RESEARCH FELLOWSHIP WORKPLAN

Research Fellowship in the scope of the "Cooperation between Human and rObotic teams in catastroPhic INcidents" (CHOPIN) research project, with the reference PTDC/EEA-CRO/119000/2010

Research Fellow: Rohit Chandra, M.Sc.

Time span: May 20, 2014 – Nov. 19, 2014[1]

Workplan Outline

The main goal of the CHOPIN research project is to develop novel methods for collaborative context awareness and efficient sharing of information between teams of humans and mobile robot teams in urban search and rescue (USAR) scenarios. The main task of the research fellow within the 6 months period is to pursue research work to devise and validate such innovative methods. Besides this scientific task, the research fellow has to deal with more technical activities related with the experimental validation with physical mobile robots in interaction with human teams. These activities encompass using the Robot Operating System (ROS) as the middleware to program basic navigation capabilities in mobile robots, and continue the on-going integration of different components developed by other members of the project. One of the key tangible results of the research fellow's work is the successful deployment of project prototype that can be used as a basis to validate the project's scientific contributions and to disseminate the project's contributions.
These tasks are specified with more detail below.

1. Collaborative context awareness and efficient sharing of information between teams of humans and mobile robot teams in USAR scenarios

A taxonomy of contexts was previously devised in the project, which comprises the stratification of information and knowledge relevant to the scope project's main test scenario (indoor fire), and the definition of an ontology for this scenario. Context recognition methods, either centered in first responders (e.g. firemen) or in mobile robots, i.e. contexts centered in an individual agent, were also developed previously in the project. Using these results as a basis, the research fellow is going to initiate a research effort to devise methods for collaborative context awareness and efficient sharing of information in teams of cooperative agents, thus focusing in the definition of contexts at the team/group level and in the related cooperative interaction. Collaborative context awareness encompasses explicit communication among context-aware agents, so that team goals are attained based on collaborative work and cooperation. Besides sharing contexts whereby an individual agent might know its peers' context, this includes the definition of context at the team level, i.e. centered in the team rather than in the individual, with the aim of adapting the collective behavior to such team context so that the team's performance is optimized. On the other hand, sharing contexts can be the basis for the definition of methods for sharing efficiently information based on metrics of information utility given the context.
The main tangible result to be obtained in this task is submitting to ICRA 2015 (Sep. 2014) a paper with novelty.

[1] The research fellowship can be eventually extended for an additional 6 months period, if both parts agree.

2. Project prototype on the interaction between human teams and mobile robot teams in USAR scenarios

In this task, the research fellow will continue previous efforts to deploy successfully a project prototype based on the integration of components developed by different members of the project, using the Robot Operating System (ROS) as the middleware. There are several components that need to be integrated, but the more challenging one is a software for performing multi-robot simultaneous localization and mapping. The technique that has been used in the project is such that each individual mobile robot runs locally the well-known Gmapping algorithm to build a local map of the team's workspace, and merges its local map with the local map of other mobile robots whenever a "rendez-vous" occurs, thus attaining a more completed map denoted as partial map. In such a process, in the long-term, the partial map of each robot converges to the environment's global map.
A technique based on this principle was studied by a M.Sc. student who elaborated his thesis within the project, but it still requires the implementation of some refinements to become sufficiently robust to be used in the project demonstrator. The solution for these refinements has been already identified but its implementation in ROS still needs to be completed by the research fellow. Also, the current project's code is still not being properly versioned through a version control tool. The research fellow is going to better organize the project's code using GIT.
The tangible result of this task is the execution of a sequence of integration tests in a realistic, though simplified, environment in order to successfully deploy the project prototype as a result of that testing effort.

3. Technical support and project dissemination

In this task, the research fellow has to carry out technical support and dissemination activities. Technical support encompasses essentially maintenance of computers and mobile robots, including their preparation for the execution of tests (see task 2), assembly and integration of sensors in mobile robots, correct maintenance of batteries used in portable computers and robots, etc. Dissemination activities includes the preparation of project deliverables, creating and/or updating slides and videos to disseminate the project's results, and presenting the CHOPIN project to others, e.g. within visits to the lab by external researchers and students.

Gantt Diagram

Task \ Month	May	Jun	Jul	Aug	Sep	Oct	Nov
1. Collaborative context awareness and efficient sharing of information between teams of humans and mobile robot teams in USAR scenarios							
2. Project prototype							
3. Technical support and project dissemination							