Using LEGO Robots to Create Smileys

M. Ali Yousuf
mali@jhu.edu
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Presentation Meant for

- K-6-8 Teachers as class room activity

Some Definitions

- MINDSTORMS
- AUTISM

Contents

1. Motivation
2. Perception of Facial expressions
3. Mindstorms ++
4. Conclusions

Motivation

Robots for Autistic Kids in Mexico, 2008 [Self]

Robots in Autism Therapy, 2013 [2,3]

Artificial Emotions to Assist Social Coordination in HRI, 2012 [1]

http://www.aldebaran.com/

A course on Robotics and Psychology at CTY? 2013

http://www.lego.com/

LEGO to express emotions?

2. Human Facial Expressions

- We now discuss some of the human facial expressions that can be represented as ‘smileys’.
- But
  - How many facial expressions are there?
  - How many are universal?
  - How many are recognizable by kids?
  - Starting from what age?
  - Do learning disabilities change this pattern?
  - …

2. Human Facial Expressions

The 21 Human Facial Expressions [9]

1. Happy
2. Sad
3. Fearful
4. Angry
5. Surprised
6. Disgusted
7. Appalled
8. Hatred
9. Awed

1. Sadly angry
2. Sadly surprised
3. Sadly disgusted
4. Sadly fearful
5. Happily surprised
6. Happily disgusted
7. Fearfully angry
8. Fearfully surprised
9. Fearfully disgusted
10. Angrily surprised
11. Angrily disgusted
12. Disgustedly surprised


HAPPY
SAD
SURPRISED
ANGRY
DISGUSTED
FEARFUL
AWESTRUCK
APPALLED
HATE-FILLED
HAPPILY SURPRISED
HAPPILY DISGUSTED
SADLY DISGUSTED
SADLY FEARFUL
SADLY ANGRY
SADLY SURPRISED
ANGRILY SURPRISED
ANGRILY DISGUSTED
DISGUSTEDLY SURPRISED
FEARFULLY SURPRISED
FEARFULLY DISGUSTED
FEARFULLY ANGRY


PUGH
'21 facial expressions
and all I ever see is
that irritable one'

2. Human Facial Expressions

- How many facial expression can you name?
  - Happy
  - Sad
  - Angry
  - Surprised
  - What else?
- Facial expressions typically classified as universal are joy, surprise, anger, sadness, disgust and fear [7].

2. Human Facial Expressions

- How do normal kids see facial expressions?
- There are significant differences in a pre-school child's ability to recognize and match the four different expressions: happy, sad, surprised, and angry (74% overall accuracy)
- Young children match happy expressions with the same frequency as sad.
- Sad faces are matched more frequently than surprised, or angry expressions [10].

2. Human Facial Expressions

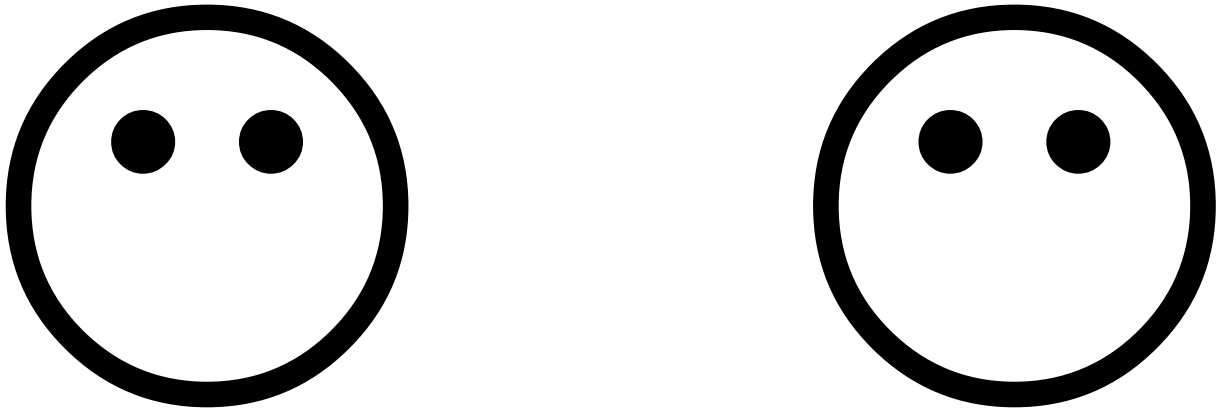
- What about autistic kids? (Human and robotic face)
- Results of another study show that the robot's "face" and "moving limb" usually draw the autistic children's attention and improve their facial expression skills, but do not contribute to the development of other social communication skills [8].
- Test results show that children interacted with the verbal-featured robot more intensively than with the experimenter. Hence robots with faces and moving limbs can engage autistic children in a better way.

2. Human Facial Expressions

- So much so for facial expressions and our ability to recognize them.
- Now let's see how to replicate them with a low cost LEGO Mindstorms
- The question is how many of these expressions can be represented in LEGO with minimum complication in design and control

2. Human Facial Expressions

Start with Mona Lisa Eyes

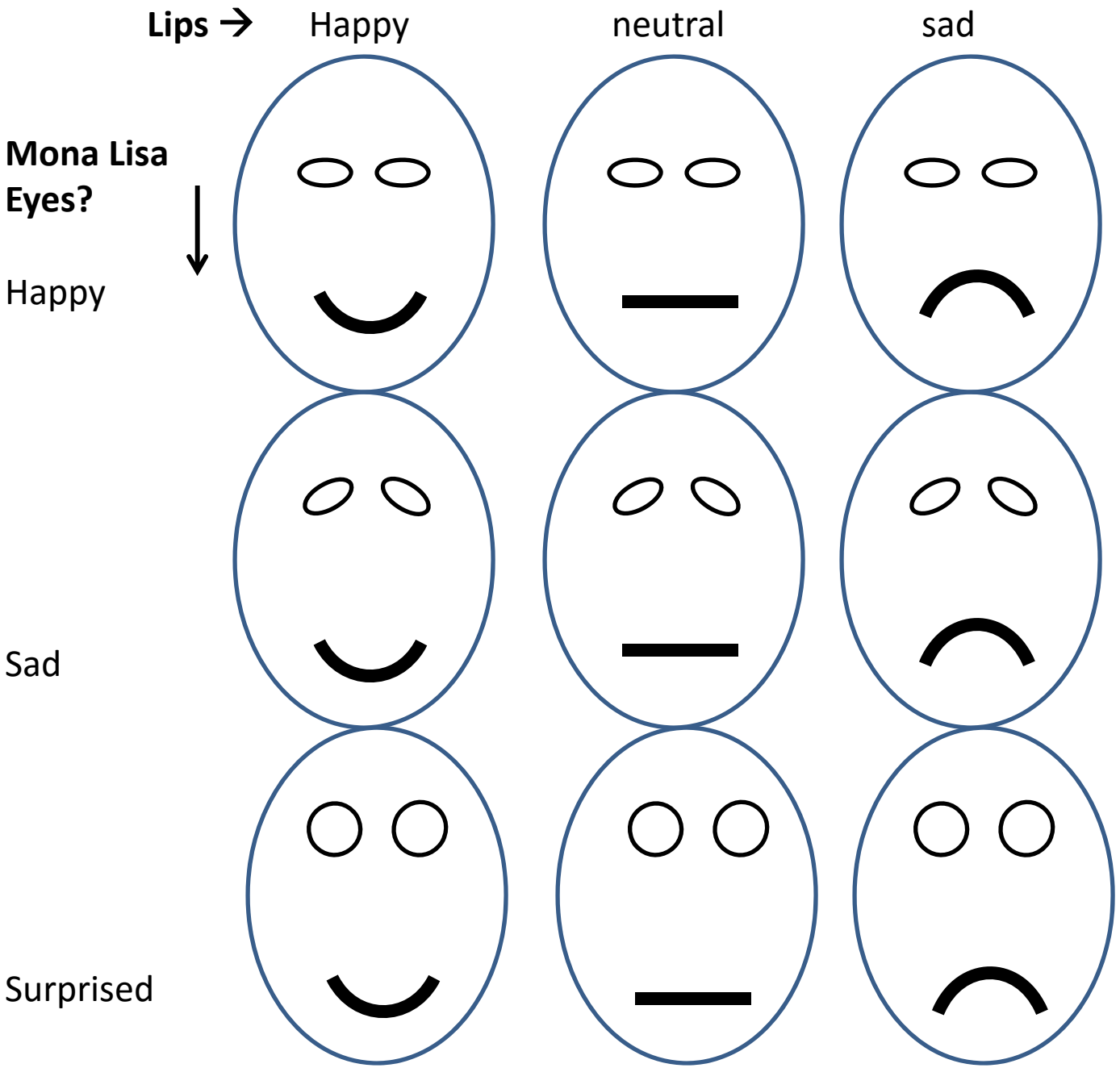


2. Human Facial Expressions

Start with Mona Lisa Eyes

2. Human Facial Expressions

- That's a good start but we need more basic facial expressions.
- Let's try more types of eyes and lip configurations.
- Two types of eyes and three lip configurations give us 3 x 3 or nine possible faces:


Lips →
Happy
neutral
sad
Mona Lisa Eyes?
Happy
Sad
Surprised

3. Mindstorms++

- Step 1: Children were given the basic pieces to try to connect them to represent lips in different configurations
- Step 2: Process repeated for different types of eyes
- Step 3: Finally they combined the above two to represent different face expressions like a smiling or sad face

3. Mindstorms++

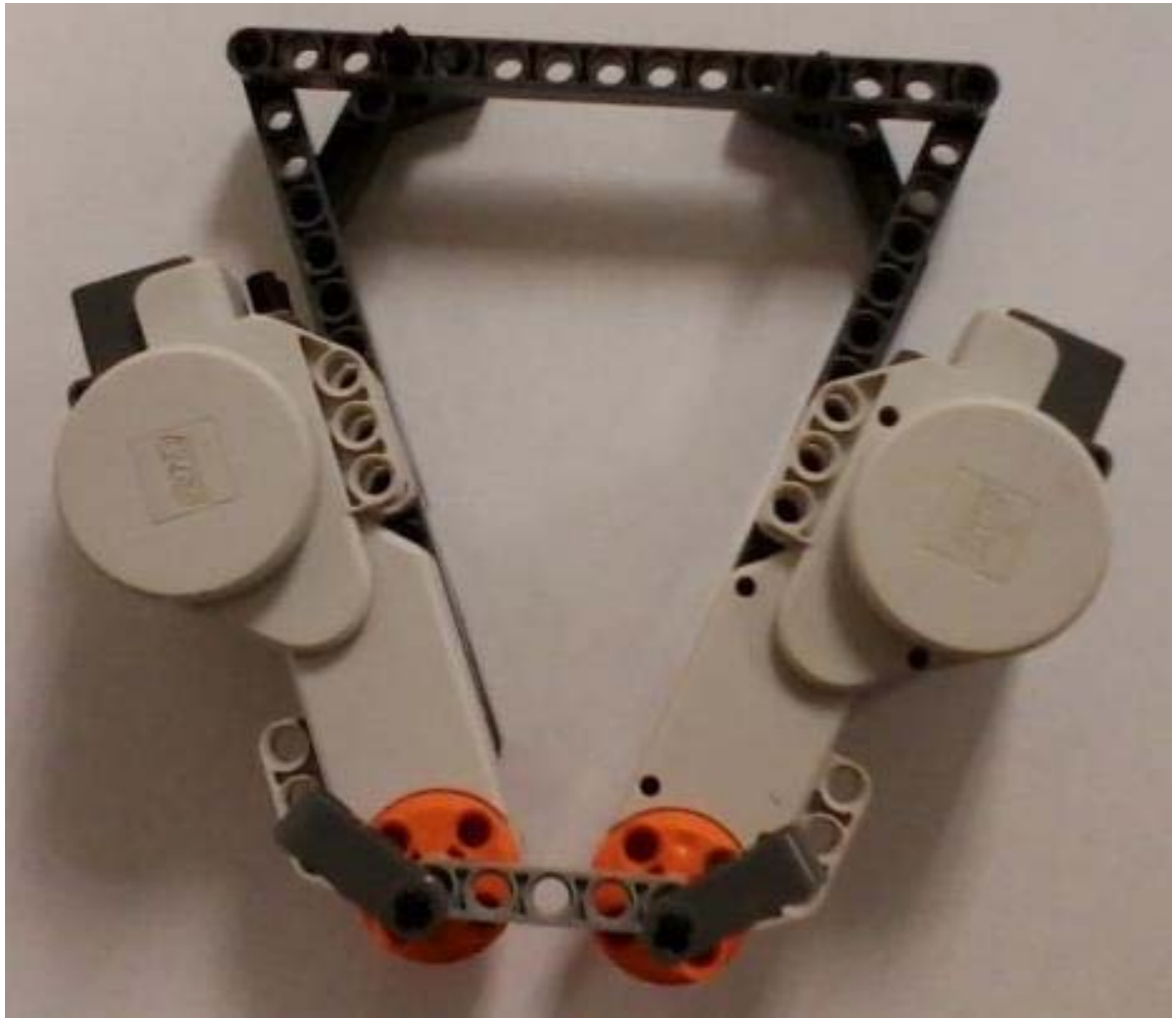
- Step 4: The designs were then revised by an adult to make them suitable for motor control
- Step 5: Students were given basic instructions on LEGO programming
- Step 6: Students created final designs with facial expressions which can change (by pressing a button, for example)

3. Mindstorms++

Some of the basic material needed for facial expressions

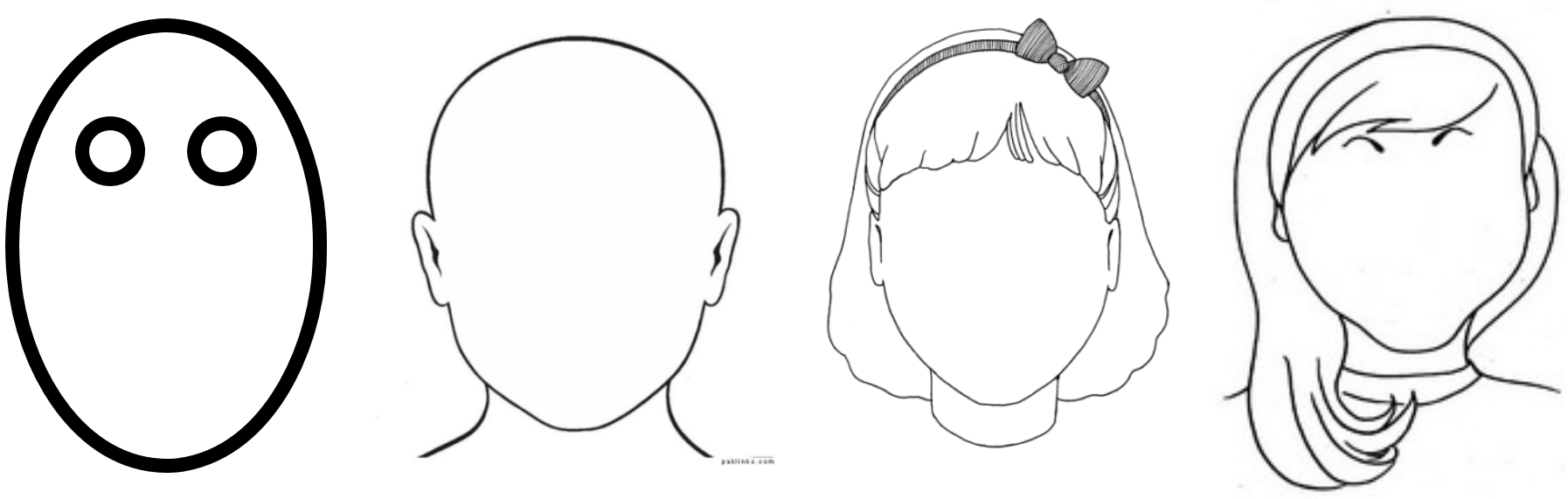
Addition of motors and some sensors make it more interesting

3. Mindstorms++

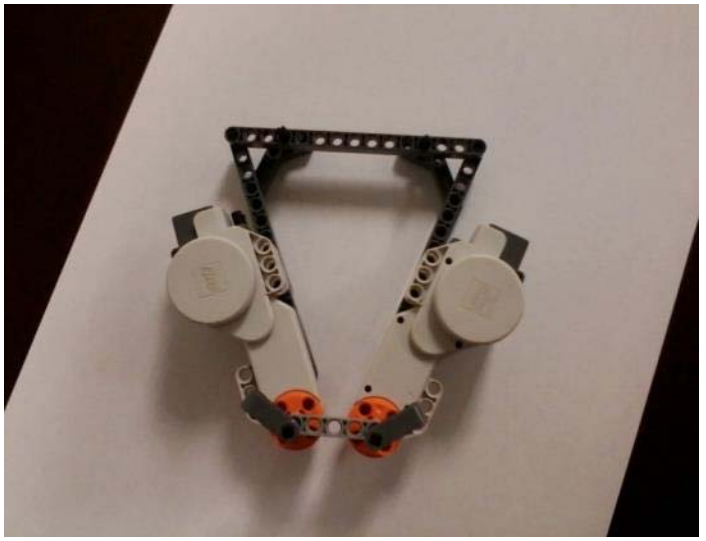


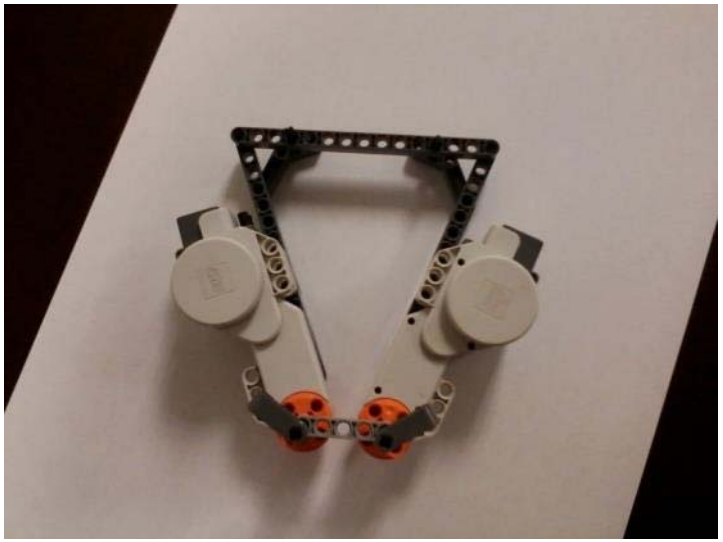
3. Mindstorms++

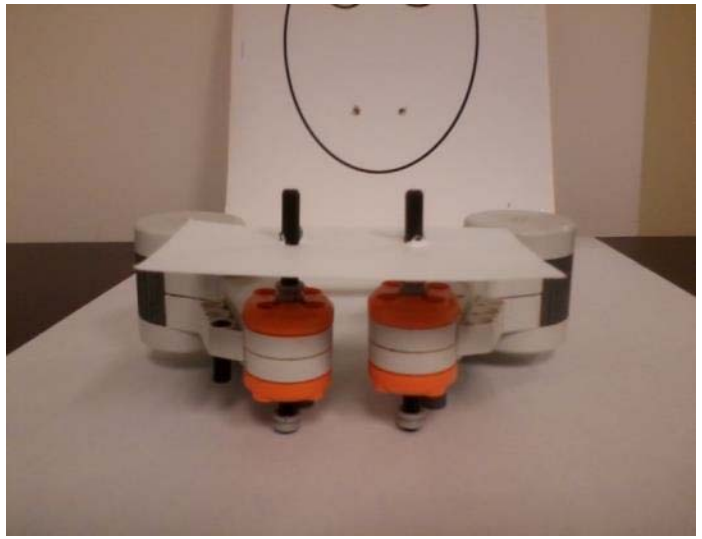
- Step 7: Simple face ‘contours’ were added to increase effectiveness

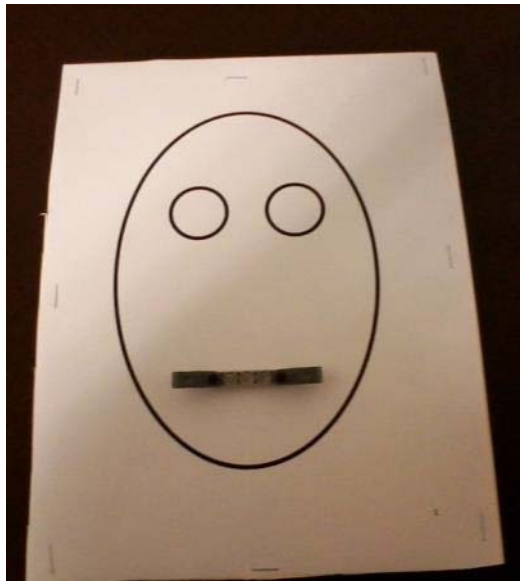


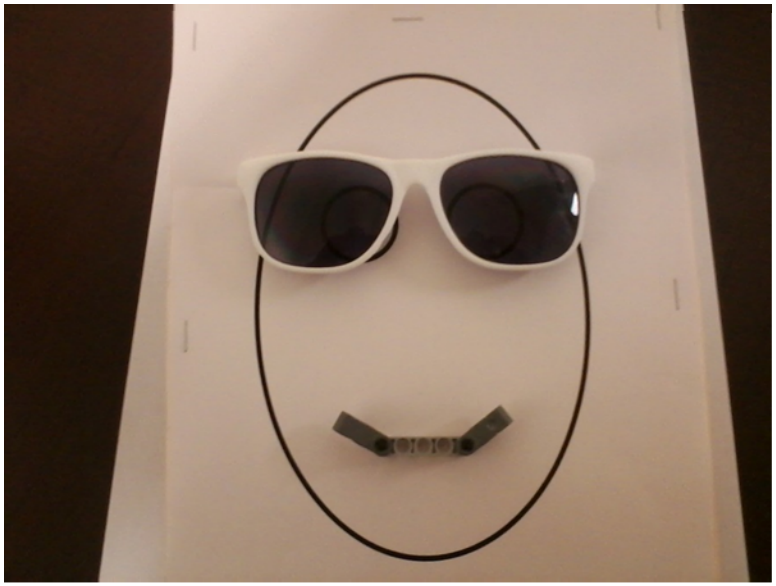
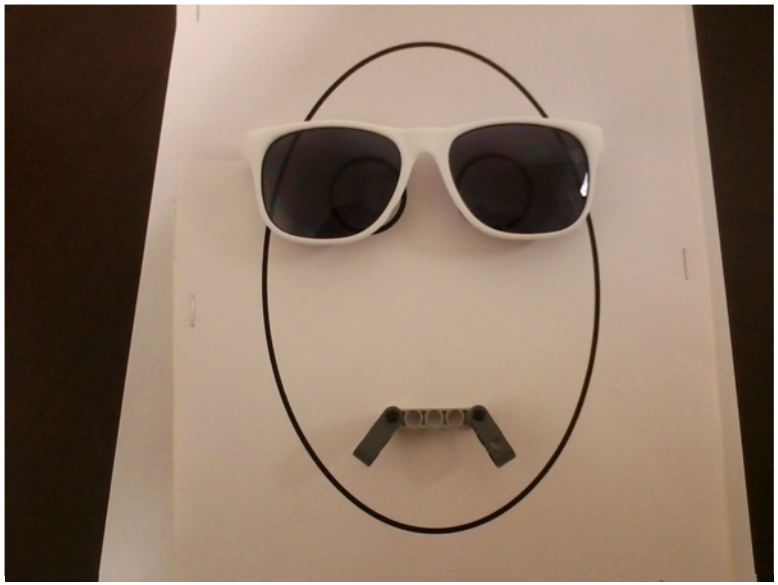
Behind the Scene

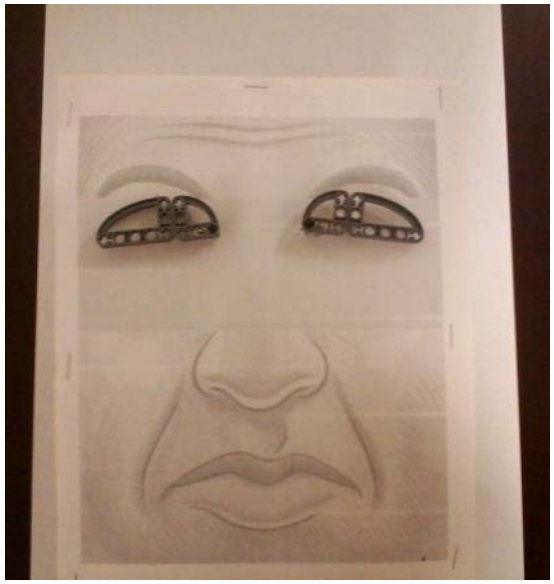
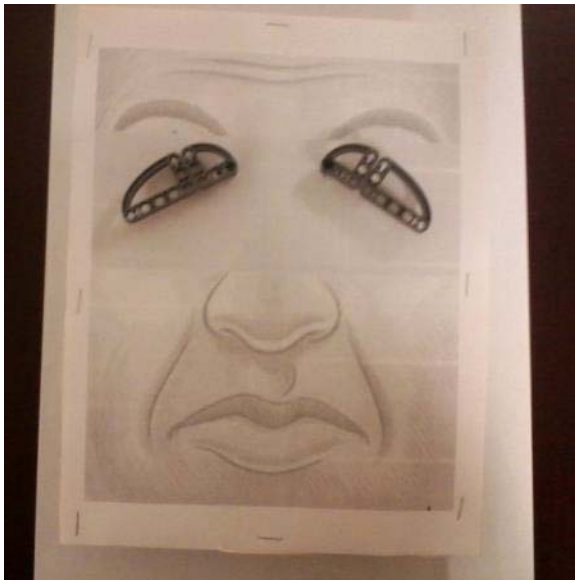
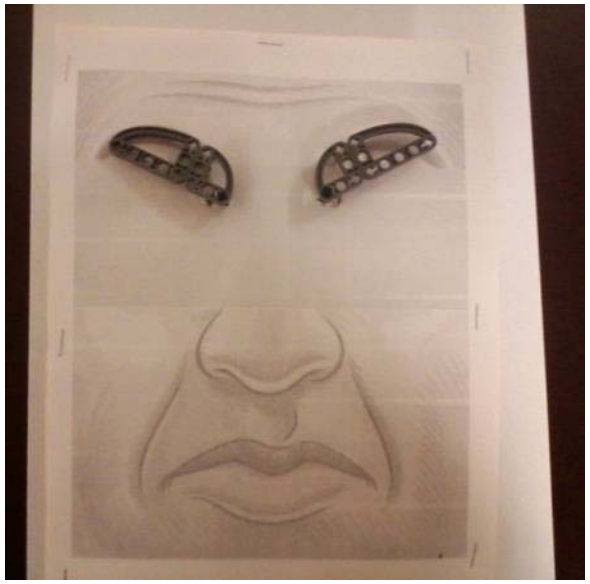
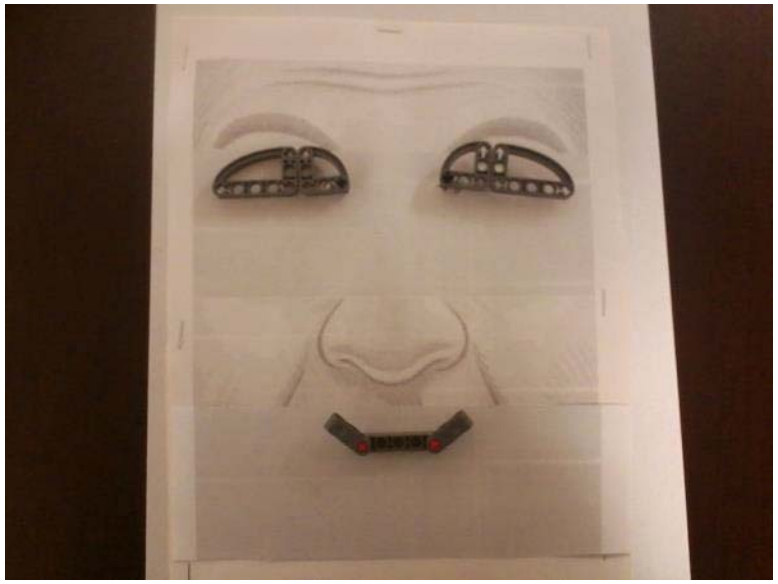
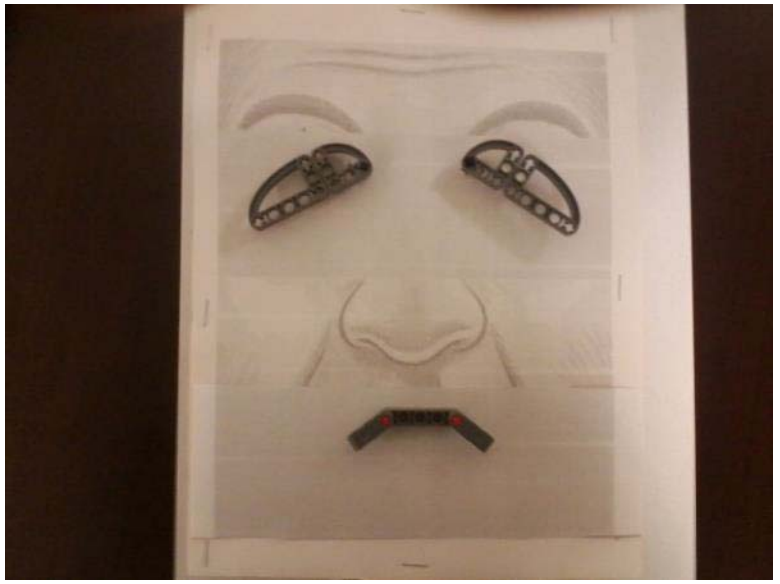


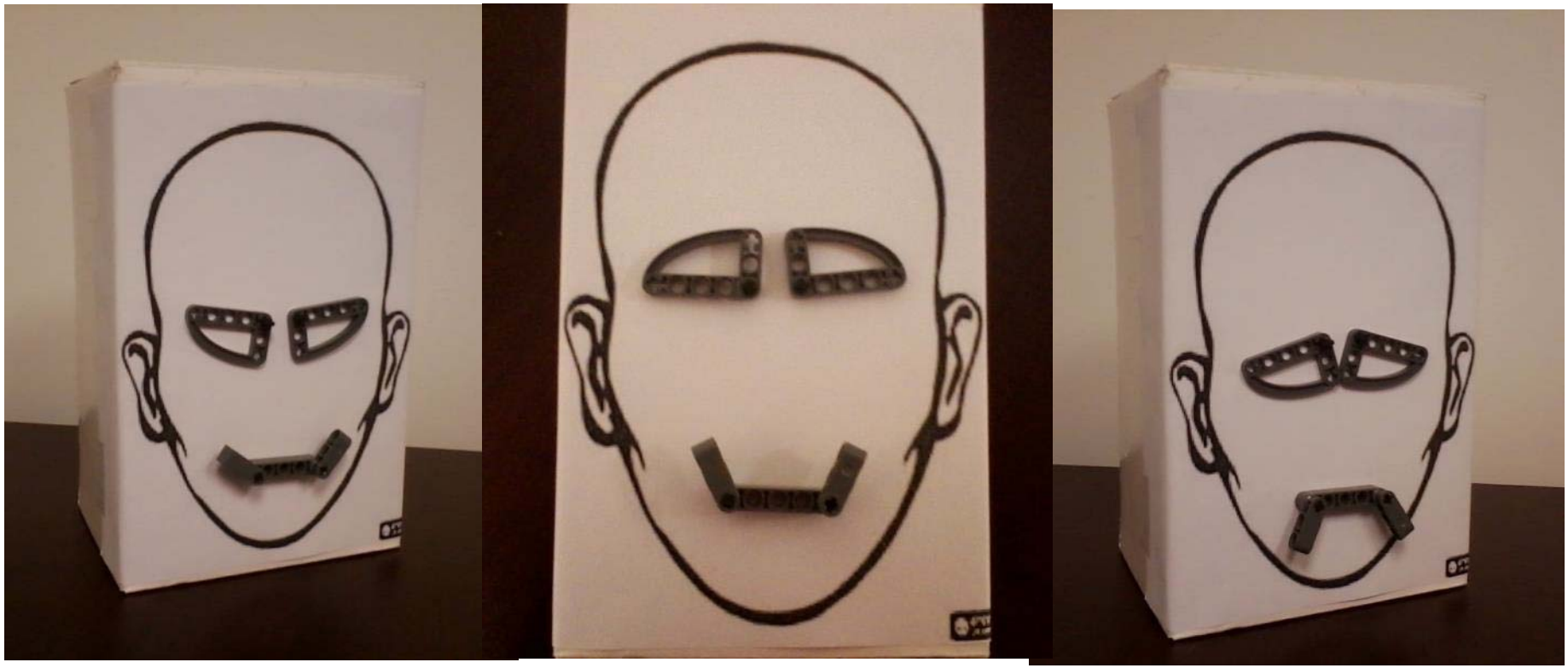


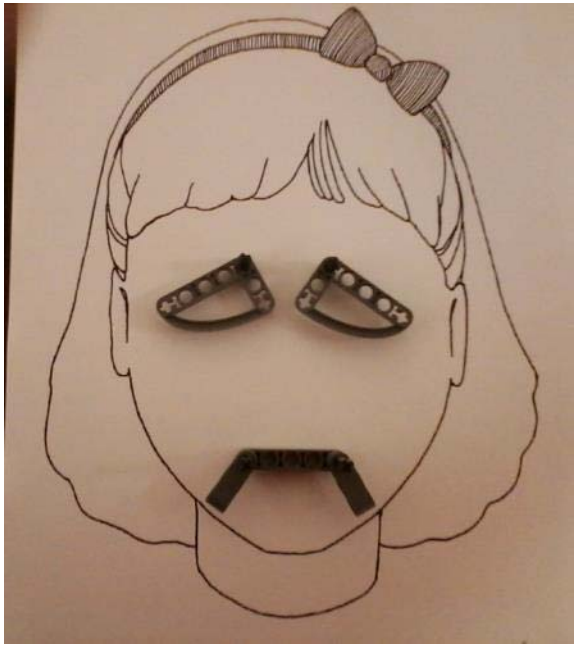


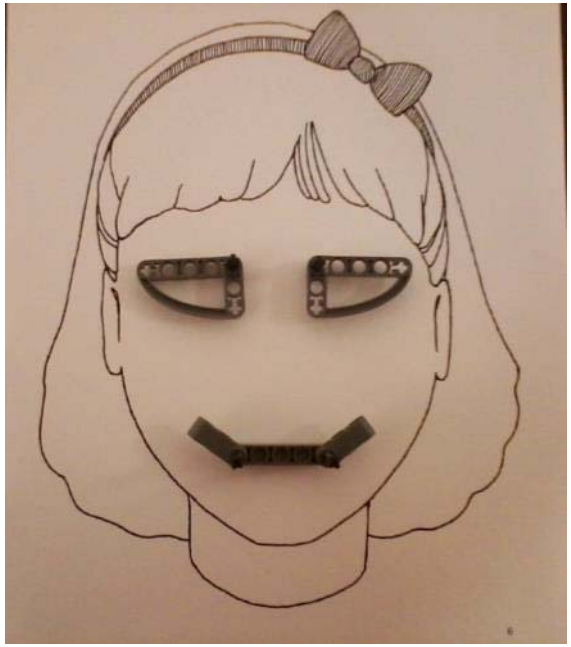



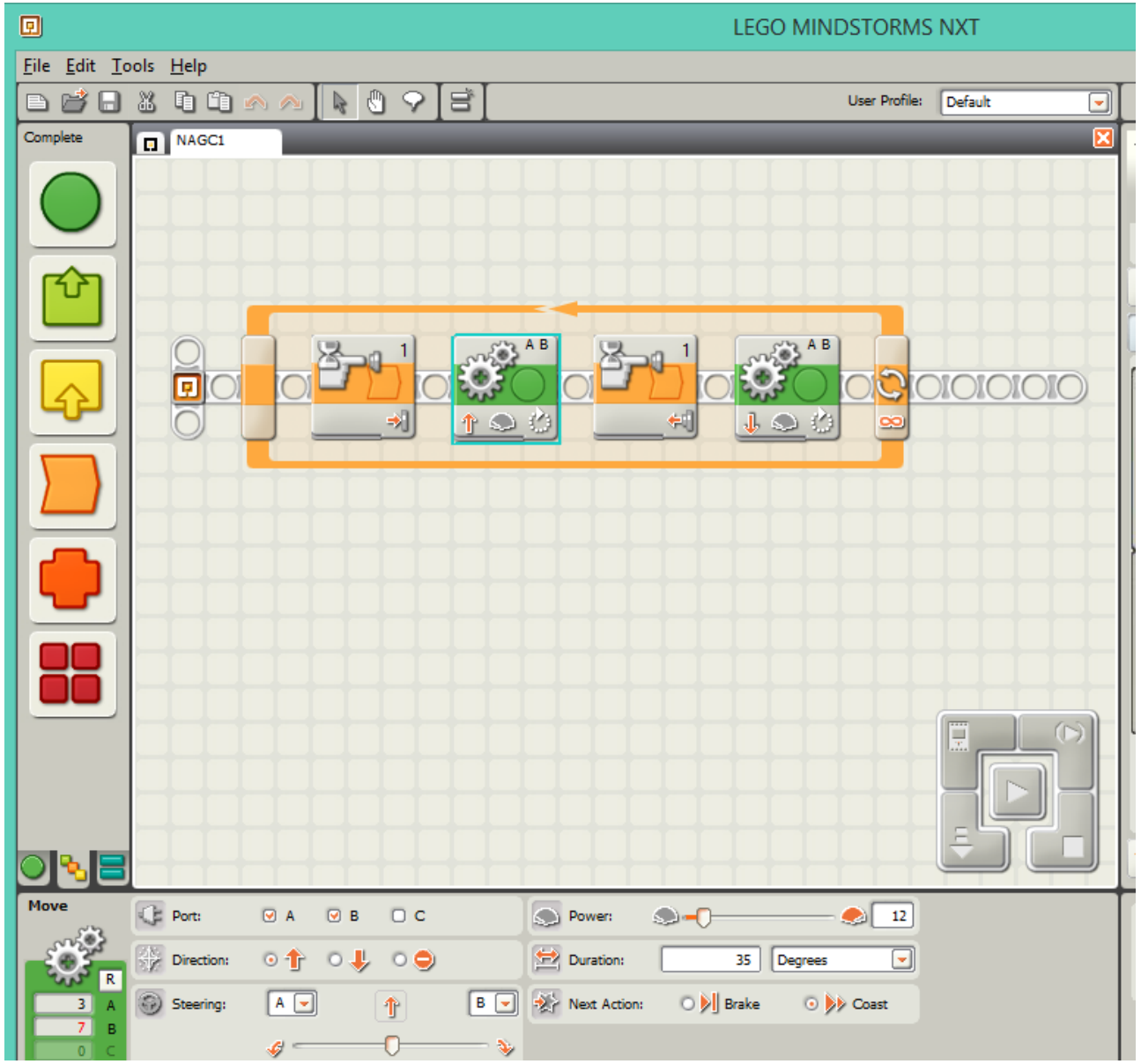





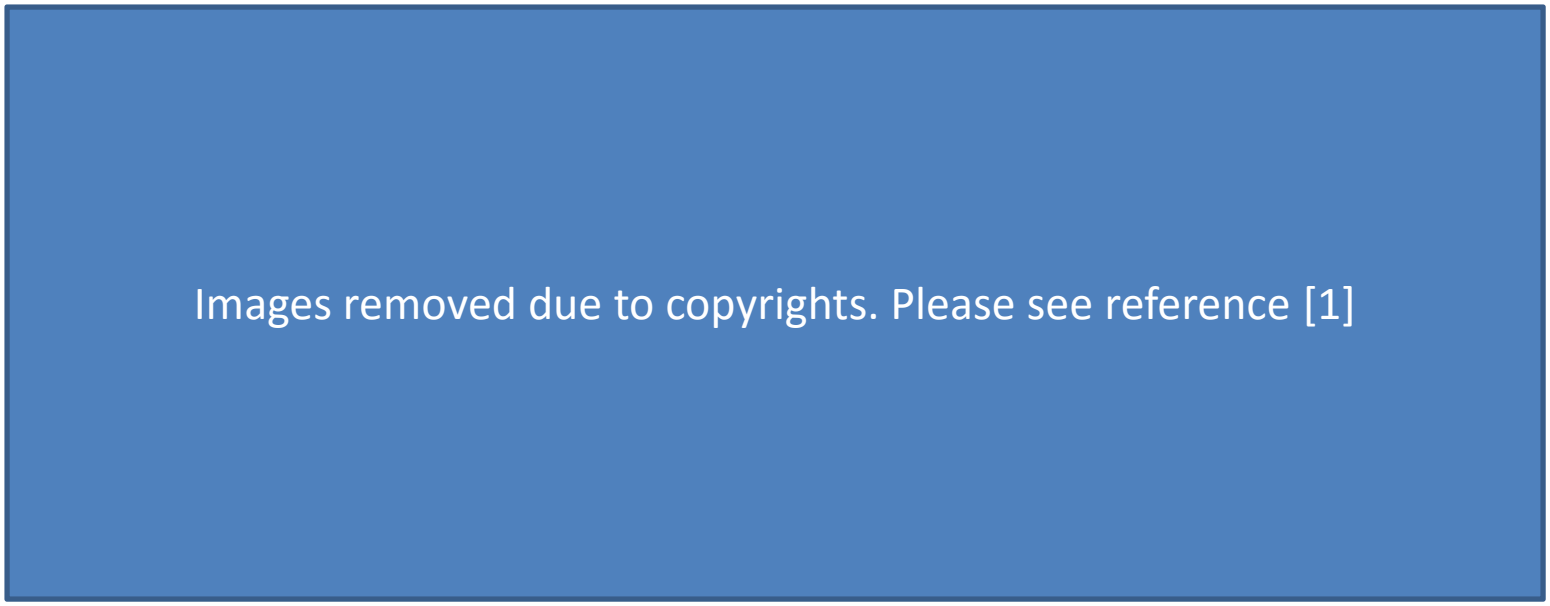





LEGO MINDSTORMS NXT
File Edit Tools Help
User Profile: Default
Complete
NAGC1
Move
Port: A B C
Direction:
Steering: A B
Power: 12
Duration: 35 Degrees
Next Action: Brake Coast

3. Mindstorms++

Adding neck position for reinforcement



Lego robot, expressing artificial emotions with the addition of two basic neck movements (forward and backwards) [1]

4. Conclusions and More Ideas (1/3)

- We have shown that even simple construction material can be used to represent facial expressions.
- At least some of the universal expressions can be interpreted by students.
- Only very basic designs were tried due to the age group of children. Elder students can design much more complicated faces and can program more intelligent behaviors

4. Conclusions and More Ideas (2/3)

- The addition of movements using robotic motors adds more dimensions and makes it even easier to understand expressions.
- There are two immediately obvious directions for further work: More movements and more sensing.
  - Just one sided movements
  - Neck movements
  - More types of eyes and more complicated lips

4. Conclusions and More Ideas (3/3)

- More sensing:
  - It is possible for these robots to ‘react’ to certain actions or noises. These reactions may mimic actual human reaction (Like KISMET Robot)
  - Ex: Wave hand in front of Ultrasonic Sensor to make it smile
  - Color detection and changing expressions
- Further experimentation is required to see how student’s age, gender, education level, etc affect perception of facial expressions [6].

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Questions?

Dr. Muhammad Ali Yousuf
Assistant Program Manager
Summer Academic Programs
Center for Talented Youth
Johns Hopkins University
McAuley Hall, 5801 Smith Avenue, Suite 400
Baltimore, MD 21209
Phone (Off): 410-735-6523
Fax: 410-735-6187
mali@jhu.edu
http://www.linkedin.com/in/maliyusuf
http://cty.jhu.edu