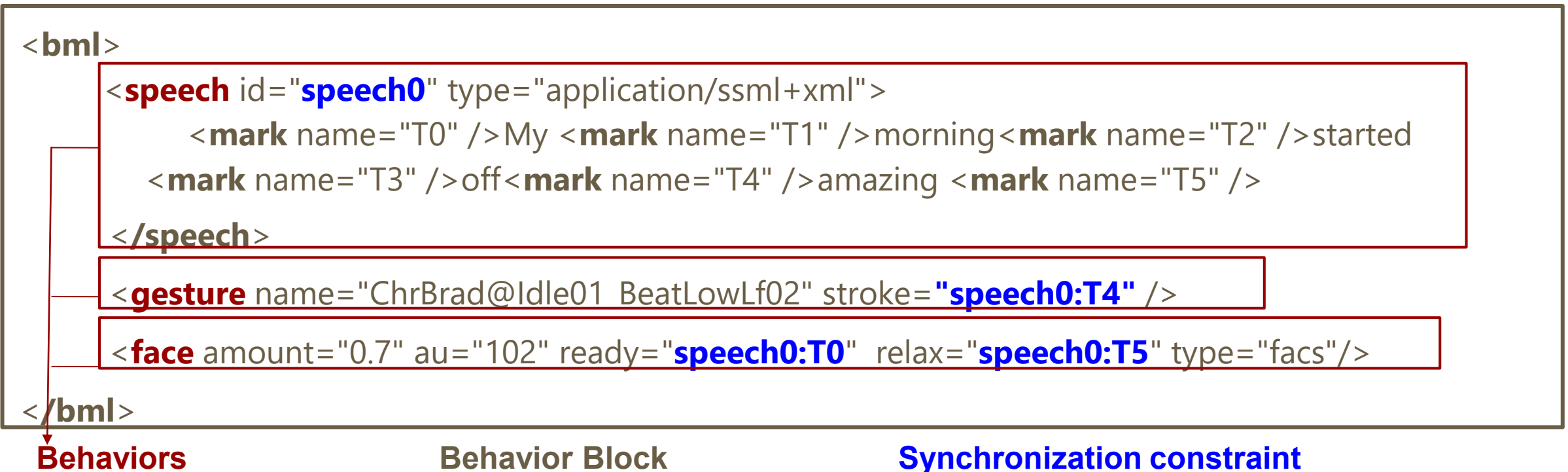
**Behaviors**

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**</speech>**

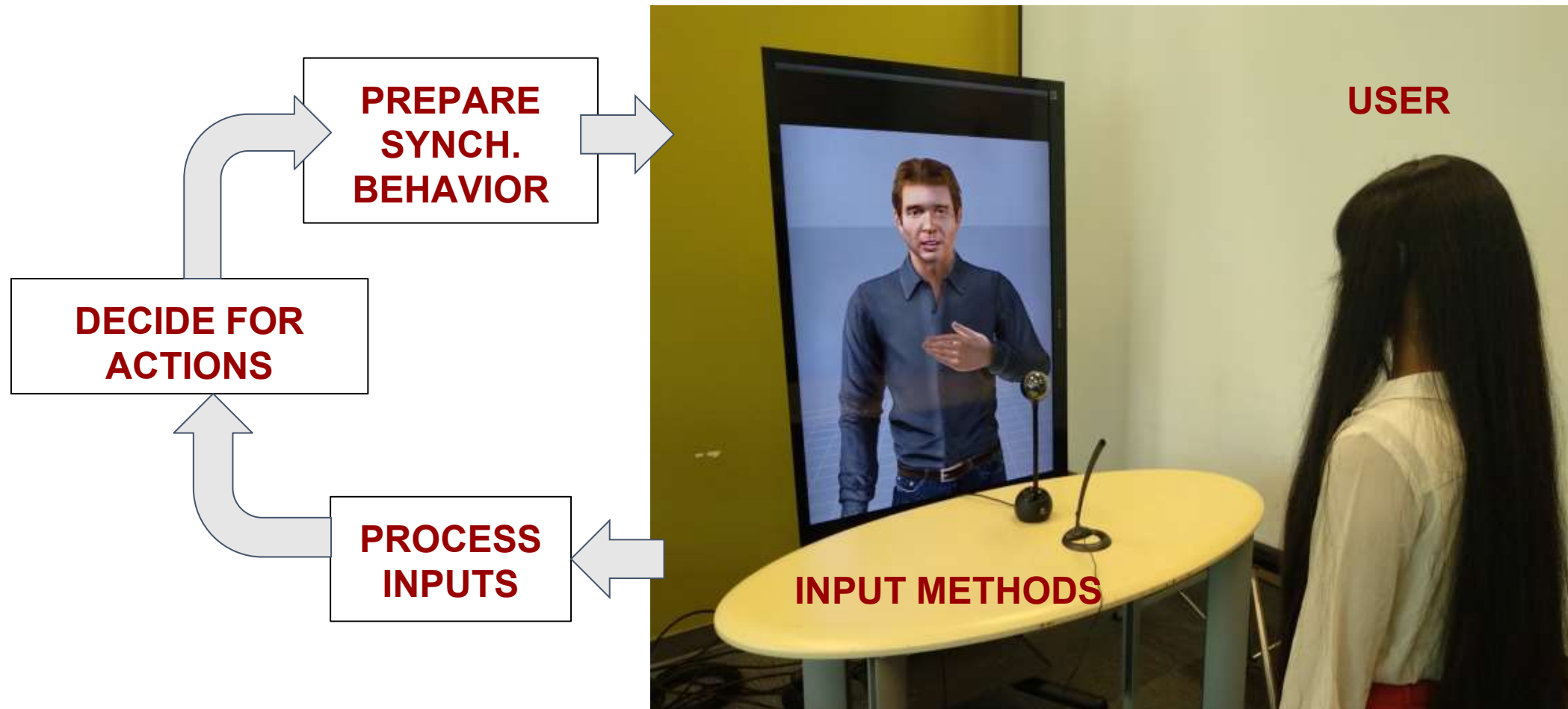
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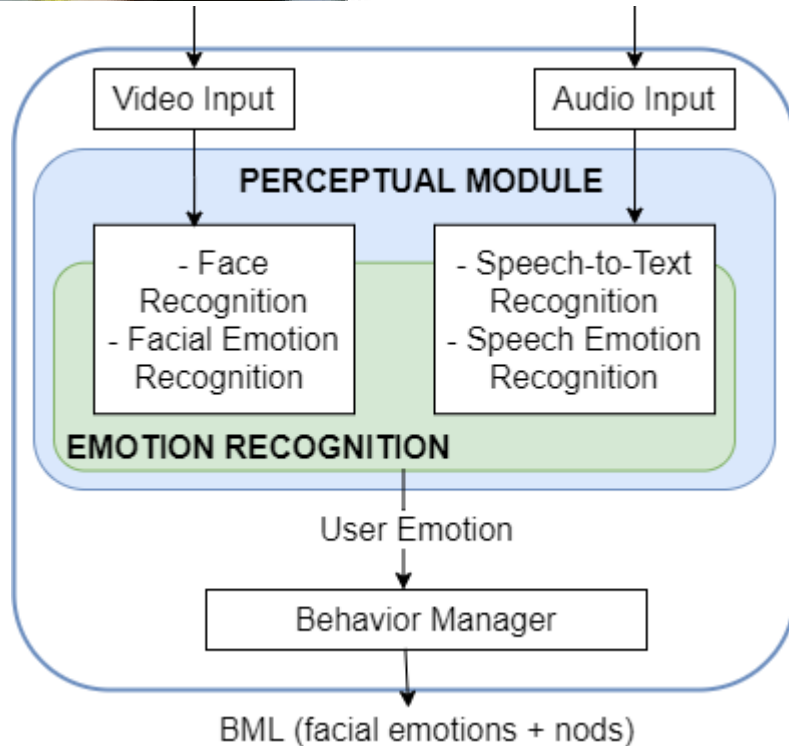
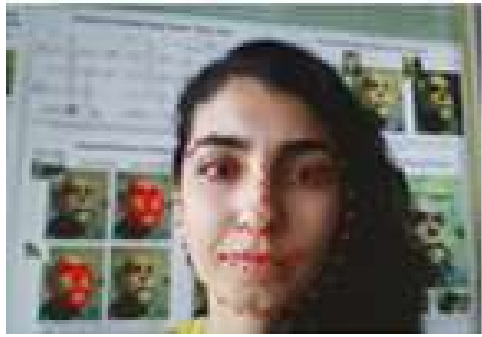
**</bml>**



# Creating the AI Framework

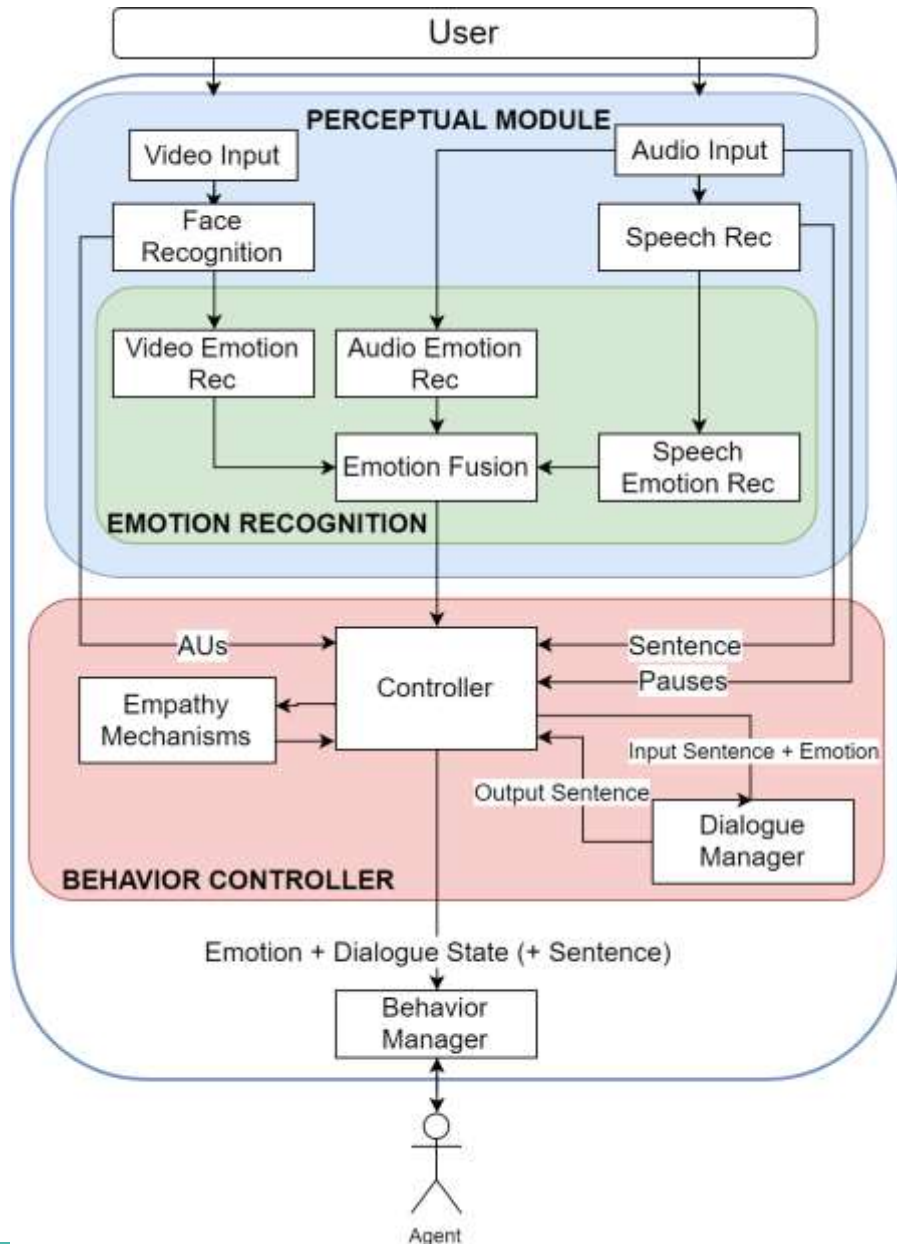


# Interested in ECAs?: Echo Bot



[https://github.com/onyalcin/echo\\_bot](https://github.com/onyalcin/echo_bot)

# Framework

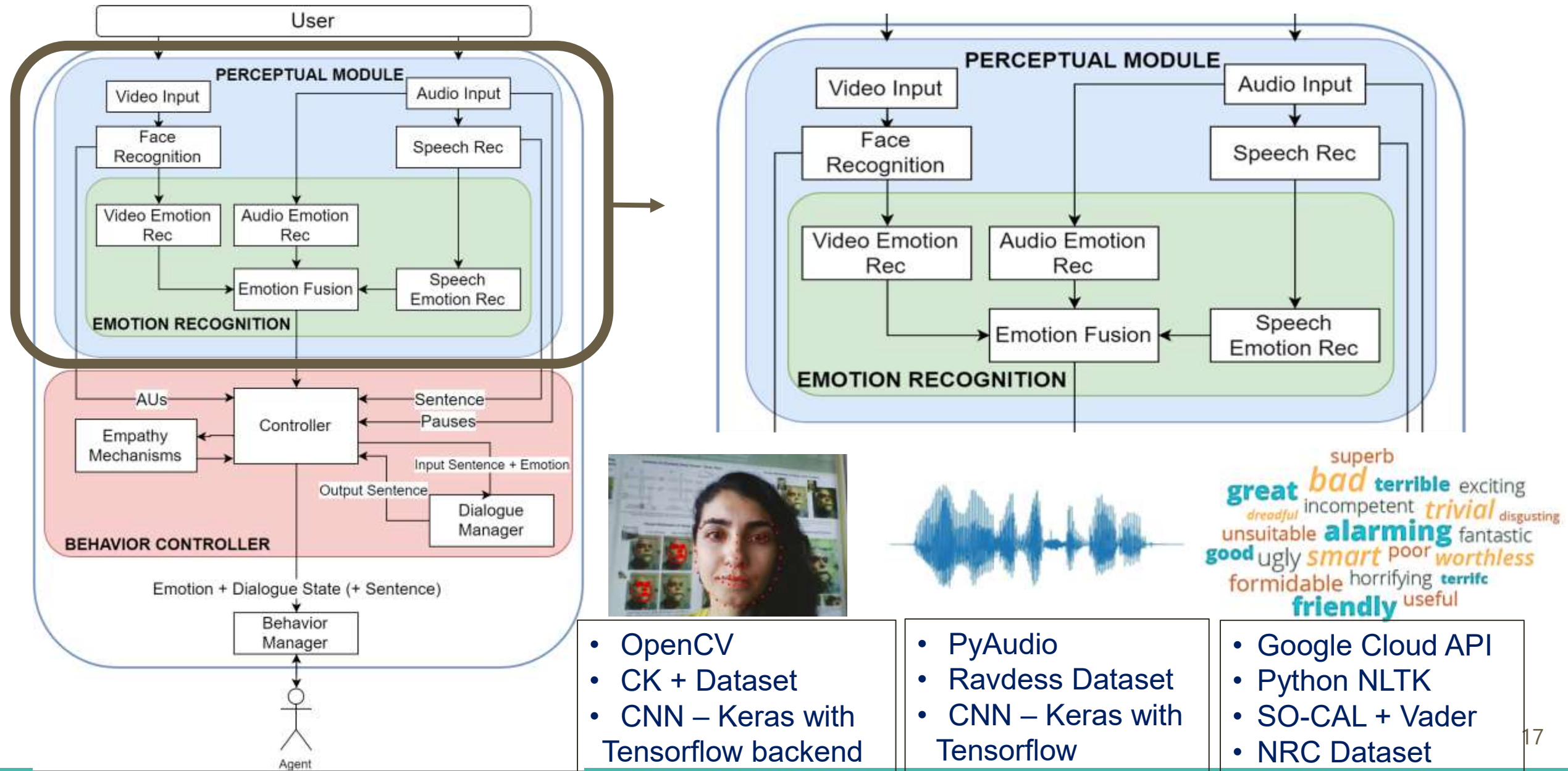


Yalçın, Ö. N. (2019). Empathy Framework for Embodied Conversational Agents. *Cognitive Systems Research*.

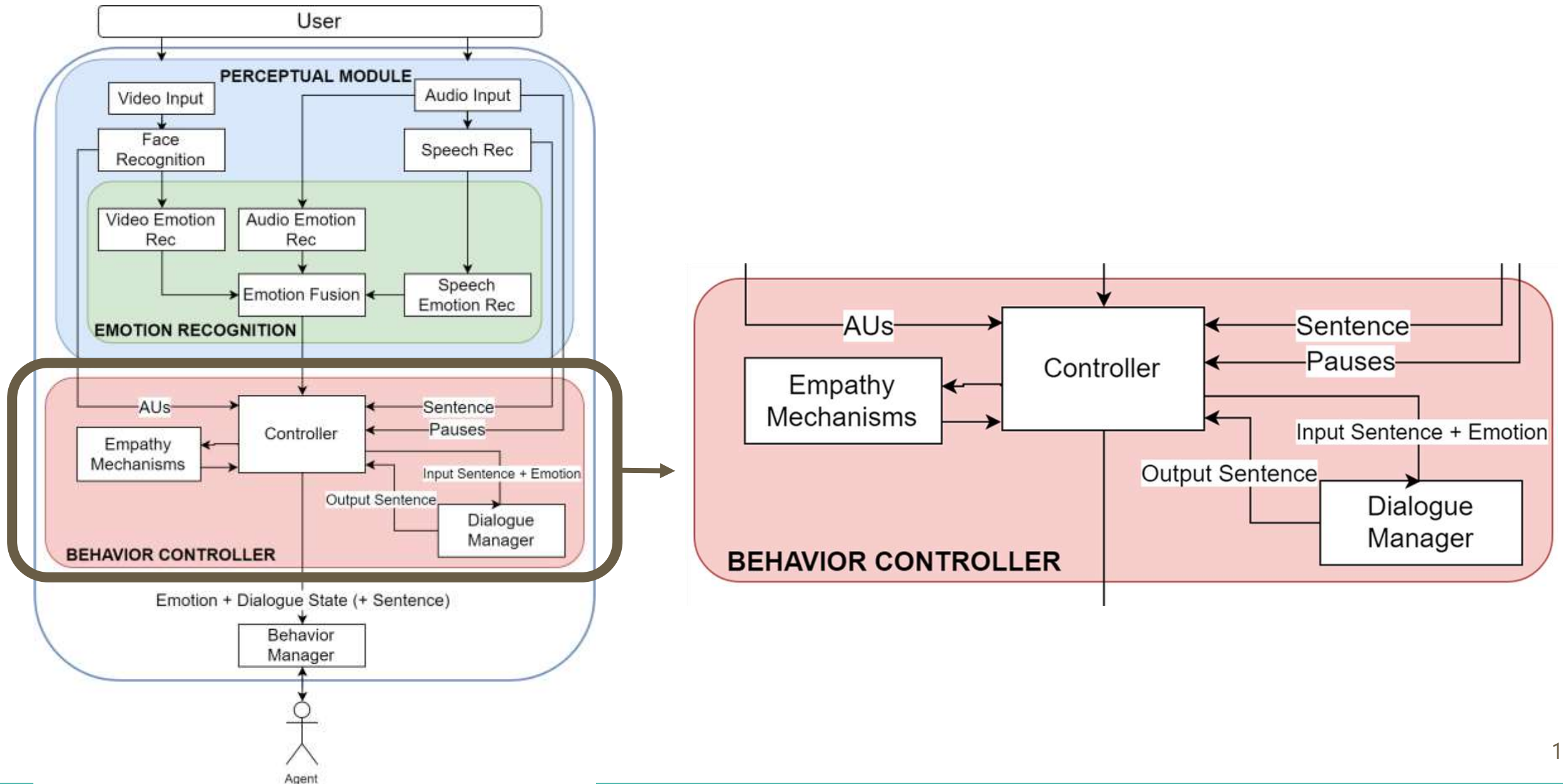
<https://doi.org/10.1016/j.cogsys.2019.09.016>

- Code available at github:  
<https://github.com/onyalcin/M-PATH/>
- Data generated available at SFU Radar:  
<https://researchdata.sfu.ca/islandora/object/islandora%3A10691>
- Python 3.5, Windows platform

# Perceptual Module



# Controller

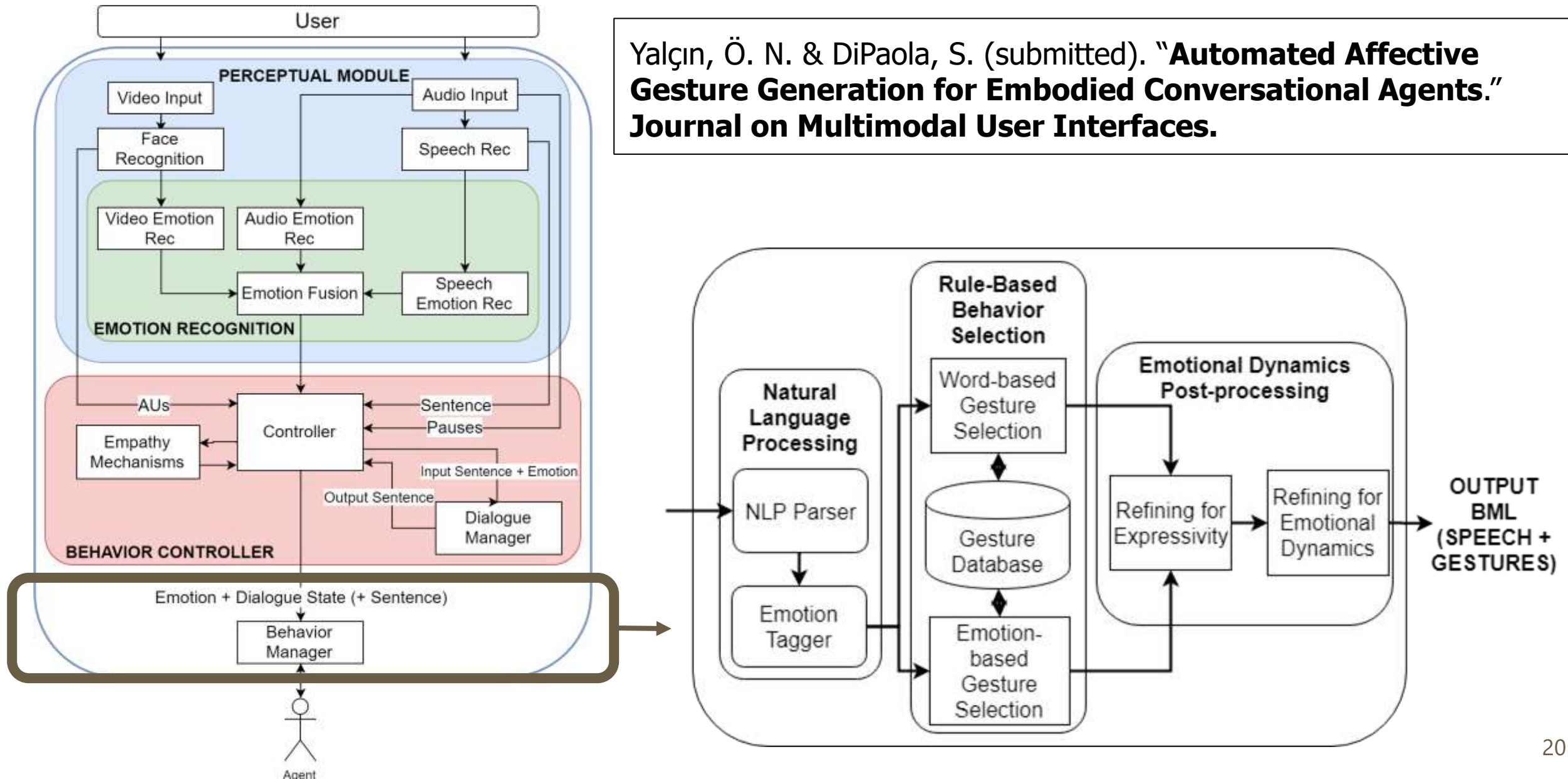


# Psychological Consultation Scenario

SPEAKER	UTTERANCE	RESPONSE TYPE
M-PATH	How often do you feel little interest or pleasure in doing things?	Context-based
User	Very often	
M-PATH	(1) I'm sorry to hear that (2) Maybe you should try to build up a routine. You can pick up a new habit with your friends (3) How often have you been feeling down, depressed, irritable, or hopeless lately?	(1) Emotional Reaction (2) Coping Reaction (3) Context-based
User	My problem is i am not used to wake up early	
M-PATH	I understand.	Topic Fallback
User	I feel down most of the time because I do not have a friend circle in campus	
M-PATH	(1) I'm so sorry you feel like that. (2) Try not to withdraw from your social life, your family and friends. They can improve your mood a lot	(1) Emotional Reaction (2) Coping Reaction

# Behavior Manager

Yalçın, Ö. N. & DiPaola, S. (submitted). **"Automated Affective Gesture Generation for Embodied Conversational Agents."** *Journal on Multimodal User Interfaces*.



# Psychological Consultation Scenario

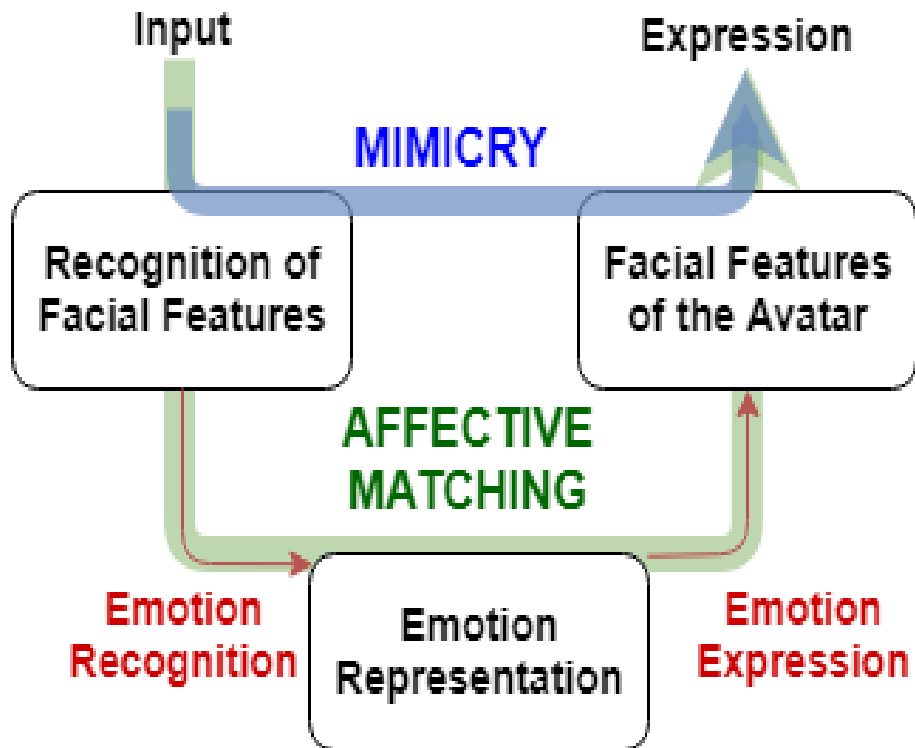


# How to Evaluate?

Evaluation Type	Humans	HCI
Feature-Level	<p>"Reading the Mind in the Eyes" test (Baron-Cohen et. al. 1997), "Reading the Mind in the Voice" test (Golan et al., 2007)</p> <p>Understanding appraisals (Baron-Cohen et al., 1986), The Picture-Stories task (Baron-Cohen et al., 1986)</p>	<p>Emotion Recognition/Expression Accuracy (speech recognition, )</p> <p>User model accuracy, Belief-Desire-Intention, Process Validity</p>
System- Level	<p>Self-report: Davis's Interpersonal Reactivity Index (IRI) (Davis, 1983), The Empathy Quotient (EQ) (Baron-Cohen &amp; Wheelwright, 2004), The Toronto Empathy Questionnaire (Spreng et al., 2009)</p>	<p>Self-report</p> <p>Observational:</p> <ul style="list-style-type: none"><li>• Behavioral Tests</li><li>• Perceived Empathy Measures</li><li>• Expert Opinions</li></ul> <p>Physiological:</p> <ul style="list-style-type: none"><li>• Neural activity, Heart rate, skin conductance etc. (see Neumann et. al., 2015 for review)</li></ul>

# Evaluation: Low-level Empathic Behaviors

Yalçın, N. Y. & DiPaola, S. (2019). “**Levels of Emotional Contagion in an Embodied Conversational Agent.**” **Proceedings of the 41st Annual Meeting of the Cognitive Science Society** , pp. 3143-3149.



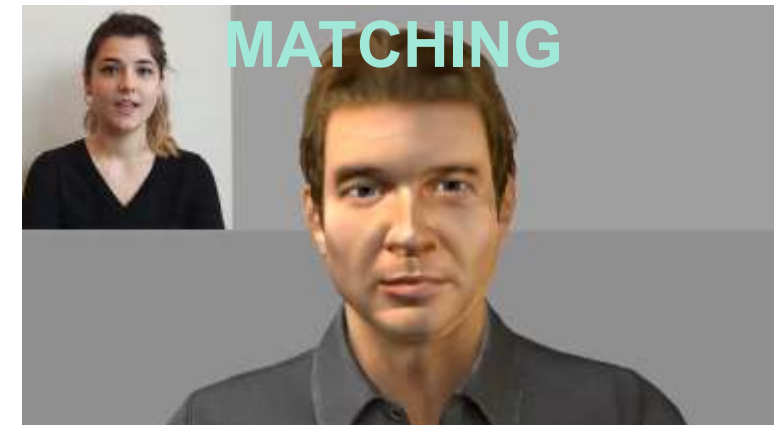
## BACKCHANNELING



## MIMICRY



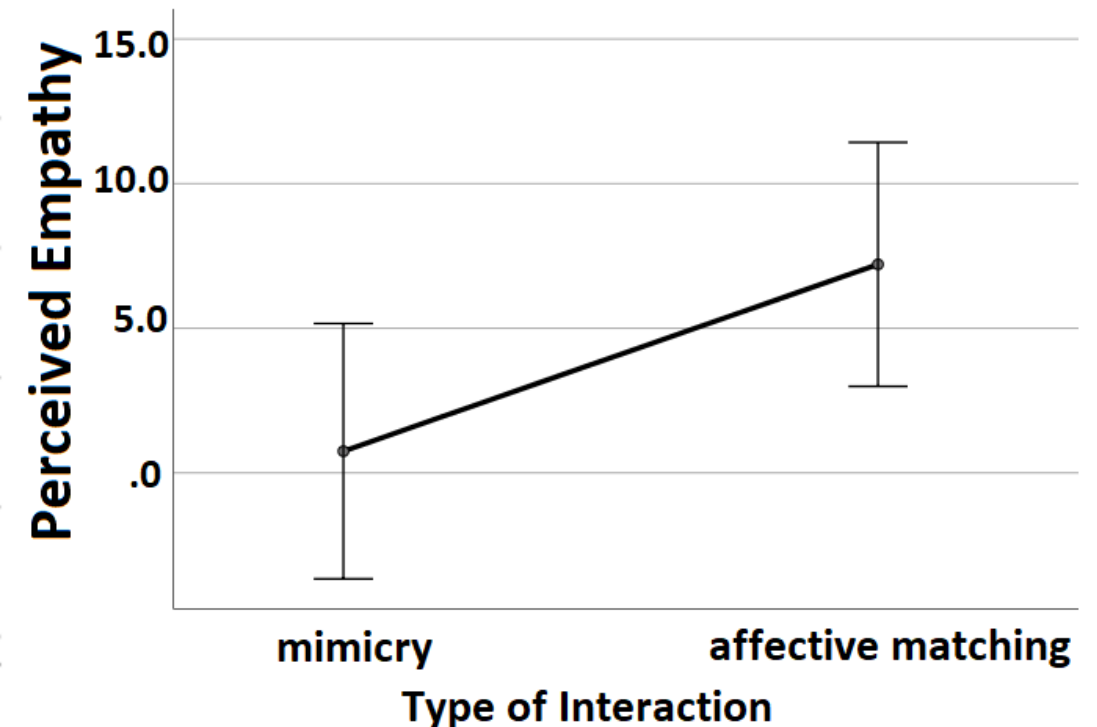
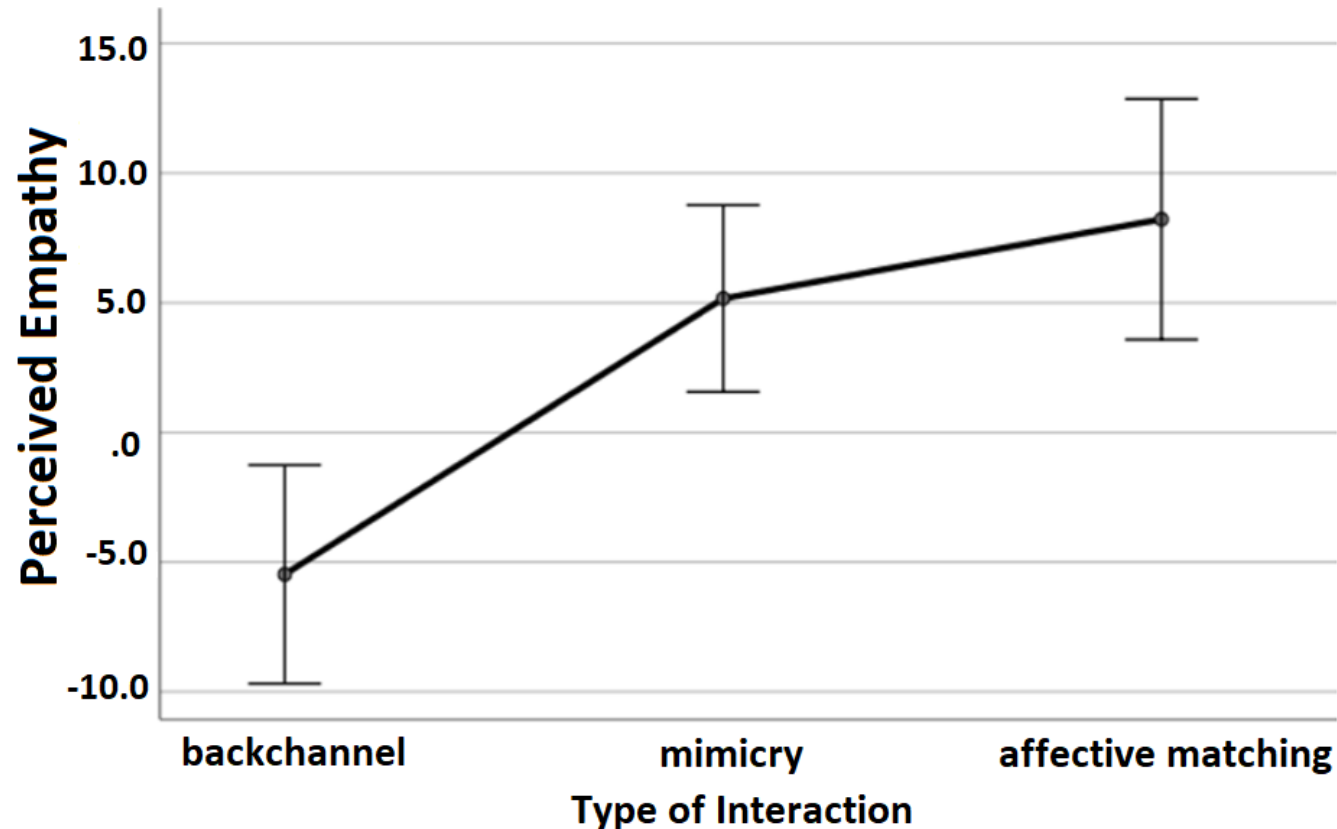
## AFFECTIVE MATCHING



# Evaluation: Low-level Empathic Behaviors

Yalçın, N. Y. & DiPaola, S. (2019). "Levels of Emotional Contagion in an Embodied Conversational Agent." Proceedings of the 41st Annual Meeting of the Cognitive Science Society , pp. 3143-3149.

- A total of 84 subjects participated in three studies.
- Perception of empathy: Toronto Empathy Q.
- MTurk environment



# Evaluation: Effect of Dialogue

- Empathic vs Non-empathic version
- Evaluation (5-point likert scale statements):
  - Perceived Empathy (Toronto Empathy Questionnaire) , scores vary between -32 to +32

Table 8.4: Results of the Evaluation

Variable	Empathic agent		Non-empathic agent		F(1,15)	p
	M	SD	M	SD		
Empathy	3.38	8.18	-1.12	7.80	6.43	.02*
Usefulness	3.06	1.00	2.56	0.96	4.29	.05*
Human-like	2.56	0.63	1.81	0.98	10.38	<.01**
Believable	2.88	1.02	2.38	0.96	5	.04*
Prefered to paper	2.06	1.24	1.69	1.40	8.99	<.01**
Prefered to human	2.88	1.36	2.62	0.96	1.36	.26
Trust	1.81	1.02	1.64	0.95	0.71	.41

# Challenges

## Implementation

- Complex set of behaviors
- **Multimodal** input/output
  - Fusion
  - Priority
  - Rule-based
- **Real-time** and **synchronized** behavior
- Consistency

## Criticism:

"Empathetic technology" cannot succeed because technology cannot feel what people feel.

Can you give an example where one person cannot feel what another person feels, and yet their empathy succeeds?

# Thank you! Questions?

[onyalcin@sfu.ca](mailto:onyalcin@sfu.ca)

<https://github.com/onyalcin/>

<https://onyalcin.github.io/>

<https://ivizlab.org/>



[https://github.com/onyalcin/echo\\_bot](https://github.com/onyalcin/echo_bot)

<http://smartbody.ict.usc.edu/>

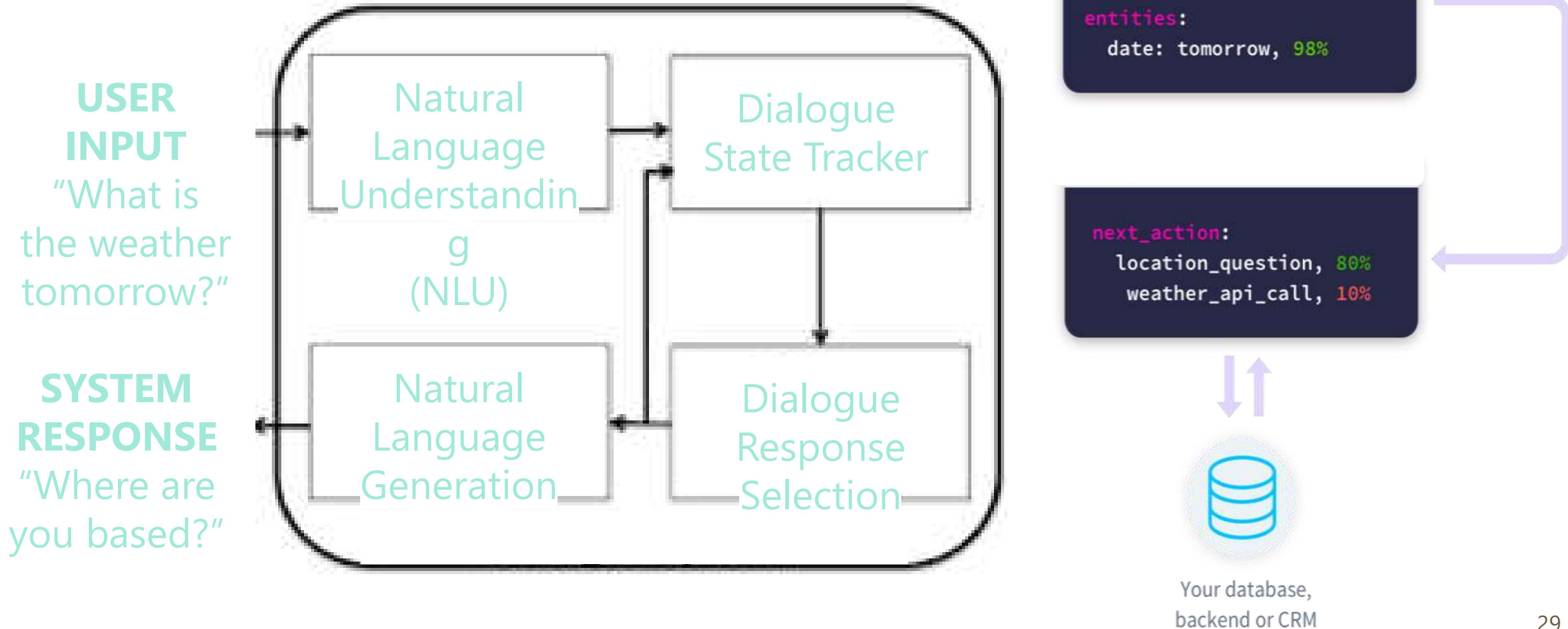
[https://drive.google.com/file/d/1ec-D4QNn0VDoC\\_VCNxlaB-Rrd3UBKofZ/view?usp=sharing](https://drive.google.com/file/d/1ec-D4QNn0VDoC_VCNxlaB-Rrd3UBKofZ/view?usp=sharing)

# Embodied Conversational Agents (ECAs)

... are **agents** that can interact with users with a **multimodal, situated** (and often anthropomorphic), and **real-time interaction** to emulate a similar experience of ***human-to-human conversational interaction*** (Cassell, Bickmore, Campbell, & Vilhjálmsón, 2000).



# Dialogue Management



# Dialogue Management

Tools:

- RASA : <https://rasa.com/docs/getting-started/>
  - <https://github.com/RasaHQ/rasa>
- DialogFlow (<https://dialogflow.com/>), Azure (<https://azure.microsoft.com/en-ca/services/bot-service/>), Watson Assistant (<https://www.ibm.com/cloud/watson-assistant/>)

Datasets:

- <https://breakend.github.io/DialogDatasets/>

# Further implementations for a rainy day ...

## Dialogue:

- <https://github.com/SenticNet/conv-emotion>
- <https://github.com/deepmipt/DeepPavlov>
- <https://tutorials.botsfloor.com/dialog-management-799c20a39aad>
- Xiaolce: <https://arxiv.org/abs/1812.08989>

## Audio Emotion Recognition:

- <https://github.com/marcogdepinto/Emotion-Classification-Ravdess>
- RAVDESS : <https://smartlaboratory.org/ravdess/>

## Sentiment Analysis:

- <https://github.com/cjhutto/vaderSentiment>
- <http://saifmohammad.com/WebPages/lexicons.html>