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U-CAMPUS APPLICATION RESEARCH

CASE STUDY WITHIN HSING-WU COLLEGE TAIWAN

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***Abstract*—Using Zigbee techniques as a back bone to develop ubiquitous applications has been warming up while current information technology evolution moving from electrification to mobilization. However, most successful business cases still rely on mobile tools, such as PDA, WIFI, RFID, and GPS, to realize the concept of ubiquitous. The main challenges ahead for making real U-applications on the market are not only the definitions of zigbee specifications and protocols, but the related optimal database build-up and interface design methods. This paper aims to explore the necessary considerations between the gaps within ubiquitous information systems analysis and design stages which could direct the right path for database arrangement. This follows the system development life cycle (SDLC) to identify a zigbee wireless network's optimal placement, data flows, and related database design and on line analysis process (OLAP).**

The case study was undertaken within Hsing-Wu college campus. This ensures the scenario based experiment design could be practical for the further applications. The main objectives are to build up a U-campus prototype to allow teachers and students getting more interactively information being everywhere. This system could benefit users to find services without asking. The research results reveal that using zigbee to build up a U-campus application are less manpower, capital assets, build-up time than the fixed intranet services. The scenario-based planning, analysis, design and test are realistic for students to realize how to implement an I.T. system in practice. The zigbee geometric placements are testing by three approaches, star, mesh and snowflakes which shows the flexibility of zigbee wireless network.

***Keywords*—zigbee、U-campus、wireless network**

I. INTRODUCTION

Using Zigbee techniques as a back bone to develop ubiquitous applications has been warming up while current information technology evolution moving from electrification to mobilization. However, most successful business cases still rely on mobile tools, such as PDA, WIFI, RFID, and GPS, to realize the concept of ubiquitous. The main challenges ahead for making real U-applications on the market are not only the definitions of zigbee specifications and protocols, but the related optimal database build-up and interface design methods. This paper aims to explore the necessary considerations between the gaps within ubiquitous information systems analysis and design stages which could direct the right path for database arrangement. This follows the system development life cycle (SDLC) to identify a zigbee wireless network's optimal placement, data flows, and related database design and on line analysis process (OLAP).

The case study was undertaken within Hsing-Wu college campus. This ensures the scenario based experiment design could be practical for the further applications. For example, conventional campus touring rely on DM, multimedia and web applications. Most of the cases are just to put business online. There are passively electronic papers allowing users surfing on the net. Partially applications are focus on the mobile services, such as real time navigation and musical instruments. This research aims to fill up the gaps between Mobilizations to U-applications. The main objectives are to build up a U-campus prototype to allow teachers and students getting more interactively information being everywhere. This is because the current campus tours are relying on experienced staff to guide visitors on the right track. The long narration usually takes people going to the black box and losing the interests. For the new comers, the question is always coming as where am I? Therefore, even, he/she is interested in specific instruments; the circumstances will limit the speech. This paper aims to solve these problems using zigbee wireless network framework to develop an optimal U-campus application.

Based on these assumptions, this research adopt practical approach to design campus tour and teacher identification applications. To provide interactive, ubiquitous information services replace the web-based screen shot will shorten the surfing time and present real time information. This project adopts zigbee's advantages such as low-power, simpler design, less cost, low data rate and secure networking to propose a better U-campus applications. [1][4]

II. RESEARCH OBJECTIVES AND METHOD

Basically, the pros of wireless network within campus tour are low speed, low powers, less cost, easy maintenance, mesh network, and high security. [3][4][5] These advantages speed up the feasibility of U-campus which combined with existing intranet infrastructure and web services. The key objectives of this research are indicating as follows.

1. Flexible campus tour planning: this ensures the high utility rate which zigbee devices actively search nodes and feedback to exist campus intranet.

2. Real time videoing presenting: once, the zigbee tags tricking the nodes, the sources will send the data record back to database and the system will pop up with the related videos and direction guides.

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3. A scenario-based testing: this makes the U-campus applications actually fitting with current campus situation and completely through the I.T. system design life cycle.

4. Dynamically campus service presentation: this improves current web-based touring applications which only provide one off arrangement. A variety touring videos and graphics are reshuffled into data warehouse for further applications.

The research method adopts prototype approach which assures zigbee applications inherit current web-based system infrastructure and functions. This aims to ensure the proposed U-applications being capable of web-based service and mobile applications. The details of research process, firstly, survey the requirements of U-campus , such as how to set-up tour guide in a short period, which sightseeing should present to VIP as he/she wishes. Secondly, the project tries to analysis and design an optimal placement of zigbee nodes and sources. The testing and review tell the pro and con of the proposed U-application. The project took 6 moths to analysis and preliminary design for U-touring and U-people identification. Then, the proposed system was implemented and tested for another 6 months. The scenarios were took and identified within Hsing-Wu College. This makes sure the proposed U-system working well and the participated students building up their practical experiences. The research approaches are indicating as follows.

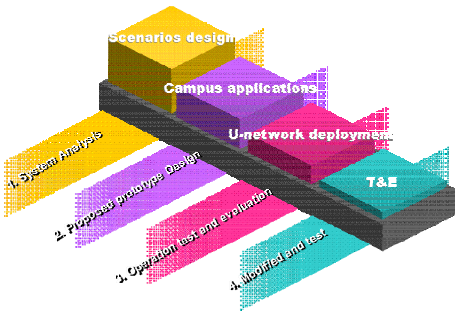

Figure 1: The proposed U-system SDLC process.

III. LITERATURE REVIEWS

The literature reviews focus on the zigbee techniques, functionality, and U-campus applications. The related facts and theories have been analyzed and classified as the basis to build up this U-project prototype. This section summaries the status of zigbee applications studies, wireless network applications, and U-campus current development trend as follows.

A. Zigbee applications study

According to Zigbee Alliance's announcements, most of zigbee applications focus on controlling and monitoring fields. For example, house appliance, factory surveillance, and security control, etc [13]. This is the advantages of zigbee which is simpler and less expensive than other wireless network devices.

ZigBee applications require a low data rate, long battery life, and secure networking which allows the technology to be widely deployed in wireless control and monitoring applications, and high reliability. [1][6][7]

Currently, ZigBee benchmarking on the market has not been found success stories in U-campus applications. The related campus touring and people identification and car parking will be interesting for research.

B. Wireless network applications s

The research is based on the Hsing-Wu college scenarios. Therefore, this paper primarily survey 'The ROC Electronic Theses and Dissertations System' to understand the literature reviews of U-applications. The author takes zigbee, intelligent campus, and wireless network as key words to inquire the latest situations. The main survey boundary sets within master thesis.

The literatures show that zigbee applications still are new for applied researchers. The markets for industrial automations and home appliance seem clearer in the nearly future. On the other hand, U-campus studies are feasible for the next step. Many researchers emphasis that the advantages of low data rate and long battery life are the key for zigbee devices playing good active sensor while wireless network deployed. This paper recognizes the zigbee wireless network for campus touring and related U-applications are worth to undertake.

To synthesize the available literatures within the considerations of content, status, scope, techniques, and appliances, this paper found that Zigbee wireless network could take the advantages to combine current internet as back-bone will be the new start in the business markets.

C. U-campus current development trend

Based on the current campus touring surveys, most of Taiwan universities adopt web-based guiding approach. Some of them use PDA, RFID or others mobile devices to guide visitors [8][9][10]. There is rare to apply zigbee network to provide actively services. That is why this project proposed a zigbee-based wireless network to marry existing web-based campus touring to provide more flexible and efficient visiting route.

As for the wireless devices selection, the author surveys the differences among zigbee, Bluetooth, WiFi and RFID as follow shows.

This research suggests zigbee as the core to be deployed within web based wireless network. This ensures the proposed U-campus application has the merits of low cost, long battery life, and position accuracy [1][11][12].

D. Literature summary

There is rare U-campus research and application on the market. The main reasons could be technical, such as protocol, specification, and wireless device selection etc. On the other hand, the deploy cost, flexibility, and easy to use could be another issues for people to implement zigbee wireless network. In this research, the author adopt zignee as the back bone of wireless network. This aims to develop an optimal zigbee module which shaping as star or mesh topology to save time and cost. Another issue is flexibility which the proposed system

consists of three tier structure. The front tier is zigbee module. The middle tier is Ethernet playing web service. The database is designed based on the suggested schema dedicating in the section 4.

IV. THE PROPOSED SYSTEM ANALYSIS AND DESIGN

The pilot study takes Hsing-Wu College as the main scenario to design related system environment and activities.

The building information is summaried as follows.

1.The ground floor: information management department,

2.The first floor is postgraduate school,

3.The second floor is information technology department,

4.The third floor is information communication department.

The hardware arrangement has been considered tow issues: web infrastructure and wireless network package as shown in table 1. The item one to four describe the main Ethernet components. The item five to seven prescribe the optimal zigbee network topology. The details function are dedicating in the section four.

Table 1 The hardware arrangement.

	Item	Function	Quantity
1	NCCU Academic Net	1G + ADSL(10M/2M*100)	1+100
2	HWC Ethernet	Giga Ethernet (1000 Base Ethernt)	15
3	WIFI	802.11a or b/g (AP*164)	164
4	Switch	Access L3 Switch	10
5	Wireless network Coordinator	Zigbee Full function device (FFD)	1
6	Wireless network Router	Zigbee Full function device, adjustable broadcasting (FFD)	3
7	TAG	Zigbee Reduce finction device (RFD)	5

The pro for this preliminary design is practical and similar scenarios as a multi-stories building planning. In the figure, the proposed system is optimized and composed of FFD coordinator, FFD router, and tag. The dataflow starts from the tag tricking the router, and the router can pass the data and key within the mesh network. Finally, the FFD coordinator collects all available data and transmits information via Ethernet into database as shown in the figure 2.

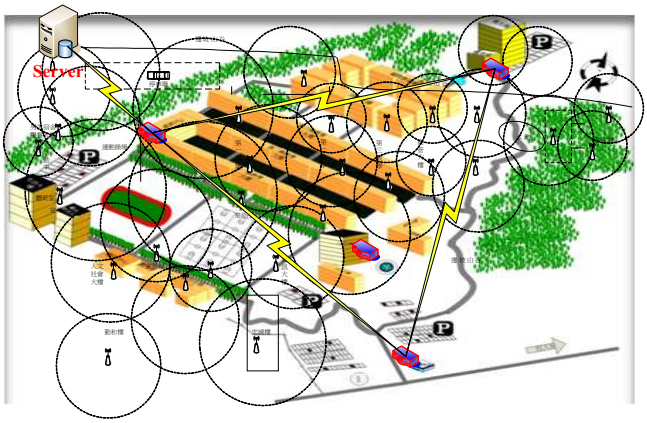

Figure 2. The proposed Zigbee environment deployment

A. *The proposed Zigbee application*

Based on the scenarios, the proposed Zigbee system adopts star and Peer-to-Peer topology as shown in figure 3.

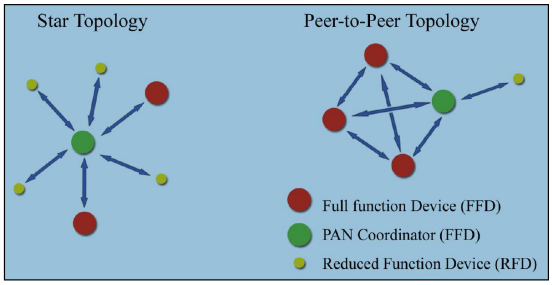

Figure 3 Star and Peer-to-Peer topology

The hardware planning and related U-campus platform components are indicating as follows.

1. Ethernet server: the main tasks are managing campus touring information exchanging and interface switching. This server also provides services for MIS and SQL database.
2. SQL server: the main objectives are to store, modify and related management issues.
3. PC: performing the real time information for visitors.
4. Notebook: node and source testing.
5. WIFI AP: provides wireless web services.
6. Zigbee coordinator: communicate data between Ethernet and zigbee module.
7. Zigbee router: adjustable broadcasting capacity allows more precise and flexibility arrangement.
8. Zigbee tag: provides details information of visitors.

B. *Data flow*

Since the FFD Zigbee could perform as a router to retrieve tag's data simultaneously, the database schema has been classified into five main table sheets. There are visitors (people), scanning frequency (time), collection (history

record), place (FFD), and events (touring). Follow the rule of DFD, the level 0 is illustrated as follows.

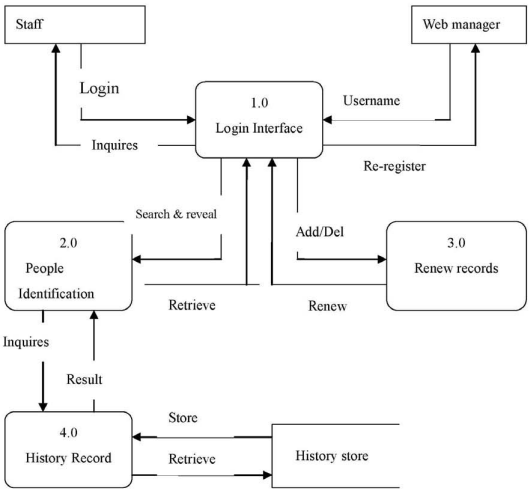

Figure 4 DFD Level 0

C. *Test and evaluation*

The prototype has been test and evaluation on the site of Hsing-Wu College. The signal strength has been adjusted based on the structure of floor plan.

The building is four floor heights and each floor area is 24.7X36.6 meter square. The number 1-6 represents the FFD which function as router to collect data from Tag (RFD). The test results shows the 100% wireless signal quality needs 6 FFD to display 6 spots for visitors. The pre-installment time for this 6-spot tour at most takes 30 minutes. The related films, pictures, and texts could flexibly presents to the guests.

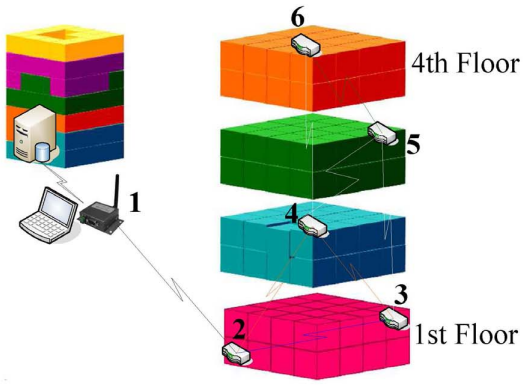

Figure 5 The testing grid results.

However, the traditional campus tour needs 2-3 days planning and half day decoration time. The tour guide is necessary for the details explanation. The fixed Ethernet routers, switches, WIFI AP, and display monitor are cost too much for a simple campus tour. The research results reveal the advantages of Zigbee network which could be applied for business touring applications.

V. CONCLUSIONS

Since, the case study was undertaken within Hsing-Wu college campus, the research findings could be benefit and practical for the further applications. The research findings are indicating as follows.

1. The proposed U-campus application is new and simple to set-up a quick touring program. This prototype could benefit users to find services without asking.
2. The research results reveal that using zigbee to build up a U-campus application are less manpower, capital assets, build-up time than the fixed intranet services.
3. The scenario-based planning, analysis, design and test are realistic for students to realize how to implement an I.T. system in practice.
4. The zigbee geometric placements are testing by star, mesh and snowflakes which shows the flexibility of zigbee wireless network.

The contribution of this work reveal the feasibility of U-campus using Zigbee to realize the requirements of low cost, flexible design, and easy to use. The further work could be investigating the optimal arrangement of the Zigbee topology and algorism.

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