Comparison of Voice Assistant SDKs for Embedded Linux

Leon Anavi
Konsulko Group
leon.anavi@konsulko.com
leon@anavi.org
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Agenda

- Introduction to smart speakers
- Overview of Amazon Alexa, Google Assistant and Mycroft SDK for integration in embedded Linux devices
- Showcases and conclusions
Virtual assistants

- AliGenie
- Amazon Alexa
- Yandex Alice
- Samsung Bixby
- Braina
- Clova
- Microsoft Cortana
- Google Assistant
- Mycroft
- Apple Siri
- Voice Mate
- More ...
Technologies in Smart Speakers

- Application Development
- A.I. & Big Data
- Internet of Things
Smart Speaker Market

U.S. Smart Speaker Market Share - May 2018

- 61.9% Amazon
- 26.9% Google
- 3.8% Sonos
- 3.4% Others
- 4.1% Apple

Source: Voicebot Voice Shopping US Consumer Adoption and Attitudes 2018 Report

Global Smart Speaker Sales - Q1 2018

- 45.6% US
- 20% China
- 8.1% Korea
- 26.3% Rest of World

Source: Canalys May 2018

Public statistics from https://voicebot.ai/
Amazon Alexa
Amazon Alexa

- Virtual assistant powered by AI and developed by Amazon
- Available for Fire OS, iOS and Android
- Powers Amazon devices such as Echo smart speakers
- Initial release November 2014
- Requires Amazon Alexa app on a smartphone to setup the smart devices
Alexa Features

- Multilingual support
- Voice profile for personalized experience
- Alexa to Alexa calling and messaging
- Mobile or landline calls in the US, Canada, and Mexico
Developer opportunities with Amazon Alexa

- Integration of Amazon Alexa in custom hardware devices using an **SDK**
- Extend the functionality of Alexa compatible devices by developing software applications called **Skills**
Amazon Smart Speakers

- Amazon Echo
- Amazon Echo Dot
- Amazon Echo Spot
- Amazon Echo Tap
- Amazon Echo Show
- Amazon Echo Plus
3\textsuperscript{rd} Party Devices with Alexa

- Ecobee4 Smart Thermostat
- Element EL4KAMZ17 (Amazon Fire TV Edition)
- Eufy Genie
- Fabriq Chorus and Riff
- Garmin Speak
- C by GE Sol Smart Lamp
- iHome AVS16 Alarm Clock
- LG Hub Robot
- More ...
## Amazon Smart Speakers

<table>
<thead>
<tr>
<th></th>
<th>SoC</th>
<th>RAM</th>
<th>Internal memory</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Amazon Echo (1st Generation)</strong></td>
<td>TI DM3725 ARM Cortex-A8 Core Digital Media Processor</td>
<td>256MB</td>
<td>4GB</td>
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<tr>
<td><strong>Amazon Echo Dot (1nd Generation)</strong></td>
<td>Texas Instruments DM3725 ARM Cortex-A8 Core Digital Media Processor</td>
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<td><strong>Amazon Echo Dot (2nd Generation)</strong></td>
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Google Assistant
Google Assistant

- Virtual assistant powered by AI and developed by Google
- Available for numerous platforms, mobile and smart home devices
- Initial release 18 May 2016
- Written in C++
- Requires Google Home app on a smartphone to setup a smart speaker with Google Assistant
Google Assistant Features

- Multilingual support
- Six different voice options (including both male and female)
- Continued conversation for follow-up questions without repeating the activation word
- Voice match feature to setup up to 6 users of the smart speaker
- Google Duplex extension for accomplishing real-world tasks through natural conversations over the phone
Developer opportunities with Google Assistant

- Integration of Google Assistant in custom hardware devices using an **SDK**
- Extend the functionality of Google Assistant by developing software applications called **Actions**
Google Smart Speakers

- Google Home - released on 4 November 2016
- Google Home Mini – announced on October 4, 2017, released on the market on October 19, 2017
- Google Home Max – announced on 4 October 2017, released on the market on 11 December 2017
- Google Home Max – announced on 9 October 2018
3rd Party Devices with Google Assistant

- Panasonic GA10
- Sony LF-S50G
- TicHome Mini
- Polk Assist
- Hogar Milo
- LG ThinQ WK7
- JBL Link
- Lenovo Smart Display
- More...
# Hardware Specifications

<table>
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<tr>
<th>Device</th>
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<tbody>
<tr>
<td>Google Home</td>
<td>Marvell ARMADA 1500 Mini Plus (88DE3006)</td>
<td>512MB</td>
<td>256 MB</td>
</tr>
<tr>
<td></td>
<td>1.2GHz dual core ARM Cortex A7</td>
<td></td>
<td></td>
</tr>
<tr>
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<tr>
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<td>1.2GHz dual core ARM Cortex A7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Google Home Max</td>
<td>1.5GHz 64-bit quad-core ARM Cortex A53</td>
<td>?</td>
<td>?</td>
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</tbody>
</table>
Building Your Own Device (1/5)

Low cost hardware options using off-the-shelf components for proof of concept demo:

- Google Voice Kit for Raspberry Pi: https://aiyprojects.withgoogle.com/voice/
- OrangePi Zero Set 6 (includes a case and an expansion board with mic and audio input) + Speaker http://www.orangepi.org/orangepizero/
Create new project in Google Platform Console
Enable Google Assistant API
Create credentials for OAuth Client ID and download JSON file
On Debian distribution install Python:

```
export LC_ALL="en_US.UTF-8"
export LC_CTYPE="en_US.UTF-8"
sudo dpkg-reconfigure locales
sudo apt-get update
sudo apt-get install -y python3-dev python3-venv
python3 -m venv env
env/bin/python -m pip install --upgrade pip setuptools
```
Activate virtual Python environment and install Google Assistant SDK:
python -m pip install --upgrade google-assistant-library

Install and run Google authorization tool:

python -m pip install --upgrade google-auth-oauthlib[tool]
google-oauthlib-tool --client-secrets
~/client_secret_xxxx.apps.googleusercontent.com.json --scope
https://www.googleapis.com/auth/assistant-sdk-prototype --save --headless

Start Google Assistant:
google-assistant-demo --device_model_id "my-speaker"
Create systemd service `/etc/systemd/system/google-assistant-demo.service` to launch Google Assistant automatically at startup:

```
[Unit]
Description=google assistant service
After=network.target ntpdate.service

[Service]
Type=simple
Environment=VIRTUAL_ENV=/home/pi/env/
Environment=PATH=/home/pi/env/bin:/usr/local/sbin:/usr/local
ExecStart=/home/pi/env/bin/google-assistant-demo --device_model_id "orangepi"
WorkingDirectory=/home/pi
StandardOutput=inherit
StandardError=inherit
Restart=always
User=pi

[Install]
WantedBy=multi-user.target
Alias=google-assistant.service
```
Enable the systemd service and start it automatically at boot:

```sh
sudo systemctl daemon-reload
sudo systemctl enable google-assistant-demo.service
sudo systemctl start google-assistant-demo.service
```
Mycroft
Mycroft

- Entirely open source project for a voice assistant
  https://mycroft.ai/
- Git repositories in GitHub
  https://github.com/MycroftAI
- Open source software available under Apache License 2.0
- Open source hardware available under CERN Open Hardware Licence
  https://github.com/MycroftAI/hardware-mycroft-mark-1
- Certified open source hardware UID US000049
Mycroft AI Inc.

- US start-up company from Kansas City founded in 2015 by Joshua Montgomery
- Initially products were crowdfunded through Kickstarter and IndieGoGo
- Currently is accepting investments at StartEngine
**Mycroft Core**, the Mycroft Artificial Intelligence platform
https://github.com/MycroftAI/mycroft-core

- Written in Python
- 2820 commits, 90 releases, 89 contributors
- 8 contributors with more than 100 commits

**Skills**, repository for sharing and collaboration for 3rd party Mycroft skills development
https://github.com/MycroftAI/mycroft-skills

- 965 commits, 65 contributors (as of 17 October)
Mycroft Features

- Officially available only in English, community support for other languages
- Supports extension of the functionality by developing software applications called skills
- Mycroft Skills Manager (msm) and a repository with 3rd party skills
- Optional device and account management system known as Mycroft Home
- Allows using devices without Mycroft Home service
Mycroft Devices

- Mycroft Mark 1 (crowdfunded in 2015, shipped in 2017)
- Mycroft Mark 2 (expected in December 2018)
- DIY smart speakers with Raspberry Pi 2 & 3 (expected support for 3 B+) with PiCroft GNU/Linux distribution based on Raspbian Jessie Lite
Showcases
Google Voice Kit

- Do-it-yourself artificial intelligence voice for Raspberry Pi
  https://aiyprojects.withgoogle.com/voice/
- Two versions, the first was distributed free with the MagPi magazine
- Cardboard case
Google Voice Kit

- Orange Pi Zero with Allwinner H2 SoC and 512MB RAM
- Expansion board with audio input, mic, IR receiver and two additional USB ports
- Speaker
- Case
- Armbian GNU/Linux distribution
  https://www.armbian.com/orange-pi-zero/
Home Assistant

- Open-source home automation platform running on Python 3
- Perfect to run on a Raspberry Pi
- More than 950 components for integration with popular Internet of Things such as IKEA Trådfri, Philips Hue, Google Assistant, Alexa / Amazon Echo, Nest, KODI, etc.
- Started in 2013 by Paulus Schoutsen
- Huge community, more than 830 contributors
- Source code available at GitHub under Apache 2.0 license
- https://home-assistant.io/
Simple Voice Control with Alexa

- Home assistant is compatible with Alexa and Amazon Echo
- Basic integration using the Emulated Hue Bridge component of Home Assistant
- Emulated Hue Bridge allows non-Philips Hue devices to be controlled though with voice the built-in support of Amazon Echo

```yaml
emulated_hue:
  type: alexa
  expose_by_default: true
```
Simple Voice Control with Alexa

- Example voice commands for MQTT JSON Light component configured with name “ANAVI Light pHAT” in `configuration.yaml`:

  - Alexa, turn **ON** ANAVI Light pHAT
  - Alexa, turn **OFF** ANAVI Light pHAT
How Does it Work?

Raspberry Pi

MQTT client for controlling the RGB LED strip

Mosquitto MQTT Broker

Home Assistant

MQTT JSON Light

Emulated Hue Bridge

Cloud

User 1

User 2

User N

ANA VI Light pHAT

12V RGB LED strip
Conclusions
Conclusions

- There is a huge demand on the market for integrating AI and voice assistants in end-consumer devices as well as for development of 3rd software applications and services for them.

- The market leaders Amazon and Google provide turn-key solutions for integration in embedded Linux devices with ARMv7 or x86-64 architecture but require difficult certifications for end-consumer devices.

- Mycroft is an entirely open source voice assistant that combines open source hardware with free and open source software.

- Apart from Mycroft, alternative solutions require connection to the cloud and mobile applications for setup.
Thank You!

Useful links:

- https://developers.google.com/actions/
- https://developers.google.com/assistant/sdk/
- https://mycroft.ai/
- https://www.armbian.com/