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Preface

It is our great pleasure to have the third workshop of the Eastern Washington University (EWU)- Iwate Prefectural University (IPU) International Exchange Program in Computer Science published by the Informatics Society. The exchange program started in the summer of 2008 after an administrative meeting the previous year. Since then, the workshop has been held every year.

This year as the fourth workshop, we had the keynote speech by Dr. Yoshia Saito from Iwate Prefectural University, followed by a presentation by Dr. Carl Hauser from Washington State University, Pullman and nine presentations by the faculty members and graduate students from Iwate Prefectural University as well as a presentation by Dr. Kosuke Imamura from Eastern Washington University. Those presentations span a wide variety of topics in computer science, networking, security, human aspects of technology and Japanese culture.

We had two more students joined from Iwate, this year, compared to last year. We hope that the workshop is a good basis for more participants in this international research exchange program and leads to further research collaboration.

Finally, but not least, we appreciate the Informatics Society for publishing the proceedings from this summer workshop.

December 2011

General Co-Chairs: Yoshitaka Shibata and Paul Schimpf
Program Co-Chairs:Carol Taylor, Kosuke Imamura and Yuko Murayama

Activities for Reconstruction Watcher in Disaster Areas

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Abstract - The Tohoku Region Pacific Coast Earthquake and its Tsunami caused serious damage to the pacific coast in northeastern Japan including Iwate prefecture. We suppose it is important to present the serious situation in the disaster areas to gain public understanding and support. In this paper, we propose Reconstruction Watcher which presents visually reconstruction progress to gain public understanding and support to the disaster areas. We introduce two activities for the Reconstruction Watcher with Internet broadcasting and with photographic recording. This paper reports the contribution and issues.

Keywords: Internet broadcasting, Photographic recording, Disaster areas, Reconstruction Watcher

1 INTRODUCTION

The Tohoku Region Pacific Coast Earthquake hit northeastern Japan on Mar. 11, 2011. Tsunami triggered by the earthquake caused serious damage to the pacific coast in Iwate prefecture. We looked for ways to contribute reconstruction of the disaster area applying our researches. Then, we found most people did not know situation in the disaster areas. The damage and reconstruction progress are not well known. We suppose it is important to present situation in the disaster areas to gain public understanding and support.

Meanwhile, we have studied Internet broadcasting technologies [1,2]. Since the Internet broadcasting can transmit information visually, it would be effective for presenting situation in the disaster areas. In this paper, we propose Reconstruction Watcher which presents visually reconstruction progress to the general public to gain public understanding and support. After the earthquake, we have carried out two activities of the Reconstruction Watcher. The first activity uses Internet broadcasting and the second one uses photographs to presents visual information of the disaster areas.

2 RECONSTRUCTION WATCHER

The Reconstruction Watcher aims to gain public understanding and support presenting reconstruction progress. Figure 1 shows a model of the Reconstruction Watcher. People in disaster areas send videos and pictures of the scenery to the Reconstruction Watcher via the Internet. The general public can receive the videos and the pictures from the Reconstruction Watcher and confirm the reconstruction progress. We suppose it helps the people who watch them understanding and supporting the disaster areas.

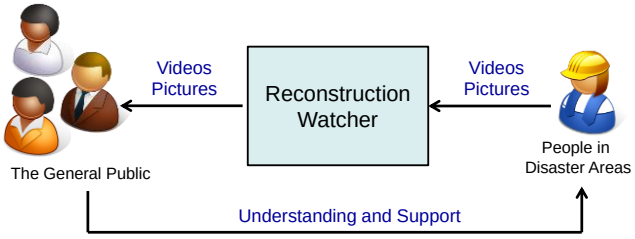

Figure 1: A model of Reconstruction Watcher

Figure 2: A Reconstruction Watcher with Internet broadcasting

3 INTERNET BROADCASTING FOR THE RECONSTRUCTION WATCHER

We started first activity for the Reconstruction Watcher with Internet broadcasting. It is an Internet broadcasting using Ustream at Yamada-cho town hall in Iwate from May 13, 2011 [3]. Figure 2 is the broadcasting page. Currently the number of views is over 10,000. We find people are interested in watching and understanding situation in the disaster area. The comments from the audience show their surprise of the situation and cheer to its reconstruction.

At the early stage, we faced an issue about the Internet broadcasting in the disaster areas. The issue is that Internet connection in disaster area is generically low-speed one. A satellite communication service [4] was used as the Internet connection at Yamada-cho town hall. The satellite communication service is very useful for the disaster areas because of its installation requirements. However, it shared about 1 Mbps Internet connection among several disaster

areas. The video streaming was stopped frequently because video streaming requires broadband internet connection. Ustream recommends 1 Mbps transmission rate at least for stable broadcasting [5]. Therefore, alternatives are required for disaster areas where low-speed Internet connections are used.

4 PHOTOGRAPHIC RECORDING FOR THE RECONSTRUCTION WATCHER

There are two issues of video streaming in the disaster areas. Firstly, it is not suitable for disaster areas where high-seed Internet connections are not equipped. Secondly, the video data size is too large to record the reconstruction progress in the long-term. To solve these issues, we propose a reconstruction watcher with photographic recording function without video streaming. The alternative reconstruction watcher takes a photograph at intervals of 1 hour or longer. Users can see all photographs and understand reconstruction progress over several years.

We implement a prototype system of the Reconstruction Watcher with photographic recording function. Figure 3 shows the system architecture of the prototype system. The system includes a server and two clients; reconstruction watcher server, photo uploader and photo viewer.

The reconstruction photo uploader has a web camera and executes a web application for the photo upload. The web application can be downloaded by accessing a URL on the Reconstruction Watcher server, and it creates a photograph captured by the camera. The photograph is compressed in JPEG format and sent to the Reconstruction Watcher server.

The server receives the photograph and creates its thumbnail. The photograph and its thumbnail are put on web server so that they can be accessed via the Internet. The URLs of the photograph and its thumbnail, the uploaded time are stored in a photograph database.

When people want to see the photographs, they access a website by their web browser for accessing photograph viewer on the server. The photograph viewer sends a query to the photograph database to get URLs of the photograph and its thumbnail selecting a time period. After that, the photograph viewer creates a HTML file dynamically which presents the photographs by a calendar style. Figure 4 shows the website to see the photographs. Currently the website presents photographs month by month. For the future, the site will provide various display methods.

5 CONCLUSION

We proposed Reconstruction Watcher which resents visually reconstruction progress to gain public understanding and support to the disaster areas. Two activities for the Reconstruction Watcher with Internet broadcasting and with photographic recording were introduced. The Internet broadcasting enabled people to understand the situation in the disaster areas and we found an issue that video streaming was stopped frequently because of the low-speed Internet connection in the disaster area. To solve this issue, we implemented the reconstruction watcher with photographic recording function which could be alternative system providing photographs of the disaster areas to the general public in long-term for presenting the reconstruction progress.

For the future work, we will continue to implement the photographic recording function and conduct a long-term trial over 1 year.

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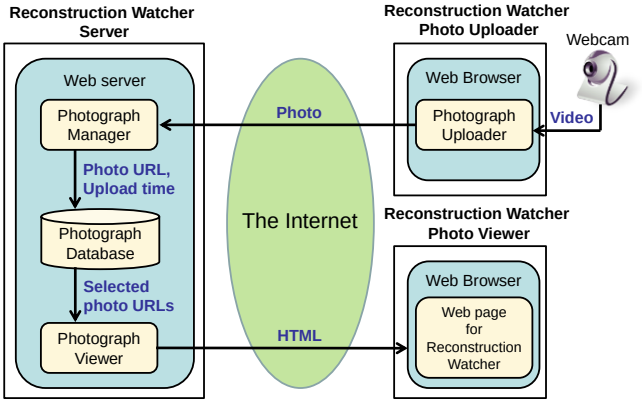


Figure 3: System architecture of a reconstruction watcher with photographic recording function.

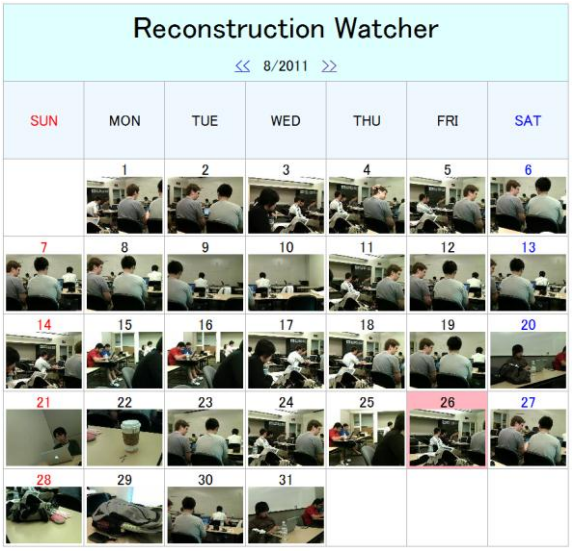
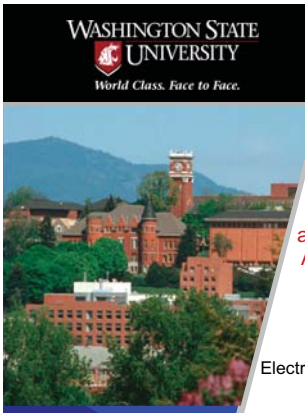


Figure 4: Photo viewer



School of Electrical Engineering and Computer Science

Tradeoffs Between Performance and Security in Multi-cast Message Authentication Protocols for Wide-area Control Systems

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September, 2011

Motivation

- We work on communication infrastructure to support power grid monitoring and control
  - "Smart Grid" craze
  - => large numbers of "intelligent devices" deployed in the grid
  - => increasingly automated control
  - What about security?
- In the smart grid many applications (subscribers) may use the data from a single source (publisher)
- How can subscribers ensure that messages originated with publisher?

Control System Challenges

- Latency – time to authenticate adds to total delivery time
- Computation cost – many devices have limited computational capability
- Signature size – low bandwidth links are often fully consumed by the operational data

Authentication Approaches

- Digital signatures using public-key cryptography
  - Send(M, Sign(M,K)) – K is signer's private key
  - Check(M, Sign(M,K), K^{-1}) -- K^{-1} is signer's public key
  - Public-key approaches are very computationally expensive – many milliseconds of computation even on a fast desktop computer
  - But public-key is the only approach that provides non-repudiation (is it necessary)?
- Symmetrically keyed message-authentication codes (MACs)
  - HMAC and CMAC based respectively on cryptographic hash function and block-cipher code
  - Very fast to compute; simple
  - Two approaches: per-recipient signing; single signing
    - Each has generally undesirable properties but may be best solution in a given situation

Authentication Approaches

- Timed-key-release (TESLA)
  - Internet RFC
  - Requires time synchronization of publisher and subscribers, estimate of network latency to most-distance subscriber
  - Publisher signs with a key, sends message, and then sends the key *after* all subscribers should have received the message
  - Subscribers only accept messages received *before* the key was sent (and for which the signature checks)
  - Hash chains (like in S-Key) are used to authenticate the *keys*
  - Low computation cost, but high latency nevertheless
  - Subscribers cannot masquerade as publisher
  - Frequent re-keying (not costly)

Authentication Approaches

- Time-valid one-time signatures (TV-OTS)
  - Public/private key technique
  - Keys are used for a configurable period of time
    - Predicated on the ratio between the time of use and the time to break the one-time signature
  - Signing and verifying are fast
  - Frequent re-keying; key generation is costly (minutes of computation per hour of use)
  - Complex implementation
  - Subscribers cannot masquerade as publisher

Improving the Symmetric-key Schemes

- Recall the issue: key disclosure by subscriber allows someone to masquerade as publisher
- Consider the context
  - The multi-cast data delivery service can be configured to deliver messages only over specified paths
    - False publisher must inject messages at one of a few specific points
    - This is difficult for the attacker but not impossible
  - Can we give the subscribers the ability to verify the path over which the message was delivered?
    - We think so, and at quite low cost: decryption and re-encryption of a hash at each forwarding node in the multi-cast forwarding tree

Conclusion

- Multi-cast data delivery should allow use of message authentication schemes appropriate for the use of the messages
  - Must respect applications' latency, bandwidth, and computational requirements
  - Message authentication based on public-key cryptography is too costly for most uses
  - HMAC, CMAC, and timed-release approaches each potentially have their uses
- HMAC and CMAC's security can be improved by adding spatial asymmetry in the form of verification of the path travelled by a message

Practice on International Exchange between Japan and USA Using CollabTest

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Abstract - In this paper, we report an international exchange learning using the CollabTest system that enables students to perform quiz creation, peer review, and online test. In addition, we evaluate the learning by using feedback obtained from students via questionnaires.

Keywords: Exchange Learning, Problem Posing, Peer Review, Online Test

1 INTRODUCTION

We have developed a web-based learning system named "CollabTest" that enables learners to acquire knowledge by creating quizzes and sharing them with peers [1]. In addition, we have continually used this system since 2002 at schools of various levels, including a university, high school, elementary school, and vocational training school. As a result, we have used this system in a total of 168 classes over 8 years. In addition, 8653 learners have used the system, over 22,000 quizzes have been created by learners, and over 52,000 comments have been posted by learners. From these practical studies, we have demonstrated that CollabTest has the potential to improve study time effectively and students who have actively used it have improved their test scores [2].

Exchange learning, which involves exchanging information between regional schools via the Internet and a video conference system, has been actively studied at junior high and elementary schools in recent years [3]. However, there are some problems such as the work-load to prepare learning materials and adjust a schedule for exchange learning. In order to solve this problem, we consider that the CollabTest system can be effectively applied to exchange learning, as exchange learning using CollabTest requires neither preparation of learning materials nor scheduling. Thus, we can expect that exchange learning between classes can be conducted more easily than other methods of exchange learning. However, practical studies of exchange learning through quiz creation and peer review have not yet been reported. [4-5]. Therefore, how much work is involved to expand the CollabTest system to the exchange learning system is unclear. In this paper, we report the results of using CollabTest between universities in Japan and USA.

2 EXCHANGE METHOD BETWEEN CLASSES USING COLLABTEST

Exchange methods between classes using CollabTest is classified into two opportunities: evaluating quizzes interactively and taking the quizzes.

(1) Exchange through Peer review

In one peer-review activity of CollabTest, a learner shares his/her quizzes with members of the same group. Therefore, the learners can share quizzes with learners in a different class by assigning them to same group.

(2) Exchange through Taking Online Tests

In online tests of CollabTest, the learner takes quizzes created by peers in the same class, quizzes created by past classes, and quizzes created by the teacher. In addition, he/she can post comments such as their questions about and impression of each quiz after taking an online test. Therefore, if a teacher can compose the test by selecting questions from quizzes created by learners in a different class, the learners can take the quizzes created by them.

As a result of above mentioned exchange, they can share not only knowledge but also exchange comments on their quizzes between classes.

3 DATA COLLECTION AND ANALYSIS

3.1 Overview of Exchange Learning

We tried international exchange using the CollabTest system between universities in Japan and USA during fall semester 2010. There were two classes (EAP UIA and EAP UIB) from Soka University Japan (SUJ) and one class (Literature and Vocabulary 4B) from Soka University of America (SUA). The total of the participants were 32, they consist of 19 students from SUJ and 13 students from SUA.

The classes that participated in the international exchange were focusing on learning English literature and vocabulary. Therefore, same textbook, which was "The Letter from Birmingham Jail", was used as the learning material for this exchange.

3.2 Flow and Procedures

The exchange learning flow is shown in Table 1. Teachers predefined categories form the learning material for quiz creation. The categories were divided based on the paragraph of the learning material. The students were required to create three quizzes according to the categories that were assigned to them by their teacher.

The peer review was carried on with two phases. In phases one, the students in each university were divided into 4 groups making the total of 8 groups. Therefore, the peer review in phase one was only within the same university. In phase two, in order to exchange comments between classes, the students were divided into 4 groups by combining the group in SUJ and SUA.

Table 1: Exchange Learning Flow.

Date	Activities
1st ~ 10th November	Quizzes creation and peer review (Phase 1)
11th November	Regrouping for Phase 2
12th ~22nd November	Peer review (Phase 2)
29th ~ 30th November	Teachers created online tests.
1st ~ 6th December	Students took online tests.
7th ~ 13th December	Questionnaire.

3.3 Participation Rate

Ttable 2 shows the number of created quizzes. Totally, 99 quizzes were created, and 569 comments were posted on these quizzes. About 94% of the quizzes received over 5 comments.

Table 2: Number of Created Quizzes.

	SUJ	SUA	Total
Group A	12	13	25
Group B	15	12	26
Group C	11	11	23
Group D	15	10	25
Total	53	46	99

3.4 Usability

We investigated the usability of the CollabTest system by questionnaires. Table 3 shows the results of a questionnaire given to student. The results indicated that CollabTest has provided a platform which managed to conduct the international exchange learning. However, there was also feedback that the system interfaces need to be improved to become more user friendly.

Table 3: Questionnaire Results.

Questions	N	Mean	SD
CollabTest provide a platform which could be access any time anywhere for international exchange learning.	32	3.78	0.97
CollabTest make interaction between peers more easier although the exchange learning peers are not located in the same time zone.	32	3.72	1.22

1: Strongly disagree, 2: disagree, 3: neither agree nor disagree, 4: agree 5: strongly agree

3.5 Learning Effects

We conducted interview with teachers to investigate learning effects by the international exchange learning. Table 4 shows summary of the interview. As shown in Table 4, we received positive feedback to the international exchange from the teachers.

4 CONCLUSION

We applied the CollabTest system to international exchange between universities in Japan and USA. As a result, the possibility of CollabTest in the international exchange learning has been identified. In the future, we will analyze the learning effects in detail. After that, we will compare between the CollabTest system and existing exchange learning system.

Table 4: Teacher's Comment from Interview.

Q1	Is CollabTest learning steps helping the students to recall what they have learned in the class and able to apply it?
A1	・Empowering students as teachers (creators) of the test items helped them to dig into the deeper and more significant meaning in the text. ・I think the quiz creation and peer review process helped students to think more deeply about the material.
Q2	Do you think students have benefited from this international exchange learning project?
A2	・Yes! Students explored the material which involves university-level vocabulary and critical thinking through the process of the international collaboration. ・Students spent time to read a difficult text, trying to come up with question. ・Working in a small group is basically a good way to increase understanding.

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Scenario Analysis and Validation of Agent-Based Models

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Abstract - In this paper, we discuss how scenario analysis can contribute to the validation of agent-based models. Scenario analysis and the concept of validity in ABSS are introduced. We conclude that scenario analysis solve the validation problem of arbitrarily presenting a result of ABSS. We mention the needs of an information system that supports users to interactively perform scenario analysis in real time.

Keywords: Validation, Agent-Based Social Simulation

1 INTRODUCTION

Today's managers are confronted with increased uncertainty and complexity inside and outside their organization. Therefore, these managers seek better-informed decisions by increasing their knowledge about the complex organization system.

Recently, Agent-Based Social Simulation (ABSS) has been studied for supporting managers' decision making. ABSS analyses provide the following two types of knowledge about a complex organization system: (1) knowledge about possible outcomes that result from the simulation of a policy alternative in a given situation and (2) knowledge about a mechanism that results in a notable outcome, which results from the simulation of a policy alternative in a given situation. ABSS researchers have concentrated on the problem of verification and validation of ABSS: common protocols, validation techniques and methodologies (*cf.* [1]). While these studies are rather for the researchers than for the stakeholders, ABSS practitioners recognize that it is critical whether the stakeholders trust the results presented by ABSS or not. If they do not trust the results, they will reject researchers' proposals or have less commitment to carry out the proposals.

ABSS analysis method called "scenario analysis" helps the users to acquire both types of knowledge described above. While this analysis method originally intends to help ABSS researchers to analyze the simulation results in a valid way, it can serve to persuade stakeholders that researchers' proposals are valid.

The primary purpose of this paper is to discuss a possibility of using scenario analysis to persuade stakeholders. This paper is organized as follows. Section 2 introduces scenario analysis briefly. The concept of validity in ABSS study is presented in Section 3. Section 4 discusses how the scenario analysis can contribute to validation for the stakeholders. Related problems are also discussed. In Section 6, we summarize this study[1].

[1] The work reported in the paper was supported in part by Grants-in-Aid for Scientific Research No. 21310097 and No. 22730312.

2 SCENARIO ANALYSIS

Agent-based systems consist of agents. Agents make a decision referring their value, norms, or attributes. Agents' behavior is determined by their own decision. The behavior at the macro level is formed by agents' behavior at the micro level. Meanwhile, a policy alternative and the system behavior have an impact on agents' behavior. These bottom-up and top-down interactions are called "micro- macro links" of agent-based systems.

Scenario analysis consists of the following two sub-analysis: landscape analysis and micro dynamics analysis. Landscape analysis serves to acquire knowledge about possible outcomes that result from the simulation of a policy alternative in a given situation. Micro dynamics analysis serves to acquire knowledge about a mechanism that results in a notable outcome, which results from the simulation of a policy alternative in a given situation.

(1) Landscape analysis [2]

A landscape of possible outcomes illustrates the performance index values based on the selected alternatives at the selected point in time (see Figure 1). This landscape records the performance index values for each policy alternative at the target point in time and plots them on a two-dimensional plane defined by a vertical performance axis and a horizontal policy-alternative axis. Therefore, analysts can select outcomes for further analysis (micro dynamics analysis) after they grab possible outcomes by each policy alternative.

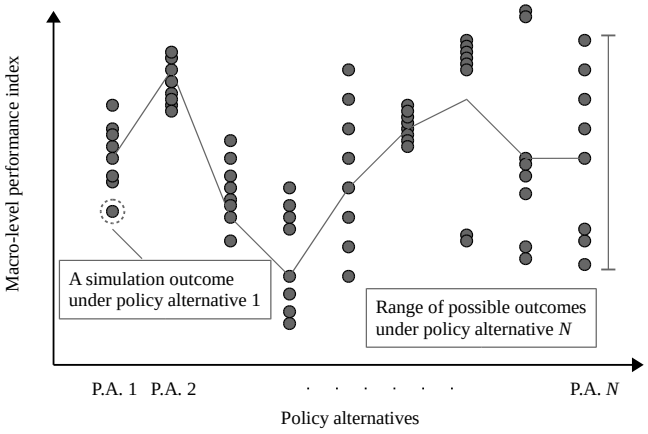

Figure 1: Landscape of possible outcomes

(2) Micro dynamics analysis

Through micro dynamics analysis, analysts attempt to understand why such an outcome is generated by the ABM. Analysts collect various agents' data, and then they link

these micro level data to the macro level behavior of the system. If micro dynamics analysis succeeds, analysts will find any mechanisms that can give a logical explanation of the micro- macro links.

3 VALIDITY IN ABSS

In recent years validity in ABSS has been discussed. The latest trend suggests that there is no perfect answer to validate ABSS because validation is a kind of social process [3]. In this paper, our concept of validity in ABSS adopts a pragmatic perspective. If stakeholders trust the results presented by ABSS, the ABM is valid for the stakeholders.

When do we trust the results presented by ABSS? The main sources of skepticism are as follows:

1. Arbitrariness of choosing a theory built into the ABM
2. Arbitrariness of determining a parameter value
3. Arbitrariness of presenting a result of ABSS

However several studies tackled the first two problems [4, 5], the last problem has not been tackled. In ABSS, the behavior at the macro level is formed by the complex interactions between a great many parameters at the micro level. These parameters' values are often determined by specific probability distributions and are changed through specific probabilistic processes. Such use of the probabilistic concept represents the uncertainties in ABM. We define these uncertainties as the concept where modelers of the system do not have sufficient information or knowledge about the elements or the interactions in the system. Therefore the behavior observed after every run of ABSS can vary considerably.

Traditional presentation of ABSS results tends to introduce an outcome of a typical run without showing any outcomes of other runs. This representation is a source of skepticism because an audience does not understand why this result is selected. Even if more than one run are considered, the traditional presentation is limited to a statistical result. It is not enough for audience to understand the mechanism of how the outcome is generated because statistical indices give no explanation about the micro-macro links of the ABM. For this, a further analysis is required.

4 DISCUSSION

(1) Our idea for validation

We discuss how scenario analysis can serve to persuade the stakeholders to trust the result presented by ABSS. Landscape analysis gives a landscape of possible outcomes, and then select outcomes for micro dynamics analysis. Therefore, stakeholders can understand why this outcome is selected. Micro dynamics analysis links micro level data to the macro level behavior of the system. Therefore, stakeholders can understand a logical explanation of why such an outcome generated. For these two reasons mentioned above, we expect that scenario analysis contributes to validation for stakeholders.

(2) Information system for effective persuasion

Validation for stakeholders in practice requires an information system (IS) that supports effective persuasion. In the persuasion process, researchers need to interactively perform scenario analysis in real time. The results of scenario analysis should be easy to understand. Therefore, the IS should have a rich graphical visualization function.

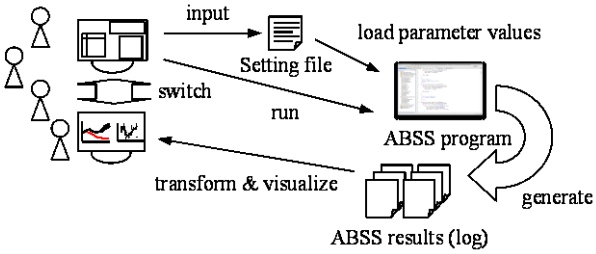

Figure 2: Tentative design of ABSS scenario analyzer

While most of the well-known ABSS toolkits[2] can perform interactively in real time with rich graphical visualization, they lack the function of supporting scenario analysis. Figure 2 shows a tentative design of ABSS scenario analyzer for effective persuasion. This system should accept user's input and run the ABSS program in real time. After the transformation and visualization of ABSS logs, ABSS results are shown to users in the rich graphical presentation. After the switch of the screen, the user can change some parameter values and rerun the ABSS.

5 CONCLUSION

In this paper, we discussed how scenario analysis can contribute to validation for stakeholders. We expect that scenario analysis contributes to the validation for stakeholders because landscape analysis and micro dynamics analysis solve the problem of the arbitrariness of presenting a result of ABSS. The validation for stakeholders in practice requires an information system (IS) that supports users to interactively perform scenario analysis in real time.

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Never Die Network Infrastructure for Disaster Areas, Study on Reconfiguration Techniques

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Abstract - In the aftermath of a disaster, various essential services experience service interruption. The standard communications infrastructure lends itself to service disruptions more than other infrastructures, due to its reliance on underground landlines. As such, this basic infrastructure generally experiences disruptions in service.

After a disaster, the demand for the communications infrastructure reaches its highest point. The existence of a fail-safe communications infrastructure becomes vital for rescue operations, and safety information.

This study focuses on the creation of a disaster fail-safe communications infrastructure, the Never Die Network (NDN). NDN can provide the minimum communication requirements after a disaster, through the cognitive wireless network (CWN) and the satellite infrastructure. CWN utilizes the available wireless LANs after the disaster, rather than relying on the landline infrastructure.

In this paper, I define the Never Die Network. I introduce the basics for the creation of the NDN infrastructure, as well as address future challenges.

Keywords: Never Die Network; Cognitive Wireless Network; Satellite communications; Disaster information network

1 INTRODUCTION

The nation of Japan suffers frequently from natural disasters. In March 2011, Japan experienced the Tohoku earthquake and tsunami, which resulted in a substantial number of casualties. After the disaster, most of the essential infrastructures were damaged or destroyed. In addition to basic services, such as electricity and water, the cellular phone and landline networking infrastructures suffered greatly. The disaster caused line failures in the landline infrastructure, which weakened network communications. Cellular network base stations experienced power supply failures, causing them to switch to auxiliary power. Communication over cellular network became erratic due to restrictions on auxiliary power usage.

Immediately after the disaster, the communication infrastructure becomes as essential as electricity, and water. The rescue and safety efforts depend on the availability of a communication infrastructure. This enables the hospitals, emergency response teams, and disaster headquarters to share information rapidly and effectively. Efficiency and quickness in dispatch of emergency response teams and transmission of safety information by the public relations help ensure safety of family members and improve rescue operations after a disaster.

Naturally, the information needed before, after and immediately after the disaster differ as time passes. Figure 1 shows this change in requirements. Table 1 provides an explanation of the change in Figure 1 in more detail. For example, refuge, safety, and emergency information are most important at t3. In contrast, public services, and lifeline information become more important afterwards.

Subject	Necessary Information / time	t_1	t_2	t_x	t_3	t_4	t_5	t_6
Victim	Disaster Prevention	△	○					
	Evacuation		○		◎			
	Safety				◎	◎	○	△
	Stricken Area				◎	○		
	Traffic				○	◎	◎	
	Relief Supplies					◎	○	
	Public Service					○	◎	
	Lifeline					○	◎	
	Local Government					○	◎	
Relatives Volunteer	Safety				◎	◎	○	
	Stricken Area				◎	○	△	
	Relief Supplies					○	◎	

Figure 1: Demand for information after the disaster

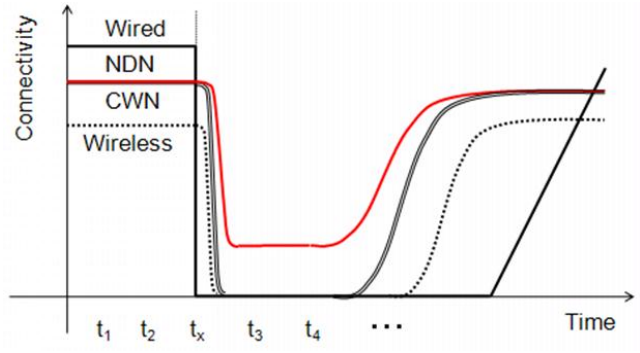
	Condition	Activities	Period
t_1	Normal		
t_2	Indication of Disaster	Indication, rumor etc	2 weeks before – Disaster
t_x	Occurrence of Disaster		During Disaster
t_3	Just after Disaster	Rescue, evacuation, safety of life	Disaster – 2 days
t_4	Calm down from Disaster	Relief materials, safety of life	3 days – 2 weeks
t_5	Restoration form Disaster	Restore lifeline, residences, and so on	3 weeks - several months
t_6	Revival		

Table 1: Definition of the time after the disaster

2 NEVER DIE NETWORK

As mentioned earlier, reliable communication becomes vital after a disaster. As such, low throughput and high delays are tolerated in favor of continued connectivity. In this paper, we propose a network capable of providing fail-safe connectivity even after a disaster. The emphasis of this network is on maintaining connectivity without regards to quality. This network is called the Never Dies Network (NDN).

Graph 1 shows the objective of the Never Die Network. At time tx on graph (immediately after the disaster), both wired and wireless infrastructures experience failure. Although communication quality is affected by disaster, minimum connectivity is maintained by NDN.



Graph 1: Never Dies The goal of the network

2.1 Cognitive Wireless Network

In this study, the wireless infrastructure's lack of reliance on landlines provides flexibility over the standard wired networking infrastructure, and provides a more fail-safe alternative. All nodes in NDN have multiple wireless LAN antennas, routing, ad hoc, and multi-hop capabilities. Each wireless specification has distinct characteristics, some provide high throughput with short signal strength, and others can withstand obstruction and span longer distances, with low throughput. Each node is connected by multiple wireless links of distinct specifications, which make up the mesh network. Combination of the different wireless LAN standards (IEEE 802.11a / b / g / j and IEE 802.16 (WiMax)) provide flexibility by switching to the preferred link depending on the traffic requirements. Each node continuously monitors the status of the link, thereby switching to the perfect link.

2.2 Satellite network system

In this study, in addition to multiple wireless LAN, using a satellite network system. Network satellite system will be less affected by the disaster more than a Wireless LAN communication is considered to be stable even after the disaster. However, there are drawbacks to satellite communications. If it is low throughput, but latency is large. In this study, treated as a common link for the satellite communications network control basically. If you can not only if the wireless LAN communication, information and communication links for use as a satellite link disaster.

3 RECONFIGURATION OF NETWORK

After a disaster, the disaster headquarters rise, rescue information and safety information is aggregated there. Network control information is centralized at the headquarters of disaster, you can send a car to a local mobile wireless LAN connection is not possible, or to change the destination, such as wireless LAN intentionally to control the network.

If wireless LAN fails, we describe using reconstruction of the satellite. Immediately after a disaster, each node to check their first victim. If wireless LAN communication can be used to initiate communication with the neighbors in the wireless LAN. Then send a message to the network via satellite survival. If the failure or wireless LAN, and there is no node that can communicate with neighbors, if you can not communicate with the wireless LAN to communicate by satellite. Then, it sends a message that it can not communicate in a wireless LAN. Headquarters and other disasters, the government sent a communication to support mobile communications vehicles, such as near a node in a wireless LAN communication is not possible.

4 CONCLUSION

This paper described the construction of communication networks that can never die even after the disaster minimal quality. Telecommunications infrastructure is important in post-disaster reconstruction in the satellite network by multiple wireless LAN standards, it is possible to construct a more flexible network.

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Automatic Safety Checking System to Reduce Manual Telephone Call Time

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Abstract –The number of solitary deaths of elders is increasing every year in Japan. We developed a wellness-report system in which an elder makes a wellness-report call to the social welfare center (SWC). The SWC staff calls the elder to check his/her wellness if no wellness-report is received from the elder. However, the system introduced a new workload to the SWC staff when many elders forgot to make the call. Our project is to reduce the staff's phone workload by an automatic wellness-report reminder call.

Keywords: solitary death, elders, safety monitoring, living alone

1 INTRODUCTION

Social isolation of elders has become a serious problem in Japan like other developed countries [1] and the number of solitary deaths of elders is increasing every year. In December 2009, Iwate Prefectural University and the Iwate Prefectural Council of Social Welfare (IPCSW) introduced a wellness-report system to monitor elders living alone and to reduce the number of solitary deaths. In this system, an elder calls the social welfare center (SWC) to report his/her wellness. When there is no call from an elder, the SWC staff calls the elder to check his/her wellness. However, the system introduced new workload to the SWC staff when many elders forgot to call. Our project is to reduce the staff's phone workload by an automatic wellness-report reminder call.

2 WELLNESS-REPORT MONITORING SYSTEM

Figure 1 shows the wellness-report system that we developed for the Iwate Prefectural Council of Social Welfare. The system works as follows: 1. An elder calls the SWC and is instructed to press one of 4 telephone push buttons according to how well he/she feels: 1= “Fine”, 2= “Not so fine”, 3= “Bad” and 4= “I want to talk”. At 4 pm, the manager of SWC decides to call or visit depending on the elders’ wellness-report on the Web page. The Web server e-mails the wellness-report to pre-registered neighbors and families who live away from the elders. Nearby supporters can also send in observations on the elder by cell-phone, e-mail, or a Web-site information board. The SWC manager can also send daily messages, which is entertaining for the elders.

The system's main characteristics are: 1. It gives the elders personal independence and initiative by letting them be aware of their wellness and make their own wellness-report calls; 2. It requires only a telephone and it is easy to use [2]. These characteristics are distinctly different from a Sensor Type Monitoring System and an Emergency Call System which have the problems of a lack of privacy and frequent false alarms.

Some elders occasionally forget or are not able to make a wellness-report call. When there is no call, an SWC manager calls the elder at the specific time to check his/her wellness. But, this is also a problem. If many elders do not call, the SWC manager has to make many calls. According to our field tests in the Kawai area of Miyako city in the Iwate Prefecture of Japan, the average no-call rate for 30 to 40 users was 12.3%. If the number of system users increased to 1,000 (expected number in the future), the SWC would have to make over 100 telephone calls per day!

Our existing system has an automatic daily calling function (reminder-call) at a specified time. However, the method to specify the time was not formulated yet and therefore this function is not used now. If the reminder call time is too early, it irritates the elder, and if too late, the wellness-report time will be late which will be of concern to the relatives. This paper proposes a method to specify the reminder-call time.

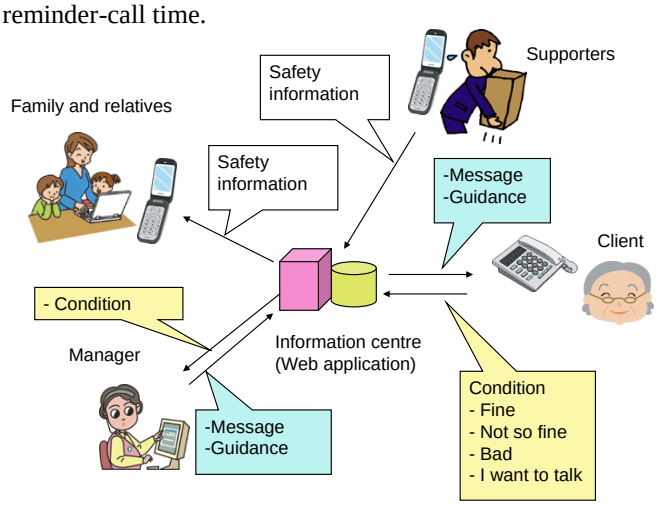

Figure 1: Wellness-report system

3 ANALYSIS OF STORED DATA

We analyze the actual wellness-report time data obtained from our experimental system.

3.1.1 Variability of daily wellness-report time

We obtained the wellness-report call time data from long term real-world users. We selected 67 out of the 440 current users. These 67 elders regularly used the system for over 360 days.

The data consist of the wellness-report of “Fine”, “Not so fine”, “Bad” and “I want to talk” and the wellness-report call time of each user.

Table 1 shows the range of the call time of the 67 elders. IQR is the “Interquartile Range” defined as:

$$IQR = Q_3 - Q_1, \quad (1)$$

where Q_1 is the 25 percentile and Q_3 is the 75 percentile of the daily call time of an elder.

We found that the call time variation in 75-100 percentile is small for this half while it is large for the other half (IQR>30). This means that an elder with a small IQR with a median at 10 o'clock makes a wellness-report call no later than 11. On the other hand, an elder with a large IQR makes a call maybe two hours after the median. Thus, it takes a long time to determine whether this elder forgot to call.

Table 1: Variability of daily self-sending time

IQR			Number of Users
1 hour	~		22
45 minutes	~	1 hour	5
30 minutes	~	45 minutes	8
15 minutes	~	30 minutes	10
7 minutes	~	15 minutes	10
0 minutes	~	7 minutes	12

3.1.2 Variability of daily wellness-report time

We analyzed the wellness-report call time data. Figure 2 shows the transition of the difference in the IQR between the successive days for all users who are on the system over a period of 360 days. We found that the difference has large variability over the initial period of 36 days. After 36 days, the variability for 95% of the users becomes less than ±30 minutes.

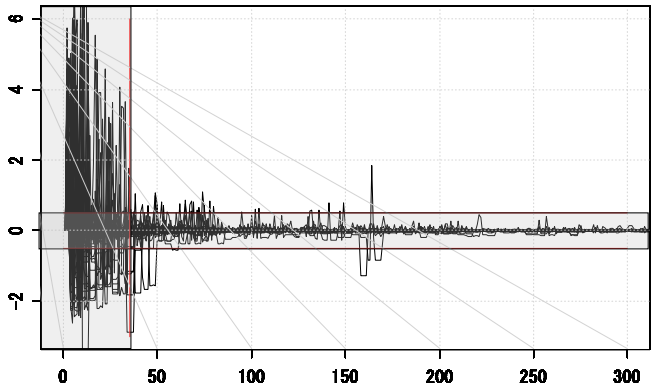

Figure 2: Difference of IQR between successive days

3.2 Trend of self-sending time for users

Based on the above analysis, we propose the following method to determine the reminder-call time.

1 Record the time of the daily call for each elder, and calculate the daily IQR

2 If the difference in the IQR between two successive days becomes a small enough value, then determine the threshold for the automatic reminder-call time.

3 If the elder does not call after the threshold time, the system gives the reminder-call.

The threshold time (T) is calculated as follows:

$$T = Q_3 + s*IQR.$$

4 SUMMARY

We proposed an automatic wellness-report reminder call to reduce the SWC staff's phone workload. It is important not to discourage the elders' willingness to stay on the system. Careful consideration was given in determining the reminder-call time. We plan to validate our automatic-reminder-call subsystem by simulation using actual data. We plan to evaluate the effectiveness of our proposal by interviewing elderly users and IPCSW staff.

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An Advanced Surveillance System Utilizing Omni-Directional Cameras

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Abstract -. Today, there is a demand for surveillance camera systems that have a wide area of coverage for safety or crime prevention. However, popular surveillance camera systems suffer from low view angle and a limited range of coverage. So far, we have been investigating surveillance video systems [1] consisting of USB type omni-directional cameras and PTZ (Pan/Tilt/Zoom) cameras. However there are some problems with real-time response of PTZ cameras and image resolution of omni-directional cameras. And, in the case of USB type omni-directional cameras, the cable length between the camera and PC is limited. Therefore, as the number of the cameras installed is increased, the whole surveillance system becomes so complicated that it can be difficult to realize a seamless surveillance system. In this paper, seamless surveillance systems by omni-directional camera network is proposed by using multiple omni-directional Gigabit Ethernet Cameras..

Keywords: Omni-Directional, Gigabit Ethernet Camera, Surveillance System.

1 INTRODUCTION

In recent years, surveillance systems has been used for security and safety of people. And it is required not only to capture high quality and wide area images, but also to automatically track to the specific suspicious persons in real-time to reduce the number of the required surveillance cameras. The popular surveillance systems use one way cameras and a large number of the recording devices must be installed to cover a wide area. First, we introduced a combination of PTZ (Pan/Tilt/Zoom) Cameras and omni-directional cameras. Omni-directioal camera can shoot video in 360 degrees and detect a moving object. The PTZ camera can be automatically controlled by properly zooming to follow and identify the moving object. But a PTZ camera's area of coverage is the same as the case of the conventional one way cameras and time lag from control input means that they are not suitable for real-time applications. On the other hand, Gigabit Ethernet cameras that provide high-quality real-time video are already being used for teleconference systems between remote locations.[2] In this paper, we propose a surveillance system which uses multiple Gigabit Ethernet cameras with multiple omni-directional cameras as sensors.

2 SYSTEM CONFIGRATION

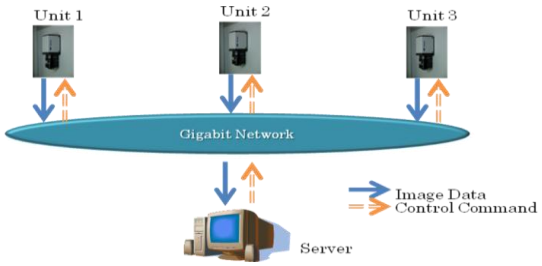

Figure 1: System configuration.

Our proposed surveillance system is organized by multiple omni-directional cameras which work on the Gigabit Ethernet as sensors for the surveillance server. Each Unit is an omni-directional camera powered over Ethernet. The surveillance server performs image conversion processing to convert the camera's ringed image to a panoramic image, and then performs moving object detection and tracking processes. Fig.1 shows our proposed system configuration.

The Omni-directional camera is a Gigabit Ethernet camera mounted with a PAL lens. The cameras capture a ringed image and transmit it to the surveillance server. The surveillance server converts the image to a panoramic image, and then processes it to extract the moving objects. After that the characteristic values of the moving objects are calculated.

The surveillance server's processed image is shown in Fig.2.

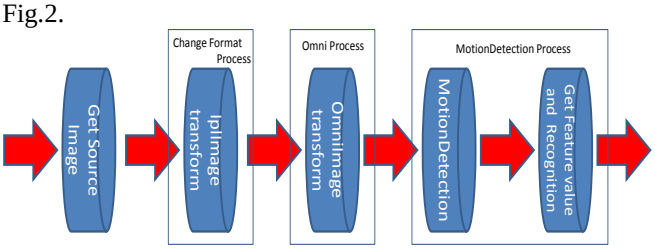

Figure.2: Image process Flow

Two of the most important processes are the Omni Process and Motion Detection Process. Omni Process expands the ringed image to a panoramic image using the Omni Image transform module. Then, moving object detection and recognition are carried out by extracting the characteristic values of the moving object in the Motion Detection Process. If the moving object is detected, then the characteristics value of the moving object is calculated.

3 OMNI PROCESS

Figure.3: Omni Image

Fig. 3 shows a 360 degree original ringed image which is captured from the omni-directional camera mounted with a PAL lens. Panorama image converted as shown in Fig. 4

Figure.4: Panorama Image

4 MOTION DETECTION PROCESS

After expanding to a panoramic image, the processing system attempts to detect a moving object. This process uses a background differencing method. Then, the noise detection process is carried out to determine whether the difference part contains noise. If there is no noise, the difference part is recognized as a moving object and estimates the location of the moving object. Fig. 5 is an output image after the area estimation process.

Figure.5: Motion Estimated Area

After estimating the area of the moving object, the extracting process of the moving area's image, which was specified by the omni process, is carried out.

After extracting the moving objects, the characteristics value of the object is calculated to be identified and modeled. Then characteristics of the moving objects between the previous and current frames are compared. If two moving objects have the same values, then they are identified as the same object and updated and assigned the same descriptor. If two characteristics values are not same, then a new descriptor value is assigned with the characteristics value.

There are two object identification methods in our system. The first method is Color Histogram. The color histogram method is popular in recent research for image identification. The second method is Motion Objects focus. This method makes it possible to track a case where the object goes outside the capture area and returns again.

5 MULTI CAMERA PROCESSING

We propose surveillance system in which multiple cameras are introduced to cooperatively operate. Using multiple cameras, more precise moving object detection can be handled in a wider area by exchanging the object information with characteristics value among those cameras. With this cooperation it is possible to track moving targets over a wider area. We propose the following cooperative work method between those multiple cameras.

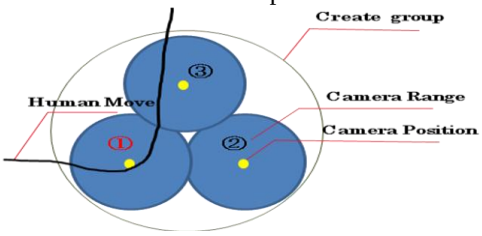

Figure.6: Multi Omni-directional camera's image

Fig. 6 show a Multi Omni-directional camera installed. First, the neighboring cameras are recognized as the same group. This group assignment is predetermined by a user in advance. When camera 1 detects the moving object, this object information, such as the characteristics value, is shared in the same group. In this case, the information which is generated from camera 1 is shared by camera 2 and camera 3 in the same group. As the moving object moves from camera 1 area to camera 3 area as shown, the process compares the moving object and the previously shared moving object information. If both are the same object, then its descriptor value is updated and the object is tracked by camera 3. By repeating this process, the moving target object is identified and tracked while the object moves in whole areas covered by the camera group.

6 CONCLUSION

In this paper, we proposed a new surveillance camera system based on the Gigabit Ethernet omni-directional camera. When compared with traditional one way camera systems, the omni-directional system provides a wider area of surveillance with fewer cameras.

In future research, our system's recognition method has to be improved. This method could not identify objects well in the effects of bright sun-light and dark human shadows. More reliable identification method which can consider the change of the environmental lights should be introduced to improve the success rate. Finally we will develop and implement a multiple omni-directional camera system to support wider area surveillance

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Adding Request Icon Enhancement Functions for Broadcasters of Audience-driven Internet Broadcasting System

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Abstract – AdlivTV, our previous work, has the issue that it is difficult for its broadcaster to respond to a lot of request icons that come in a short time. In this paper, we propose request icon enhancement functions that tell the broadcaster which request icon the most audience members have sent. By these functions, the broadcaster can choose a request that is desired by many audience members. We implemented a management function of audience IDs on the client so that the broadcaster can understand how many audience members send the same requests. Server functions are also implemented to send the audience ID of each request and the total number of the current audience. This paper reports the operation verification result of a prototype system that had three different request icon enhancement functions.

Keywords: Internet broadcasting, Audience Driven Live TV

1 INTRODUCTION

As the Internet becomes faster and web applications become better, broadcasting services become more popular. People who have never broadcast before can now easily and cheaply buy equipment and use services like Ustream and JustinTV. It is difficult for people who have never broadcast before to make profesional looking videos. So to solve this problem, we proposed audience driven live TV(AdlivTV) so that the broadcaster can receive audience suggestions. Using AdlivTV the audience can send requests in the form of icons to the broadcaster. An AdlivTV broadcast with audience requests will help a broadcaster create a more intresting broadcast. With the previous system of AdlivTV we found that it was difficult for the broadcaster to know which icon to follow because request icons could arrive too quickly. For this project we decided to add request icon enhancement functions for broadcasters to assist them in useing the AdlivTV system. We made three enhancement functions that we found from research into related work and checked that all the functions worked togther.

2 PREVIOUS WORK

AdlivTV is an Audience Driven Internet broadcasting system. Figure1 is representation of the design of the original AdlivTV. The audience can send requests to the broadcaster by icon. By using the audience requests the broadcaster can make an audience driven broadcast that will be a more interesting broadcast. As part of the previous work we preformed experiments where the broadcaster would receive requests too quickly making it difficult to know which request to follow.

Experience from the previous work shows that requests could arrive at a rate of over 200 per minute. With some request combinations it was difficult for the broadcaster to choose which to obey.

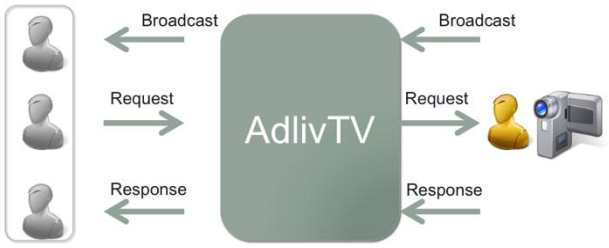

Figure1: Design of the previous work

3 NEW APPROACH

The purpose of the new project was to solve the problem where audience requests would arrive too quickly. For the new project we realized that we could assist the broadcaster by highlighting the icon with the majority of requests. To calculate the audience majority we added functionality to both the server and the broadcaster's client. On the AdlivTV server we added an ID to track audience members and on the broadcaster's client we added a way to calculate the majority and highlight the icon of the request with the majority. We then did research for the project on which highlights were most used by related works. From this research we found that the most commonly used highlights were expanding the icon and adding color to the icon. We focused on a medium to small audience. Because previous work focused on medium to small audiences and most Internet streaming services have about 30 audience members at the same time.

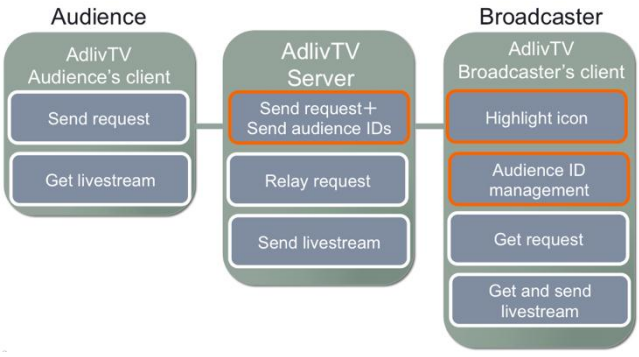

Figure2: Additions from the new approach

4 IMPLEMENTATION

To implement the broadcaster's client we added audience ID management and the ability to calculate the majority and highlight the icon with the majority of unique requests. In the server we implemented the ability to assign audience IDs and send the total number of audience members.

4.1 Audience ID management

We implemented the ability to use audience IDs to calculate which requests had majority. We used the audience IDs along with the total number of audience members to calculate the majority. Part of the function of the AdlivTV server is to send the total number of audience members and audience IDs to the broadcaster's client. In the broadcaster's client we implemented the ability to calculate which request has majority and the ability to highlight that icon. Based on previous work we decided that any request with at least a 10% majority would have its icon highlighted.

4.2 Highlight effects

Because of how our project differed from related work we choose three highlight effects. The expand effect, to make an icon with majority bigger in size than an icon without majority. Depending on the size of the majority the expand effect on the icon will be greater. The color effect, to make an icon with majority have a colored shadow that is more shaded than an icon without majority. Depending on the size of the majority the amount of shading on the icon will be greater. We also implemented a highlight which is a combination of the expand and colored effects with is also affected by the size of the majority.

Figure3: Example of expand and color effects

5 SYSTEM CHECK

We did a system check to make sure the system worked and to get comments from the examinees. Figure4 is a diagram of the system check environment. For the system check, seven third year students from Iwate Prefectural University used the system. During test the students used four systems, the original AdlivTV system, and a broadcasters client with each of the three highlight effects, expand, add color, and a combination two. Examinees used each system for five minutes. We set up three AdlivTV audience clients to be used by high school students who were on a tour of our university. We then interviewed the examinees on their opinions of the different systems.

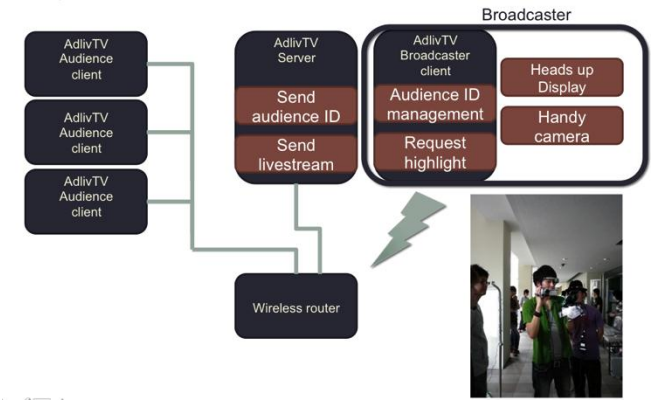

Figure4: System check environment

6 RESULT

The result of the system check was that the system worked as expected. From the interviews of the broadcasters we found that the view of the screen is not blocked by any of the highlight effects. Also that the Icon expand effect is easy to understand and the colored effect is difficult to notice. We found that there was a difference between how noticeable the different highlight effects were.

7 CONCLUSION

The challenge of previous work was that request icon would arrive too quickly and the broadcaster would have difficulty knowing which request to obey. For the new approach we added request icon enhancement functions that show that a request icon is sent by a majority of audience members. To get the majority, we added functions to both the AdlivTV server and broadcaster's client. The server sends requests and audience member totals to the broadcaster's client, which uses them to calculate the majority. We did research and decided on three enhancement effects, the expand effect, colored effect, and a combination of the two. We checked the system to make sure it all worked together and to get comments from the examinees. Examinees tested the original system and three versions of the new system. We then interviewed the examinees on their opinions of the different systems. We found out that we will have to account for the difference between how noticeable the different highlight effects are. We need to research why the highlight effects are different and test under the same conditions as previous works.

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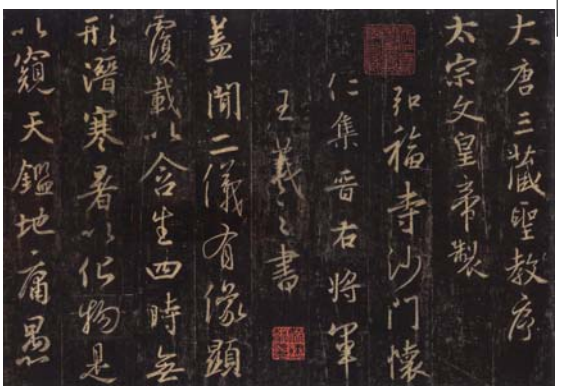
Ancient Chinese Calligraphic Letter Matching (Project Proposal)

Kosuke Imamura, Akemi Nishiyama

"Ji Wang Sheng Jiao Xu (集字聖教序)
Wang Xizhi (Chinese: 王羲之 , 303–361)



What are we after?

Wang Xizhi (王羲之) did not write Ji Wang Sheng Jiao Xu (集字聖教序).

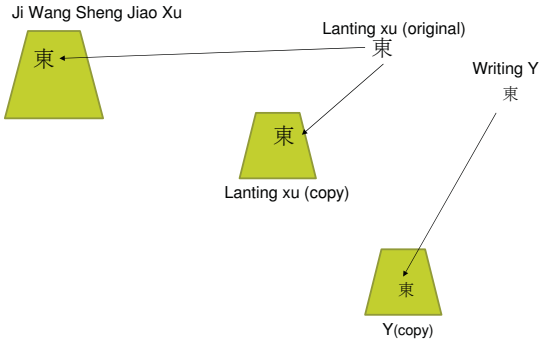
It is a Buddhist Sutra inscribed using letters collected from various writings of Wang Xizhi.

But nobody knows from which writings those letters came, so we are trying to find the writings.

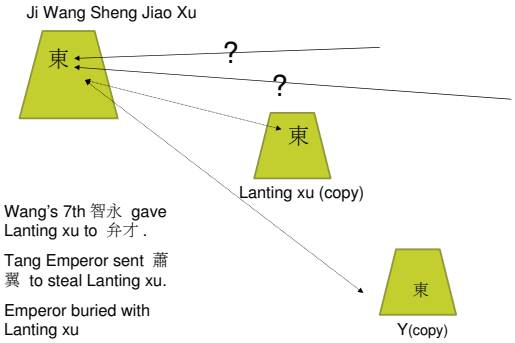
Project Goal

- To find Wang's calligraphic letters in "Ji Wang Sheng Jiao Xu (集字聖教序)" resembling to ones in " 興福寺断碑" and other writings

Wang's writings were copied by capable calligraphers



Original Writings are all Lost!!!!



ISBN978-4-902523-26-3

Preface to the Poems Composed at the Orchid Pavilion (蘭亭集序)

7

Why?

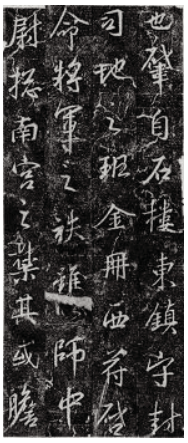
- Wang Xizhi (Chinese: 王羲之 , 303–361) “Calligraphy Saint”, all his original calligraphic works are lost, except a stele of “Ji Wang Sheng Jiao Xu (集字聖教序)”.
- Historical Curiosity! A step forward in restoring Wang’s calligraphy

8

興福寺断碑

- Noise removal
  - Wavelet
  - Fourier transform
  - Artificial learning

  (NN, GP, …)
- Database creation
  - Character storing



9

A few things

- Pattern recognition
- Creative in order to find matching parts
- Computing power (thousands of characters)
- Data preparation (separating characters, finding searchable patterns, image scaling/orientation)

10

Conclusion

Need people who are interested in

- Machine learning,
- Image processing,

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Media Transmission System Considering QoS on the Heterogeneous LANs

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Abstract – In this paper, We propose a system which considers QoS of video and audio on the heterogeneous LANs. We built the heterogeneous LANs in our past study [1]. We explain the summary of this system, but focus on the media transmission system. And we preform media transmission on the network which we built. Our system chooses the media quality that is most suitable for the network. Furthermore, when the network state changes, the system chooses the most suitable media quality again. We suggest an algorithm to decide the media quality. The media quality selection algorithm expanded the decision making method called the AHP.

Keywords: heterogeneous LANs, QoS, media transmission, AHP, wireless network

1 BACKGROUND OF RESEARCH

Japan is vulnerable to natural disasters. For example, there are secondary disasters caused form earthquakes such as Tsunami and fire. About 60 percent of the country in Japan is an intermediate and mountainous area. An existing communication infrastructure cannot be used in those areas and many villages are isolated when the disaster occurs.

We choose wireless communication because its ease of installation, mobility, and disasters have a smaller impact on wireless networks.

2 RELATED WORKS

COBRA[1] System always monitors network performances which are throughput, packet loss ratio, delay and signal strength. Depending on the change of those network parameters and the user requirements, COBRA System calculates the most suitable route. In this way, COBRA System continues choosing the most suitable route depending on real network performance. Furthermore, realization of QoS control that accepted user requirements to choose the route of delay line is enabled when it carries away important media content of the delay line.

2.1 About COBRA System

COBRA System consists of two layers. The first layer is "Network Monitoring layer". This layer acquires the network parameters from the networks. The second layer is "Network Configuration layer". This layer decides the route from the network parameters and user requirements. And COBRA System communicates by the decided route. COBRA System uses AODV routing protocol. COBRA System changes a cost level of the OSPF to communicate by deciding the route and perform routing in AODV. The control line is used to send an important message. For example, it is the control message renewing the cost level of OSPF. The control line is needed because it avoids what the packet of the control message loses when media stream data has already drifted. In addition, COBRA System exchanges the messages which are important to the media communication with this control line.

3 PURPOSE OF RESEARCH

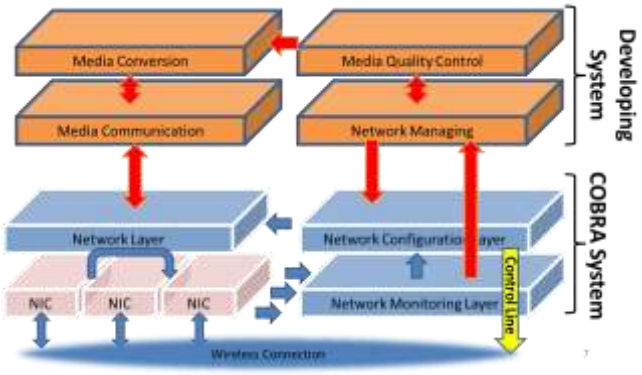
The purpose of this study is to offer a video and audio system that guarantees quality in a heterogeneous LAN environment. The system developed realizes this by acquiring network parameters and user requirements. Developing system using extended AHP to suggest from the data which the system acquired this time decides the media quality that is most suitable for the network. This system has to communicate with COBRA System to acquire network parameters.

4 SYSTEM SUMMARY

Developing system realizes media transmission controlled QoS between the end users. Therefore we acquire user requirements and network parameters to understand network state more from COBRA. The system choses the media quality that is most suitable for the network satisfying user requirements from the information that the system acquired.

5 ABOUT DEVELOPING SYSTEM

Figure 1 is the whole system which is developing system and COBRA System. Our developing system is divided into four main big functions. The first function is "Network Managing". The system communicates with COBRA System, and acquires network parameters and introduces user requirements into COBRA System. The second function is "Media Quality Control". This function acquires user requirements and decides media quality from user requirements and network parameters. Furthermore, there is the role to process so that COBRA System understands the user requirements that the developing system acquired. The third function is "Media Conversion". This processes then moves the media into the network with the decided media quality. The last function is "Media Communication" This function communicates the media according to the name.



5.1 System Flow

The developing system can divide the process flow into four steps. The first stage is the "Connection phase". In this phase, the system acquires user requirements and introduces them into COBRA. Then COBRA System builds a network. The second stage is the "Media accept phase". In this phase, the system decides the media quality from user requirements and the network state. The third stage is the "Media transmission phase". In this phase, the receiving side gives its requirements and then the media transmission begins. The last stage is the "Change in network phase". In this phase the network state is changed. At first, the network state is changed by the changes in the route. And the changed network parameters are written. The system detects and acquires network parameters again. And the system decides the media quality that was in the network state. Furthermore, the system begins the media communication again.

5.2 Media Quality Selection Algorithm

First the algorithm prepares. Preparations are the acquisition of user requirements, the making of the media quality list and the making of the hierarchy figure. Secondly the algorithm finds the weight of each parameter from the network parameters. Then the algorithm requires the geometric mean of each parameter in reference to [2] and [3]. NW is the weight of each parameter (1). The algorithm finds general values of each media and priority requirement for the network [2], *VGV* (2) and *AGV (3)*. The algorithm finds the ratio of video and audio from the general values. And the ratio of "Network or User" of the user requirement is *NUR*. The algorithm established it like the other user requirements. The algorithm, using the previously determined values, calculates the video and audio weights with the formulas (4) and (5). The geometric mean is determined from the paired comparison matrix (Table 1). After the quality values are found, the algorithm selects an item from the media quality list.

$$\frac{GM_n}{\sum_{i=1}^{4} GM_i} = NW_n \quad (1)$$

$$VGV = \sum_{i=i}^{4} (NW_i \times VNP_i) \quad (2)$$

$$AGV = \sum_{i=i}^{4} (NW_i \times ANP_i) \quad (3)$$

$$VW = VR \times NUR + VV \times NUR \quad (4)$$

$$AW = AR \times NUR + AV \times NUR \quad (5)$$

	Picture quality	Frame rate	quantization bit rate	Sampling frequency
Picture quality	1	$1/VV$	$\frac{VW}{AW}$	
Frame rate	VV	1		
quantization bit rate	$\frac{AW}{VW}$		1	$1/AV$
Sampling frequency			AV	1

6 CONCLUSION

This paper explained media communication method in consideration of QoS of the cognitive radio environment. And explained the extended AHP method to decide media quality.

A problem this research encountered was the inability to create a clear media quality list. This problem leads to an inability to select an appropriate item from the media quality list.

ACKNOWLEDGMENTS

I am also indebted to all persons whose opinions and information have helped me throughout my research. Finally, I would like to thank EWU for the opportunity

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Implementation and Evaluation of Hybrid routing protocol for wired/wireless mutually complementary communication protocol

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Abstract - In recent years, technologies of HEMS (Home energy management system) are studied by many researchers. There are various protocols to build a network for HEMS. We focus on a wired/wireless mutually complementary communication protocol which uses PLC for wired communications and IEEE802.15.4 for wireless communications. The protocol is currently implemented as proactive [1] or on-demand [2] routing protocols.

In this paper, we implement and evaluate a hybrid routing protocol which uses an on-demand protocol for uplink communication and a proactive protocol for downlink communication.

Keywords: HEMS, Hybrid routing protocol

1 INTRODUCTION

In recent years, energy consumption for households is rising. The reasons include changes in lifestyle to convenience of life, change of Structural society to increase in the elderly, and an Increase in the number of households and consumer electronics.

There is a need to promote energy saving in Japanese households. We should carry out energy saving as mandated by the Kyoto Protocol and Law Concerning The Rational Use of Energy.

Recently, we are investigating Home Energy Management Systems as a way to reduce energy consumption. It is automatic/indirect control and visualization for energy equipment by ICT (Information and Communication Technology). Because HEMS needs reliable control equipment and puts sensor nodes at variety of place, it requires high reachability and extensive network without installing new wire.

In this paper, we implement and evaluate a hybrid routing protocol which uses an on-demand protocol for uplink communication and a proactive protocol for downlink communication.

2 RELATED PROTOCOLS

The wired communication and wireless communication have some issues. For the wired communication, Ethernet has a high cost. . Power Line Communication communicates by inserting a plug into a socket. PLC is largely affected by the noise of the electronics. The wireless communication is affected by radio interference.

Therefore, we are focusing on a wired/wireless mutually complementary communication protocol. This protocol uses PLC for wired communications and IEEE802.15.4 for wireless communications. If wired communication isn't used, wireless communication is used. If wireless communication isn't used, wired communication is used. Wired/wireless mutually complementary communication is possible with high reachability and extensive network without new wire.

There are 3 protocols for MANET. Protocols for MANENT are proactive, on-demand and hybrid routing protocol. Wired/wireless mutually complementary communication uses Proactive routing protocol or On-demand routing protocol.

Proactive routing protocol is rapid communication by keeping routing table. So latency is low. If communication is interrupted, it requires route search. We can expect some disruptions. If it doesn't do route search, communication is unreachable. So, reachability is low.

On-demand routing protocol decides the route each time it sends. So, reachability is high. In order to determine the route each time the node sends a packet. So latency is high.

Because hybrid routing protocol changes depending on the situation for the two protocols, we think that it is possible to further improve latency and reachability by the hybrid routing protocol. Where to apply two methods in the HEMS in order to apply the hybrid routing protocol?

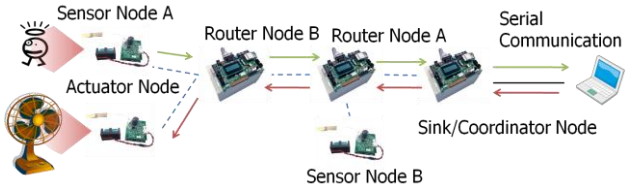
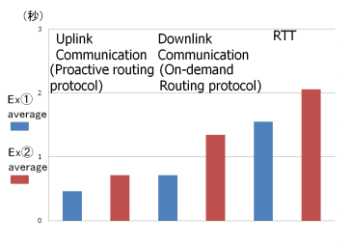


Figure 1: Topology for HEMS.

3 PROPOSED SYSTEM

3.1 Environment for HEMS

Figure.1 is topology for HEMS. The Sink/Coordinator node implements network and router node realize relay.



Number of Router	Latency of uplink Average(Sec)
2	0.442
3	0.713

Number of Router	Latency of downlink Average(Sec)
2	1.091
3	1.346

Number of Router	Latency of RTT Average(Sec)
2	1.55
3	2.054

Figure2 First experiment (latency measurement)

Sink/Coordinator and router node uses wired/wireless mutually complementary protocol. For end node, Sensor node does data collection and actuator node does equipment control. The end node uses IEEE802.15.4.

For construction of HEMS, there is one Sink/Coordinator node, about 6-8 Router Nodes, about 50 Sensor Nodes per house and one Actuator Node per electronic device.

3.2 Proposed Method

Our Hybrid routing protocol takes advantage of the features of the Proactive routing protocol and On-demand routing protocol. We divided uplink communication and downlink communication. Uplink communication sends to sink/coordinator node. Downlink communication sends to sink/coordinator node.

For uplink communication, a sensor node generates a large amount of sensor data. Uplink communication is thus characterized by high latency as a result of the sensor data. Protocol of uplink communication requires a method of low latency. Proactive routing protocol is used for uplink communication.

For downlink communication, the Sink/Coordinator Node sends to the actuator node control command of equipment. Sending time for downlink communication is less than for uplink communication. In order for reliable control of equipment, it requires reliability communication. On-demand routing protocol is used for downlink communication.

3.3 IMPLEMENTATION

We developed an application board to evaluate wired/wireless mutually complementary protocol. This time, we evaluated the hybrid routing protocol for wired/wireless mutually complementary protocol. We selected an IEEE802.15.4 RF module and a middle speed PLC module. Our hybrid routing protocol selects Proactive routing protocol for Uplink communication and On-demand routing protocol for downlink communication.

When we build a sensor network, we first start the Sink/Coordinator node. Because collected sensor data is sent to the Sink/Coordinator node, we first start the Sink/Coordinator node. So, the Sink/Coordinator node is Subnet ID 0x00 and Device ID 0x00.Our protocol rules decide the Sink/Coordinator and router node is Device ID 0x00 and end node is Device ID excluding 0x00. If Subnet ID is 0x00 and Device ID is 0x00, it is Uplink communication. If Device ID is not 0x00, it is Downlink communication.

Table 1: Second experiment (reachability measurement)

Send output value 0dBm (Stable)	Packet arrival rate(%)
Proactive	100
On-demand	100
Send output value −3dBm (Unstable)	Packet arrival rate(%)
Proactive	65
On-demand	100

4 EXPERIMENT AND RESULT

We performed two fundamental experiments. ED means end node. RT1 and RT2 means router nodes. Sink means Sink/coordinator node. GW is gateway.

First experiment is latency measurement for hybrid routing protocol. The end node sends to the GW sensor data. This experiment compares the latency of the uplink communication and downlink communication. This experiment was conducted in our Lab. Experiment 1 is the end node send to the GW the sensor data through RT1 and SINK. Experiment.2 is the end node send to the GW the sensor data through RT1, RT2 and SINK. Content of Sensor Data is Sensor ID, two temperatures, humidity, battery voltage, motion and lux. This experiment measured the latency of sending 100 packets. Figure.2 shows this result. Latency of uplink communication is less than latency of downlink communication.

The second experiment is a reachability experiment for the hybrid routing protocol. The RT1 sends to the Sink control commands for equipment through RT2 or RT3. Transmitted data is the control command,「IRTX 0 1」.

Experiment measured reachability by also sending 100 packets in 5 trials. This experiment switches the sent output value of RT2. Experiment.2 records a reachability state of Stable vs. Unstable. The output value is 0dBm for Stable and -3dBm for Unstable (See Table 1). When it uses On-demand routing protocol, packet arrival rate is always 100%. Reachability of downlink communication is more than reachability of uplink communication.

5 CONCLUSION

For latency measurement, latency of uplink communication is less than latency of downlink communication. For reachability measurement, reachability of downlink communication is more than reachability of uplink communication. Uplink communication has low latency and downlink communication has high reachability for wired/wireless mutually complementary communication.

For future work, we will perform long-term data collection.

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