SDP17: PDR Presentation

Team 23 Phil, Liam, Jason, Paul

Prelude: Our Prior (Failed) Idea

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BIGSTOCK

Object Detecting Long Cane

- Meant to augment the cane
- Could give notification of objects outside the cane's range
- Could give alerts to objects that are difficult to detect with cane (such as a car in motion
- Planned to allow better sense of depth, such as when going down a flight of stairs
- Would easily fit into existing long cane training

Why Did We Discontinue This Idea?

Insufficient demand

• Blind community resistant to changing design of the white cane

However our research into signal processing and feature detection led us to a new idea...

New Idea: Speaker Identification System

Speaker Identification System (SIS): A system that can verify the identity of the speaker by analyzing a sample of their voice.

- Generate a "voiceprint" from a voice sample
- Replace/Supplement traditional password

Context: Improving Multi-step Verification

Multi-step verification greatly improves access security. But it has drawbacks:

- More passcodes to remember
- More complicated interface

Biometrics help solve the above problems but:

- Certain types not usable by all
- May be seen as invasive/obtrusive



Context: Voice Biometrics

How do voices differ?

- Pitch (spectrum)
- Timbre (envelope, harmonic groupings)
- Loudness (amplitude)

Why do voices differ?

- Shape of mouth, nose, throat, etc.
- Gender, age
- Accents



FIGURE 5. Statistical speaker model. The speaker is modeled as a random source producing the observed feature vectors. Within the random source are states corresponding to characteristic vocal-tract shapes.

Alternatives

Intelligent Personal Assistant

ex.) Cortana (Google), Siri (Apple)

- Recognize certain words to process commands
- Designed to recognize words and phrases despite different accents, dialects
- Our project differs in that we aim to recognize specific people from commands, rather than commands from people.



Alternatives



STRAIGHT

- Wakyama University (Japan) project
- Analyzes voice signals in depth (timbre, pitch, speed, quality)
- Capable of manipulating these attributes
- Originally intended to help conduct experiments on speech perception

Requirement Analysis: Specifications

- 1. Record human voice in a digital format with reasonable quality
- 2. Database of name-voiceprint pairs
 - Relates known user
- 3. Identify speakers with high degree of accuracy
 - Compare stored
 - Probability of "false positive" less than 0.05

Requirements Analysis: Inputs/Outputs

Inputs:

- Human voice
- User identifier (if new DB entry)

Outputs:

• UI feedback (positive or negative ID)

Block Diagram



Subsystem: Voice Collection

Requirements:

- Convert analog audio signal to digital
- Transmit digital signal to data processing unit

Inputs:

• Analog audio signal

Outputs:

• Digital audio signal





Subsystem: Voice Processing

Requirements:

- Process audio signal and generate "voiceprint"
- Match voiceprint-ID pair to database entries, if any

Inputs:

- Digital audio signal
- UI input (e.g. PIN, name, ID number)

Outputs:

- Database entries/queries
- UI feedback



MDR Deliverables

1. Demonstrate ability to record voice sample in digital format

2. Demonstrate communication between Voice Recording and Voice Processing subsystems

3. Implementation of signal processing components in MATLAB