The OptiCue
Real-Time Facial Expression Detection

Project Team:
Maggie Parkhurst-Bartel
Ricardo Dupouy
Steven Lippmann
Greyson Wang

SFU

FACULTY OF APPLIED SCIENCES

Contact: Maggie Parkhurst-Bartel, mparkhur@sfu.ca

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Introduction:
- Global population of between 1-2%, or around 76 million people diagnosed with Autism Spectrum Disorders.
- Very common symptom is inability to recognize social cues, can be very isolating
- Solution: Create a device that detects facial expressions in real-time and provides feedback.
- Device will act as a tool during social interactions and help people learn to recognize facial expressions.

Device Overview:
- Real-time facial expression detection with audio feedback.
- Raspberry Pi ZeroW connected to 5 megapixel camera and audio jack.
- Small 3D printed enclosure to abstract device and make it easy to use.
- Rechargeable battery used to make the device portable.
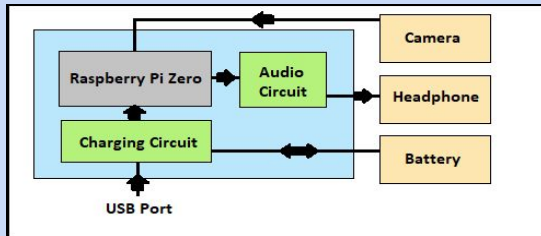
Facial Detection:
- Uses OpenCV and Haar cascades to detect all faces within image.
- Identify the largest face and use 68 (x,y) coordinates to map face and find facial landmarks.
- Software uses facial coordinates to determine if face is neutral, smiling, or shocked.
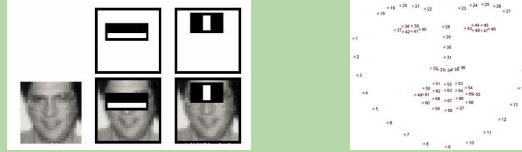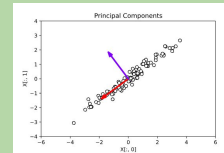

Image Compression:
- Uses principal component analysis to reduce the dimensionality of the data to reduce image size.

Expression Detection:
- Train a Convolutional Neural Network to recognize several facial expressions more accurately.
- Train the CNN for sad, happy, angry, shocked, and neutral emotions (possibly more).
- Detect emotions with ~ 60% accuracy.
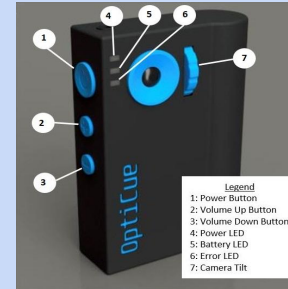
Audio Feedback:
- Software reports the identified expression to the user through audio output.
- Pulse Width Modulation used to generate feedback signal from the board.

Power and Battery Charging Circuit:
- Supply voltage regulated using a TPS61090 switching regulator.
- Battery charged using the MCP73831 charge management controller.

Enclosure:
- 3D printed a custom enclosure to abstract the device and provide a user interface.

Legend
1: Power Button
2: Volume Up Button
3: Volume Down Button
4: Power LED
5: Battery LED
6: Error LED
7: Camera Tilt

Conclusion:
- Intuitive and portable device can be easily integrated into daily routines or learning environment of the user.
- Affordable design makes device accessible to all individuals diagnosed with Autism Spectrum Disorders.