UI-AI 2008 Mixed Reality Team

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Abstract. UI-AI has been involved with RoboCup Simulation leagues since 2003, from the University of Isfahan, AI Labs.. In this paper, the group's research status on Mixed Reality using the new Citizen micro-robots is presented, we describe a new camera-equipped Eco-Be! robot with an on-board camera and using this new educational platform in research areas such as Wireless Sensor Networks.

1 Introduction

Mixed Reality (MR for short) is a RoboCup sub-league of the Soccer Simulation League that covers a broad range of fields in a variety of different competitions using standard hardware and software platforms with the CITIZEN Eco-Be! mini robot as the core of the project which is built using cutting edge technology in miniature robotics using high quality and low-cost CITIZEN watch technology [4].
The current MR system uses a central camera for feeding the server; we have designed a new system with distributed vision. In the new system there is an on-board camera on each robot and the vision processing can be done by the robot or even by the server.
Also the new equipped robots can be used in many research areas such as the Wireless Sensor Network approach with the camera as a sensor.

2 Contributions to League Infrastructure

In this section, we are going to introduce our proposed model for replacing the global vision system of MR with separate local view systems for each agent.

2.1 Distributed Vision in Mixed Reality

In this model, agents are responsible for acquiring the visual information by themselves. The sense of each agent is provided through its own camera, so each robot contains a mini camera on top of it; and to take a partial view of

surrounding environment the robot has to turn around itself.
The critical point of attention is deciding about the location where the processing of perception data must be performed. Two approaches are in agenda:

1. In the first approach, each robot may be able to do its related processes by itself, but it needs superior processing ability and also the consumed energy is to be considered. We have decided to utilize an ARM processor by each agent for processing -see figure1.
2. In the second approach, each agent only transmits its own view of field to the server and server decides about the actions of each agent to be performed (similar to the current Eco-Be! League but without global view of the field). For this approach, each robot requires the ability to transmit its view via wireless connections such as Bluetooth -see figure2.

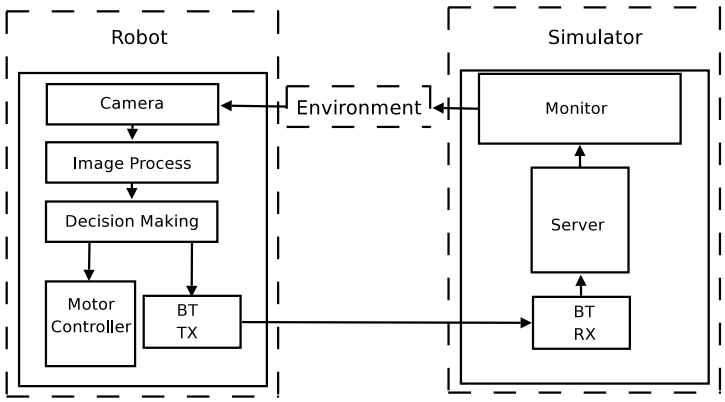

Fig. 1. The first camera approach

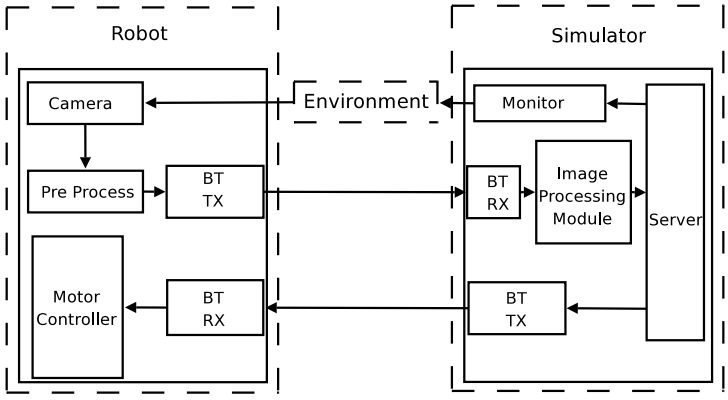

Fig. 2. The second camera approach

3 Proposed Research Programs

Wireless Sensor Network approach is a proposed research program which the Eco-Be! robots can play a great role in that.

3.1 Wireless Sensor Network

A Wireless Sensor Network (WSN) is a wireless network consisting of spatially distributed autonomous devices using sensors to cooperatively monitor physical or environmental conditions, such as temperature, sound, vibration, pressure, motion or pollutants, at different locations[1][2].The development of wireless sensor networks was originally motivated by military applications such as battlefield surveillance. However, wireless sensor networks are now used in many civilian application areas, including environment and habitat monitoring, healthcare applications, home automation, and traffic control[1][3].
In addition to one or more sensors, each node in a sensor network is typically equipped with a radio transceiver or other wireless communications device, a small microcontroller, and an energy source, usually a battery. The envisaged size of a single sensor node can vary from shoebox-sized nodes down to devices the size of grain of dust[1], although functioning 'motes' of genuine microscopic dimensions have yet to be created. The cost of sensor nodes is similarly variable, ranging from hundreds of dollars to a few cents, depending on the size of the sensor network and the complexity required of individual sensor nodes[1]. Size and cost constraints on sensor nodes result in corresponding constraints on resources such as energy, memory, computational speed and bandwidth[1].
A sensor network normally constitutes a Wireless ad-hoc network, meaning that each sensor supports a multi-hop routing algorithm (several nodes may forward data packets to the sink).

WSN Applications The applications for WSNs are many and varied. They are used in commercial and industrial applications to monitor data that would be difficult or expensive to monitor using wired sensors. They could be deployed in wilderness areas, where they would remain for many years (monitoring some environmental variables) without the need to recharge/replace their power supplies. They could form a perimeter about a property and monitor the progression of intruders (passing information from one node to the next). There are many uses for WSNs.
Typical applications of WSNs include monitoring, tracking, and controlling. Some of the specific applications are habitat monitoring, object tracking, fire detection, traffic monitoring, etc. In a typical application, a WSN is scattered in a region where it is meant to collect data through its sensor nodes.

The Role of MR in WSN Research Using our own new Eco-Be! robots which are equipped by an on-board camera, we will have a standard component which is available for using in WSN research.

A critical problem in the current WSN applications is non-distributed power consumption which leads to degradation in part of mass. A lot of works in the literature are accomplished to improve the routing algorithms for balancing the power consumption over all the mass.
Since these robots are well-structured in their mechanical operations, we are not to worry about accuracy of nodes' mobility; so we are now trying to propose an innovative routing algorithm where sensor nodes are restructured cooperatively to balance the power consumption. The new equipped Eco-Be! robots are a good testbed for evaluation of the mentioned innovations.

3.2 Artificial Immune Systems

Recently, a novel computational intelligence technique inspired by immunology has emerged, called Artificial Immune Systems (AIS). This immune system inspired technique has already been useful in solving some computational problems.
Of most interest to us is the adaptive immune system, which is composed of a number of different agents performing different functions at a number of different locations in the body. The precise interaction of these agents is still a topic for debate.
There is more than one mechanism at work in the human immune system. However let us now concentrate on the essential process exploited in most AIS: The matching between antigen and antibody which subsequently leads to increased consentrations (proliferation) of more closely matched antibodies.
Inspired from matching techniques in AIS, we are going to implement a similar testbed for evaluating that matching algorithms. In this idea, robots are assigned into two groups which have group specific movement patterns. Agents of each group try to change their movement such that they have so similar to agents of opponent group and so have not being detected by them. The group of agents with the minimum detected agents is the winner.
Regarding implementation aspect, in this idea the server is responsible for providing agents' code with the image of opponents mobility. So, the agents code can decide about new mobility patterns which can not be followed by opponent robots and in addition, the agents of the same group do not mistake to kill themselves.

4 Educational Experiences

Previously we had been developing a similar platform simulating an automatic vacuum cleaner in a partially observable environment for educational proposes. A group of students volunteered to make an intelligent agent using our platform. The task of writing intelligent agents using the platform was then assigned to a group of undergraduate students as their AI course assignment -an assignment similar to one in their textbook. We also plan to prepare more interesting and

challenging games, matching student interest, as assignments for this course to be used during next semester.

References

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