Design of Cloud Robotics Solution for Independent Living: the KuBo example*

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Abstract—This paper describes a system based on the user-friendly KuBo robot, which relies on cloud resources to extend its functionality to address services for independent living. Cloud robotics paradigm enhances robot capabilities thanks to cloud computing resources and the availability of big amount of data.

I. INTRODUCTION

Robot companions are become more common and familiar in our lives. They can support senior citizens during daily activities (e.g. participation to social event, reminding, surveillance) enhancing their independent living. Robot companions are used in close collaboration with humans sharing the same workspace [1]. As a result, robots need to be friendly, interact with users, and autonomously move inside the house without revolutionize the familiar environment. On the other side, the solutions provided by robotics services should guarantee time continuity during all daily activities. In this context cloud robotic paradigm is trying to overcome the stand-alone and networked robotics limitations by integrating robots in cloud computing resources [2]. Therefore, this new generation of robots can use wireless networking, big data, machine learning techniques, and the Internet of Things to improve how they assist citizens in different tasks [3].

II. SYSTEM ARCHITECTURE

The architecture of the system is based on three components: the KuBo robot, the smart environments, and the cloud resources. Several KuBo functionality rely on the cloud in order to increase the modularity of the overall system and to add other computational capabilities. Using this approach, the services adapt to changing user needs.

A. Proposed Services

In order to accomplish main users needs some services have been implemented: (I) Reminder Service. This service remembers the user commitments and appointments. (II) Monitoring Service. Smart environments and algorithms are able to recognize dangerous situations to automatically alert the user. (III) Internet Access. By means of KuBo, the user can access Internet resources, such as weather forecast. Furthermore, the robot is able to autonomously access and exploit web resources to modulate its interaction with user. For instance, if the user has an appointment outside and the weather forecast states that it is going to rain, KuBo suggests to take the umbrella.

B. KuBo Robot

In order to develop a friendly robot, the design of the platform is primarily focused on two key points: reduced dimensions to move easily in domestic environment, and high friendliness to enhance the user acceptability. For these reasons, the KuBo is based on the youBot platform (commercialized by KUKA), and it is equipped with a laser scanner, an RGBD sensor, speakers, microphone and a tablet. In order to increase the robot acceptance, the original platform is modified with a design inspired by a typical “coffee table”, a common object already present in homes. KuBo robot is conceived as a platform with low computation capabilities that has to exploits cloud resources to implement its functionality. The only on-board ability is the autonomous indoor navigation. The other functionality rely on cloud resources.

C. Cloud functionality

The KuBo robot exploits several cloud resources. The text-to-speech module uses the Acapela service for the unknown sentences, otherwise they are stored locally to reduce the response time. The speech recognition module relies on the Google Recognition API. Using this tool, the robot has the potentiality to manage multi-languages without the need of specifics acoustic speech model. Appointments and commitments are managed by the reminder module that is based on Google calendar. The monitoring module has access to a public database, which stores environmental data collected by sensors installed in the home. The Internet Access module can potentially retrieve any kind of information from the web. In this implementation, the authors have implemented the weather forecast as example.

III. CONCLUSION AND FUTURE WORK

In this paper, the authors describe a robotic platform with autonomous navigation skills, that heavily rely on cloud resources to implement its functionality and to address services. The cloud approach gives the possibility to increase the skills of a robot in a modularity way. As a drawback, the time of response has to be taken into account, especially when a direct interaction with the user occurs. Future works will cover exhaustive test with real users to understand the usability and the acceptability of this approach.

A video demonstration is available at: https://www.youtube.com/watch?v=XWQ0SyNhvUg&feature=youtu.be.

REFERENCES