Cooking-with-a-robot: The Cognitive Kitchen-Net

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Abstract

The presented system supports inexperienced users in dressing dishes and inspires adept users to try new recipes. A selected recipe arranges the workflow. The relevant step information are published as well as up-to-date status information on kitchen devices. Available actions on devices are published and can be triggered by sending a correspondent message. Different user interfaces can connect to the control architecture because of the message publishing system. This work is part of a bigger project of three teams, in that the other teams provide different user interfaces.

Introduction

In a modern kitchen, many different devices are connected to an operation system which provides an overview of all accessible functions. Additional, the devices help the user to interact with them and to react precisely if a specific action is to be performed. During a regular cooking process, the user has to coordinate several tasks, e.g., preparing ingredients, timing processes and monitoring temperature. Furthermore, the user has to study the recipe, which can be intimidating for novice cooks. To avoid instant meals and daubed pages in the cookbook the solution is a guided cooking process. This process coordinates user activities with kitchen devices.

The project is divided into three teams. Two of them interact with the user, one using a virtual cookbook, another one via a dialogue system. This third group does the system framework: Hold recipes, manage workflow and integrate kitchen devices.

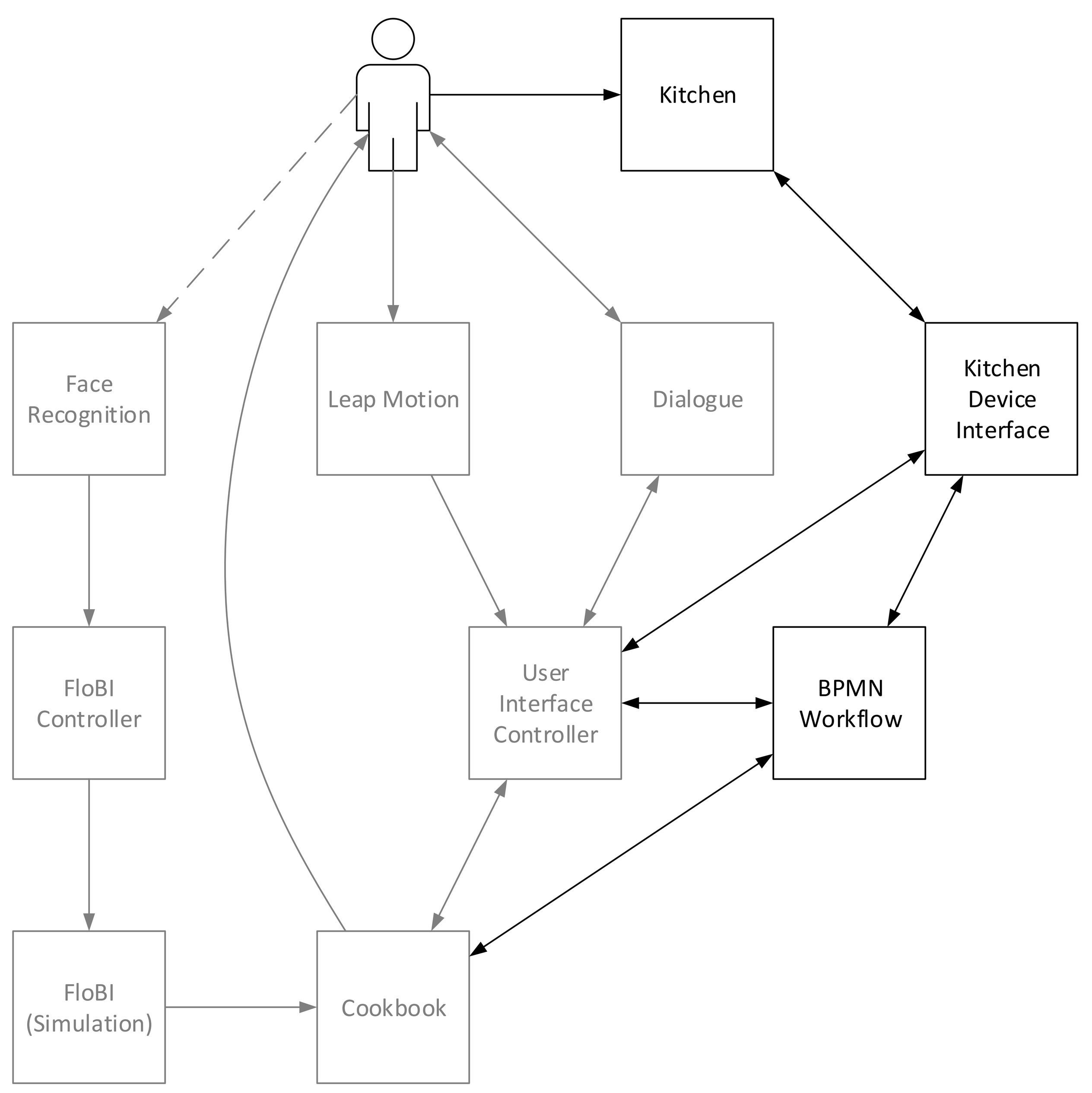

Figure 1: The part of this team in the whole project.

Main Objectives

1. create data structure for a recipe
2. model workflow with ingredients and cooking steps
3. provide next steps to user interface teams
4. integrate kitchen devices
5. provide status information of devices to user interface teams

Materials, Methods, Domain Models, Architecture

The control project is divided into two main parts: The control structure that holds the workflow model and the interface to the kitchen devices.

The two parts of this project as well as the programs of the other teams communicate with messages by Robotics Service Bus (RSB) [2]. This portable flexible tool provides the exchange Robotics Systems Types (RST) in an easy way. With RSB informers and listeners data can be send via scopes. There are different scopes for requests, answers to these requests and status updates so that it can be chosen individually on which scopes to listen.

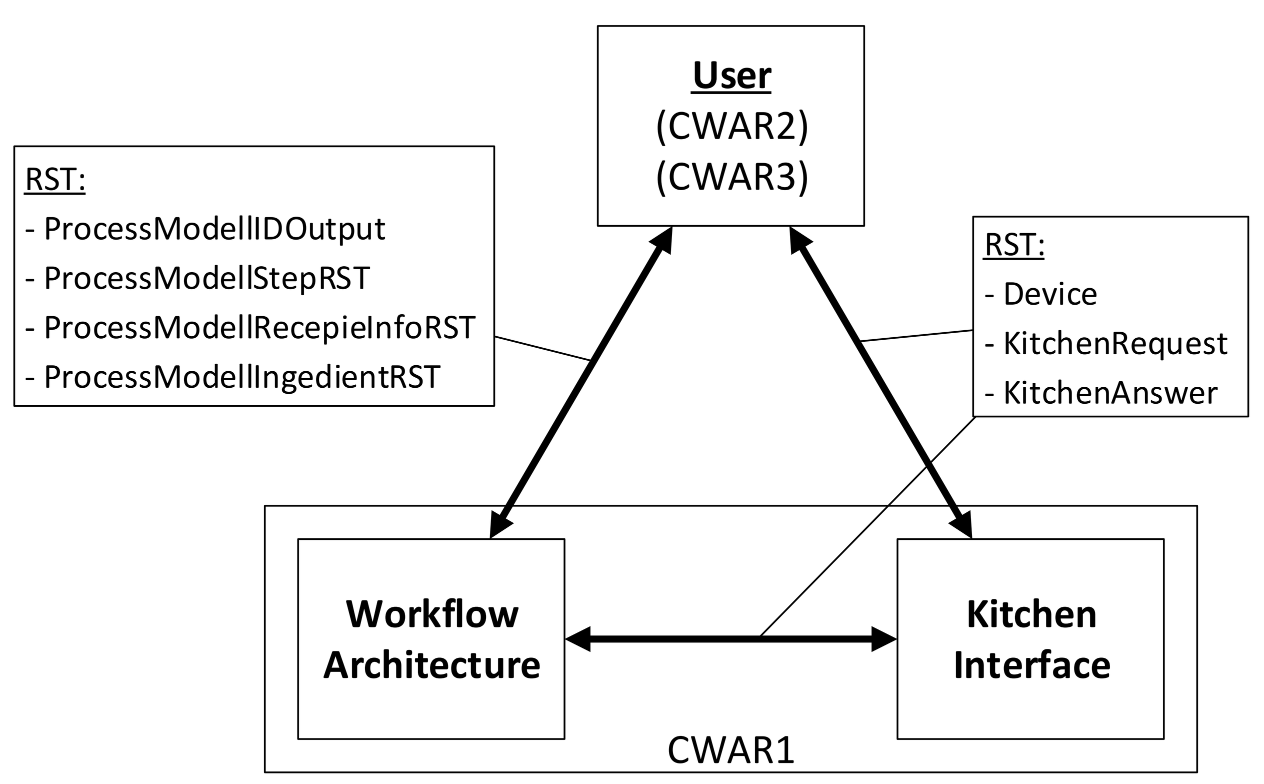

Figure 2: Communication between different project parts with RSB.

Workflow model

Hypothesis of this project is that coordination can be achieved by utilizing workflow models in a flexible cognitive software architecture. Business Process Model Notation (BPMN) 2.0 is used for this control architecture. An existing architecture for coordination of human-machine interaction inspired to utilise Activiti as process engine [1].

The basis for communication is a detached cyclic process using asynchronous RSB-Message-Interface. In every single cycle a step of a recipe is illustrated, necessary data is generated, processed and verified with the kitchen hardware. If a problem occurs during the verification process, the model freezes and waits for an appropriate user action. Such a problem may be a low temperature reading on a hob or a too high temperature reading or a serious incident like a broken stove. This information is provided via the hardware interface.

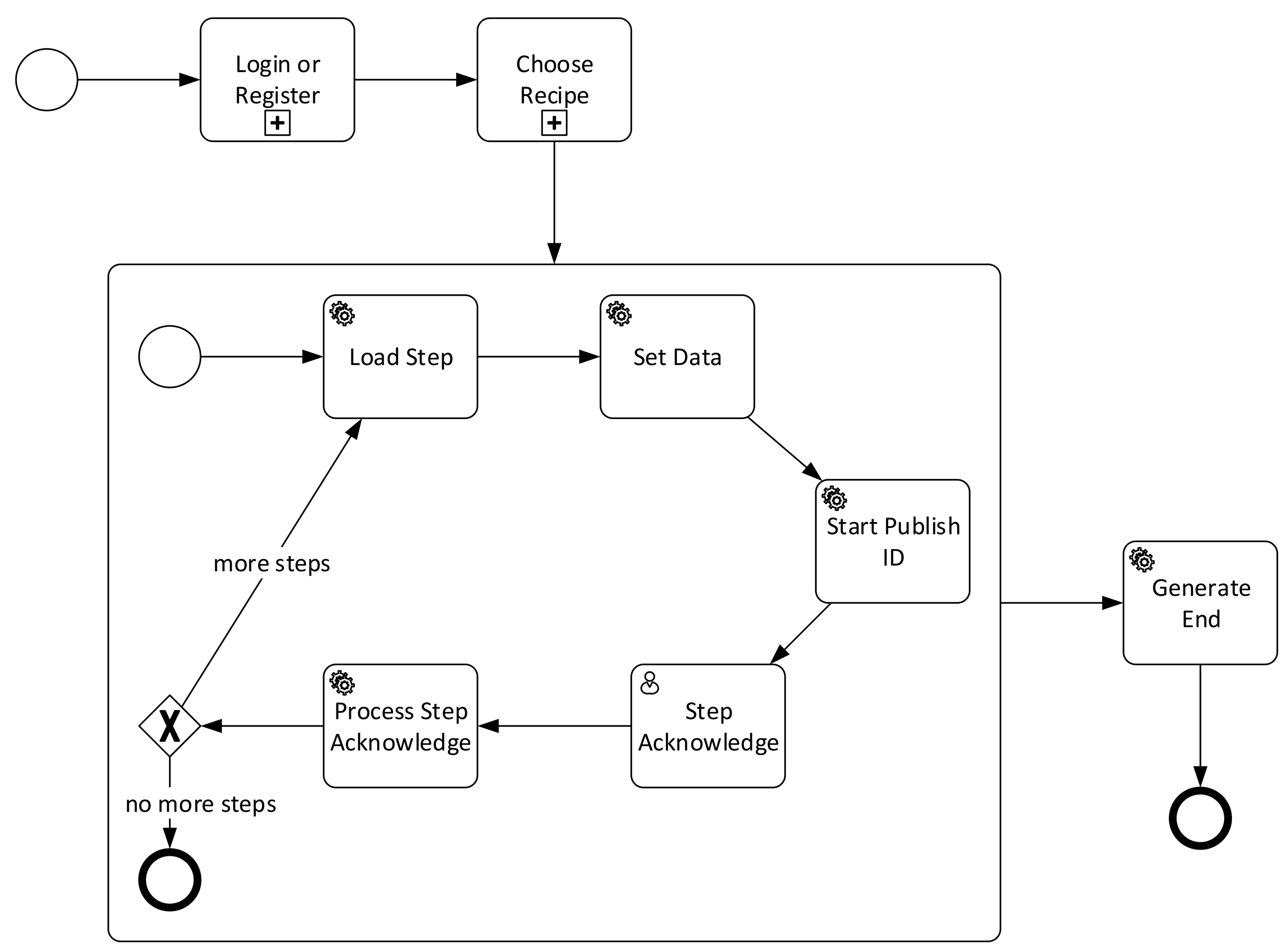

Figure 3: BPMN representation of recipe workflow.

Kitchen device gateway

The kitchen devices are connected with the Miele@Home system of the Miele company. With the Miele@Home gateway states of the devices can be read, selected actions (e.g. turning on the light of the hood) can be performed. Further more one can listen to update information about state changes of the devices. A key feature of the system is to parse this information and provide it to the control architecture and the other teams. An interface is available to request single device states or actions. At the moment the supported devices are a hob, an oven as well as a hood. Other devices such as a microwave oven can be integrated easily.

Results

- workflow based on recipes
- recipe editor
- send step information via RSB
- send device states via RSB
- perform actions on kitchen devices
- automatic status update
- currently supported devices: hob, oven, hood

Conclusions

The defined goals are achieved. Further work:

- integration of all three teams
- initial system check of devices
- security advice
- usability evaluation

References

[1] Stefan Rüther, Thomas Hermann, Maik Mracek, Stefan Kopp, and Jochen J. Steil. An assistance system for guiding workers in central sterilization supply departments. Proceedings of the 6th International Conference on Pervasive Technologies Related to Assistive Environments, pages 31–38. ACM, 2013.

[2] Johannes Wienke and Sebastian Wrede. A middleware for collaborative research in experimental robotics. IEEE/SICE International Symposium on System Integration (SII2011). IEEE, 2011.