APPLYING FUEGO WITH AUDIO TEST AUTOMATION TO AUTOMATE MULTIMEDIA VERIFICATION FOR AGL DISTROS

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TRIET HUYNH

SENIOR SOFTWARE ENGINEER, SOFTWARE ENGINEERING DIVISION, RENESAS DESIGN VIETNAM
Renesas Design Vietnam Co., Ltd. (RVC) was founded in October 2004, as one of the main design centers in Renesas group.

Business line: Design of semiconductor for both hardware and software.
INTRODUCTION

WHO AM I?

- Name: Triet Luu. Huynh (TRIET Huynh – チエト ヒュイン)
- Company: Renesas Design Vietnam
- Career: 06 years experiences in embedded software development (software verification)
  - Quality Verification for Mobile software platform
  - Development and verification for In-vehicle software platform
  - Development for test automation solutions of In-vehicle software platform
- Email: triet.huynh.jy@rvc.renesas.com
AGENDA

➤ Introduction about Audio Automation Test

➤ An approach for Audio Automation Test

➤ How to apply the audio automation test

➤ Limitation and Future plan

➤ Conclusion
Introduction about Audio Automation Test
INTRODUCTION ABOUT AUDIO AUTOMATION TEST

- **The Audio Manual test:**
  - Testers will hear and judge the audio’s quality by human ears

- **Big problem:**
  - The audio testing results are based on the tester’s feeling/experiment

→ The test result is un-reliable
INTRODUCTION ABOUT AUDIO AUTOMATION TEST

- **The Audio Manual test:**
  - Testers will **hear and judge** the audio’s quality by human ears

- **Big problem:**
  - The audio testing results are based on the tester’s **feeling / experiment**

→ The test result is un-reliable

→ We need to automate this, to make the reliable test results, **NOT** depends on Human Feeling

→ Replace “human role” by “MACHINE ROLE”
INTRODUCTION ABOUT AUDIO AUTOMATION TEST

- **The Audio Automation test:**
  - Testers will check the report from automation judgment
  - The test result is **NOT depend on tester’s feeling**

- **Big problem:**
  - **Difficult to implement** the audio automation test / the reliable audio automation judgment

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Propose an approach for Audio Automation Testing
INTRODUCTION ABOUT AUDIO AUTOMATION TEST

- The Audio Automation test:
  - Testers will check the report from automation judgment
  - The test result is **NOT depend on tester’s feeling**

- Solution:
  - The automation test framework: Fuego
  - The hardware connection
  - Audio issue detection method: the OSS Application / Tools
INTRODUCTION ABOUT AUDIO AUTOMATION TEST

- **What is Fuego?**
  - Fuego is a test framework specifically designed for embedded Linux testing. It supports automated testing of embedded targets from a host system, as it's primary method of test execution.
  - Fuego consists of a host/target script engine, with a Jenkins front-end, and over 50 pre-packaged tests, installed in a docker container.
  - Tim Bird gave a talk introducing Fuego, at *Embedded Linux Conference in April 2016, and LinuxCon Japan 2016*.

Fuego = (Jenkins + abstraction scripts + pre-packed tests) inside a container
INTRODUCTION ABOUT AUDIO AUTOMATION TEST

- **Hardware connection:**

Fuego PC → HUB → Sound Card → Target board

**Advantages:**
- The test results are more reliable
- Can apply for overnight testing -> reduce the workload
An approach for Audio Automation Test
AN APPROACH FOR AUDIO AUTOMATION TEST

Audio issues:

- We list the common audio issues which usually occur in our testing (based on the experimental)
  - Burst noise
  - Background noise
  - Gap (silence) issue
  - Left/Right Channel Reverse
AN APPROACH FOR AUDIO AUTOMATION TEST

Definition:
- **Burst Noise** is the sound we hear like popcorn (white noise)
- When transform the waveform in time domain to Frequency domain and power domain, in which there are high energy and almost random distribution of sample values across the full bandwidth

Solution:
- Utilize the **Open Source Software tools** (E.g. Audacity, ffmpeg) to detect the noise

Limitation:
- Wrong issue judgment if audio hardware’s quality is not good
AN APPROACH FOR AUDIO AUTOMATION TEST

Definition:
- **Background noise** is the *pink noise* which causes the different waveform between original audio and recorded audio.

Solution:
- Use **Open Source Applications** to compare the similarity between recorded audio and original audio (E.g. ffmpeg, Musly).
Definition:
- **Gap or silence** is the issue that there is **silent part** while playing audio.

Solution:
- Use silent detection feature in some **Open Source Applications** to detect (E.g. ffmpeg, Audacity, …)

Limitation:
- Now, the Open Source Applications cannot detect silent in one audio channel
**AN APPROACH FOR AUDIO AUTOMATION TEST**

- **Definition:**
  - **Left/Right Reverse** is the issue that the Left and Right channels of the recorded audio file are reversed.

- **Solution:**
  - Use the **Fast Dynamic Time Warping algorithm** (*) to compare the recorded file with the original file.

(*) https://pdfs.semanticscholar.org/05a2/0cde15e172fc82f32774dd0cf4f05827cad2.pdf
AN APPROACH FOR AUDIO AUTOMATION TEST

Fuego PC

Sound Card

Target board

HUB

Sound Card

Target board

Sound Card

Target board

Issue Detection Modules

Common

Scripts

Test cases

Tools

DOCKER - FUEGO

AUDIO AUTOMATION

<<browser>>

Fuego interface

AAT’s recorder tool

Host PC

Ubuntu

Target Board

Linux

Test script

Audio Player

Issue Detection Modules

Test streams
How to apply the audio automation test
HOW TO APPLY THE AUDIO AUTOMATION TEST

Procedure to apply the Audio Automation Test:

- **Target Board:**
  - Modify the Software on Target boards (E.g. Audio Player) to synchronize Host PC and Target Board
HOW TO APPLY THE AUDIO AUTOMATION TEST

Procedure to apply the Audio Automation Test:

- **Target Board:**
  - Modify the Software on Target boards (E.g. Audio Player) to synchronize Host PC and Target Board

- **Host PC:**
  - Install Fuego on Host PC
  - Install the Audio Automation Test on Fuego
HOW TO APPLY THE AUDIO AUTOMATION TEST

Procedure to apply the Audio Automation Test:

- **Target Board:**
  - Modify the Software on Target boards (E.g. Audio Player) to synchronize Host PC and Target Board

- **Host PC:**
  - Install Fuego on Host PC
  - Install the Audio Automation Test on Fuego

- **Hardware Connection:**
  - Connect the Audio Output from Target Board to the Sound Card of Host PC
HOW TO APPLY THE AUDIO AUTOMATION TEST

Fuego PC

HOST PC

Ubuntu

<<browser>>
Fuego interface

AATF's recorder tool

AUDIO AUTOMATION

Issue Detection Modules

Module 1
Module 2
Module 3
Module 4
Module ...

Common

Scripts
Test cases
Tools

DOCKER - FUEGO

Target Board

Linux

Test script
Audio Player

Issue Detection Modules

Test streams

Sound Card

Target board

HUB

Sound Card

Target board

Sound Card

Target board
HOW TO APPLY THE AUDIO AUTOMATION TEST

Impact of Audio Automation Test:

Compare the testing time:

- **Audio – Manual Test:**
  - Audio length (E.g: 4 mins)
- **Audio – Automation Test:**
  - Audio length (4 mins)
  - Recording time (~15 secs)
  - Issue detection (~1 min 30 secs)

Total: ~6 mins (1.5 times comparing with manual test)

Compare the productivity:

- **Audio – Manual Test:**
  - 1 person / 1 board / 1 day: 30 TCs
- **Audio – Automation Test:**
  - 1 person / 1 boards / 1 day (24-hours): ~100 TCs
  (could use for **overnight testing**)
Limitation and Future plan
LIMITATION OF AUDIO AUTOMATION TEST

Current limitations:

➢ “False-positive”:
  ▪ Using the “bad-quality test stream” ➔ Result is always FAIL

➢ MUST modify the software on Target Board
  ▪ In order to synchronize the Target Board and Host PC while testing

➢ Limitation of Open Source applications / tools:
  ▪ Because of the current limitation of some Open Source applications (E.g. ffmpeg, Audacity, …)
FUTURE PLAN

- Fix the current limitations:
  - “False-positive”:
    - Re-order the detection modules: Compare waveform ➔ Check issues
  - MUST modify the software on Target Board
    - Re-searching the solutions: E.g. Detect the first audio signal from target board, ...
  - Limitation of Open Source applications / tools:
    - Try to feedback the limitations to the Community
- Expand the Audio Automation Test for various systems
- Make the Audio Automation Test become more friendly for every user
CONCLUSION

- By combination between the Fuego and the Open Source Applications, Renesas could make an simple Audio Automation Test for Linux platform.

- With the Audio automation test => reduce the testing workload and get the reliable results

- But, still some current limitations (in the development and Open Source side)

- Continue to fix these and promote the Audio automation test for various platforms
REFERENCE


THE END

THANK YOU VERY MUCH!
Q & A