R-MAGIC:
A COOPERATIVE AGENT BASED ARCHITECTURE FOR RETRIEVAL OF MULTIMEDIA DOCUMENTS DISTRIBUTED OVER HETEROGENEOUS REPOSITORIES

by

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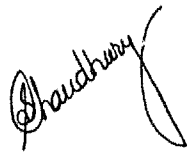
Certificate

This is to certify that the thesis titled **R-MAGIC: A Cooperative Agent based Architecture for Retrieval of Multimedia Documents Distributed over Heterogeneous Repositories** being submitted by Hiranmay Ghosh to the Department of Electrical Engineering, Indian Institute of Technology, Delhi, for the award of the degree of Doctor of Philosophy, is a record of bona-fide research work carried out by him under my guidance and supervision. In my opinion, the thesis has reached the standards fulfilling the requirements of the regulations relating to the degree.

The results contained in this thesis have not been submitted to any other university or institute for the award of any degree or diploma.



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To
Sharmila

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Abstract

This thesis proposes R-MAGIC, a novel agent based architecture for multimedia retrieval. An open environment such as the Internet or a corporate intranet may contain several independently developed collections of multimedia documents. In general, these collections contain documents in different media forms and may have different organizations. R-MAGIC has the capability to integrate several such repositories in a digital library framework. A major innovation in R-MAGIC is stratification of knowledge required for retrieval and their encapsulation into independent and autonomous agents that results in flexible deployment of these retrieval resources. Retrieval in R-MAGIC is a result of cooperation between these agents, each of which can perform a retrieval sub-task.

A semantic query in R-MAGIC is interpreted as a set of observable media pattern specifications with collection-independent domain knowledge. Analysis of the multimedia documents with autonomous media analysis routines results in observation of some of these media patterns. Semantic retrieval in R-MAGIC uses a new abductive reasoning model that is based on the evidential strength of the observed media patterns in a dynamically constructed Bayesian Network. Collaboration between the wrapper agents encapsulating the repositories and independent agents with media analysis capabilities result in enhanced retrieval capability of the repositories. R-MAGIC handles the heterogeneity of the repositories by formulating a unique retrieval plan for every repository, dynamically in context of a query by an agent team in a distributed fashion. A feedback mechanism during the

execution results in reactive updates in the retrieval plan.

R-MAGIC defines a query language that supports both semantic and feature based query paradigms for multimedia retrieval. A generic knowledge description language facilitates encoding of domain knowledge in different application domains. These languages are extensions of a flexible content language that facilitates agent communication in R-MAGIC.

R-MAGIC is a flexible architecture and can be adapted to support a wide range of applications involving multimedia retrieval. We describe two different prototype applications of R-MAGIC in this thesis and study their performance. One of the applications, a virtual encyclopedia of Indian heritage, is informational in nature. The other application, a web-based mediation service for shopping, targets e-commerce.

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