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MULTI-AGENT BASED IMAGE PROCESSING

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Abstract

Our purpose is, in medium term, to detect in air images, characteristic shapes and objects such as airports, industrial plants, planes, tanks, trucks, etc., with great accuracy and low rate of mistakes. The most difficult area in any implementation of a successful processing of image is handling the image analysis, interpretation and recognitions. However, we also want to value whether the link between image processing and multi-agent systems is relevant and effective. That would be an easy and convenient way to depict and to use the agents' knowledge which is distributed and fragmented. After a first phase of preliminary tests to know if agents are able to give relevant information to an image processing system, we verify that only a few agents running on an image are enough to inform the system and let it generalize the agents' distributed and fragmented knowledge. All those agents send information to an image processing system whose job is to identify the shapes detected by the agents. Unlike the other system, the Multi Agent System (MAS) works in a distributed computing paradigm. Object-based classification, including object-based segmentation and classification, has been applied for the classification of high spatial resolution imagery due to the increase in the spatial resolution and the limited spectral resolution. This paper discusses a MAS solution with a multi-agent object- based classification framework (MAOCF) method to certain real world requirements of any image processing.

Keywords: MAS; MAOCF.

1. Introduction

Decker (1987) brings out a solution to the problem by suggesting a Distributed Problem Solving (DPS) technique where a number of relatively smaller systems or agents are used cooperatively to solve a problem. And the object-based segmentation algorithms, e.g., the fractal net evolution approach (FNEA), have been successfully utilized to provide the homogeneous regions, and are the basis of object-based classification. However, the traditional FNEA

algorithm is greatly influenced by the global control strategy of the region-growing procedure. In addition, the existing object classification methods take little account of the object context information, which is important for high spatial-resolution image interpretation.

The proposed approach avoids the issue of segmentation algorithm selection by unifying the processing of object-based segmentation and classification through the use of a 4-tuple agent model. In the uniform framework, a multiagent object-based segmentation (MAOS) algorithm is proposed to optimally control the procedure of object merging. In addition, a MAOC is proposed to utilize the contextual information from the surrounding objects by taking advantage of the benefits of a multiagent system, e.g., strong interaction, high flexibility, and parallel global control capability. Due to the characteristics of a multiagent system, MAOCF has the potential for a parallel computing ability. Three experiments with different types of images were performed to evaluate the performance-of MAOS and MAOC in comparison to other segmentation and classification algorithms: 1) mean-shift segmentation; 2) FNEA; 3) recursive hierarchical segmentation; and 4) the majority voting object-based classification method. The experimental results demonstrate that MAOS and MAOC give a stable performance with high spatial resolution remote-sensing imagery, and are competitive with the other methods. Because of the independent design of the object-based segmentation and classification in many of the traditional object-based classification methods, additional work is required to select the appropriate segmentation algorithms to match the classification algorithms.

In section 2 of this paper the concept of agents and its importance is discussed, in section 3, the problem of image processing is defined, in section 4 the solution to the problem using MAS is discussed, in Section 5 the conclusion and possible future work is given.

2. Agents

Russell et al., (1995) defines agents as anything that can be viewed as perceiving its environment through sensors and acting upon that environment through effectors. (Chang, 1998) describes intelligent agents as software entities that carry out some set of operations on behalf of the user or another program with some degree of independence or autonomy and employ some knowledge or representation of the user's goals or desires. Autonomous agents are described as computational systems that inhibit some complex dynamic environment, can sense and act autonomously in its environment and realize the designed goals and tasks.

Franklin et al., (1996) describes the following agent characteristics:

a. Agent responds in a timely fashion to changes in the environment.

b. Agent exercises control over its own actions.

c. Agent does not act in response to the environment.

d. Agent is a continues running process.

e. Agents communicate to other agents and systems.

f. Agent can change its behaviors based on previous experience.

g. Agent can migrate from one machine to another.

h. Agent actions may not be scripted.

3. Problem in the Image Processing

The main problem of concern is that the analysis of images for interpretation and recognition accurately by using the object-based classification. The image processing system can only take the images from the image capturing system and is left in a state of helpless situation of not be able to interpret the images or unable recognize them. This leaves the image processing system knowing what the change is, but not knowing the cause and therefore lacks the ability to interpret and recognize.

4. MAS solution

The solution to the problem discussed in section 4 is given by the use of agents. Java Agent Development Environment (JADE) is used to implement the solution.

Step1: The first step of the solution is to learn the image capturing system. This will be helping the system to know the source of the changes in the images well in advance for initiating the analysis.

Step 2: The monitoring agent is the central decision making node where all the sensor agents would report in an event of image changes

Step 3: The image processing administrator sets an image change threshold and this is taken as input by the monitoring agent. While dispatching a sensor agent the image change threshold is set to the agent.

Step 4: The sensor agent which resides in the node monitors the image change by the node and informs the cause to the monitoring agent when the set threshold exceeds.

Step 5: The monitoring agent prepares the report of incidents reported by the sensor agents and presents it to the administrator for further necessary action.

With this solution the administrator would be able to isolate the image changes and the cause of the same from the

nodes with object-based classification for the accurate interpretation and recognition and thus the solution

5. Conclusion

The agent paradigm provides an efficient technology of the future to solve many problems of any big may face. As JADE can work on heterogeneous platforms the future system may be compatible to the technology. Further JADE has progressed further into mobile platforms which would be part of any state-of-the-art network of today. Much of the research in this area is in its infancy and the reason for no image processing management tool that uses agents are available in the market. The authors future mission would be to build a suite of tools on agent technology and to make it open source so as to provide benefit to the society.

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