

GuitarSolo

IT Convergence Guitar For Interactive Lesson

09.14.2020

Jeonghyeok Park

Research Team

- Chief of research : Soonuk Seol (suseol@koreatech.ac.kr)
- Cooperation researcher :
Cho Gyeongmin, Lee Saehan, Lee Hojae, Choi Jongho, Kim Byeonggil
(<http://dame.co.kr/>)
- Participating researcher :
Shin Yejin, Lee Gangwon, Lee Jaeyeong, **Park Jeonghyeok**, Park Jinuk, Han Yumin

Development goals

- Develop IT convergence guitar that can learn various methods based on LEDs and sensors
- Provide real-time lesson capability through exclusive practice mode and smartphone interworking
- Build a platform that enables the production and sharing of performance content

Development content

- Study guitar design manufacturing methods with embedded devices and electronic components and design/manufacture IT convergence guitars with high design and robustness
- Develop embedded devices and software that utilize LEDs and sensors to provide a variety of performance methods (e.g., next playing position, finger number, note length, stroke direction, line number mark for Arpeggio, etc.)
- Develop single-mode features that control LEDs by selecting performance files stored in embedded systems and real-time lesson functions that work with smartphones
- Develop smartphone apps and platforms to create user-playing content and share playing content

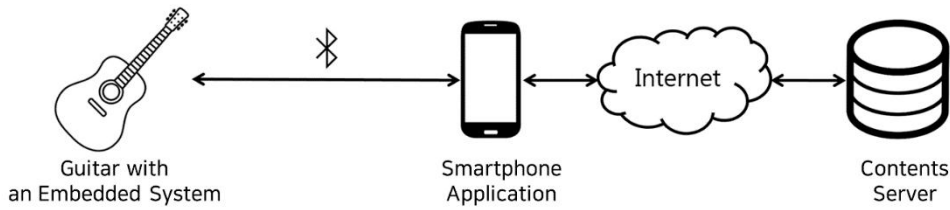
Explanation

The GuitarSolo allows a user to practice guitar without music scores by lightening LEDs on the corresponding positions at the guitar neck and provides feedback on her performance. With our smartphone app, the user can see what she is playing through the screen, record it as a music score, and share it with others through our content server. In addition, our guitar helps users do a highly efficient practice with rewind, fast-forward, tempo control, and repeat features.

Parts

Smartphone, PC server, Tricolor SMD LED, Piezo sensor, Cortex-M3 ATSAM3A8C, 0.96 inch OLED, SD card, Bluetooth module, LiPo battery, Acoustic guitar body, Mock-up fingerboard & covers, etc.

System configuration



GuitarSolo is composed of guitar embedded system equipped with various modules such as Bluetooth module, SD card module, and smartphone app for enhancing guitar performance efficiency. Smartphone apps connect to content servers via the Internet. The guitar and smartphone apps work together to form a new guitar platform, and can use a variety of content, such as practicing songs or sharing scores.

Hardware Configuration

Embedded devices have been made independently for the purpose of miniaturization of device and simplification of cabling. The main controller consists of various modules and uses an integrated board based on Atmel's Cortex-M3 family SAM3A8C. LED and sensing board are attached to the fingerboard, and a case that wraps the board together with the controller board is attached to the right side of the body.



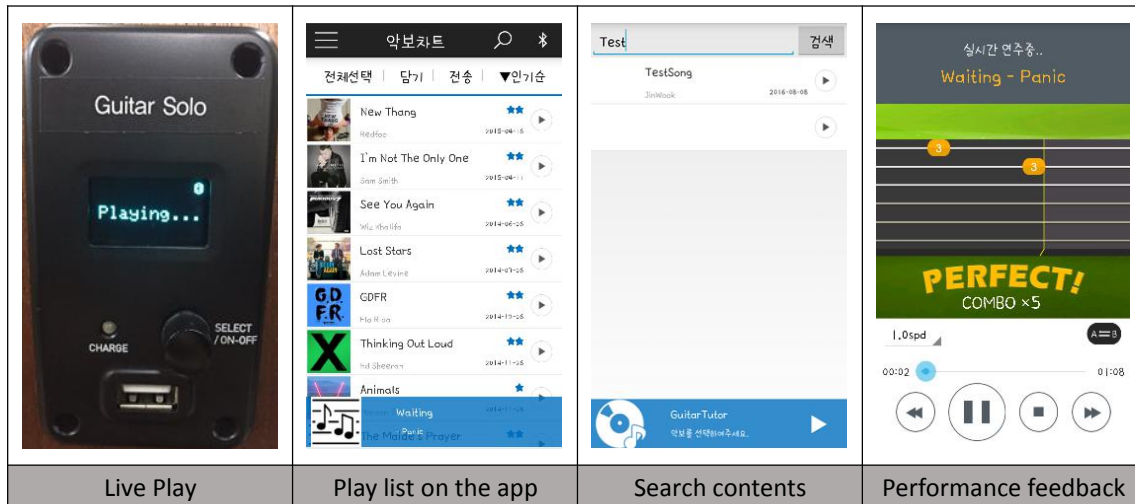
The main controller controls the lighting of the LED and performs the function of sensing the user of the performance information. Guitar bridges have a copper plate and a piezo sensor attached to them, and a voltage is applied to each guitar line through a copper plate to sense which frets the user puts on. A piezo sensor is also used to sense which guitar line the user has bounced.

Software Configuration

- **Guitar control software for embedded devices**
It is software that controls guitar LED lighting and feedback on performance information and controls the functions of the embedded device. Embedded software development language for device control is written in C / C ++ language(Arduino IDE).
- **Android Application**
The Android application that performs guitar interlocking functions is based on Android 4.4 (KITKAT) and Eclipse Standard Luna SR2 is used as the development environment.
- **Score content server, DB**

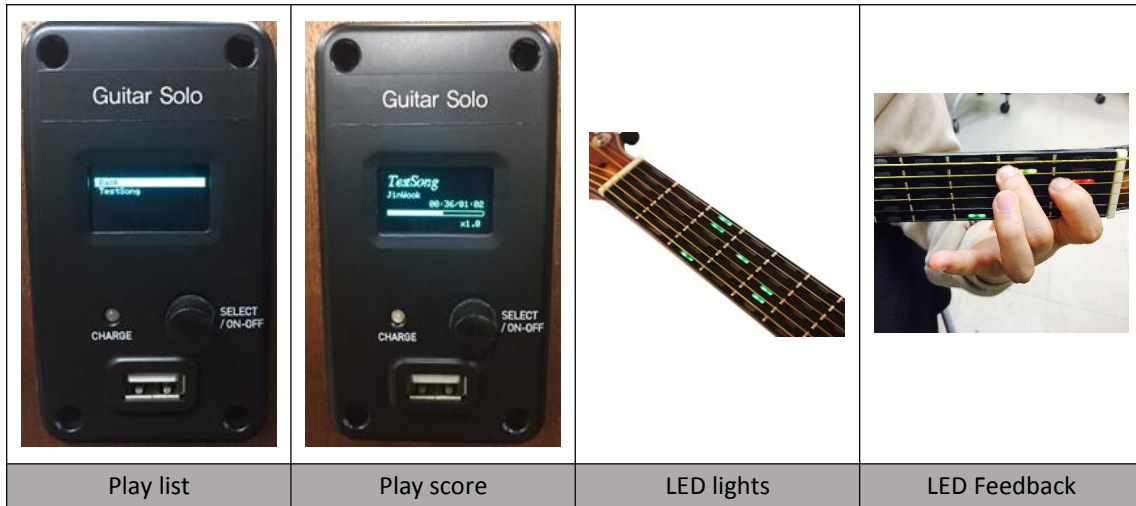
Software function

- **Learning support function**



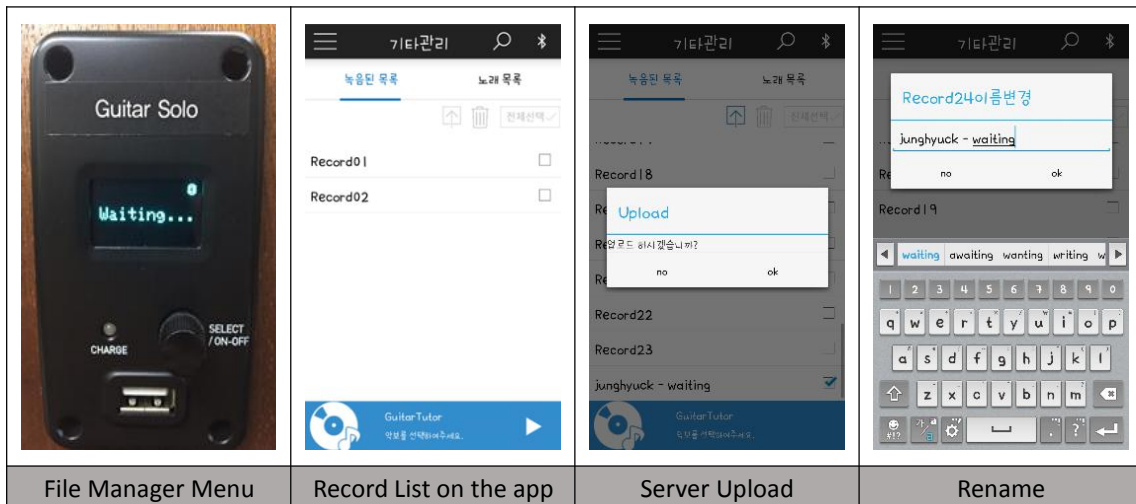
Our work basically provides a guide by lighting the LED on the place where the learner is to fingering through the LED installed on the guitar fingerboard. When the user selects a song or code for practice, the embedded system controls the LEDs installed on the fingerboard according to the performance information of the song. The LED lights up in three colors of green, red, and yellow to express various performance information according to the color change. In addition, our work features playback feedback, play / pause, fast forward / rewind, speed control, and interval repeat.

- **Offline practice function**





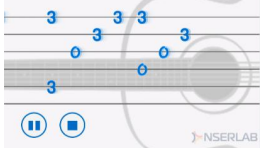
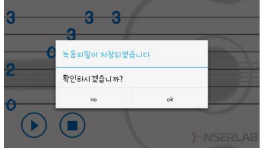
We have developed an embedded system that can be practiced with guitar without the need to interwork with other devices such as a smart phone or a PC, and installed it on guitar. The smartphone app provides a function to select a desired song on the content server and to transmit the performance file for the song to embedded device and store it. In the offline environment, it is possible to check the list of the performance files stored in the embedded system and to practice and master the desired song repeatedly, thus providing the user with easy accessibility and easy accessibility.

- Content Sharing function



By building a content server, users can easily access various contents, and the contents can be stored in embedded device. When an administrator or a member accesses a homepage and uploads a performance file, the performance file is registered in the content server. All performance files registered on the server can be checked through the smartphone app, and you can search for songs you want to practice in the smartphone app and send them directly to the guitar.

- Music score generation function

			
Record Menu	Recording..	User's real-time performance on the app	Complete recording

The frets installed on the guitar fingerboard serve to sense the fingering position of the user. The score creation function uses the sensed information to determine how the user is playing the guitar, and generates score data to match the notes and beats played according to the result. During recording score, the LED lights up at the user's performance position to confirm that the performance information is correctly recognized. With this feature, users can save their performance as a file, and the recorded file can be uploaded to the content server using the smartphone app. Also, beginners can learn various playing techniques by using the performance files shared by guitarists all over the world.

- Other features

In addition to the functions mentioned above, it provides additional functions such as code practice, file management, calibration, and configuration.

My work

- Develop android application and data transfer algorithm between embedded system and application
- Search suitable sensor and Design algorithm for real-time recognition of guitar performance.
- Design and build a prototype of a dedicated guitar (produce dedicated guitars at DAME plant in Guangzhou)
- Design main controller (Atmel's Cortex-M3 family SAM3A8C) and develop embedded software (C / C ++ language(Arduino IDE))

Introduction video

Youku (Chinese subtitles)

http://v.youku.com/v_show/id_XMjU3MDU0Mzc0OA==.html

Youtube (English subtitles)

<https://www.youtube.com/watch?v=u4bg4OCMY10>

Paper

Yejin Shin, Jemin Hwang, Jeonghyeok Park, and Soouk Seol, "Real-time Recognition of Guitar Performance Using Two Sensor Groups for Interactive Lesson", TEI '18 Proceedings of the Twelfth International Conference on Tangible, Embedded, and Embodied Interaction, ACM, March 18-21, 2018.

Patent

Patent name: Apparatus for Controlling Performance and Control Method Thereof

Applicant : KOREATECH (<https://sandan.koreatech.ac.kr/>)

Inventor : Soouk Seol, Lee Jaeyeong, **Park Jeonghyeok**, Park Jinuk, Han Yumin

application number : 10-2016-0156882

registration number : 10-1836332