Chapter 1
Design of Multi Agent System for Resource Allocation and Monitoring

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ABSTRACT
The objective of Resource Allocation and Monitoring System is to make the procedures involved in allocating fund resources to competing clients transparent so that deserving candidates get funds. Proactive and goal directed behaviour of agents make the system transparent and intelligent. This paper presents design of Multi Agent Systems for Resource Allocation and Monitoring using Agent Unified Modelling Language (AUML) and implementation in agent based development tool. At a conceptual level, three agents are identified with their roles and responsibilities. The identified agents, functionalities, and interactions are also included and results show that multi agent technology can be used for effective decision making for resource allocation and monitoring problem.

INTRODUCTION
Resource Allocation problem occurs when fixed and limited resources are allocated to competing fund seekers to execute their projects. These resources may be of different types like work force, machine timings, raw material and funds. Fund seekers can submit their project proposals to avail grant to allocating agencies. Projects can be of different nature like R & D projects and social oriented schemes. On receiving the project proposals from fund seekers, funding allocation agencies evaluate proposals technically as well as financially. After the submission of funds request, committee on the behalf of funding agency evaluates request. In some cases, fund seekers are asked to present the project proposal. Based on the recommendation of committee, funds are allocated from 0 percent (no allocation) to 100 percent (full
Design of Multi Agent System for Resource Allocation and Monitoring

Factors considered to make decision to allocate funds are classified into quantifiable factors like number of students trained in case of education sector and non-quantifiable factors like impact on society and image of fund seeker.

In India, there are different government agencies giving financial support to different organizations. Education is one such sector, where many funds are given for research and development and to provide quality education. One such organization is University Grant Commission (UGC). UGC receives financial aids from Ministry of Human Resources and Development and disburses the same to universities and colleges all over India. In Information Technology sector, Department of Information Technology, Ministry of Communication and Information Technology has gained software products by granting funds to various institutions who are engaged in development of software products.

Second part of the problem is timely monitoring the utilization of funds. The proper and timely utilization of funds ensures the fulfillment of objective of allocation of funds. An integrated decision making system, Multi Agent System for Resource Allocation and Monitoring (MASRAM) is designed based on above facts.

An Agent in Multi Agent System (MAS) is an autonomous entity that performs a given task using information gathered from its environment to act in a suitable manner to complete the task. Multi-Agent System comprises of multiple agents that interact with one another. Agent acts on the behalf of users / other agents with different goals and motivation. Agents require ability to cooperate, coordinate and negotiate with each other to have successful interaction. The Agents in MAS work in a team to achieve common goal.

Deployment of agent-based systems depends on how well agents are designed and depicted during early phases of agent oriented software development along with their roles and responsibilities (James et al., 2000). AUML is graphical modelling technique that is standardized by Technical Committee of Foundation for Intelligent Physical Agents (FIPA) (Janilma et al., 2005). AUML is the specification technique supporting the whole software engineering process- from planning, through analysis, design and finally to system construction, transition and maintenance. This modelling language is used to design the system. The designed system helps in developing agents using application development platform.

REVIEW OF RELATED RESEARCH

In their study, Jenyl Mumpower and Thomas A. Darling (1991) have discussed three procedures that can be used to resolve Resource Allocation Problem. In Incremental Appropriation, resource allocation begins with no allocation and then allocates small resources. The process is repeated until resources are exhausted. In the second procedure, multiple negotiators give different concessions. Resources are moved from one point to another and utility function is checked. In the third procedure, different negotiators assign different weights to different programmes.

Quantification of non-quantitative indicators is important to make decision of allocation (Jin et al., 2008). The non-quantifiable indicators can be measured through fuzzy comprehensive measurement method. Since non-quantifiable indicators are measured by human, whose knowledge and experiences may not be complete and exact. The probabilistic tools are used to deal with such data. This approach is also used to rank employees’ performance using both quantitative and non-quantitative measures.

Multi Criteria Decision-Making (MCDM) helps in making decision of evaluation and selection problems where quantifiable and non-quantifiable factors are used (Mohamad et al., 2007). Non-quantifiable factors deal with vague data and fuzzy system handles such data. Two layered approach is used to assign weights to subjective (non quantifiable) factors and quantifiable factors. Top
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