Modelling Online Admission System: A Multi-Agent Based Approach

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Abstract—We have proposed an integrated Web-based online admission system using multi-agent system and Web-based technologies. Every year, most of the Universities have to organise centralised admission for under-graduate courses of its affiliated colleges. The centralised online admission system is a major reform initiative in education sector to bring about greater transparency, efficiency and accountability in complicated and time-consuming admission process. It encompasses every institution under the university to accomplish the admission process where potential student community is involved. As a result of various agents' involvement in the whole process, coordination and communication among them are the core issue which can be efficiently handled in a multi-agent environment. Thus dynamic behaviours of the agents reveal better results. Multi-agent systems represent a new paradigm for the development of distributed software. Preliminary implementation issues for this system have been discussed with Java Agent Development Environment Technology, a java-based software platform that provides middleware-layer functionalities which facilitate the development of agent-based application, at the end of the paper.

Index Terms—Online Admission Process, Higher Educational Institutions, Agent-based Technology, Multi-Agent Systems.

I. Introduction

During admission season, students as well as their parents queue at multiple colleges located at different places to collect admission forms to study at under-graduate level. Subsequently they have to follow same methodology to submit the forms. Again they have to hop from one college to another to know their position in the merit list physically as well as to complete admission process in the college where they get chance to study. This period of admission becomes a tiresome, hectic and troublesome for the students and their parents.

As information gathered from the University of Burdwan regarding admission process, problems not only can be seen from the student's perspective but also from colleges as well as of the University. Every institute incurs expenses for printing admission-related documents such as application form, brochure, etc. whose quantity is imaginary as the volume of applicants is totally unknown to the authority concern when order for printing is placed for the same. Thus the wastage of materials is easily foreseen.

Secondly, unnecessary and prolong involvement of manpower for distribution of forms, handling redundant queries, collecting filled-in forms, manually scrutinising the data given in the forms against documents submitted, generating merit list, etc. makes this admission process complicated and error-prone.

Thirdly, constant updating of merit lists at regular interval becomes a headache for both the authorities as it is a repetitive manual computational task and the applicants as they have to visit again and again to check their latest position in the merit list.

In general perspective, every year the universities are receiving complaints about the difficulties being faced by students seeking admission to affiliated colleges from every sections of the society. It has become an absolute necessary, for the well-being of the society, to make this admission process hassle-free and transparent for the benefit of all the stakeholders involved in this admission process.

As the required centralised online admission system need to be developed under the supervision of the university based task force comprising of experts from university as well as from the colleges, a comprehensive scope has to be framed to enable conduct of online admission. Thus it ensures uniform admission directives for central online admission system.

For the design of online admission system, several factors such as the number of colleges, subjects/ subjects combination on offer by different colleges, number of seats, number of courses/combination of subjects an applicant may apply for, fee structure, etc. are the vital information that are to be incorporated in the system for successful execution of the process.

Keeping in view the above short-comings and challenges, in the manual and existing online admission process, the proposed Multi-Agent System (MAS) based

architecture for online admission system can give fruitful results which can effectively minimize the concerned factors such as operating cost of entire process, total time of completion, manpower involvement, data redundancy, paperwork, hassle faced by students, etc. Also enhance the performance measures such as acceptability in the society, transparency, accuracy, reliability and productivity. It allows University to receive applications through their official website, thus candidates sitting at remote locations can submit forms electronically without physically attending the respective institutes. All relevant information required by the students is available in the website. Dynamism in respect to status updating and instance report generation as required by the authority to monitor the progress of the admission from time to time is achieved.

An online admission model is based inherently on MAS and it has the following advantages over existing traditional approach:

Computational activities are spread across several places (colleges, universities, banks, students) with their own characteristics across a network of interconnected so-called agents.

In synchronisation with the merits of the multi-agent technology [1], this proposed multi-agent based architecture decomposes the activities into sub-modules and distributes them across the network of interconnected agents. It also decentralizes the complex activities and eradicates the performance bottleneck generally associated with centralized systems overcome the hurdle of resource crisis, performance break-down and unpredictable run-time failures.

This paper is organized as follows: Section II presents the general overview about the agent technology and Multi-Agent System (MAS), Section III discusses the step-wise procedure of the online admission system for the affiliated colleges under the university, Section IV presents our proposed multi-agent based architecture for online admission system, Section V discusses the agents interaction process of the system along with the supportive diagram, Section VI discusses about implementation issues related to the proposed model. Finally, section VII draws the conclusion of this paper.

II. AGENTS AND MULTI-AGENT SYSTEM (MAS)

According to Wooldridge [2], "An agent is a computer system that is situated in some environment, and that is capable of autonomous action in this environment in order to meet its design objectives."

Multi-agent systems represent a new paradigm for the development of distributed software. It is composed of multiple interacting computing elements known as agents.

As describe in various resources, agent-based technology is capable of imparting actions in response to the perception from its environment to achieve desire goals. They are autonomous computer programs with the capabilities of taking actions, in case the environment demands, on behalf of the users to satisfy the need of the system. Then the results may be transmitted via messages

to other agent(s), if necessary, to accomplish the task. Thus, MAS based technology requires multiple agents to work together, thus ability to cooperate, coordinate, and negotiate with each other. A multi-agent system is a collection of software agents that interact to solve collectively a problem that cannot be tackled by any entity individually [1-5].

Moreover, agent-based paradigm is capable of improving the system performance in respect to the efficiency, reliability, extensibility, maintainability, acceptability, flexibility, productivity against the traditional non-agent-based system [6-7].

III. STEPWISE PROCEDURE OF THE ONLINE-ADMISSION SYSTEM

The following steps illustrate the general procedure for online admission to colleges affiliated to the universities. The sequence of activities listed here, is the improvement of procedure that may be followed by the university, and is subject to change in response to the scenario demands [8].

1. Students and other interested communities generally want to know about different institutes and its subjects-related matters. Appropriate user-friendly interface is to be designed to take care of the queries placed in this connection and forward them to the distributed databases of the institutes under this university to process, retrieve and display the results. The queries are generally related to the number of seats institute-wise category-wise and its respective eligibility criteria.

2. Candidates intended to take admission in any of the affiliated colleges under this university have to register themselves through the designated web portal online through Internet.

3. Registration includes mandatory academic and personal details as required in this process such as Name, parent's name, address, email id, category (UR, PwD, etc.), marks scored in all the prerequisite qualifications. It is to be noted here that proper instructions are to be displayed for every input control given in the registration form. Appropriate dialog boxes are to be displayed with adequate guiding information.

4. Successful registration generates registration id and password of respective students. Thereafter the system will automatically generate candidate specific e-challan for payment of registration fees. It can be paid via online service or at the bank counter. Henceforth, every registered candidate can access his/her information pages through user login.

5. Through login process, there will be provision for details modification by the applicants within stipulated time. Also there will be scope for resetting password as well. Only after his/her details modification is permanently locked in the database by clicking the lock button, he/she will be allowed to select colleges along with the subjects.

6. After the payment status gets updated in the database, students shall be able to select college-wise subjects in unlimited numbers on the basis of his/her subject
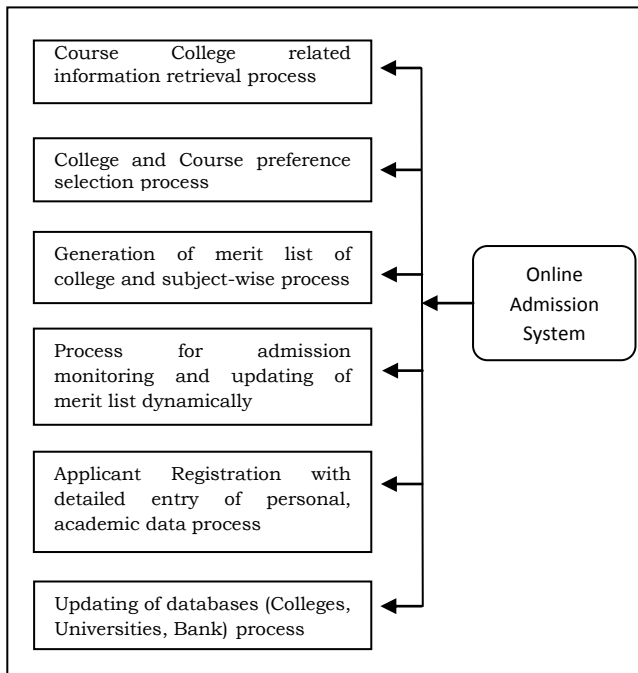

Fig. 1: Activities of Online Admission System

combinations in acquired qualification and after satisfying minimum qualifying criteria as per his/her preference. The number of preferences given by the candidates can be restricted by the university authority depending on the complexity of the process.

7. Changes in their preferences are permitted either till the last date of application or clicking the lock button, whichever is earlier, after which the given preferences become permanent.

8. Merit point in the Merit list will be calculated in accordance with the prescribed eligibility criteria specified by the University.

9. College-wise merit list will be generated on the basis of Category, subjects and intake capacity. All reserved candidates shall be considered in unreserved (UR) list as well as reserved list. If such a candidate be found eligible for admission in both lists and (s) he gets admission, (s) he will be considered to have filled in the UR list. However, his/her name will be deleted from both lists.

10. College-wise merit list shall be displayed in the site. There shall be certain number of admission phase as determined by the University. An applicant will get scope for viewing his/her status by his/her user interface through logging in. Also SMS information of allotted preferences will be sent to applicant as per serial number in the applicant's preference list. Whenever an applicant is allotted seat/seats due to status updating, SMS information would be sent.

11. The interface provided to the colleges to view the status of the candidates applying for admission in the college. Colleges shall be provided with secure login interfaces for their operation. Through their interfaces, they will be able to generate various pre-defined and dynamic reports for their perusal. Proper interfaces for data insertion, modification and deletion related to the college information are provided so as to feed into the system easily by the college authority from their sites.

12. Applicant can view the status of all his/her preferences of college-wise subjects given, after the login into the web portal. If an applicant finds one/more preference(s) allotted in his/her favour then he/she can selects one from them for admission by clicking "Apply" button and then an e-challan (pre-determined admission fees) along with pre-formatted admission document will be generated and the other chances of that phase will be lapsed after confirmation dialog box. Instantly, this preference will be locked in his/her favour. If (s)he seeks chances in further phases then select "up-gradation desired" option and (s)he will be considered in further admission process and his/her status updating will take place during further admission process. Here the university has to decide whether other chances will become invalid for further course of process or will be considered further.

13. Bank database will be updated with latest payment status to collect the admission fees from the applicants and collect the amount via online/counter and update the databases as specified. The bank authority will populate the system's databases of the online admission system within 24 hours of the payment by the students, which will trigger the process of permanently block the occupied seats of the students. This will ultimately gives the up-to-date vacancy and filled-in status of the colleges.

14. Ultimately, the student should reach the college requisite documents for verification by college authority. If everything is ok, college shall process the admission and update the system to reflect the changes taken place.

15. However if any candidate is failed to execute the above step, then his/her admission will be treated as cancelled and the preferences above the current allotted preference will only be considered for further allotted if possible. At any stage of his/her admission, upgradation option can be set as NO to indicate that this current allotment is the final one and not desire for further improvement in allotment.

16. Each applicant will be allowed to get admission for fixed number of times at the best, as specified by the University. Automatically, previous admission shall stand cancelled after an applicant has been allotted the new selection.

17. Log process should be available for every activity of a candidate and the college.

18. Continuation of admission phase(s) (if any) shall be under the discretion of the university as situation arises.

19. Interface allotted to the university authority have the following features: A. College-wise subject-wise admission descriptive and summary report, B. Parameters based registered candidates report, C. College-wise fees collection details report, D. Notification management module to convey notices to the applicants and colleges related to admission development.

IV. MULTI-AGENTS BASED ARCHITECTURE

The purpose of this proposed architecture, as given in Fig. 2, is to segregate online admission process among definite number of agents, capable to process in parallel and communicate by sending messages. This section describes all the requisite agents that constitute the system. It is to be kept in mind that the further enhancement, in response to the new features, can conveniently be plugged to this proposed architecture as and when needed.

A. User Interface Agent (IAg)

This agent establishes connection between users and the agent based online admission system. The users are mainly of three types: the applicants, college authorities and university. Applicants put their queries to get the college-related information as per their conditions imposed. Colleges monitor their on-going admission status and update their information in their database. University keeps track of the admission status and acts as a coordinator among the affiliated institutes. This agent displays login screen and as per the user type, appropriate interface gets display with its individual functionalities in coordination with coordinator agent.
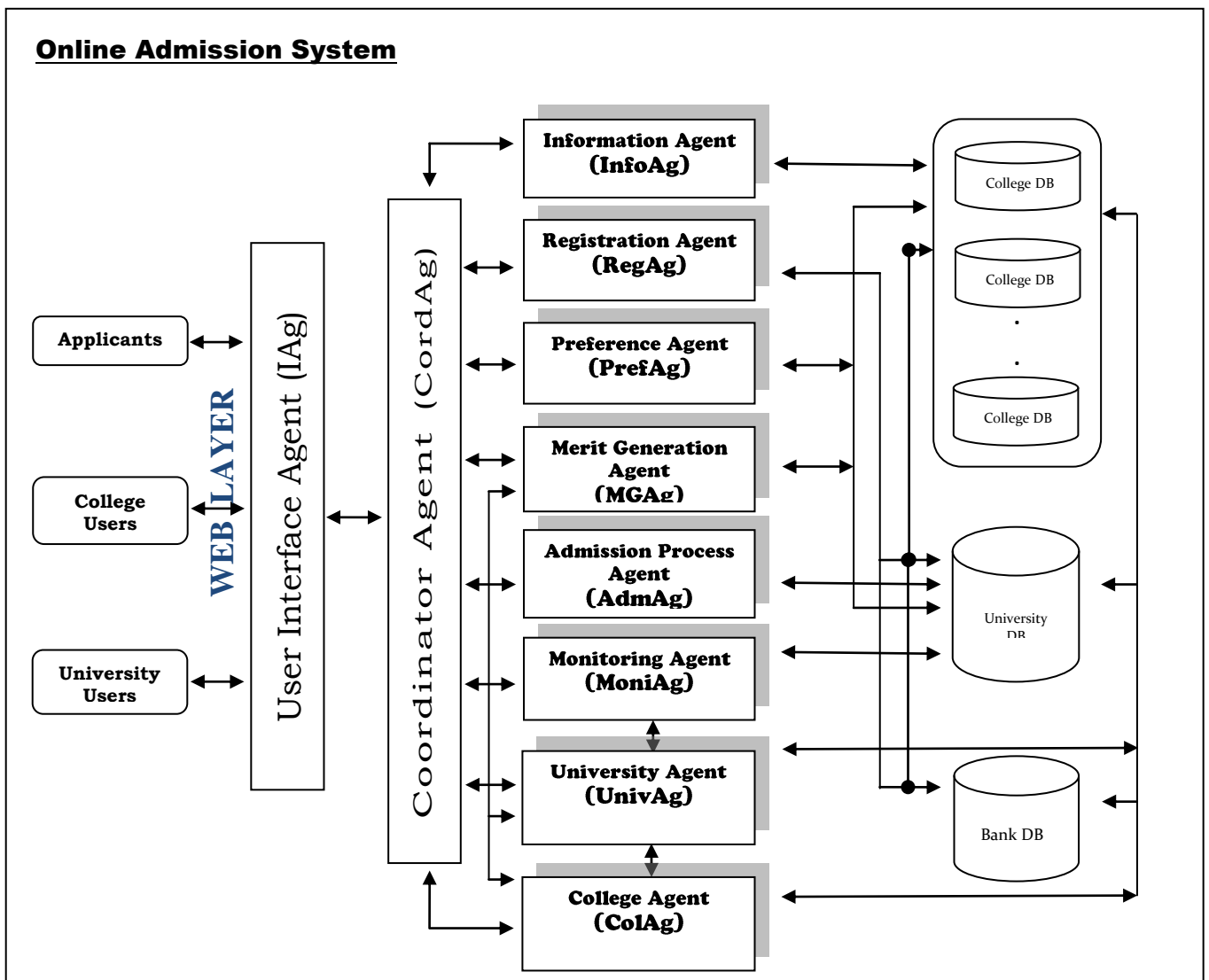

Fig. 2: Proposed MAS based architecture of Online Admission System

B. Coordinator Agent (CordAg)

This agent acts as a main agent of the Online Admission System, as it coordinates with various agents. As per the type of messages input from the IAg, appropriate agent gets involved automatically and may subsequently invoke other agent(s) to accomplish the task. Alteration in this agent can include new agent in the system or exclude the existing one. If we look carefully at the proposed architecture diagram and more clearly depicts in the sequence diagram, that this agent has communication pathways to all the constituent agents of the system implying its strong presence in the system.

C. Information Agent (InfoAg)

The student community, who are interested in the admission process, generally want to know about institutes and its subjects-related matters. This agent takes care of the queries placed in this connection by involving distributed institutes' databases and display the result of the same by delivering it to the IAg. This agent has the critical role of establishing connections between the student's interface, university agent, college agent and back-end databases, thus maximum resources get involved in this process under the coordination of this agent. Proper synchronisation between these underlying agents is highly solicited to perform the task in time and perfection.

D. Registration Agent (RegAg)

This system requires all eligible candidates to register to get their registration id and password. Registration includes mandatory academic and personal details as specified before and responsible to collect registration fee online else facilitate e-challan for payment of registration fees at the counter. This agent performs above task, thus effecting university and bank databases. Applicant data get stored at the university level databases, to be utilized by the other agents at appropriate time.

E. Preference Agent (PrefAg)

After the registration process gets completed successfully, applicants are allowed to fill up their preferences i.e. college-wise courses through the interface subject to their eligibility criteria. This agent takes care of this preference–filling process and stores the records at university–level database. It is also to be kept in mind that the data-filling keep track of the students' identity in respect to their likes and dislikes in response of which the information that get displayed after their individual login are synonymous to their identities. It also displays the last 10(ten) activities perform by the candidates in their respective last sessions.

F. Merit Generation Agent (MGAg)

Success of this admission process depends on this agent as it triggers the automated merit list generation of all courses institute-wise. It generates confirm as well as waiting merit list as per the criteria specified by the university. It is not a one-time but a continuous process as the process gets repeated at the beginning of every phase until and unless the whole admission system is over. This agent activates the respective agent of the colleges for current admission status i.e. to know the current vacancy subject-wise, category-wise, etc. without which this agent will be unable to execute its process to generate the accurate merit list for all college-subject-category-wise list.

G. Admission Process Agent (AdmAg)

After the merit list generation, the listed applicants now shall select one of their preferences where they have got chance to confirm their admission. Instantly, that seat will be blocked for him/her and other chances will be released for other applicants who are in waiting list. Admission status of that effected college database will be updated to reflect the current status. Moreover, the applicants will be asked to pay the admission fee through online payment or e-challan will be generated to be paid at the bank counter.

H. Monitoring Agent (MoniAg)

This agent is responsible for generation of reports using dynamic and static formats as required by the colleges and university to monitor the admission process. These reports will assist the concern authorities to decide further course of action. It has another significant of system upgradation i.e. plugging/unplugging of new/existing agents, modification of existing modules features are to be incorporated through this agent.

I. University Agent (UnivAg)

This agent is responsible for updating of university database dynamically as invoked by other agents such as MGAg, PrefAg, RegAg and AdmAg. It always invoke ColAg agent for respective colleges for its updation of information in its database which is highly sought at regular interval of time for updated report generation and for decision support system.

J. College Agent (ColAg)

This agent is responsible for updating of concern college database dynamically as invoked by other agents such as MGAg and AdmAg. It also takes care of retrieval of data from the concerned college databases for different categories of users in this system, thus abstraction and encapsulation of data has been incorporated.

V. Interaction Process

An interaction diagram is a graphical representation that depicts how agents interact with one another and in what sequence. It shows agent interactions arranged in time sequence. It depicts all the agents that are involved

in the system and sequence of messages exchanged between the agents needed to carry out the functionality of the system.

A sequence diagram, is a graphical illustration, consists of parallel vertical lines which represent different agents that constitute the system and horizontal arrows that represent the messages flow between them, in the order in which they occur.

In connection to the above sections, agents interact with each other or one invokes other automatically without user interference can be clearly visualized from Fig. 3. Communication takes place with the transfer of messages among the agents though standard communication protocol. This diagram demonstrates the several series of steps to be executed for different users as per their requirement to achieve desire goals.

Students via their interface, under the supervision of the co-ordinator agent (CordAg), interact with the system, as per their requirements, enable information agent (InfoAg) for retrieving information about the admission-related details. To achieve this goal, InfoAg sequentially activates the University agent (UnivAg) which in turn enables College Agent (ColAg) for ultimately retrieving requested data from the underlying database(s) and reversely routed it sequentially to the concern students.

VI. IMPLEMENTATION ISSUES RELATED TO THE PROPOSED SYSTEM

The hardware and software design and planning should be done to facilitate a robust and crash-proof system with feasible economical obligations considering the financial obligations of the colleges participated in the process, as they have the financial burden of Information and Communication Technology (ICT) infrastructure development for smooth and seamless running of the process at their respective sites.

Different modules under the supervision of pre-defined agents are to be developed using diversified technologies. Java Agent Development Environment (JADE), a software platform that provides middleware-layer functionalities which facilitate the development of agent-based application using java-based API thus exploit the software agent abstraction, can be used to implement this system. It is distributed under an Open Source License. JADE is a mature product, used by both the research and industrial communities. As each agent has global unique name known as AgentIdentifier (AID) as specified by FIPA, to enable it to communicate with other agents in compliance with FIPA specifications [9-10].
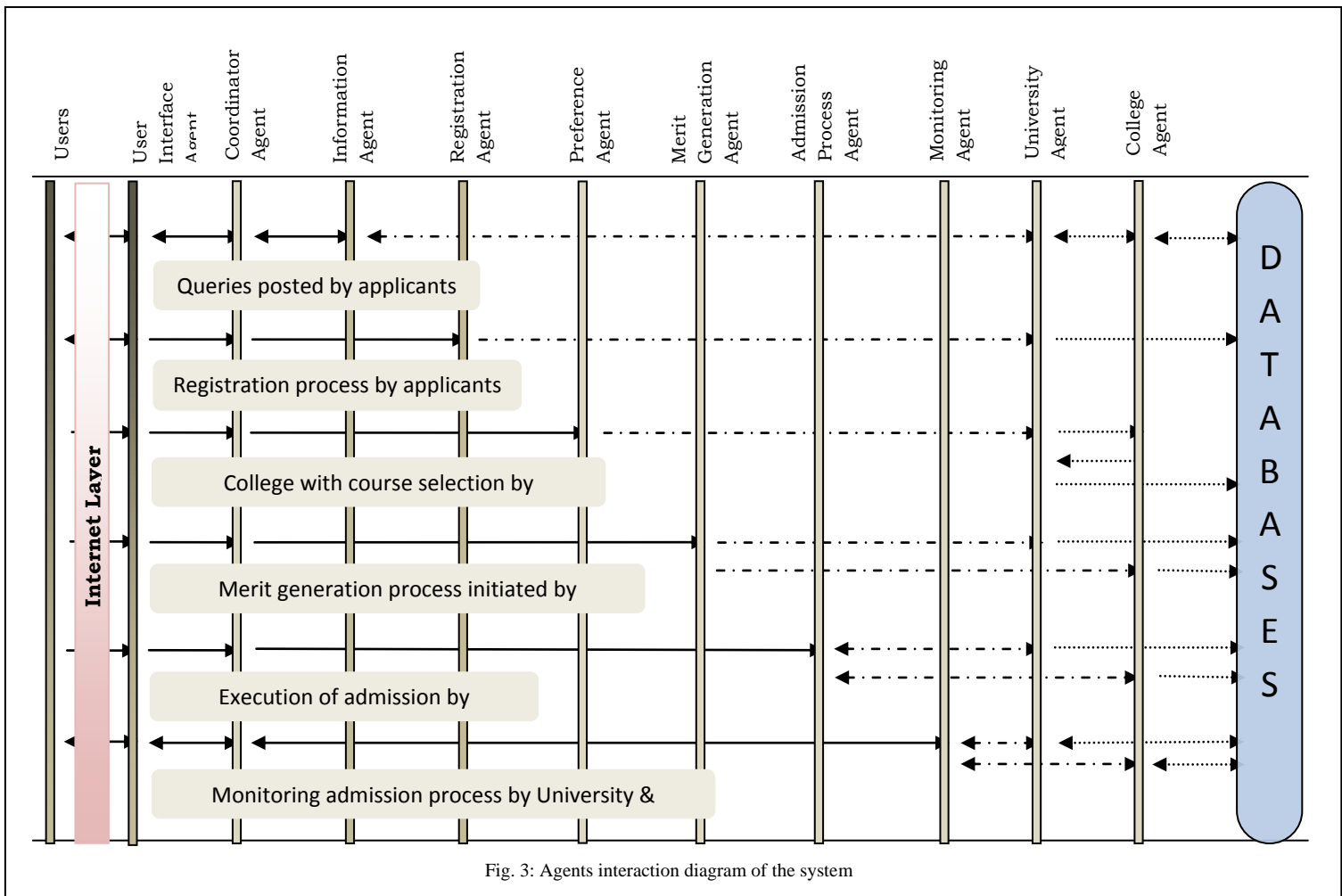

Fig. 3: Agents interaction diagram of the system

Keeping in mind the above features of agents, JADE has the features to support the development of multi-agent system such as agent life-cycle, agent mobility, agent security, white & yellow-page services, peer-to-peer message transportation, scheduling of multiple agent tasks and a set of graphical tools to support monitoring, logging, and debugging. JADE platform has a container known as Main Container, which is the starting container, has the responsibility to coordinates the activities of all other containers created during run-time, after their registrations with the main. Agents, which reside across the network, are controlled by these containers and are all Java processes running in run-time environment [9-10].

VII. CONCLUSION

This paper has proposed multi-agent based architecture for Online Admission System for affiliated institutions under Higher Education system. This online admission system is a major reform initiative in education sector to bring about greater transparency, efficiency and accountability in complicated and time-consuming admission process.

This alternative approach can eradicate several lacuna of the traditional system in this domain in respect to performance, reach-ability, reliability, accuracy and transparency. This framework encompasses every institution under the university to accomplish the admission process where potential student community is involved. Distribution of tasks among the agents which are autonomous, communicable among them and conveniently pluggable to existing system can make this complex system more robust and compactable to future technical expansion. Multi-Agent technology covers wide areas of different domains such e-learning, healthcare, e-commerce, financial management, etc. to name a few. This system can further be upgraded with features as applicable in future and to implement the same.

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