

Voice-Enabled Smart Home Modules

Josef Šanda¹, Martin Bulín²

1 Introduction

The use of modern technologies in the home opens up new possibilities for manage the user's time and efficient energy. The smart home responds to the user's needs and uses automatic control to increase the comfort of living. The smart home centre is a complex system with various separate modules which collects locally measured data. Based on this data and active interventions from the user, they automate operations in the home. The main features of a smart home include the ability for the user to interact with the system easily. This feature is often mediated through a website or voice interaction. This project focuses on one aspect of the smart home - enabling the user to build modules and control them by voice.

The voice-enabled modules help the user control the smart home more efficiently, quickly and increase the entire solution's comfort. The user simply says his command or question and gets voice responses with the system's action, so the user does not have to go anywhere or even interrupt his work.

The project aims to build a modular functional system with voice-enabled modules for the smart home, fulfilling specific real applications. This example application consists of three development boards connected to four lights and three sensors measuring different physical quantities. These control and analytical components are connected to a central modular functional system. Voice interaction is done by a custom solution - by connecting VoiceKit³ Google (2017) and SpeechCloud⁴. The entire project is accessible to the user via a web interface, which clearly provides all available information.

2 Methods and Results

As part of the bachelor's thesis Šanda (2021), an *engine* was designed for this project used as a central modular functional system. As shown in the diagram of project architecture in Fig. 1, this system includes tools such as MQTT, WebSocket, MongoDB and Tornado web server, which allow communication, data visualization and data storage throughout the smart home. A critical block of this system is *logic*. This block captures a command from the VoiceKit or keyboard interface, then browse a pre-defined list of each module's commands and determines the best match for the user voice command or command written on the keyboard.

¹bachelor-degree student of Applied Sciences and Computer Engineering, field of study Cybernetics and Control Engineering. E-mail: jsanda@students.zcu.cz

²PhD student of Applied Sciences and Computer Engineering, field of study Cybernetics and Control Engineering, focused on Neural Networks. E-mail: bulinm@kky.zcu.cz

³VoiceKit - is a building kit made by Google that lets users create their natural language processor and connect it to the Cloud TTS and ASR service.

⁴SpeechCloud - is a platform developed at the Department of Cybernetics of the University of West Bohemia. It connects ASR and TTS systems operating together via one interface.

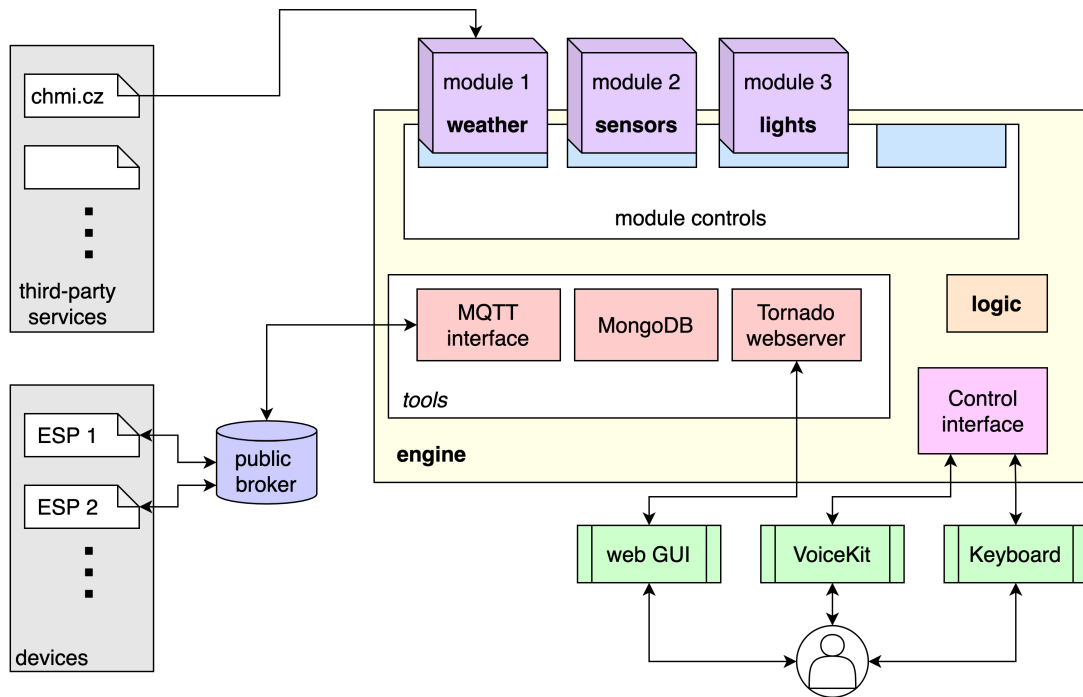


Figure 1: Diagram of project architecture

All the functions and automation of the whole smart house are programmed in Python as modules that are very easy to build and insert into the project. These modules need to be saved to the correct folder and create the file according to the prescribed template. Then when the user says the command to reload the modules, these modules will automatically connect to the entire system. Each module can communicate with development boards connected to the *engine* and thus draw data from sensors or control actuators. Alternatively, these modules can communicate with the Internet and third-party services.

A unique communication interface called a keyboard is created for developers. Using this keyboard, it is possible to quickly enter and debug voice commands in various form with high accuracy via the command line.

The user can communicate with the system using VoiceKit and a website. The main communication interface for the user in this project is VoiceKit, where after pressing the upper button, the user can say a question or give an order for any module. The module can also respond via VoiceKit. The website is created to present data, states, and voice commands. In addition, the user can control the lights via a web application.

Example of using a function to measure illuminance from the *Sensors* module.

- (User) How much is the light intensity?
- (System) The light is off. The specific light intensity value is 22 lx.

References

Google LLC, 2017. *VoiceKit - Do-it-yourself intelligent speaker*. Available at: <https://aiyprojects.withgoogle.com/voice/> [Accessed May 22, 2021].

Šanda, J., 2021. *Voice-Enabled Smart Home Modules*. Bachelor thesis. University of West Bohemia, Univerzitiní 2732/8, 30100 Pilsen 3, Czech Republic