Wireless Sensor Network apply for the Blind U-bus System

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Abstract

This paper proposed the U-bus system design based on wireless sensor network (WSN) for blind people. This system has two main parts. First part is blind people recognition. Another part is communication between a bus and bus station. Blind people recognition part is constructed simple device and system. This part decides existing or non-existing of the blind at bus station. And then if pre-process recognize blind people, the bus station will communicate the bus. We make up the announcement system about arrived bus information for the blind people using these parts. This announcement about arrived bus is very useful to blind people for taking the bus.

Keywords: *WSN, Blind people, Recognition, U-Bus system, Announcement.*

1. Introduction

With WSN technology, not only small applications such as smart house but also in the larger society such as environmental, military ,health and commercial applications. More and more we see the importance of WSN technology. To make human life become more convenience we should apply development technologies [1][2].

One of the main reasons we are interested in the design and desire to deploy U-bus system are: In addition to the facilities such as subway which are developed fairly complete, with sound and image messages, camera network is very modern there, so that it is very well to support for people with disabilities, especially blind people. Another way the blind people or disable people can take taxi. We understand that taxi is very convenient but the cost is so expensive, this is not an advantage to blind people usually take taxi. For the bus – the transportation was developed long time ago with bus network was very complete. It is waste if blind people can not join in bus traffic.

For reasons above we show a system: U-Bus system for the Blind. This system is designed for the purpose to transfer sound message of bus number which is currently parked in front of the blind. So that this system can help blind people to recognize the bus which blind people want to take without the help of others. With this system, again WSN technology is applied.

Nowadays have many systems support blind people are researched and developed. Not only simple applications such as Braille keyboard for the blind, the system protects the blind when crossing the street, but also complex systems such as car for the blind and so many other systems. Maybe the practicality of the system needs some time in the future but for the purpose of the blind are closer to society, to avoid the inferiority with society as well as research, design and deployment of this system is absolutely necessary. This system, have some main advantages: such as creating the possibility to

participate in bus transportation for the blind are more convenient, Blind can go to somewhere by bus or subway, some places that subway can not come blind people can go there by bus. Weaknesses exist: some things to be upgraded and designed to more efficacy in use, with this system blind people can not search the destination which they want to go, how to recognize exactly blind people who are staying at the bus station and want to take bus.

This paper is divided into five sections, in the next section discusses the technology are used to design systems, how K-mote is applied in this system. Section 3 is system propose with flowchart and block diagram of system. Section 4 is the analysis of advantages and disadvantages. Section 5 shows other issue and future researching for this system. Finally, section 6 concludes the paper.

2. Technology construction of WNS

The U-bus system is designed to combine two elements: hardware part and software part. The hardware part use INtech's K-mote. The K-mote have CC2420 which is a true single-chip 2.4 GHz IEEE 802.15.4 compliant RF (Radio Frequency) transceiver designed for low-power and low-voltage wireless applications so we can send or receive useful information through using this chip. Fig. 1 show a device is used this paper.

Figure 1. *K-mote*

And next part is software part. We use TinyOS for this design project with OS (Operating System). TinyOS is a free and open source component-based operating system and platform targeting wireless sensor networks (WSNs). It started as collaboration between the University of California, Berkeley in co-operation with Intel Research and Crossbow Technology, and has since grown to be an international consortium, the TinyOS Alliance [3]. Especially we use TinyOs -1.x version for stable development. The above version has been developed for a long time so more stabilized than TinyOs-2.x version. TinyOS is an embedded operating system which is written by nesC programming language as a set of cooperating tasks and processes [3].

It is a kind way of the pre-processor. The nesC is a component-based and syntax is similar to the C programming language. The nesC compiler convert source code into C program file and this file is responsible compile and link through the GCC (GNU Compiler Collection) compiler [4]. Fig. 2 is the nesC compiler process.

Figure 2. *nesC compiler process*

With population of C programming language, Use TinyOS will avoid some mistakes when we program, implement and troubleshoot this system. Update for system will be easier.

3. Proposed U-bus system

3.1. System design

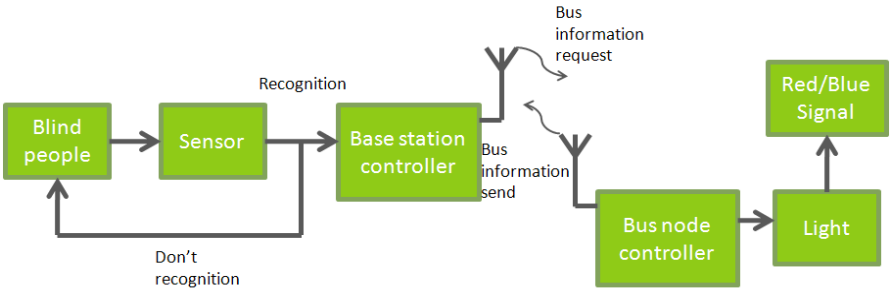

Figure 3. *Proposed U-bus system block diagram*

Figure.3 shows very clear about two important parts of U-Bus system that are recognition of blind people at the bus station and communication between bus and bus station.

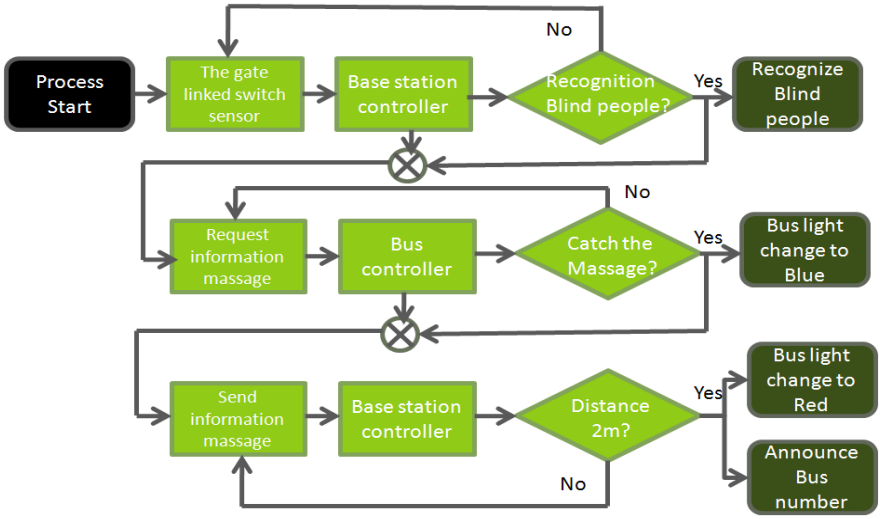

Figure 4. *Proposed U-bus system Process diagram*

Figure 4 shows this proposed U-bus system process diagram. We will explain this process. First blind people are recognized by using switch. The bus station has two areas include normal people area and blind people area. It is showed in Figure 5.

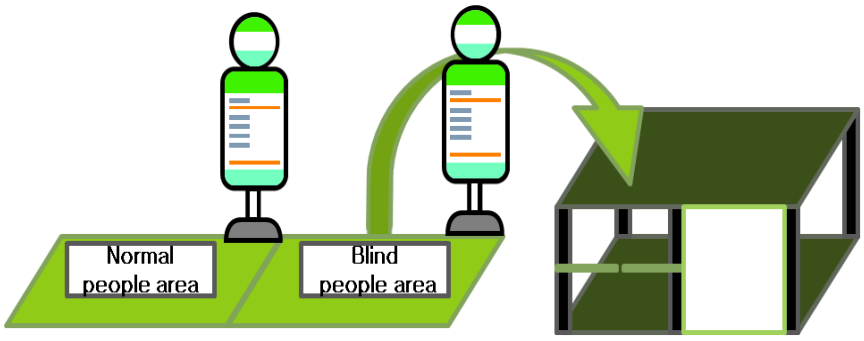

Figure 5. *Bus station Structure*

Doorway of blind people area has gate consist of two stick that link switch. If person into this area through the gate, we can assume that someone exists in this area. Maybe you will have a question that: can normal people go wrong in the blind area? So that we will have Notice board: Only for blind people (or disable people). We propose optimize this part in next version of U-bus system.

When the system recognizes people as above, thee bus and bus station communicate. The bus station will announce exiting of blind people at station to any bus in the RF communication area. If the bus catches this massage, it will send information about itself number etc. Figure 6 shows bus and bus station communication process.

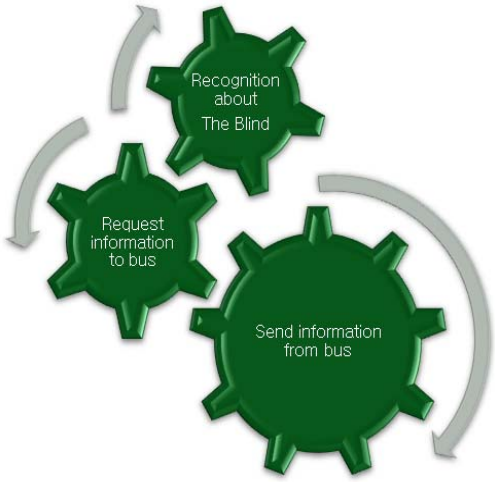

Figure 6. *Bus and bus station communication process.*

Figure 7. Show the flowchart of U-bus system. It explains more detail about overall proposed U-bus system. We previously examined the behavior of the system.

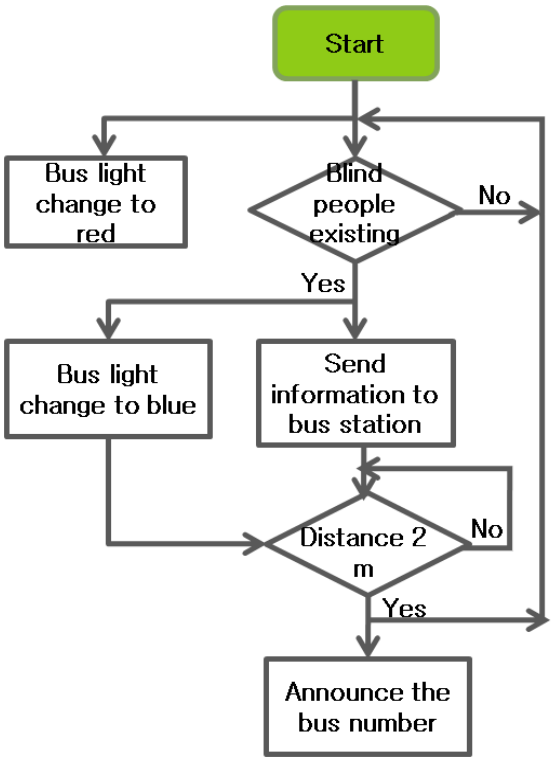

Figure 7. *Proposal U-bus system flow chart*.

In addition, bus light system announces the availability of the blind. Each one means sign that red is non-existing and blue is existing of the blind at bus station. And this system announce the information about bus number to blind people just one and distance 2m between the bus and bus station. It makes the blind choose right bus which is stopping in front of them. So, after the bus station announces the number through speaker, this system reset to start line. And distance is assumed by RSSI (Received Signal Strength Indication).

Some explanations above can help you more understand process and construction of U-bus system. In the next part we would discuss about experiment when we designed this system.

3.2 Experiment

First we want to explain something about RSSI which we mentioned in previous part. RSSI can be used as a tool to give an indication of link quality; it does not always give definitive results. In addition to normal variation in received signal levels, the signal level can also be affected by in-band interference sources. Communication systems should be designed with some link margin to ensure reliable communications in changing conditions.

This project is necessary to estimate the distance through using RSSI. Estimate distance of requirement message range and announcement. So we experiment distance follow RSSI measurement at first.

Table 1. *Distance follow RSSI measurement experiment result*.

Purpose	Maximum Effective Range	RSSI Magnitude	Error Distance
Request msg. range	20m	-150dbm	±2m
For Announcement	2m	-60dbm	±0.1m

Distance follow RSSI measurement has huge error according to surrounding environment. In environments where it is desired to test signal quality, a loop back test should be performed to give the best indication of link quality by measuring actual data transfer success. The percentage of good packets received during a loop back test is the surest way to get an idea of the quality of communication in a data radio system Therefore, assuming the exact distance is very hard. However this project is not required the exact value. So, we can use approximate value. Table1 shows the experimental value of 30 times the average data at the space without obstacles.

Following this experimental result data, when the bus station request information to the bus, the bus light change in require massage range.

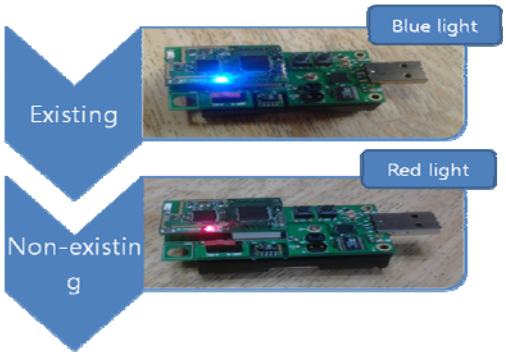

Figure 8. *Bus light change experiment result*.

Figure 8 shows the result color of bus light. It change the color according to check existing of the blind. The signal is sent by bus station will decide the color of bus light. And check the result of announces bus number which is sent by bus.

When the whole process is completed for communicate between the bus and bus station, final process works. This final process is announcement process. We make MFC cording for check this process result. Figure 9 shows the result of it. The bus send massage 25 bytes data include RSSI magnitude, tag node id and bus number etc. We can find thus data information at Receive part of this program. However, interpreting this data is very hard and complex. So we should classify data for using easy. We can see the id part and RSSI part are very clear in Figure 9 with ID: 100 and RSSI: -59dbm. We can understand bus number about approached bus through classified data.

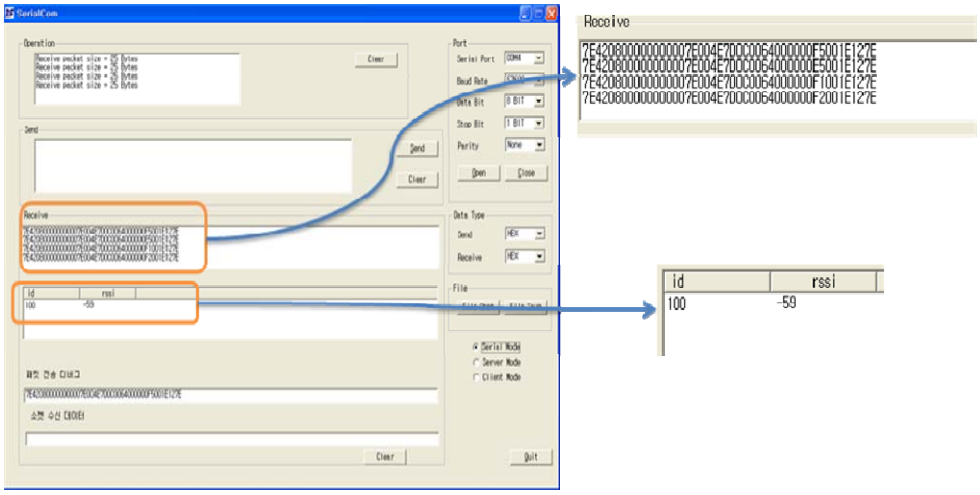

Figure 9. *MFC program for identification about bus number information.*

Table 2. *Success rate about how many bus arrived station*.

How many Bus	Between Buses Distance	Success rate
1 bus	-	100%
2 buses	5m	100%
2 buses	10m	100%
3 buses	5m	100%
3 buses	10m	100%

Finally, we experiment that change number of buses arriving at the bus station (BS) and each between the buses distance: The between buses distance not include bus length and we suppose the bus lengths 12m. Each experiment carries out 15th times. Table 2 is result about this experiment.

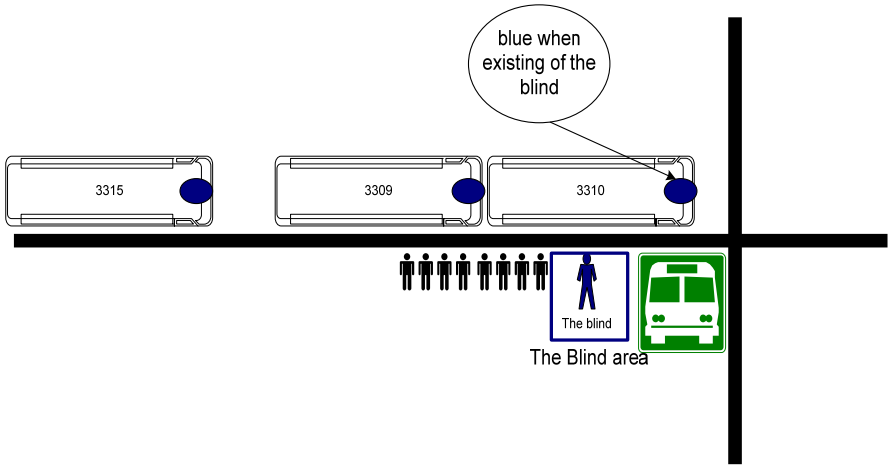

Figure 10. Example *experiment that change number of buses arriving at the BS*

Figure 10 shows bus station has 2 buses is stopping and another bus is coming. Success rate is 100% about how many buses arrived at BS.

4. Advantage and Disadvantage

In previous section we presented the model of system proposed and process of system. The same with other applications which support the blind, this application make the blind feel more closeness with normal life, they will feel self-confident Further with features of system we can clearly understand the advantages that this system can support the blind. Blind people will not worry because they could not go to places where subway can not go or if they go by taxi they will have to pay much money. This system also can support the blind correct bus which they want to take without the help of other people around them. In addition to the blind, the elderly who become slow or other disabled people can also get the benefits of participating in the use of U-Bus system. With exiting of the blind is received from BS, the bus will stop in a good position and with time enough for blind people take bus. It is really convenience for disable people, especially the blind.

It is wrong if we think that U-bus which we presented above is complete. Have some disadvantage is exiting. We will fell complex to recognize the person who is staying at bus station is blind person or normal person - sometime people may wrong place. Because we used only switch to recognize blind people so that if the blind change them mind and move out blind place, how bus station can recognize. For finding information also important in this system but we did not have occasion to mention, how blind people can search destination which they will come and how station can recommend the blind what the bus number you should take. Finally, to avoid waste time, only a bus which blind people want to take should stop at the blind people area.

5. Other issue and future researching

To improve advantages and solve some U-bus features are limited, we want to give some issue and future researching the follow:

Through the application and implementation of this system we hope to apply this principle on many other systems as Kiosk System and other public systems. With purpose to support more for the blind in particular and disabled people in general we need optimize the features of U-bus system.

In blind recognition part, we interested to use RFID (Radio Frequency Identification) technology which is very relevant and high efficiency when the blind can control their situation. They can allow bus station identifies themselves are or are not staying at the bus station by Tag - a main component of RFID system. With this solution, build the blind place is not necessary. We will present more detail in next paper.

For the information searching part, we are thinking about PDA which have Braille keyboard for the blind. This system will help blind people to find accurate information of the bus which they should take. So the blind can go to the desire destination. In addition to the more complex technologies such as voice recognition can also be applied aimed to optimize the system. U-bus system will give a best support for the participants to use, especially the blind.

The complete U-bus will be showed in next paper. Follow is illustrative figure for next version of U-bus system.

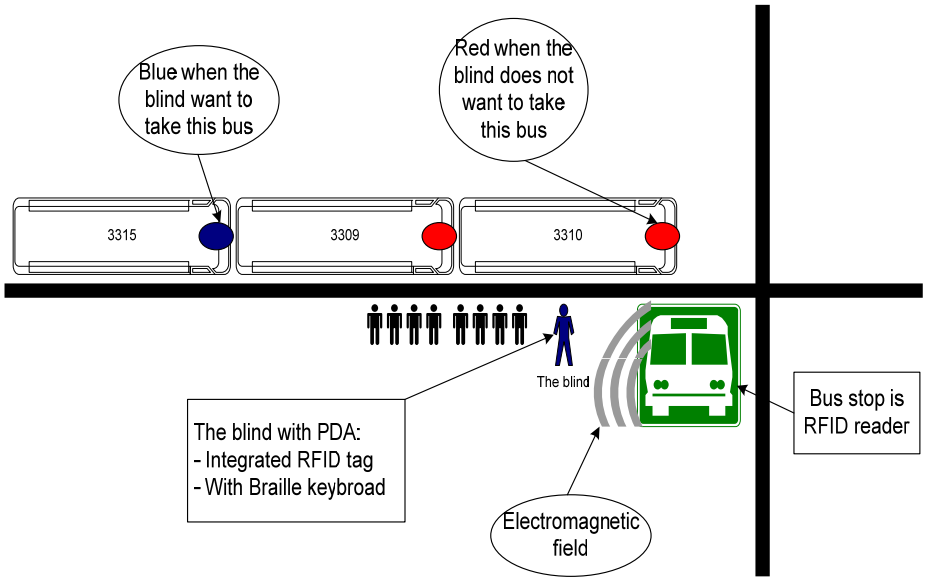

Figure 11. *Complete proposal of U-bus system based on WSNs for the blind.*

In Figure 11 shows complete proposal of U-bus system based on WSNs for the blind. In this system we want to show some advantage features.

a) PDA for the blind:

- Integrated RFID tag.

- Use to search destination and chose bus number which the blind want to take.

- Receive information from bus station by headphone. It will avoid noisy for the normal people.

b) Bus station (BS):

- Recognize the blind who want to take the bus by RFID technology (like Reader).

- Send bus number that the blind want to take to the bus.

- Receive the bus number of the bus and sent to the blind by PDA (the blind can hear information about bus number by headphone).

c) Bus:

- Receive information from BS.

- If bus have the blind want to take, bus will stop at the blind area.

- If the bus does not have the blind want to take, do not need stop at the blind area.

- If the bus does not have the blind want to take, do not need stop at the blind area.

Process:

The blind with PDA (Integrated RFID tag) go to Electromagnetic field of BS. The blind can search destination and register the bus number which they want to take to BS.

One of features of BS is RFID Reader, when the blind in the bind area, BS will announce exiting of blind people to them. Other feature BS is transfer to buses number that the blind want to take.

The bus receives bus number which is required by the blind in RF communication area. It will compare number with itself. If match, bus light will change to blue and it will send back BS its number when it stop at the blind area. Else bus light is red and it need not stop at the blind area.

The blind can hear number of the bus which they want to take when this bus stop in front of the blind.

The blind can easy to take the bus.

6. Conclusion

Through this paper we hope to study the subject of applications to support disable people, especially blind people increasingly spend a lot more attention. The idea of the U-bus system was again demonstrate the broad applicability of the WSN technology. Although we realize the limitations of the system that is still exiting as blind people identification at the bus station, or need to add some features such as equipment necessary to search destination information for blind people, RFID technology is used at the bus station to recognize the blind people automatically etc, but this system has reduced the inconvenience of the blind people when they participate bus transportation.

The construct of system is designed by TinyOs (software part) and K-mote (hard ware part) based on WSN. We take experiment two parts for check about performance of this system. First part particularizes distance according to RSSI (Received Signal Strength Indication). Another part checks process whole system. We can expect excellence more easily to take bus by experiment result.

Understand some features are limited of this version. And the complete U-bus system is showed in section 5 of this paper with PDA which is integrated RFID Tag to easier discover BS, we will research more carefully about the design systems and technology used to design. So that we will design next version of this system early with more complete, as well as optimization function for the blind when they participate U-bus system. Finally, we hope principle of U-bus system can apply to other systems such as Kiosk or Automatic shop to support disable people in near future.

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