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Capturing Sensor Data Using Mobile Cloud Computing

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***Abstract*— Mobile Cloud Computing (MCC) which combines mobile computing and cloud computing, has become one of the industry buzz words and a major discussion thread in the IT world since 2009. It is a technique or model in which mobile applications are built, powered and hosted using cloud computing technology. A mobile cloud approach enables developers to build applications for mobile users without OS and memory bounds. In this study, we propose to record, store, and analyze atmospheric data by means of mobile cloud computing. Specifically, the temperature and humidity sensors in smart phones are used to record atmospheric data in real time. Then, the recorded data are periodically transmitted to the cloud for storage and analysis. The analyzed results are then made available to specific domain user like agriculture, army, disaster management team, etc. The combination of mobile computing and cloud computing leverages the advantages of both techniques and extends the smart phone's capabilities of computing and data storage via the Internet. We will perform a case study to implement the mobile cloud computing framework using Android smart phones and Google App Engine, a popular cloud computing platform.**

***Keywords*— Mobile Computing, Cloud computing, Mobile Cloud Computing , Sensor .**

I. INTRODUCTION

Mobile Computing: A technology that allows transmission of data, via a computer, without having to be connected to a fixed physical link. Mobile voice communication is widely established throughout the world and has had a very rapid increase in the number of subscribers to the various cellular networks over the last few years. An extension of this technology is the ability to send and receive data across these cellular networks. This is the principle of mobile computing. Mobile data communication has become a very important and rapidly evolving technology as it allows users to transmit data from remote locations to other remote or fixed locations

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Cloud computing is becoming popular day by day in distributed computing environment. Cloud environments are used for storage and processing of data. Services provided by Cloud Computing can be categorized into three classes: Software-as-a-Service (SaaS), Platform-as a-Service (PaaS) and Infrastructure-as-a-Service (IaaS).

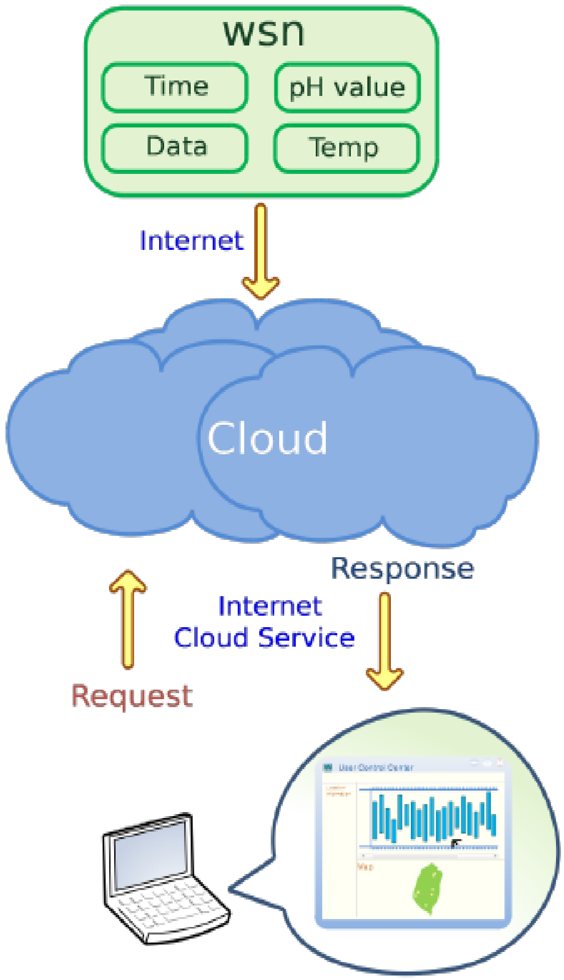

Figure 1: Cloud concept

Mobile Cloud Computing (MCC) which combines mobile computing and cloud computing, has become one of the industry buzz words and a major discussion thread in the IT world since 2009. It is a technique or model in which mobile applications are built, powered and hosted using cloud computing technology. A mobile cloud approach enables developers to build applications for mobile users without OS and memory bounds.

The main objective of mobile cloud computing is to provide a convenient and rapid method for users to access and receive data from the cloud, such convenient and rapid method means accessing cloud computing resources effectively by using mobile devices. Cloud computing has cultivated the outsourcing of computing resources like IT infrastructures, service platforms, and software. Mobile phones or smart phones are rapidly becoming the central computer and communication device in people's lives. The cloud computing based mobile software and application are expected to rise 88% annually from 2009 to 2014, and such growth may create US 9.5 billion dollars in 2014.

Today's smart phones are programmable and come with a growing set of cheap powerful embedded sensors, such as an accelerometer, digital compass, gyroscope, GPS, microphone, and camera, which are enabling the emergence of personal, group, and community scale sensing applications. Future applications of mobile cloud computing will take advantage of the many sensors available on mobile devices. We believe that sensor-equipped mobile phones will revolutionize many sectors of our economy, including business, healthcare, social networks, environmental monitoring, and transportation.

One issue common to the different types of sensing scale is to what extent the user is actively involved in the sensing system. We discuss two points in the design space: participatory sensing, where the user actively engages in the data collection activity (i.e., the user manually determines how, when, what, and where to sample) and opportunistic sensing, where the data collection stage is fully automated with no user involvement.

II. Mobile Phone Sensing

Sensors are devices that convert a physical parameter such as room temperature, blood pressure or wind speed into a signal that can be measured electrically or read by an observer. e.g. visual output from a glass thermometer. Sensors are a bridge between the physical world and the internet. The phone's sensors include a gyroscope, compass, accelerometer, proximity sensor, and ambient light sensor, as well as other more conventional devices that can be used to sense such as front and back facing cameras, a microphone, GPS and WiFi, and Bluetooth radios.

Sensors (wired and wireless) are ubiquitous and are used in domestic appliances, medical equipment, industrial control systems, air-conditioning systems, aircraft, satellites, smoke detectors, robotics, missiles and toys. They are built into many consumer electronic devices, cars, medical devices, security and safety devices, and systems for monitoring pollution and environmental conditions. Sensors support applications across the economy - industrial processes, and those in construction, extractive industries, agriculture, health care and so on - and can be incorporated into new or existing products. In a city, ambient noise levels, CO_2 levels, atmospheric temperature, humidity, wind speed, radiation levels etc. are monitored. Sensors can produce large volumes of continuous data over a period of time. The data can be live data, existing data, low resolution, high resolution etc .

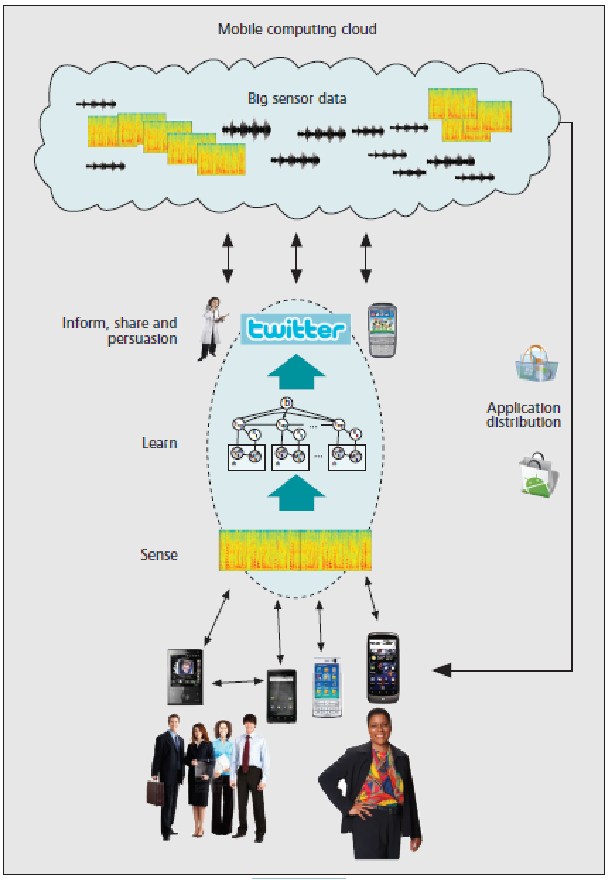

Figure 2: Mobile Phone Sensing Architecture

Mobile phones or Smartphone's are rapidly becoming the central computer and communication device in people's lives. [26] Along with the development of mobile phones, mobile phone sensing has also gain much popularity due to its convenience . Mobile sensing applications open the door to building novel persuasive systems that are still largely unexplored. Mobile phone sensing systems will ultimately provide both micro- and macroscopic views of cities, communities, and individuals, and help improve how society functions as a whole.

Mobile phone sensing is effective across multiple scales, including: 1) a single individual- Personal sensing applications are designed for a single individual, and are often focused on data collection and analysis. This personal sensing application adopts persuasive technology ideas to encourage the user to reach her personal fitness goals using the metaphor of a garden blooming as the user progresses toward their goals. 2) groups such as social networks or special interest groups- Individuals who participate in sensing applications that share a common goal, concern, or interest collectively represent a group. These group sensing applications are likely to be popular and reflect the growing interest in social networks or connected groups (e.g., at work, in the neighborhood, friends) who may want to share sensing information freely or with privacy protection and 3) entire communities population of a city- Most examples of community sensing only become useful once they have a large number of people participating; for example, tracking the spread of disease across a city, the migration patterns of birds, congestion patterns across city roads , or a noise map of a city.

One issue common to the different types of sensing scale is to what extent the user is actively involved in the sensing system . We discuss two points in the design space:1)participatory sensing, where the user actively engages in the data collection activity (i.e., the user manually determines how, when, what, and where to sample) and 2)opportunistic sensing, where the data collection stage is fully automated with no user involvement.

III. RELATED WORK

In recent years, sensors have been readily implemented in agriculture, industry, environmental protection and other fields. With the development of hardware limitations, and in pursuit of a better performance and enhancing greater computing capability, people turn to find other techniques to achieve these goals. Therefore, the concept of "Cloud" was born. "Cloud" refers to a network. author discuss the emerging sensing paradigms, and formulate an architectural framework for discussing a number of the open issues and challenges emerging in the new area of mobile phone sensing research.

A Survey of Mobile Phone Sensing- In this paper [1] a survey on existing mobile phone sensing algorithms, applications, and systems has been done. Author discuss the emerging sensing paradigms, and formulate an architectural framework for discussing a number of the open issues and challenges emerging in the new area of mobile phone sensing research.

Cloud-Based Augmentation for Mobile Devices- In this paper[2], author survey the state-of-the-art mobile augmentation efforts that employ cloud computing infrastructures to enhance computing capabilities of resource-constraint mobile devices, especially Smartphone's. The objectives of this study is to highlight the effects of remote resources on the quality and reliability of augmentation processes and discuss the challenges and opportunities of employing varied cloud-based resources in augmenting mobile devices.

Energy Management Techniques in Modern Mobile Handsets- [3]The author has surveyed various software solutions at six different levels: energy-aware operating systems, efficient resource management, the impact of users' interaction patterns with mobile devices and applications, wireless interfaces and sensors management, and finally the benefits of integrating mobile devices with cloud computing services.

Barrier Coverage with Sensors of Limited Mobility- In this paper[4] we study how to efficiently improve barrier coverage using mobile sensors with limited mobility. After the initial deployment, mobile sensors can move to desired locations and connect with other sensors in order to create new barriers. This global nature of barrier coverage makes it a challenging task to devise effective sensor mobility schemes.

Energy-Efficient Collaborative Sensing with Mobile Phones-In this work[5], we study how to minimize sensing energy consumption such that mobile phones can undertake sensing tasks, and in the meanwhile, they can still fulfill their regular duties, such as phone calls, emails, etc. The author aims to develop general (application-independent) methods to control the sensing procedure with the objective of minimizing sensing energy consumption. To this end, it is proposed to use a cloud-assisted collaborative sensing approach.

Sensing as a Service A Cloud Computing System for Mobile Phone Sensing- In this paper[6], the author proposes to leverage emerging cloud computing model to provide various sensing services using mobile phones for a large number of cloud users and introduce a new Sensing as a Service (S2aaS), i.e., providing sensing services using mobile phones via a cloud computing system.

Cloud Computing System Based on Wireless Sensor Network-In this paper[7], the system presents an integrated wireless sensor network (WSN) to monitor the information from agriculture systems namely temperature, humidity, pondus hydrogenii (pH) value…etc. The system proposed an internet database design by using the SQL database, LINQ-to-SQL technique, Web Service, virtualization technology and C# interface. By using this paper's method, the client's end can monitor the environmental condition of the agricultural place at any place. Besides this, the sensor data will be uploaded to the cloud database allowing the client to use our Cloud Service as long as the user's display facility has internet connectivity.

Capturing and Analyzing Wheelchair Maneuvering Patterns with Mobile Cloud Computing-The author [8]proposes a general mobile cloud computing framework, consisting of wheelchairs, smart mobile devices, cloud services, and information recipients. The smart mobile devices are attached to the wheelchairs. Wheelchair maneuvering data are continuously recorded and periodically transmitted to the cloud for storage and analysis. Then, the results are made available to various types of information recipients. The combination of these two techniques yields the so-called mobile cloud computing, which leverages the benefits of both techniques.

Cloud based Social and Sensor Data Fusion-In this paper[9], the possibility of fusing social and sensor data in the cloud, while dealing with massive data streams is explored. To this end, a travel recommendation system as a practice of the fusion is presented, which offers the information of people's moods regarding the predicted weather on where and when users wish to travel.

IV. Proposed Work

The need of sensor data by users of certain fields will be analyzed like agriculture, army, disaster management team, etc. Mobile computing technology will be studied to transmit of data, via a computer, without having to be connected to a fixed physical link. Cloud environments are used for storage and processing of data. Mobile Cloud Computing (MCC) which combines mobile computing and cloud computing, will become a major discussion thread as it is a technique or model, in which mobile applications are built, powered and hosted using cloud computing technology. Major focus will be on tracking the acquisition locations of atmospheric sensor data by means of mobile cloud computing. The temperature and humidity sensors in smart phones are used to record atmospheric data in real time. The analyzed results are then made available to end users like army base.

We performed a case study to evaluate the feasibility of the proposed mobile cloud framework as shown in Figure 3. Specifically, we used a Samsung Galaxy S4 and Samsung galaxy note 3 with Android OS 4.4 to collect Temperature and humidity sensor data. We used Azure as the cloud computing platform. Azure enables software platforms to move from their traditional development environments into the cloud. Azure offers Platform-as-a-Service (PAAS), providing an ideal foundation to build robust and scalable Web applications. . Abundant APIs are available to developers to make the mobile devices work seamlessly with Azure. Figure 3 shows the data flow in the sequence of data recording, storage, analysis, and results notification.

Figure 3: Report Analysis Screen

Our system works as follows-

Sensor data collection starts as soon as the app starts. Data of temperature and humidity sensor is recorded .Collected sensor data is stored in local database on the phone (Android has built-in support for SQLite database), and the reported data will also be stored in text format. Communication statistic data is collected from Android system log before the upload operation. Data uploading happens automatically when the phone has a valid WIFI Internet connection. If the phone has not connected to WIFI network for a whole day, the data will then be saved on the phone until the time the WIFI connection is available.

Figure 4: Data flow of Experimental setup

V. Conclusion

Mobile phones have evolved as key electronic devices for communications, computing and entertainments, and have become an important part of people's daily life. . We believe that sensor-equipped mobile phones will revolutionize many sectors of our economy, including business, healthcare, social networks, environmental monitoring, and transportation. Mobile cloud computing gains advantage in providing rich execution environments, rich resource pool for applications and greater data storage facility to mobile devices there by making mobile devices less specific and independence to platform dependent applications.

By using this paper's method, the client's end can monitor the environmental condition like temperature and humidity at any place. We also conducted a case study to evaluate the feasibility of the proposed mobile cloud computing framework by using Android smart phones and Windows Azure Platform. Experimental results demonstrate that this approach is feasible for conveniently collecting data and performing analysis. The major elements of this work are mobile phone sensing, Web interface, cloud computing system, Web Services, and user control center. Besides this, the sensor data will be uploaded to the cloud database allowing the client to use our Cloud Service as long as the user's display facility has internet connectivity.

The proposed Mobile Cloud Computing framework will provide an optimal approach to user management, access control, storage and retrieval of distributed data. Future work will include further development of the data processing, storage and retrieval methodology. Another aspect of future research will be to identify an optimal approach to permit data manipulation prior to publishing.

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REFERENCES

[1] Nicholas D. Lane, Emiliano Miluzzo, Hong Lu, Daniel Peebles, Tanzeem choudhury and Andrew T. Campbell " A Survey of Mobile Phone Sensing", Communications Magazine, IEEE , On page(s): 140 - 150, Volume:48, Issue:9 , Sept. 2010.

[2] Saeid Abolfazli, Zohreh Sanaei, Ejaz Ahmed, Abdullah Gani, and Rajkumar Buyya " Cloud-Based Augmentation for Mobile Devices: Motivation, Taxonomies, and Open Challenges ", IEEE Communications Surveys & Tutorials, Volume:16, Issue:1, First Quarter 2014.

[3] Narseo Vallina-Rodriguez and Jon Crowcroft " Energy Management Techniques in Modern Mobile Handsets" Ieee Communications Surveys & Tutorials, On page(s): 179 - 198, Volume:15 , Issue: 1, February 2012.

[4] Anwar Saipulla, Benyuan Liu, Guoliang Xing, Xinwen Fu, Jie Wang " Barrier Coverage with Sensors of Limited Mobility", in ACM on Computer-Communication Networks (MobiHoc), September 20–24, 2010.

[5] Xiang Sheng, Jian Tang and Weiyi Zhang " Energy-Efficient Collaborative Sensing with Mobile Phones " , 2012 Proceedings IEEE INFOCOM, On page(s): 1916 - 1924, 25-30 March 2012.

[6] Xiang Sheng, Xuejie Xiao, Jian Tang and Guoliang Xue " Sensing as a Service: A Cloud Computing System for Mobile Phone Sensing", IEEE conference Publications on Sensors, On page(s): 1 - 4, 28-31 Oct. 2012.

[7] Wen-Yaw Chung; Pei-Shan Yu; Chao-Jen Huang "Cloud computing system based on wireless sensor network", Computer Science and Information Systems (FedCSIS), 2013 Federated Conference on, On page(s): 877 - 880, 8-11 Sept. 2013.

[8] Jicheng Fu, Wei Hao, Travis White, Yuqing Yan, Maria Jones, Yih-Kuen Jan " Capturing and Analyzing Wheelchair Maneuvering Patterns with Mobile Cloud Computing", Engineering in Medicine and Biology Society (EMBC), 2013 35th Annual International Conference of the IEEE, On page(s): 2419 - 2422, 3 - 7 July, 2013.

[9] Surender Reddy Yerva, Hoyoung Jeung and Karl Aberer "Cloud based Social and Sensor Data Fusion" , Information Fusion (FUSION), 2012 15th International Conference, IEEE, On page(s): 2494 - 2501, 9-12 July 2012.

[10] Zhenyun Zhuang, Kyu-Han Kim, Jatinder Pal Singh "Improving Energy Efficiency of Location Sensing on Smartphones", MobiSys'10, San Francisco, California, USA, ACM, June 15–18, 2010.

[11] Shravan Gaonkar, Jack Li, Romit Roy Choudhury, Landon Cox, Al Schmidt "Micro-Blog Sharing and Querying Content Through Mobile Phones and Social Participation", MobiSys'08, Breckenridge, Colorado, USA ,ACM, June 17–20, 2008.

[12] Harald Weinschrott, Frank D¨urr, and Kurt Rothermel "StreamShaper Coordination Algorithms for Participatory Mobile Urban Sensing", 7th IEEE International Conference on (MASS'10), San Francisco, CA, USA, Nov. 2010.

[13] Igor Crk , Fahd Albinali , Chris Gniady , John Hartman , "Understanding energy consumption of sensor enabled applications on mobile phones", 31st Annual International Conference of the IEEE EMBS,Minneapolis, Minnesota, USA, September 2-6, 2009.

[14] Atif Alamri, Wasai Shadab Ansari, Mohammad Mehedi Hassan, M. Shamim Hossain, Abdulhameed Alelaiwi, and M. Anwar Hossain "A Survey on Sensor-Cloud Architecture,Applications, and Approaches", International Journal of Distributed Sensor Networks, 28 November 2012.

[15] Mr. Mahesh D. S, Ms. Savitha S, Dr. Dinesh K. Anvekar"A Cloud Computing Architecture with Wireless Sensor Networks for Agricultural Applications", International Journal of Computer Networks and Communications Security, Volume 2, NO.1, January 2014, 34–38.

[16] Jose Melchor , Munehiro Fukuda "A Design of Flexible Data Channels for Sensor-Cloud Integration", IEEE, 21st International Conference on Systems Engineering (ICSEng), 16-18 Aug. 2011.

[17] Kumaraswamy Krishnakumar, Ling wan "A Framework for IoT Sensor Data Analytics and Visualisation in Cloud Computing Environments".

[18] Mohammad Mehedi Hassan, Biao Song, Eui-Nam Huh "A Framework of Sensor - Cloud Integration Opportunities and Challenges", ICUIMC-09, Suwon S. Korea, ACM, January 15-16,2009.

[19] K.Sarammal, R.A.Roseline "A Review Wireless Sensor Networks and Its Application Platforms Standards and Tools", International Journal of Computer Trends and Technology (IJCTT) – volume 4 Issue 8 August 2013.

[20] Junya Niwa, Kazuya Okada, Takeshi Okuda, Suguru Yamaguchi "A Sensor Data Repository System for Mobile Participatory Sensing", MCC'13, Hong Kong, China, ACM, August 12, 2013.