Real-time Camera Image Transmission and Disclosure System of a Local Tourist Spot and its Application to an Advertising Campaign for Tourist and Citizens at Public Facilities Managed Mainly by Students Utilizing the Student Challenge Project Organized by Hachinohe Inst. of Tech

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ABSTRACT

The authors previously developed an ultra-small and economical remote monitoring system featuring low operational cost by connecting various sensors to a microcomputer running on Linux OS and embedding VPN software, which can be operated with a private IP address. Moreover, the authors have also shown that the camera images and information from sensor-remote locations can be acquired through a web browser using a smart device such ad tablet PCs. Against such a background, this paper reported the application to regional economic development projects at public facilities managed mainly by students using the above system and utilizing the student challenge project organized by the HIT (Hachinohe institute of technology). Specifically, an ultra-small and economical real-time camera image transmission system featuring low operational cost constructed by improving the software of the above system was temporarily installed to the tourist spots. Moreover, the system for distributing camera image and sensor information on an internet via the cellular network and HTTP server on the campus of HIT was constructed targeted at the whole world. An event of a course of lectures was held managed mainly by students targeted at local residents using above system in Tanesashi coast, Hachinohe city, Aomori, which is tourist spot on December 14th, 2014 hosted by HIT Team Tanechan, which is a volunteer activity groups. They were able to have exhibit this event for the purpose of getting only local residents but also tourist to understand the Tanesashi coast managed mainly by students trough these activity. Moreover, an educational campaign for ICT for local residents and tourist can also be practiced through their activities at Tanesashi coast as a role of regional institute of technology. This paper reported the specific result regarding above activities in order to revitalize the local area. In addition, thereafter, in 2015, this association applied and adopted for the subsidy program of 2015 fiscal year Hachinohe city town development by the students, which is referred and served from the Hachinohe city hall, Aomori. Then, they are unfolding activities in cooperation with the local community extremely actively for the purpose of the various town development project utilizing ICT using funds from the Hachinohe city by evolving above activity.

Key Words: *Internet, VPN, Cellular network, Remote monitoring, Raspberry Pi, Computer Network education*

1. Introduction

In previous research, the authors embedded a VPN (Vertical Private Network) program using a Linux microcomputer and connected various sensors with USB

and similar [1]. As a result, we have constructed an extremely compact and inexpensive remote monitoring system that eliminates the VPN router and sensor information acquisition device. Here, the VPN embedded in the microcomputer was operated even with a private IP address dynamically assigned from the Internet service provider or Cellular network carrier. Furthermore, this VPN program can connect between terminals (or between server and client) traverse NAT (Network Address Transmission) and firewall. Thus, temperature and humidity data and camera images from a sensor system installed in a remote place can be acquired with a simple and low operation cost using a notebook PC, a tablet PC, a Smartphone, and similar.

In the past, the authors carried out ICT skills acquisition courses such as installing the operating system on the microcomputer, setting up the network, capturing cameras and sensor information, and transmitting information via the Internet for normal high school students in order to utilize these systems. And, the practical example of the above ICT education was reported [2].

Furthermore, we formed an activity group by students of the HIT to utilize this low-cost sensor information remote monitoring system and to carry out various activities that contribute to the local community in fiscal 2014. This activity group was adopted as one theme of the student challenge project in the same year, and funds were issued from HIT. Utilizing these funds, the students of our university constructed a system under the guidance of teachers that transfers sensor information of cameras etc. acquired at a remote place to the FTP server set up in the computer in the university via VPN, and distributes information from the web server. A microcomputer connected with a sensor that can be connected to the Internet via a mobile phone line was temporarily installed in the Tanesashi Coast Information Center in Hachinohe City, Aomori Prefecture in order to apply these developed systems to regional development. Moreover, we conducted a seminar on IT technology in order to disseminate IT to the local residents that discloses information to the world from Web servers installed at Hachinohe Institute of Technology with these devices. This paper reports on these activities.

2. Overview of the student challenge project

The objectives of the activities of the Hachinohe Institute of Technology Student Challenge Project, which we adopted in FY 2014, are as follows.

1. Acquire information such as temperature and humidity sensors and images of cameras with ultra small and inexpensive microcomputer installed at tourist spot.

2. Distribute camera images and sensor information to all over the world along with sightseeing spots of Tanesashi coast in Hachinohe via Internet and web server in campus.

Accordingly, we thought that further increase of tourists could be expected on the Tanesashi coast designated by Sanriku Reconstruction National Park in 2013 if these activities work well. In addition, we thought that this project could be flexibly handled by voluntarily implemented by students of local Institute of technology. And we thought that we could spread Hachinohe 's appeal not only to Hachinohe citizens but also to tourists inside and outside the prefecture using IT. Furthermore, we believe that the following effects can be obtained by actively implementing the above activities.

1. Expanding interest in tourists to Hachinohe Institute of Technology and student challenge project.

2. Promotion of activities by Hachinohe Institute of Technology to Hachinohe citizens and neighboring residents.

Through these activities, students at Hachinohe Institute of Technology can learn about the reconstruction from the damage caused by the Great East Japan Earthquake at the Sanriku Reconstruction National Park established by the Japanese Ministry of the Environment. Moreover, we also thought that the activitiy members' understanding and interest in Hachinohe will deepen by experiencing reconstruction projects (contribution to the local) by local university students, not corporations and government agencies. All the members of the student who participated in the activity are from Tohoku. In the March 2011 Great East Japan Earthquake all the members were affected. Accordingly, they were searching for possibilities for reconstruction of Tohoku after entering Hachinohe Institute of Technology. In such a background, a fourth grade student who had decided to graduate found a student challenge project in the university. Therefore, they applied for this project thought that it would be possible to disclose the state of reconstruction using ICT to Hachinohe citizens and many tourists. Members are hybrid teams of students of various grade ranging from 2nd grade to 4th graders as follows. Therefore, even lower level students are able to

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experience ICT at an early stage under the guidance of senior students. The leader in this activity group in fiscal 2014 served as a fourth grader of the Department of Electrical and Electronic Systems at the Faculty of Engineering. And it is composed of members consisting of 2 fourth grade students, 3 of the third graders and 3 of the second graders of the Department of Electrical and Electronic Systems. In addition, "Chan" in the group name "HIT Team Tanechan" has a meaning as a nickname attached to the back of the child's name in Japanese. Also, the following three thoughts are put in, and students themselves have named them.

1. Sanriku Reconstruction National Park Tenesashi Channel

2. Challenge project

3. Chances for reconstruction in the Tohoku area

In addition, **Figure 1** shows the state of the kick-off meeting, and students are voluntarily conducting activities from the launch of the project to the planning and implementation of the event.

Figure 1 A state of the kick-off meeting

3. Web distribution system of sensor information installed at remote location

The sensor information Web distribution system constructed at the remote site constructed to carry out the above activities is as shown in **Figure 2,** and it consists of a Linux microcomputer connected with sensors such as cameras installed outside the university and FTP and HTTP servers installed in the campus. Among these systems, software named Motion is installed in the microcomputer [3] for acquiring sensor information installed

in a remote place in order to capture the camera image. Then, a program named wput was installed by command operation of "sudo apt - get install wput" in order to transfer the file as a command of Raspbian OS using the function of FTP. Also, after adding the script shown in **Figure 3** to the file in the directory "/etc /motion/motion.conf" and save it, "sudo motion restart" was executed. As a result, the image file is transferred under the directory "/tmp/motion" of the FTP server constructed by Windows PC installed in Hachinohe Institute of Technology. Then, the still images acquired by the camera can be transferred at regular time intervals to the PC that installed Windows 7 OS and FTP server (Filezilla Server) on the campus. In this case, we established a secure connection using HAMACHI VPN that can pass through the NAT firewall between the microcomputer installed outside the university and the server in the university, and transferred image data etc. under this communication environment. In addition, the script of **Figure 4** was incorporated into the HTML file read by the HTTP server on which Windwos 7 was installed to release onto the Internet. As a result, the 04 Web server registered with the fixed global IP address (133.98.87.222) and the original domain (tanechan.elec.hi-tech.ac.jp) can continuously display image files transferred from the microcomputer. Moreover, camera images installed in remote locations can be viewed in this system from the whole world via the Internet using the client's Web browser as shown in **Figure 5**. In addition to camera images, temperature and humidity sensors are also connected to the system constructed this time. Therefore, these information also need to be displayed on the Internet by the Web server in near future.

Figure 2 Configuration of a system using Web server that displays sensor information transferred via VPN to FTP server

output_normal off
output_motion off
ffmpeg_cap_new off
snapshot_interval 100
snapshot_filename file1
jpeg_filename file1
on_picture_save wput –RB ftp://***:***@25.*.*.*%f

Figure 3 Change status of configuration file "/etc/motion/motion.conf"

```
<!DOCTYPE html>
<html lang="ja">
<head>
Live image of Tanesashi coast1        Live image of Tanesashi coast12
<br>
<TD width="186" align="right" valign="top" class="hpb-dp-tb1-cell2"><IMG
src="file/tmp/motion/file1a.jpg" alt="Tanesashi1" width="279" height="210"
border="0"></TD>

<TD width="186" align="right" valign="top" class="hpb-dp-tb1-cell2"><IMG
src="file/tmp/motion/file2a.jpg" alt="Tanesashi2" width="279" height="210"
border="0"></TD>
<br>
</font>
```

Figure 4　Part of the contents of the file index.php to be loaded into the HTTP server

Figure 5 Examples of sending images on the Tanesashi coast (In Japanese)

4. Proposing events and preparing in advance

For the purpose of publicizing and disclosing the constructed system to the local residents, we considered installing the system in the Tanesashi information center established in July 2014 on the Tanesashi coast near the campus. Accordingly, it was decided to hold an event where citizens can participate on the Tanesashi coast, as a result of going to the secretariat which manages facilities and repeating meetings. Therefore, we set up a workshop titled "Tanesashi WATCH (Let's take a look at the image of the web camera with smartphone)" on Sunday, December 14, 2014 and proceeded with this preparatory work. And, in order to make the event carried out on the day succeed by stably operating the system we developed at the site, Installation of the equipment was carried out carefully. We also made arrangements with representatives from the Tanesashi information center closely.

In addition, students led the event to success by voluntarily sharing roles and carrying out various tasks such as preparing a publicity leaflet and preparation of a quiz tournament. Also, we distributed the leaflet of **Figure 6** at various places in the city in order to solicit participants. Also, the leaflets shown in **Figure 6** were distributed at various places in the city in order to solicit participants. The date, time and place of distribution were as follows.

December 4th (Thu)
　Rapia (City shopping center)　35 sheets
　Hacchi (Municipal public facilities)　35 sheets
　PC shop in the city　30 sheets

December 5th (Fri)
　Hachinohe City Children's Science Learning Center 30 sheets

December 6th (Sat)
　Elementary school student at a cram school located in Hachinohe city　30 sheets

December 10th (Wed)
　Elementary school student at Hachinohe City Tanesashi Elementary School

These were also distributed to the Hashikami town office via the Tanesashi coast information center. Furthermore, the staff of the Tanesashi information center promoted the opening of the event as follows on their homepage.

http://tanesashi.info/
http://megalodon.jp/2014-1213-1027-48/tanesashi.info/

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Figure 8 Work scenery in preparation

5. Activity report on the day

The event introducing ICT to citizens planned by students "Tanesashi WATCH (Let's take a look at the image of the web camera with smartphone)" was held at the Tanesashi Coast Information Center from 10: 30-12: 00 on Sunday, December 14, 2014. This event was held without problems, despite the day when parliamentary elections overlapped, thanks to the careful preparations in advance and active by the members of the student project belonging to HIT Team Tanechan. Results of implementation on the day of the event are shown below.

Members composed of university students from various grade levels from 2nd grade to 4th grade gathered at 9:00 on the day of December 14th. The event was executed after the final preparation and rehearsing. And we held the following seminar event for about 10 participants.

1. Member introduction

2. Explanation of remote monitoring system used for web distribution

3. Exercises to access sites that provide remote monitoring using participants' own smartphone

4. Experience of video distribution by Web camera while holding a poster of "Tanesashi WATCH"

5. Reconfirmation of the delivery status of the image by the participant's smartphone.

Figure 6 A poster distributed to the city for recruitment of participants
(In Japanese)

Prior to holding the event, preparatory work was carried out from 11th to 13th December. As shown in **Figsure 7** to 8, each member shares their work under the direction of the leader of the student, carefully made preparations of handouts and rehearsals for presentations and quiz meetings.
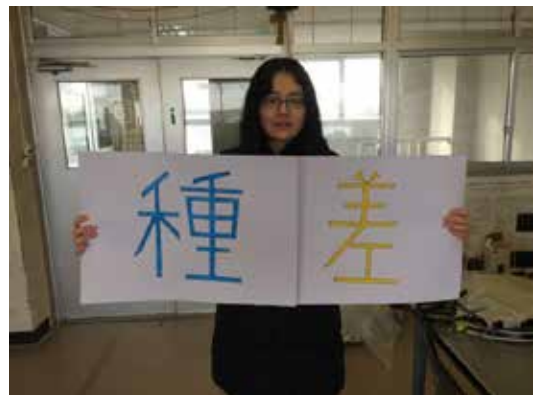

Figure 7 Work scenery in preparation

6. Implementation of Internet-related quiz tournament

7. Shooting commemorative photos outdoors

After completing each of the above work, this event was concluded. It is confirmed that the event has been performed gently as shown in **Figure 9** to **13**. The points to be reflected as a result of carrying out the event are as follows.

1. It is better for the domain to be shorter in order to enter the URL using participant's own smartphone on the day of the event and display the target site.

2. Events will proceed smoothly by becoming searched on google by launching the site before the event is held.

3. It is also important to thoroughly inform about holding events in advance and to determine the number of participants before the event.

Figure 9　Explanation of the remote monitoring system by students

Figure 10　Confirmation of web site by participant's smartphone

Figure 11　Explanation of installation status of Web camera to participants

Figure 12　Commemorative photo taken outdoors at Tanesashi Coast

Figure 13　Evaluation meeting after the event

At a later date, student project members reported on details of the work at the outcome meeting. The picture at that

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time is as shown in **Figure 14**. Finally, the following findings were obtained through this project. Participating students were able to learn about town development techniques while experiencing the promotion of sightseeing sites using ICT through cooperation with local residents.
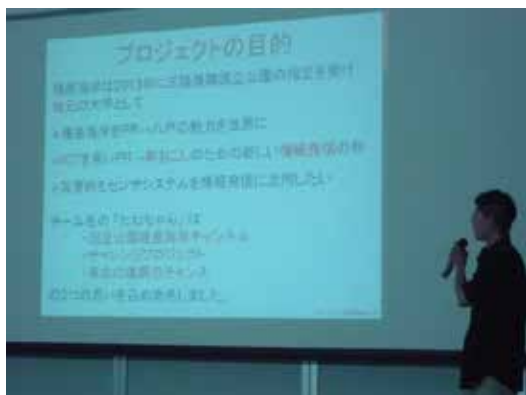

Figure 14 A state at the result report meeting (In Japanese)

6. Conclusions

We previously developed a system that can acquire camera images and sensor information with remote web cameras and temperature and humidity sensor information at low cost with smart devices thanks to the VPN that is embedded in an ultra-small microcomputer running Linux. In this report, we also developed a system to transfer the camera image of a remote place to the server installed on the campus and release the image from this server to the Internet by improving the above system. Against this background, we applied this system to the city development caused by voluntary social participation of students. Specifically, students made events related to ICT at sightseeing spots. In the future, we are planning to apply to ICT-based sightseeing and town planning etc. in cooperation with local municipalities.

References

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