An Insight on Context-Aware Mobile Application Execution in Mobile Cloud IoT (MCIoT)

L. Shakkeera, Y. Sharmasth Vali, and Santosh Karthikeyan Viswanathan

Abstract The present-day significance of mobile cloud and Internet of things (IoT) in the evolving digital world, MCIoT framework affords the flexibility service for IoT-based mobile applications and also bids highly scalable service to the storage and computing of large streaming data. Owing to the several mobile devices, high mobility, change in network overlay and bandwidth, conserving the seamless connection is the challenging tasks in MCIoT environment, resulting in higher handover delay. To overcome the above constraints, this paper discusses the perceptive with context-aware mobile application execution that effectually provides the service guarantee, improving the user's experience, enhancing processing capability by reducing interaction delay. In future, MCIoT possibly can enable the mobile users to openly access the applications in the mobile cloud through SaaS provisioning rather than installing the applications on the mobile devices. Finally, MCIoT dominates the mobile industry due to its significant factor and context-aware seamless mobile application execution.

Keywords Context-aware execution · Mobile cloud computing · Mobile networking · Service accessibility · MCIoT

1 Introduction

The client–server models were used as traditional method which is very successful for using the mobile devices and for also holding the resources in the cloud. Onloading and offloading work during server runtime is more beneficial. Offloading may also bring security threats. Many Web or cloud apps can slower the execution process in mobile devices. So online cloud services are introduced to process and

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access seamless application execution. For cloud providers and network operators, it provides huge career opportunities. It also has a rich computational technology that supports unique versatile resource of different clouds and network technology. It also serves a host for devices anytime, anywhere by using the medium called Internet in diverse environment and all platforms. State-of-the-art application for mobile phones and cloud are major services in today's market, and also we suspect that possible services are yet to be explored.

MCC frameworks [1, 2] are mainly modeled for energy-efficiency mobile applications and mobile-based IoT application execution in smartphones. The framework was developed based on task scheduling, resource allocation, optimization, and adaptive workflow management approaches with the limitations of context-aware mobile application execution based on mobile networking concepts. To overcome the above-mentioned constraints, this paper gives insights on context-aware mobile application execution in MCIoT environment by reducing congestion rate, and eliminating handover delay during service accessibility from remote cloud server. For IoT-based applications, the application structuring depends on dynamic analysis of request characteristics, diverse nature of workflow, resource availability, device characteristics, and task dependency at a runtime environment.

1.1 Mobile Computing

Mobile computing which permits for transmission of data, voice, and video. Mobile computing mainly comprises of three strategies: mobile hardware; mobile software; and mobile communication. The mobile communication includes protocols, data formats, network properties, and communication technologies. Mobile hardware embraces mobile devices (smartphones) or device components. Mobile software compacts requirements and characteristics of mobile applications. The main principles of mobile computing are: portability; connectivity; interactivity; and individuality. The furthermost communal forms of mobile computing devices are: smartphones; wearable computer; tablets, etc. The important limitations such as transmission interferences, power consumption; energy efficiency; human-device interface; communication range and bandwidth; expandability; and security standards. Mobile computing uses mobile/wireless data connections, it uses technologies like GSM, GPRS, 3G or 4G networks.

1.2 Mobile Cloud Computing

Mobile cloud computing (MCC) [3] is a set of cloud computing and mobile computing technology which is combined for rich computational resources for a mobile user as well as network operators and to cloud service providers. The major goal of a mobile cloud is enabling an execution process of applications in mobile

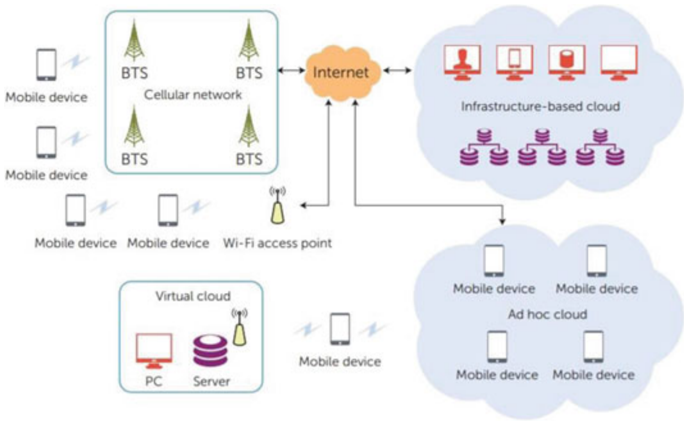

Fig. 1 Mobile cloud architecture with infrastructure-based cloud, virtual cloud, and ad hoc cloud [5]

devices and remote cloud server, in which user can also have a rich experience. The vogue of mobile device and mobile networks has significantly changed the way of people to access network services and computers. The main merits of MCC such as battery lifetime can be extended [4], improvement in processing power and data storage capacity, dynamic provisioning, improving reliability and scalability, multi-tenancy, and ease of integration. The advantages of MCC are directly linked with the present mobile computing and cloud computing and accessing mobile applications. The applications are categorized as image processing, multimedia such as audio and video streaming, sensor-based data application in IoT entities, crowd computing, online gaming, and text processing. Figure 1 [5] shows mobile cloud architecture with infrastructure-based cloud, virtual cloud, and ad hoc cloud-based on which mobile devices computation offloading.

Technological Challenges of MCC. MCC has several advantages for mobile users and cloud service providers, but by combining various fields, which comprises of cloud computing, mobile computing, mobile networks, and mobile communication, MCC necessities to address several technological challenges. The challenges include resource scarcity in mobile devices (smartphones), network bandwidth, latency, network availability, computation offloading, heterogeneity, data access efficiency, ownership on data, elastic application models, and finally security and privacy for mobile applications. These issues focused in many of the MCC research studies that directly connected to cloud computing and mobile communication.

1.3 MCIoT

The mobile cloud IoT is rising in many Internet applications [6]. IoT equipment from vehicles to smartphones which can be used as day to day life. The generation of used amount of data selection and distribution of IoT devices is necessary to achieve accurate results and efficient way of working the application system is therefore important. Data collections are located from outside the devices using cloud computing with mobile cloud IoT which reduces the pressure on the mobile devices in terms of energy efficiency. Wireless cloud connection is also needed for mobile application. The combination of mobile computing includes telephones, devices, and how they wirelessly connect with other devices. The MCIoT needs to support the services while processing several dynamic mobile applications such as video streaming, financial transaction, health care, and online gaming rely on the instant response to the lively variation.

1.4 Contributions

Context-aware remote execution is the progression of examining the mobile application based on the device constraints to achieve dynamic and seamless execution of an application on a mobile device and a remote server even in the increase of congestion rate in mobile networks. The main overview and contributions of this paper discusses context-aware mobile application execution in MCIoT, the process of mobile application execution in cloud server, service accessibility using mobile devices in MCC communication, the process of context-aware healthcare service system, and IoT-based remote application execution.

2 Related Research Works

The related research works in this section describe the concepts and methodologies of context-aware mobile application execution, context-aware energy-efficient communication, context-aware strategy for IoT-cloud services, energy-efficient approach for application execution in mobile cloud IoT environment, and context-aware mobile application recommendation in remote cloud server.

Abusair et al. [7] "Context-aware adaptation of mobile applications driven by software quality and user satisfaction," this paper discusses context-aware approach. Which is mainly for the mobile applications that totally work on the quality of software as well as satisfaction of mobile users. Particularly, they focus on services that should be available at any time and to acquire a term that selects the optimal application adaptation that is to be implemented in a given context by incorporating a devised methodology which has the concept of product availability and user feedback.

Masango et al. [8], "Context-aware mobile application for mobile devices," this paper discusses android smart devices that offers smart lock capability which utilize various methods for authentication to unlock the device by user's location. Though android smart lock does not allow individual applications to lock. So they have come up with an application uses a context-aware approach as solution. This paper proposes a framework that offers multiple user authentication mechanisms which are set by the user to auto-detect areas identified as safe zones. This application focuses on improving the security level of a given device content by safeguarding the individual apps.

Aksanli et al. [8], "Context-aware and user-centric residential energy management," this paper describes hierarchical model for the concept of energy management in residents which is IoT-based, which involves a general functional framework to guide processing of data and reasoning. They extended this hierarchy to describe the power supply network to all individual households. This system collects additional data generated as user context from multiple devices and uses to determine flexibility to handle the energy by the user. Further, the paper demonstrates that consumers experience simulation provides 14% increase in forecast accuracy for electricity efficiency and 12% decrease in average grid energy costs.

Sen et al. [9], "Invited: Context-aware energy-efficient communication for IoT sensor nodes," the paper describes that wireless communication is a major energy consumption in this data-based IoT environment, so paying particular attention to differences of local area and remote area connectivity is crucial to total usage of energy. In changing contexts such as channel conditions and data-rate requirements, the communication connectors which will control this huge of IoT workload needed to be an energy efficient. In addition, IoT devices include several multiple parallel communication materials like proximity, wired, mm-wave, 5G, etc. The author discusses how self-learning facilitates context-aware activity in these communication systems that allow minimal energy data for every communication. Need for context-aware activity inside and within multiple physical layers would be stressed in upcoming IoT research challenges. Hence, these energy-efficient networking along with the low-power computing will harness the promise of the IoT system revolution and generate major impacts.

Sneps-Sneppe et al. [10], "On context-aware proxy in mobile cloud computing for emergency services," in this paper for emergency services, they define a new paradigm with 5G networks for the context-aware computation. They introduced a different mobile services model that effectively enhances 5G network power. The ultimate strength of 5G networks is always to allow applications that previously were not possible to use. They build a duplicate copy for mobile data sensing in their model and enable server-side processing to make efficient use of context information during processing. They are proposing a context-aware proxy centered on the proximity-related cloud-targeted applications and services.

Liang et al. [11], "A broad learning approach for context-aware mobile application recommendation," this paper discusses with tensor analysis. They suggest large learning approach for context-aware application recommendations. In particular, they use a tensor-based framework to incorporate new app category information and a multi-view features for users and apps to facilitate the performance of prediction ratings. The multilayered framework is used to capture the relationships between app categories and multi-view features that are hidden. They also create an effective factorization method that uses Tucker decomposition to realize the entire-order relationships between device's groups and functions.

Kumari et al. [12], "Energy efficient approach for application execution in mobile cloud IoT environment," states and explains that Internet of things (IoT) provides dynamic energy resource control and monitoring facilitating stakeholders to save more energy use at granular levels. A new technology called mobile cloud IoT (MCIoT) is being developed for the advancement of IoT technologies and the mobile cloud, which is the integration of both. The main objective of MCIoT is to provide appropriate resources for the application to allow it to execute the mobile application without any deficiencies. The SMDs battery life significantly increases when a device is partitioned complex component is on the cloud and the remainder is on the SMD. In this paper, they provided an empirical model in the MCIoT context to show the correct partitioning rate that affects the time and energy usage of SMD and cloud execution. Their experiments are conducted based on the different partition rate, processing power and also data size of an application. Furthermore, the influence of these parameters is evaluated on the residual energy of SMD.

3 Mobile Application Execution in Cloud Server

Online cloud services become increasingly popular through these years, and the user has to believe the cloud service provider with their personal data. The user's private information is kept as highly confidential. In android application, streaming of data is good and it is very much beneficial for the user to store the information. It is impossible for the user to monitor the data usage in users mobile devices. In recent years, Samsung Galaxy has been partner with Drop-box, while Microsoft similarly offers Microsoft One-drive. i-Cloud is cloud storage portal which is pre-loaded and designed for Apple iOS device. Most of the companies offer cloud storage with highly secured Web sites for access files and any device can also browse to the Internet. By using these cloud services, backing up process can be done easily in case of emergency. Figure 2 shows mobile application execution in cloud server environment. Based on user preferences and application requirements, the mobile applications are executed in mobile devices. Resource-intensive applications are offloaded into remote cloud server and cloud execution manager allocates computational and storage resources in the form virtual and physical resources. The mobile devices and cloud server process the data to and from between mobile and servers.

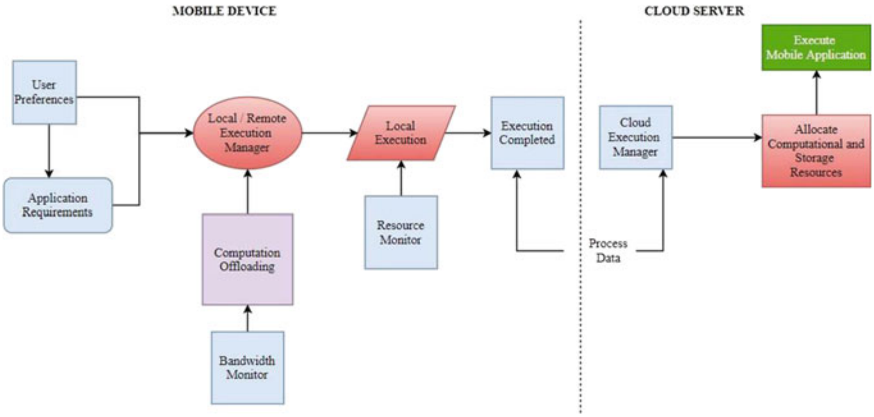

Fig. 2 Mobile application execution in cloud server

4 Mobile Networking in MCC

4.1 Mobile Networking in MCC Communication

For MCC and telecommunications services, wireless and mobile networks quickly become the most important type of network access. There have now been two different paths for the progress of the wireless network and the future generation of mobile networks in MCC. All of them are following the direction of mobile cellular networks with their worldwide long-standing infrastructure. Mobile communication is also one of the most sophisticated and challenging technologies for transmission. Wireless technologies are on the verge of being developed in their fourth generation. In the past, wireless access systems have taken different evolutionary paths for the same goals such as high mobile performance and capacity.

In a mobile technology generation, Universal Mobile Phone Service (UMPS) is a third system that offers code division multiple access wideband application. Universal Mobile Telecommunications System (UMTS) has greater flexibility, enhanced storage capacity, and much broader range of services with storage rates of up to 2 Mbps. Code division multiple access (CDMA) infrastructures is capable of delivering images, video messaging to location services, and also offers superior performance and distribution capability.

Mobile networks in the fourth generation are the advanced edition of Internet services in the third generation. The last generation of broadband services has high power, fast transmission data that enables uses to connect interactive digital services in high quality which includes telecommunication, 3D animation games, audio content, and facilities. Furthermore, 4G networks should offer portability of services and lower-cost scalability. It is based on the multiplexing of orthogonal frequency division with thousands of simultaneous channels available. The data transfer rates are scheduled in mobile mode in the range of 20–100 Mbps. This framework enables the fast and efficient convergence of various mobile networks that allows telephone, radio, and satellite communications to switch from indoor networks such as Wi-Fi and Bluetooth. Wireless networks always have changed topologies, mainly made up of wireless links with restricted bandwidth. It has wireless sender and receivers, with a network like a router.

4.2 Service Accessibility Using Mobile Devices

New levels of utilizability, performance, and computation power have been attained by mobile devices such as smartphones and personal digital assistant. More and more wireless communication and location technology are being added to these devices in a wireless phone like Subscriber Identity Module card. This module is also available for smartphones. After the mobile card is entered, network begins checking the validity of SIM card by verification process connecting to the center for authentication. Mobile phones and their size are portable the other performance metrics of mobile phones and new technologies make these phones smaller by weight and battery life. GSM systems are comparable to analog systems, and interference is weak singles that are related under unfavorable circumstances. GSM systems produce good quality under conditions that range from moderate to good speech quality in GSM systems.

There are several other technologies that can be grouped into two sections of radio transmission, one width frequency challenges and other with technology of transmission. For sending the information, radio devices do not work with radio equipment and cables. Intensity is the limitless resource that can be utilized efficiently. Three key issues need to be addressed in system design is technical effect on routers and sensors which includes propagation features such as ability to reflect and decrease the system. Any device connected to and running network of mobile devices, including pages and cellphone if commonly classified as a mobile network. However, there is a large number of valuable electronic information for mobile devices similar elements will be maintained by a network service provider using report and billing records, and the researches can capture mobile network traffic. It is also effective for people to analyze the fundamental concepts of network, types of data it can collected, and analyzed mobile network. Figure 3 depicts Service accessibility using mobile devices through mobile networking.

4.3 Issues in Mobile Networking Communication

In mobile networking, many of the techniques are identified in order to manage and obtain the data from mobile cloud environment. For example, obtaining geo-location data from mobile networks. It includes the components and evaluation of details and utility of textual and visual messages. Cellular services are also built

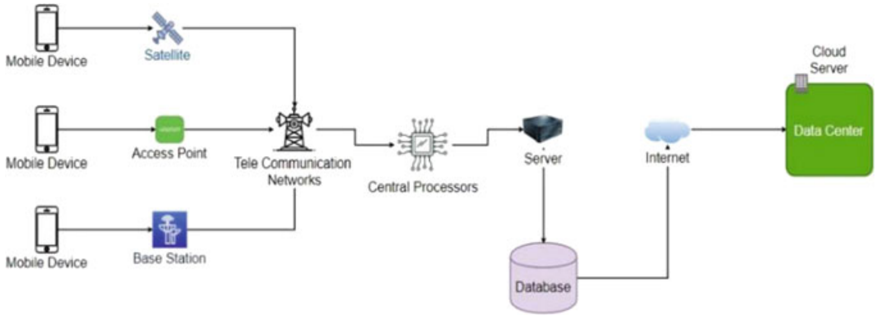

Fig. 3 Service accessibility using mobile devices through mobile networking

in network node environment and frequently implemented in areas with unsecured nodes, which provide less protection against attack. Many other strategies to safe guard client data privacy and their data confidentiality on cellular networks have been suggested. The dynamic movement of the network nodes is an another difficult issue in mobile networks. Different classification in membership location must be expected to deal with data integrity when client enters sub-net and enters the new sub-net.

Network congestion in mobile data networking [13] is an important issue that will reduce quality of service when network nodes carry more data that it can manage to handle. This effects network communication and leads to packet loss and canceling connections by using same mobile networks. Consequence of network congestion leads to increase the network load and decreases the throughput. Several network protocols are suggested to compensate packet loss and use destructive retransmission of packets. Federated architecture of management therefore suggested to encourage communication between mobile network entities.

5 Application Context-Aware Remote Execution

5.1 Context-Aware Application Execution

Context-aware derived from concept of pervasive computing which uses heterogeneous source to adapt and provide a service based on user needs. It offers new possibility in decreasing the necessity of user interaction instead of requiring the operator to choose the needed functionalities. The context-aware mobile application execution [14] provides the desired service automatically. Context-aware execution based on different types of parameter like location, identity, activity, and time. Based on this, there are three models are there for context- aware application execution: activity determination, process definition, and context elicitation.

Activity Determination: Context-aware execution is to identify the activities. Therefore, it may help to decide whether the contextual data could assist the users. They are represented using modeling language like UML. *Process Definition:* Based on the result of activity determination, the actions are categorized into two parts such as active execution and passive execution. This execution triggers the user a new process flow which changes the functionality. It also requires to define the changes in working procedures. The process definition ends in validating of preliminary results.

Context Elicitation: After defining context, it validates to ensure the following properties: uniqueness (each activity must be unique) and measurability (all the contextual data must be measurable). If any of this condition is violated, the execution will not operate in the intendant way. So it required new elements such as sensor, additional conceptual data ensuring the uniqueness and measurability of all contextual data.

Figure 4 depicts context-aware application execution with three difference model process. Following the activity determination, response and corresponding contextual are consider concurrently. If necessary, process adjustment is performed to change the requirements. After the adjustment, it is necessary for each newly created process flow to repeat a response and context definitions steps. Once the process definition is performed, then validate the preliminary results. During context elicitation, define and validate contexts. If system architecture adjustment is necessary based on contexts, then incorporate system architecture requirements otherwise end the activity which leads to execution model.

Context-aware computing system [15] provides few key issues like high dimensionality different format, missing data, repetitive data, and high dispersion due to large volume of data. This kind of issues leads to data inconsistency (detect to avoid error context analysis) and difficult to validate. Context-activity matrix is enhanced by integrating the different abstraction level and easing the validation of properties like uniqueness and measurability while focusing on identification of critical situations. In context-activity matrix, labeling the rows with type of activity, column is labeling by sensed contextual data, specific data are noted in remaining field, and finally, top left field is used to identify the state that allow differentiation between different matrices. This construction is efficient for two reasons, first reasons is to identify the activities with limited set of context type. It helps us to allow the usage of same header for different matrices. Secondly, the uniqueness of contextual data valid by comparing with other rows and measurability is secured by ensuring functionalities and sensors to measure the contextual data. Context types are used for separation. Introducing different level of abstraction for extensive of number of activity and context data help to improve the clarity. Encourage to follow use case breakdown while there is no restriction on splitting matrix so it provides clear line for separation and their subdivision is aligned with other developed approaches. For example, various locations are mapped, each matrix contains the activity of one location. It also helpful for specified applications using separate matrix with unique set context like monitoring the characteristics of machine with various internal sensors result in set of specialized in contextual data. Therefore, clear separation is also possible for another matrix.

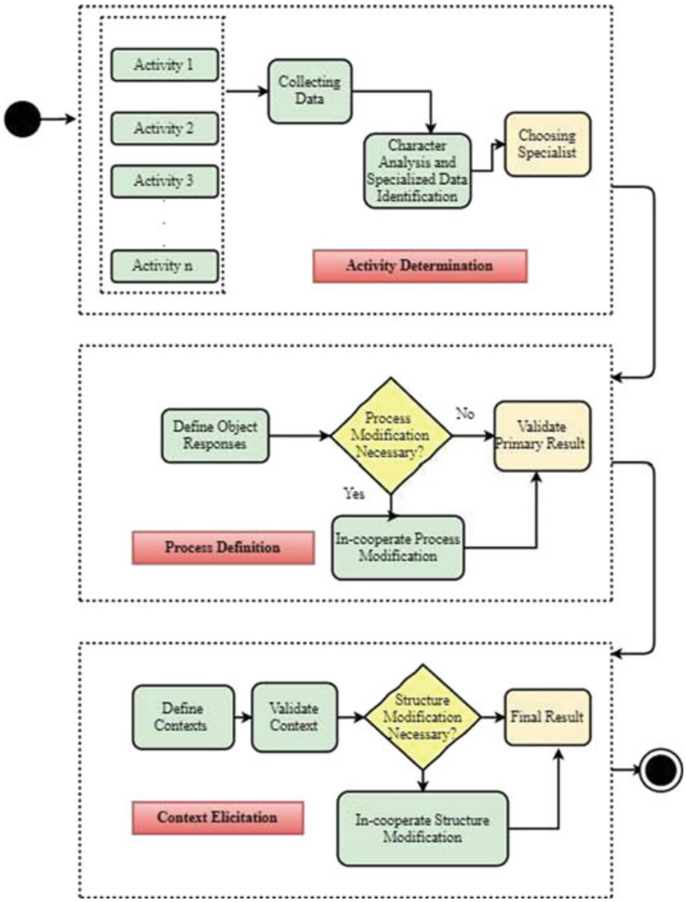

Fig. 4 Context-aware application execution

5.2 *Efficient Remote Execution-Based Approaches*

In current scenario, the usage of smartphones by the mobile end users become essential with emerging mobile cloud computing concepts with offloading the code from resource constrained mobile devices to resource-rich cloud servers. The remote execution of mobile cloud applications aims at enhancing the seamless application execution [16], application performance, and achieves energy efficiency in mobile devices. There were several approaches developed for efficient remote execution (computation offloading) of applications from mobile devices to cloud. The part of the application code needs to be offloaded from smartphones to remote cloud in the form of partial offloading or full offloading. In full offloading, the full application code along with all the necessary data need to be offloaded to the cloud where the entire computation process should be taken place, and finally, the computation results are sent back to the mobile devices. In the partial offloading, only part of the application code that ingests more energy and leads to computation complexity should be offloaded to the cloud. Some of the tasks are executed locally which eliminates runtime complexity between mobile devices and cloud. The efficient remote execution leads to offloading benefits such as improvement in lifespan of battery of mobile devices, reduced computation complexity, and the approaches includes static and dynamic-based code partitioning, dynamic resource allocations, execution optimization techniques, workflow-aware execution [17], energy-efficient execution, workflow-based computing techniques for IoT in mobile cloud includes application structuring, application partitioning, and computation offloading. Mobile cloud IoT systems implements remote execution for influencing the data storage and computation requirements of the IoT applications such as mobile gaming, smart health care, cloud-assistive vehicular transportation, smart network, and smart city [18].

5.3 Context-Aware Application Development Models

Mobile cloud computing technologies are evolved, however, this requires specific context-aware application development models that can expedite the development of cloud and IoT-based applications adept of taking context-aware computation offloading decisions. Context-aware applications are trending applications that are able to sense the entire environment and manage the situational context to facilitate better end users experience. To enable effective computation offloading in MCC, context-aware application development models are designed to enhance performance of the system, energy-efficiency, and local and remote execution support on mobile devices and cloud server. Model-driven context-aware application models are developed for Web applications on a Web service context management architecture [19]. In context-aware application models, they are two aspects are there such as context-aware computation offloading and context-aware application partitioning. The context-aware computation offloading is developed for system performance enhancement, energy-efficiency, and effective way of application execution. The main entities involved context-aware computation offloading includes smartphones, cloud resources (both physical and virtual), communication technologies such as Wi-Fi or cellular, data size and location, network bandwidth, and application model for computation offloading technique. The context-aware application partitioning to enable selective offloading between smartphones and remote cloud. Because entire application execution requires smartphones hardware support, high amount of communication bandwidth and it increases handover delay and energy consumption in mobile devices. The partitioning the applications can be static or dynamic based on development and runtime environment conditions.

The current mobile cloud application development models are: CloneCloud, μ Cloud, eXCloud, MAUI, and ThinkAir. Paper [20] discusses an application development model (Mobibyte) for mobile cloud computing. These application models offload resource-intensive applications from mobile device to cloud server based on different procedures. The model uses computation offloading, method-level offloading, on-demand data migration, context-aware offloading decisions, energy-level modeling decisions, application partitioning, and application structuring depending on the available mobile and cloud resources and user preferences.

5.4 Context-Aware Mobile Application Execution

The context-aware (contextual) information relevant between user and an application. These information parameters will change during dynamic execution. Based on set of environment states and settings, context- awareness defined and determines application's behavior. It is an ability of a system component to collect the information from its surroundings at any given time and embrace user's behaviors accordingly. The context-aware computing utilizes both hardware and software to routinely collect and analyze the data and to monitor the responses. The context in mobile devices includes various fields (mobile computing, wearable computing, and ubiquitous computing). Context-aware computation offloading in MCC [21] faces many challenges such as application partitioning, computational time, computational energy, offloading time, offloading energy, and application support. These challenges obstruct mobile cloud application models from effective context-aware offloading decisions.

Context-aware mobile application execution [22] of mobile devices defines location awareness where location determines how the firm the processes contribute the device to operate. The term context-awareness derived from the form ubiquitous computing or also called as pervasive computing. Context-aware mobile application execution linked with contextual application design and business process management. For example, Fig. 5 depicts context-aware mobile application execution for healthcare service system. Using mobile health monitoring apps access the context-aware healthcare service system [23] through communication interface. The system is connected with database server to access the Web service cache, user requirement database, geographic information database and connection and control module.

6 Mobile Cloud Computing Over Dynamic IoT Environments

In recent times, both academic and industry have shown serious attention to integration between Internet of things with IoT sensor cloud. The coordination is driven by the benefits of effective cloud computing processing and storage for data sensing. With this integration, cloud sensing allows the cloud application to provide sensing of data. Moreover, restricted nodes in the sensor pass the energy saving computer activities to the cloud. The system for enabling the IoT-cloud in the situation of different tasks to reduce the impact of queries shared to sensing devices to maximize

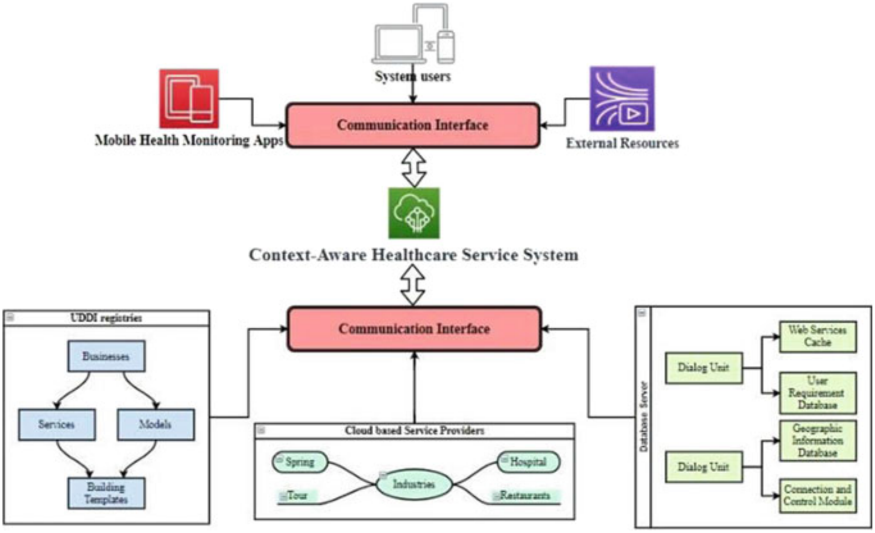

Fig. 5 Context-aware healthcare service system

the energy consumption of sensor. Their devices sensing also fulfills application requirements. For reducing the transmission of data, processes such as data catching and request aggregation will be helpful and data is transmitted regularly by the use of sensors. For periodically reporting their sensing data, their devices are needed. The report of predictive analysis which does not understand the sensing demands, results in extreme loss of energy due to duplicate transfer.

The position of mobile users is generally recognizable by cloud in much mobile cloud application such as vehicle safety and computer hacker systems. The cloud will know where the users require sensing services. The cloud therefore has knowledge about the location needed and the location where sensing services are required. The location-based (context-aware) collaborative model between IoT and cloud [24, 25] can be introduced for a successful area of application and therefore it will be modeled. The model allowing on-demand interaction of the cloud with the IoT enabled cloud to save power by controlling and scheduling the sensors as a coordinator for resource-restricted sensors. The cloud-controlled sensor services offer three main advantages. The data are collected on-demand based upon request interest, thus, reducing data redundancy and the quality of service of the sensing system can be set on the basis of application users requirements. IoT sensor cloud has recently been put forward as a hopeful and research-related approach. The IoT-cloud virtualizes the physical sensors into digital cloud sensors. Sensing and transmission of their sensing data to the cloud are responsible for physical sensor network.

6.1 IoT-Based Remote Application Execution

In recent years, variety of applications have been programmed in connection with IoT devices which plays a huge role in market today and those applications can be installed in any type of android or iOS devices according their norms and conditions. These IoT devices created a huge business platform. Some type of IoT devices are programmed to be accessed from anywhere and anytime and it also connected to cloud storage for quick backing up process. The users of IoT devices are also demanding such type of facilities from the developers. IoT devices also include health care, fitness, home appliances, etc.

For example, nowadays, IoT started contributing to healthcare industry. It allows medical devices to stay connected with cloud and to its applications. It plays a pivotal role in devices which collects patient records, data, staff records, inventory, facilities, smart beds, etc. It directly benefits to patients and healthcare providers for quick accessing and detecting failures before they become serious and can provide personalized therapy soon. Managing hospital equipment: It is also easy for physicians or healthcare professionals to check via mobile devices as it is connected to cloud storage. Stock management: apart from all the records, their supplies stock can also be maintained in real time with use of RFID tags and mobile scanners. By making these devices connected, the manufacturing cost can be easily reduced. Machine learning techniques are also combined the data for identifying new patterns which can lead to new product or services.

Currently, IoT application is created and its execution is done in cloud platform. For example, Amazon has created an IoT device with an application for both android users can download it in “Google Play Store” and for iOS “Apple Play Store” which is connected to cloud database for storage which is now major moving product on online market. The specialty of that product is it can connected through Bluetooth and also Wi-Fi technology can track all type of actions and movements, using that product, we can access find your phone, calls, messages, emails, and other specified applications. And all type of fitness applications which is connected to IoT can be tracked and backup for good results.

6.2 IoT-Based Applications in MCC

Mobile cloud computing platform is the important step to implement precise planting to collect information on spatially time variance that effects plant crop growth and development in a timely manner. The accurate environmental monitoring and early warning analysis is used to intelligently surveillance the situation of large- scale planting. Firstly, continuous collection of data and information such as carbon-dioxide, concentration, soil humidity, and NPK soil content. These data are indexed so that mobile query application can easily access the information in the second location, and we begin to store and upload and transfer all data sets to the cloud computing center. The mobile cloud IoT database manages the data relating to quality characteristics which is used to analyze and calculate production plant. The development of mobile cloud IoT can also be recognized to use pattern recognition technology and carry out complex plant-growing monitoring using other measuring instruments, and then, mobile front end service provides online investigation to users. Agricultural workers understand the specific real-time planting state using mobile devices. This mobile network provides analysts with the clear view of plant production and also reduces the problems and which causes natural disaster, viruses, yield of crops, and impact of crop production.

7 Conclusion

Context-aware mobile application execution incorporates context information, application requirements, and user preferences in cloud server database information systems. The adaptive, responsive, reactive, and environmental- directed applications have special emphasis on the location context. Context in mobile devices based on user contexts that comprises mainly personal attributes of the mobile users, point-of-interest, and environmental context. So, based on the incorporation of context information, the mobile applications are provided to the mobile users may expressively enhance the quality of service accessibility in terms of finding more related results. In present days, the context-awareness [26] in mobile cloud computing take advantages in various mobile contexts, namely, microblogging (e.g., Instagram, Twitter), social news feed, and mainly recommendation system services. This paper discusses a perception on context-aware mobile application execution in MCIoT environment by considering the issues of mobile networking in MCC communication, process of service accessibility using mobile devices, efficient remote execution-based approaches, different context-aware application development models, and MCC over dynamic IoT environments. Finally, by achieving context-aware mobile application execution in MCIoT, it reduces network delay, conserving energy-efficiency in mobile devices, and cloud server with better user experience while accessing seamless service accessibility.

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