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# Living spaces - dynamic lighting and music

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# Overview

- Dynamic living spaces
  - Ambient music and lighting
  - Reading human signals with AI
  - Demo: emotion detection + Raspberry Pi + LEDs
  - Conclusion
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# We create our environment

Bee hive



[P]

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# and our environment creates us

Japanese sand  
garden in Monaco



[W]

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# Not only smart, but “caring” homes

Ambient environment affects learning, mood, and interactions

Hack home lighting, music, etc

Anticipate algorithms that maximize personal target functions with machine learning

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# Hardware + software setup

- Raspberry Pi 3B (for deep inference use NUC or NCS)
  - Camera software: fswebcam (or raspicam, OpenCV)
  - Emotion detection: Microsoft/Oxford Emotion API
    - Free trial good for ~1000 API calls
  - WS2812 addressable LEDs
  - Library for controller: [github.com/jgarff/rpi\\_ws281x](https://github.com/jgarff/rpi_ws281x)
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# Projecting emotion scores into color space

Task: find the matrix  $P$  that projects emotion scores onto RGB space:

$$P \begin{pmatrix} \textit{anger} \\ \textit{contempt} \\ \textit{disgust} \\ \textit{fear} \\ \textit{happiness} \\ \textit{neutral} \\ \textit{sadness} \\ \textit{surprise} \end{pmatrix} = \begin{pmatrix} \textit{red} \\ \textit{green} \\ \textit{blue} \end{pmatrix}$$

example:

$$P \begin{pmatrix} 0.00 \\ 0.00 \\ 0.00 \\ 0.00 \\ 0.65 \\ 0.05 \\ 0.00 \\ 0.30 \end{pmatrix} = \begin{pmatrix} 180 \\ 170 \\ 10 \end{pmatrix} =$$



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# Human signals as data

Party Pi:  
emotion-detection game



<https://github.com/JustinShenk/party-pi>

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# Human signals, continued

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Analysis of emotions in a room.  
<https://youtu.be/urHMHEAgpPo>



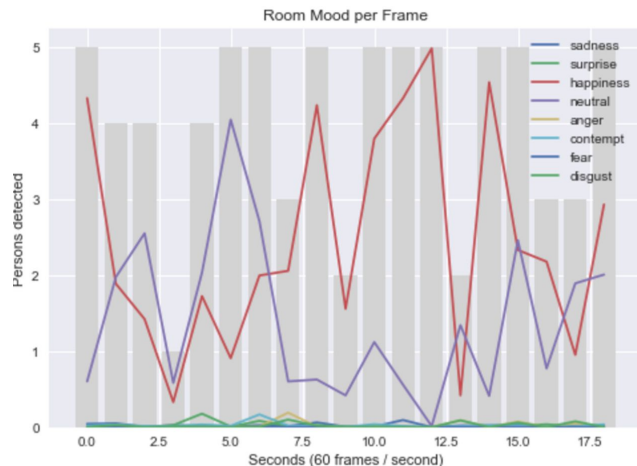
<https://devmesh.intel.com/projects/party-pi-group-dynamics-analytics>

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# Human signals, continued

Can be extended to read other human signals, eg, motion, posture, etc.



<https://devmesh.intel.com/projects/party-pi-group-dynamics-analytics>

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# Human signals, continued

Body pose/gestures as input:



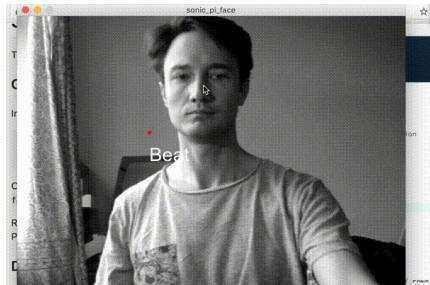
[1]

<https://github.com/JustinShenk/video-pose-extractor>

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# Human signals, continued



Music / ambient sound as output

- Sonic Pi + OpenCV + Open Sound Control

Example: Sonic-Face, face activated music loops

<https://github.com/JustinShenk/sonic-face>

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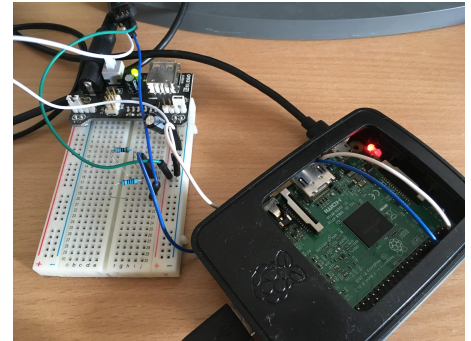
# Emolight

Emotion detection with Raspberry Pi, computer vision API and LED strip demo

<https://github.com/JustinShenk/emolight>  
(development stage)

Wiring guides:

- <https://learn.adafruit.com/neopixels-on-raspberry-pi/wiring>
- <http://dordnung.de/raspberrypi-ledstrip/>



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# Outlook for human signal apps

Living spaces that:

- read human and social signals
  - perform machine learning
  - optimize a target function (happiness, etc.)
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# Conclusion

- Lighting and sound are promising targets for machine learning in a sensory environment
  - Developing not only smart homes, but *caring* homes a task for future researchers and developers
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# Image sources

[I] - Intel DevMesh, user: JustinShenk,  
<https://devmesh.intel.com/projects/party-pi-group-dynamics-analytics>

[P] - Pixabay, user: Pollydot,  
<https://pixabay.com/en/bees-honey-honey-bees-honeycomb-345628/>

[W] - Wikimedia, user: Tangopaso,  
[https://commons.wikimedia.org/wiki/File:Japanese\\_garden\\_Monaco3.jpg](https://commons.wikimedia.org/wiki/File:Japanese_garden_Monaco3.jpg).

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# Questions?

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