Queen Mary
University of London

CS4FN

Computer science activities with a sense of fun

Emotional robot video

Created by Peter McOwan and Paul Curzon of Queen Mary, University of London with support from EPSRC and Google

www.cs4fn.org

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Age group: 8 – adult

Abilities assumed: answering general questions

Time: 10 minutes

Size of group: any size

Focus

What might the human-computer interaction of the future be like?

How might neural networks be used to create human-like behaviour?

Summary

This short (1 minute) video demonstrates a robot created by a university student that reacts to the tone of a speaker's voice. It responds by changing its expression to suggest emotions such as happy, sad and surprised.

Aims

This activity aims to show that the future of human-computer interaction is not about keyboards and mice. In the future computers will be able to understand the subtleties of human-human interaction. We focus here on the way we react to facial expressions and tone of voice. It also demonstrates that a robot 'brain' based on a neural network can learn human-like behaviour in the form of emotions.

Technical terms

Neural networks, affective computing, artificial intelligence, robots, human-computer interaction.

Materials

- Video of Blade the affective robot. This is available from (www.cs4fn.org/alife/robot/blade.php) or the cs4fn YouTube channel (www.youtube.com/cs4fn)
- Data projector

What to do

Explain that you are going to show a video of a robot called Blade. It was created by a student, Zabir, as part of his undergraduate final year project at Queen Mary, University of London. It is not what it is made of or looks like that matters though. It is its behaviour, and how it is able to do it. It has a brain modelled on the human brain that works in a similar way to ours. It cannot understand what the person is saying, only the tone of voice.

Start the video.
Point out that when Zabir is happy and talking softly the robot is “happy”, but when he gets angry and starts to shout it is unhappy. Then when he talks softly again it “cheers up”. Just before Zabir shouts suddenly, mention they should watch its eyebrows. It can be surprised!

The robot analyses the sounds it hears and these are linked to different expressions. The area of research that tries to create computers that can interpret human emotions is called affective computing. An affective robot is thus one that relates to a person’s moods and emotions.

Blade’s behaviour was not programmed, however. It learnt to link the right movements of its face to the correct tone of voice. Zabir spent hours talking to it, shouting and talking softly. Each time he gave it feedback about whether its expression was appropriate. It learnt a little like a dog. It was rewarded when it did the right thing and punished for doing the wrong thing.

Blade’s brain is a neural network. It consists of virtual neurons that each have a simple rule about when to fire. When it learns it is just adapting the rules in its neurons.

At the moment humans have to learn how to use a computer – how to use a mouse, a keyboard and so on. Instead of us having to learn how to communicate with a computer, computers are learning how to communicate with us. We do not just communicate with words. People understand what we mean by our tone of voice, our body language, our emotions. In the future, computers will need to be able to both understand those subtle cues themselves and also use them to communicate their meaning to us.

Eventually Blade was taken apart. It was turned into a fencing robot the following year. Somehow, after seeing it smile and frown, reacting to our voice, it seemed something more than just a pile of Lego.

Variations and extensions

This video can slot into a range of other larger activities. For example, it can be played after the brain in a bag activity for building a neural network brain to play snap. Explain that if you can make a physical model of a brain that can do things (as the class has done), you can write a program that does the same thing. Such a program creates virtual neurons and simulates the sending of messages between them according to the rules in each neuron. Point out that there is a difference though. In the physical rope-and-toilet-roll brain we had to program the rules. We wrote the different rules and gave them to appropriate neurons. A software neural network like the one in the robot would allow it to learn to play the game. It would learn the rules for each neuron from experience.

It can also be used as the grab for another activity you’ll find on cs4fn, called 'Create-a-face' (see 'Links to other activities' below for the address). In this case play the video first. There is no need to discuss the neural network aspect of the robot’s brain. After showing the video explain that you are going to build and program a robot that can behave in the same way. The only difference is that instead of using Lego and a laptop, you will use class members, card and tubes.

This could also be used to start an open philosophical discussion of whether robots can have emotions. Blade simulates emotions but does not feel anything. Could a robot ever be conscious?

Further Reading

Blade the affective robot
The story behind the video.
www.cs4fn.org/alife/robot/blade.php

Future Friendly: focus on Kerstin Dautenhahn
How Kerstin Dautenhahn is teaching robots social intelligence.
www.cs4fn.org/alife/robot/kerstindautenhahn.php

Into the Uncanny Valley
What makes a robot seem human and what makes it freaky?
www.cs4fn.org/ai/creepout.php

Can computers help understand the brain?
How might you do statistics using neural networks?
www.cs4fn.org/biology/basalganglia.php

Links to other activities

Brain in a bag
Make a neural network out of rope and toilet roll. Once the group agrees that intelligent things don't blindly follow rules, this activity can be used to show how the brain works – and that it follows rules.
www.cs4fn.org/teachers/activities/

Create-a-face: Programming an emotional robot
Make and program a giant "robot" face. This can be used to introduce the idea of breaking a program into "objects".
www.cs4fn.org/teachers/activities/

The intelligent piece of paper
Take part in a test of intelligence against an intelligent piece of paper! This is a good introduction to what a computer program is, and also to start a discussion on what it would mean for a computer to be intelligent.
www.cs4fn.org/teachers/activities/

The sweet learning computer
Make a computer that teaches itself to play a game perfectly. A computer can be programmed to work the rules of how to play the game out for itself (so where is the intelligence then?) This activity is one way to illustrate how that can be done.
www.cs4fn.org/teachers/activities/

Conversations with computers — The Turing test (CS Unplugged activity)
How would you tell if a computer was intelligent? Having possibly dismissed the idea that something following rules like the 'intelligent' paper is intelligent, move on to explore how you would tell if a computer was intelligent or not.
http://csunplugged.org/turing-test