Automatic Synthesis of Home Assistant Automation

Jaeho Choi*
KAIST
Daejeon, Republic of Korea
zero0000@kaist.ac.kr

Abstract

Home Assistant (HA) is an open source software for local control of IoT devices. Automation in HA is a rule that allows devices to automatically respond to what happens to each other. By properly generating this rule, users can control their devices to interact and deal with many annoying things in their lives. Unfortunately, HA users often have difficulty in writing automation as intended, because there are a lot of conditions to consider. To help users with this problem, HA provide useful tools such as blueprints and debugging tools. However, they do not directly contribute to solving the problem of writing automation that fit the user's lifestyle. In this paper, we propose a new framework for generating automation with data extracted from users' daily lives. Through Programming by example (PBE), our framework is able to synthesize rules that generalize users' lifestyles well.

Keywords: program synthesis, programming by example, home assistant

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1 Introduction

Home Assistant (HA) is a widely used platform for building a smart home. It stores the states of each entities and controls IoT devices to work as intended by the user.

Automation in HA is a rule in which the user defines how his devices behave based on the interactions between them. It consists of three components: trigger, condition, and action. Trigger describes state change that should trigger the automation rule. Condition is a optional predicate of state that allows automation to proceed only when it is true. Action means what we actually want to perform through automation. Through these predefined automation and data from each entities, HA determines the behavior of devices.

The problem is that it is quite difficult for HA users to write automation properly. This is because, considering all possible circumstances, it is not clear when the action should run. In fact, we could find several users who had related problems in the HA community.

To handle this problem, we suggest an automatic generation of automation with Programming by example technique that uses the state data from entities as examples. In the section 2, we describe our approach in more detail and why we think it is promising. In section 3, we explain how to implement it. In the section 4, we present our research questions.

2 Our Approach

Recently, HA has provided a debugging tool to check whether the given automation is written well. This makes it easier to find which part of the automation is wrong, but it does not help create the rule.

Blueprint is another help in creating automation. It's a template that a user can configure to write his own automation. Though, finding and modifying a blueprint to create the desired rule is cumbersome and incomplete process.

What if these YAML program could automatically created, based on the user's lifestyle? From this point of view, We found that Programming by example (PBE) is very suitable technique for solving this problem. First, this method is likely to create what the user wants from his devices because it observes and generalizes his daily life. Second, since YAML is a very limited logical programming language, it is easy for users to understand and modify the generated program. Third, since the sensor value is finite, the search space is small, so we will be able to find the answer quickly.

3 Implementation Plan

First, we will come up with some appropriate possible scenario (determining which state data and actions to use) and define a corresponding DSL.

Then we will obtain several data to fit the scenario from HA server data by SQL query. We will use SQLite which is the default database in HA.

We will implement PBE through PROSE framework, which is program synthesis framework for custom domain-specific languages (DSLs).

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Finally, We will investigate the generated automation rules and test them in HA.

4 Research Questions

RQ1. Do the synthesized rules generalize lifestyle sufficiently?
RQ2. Is the synthesizer reasonably fast to use?
RQ3. Does the synthesizer work well even when the data is added or modified?
RQ4. How complicated and long rules can be synthesized?