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Procedia Computer Science 83 (2016) 457 – 464

Procedia Computer Science

The 7th International Conference on Ambient Systems, Networks and Technologies (ANT 2016)

Fission Engine for an Ambient Assistance Robot Based on the Ontology Concept

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Abstract

The robotic world is gaining more and more place in our daily life. Nowadays, the robot as an autonomous entity is a common assistance partner. The robot may assist in different ways, as for instance in navigation, in medical exploration or health assistance. The main focus of actual research goals is to introduce a robot as a life partner in the human environment. To do so, the robot must be able to interact with people using the natural human interaction methods. Also, the robot must be able to understand and be understood and provide the service requested by the user. The aim of this research work is to build a multimodal fusion and fission engine using the semantic web. This multimodal system will be applied on a wheelchair with a manipulated arm to help people with disabilities interact with their main tool of movement and their environment. This work focuses on building a multimodal interaction fusion and fission engine to better understand the multimodal inputs using the concept of ontology while taking into consideration the context.

Peer-review under responsibility of the Conference Program Chairs

Keywords: Assistance robot; multimodal systems; ontology; SWRL rules; fission engine;

1. Introduction

The robot in general may be an entertainment object or a useful one like a toy or a work tool, but also a life changing tool for a category of people like those with disabilities. In fact, the robot can act like a personal helper in

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Peer-review under responsibility of the Conference Program Chairs
doi:10.1016/j.procs.2016.04.209

some way when used to help people with disabilities to interact with their environment. The aim of our work is to build a robot interaction system using the concept of ontology while taking into consideration the context. Our case study will be the conception of an interaction system between the wheelchair (which is the robot in our case) and a person. Indeed, the wheelchair user will be able to interact with his main tool of living by requesting a service using multiple modalities such as the voice, gesture, eye gaze…etc. We have chosen to build the fusion and fission engine using the concept of ontology. The ontology will be the knowledge base of our system. This choice is guided by the fact that the use of ontology will ensure the usability and the openness of the system. The robot, which becomes an intelligent system, will be able to understand the environment in which events are detected by sensors. This system must be able to merge events in order to understand a situation and be able to decide, act and perform different services[1].The work presented in this article is the continuation of our previous work[1]. In that previous work, we presented the fusion engine that allowed the system to understand the users request and merge the information according to the context using a rule based fusion engine. Hence, we will focus here on the second part on our global system which is the fission engine.

2. Related work

In recent years, multimodal fusion is gaining attention of researchers of various domains due to the benefits of using multimodal inputs and outputs. Multimodality provides access to various modalities, and their use based upon accessibility and availability [1]. Furthermore, the fission process which consists of subdividing the results of the fusion engine into elementary subtask is very important in a multimodal interaction. We found a work on multimodal fusion, fission and virtual reality simulation for an ambient robotic intelligence [2]. In this work, the authors designed fusion and fission agents that communicates with the semantic web using the EKRL language. “Programming the agents is done by reusing default concepts and models, and by adding specific query models in the agent memory using the memory editor” [2]. Also, in the work on adapting multimodal fission to user’s abilities [3] the authors are building a gentle user interfaces for elderly people (GUIDE) to enhance the interaction between humans and computers. Their fission engine follows three tasks: message construction, modality selection and output coordination. This work[3] is based on the What-Which-How-Then (WWHT) [4] conceptual model for multimodal interaction that describes the lifecycle of a multimodal presentation through its evolution within a perpetual change of an interaction context. Also, for the smart home dialog management, we find [5] the description of an integration of multimodal fusion and fission with an SCXML dialog manager. The authors employed open source software components that satisfied the W3CMMI architectural recommendation. Moreover, the nomination of the benefit of the combination of multiple modalities on the input and output side of a multimodal system is presented by Oviatt and Cohen [6]. The benefit reside in making the system more robust and the probability of errors is reduced. Furthermore, we find the combination of multimodal fusion and fission for a dialog management [7]. The authors present their work on a companion system’s ability of interaction and communication. The system presented is a context adaptive approach for multimodal interaction using a layered context model. Likewise, a context aware approach [8] for the multimodal feedback generation in a smart environment is presented by Perroud et al. In this work, the NAIF (Natural Ambient Intelligence Framework) that allows the creation of smart environments is used for the multimodal output generation. Finally, we find a study on multimodal interaction within an ambient environment [9]. Actually, this work is an exploratory study to determine the relationship between the input and output modalities and how the output modalities may influence the choice of the input modalities used by a user.

Based to the works mentioned above we aim to present an innovative work for the control of a wheelchair with a manipulated arm by a multimodal ontology-based fusion and fission engine using the WWHT model [4]. This choice is guided by the fact that the use of ontology allows the full description of the environment of a user and takes into consideration its context. It provides an easy access to information and allows the possibility of reusing it and allows us to introduce fusion and fission rules to facilitate the fusion and fission process according to predefined models in the ontology. We have chosen to use a rule based fusion and fission engine because it allows a good temporal alignment between different modalities and is often used to better estimate the state of a moving object [1].