

인간 친화적 로봇 서비스를 위한 대용량 분산 처리 기술 및 사용자 인증에 관한 연구[☆]

A Study on Distributed Processing of Big Data and User Authentication for Human-friendly Robot Service on Smartphone

최 옥 경¹ 정 우 열² 이 봉 규³ 문 승 빈^{1*}
Okkyung Choi Wooyeol Jung Bong Gyou Lee Seungbin Moon

요 약

현재 기업에서는 다양한 인간 친화적 로봇 서비스와 인터넷을 이용해 IT 자원을 필요한 만큼 빌려 쓰는 컴퓨팅 패러다임인 모바일 클라우드 컴퓨팅을 이용한 업무 처리 프로세스가 활발히 진행되고 있다. 그러나 모바일 클라우드 컴퓨팅 접속시 필요한 인증 서비스와 대용량 분산 처리 기술에 대한 부분은 현재 많은 취약점들을 내포하고 있는 실정이다. 본 연구에서는 모바일 클라우드 컴퓨팅 모델의 인증 서비스 취약점을 분석하고 이러한 문제점을 개선시킨 모바일 클라우드 컴퓨팅 모델을 구축하여 효율적이고 안전한 업무 처리 프로세스가 가능하도록 하고자 한다. 제안하는 모바일 클라우드 컴퓨팅 모델은 실시간 비정형 데이터를 분석하고 처리하는 기술에 대한 연구를 함께 진행함으로써 향후 비정형 데이터를 활용한 개인 맞춤형 정보 제공 서비스가 가능하다.

☞ 주제어 : 모바일 클라우드 컴퓨팅, 인간 친화적 로봇 서비스, 사용자 인증, 대용량 데이터 처리 기술, 로그 데이터 분석

ABSTRACT

Various human-friendly robot services have been developed and mobile cloud computing is a real time computing service that allows users to rent IT resources what they want over the internet and has become the new-generation computing paradigm of information society. The enterprises and nations are actively underway of the business process using mobile cloud computing and they are aware of need for implementing mobile cloud computing to their business practice, but it has some weak points such as authentication services and distributed processing technologies of big data. Sometimes it is difficult to clarify the objective of cloud computing service. In this study, the vulnerability of authentication services on mobile cloud computing is analyzed and mobile cloud computing model is constructed for efficient and safe business process. We will also be able to study how to process and analyze unstructured data in parallel to this model, so that in the future, providing customized information for individuals may be possible using unstructured data.

☞ keyword : Mobile Cloud Computing, Human-friendly Robot Service, User Authentication, Big Data Processing Technology, Log-data Analysis

1. Introduction

With the rapid development of robot technologies, robots are replacing the humans' roles gradually and convergence business services between human and robot using mobile terminals are also increasing. However, as such business processes are expanding, the technologies of big data analysis and processing are demanded. Mobile cloud computing is a real time computing service that allows users to rent IT resources such as, server, software, network, and etc remotely over the internet[1-3]. Since the processing and management of big data in mobile cloud computing

¹ Dept. of Computer Engineering, Sejong University, Seoul, 143-747, Korea

² Dept. of Knowledge Information Engineering, Graduate School of Ajou University, Suwon, 443-749, Korea

³ Graduate School of Information, Yonsei University, Seoul, 120-749, Korea

* Corresponding author (sbmoon@sejong.ac.kr)

[Received 21 October 2013, Reviewed 29 October 2013, Accepted 9 December 2013]

☆ This research was supported by Technology Innovation Program of the Knowledge economy (No. 10041834) funded by the Ministry of Trade, Industry and Energy(MOTIE, Korea).

☆ A preliminary version of this paper appeared in APIC-IST 2013, Aug 12-14, Jeju Island, Korea. This version is improved considerably from the previous version by including new results and features.

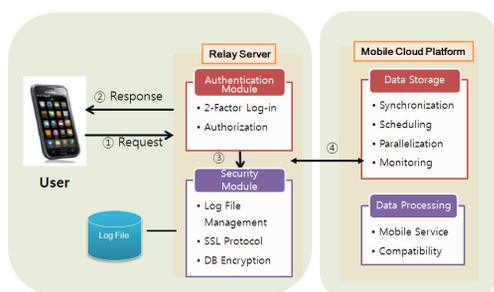
environment has big difference from existing traditional DBMS management method, separate framework technology on big data processing and management is required[1]. In this paper, we designed and implemented an efficient mobile cloud computing model for human-friendly robot service environments to solve the problem of existing technology. So it could be deal with large scale big data more efficiently.

2. Proposed Method

In this section, the outline of overall flow chart and implementation of proposed method are described, along with the principles of its modules and execution results.

2.1 Overall Flow Chart

Figure 1 is the overall flow chart suggested by this study. The procedure of collection and analysis step is as below.



(Figure 1) Overall Flow Chart

- ① User connects to relay server by 2-factor log-in authentication
- ② Relay server authorizes logged-in user after authentication
- ③ Log information is stored at DB. Real-time report is generated by stored log data verification process.
- ④ When log-in has succeeded, home directory by user is shown. User can store and change data. Synchronization, scheduling, monitoring and parallel-processing technologies are used in data storing. Data analysis supporting mutual compatibility is also possible.

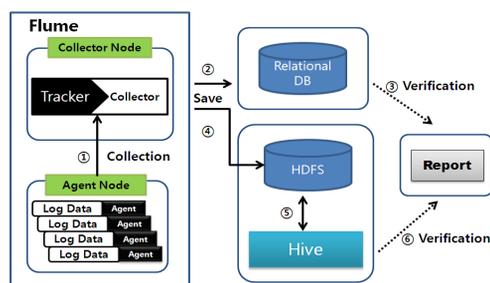
2.2 Function of each module

(1) Authentication Module: 2-Factor Log-in Method

The suggested Log-in Authentication method is combining the graphical based method and the OTP to prevent the password from shoulder surfing attacks or smudge attacks. The suggested method uses graphical based password that can be identified only by user and it made impossible to recognize OTP characterized array. With their own story, users can easily identify their password so the proposed method has the advantage of excellent applicability.

(2) Security Module: Log Analyzer Method

Log Analyzer plays an important role of data storage and analysis of large quantity log data distributed in different servers using Flume which is distributed in different servers. Figure 2 is the Log Analyzer proposed by this study. The procedure of collection and analysis step is as below.



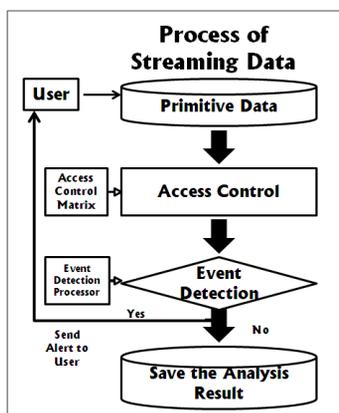
(Figure 2) Log Analyzer

- ① Log data collected at agent node is transferred to collector node.
- ② Collected log data are stored at mysql DB.
- ③ Real-time report is generated by stored log data verification process.
- ④ Log data at collector node is stored at Hbase.
- ⑤ Real-time report is generated after analyzing log data by Hive.
- ⑥ Log data analysis is performed based on real-time report analyzed by mysql DB and Hbase.

(3) CEP(Complex Event Processing) Module

This paper does CEP based analysis in effort to process streaming big data. CEP is a service based information system that analyzes relations between different events from various event sources and extracts meaningful data according to the relations. So it is a kind of event based architecture which supports real-time event processing and real-time response of constantly changing big data from social network services[3-8,11,16].

Figure 3 shows a real-time data processing technique proposed by this research. Step by step procedure for granting authority to access public document and real-time event processing is as follows.



(Figure 3) Real-time Data Processing Process

- ① Access of public document (source data): Authority to access public document is set to each user so user with the authority may access the public document. Then authority to read, write, and edit is set separately for the public document. Authority to access can be granted by Access Control Matrix. Access Control Matrix is a subject-based access control tool, which takes form of a table mapped with objects accessible to certain subjects.
- ② Event handling: In case where more than two different users with the authority to read and write access a file and edit it at the same period of time, it allows process of the first edit and the later edit request will be sent to event handler so that no additional edit would occur.
- ③ Message display: In case where there are two edits on the same document, the later edit request will be sent to

event handler so the document won't be edited and stored. After that, it sends a message "Unable to Edit" to the client.

- ④ Event handling complete: Adjusts event request order so that different edit requests won't overlap and completes event handling.

2.3 Execution Results

When the user is entered successfully, relay server processes user authentication and delivers the user's home directory list to the client app. Then the client app displays the contents on ListView like the following Figure 4.



(Figure 4) After logging in, each user's own home directory shows up.

Device's menu button shows new dir, new text and exit menus. When the user clicks new dir menu pops up a dialog, which allows user to enter name of a new directory and creates the directory. New text file menu allows user to create a new file with the name he/she wants. When a directory is selected on ListView, user moves into the directory. If a text file is selected, it shows the file's contents on a new activity as shown in Figure 5. Clicking on the device's menu button after opening the new window, it would then show save, exit menu. When save menu is selected, the contents are stored in HDFS[10].

If multiple users opened a file at the same time, synchronization is triggered as shown in Figure 6. The process of synchronization is calculated by the time the file is opened and edited. If a user tries to save the file while some is editing or saving, a dialog box will be shown with the "Warning" message. If the user clicks the [Yes] button, the file would be overwritten, otherwise save will not occur[10].



(Figure 5) User Screen - This is the screen after clicking on the menu button. The screen on the left shows creation of a new directory and the screen in the middle shows creation of a new file.



(Figure 6) User Screen - If other user already made a change and saved the file, this user will receive a warning message when trying to save the same file again so that it won't undo the previous save.



(Figure 7) User Screen - File Upload & Download

When the file explorer button at the bottom of file list is selected, a screen in dialogue form pops up showing the file in /sdcard directory of current device as shown in the left side of Figure 7. When you select a file to upload, a dialogue box asking you whether you would upload or not as shown in the right side of Figure 7. If you choose the 'Yes' button, the upload starts. If you choose a file in the

file list to download, a dialogue box asking you whether you would download or not as shown in the middle of Figure 7. If you choose the 'Yes' button, the selected file would be stored in /sdcard/HadoopApp directory.

3. Experiments

This experimental evaluation was taken after collecting trustful statistical information by previous operation for three weeks. The object of this experiment is to show a way that is convenient like existing method but more secured in the aspect of qualitative evaluation by comparing connection time of the proposed method to existing smartphone application. In addition, this paper is compared to the existing method by a connection speed test. As a result of comparing the connection speed of each account logged-in following the user verification until connecting to the home directory, the proposed method showed a better performance in terms of security and convenience.

3.1 Experimental Environment

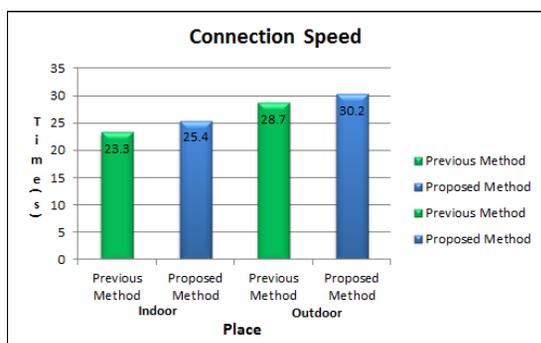
The comparison group of this experiment consists of the places which divided by inside and outside of a building. It has proceeded in Wi-Fi network environment. To make experimental environment that can connect only by the experimental smartphone, it is configured SSID : ISL and password to ipTIME N6004 wireless router. The outside experiment was preceded by installing wireless router at the first floor and places it in 10m like the inside. The proposed experimental environment is shown in Table 1.

(Table 1) Experimental Environment

Period	2013.09.30.-2013.10.18.(Approximately 3 weeks)		
Time	09:00-21:00 (Measured in 2 hours)		
Method	measuring from the time the authentication for user log-in begins until the time of completed connection to home directory		
Place	University which is located in Seoul. Indoor : Laboratory, Classroom Outdoor : Main Entrance of University, Subway		
Device	Client	Platform	Galaxy Note, Galaxy Tab, Galaxy S3, Nexus S2
		OS	Android 2.4
	Server	OS	Windows Server 2010
		Server	Apache Web Server
	Database	Mysql	

3.2 Experimental Result

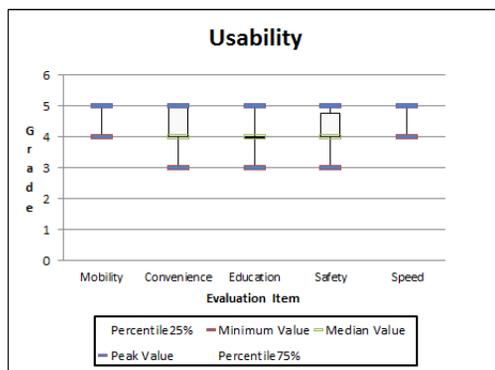
To compare connection speed by place, this study divided the place into indoor and outdoor and proceeded with a test. As Wi-Fi speed may vary by hour, the final average was calculated after performing the measurement every two hours between 9am and 9pm. As for the indoor, the existing method and proposed method are 2.1 seconds apart under Wi-Fi communication conditions, as shown in the figure 8, whereas the outdoor is 1.5 seconds apart. Regarding the proposed method, one can check it shows little difference in speed even though the security was tightened up using the 2-factor user authentication.



(Figure 8) Connection Speed by place

3.3 Usability

Usability means how convenient a certain product is when used for a specific purpose. For the ideal evaluation on the usability, various elements should be evaluated[9]. The essential elements for the measurement and research on the usability are the efficiency of interface, convenience of measuring the usability, speed, movability and safety. Each user has different ability in identifying the texts on a display device, usability was established using a Likert scale[12]. A Likert scale is a psychometric scale commonly involved in research that employs questionnaires. The questionnaire used for Likert scale had 5 step scale and used the score between 1 point (Very negative) and 5 point (Very positive) as measures. The evaluation item lists and respective result are showed in Table 2 and Figure 9.



(Figure 9) Result of Usability

(Table 2) Usability

Evaluation item		AV	ST
Mobility	1. Is it easy to portable the certification of the media?	4.9	0.32
	2. Is it convenient to mobile the certification of the media?	4.9	0.32
Convenience	3. Is the proposed method easy to use?	4.3	0.67
	4. Is it useful when many people have used at the same time?	4.0	0.67
	5. Is it intuitive to use the interface of proposed method?	4.2	0.63
	6. Are you willing to use the proposed method in the future?	4.1	0.57
Education	7. Is it easy to learn the proposed method?	4.1	0.57
Safety	8. Is it safe compared with the existing method?	4.1	0.74
Speed	9. Is it fast when many people have accessed at the same time?	4.8	0.42
Total Average		4.3	0.51

* AV : Average, ST : Standard Deviation

4. Conclusion

Mobile cloud computing is a core technology of mobile platform to support the best services of virtualized IT resources utilizing mobile device by combining mobile service and cloud technology[13]. In case of simultaneously accessing files in different areas, an effective way of handling data is needed for file compatibility[14].

In this paper, we designed and implemented an Efficient Mobile Cloud Computing Model on Smartphone. The existing authentication mechanism has the weakness that the efficiency is low in the aspect of usability and it is inconvenient to use. But the proposed method complemented such weaknesses and made it easy to be used in the smart phone environment in consideration of visibility, usability

and security. It consists of Authentication Module of 2-Factor Log-in Method, Security Module of Log Analyzer technology and Application Module for complex event processing. Using this method, an efficient big data processing and analysis are possible and users can easily access and find the big data what they want. This paper also conducted a comparison test on connection speed between the proposal method under Wi-Fi conditions and existing smartphone application. As a result of comparing the connection speed of each account logged-in following the user verification until connecting to the home directory, the proposed method showed a better performance in terms of security and convenience. Besides, the test results verified that the proposed method that reinforced user authentication shows little difference in speed from the existing method.

Future research plan includes moving one-step forward to enable an effective information sharing and analysis using a cloud robot[15].

참 고 문 헌(Reference)

- [1] Kyung Ha Lee, Hyunsik Choi, Yeondon Jung, "Massive Data Processing and Management in Cloud Computing", Journal of KIISE : Database, Vol. 38, No. 2, (2011)
- [2] Miyong Lee, Ywan Choi, "Big Data Processing Technology Agenda for Big Data Analysis", Korea Information Processing Society Review, Vol. 19, No. 04, (2012)
- [3] Sung Choi, Sung Koo Woo, "Definition, Application and Trends for Big Data", Korea Information Processing Society Review, Vol. 19, No. 03, (2012)
- [4] Seung Yil Choi, "A Study on Establishment of IaaS for SMEs based on Cloud Computing through the Development of Cloudcast Technology", thesis of Ph.D, (2010)
- [5] Jonghee Na, "Qualitative Study on Service Features for Cloud Computing", Digital Contents Journal, Vol 12, No 3, pp.319-327, (2011)
- [6] Okkyung Choi, Wooyeol Jung, Kangseok Kim, Hongjin Yeh, "Mobile Cloud Computing Model for Data Processing and Analysis on Smartphone", The 6th International Conference on New Trends in Information Science (2012)
- [7] David C. Luckham, "The Power of Events: An Introduction to Complex Event Processing in Distributed Enterprise Systems", Addison-Wesley Longman Publishing Co., Inc. Boston, MA, USA (2001)
- [8] Alejandro Buchmann, Boris Koldehofe, "Complex Event Processing", Information Technology, Vol. 51, No. 5, pp. 241-242 (2009)
- [9] Yunlim Ku, Okkyung Choi, Kangseok Kim, Taeshik Shon, Manpyo Hong, Hongjin Yeh, Jai-Hoon Kim, "Extended OTP Mechanism Based on Graphical Password Method", Lecture Notes in Electrical Engineering, Vol. 164, No. 1, pp 203-212 (2012)
- [10] IANPAOLO CUGOLA and ALESSANDRO MARGARA, "Processing Flows of Information: From Data Stream to Complex Event Processing", GI, ACM Journal (2011)
- [11] Yeongsoo Min, Heungyeon Kim, YeongKyun Kim, "Distributed File System for Cloud Computing", Journal of KIISE : Vol. 27, No. 5, pp. 86-94 (2009)
- [12] Jaehyun Park, Sung H. Han, Hyun k. Kim, Seunghwan Oh, Heekyung Moon, JooHwan Park, "Development and Verification of User Value Assessment Method", Daehan Human Engineering Association 2010 Fall Academic Seminar, pp.124-127 (2010)
- [13] Young Bae Yoon, Junseok Oh, Bong Gyou Lee, "The Important Factors in Security for Introducing the Cloud Services", Journal of Korean Society for Internet Information, Vol. 13, No. 6, pp. 33-40, (2012)
- [14] Frank I. Eljorje, Hyunho Yang, Jaewan Lee, "Ubiquitous Workspace Synchronization in a Cloud-based Framework", Journal of Korean Society for Internet Information, Vol. 14, No. 1, pp. 53-62, (2013)
- [15] Romeo Mark Mateo, Jaewan Lee, "Information Sharing Model based on Adaptive Group Communication for Cloud-Enabled Robots", Journal of Korean Society for Internet Information, Vol. 14, No. 4, pp.

53-62, (2013)
[16] Okkyung Choi, Hongjin Yeh, Bong Gyou Lee,
Seungbin Moon, "An Efficient Data Processing and
Analysis Method for Human-friendly Robot Service

Environments on Smartphone", The 8th Asia Pacific
International Conference on Information Science and
Technology, pp.27-33, (2013)

◎ 저 자 소 개 ◎

최 옥 경(Okkyung Choi)



2000년 중앙대학교 대학원 컴퓨터소프트웨어학과(공학석사)
2006년 중앙대학교 대학원 컴퓨터공학과(공학박사)
2007년~2011년 세종대학교 컴퓨터공학과 초빙 교수
2011년~2013년 아주대학교 대학원 지식정보공학과 연구 교수
2013년~현재 세종대학교 컴퓨터공학과 연구 교수
관심분야 : 시맨틱 웹 서비스, 빅데이터, 정보보안, 클라우드 컴퓨팅, 서비스 로봇
E-mail : okchoi@sejong.ac.kr

정 우 열(Wooyeol Jung)



2014년 아주대학교 대학원 지식정보공학과(공학석사)
관심분야 : 모바일 플랫폼, 모바일 보안, BYOD, MDM
E-mail : rightline@ajou.ac.kr

이 봉 규(Bong Gyou Lee)



1992년 Cornell University (석사)
1994년 Cornell University (박사)
1997년~2004년 한성대학교 정보전산학부 교수
2005년~현재 연세대학교 정보대학원 교수
관심분야 : IT 정책·산업, 방송통신융합정책, 모바일 인터넷
E-mail : bglee@yonsei.ac.kr

문 승 빈(Seungbin Moon)



1988년 University of Michigan(공학석사)
1993년 Purdue University(공학박사)
1993년~1999년 삼성전자 생산기술센터 수석연구원
1999년~현재 세종대학교 컴퓨터공학과 교수
관심분야 : 로보틱스, 컴퓨터비전, 서비스 로봇, 얼굴인식
E-mail : sbmoon@sejong.ac.kr