The Angel-Echo Project

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Outline

- Background of Devices
- Overview of the System
- Goals
- Work on Angel Sensor
- Work on Amazon Echo
- Experiment
- Conclusion
Amazon Echo

• Voice enabled wireless speaker
• Capable of voice interaction, making to-do lists, streaming podcasts, other real time information
• Responds to "Alexa" or "Amazon" or "Echo"
Angel Sensor

• Wearable sensor device
• Tracks health information
• Sensors include:
  • Heart rate
  • Skin temperature
  • Steps
  • And more
• Personalize user health status
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Overview of the System

• Create an interactive health care app
• Use information from the Angel Sensor
• Interact with the Amazon Echo
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Objective 1 (Angel Sensor Part)

- Implement a smart app that monitors health status
Objective 2 (Amazon Echo Part)

• Design a system to receive health status by voice command interface
Objective 3 (Experiments)

• Conduct experiments to analysis the speech recognition accuracy

• **Key Results:**
  • Test the implemented system on different groups of people
  • Propose a method to show the speech recognition accuracy
  • Compare the results from different groups
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Why the Angel Sensor?

- Open source device
- Unrestricted access to sensor data
- Offers variety of health information
- Bluetooth low energy (BLE)
System Flow Diagram

Angel Sensor

BLE communication

Sensor data sent to BLE-enabled device

Client Device

wireless communication

Data is processed and sent to AWS database

DynamoDB
GATT Protocol

- Generic Attribute Profile Service
  - Protocol for data transfer procedures and formats over BLE connected devices
- Attributes
- Handles and UUIDs (Universally Unique Identifiers)
- GATT Hierarchy:
  - Services
    - Characteristics
      - Value
      - Descriptors
GATT Diagram
Subscribing to Characteristics

- PyGattlib python module
- Descriptor attributes
- Notifications (faster)
- Indications (slower)
- In Requester class object, write necessary values to corresponding descriptor attributes
- Pseudo-code with object “req” below where thermometer handle is 26

```python
req.write_by_handle(26, str(2))  # Enable Thermometer indications
```
Collecting/Handling Data

**Step 1**
Data retrieved as ascii values

**Step 2**
Ascii values are converted to hex (binascii python module)

**Step 3**
Hex bits are interpreted

Data sent to AWS DynamoDB database
### Sample Data

<table>
<thead>
<tr>
<th>date</th>
<th>time</th>
<th>name</th>
<th>pulse</th>
<th>resident_id</th>
<th>skin_temp</th>
<th>steps</th>
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</tbody>
</table>
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Amazon Echo Procedure

Angel Sensor puts data in database

Access data in database

Amazon Echo reads data for users
The Amazon System

- Database with health info ready
- Must access info

Request & Response

- A cloud web server provides service
- Amazon skill

Request & Response

- Alexa Voice service
- Provide info to users

Speaks to user

Need a web server run a skill program to provide service.

First try with Amazon Lambda server, then lab server.
Amazon Skill & Alexa Skill Kit

• Amazon Echo skill
  - is capability that allows users to interact with the device with functionalities of Echo

• Alexa Skills Kit
  - Collection of self-service APIs, tools, documentation and code samples
**Amazon Skill with Alexa Voice Service**

- “Alexa” is the wake word.
- “Ask...Doctor” is one of the supported phrases for requesting service.
- “Doctor” is the invocation name that identifies the service the customer wants.
- “What is my heart rate?” is the specific question that elicits response.
- “heart rate” is the keyword invoke heart rate intent.
Amazon Skill with Alexa Voice Service

StatusIntent:
Get both pulse and step count info, generate a feedback statement.

HeartRateIntent:
Get pulse info, generate a feedback statement.

StatusIntent:
Get step count info, generate a feedback statement.

LaunchRequest – Maps to onLaunch(). Occurs when a user launches a skill without an intent.

IntentRequest – Maps to onIntent(). Occurs when the user specifies an intent.

SessionEndedRequest – Maps to OnSessionEnded(). Occurs when session ends.
var docClient = new AWS.DynamoDB.DocumentClient();
docClient.query(Table information);
Save the information fetched;
Resulting Skill

Ask: What is my pulse?

Amazon Voice Service

Skill on Amazon Lambda Service

Data in Database

<table>
<thead>
<tr>
<th>timestamp</th>
<th>name</th>
<th>pulse</th>
<th>resident_id</th>
<th>skin_temp</th>
<th>steps</th>
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Setting Up a Server

• Outside server would run code and access database

• Issues:
  • Issuing certification for server
  • Finding remote endpoint

• Eventually transitioned back to AWS Lambda Services
  • Runs code in response to events such as changes in data

• Used Amazon DynamoDB as database to enter information
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Experiment

• Test accuracy of voice recognition capabilities
• Recruited members from two age groups
  • 18 – 30
  • 65 and older
• Compare voice recognition results
• Sense of phrases to focus on
Procedures

• Used Amazon Echo skill
• Created list of phrases
  • Tested key words
  • Tested different sounds
• Had subjects read sentences in controlled environment
• Made adjustments to procedure along the way
Experiment

• Currently female voices picked up more accurately
  • Tested way more females than males

• Certain words picked up incorrectly often
  • Pulse → Pause
  • Enhance
  • Health → House

• Ideas about sounds to avoid
## Results

<table>
<thead>
<tr>
<th>Percentage of Words Missed</th>
<th>Older Adults (65 and older)</th>
<th>Younger Adults (18 – 30)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>10.9%</td>
<td>3.9%</td>
</tr>
<tr>
<td>Female</td>
<td>7.66%</td>
<td>5.58%</td>
</tr>
<tr>
<td>All</td>
<td>8.75%</td>
<td>4.6%</td>
</tr>
</tbody>
</table>

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</tr>
<tr>
<td>Female</td>
<td>59</td>
<td>21</td>
</tr>
<tr>
<td>All</td>
<td>101</td>
<td>43</td>
</tr>
<tr>
<td>Total Words</td>
<td>1155</td>
<td>940</td>
</tr>
</tbody>
</table>
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Conclusion

• Successfully implemented goals
• Experiment provided useful feedback
• Hopefully can improve application and have more detailed experiment
Thank you!