Framework for Smart Agent-based Mobile Multimedia Applications

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Abstract

The mobile multimedia enabled a lot of applications, which includes E-healthcare, distributed data right management, ICT, and mobile TV. Thus the need for an open architecture to handle all these types of multimedia in mobile environment is necessity. In this paper we will present a framework for smart multimedia mobile applications based on agents. The purpose of this framework is to assist mobile multimedia applications to run seamlessly, smartly and to adapt it-self based on various changeable environment variables such as location, context, device and network parameters. The framework consists of several components such as Mobile multimedia application, Multimedia service proxy, Multimedia service provider, Broker, Multimedia server and User profile to achieve framework target.

Keywords: *Mobile Application, Multimedia, Multimedia Service, Distributed Framework.*

1. Introduction

Currently, Mobile Multimedia Systems allow a high number of multimedia elements to be reachable anywhere and anytime by using a various types of handheld devices, also characterized from limited computational and storage resources [1]. In addition, users have to continuously deal with a great amount of information covering a number of areas and contexts such as text, audio, images and video. The continuous growth of information and communication technologies combined with user preferences, mean a significant modification of mobile multimedia usage trends. The new power saver and low-cost computational devices, user-friendly mobile interfaces and mobile network infrastructures heavily contributed to a wide dissemination of Multimedia data to create the so-called Mobile Multimedia.

In mobile networks, entities need to communicate with each other using real-time media such as text, audio, images and video by mobile multimedia system that can integrate various real-time and discrete media data. Multimedia Service system for mobile applications and users not only incorporate various multimedia information distributed over networks but also provides it to users in accordance with the mobile user's requirements and device profile in real-time. These conditions must be met even though the mobile and network resources change statically or dynamically.

Previously, to deliver the multimedia with proper format and according to the user and device preferences implies that a user has to personally search over the Internet spending a lot of time;

moreover, manual searching on mobile devices is generally ineffective [2].

Therefore, we have proposed a Mobile Multimedia System based on Agent (MMSA) that is able to deliver required multimedia based on many requirements, such as location, language, handheld device profile, and user's extra specs. In addition, the system is able to organize various multimedia services dynamically. The MMSA is mobile agent based system; therefore the system will be able to organize itself dynamically. The proposed framework is based on agent-oriented architecture. The system is able to organize required functions by itself, provide both real-time and stored multimedia information services simultaneously to mobile users even though various user's multimedia environment and the resource utility of mobile or networks has been dynamically changed. The changes are happening in many aspects including location, current used language, operator (roaming services), time zone, and etc. This paper describes the architecture for multimedia services for mobile user using smart agent to discover the needed services based on the current requirements, then perform any needed actions using distributed agents and finally deliver the multimedia to the user.

Researchers in [3] design architecture to mobile multimedia services. Their architecture was focused on protocol level mainly. They were interested in the networking aspects and interfaces and they discard the user preference and their distributed computing does not include any intelligence. The work in [4] focus on allowing mobile content sharing scenario in which a networked device can discover neighboring devices and share multimedia content in a convenient, networked manner. In short, they propose user-provided multimedia content distribution architecture for a mobile and ubiquitous network environment. Although their proposed architecture integrates several specific mechanisms including device discovery, asynchronous content delivery, secure access control, and virtual file system, still the proposed architecture lacks many user and device oriented considerations. In addition, they don't consider a lot about distribute computing.

This research in [5] consider an open architecture for mobile multimedia service, where their goal was to find a way to access IMS services for non-IMS devices, especially for the mobile phone devices. They try to make a browser-based IMS System Architecture for the non-IMS devices to access IMS services. They have managed to proposed several technical solutions to the problems in security, provisioning, identity management, inter- working, and device management. This architecture has missed the multimedia services, which is in some sense concern the users more. Beside the service issue, the architecture does not benefit from the available distributed resources. The work in [6] uses distributed data right management (DRM) for secure digital content distribution it is only dedicated for digital right management. The research in [7] describes an architecture that supports the development of interactive, multimedia, personalized applications, providing an extra level of service to the users. This research has taken benefit from the user needs but on small scale given that they have not benefit from both distribute computing resources and machine intelligence when dealing with user multimedia requests.

2. Framework

The framework will help the multimedia mobile application to present its content based on the user preferences without the need for the user to specify these preferences ever time (s)he uses

the application, furthermore the framework will provide a set agents to smartly adapt the multimedia content based on user preferences in case the original service provider does not support the user preferences (e.g. video format or language settings). The framework will provide a set of algorithms to help the application to determine how the content should be presented to the user. Another set of algorithms will be provided to help the service provider to adapt the content based on the user preferences. The framework will use a various parameters to help in content search and adaptation, parameters such as current location, context, device spec, localized and personalized user settings. All these information and settings will be kept in a user profile which will be dynamically updated by the mobile application and the framework, one of the main benefits of using such profile is to reduce the amount of data sent by the application with every request, hence speed up the response time of the application. The framework will take advantage of the state of the art technologies such as HTML 5, and web 3 in order to provide the best support to users and applications. Figure 1 shows a general overview of the proposed framework.

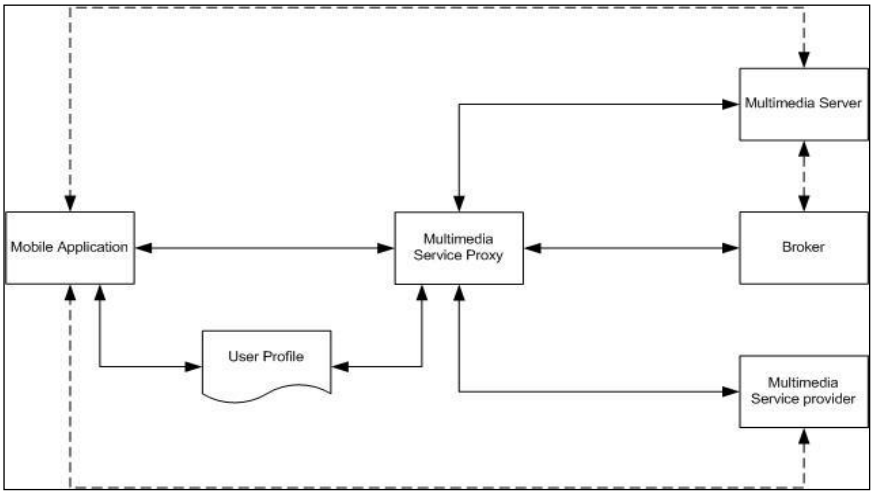

Figure 1:System Overview

Figure 1 present the main component of the proposed framework and a rough description of the interaction between the components. In the following sections each of these components will be described in details from a design point of view.

2.1 System components

- **Mobile multimedia application (MA)** – a software application for mobile devices which designed to handle multimedia context services, e.g. TV or radio broadcast, image viewer, etc.
- **Multimedia service proxy (MSP)** – is the core component in our proposed system, it will be receiving request form mobile application
- **Multimedia service provider (provider)** – the service provider of the desired multimedia context, e.g. new service provider, TV, radio, etc.
- **Broker** – the broker provides set agents to be used adapt the services based on the customer profile, e.g. translation agent, transcending agent, etc.

- **Multimedia server (MS)** – this multimedia server will be used to catch adapted service.
- **User profile (profile)** – the user profile contains all relevant information about the user, device, multimedia content and application.

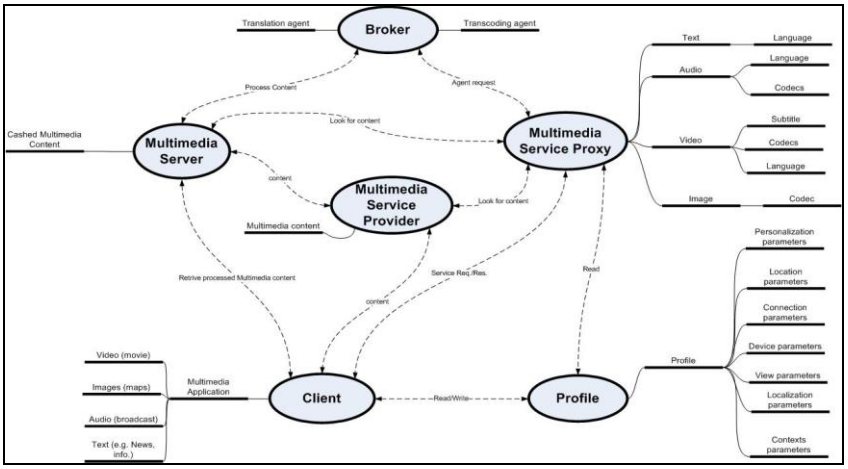

Figure 2 : Detailed Data Flow Diagram

In the following sections exact details on the framework combined with detailed dataflow diagram figure 2. In this figure, reader may refer to the data and commands flow among the system components. In addition an extend description for each system component will be provided.

2.2 Mobile application

Multimedia application will be installed on the mobile device which is the entry point to system. An application will first form a request then it will send it to the multimedia service proxy. The proxy will then analyze and handle the request then it will send a response to the application. The application will then analyze the response and then view the result to the user. Figure 3 shows the mechanism behind the application workflow.

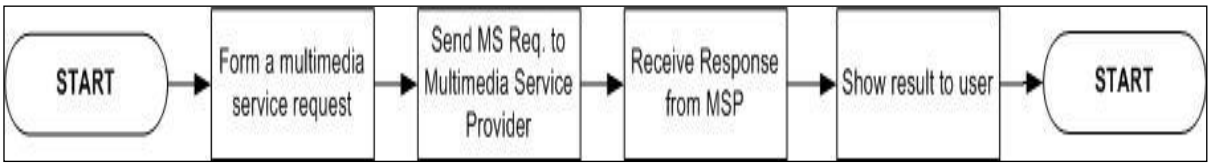

Figure 3 : Multimedia Application Algorithm

As shown in Figure 3 the algorithm stated at the mobile application is very simple, the application only needs to form a request and forward it to the MSP. The application will benefit from algorithms provided by the MSP in order to analyze users request and inquiry, using the proposed framework the application developer does not need to worry about location awareness or context awareness, instead s(he) can direct his focus on the main purpose of the application, furthermore by shifting these operation the MSP the application will become lighter, hence

reduce the resource needed by application on mobile device which is very limited even with advancement of mobile hardware technologies, as the mobile hardware get more advanced mobile software get more complicated and require more resources.

2.3 Multimedia services proxy

Multimedia services proxy (MSP) is the core of in the system. Mobile application will send request to MSP, which then will query the service from the multimedia service provider (SP). Figure 3 describe the algorithm behind the MSP.

The role of the MSP is mainly analysis, negotiation, management and analysis, the MSP will not do any actual adaptation or store content by it-self. First, analyze the request coming from the application and decide the best way to serve them, it also will try to negotiate with service provider in order to find the requested content based on user profile, if the service provider fail to help the MSP will then negotiate with broker to find the proper agent for content adaptation. The MSP will keep history of all request and responses in order to speed up response time. It will take advantage of this history to serve other application with similar user profile and of course it will keep updating user profile as environment parameter changes, so next request will be handled much intelligently and in speedy matter. It will also manage organize the MS policies in order to optimize its performance, for example the policy of how long a content shall be kept on the MS will be decided by the MSP based on received requests. As describe before, the MSP acting as the brain for the whole framework and all the heavy lifting is distributed among the other parts of the system in balanced way, and best of all is that all these operations are done in seamless way so not the application nor the user are interrupted.

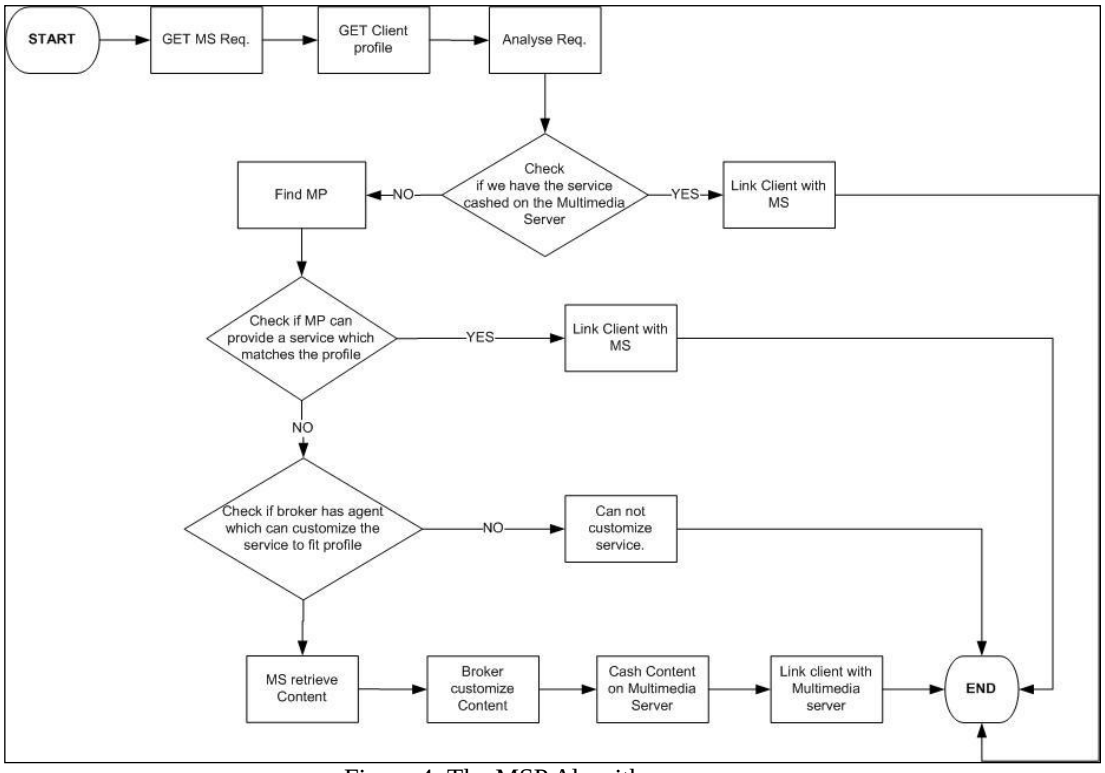

Figure 4: The MSP Algorithm

2.4 Multimedia server

In case the service provider could not provide the content with same specification as requested by the user profile (language, or video format, etc.), the MSP will download the original content to Multimedia server (MS), and then it will ask the broker to use once its agents to adjust to content in order to match the specified requirement, then the mobile application will be directed to use the content stored on the MS. The MS will cash the content for longer time, in case the same content with same specification is requested again.

2.5 Broker and Agents

Agents are autonomous modules which can analyze a given situation, make response depending upon the current status and specifications of the environment using its knowledge base and also it may have machine learning capabilities to react for new requirement. Agent features are included in the following graph:

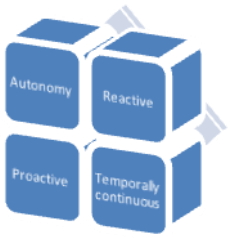

Figure 5 : Agent Feature

Other important and optional agent features are mobility and ability to learn [8, 9]. The agents can move around in a heterogeneous network such as mobile networks to accomplish various tasks assigned to them.

The mobile agent code should be independent of the platform so that it can execute at any remote platform in a heterogeneous network [10, 11]. Given all these features we can brief the agent's advantages into the following:

- Agents may increase system robustness in environments where communication between agents and their controllers may be difficult.
- Agent systems are inherently modular by nature and therefore improve system maintainability.
- Agent systems may take advantage of distributed computing resources which is the case in mobile multimedia system.

The broker will be responsible on providing the agents of which will be used to adapt the multimedia content based on the specified user profile (e.g. video transcoding agent, or a translation agent, etc.). After the content is being downloaded to MS, the broker will be given a link to that content with a specific adaptation request, the broker then will use its agent to convert the content according to the attached request, afterword the broker will inform the MSP of the result and provide it with a link of the new converted content so the MSP and can respond to the mobile application.

2.6 Profile and User Profile

To support users in multimedia requests, our system considers the effects of the exploited devices where each device is provided with a profile. To achieve better results, the Multimedia services system requires having knowledge about users' characteristics (i.e., their behaviors, interests and preferences) and context information (i.e., location, environmental conditions and device characteristics).

The key part in our system is to interact with potential users for providing them with personalized multimedia that meet their desires, interests and behaviors. Constructing, maintain and exploit a profile (usually built using data derived from different sources) is another challenge for our system to do. By comparing the user's profile with the available multimedia it is possible to select the most suitable agent to perform any needed task to customize it to be in a suitable form for that user. As consequence, these systems can be considered adaptive with respect to the user. Obviously, the more representative and comprehensive the user's profile is (representing location, behaviors, device capabilities, etc) the closer to the user's interests and preferences the selected multimedia will be.

The second problem is represented by accessing and handling multimedia exploiting different devices (such as notebooks, cell phones, PDAs and so on), where each device is characterized by different physique and technological characteristics (such as display or bandwidth capabilities).

Hence, user shows different trends in presence of different devices (e.g., limiting multimedia requests over cell phones). This way, the exploited device affects the user's behavior with respect to both media attributes and content of multimedia.

Results and Future work

In order to verify the system objective, we have set up two tests. The first one is subjective and another is objective. In the subjective tests we have distributed the system after deploying it on a group of 100 persons. This group consists of several age categories and educational backgrounds. There were given a questioner after 10 days of using our system to check the objectives. We use J2ME platform for developing our system and Nokia N-Series for testing.

The question includes the following questions:

1-Rate the system user friendly from 1 to 5 being 5 is the great and one is not user friend at all

2- Rate the system convenient from 1 to 5 being 5 is so convenient and one I cannot handle it at all.

3- Will be using this system in the future if you can have? it yes or no.

The result came as in the following figure 1. As one can see many end user this the system is convenient and user friendly. Moreover, 87 percent of users prefer to have the system installed on their handset.

Secondly the objective test includes run time test and memory test. We gave the user some tasks to perform iteratively using a typical method without the use of our system. Then few days later we gave the same user the same tasks using our system. The result was impressive as user save 80% to 90% percent of their time in all the cases while using our system. Another test was held on comparing the Memory usage with and with our system. A comparative analysis found that

using our system increase the RAM usage and spare the IO system call with 80-85% in most cases. This is justified and expected results according to the smart usage of secondary storage and the elimination of unnecessary hits for pre-stored data.

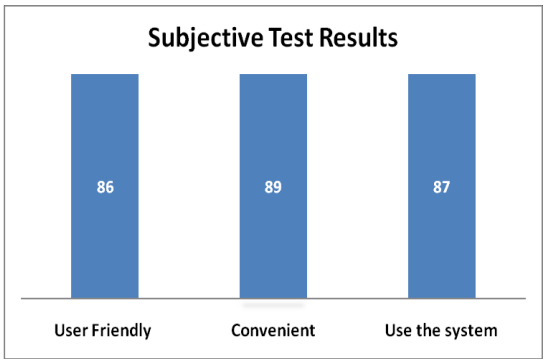

Figure 6: Result Graph for the Subjective Test

We may conclude that our system achieve a set of goals, these are;

1- Saves the end – user's time and effort.
2- Effectively utilizes the mobile phone's resources, by making decisions, based on the user's behaviour.
3- Portability; the user can use the system whenever wherever he/she likes.
4- User friendly; the system has improved the users experiences through most of the tasks.
5- Convenience: the system is convenient to the user as proven by results.

Our future work will be focused mainly on Quality of service (QoS), which is a important issue in multimedia service systems. Naturally, QoS helps in telling how valuable the services provided by a multimedia system are. Regularly, QoS is established through negotiation between users and multimedia service providers. The negotiation involves allocation and management of resources and services in order to gain a certain level of quality. The process of negotiation is straightforward if the services or resources are managed by a single entity or by a set of entities supporting a common negotiation protocol [12]. Regrettably, in mobile multimedia systems, negotiation and management of resources are complex tasks since resources and services provider are scattered, distributed and managed by autonomous entities. In order to minimize such difficulties, an agent-based module for QoS negotiation and management in mobile multimedia systems will be proposed|.

Conclusion

In this paper a framework for smart multimedia mobile applications has been presented. The purpose of this framework is to assist mobile multimedia applications to run seamlessly and smartly and to adapt it-self based on various changeable environment variables such as location, context, device and network parameters. The framework has been built on top of agent technology to gain both distribute computing resources and the AI extracted from the knowledge base stored in the scattered agents. This framework will save the user time bring him usage convince. It will make vast amount of mobile multimedia application possible.

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