Spidey: a Robotic Tabletop Assistant

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ABSTRACT

This paper presents our efforts of exploring the possibilities of combining tabletop robots and assistant robots. Our paper presents the design and prototyping of *Spidey*, a robotic assistant on a tabletop environment which works together as a team member with its human companions, aware of their tabletop actions and reacting or initiating tabletop actions according to the task requirements. *Spidey* is designed both as a proof of concept, suggesting the benefits, and reflecting on the limitations of a robotic assistant in an interactive reservoir engineering tabletop visualization application we are implementing. This paper motivates our concept of a robotic tabletop assistant, and outlines our design efforts and the current *Spidey* prototype.

Keywords

HRI, Tabletop Robots.

1. INTRODUCTION

The concept of assistive robots is fundamental to the field of robotics (e.g. [4]),to HRI and social HRI, with various examples in the domain of rehabilitation assistive robots [1].As soon as we introduce a robot into a person work environment we need to consider the social impact of the robotic interface and to design it accordingly. We see our *Spidey* as an attempt to introduce a robot into the tabletop work environment in a manner that would be both task oriented and efficient, as well as socially valid.

The concept of interactive tabletop robots has been introduced by several past researchers, for example as interactive mixed reality framework with a game application [3], as widgets for tabletop interaction with a robotic group [2], and as motorized tangibles with haptic feedback for interaction on tabletop surfaces [5]. We are exploring the concept of a tabletop assistant robot, sharing the tabletop interactive surface and working collaboratively with the users. The potential advantages of our approach are straightforward: the tabletop robot is aware of the tabletop virtual task; it is also aware of the users physical actions manifested as touch on the tabletop, and thus can mediate and help the user in performing the task both physically and virtually. The robot can highlight and act upon any task components via movement as well as via virtual content as if it is an autonomous team member attempting to assist in approaching the task at hand.

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In this paper we propose the use of *Spidey* as an assistant on a tabletop environment sharing the workspace of the human operator and helping her in specific tasks in the domain of reservoir engineering (a domain which is already being explored using tabletop interfaces, see [6]). We start with a few technical details with respect to controlling the robot; highlight possible usage scenarios and finally conclude with directions for future work.

2. Designing Spidey

An overview of our *Spidey* prototype is shown in Figure 1. The current prototype of *Spidey* was designed as a tabletop robot situated on a Microsoft Surface multi-touch interface. While we believe our approach can be scaled to a generic tabletop assistant, or sort of an interactive surface "butler", we have explicitly explored the uses of *Spidey* in the context of reservoir visualization application environment [6].

The reservoir visualization application is a framework used to visualize and explore the 3D virtual representation of the actual oil reservoir models hidden several feet below the surface of the earth. The reservoir engineers rely heavily on these virtual representations to analyze the data and make crucial decisions.[6] Discusses a range of exploratory tools which present different views of the reservoir, to might better inform the user and help in the decision making process.

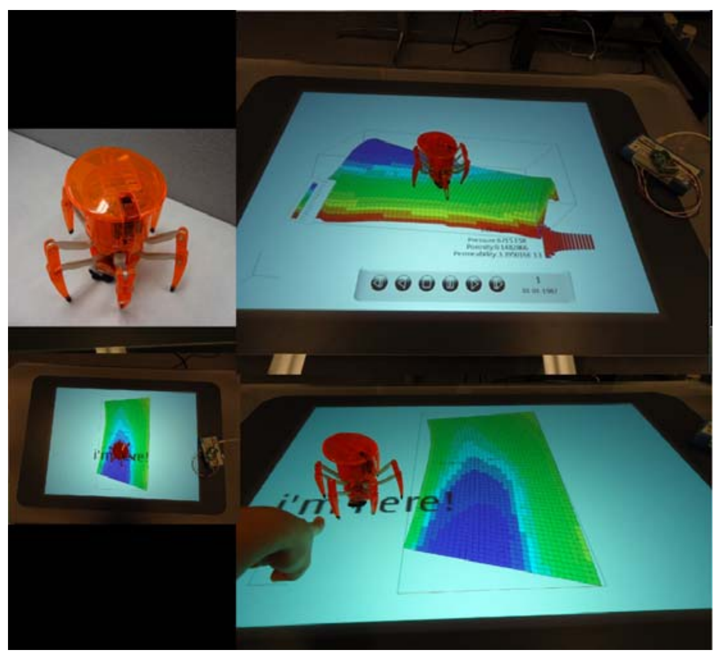

Figure 1. *Spidey*- at its tabletop workplace. (a) top left – *Spidey*, (b) bottom left – Overview, (c) top right–*Spidey* inspecting the reservoir model and visualizing the information and (d) right bottom – *Spidey* navigating its path to the User's finger position.

We implemented *Spidey* using a simple Hexbug™ spider robot which is controlled by an IR remote. *Spidey* can move forward and backward and rotate left and right. The robot is tracked using byte tags of the Microsoft Surface placed on the bottom part of its body as seen in Figure 2. Tracking the robot still allows the Surface to track multi-touch which can be associated with user's fingers or with other robots. The robot is controlled via its original IR remote, and which we are controlling directly using a USB data acquisition interface unit (ONTRAK ADU100). The IR remote is placed either on the side of the Surface, or hanging above it to avoid occlusions from the user's hands. In this manner *Spidey* is being spatially tracked as one of the MS Surface multi-touch entities, while its commands are sent to it via the IR port.

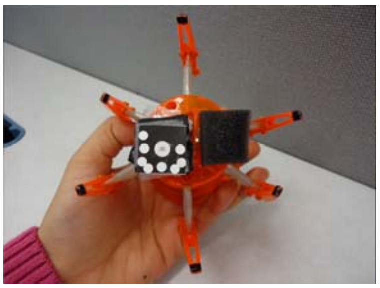

Figure 2. Byte tag attached to the robot for tracking on the MS Surface

In practice the Surface PC is fully controlling the tabletop robot and is responsible for augmenting the robot vicinity, on the tabletop, with visual information, creating the illusion that it is, the robot inspecting the reservoir model (Figure 1c), or chatting via a visual tabletop text message (Figure 3).

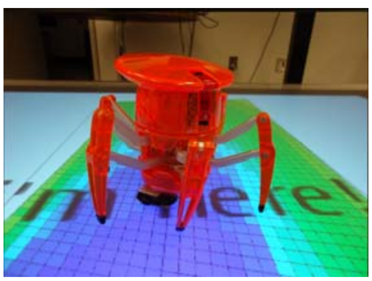

Figure 3. Visual tabletop text message augmenting the robot's current location

3. Scenarios

Below we outline a few of the case study scenarios and tasks we are designing for *Spidey* in the context of reservoir engineering.

3.1 A Robotic Probe

One possible usage of *Spidey* in the reservoir application environment is as an inspection probe which is an essential tool to the reservoir engineer [6]. These models have lot of information contained in them, making explorations quite a laborious task for the engineer. One possible scenario that we explored is to use *Spidey* as a probe or an inspection agent. The robot can walk around the tabletop, scanning the reservoir randomly methodically or go to a user defined position inspecting and communicating via visualizations (see Figure 1D). The robot can become almost another focal point.

3.2 A Tabletop "Butler"

A concept to explore is to reflect upon the robot's behavior similar to the metaphor of history elements. Scenario's where the robot setups the tabletop environment for the user during the first interactions of the day by – opening up weather reports, displaying to-do lists or open up programs which the user constantly uses, would be interesting to explore. The robot can be a reflection of our everyday activities on the UI.

4. Conclusion and Future Work

In this paper we have presented our initial design efforts and prototype for *Spidey* - a tabletop assistant robot which can share the workspace with its human companion and work collaboratively with the user.

In the short term we are planning to improve our *Spidey's* prototype and reach a more robust and stable implementation. We will be exploring with reservoir engineering domain experts various tasks in which Spidey can assist the tabletop users with a set of valid and useful information and actions, these specific tasks that should allow us to perform a thorough evaluation of Spidey, of its limitations and strengths.

5. REFERENCES

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