UML to Develop Mobile Cloud Applications

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Abstract*: Since mobile computing is blending well with cloud services, a new type of application called Mobile Cloud Applications (MCAs) has become available and it needs to be designed carefully to take care of scalability problems, security and platform variety. Unified Modeling Language (UML) is a standardized tool used to design a visual system architecture, behavior and interaction models, and thus an effective model when creating MCAs. The present paper investigates the question of how UML can be used during the development lifecycle of MCAs to promote communication between stakeholders, provide systematic design as well as help identify design flaws before they are instantiated in the system. Developers can use the UML diagrams, including use case, class, sequence, and deployment diagrams, in order to model both mobile front-end and the cloud-based back-ended components, which makes the applications more robust, maintainable and interoperable.*

Keywords*: Cloud computing, Mobile applications, Android mobile platform, Software modelling, Unified modeling language*

I. Introduction

The Mobile Cloud Applications (MCAs) benefit of using the benefits of cloud computing applied to mobile devices to deliver resources efficient as well as scalable consumer-facing services anytime and anywhere. Nevertheless, the production of MCAs requires some challenging issues, including heterogeneous platforms, distributed architecture, and dynamic user requirements. The design strategy should be systematic and standardised to overcome these hurdles. The Unified Modelling Language (UML) offers a powerful solution that contains a set of graphical modelling tools, used in visualising, defining, building and documentation of artefacts of software systems. UML supports the object-oriented design and enables developers, stakeholders and system architects to talk to one another. It is ensuring an integrated and comprehensive architecture of the system through the prism of being able to simulate not only the server-side cloud infrastructure but also the client-side mobile elements. This paper covers the utilization of UML on the MCA development life cycle and how it can lead to stability and maintenance of the system in the complex situations of mobile-cloud, development time reduction, and clarification of design.

II. Proposed Approach

The proposed approach consists of a systematic way of developing Mobile Cloud Applications (MCAs) with the help of Unified Modelling Language (UML). It has a model-driven technique to the collection of requirements through to the deployment, which involves the use of UML diagrams in all stages of the application development life-cycle. At the beginning of the process, use case diagrams are employed to describe the functioning of the system and document interactions by the users. Next activity diagrams which depict business logic and/or workflows. The structural aspects are then modelled as the data models and connections between objects using the class diagrams, which extends both sides of the cloud server and the mobile client. With sequence diagrams, you can get a clear snapshot of the contact between mobile devices, access cloud services, and third-party APIs. Component and Deployment Diagrams are created to demonstrate the infrastructure like the network connectivity, mobile platforms etc. and the cloud service layers to manage the system distribution and deployment. The approach ensures both functional and non-functional needs are met through facilitating the reusability, consistency, and the platform independence. By employing UML as a blueprint early in the development process the developers are able to reduce the number of errors, optimise resource usage and identify potential bottlenecks. The technique allows expanding,

secure, and maintainable MCA solutions and is designed to accommodate a variety of needs. This is done by facilitating superior teamwork.

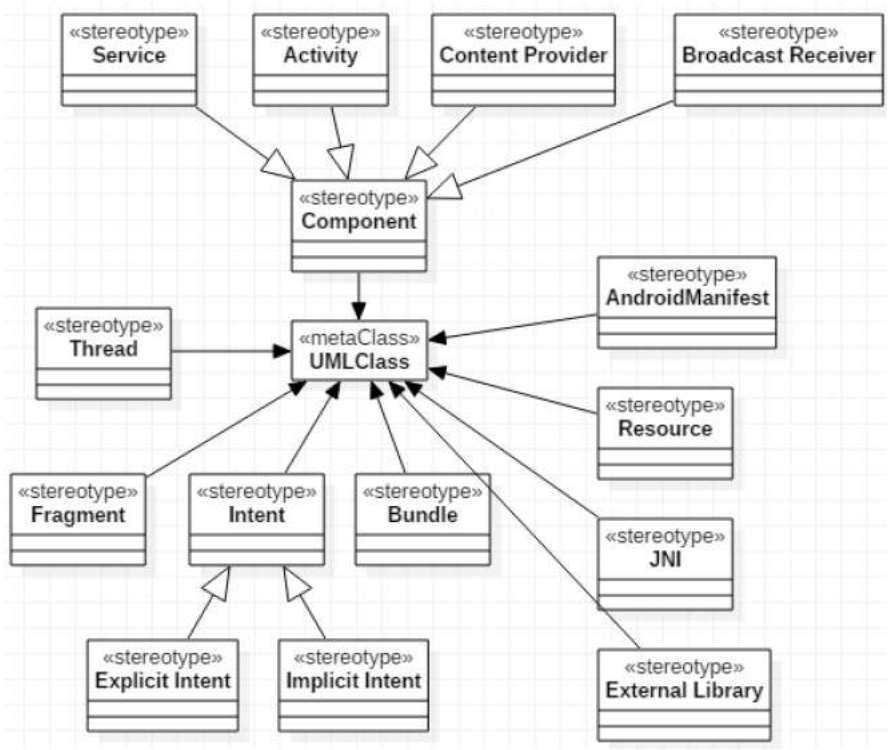

Fig 1: UML Profile Diagram

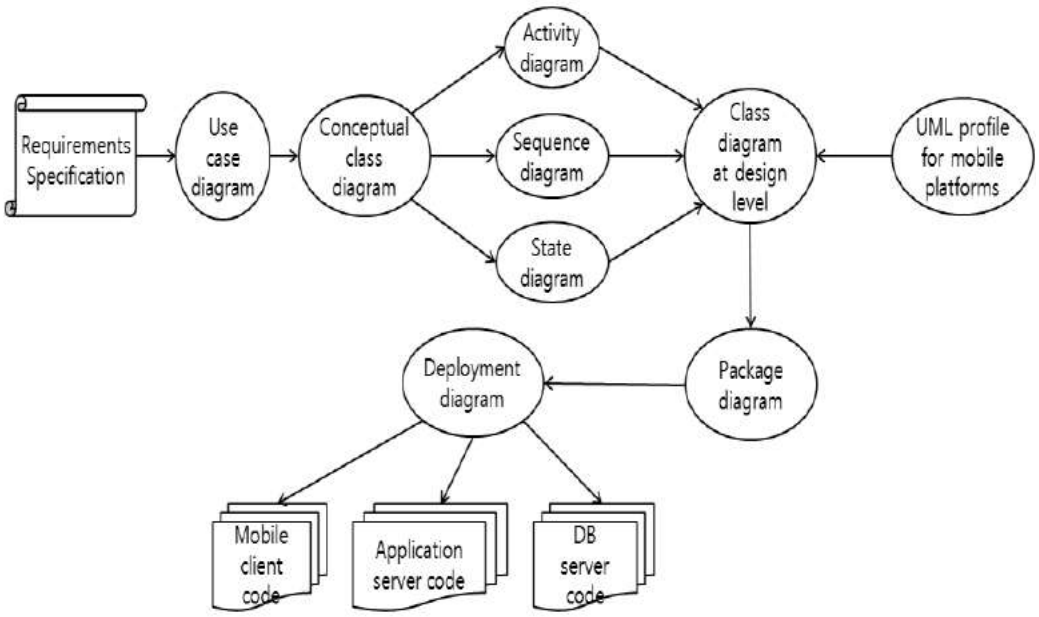

Fig 2: Mobile cloud applications

III. Case Study

This case study illustrates the application of UML with regard to its planning and development of a remote patient healthcare monitoring cloud-based mobile application. This was to allow individuals to manage their health on the move on mobile devices connected to cloud-based services and provide doctors with real-time access to patient information. Use case diagrams were employed at the inception point in the development with the aim of identifying the key stakeholders i.e. the patients, physicians, and administrators who would meet with the system and use it to make appointments, upload medical information and avail reports. Activity diagrams helped to elucidate the logic of work and modelling of such processes as having a report produced or having patients registered.

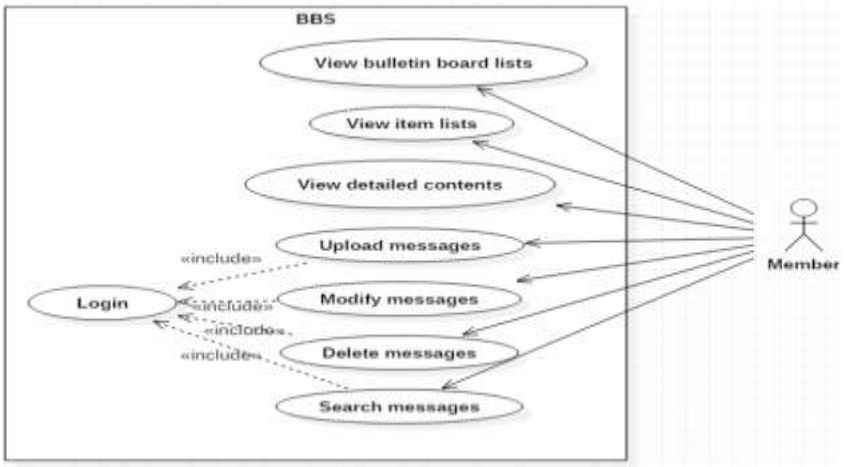

Fig 3: BBS android application

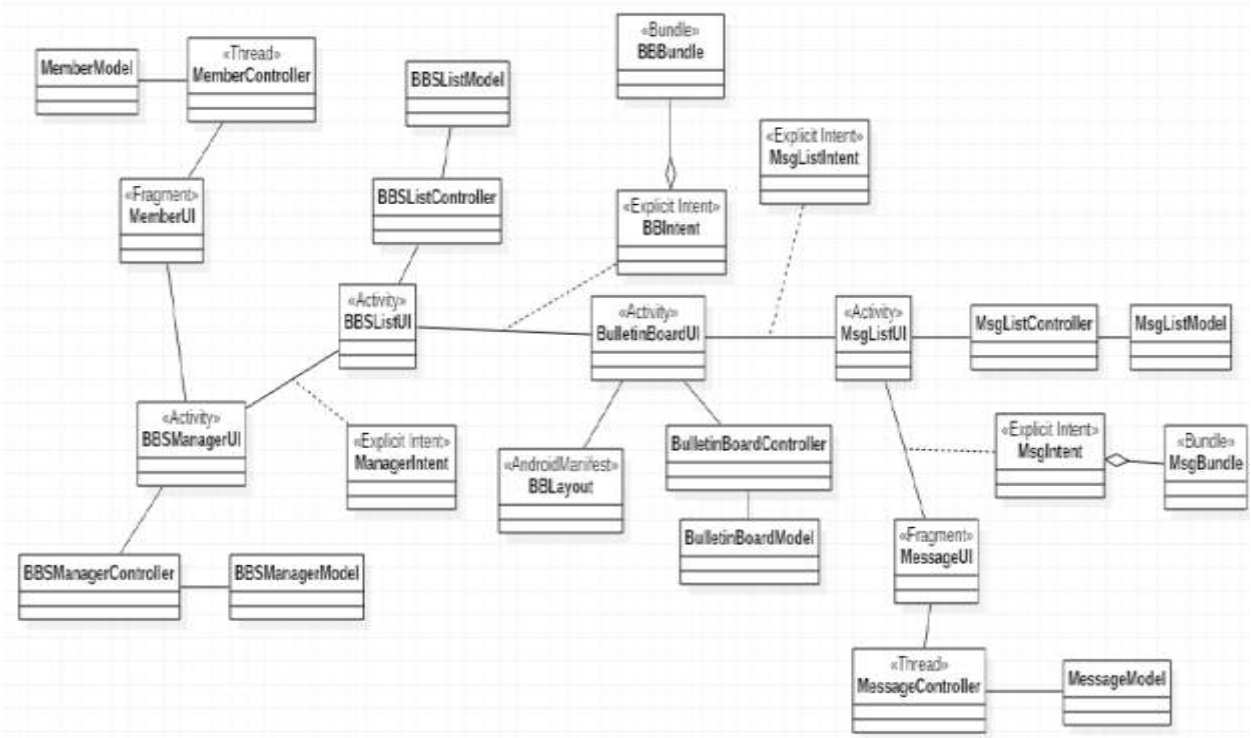

Fig 4: Stereo types for android application

To develop the clear picture of object structure which might be applied both to the mobile and cloud environments, different components (patient, doctor, health record and appointment) were recognized as important through class diagrams. Sequence diagrams were used to model an interaction such as where a patient issues a health report and the cloud server can process it and notify the physician. These schematics prioritised component dependencies and time of communication. Implementation To be able to visualise spread of the system, mobile clients, cloud infrastructure, APIs like cloud and storage, Tokens like cloud storage and authentication services and the like, diagrams were necessary. This helped in the determination of the impact of latency and network requirements planning.

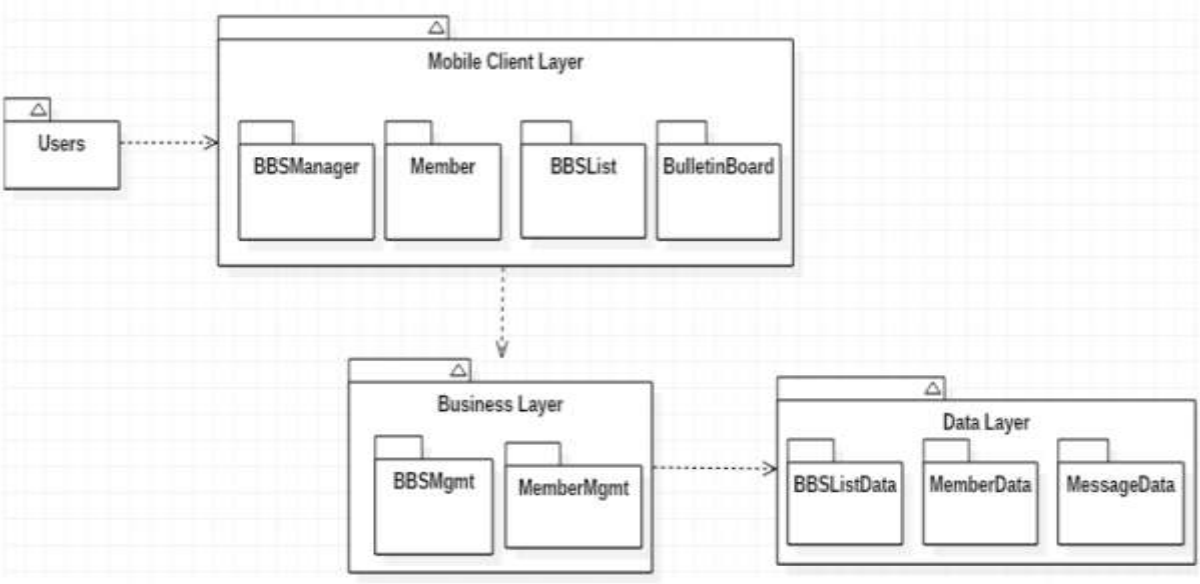

Fig 5: BBS package diagram

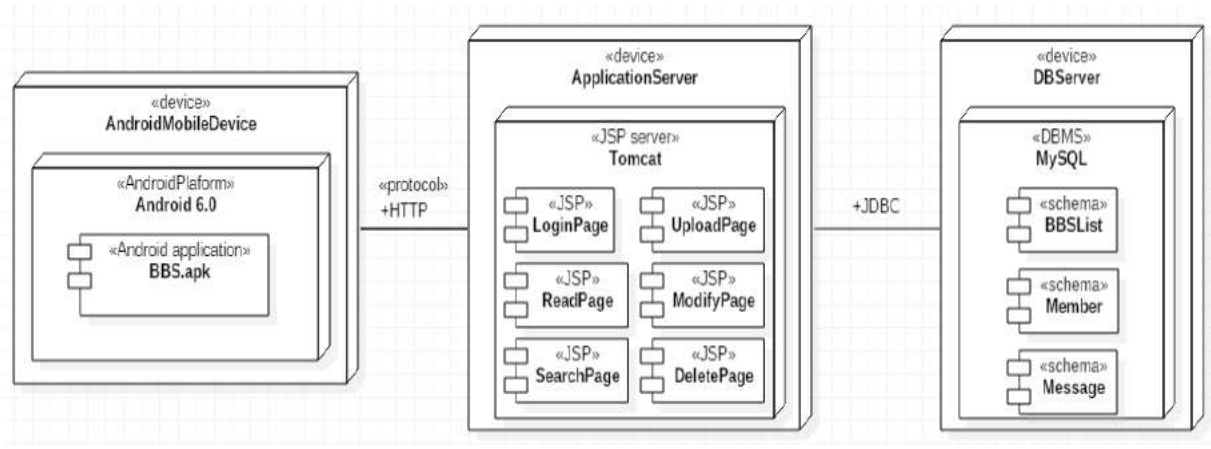

Fig 6: BBS deployment diagram

UML was used by the development team to come up with a system that can be scaled up, maintained and well documented. The validation of the design early in the process reduced the number of errors and increased the collaboration between the stakeholders, developers, and medical expertise. This case study demonstrates that UML can significantly enhance the process of communicating, design and architecting a complex application on a mobile cloud [3].

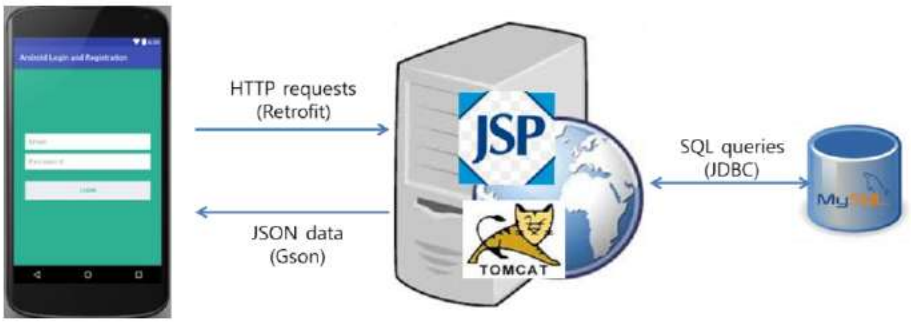

Fig 7: System architecture for cloud computing

IV. Related Work

The application of UML as part of the process of creating Mobile Cloud Applications (MCAs) has been the subject of many studies that stress the positive effect of using UML to simulate highly complex, decentralised systems. Since mobile devices and cloud services are heterogeneous, researchers have raised the fact that UML provides a platform-free way of modeling both functional and non functional details of MCAs [4-6]. To narrow the gap between requirements and implementation, the previous work demonstrated how one can describe user interactions and system behaviours with Use Case and Sequence Diagrams. Some scholars have resorted to the use of class and component diagrams to explicitly outline modular formative structures of cloud and mobile parts with a view to promoting maintainability as well as reuse of code. Certain approaches use less development effort involving the use of UML and Model-Driven Architecture (MDA) to automatically generate executable code out of UML models. The high security, availability and real-time MCAs deployed in the e-learning and health sector have been designed successfully using the UML. Nevertheless, in available literature, comprehensive solutions, which address the entire MCAs lifetime, are often lacking. Most of them just focus on specific areas or partial modelling. This underlines the need of an integrated, systematic methodology that can facilitate the process of designing, developing and deploying MCAs in a broader set of applications through the use of UML.

V. Conclusion

The importance of UML to develop mobile cloud applications is that it offers a systematic and visible approach in the management of the complexity of distributed systems that exists within mobile and cloud computations. UML diagrams enhance the quality and maintainability of the application through a better communication process, proper system modelling and early identification of design problems. Developers can ensure that these essential guidelines of consistency, scalability, and efficiency are consistent throughout the development lifecycle which involves use cases, system design, processes as well as deployment of UML. Besides promoting a better collaboration among stakeholders, the strategy will be used to address critical concerns such as management of resources, diversity of the platforms, and security. The development of mobile cloud applications has not made UML an unfruitful model in developing reliable, user-centric and future-proof software [3-6].

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