

Wiggly

Emotional Adaptive Robot

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1 Intro

Wiggly is a cute and expressive robot designed to react to human emotions. Its character is inspired by Pixar-style robots, using eye animations, body movements, and color changes to clearly communicate emotional expressions. Our goals for this project was:

- Build a cute, appealing robot character
- Detect emotions from a human face
- Express emotions through eyes, LEDs, and body movements
- Track and follow faces in real time

2 Tools

Hardware:

- Dynamixel AX12
- Raspberry Pi 3b+
- Raspberry Pi Camera
- LED strips
- OLED display

Emotion Detection Optimization. We used YuNet for real-time face detection and a YOLO-based classifier (Ultralytics) trained on a Kaggle emotion dataset. The model reached 0.70 accuracy. Live performance was improved by adding custom confidence thresholds for each emotion and requiring 3 consecutive detections before the robot reacts. The robot software is written in Python 3.13 and uses OpenCV for video processing, Ultralytics YOLO for training the emotion classification, and onnxruntime to run both the face and emotion models efficiently on the Raspberry Pi.

3 Conclusion

Goal Achievement. We successfully built a robot capable of detecting faces, recognizing emotions, and expressing them using motion, eye animations, and color. Wiggly is capable of reading and expressing the emotion **happy**, **sad**, **angry**, **surprise** and **fear**.

Optimization Results. The optimization of the emotion classifier, custom confidence thresholds, and consecutive-frame filtering significantly improved stability. The robot became less sensitive to noise and only reacted when emotions were expressed clearly.

Future Work. Future improvements include adding a microphone and speaker for sound-based interaction, redesigning internal cable routing, and reducing mechanical friction noise. A larger internal gear system and a more robust head mechanism (with both yaw and roll) would improve movement accuracy and emotional expression. Faster reaction time and better emotion classification, especially for subtle expressions would further increase the robot's natural behavior.



Extra figures



Happy



Angry



Sad



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