Performance Comparison of Communication Module againts Detection Location for Blind Cane

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Performance Comparison of Communication Module againts Detection Location for Blind Cane

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***Abstract*— A Blind Cane is a tools resembles an ordinary wooden stick that can help blind people to recognize the environment atmosphere around them. However, this Blind Cane only help the blind, passively. Many research has been developed and enhanced for the Blind Cane. One of the research conducted is to create a smart cane that can detect the location while the blind doing travel. This research is comparing the performance comparison of module communication that will be implemented on Blind Cane in Telkom University area. There are three module communications that will be compared in order to have the best performance and the most economics cost implementation. They are module NRF24L01, module XBee Pro S2C, and module USR-BLE101. Based on the testing scenario, the best performance module communication is gained by XBee Pro S2C Module. While the minimum cost for implementation system is using module communication NRF24L01.**

Keywords—Blind Cane; Module Communication; NRF24L01; XBee Pro S2C; USR BLE101.

I. INTRODUCTION

Based on the analysis of Global Burden of disease in year 2004 its yield about 15.3% of world population (about 978 million people out of estimated 64 billion world population) were moderately or severely disabled and 2.9% or about 185 million had severe disability. Based on Susenas 2012, Indonesia gained a population with a disability of 2.45% and since years 2003 has increased prevalence [1]. People with disabilities become 39.97% or equivalent to 3.5 million residents of Indonesia in 2012 and increase to 3.75 million people in years 2016 [2].

In daily activities, blind people have limitations to be able to do their activities like a normal people. The blind need a tools to guide them, and most of them use the cane as a tool to help their mobility. Takuma Murakami's opinion:" a cane is a stick as a tools for someone with visual impairment, that is, overcoming obstacles directly like detecting stairs and determining one location. Another function of the cane is as a protector. With the skill of using a good and right stick, the blind person is able to move or mobile from one place to another place independently, flexibly and understand the new environment [3].

Unfortunately, these tools only can help the blind, passively. Some of blind people still must be accompanied by normal people in carrying out their activities. Blind can also have their own activities which is assisted by a cane, but sometimes blind people move in a wrong way direction and often get lost. They do not know the area where they are exactly stands and their environment around them. Based on this situation the blind really need a cane which can give them the direction and information about the place surrounding their area.

There are several studies about the research to enhanced and developed the cane to detect a location such as N.V Kalyan et.al, they used GPS and GSM module communication to provide the information of the blind [4] while the Rangsipan Marukatat et.al is developed a navigation system using GPS and voice alert in Thai language. Voice alert is used to inform the blind about the direction path to do a travel [5]. Similar with Rangsipan, Varun Raj et.al, also made a research that can help a blind people to travel using portable computer which is connected to GPS [6]. Other research done by Fernandes, which is developed a navigation system and location using GIS and RFID [7]. M Saranya, proposed a navigation campus by identifying current location through android device to guide blind people. This system will give the information to the blind if the blind enter the wrong root using GIS devices [8]. D.Sarala, et.al, developed a system for guiding blind people system in travelling using wireless sensor network which consists of Zigbee unit and sensor Bluetooth, but this research is implemented in a bus station [9]. Some research is doing in Indoor navigation. Gordon et.al, is enhanced the blind cane together with digital sign system technology made a tag reader to know the information about the room or location indoor [10].

In our previous research we are already have a proposed system that can help the blind to do travel and determine the direction using GPS based on 8 wind directions [11]. Next, we will propose a system that can recognize the place in blind people surrounding area.

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Based on that information above, in this research we study about several module communications that will be proposed to do a comparison between three module communication which can be design as a wireless sensor network. This comparison is need in order to decide a module communication that will be choose to be implemented in the next research. The three modules communication are module NRF24L01, XBee Pro S2C, and Bluetooth USR BLE 101.

II. Proposed System

A. *Literature Study*

After doing study the related research, we study several modules communication that has been implemented to any kind of system that need communication modules in their system. The first module is NRF24L01 as a single chip radio transceiver for the world wide with 2.4 – 2.5 GHz ISM (industrial, scientific and medical) band. The transceiver consists of a fully integrated frequency synthesizer, a power amplifier, a crystal oscillator, a demodulator, modulator and Enhanced Shock Burst protocol engine. Output power, frequency channels, and protocol setup are easily programmable through a SPI interface. Current consumption is very low, only 9.0 mA at an output power of -6dBm and 12.3 mA in RX mode. Built-in Power Down and Standby modes makes power saving easily realizable [12]. Fig. 1 shown the NRF24L01 module.

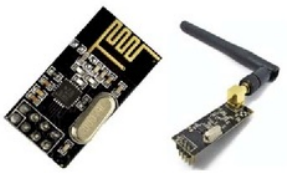

Fig. 1. Module NRF 24L01

The second module is XBee Pro S2C as a module communication that can receive RF Technology bidirectional. XBee provides a protocol than can used for multi-node RF network data communications and wireless sensor network (WSN) also can be used as coordinator, router and end point. XBee has an addressing feature and an acknowledgment that ensures data is delivered to the destination. Beside that, XBee also has additional features to use in remote device monitoring and control [13]. Fig. 2 shown XBee module.

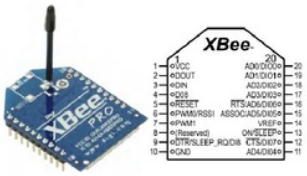

Fig. 2. Module XBee Pro S2C

The third module can be seen in fig. 3 is USR Bluetooth Low Energy (BLE) 101 as an evolution of mobile applications and mobile payments industries that has been accompanied by the continual introduction of new technologies. BLE is compared with similar technologies such as WiFi, GPS, NFC, and QR codes. BLE is a wireless computer network technology designed and marketed as Bluetooth Smart by the not-for-profit non-stock corporation Bluetooth Special Interest Group (SIG). While originally intended for use in the health care, fitness, security, and home entertainment industries. BLE shows promise for geolocation and other functions in application like restaurant, tracking, etc [14].

Fig. 3. Bluetooth USR BLE101

B. *Architecture System*

In fig. 4 shown the blind person will perform a travel from one place towards the Selaru Building (School of Applied Science building). Each building in Telkom University areas are installed a transmitter and a power supply connected to a microcontroller that will be processed the data to be sent to a receiver. On the blind cane side is installed an integrated receiver system that will receive the signal from the transmitter which is installed in each building in Telkom University area.

Fig. 4. Proposed System

Fig.5 shown the receiver part construction, it is a power bank to deliver the power energy to the system, a microcontroller to process the system from push button and receiver, also connected to head set/ speaker to inform the user in form of the voice message.

On the transmitter's side there is a microcontroller also that can control the transmitter to transmit the broadcasting signal. Power bank is requiring in order to deliver the power to microcontroller.

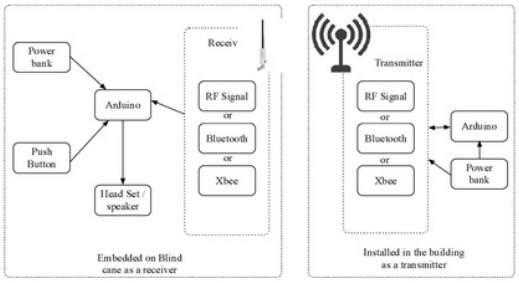

Fig. 5. Block Diagram System

Fig.6 shown the flowchart of system. When the transmitter is activated, the signal is broadcasting from the transmitter surrounding the building area. While the blinds do the travel, the blinds can press the push button randomly in certain area. Once the push button pressed, it will trigger the receiver to find the signal from the transmitter. If the receiver finds the signal, the system will find the id_building and inform the blind about the detection building near the blind environment. When the system cannot find the signal, the system will inform the user, "you are out of range area". The system will off in 3 second after the information send to the user.

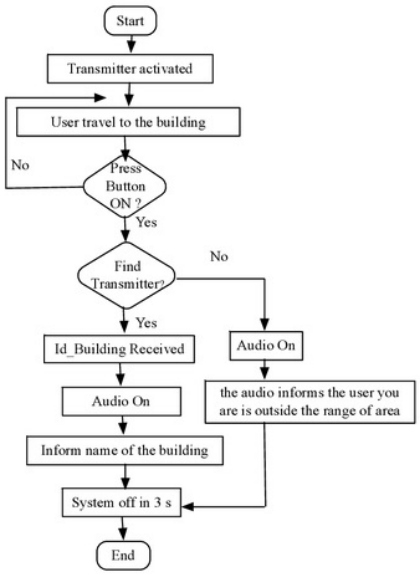

Fig. 6. Flowchart System

The architecture of the system will be tested by using different module communication. They are NRF24L01, XBee Pro S2C pro, and Bluetooth USR BLE 101. All of the module communication will be tested in the outdoor area in a state of loss area and no loss area.

III. Testing and Analysis

In order to measure the performance of the module communication, the testing and analysis will be tested in a several scenarios. The scenarios are:

- Testing the strength of transmitter signal
- Testing the number of transmitter that should be installed in each building around Telkom University area.
- Calculate the minimum cost for the implemented system

A. First Scenario

The first scenario is do testing the strength of transmitter signal without obstacle (in the state of loss) and with obstacle (no loss). This testing aims to perform the distance parameter measurements to obtain the furthest distance that a transmitter can transmit and detect by the receiver. This parameter will be used to determine the number of transmitters that must be installed in one building (on second scenario).

Fig.7 explained about how to measure the strength of the signal transmitter. We take Selaru building as a School of Applied science at Telkom University as an example. The system is tested by the blind people. They are doing the travel from Selaru building, walk away from the building and press the push button randomly in certain area. When the system informed "you are out of range area," it will be measured as a distance performance of a module communication.

Fig. 7. Testing a Strength of Signal Transmitter

The result of this scenario can be seen in table I. This table is the result of the measurement of the strength of transmitter signal in loss area (without obstacle). As we seen in the table, the strength of the signal transmitter for NRF24L01 module and XBee module which is stage in low level signal have the same performance, it is equal about 40 m. While the signal performance of module Bluetooth USR BLE 101 is 60 m, and then followed by XBee module in stage of medium level signal. The most strength signal is the signal performance of XBee in stage of high level signal.

TABLE I. STRENGTH SIGNAL TRANSMITTER IN LOSS AREA

No	Distance	NRF24L01	XBee			USR BLE 101
			Low	Medium	High	
1	10 m	✓	✓	✓	✓	✓
2	20 m	✓	✓	✓	✓	✓
3	30 m	✓	✓	✓	✓	✓
4	40 m	✓	✓	✓	✓	✓
5	50 m	×	×	✓	✓	✓
6	60 m	×	×	✓	✓	✓
7	70 m	×	×	✓	✓	×
8	80 m	×	×	✓	✓	×
9	90 m	×	×	✓	✓	×
10	100 m	×	×	✓	✓	×
11	200 m	×	×	×	✓	×
12	300 m	×	×	×	✓	×
13	400 m	×	×	×	✓	×
14	500 m	×	×	×	✓	×
15	600 m	×	×	×	×	×

✓ detected × not detected

Meanwhile the result of the strength of signal transmitter in no loss area (with obstacle) can be seen in table II.

TABLE II. STRENGTH SIGNAL TRANSMITTER IN NO LOSS AREA

No	Distance	NRF24L01	XBee			USR BLE 101
			Low	Medium	High	
1	1 m	✓	✓	✓	✓	✓
2	2 m	✓	✓	✓	✓	✓
3	3 m	✓	✓	✓	✓	✓
4	4 m	✓	✓	✓	✓	✓
5	5 m	✓	✓	✓	✓	×
6	6 m	✓	✓	✓	✓	×
7	7 m	✓	✓	✓	✓	×
8	8 m	×	✓	✓	✓	×
9	9 m	×	✓	✓	✓	×
10	10 m	×	✓	✓	✓	×
11	15 m	×	×	×	✓	×
12	20 m	×	×	×	✓	×
13	25 m	×	×	×	✓	×
14	30 m	×	×	×	×	×

✓ detected × not detected

Based on the table II above, differs from table I, module USR BLE 101 only detected in range 4 m, while NRF24L01 can reach in range 7 m, the best performance is yields by the XBee Pro S2C performance on low, medium, and high level stage signal transmitter. XBee Pro S2C performance signal has better range performance than the other module communications because they have their own protocol to manage the communication between transmitter and the receiver. The result of measurement in the state of no loss area (with obstacle) is yields shorter range than in the state of loss area (without obstacle). It is because of the circumstances of the environment of a building have a lot of obstacle like barriers, trees or others in the surrounding building.

B. Second Scenario

Based on the result of first scenario above, we can state and simulate a number of transmitter around the building. This scenario aims to state a number of transmitter that can be installed in a building. In Fig. 8 shown the measurement method based on google map and experiment setup [15] whereas the white lines are determining the perimeter of the building. The white lines of perimeter in a school of Applied Science building are formed resembles the pentagon shape [16].

Fig. 8. Buiding Shape Perimeter of School Applied Science

After we determine the perimeter of the building, it is easy to measure and state how many transmitters that can be implemented in Pentagon shape building area. A number of transmitter can be measure and state. It can be seen in Fig. 9, the transmitters can be placed in the certain area with the maximum range area detection if the system using NRF24L01 module communication. It is need at least three transmitters to have the best performance in School of Applied Science building area (red node). Based on the three transmitters installed at the building, the School of Applied Science will be recognized by the blind cane from a certain area surrounding the building area. (purple node).

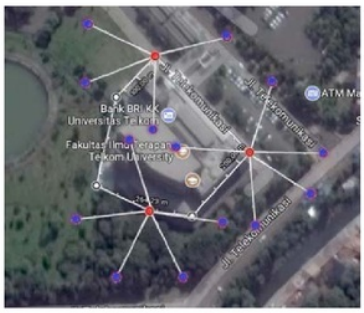

Fig. 9. The Placement Area of Transmitter in School Applied Science Building

The result of second scenario can be seen in table III. To implement a transmitter in School Applied Science building, it is need at least 1 transmitter if the system used XBee Pro S2C as a module communication and 3 transmitters if the system used NRF24L01, XBee Pro S2C in low level signal, and USR BLE 101.

TABLE III. THE NUMBER OF TRANSMITTER IN SCHOOL OF APPLIED SCIENCES BUILDING

No	Communication Module	Distance	A number of transmitter
1	NRF24L01	40 m	3
2	Xbee Low	40 m	3
3	Xbee Medium	100 m	2
4	Xbee High	500 m	1
5	USR BLE 101	60 m	3

Based on the result of the second scenario above, we can do the calculation for minimum cost of implementation system in third scenario.

C. *Third Scenario*

The third scenario aims to have a minimum cost of implementation system. In this scenario, we calculate the cost of implementation system on School of Applied Science building.

The cost of implementation system can be seen in table IV.

TABLE IV. COST IMPLEMENTATION

No	Module	Tx cost	Rx cost	Add node Tx cost	Cost in Applied Science School
1	NRF24L01	USD 23	USD 12	USD 23	USD 81
2	XBee Pro S2C	USD 60	USD 50	USD 50	USD 110
3	USR BLE 101	USD 25	USD 15	USD 15	USD 90

Table IV shown the minimum cost that can be implemented using module NRF24L01 while the maximum cost that can be implemented in the system is using XBee Pro S2C module. If the system using NRF24L01 module, it will require at least 3 transmitters and 1 receiver. The total cost implementation is USD 81. If the system using XBee Pro S2C it requires 1 transmitter (set the high level signal) and 1 receiver. The cost implementation using XBee Pro 2C mode is USD 110. If we implemented USR BLE 101 it needs 3 transmitters and 1 receiver. The total cost for USR BLE 101 implementation is USD 90.

IV. CONCLUSION

Detection of location signals by utilizing Module communication like RF module, XBee module, and Bluetooth modules can be implemented in an ordinary cane in order to help the blind to recognize the building in their circumstance area. This module communication can be implemented in simple circuit. Based on the testing result, the best performance is gained by XBee Pro S2C implementation in the system. Using Xbee, we can implement less transmitter than other module communication, but Xbee is a little bit expensive to be implemented and the configuration of the system is not simple as Bluetooth module or RF module implementation. Besides that, NRF24L01 module is cheaper than other communication module, but the performance of RF module communication is not strength enough in no loss area activity. The implementation of Bluetooth module communication is the simplest method, but has not good performance as XBee or RF modules communication.

Building a system is not only seen the minimum cost, but also it depends on various aspects, such as technology of the system and modules, complexity of the circuit design, dimension of the system, easy to implement, easy use by the user, the scope and characteristics of area implementation and maintenance the system. The selection from the point of view of ease, to do the installation and implementation refers to the ease of standard multiplatform system for the next future enhancement and system development. The comparison of the performance of modules communication can helps the designer to choose the best modules based on their needs.

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REFERENCES

[1] Infodatin, "Penyandang Disabilitas Pada Anak", Pusat Data dan Informasi Kementrian Kesehatan RI, 2014, p.1-8

[2] S. Aries, "3.75 Juta Tuna Netra tuntut Hak Bersekolah", Harian Jogja. 2016, [online] Available: http://www.harianjogja.com/baca/2016/01/26/penyandang-disabilitas-375-juta-tunanetra-tuntut-hak-bersekolah-684663. [accessed: 5 August 2017]

[3] M.T. Silabat, Jurnal Ilmiah Pembelajaran Keterampilan Penggunaan Tongkat Bagi Anak Tuna Netra, Jurnal Ilmiah Pendidikan Khusus, Vol.1, no.2, 2012.

[4] N.V.Kalyan, "Voice Guidance and Location Indication System for The Blind using GSM, GPS and Optical Device Indicator," International Journal of Scientific and Engineering Research, Vol.5, no.12, p.650, 2014.

[5] e.a. Rangsipan Murakatat, "GPS Navigator for Blind Walking Campus," International Journal of Computer, Electrical Automation, Control and Information Engineering, vol.4, no.10, 2010.

[6] Varun Raj S .P., Annie R. Das, "A Low Cost Outdor Assistive Navigation System For Blind People.," International Journal of Innovative Research in Computer and Communication Engineering, vol. 3, no. 6, pp. 5767-5774, 2015

[7] H.Fernandez, "Location Based Services for The Blind Supported by RFID Technology,"in 5th International on Software Development and Technologies for Enhancing Accessibility and Fighting Info-Exclusion, DSAI 2013,2014.

[8] M.Saranya, K. Nithya, "Campus Navigation and Identifying Current Location through Android Device to Guide Blind People," International Research Journal of Engineering and Technologi (IRJET), vol. 2, no. 8, p. 13391343, 2015

[9] D. Sarala, V. Suresh, P. Bala Murali Krishna, " Blind People Guiding System in Travelling, " International Journal of Innovative Research in Computer and Communication Engineering. Vol.3, Issue 11, November 2015. P.11467-11475

[10] Legge GE, Beckmann PJ, Tjan BS, Havey G, Kramer K, Rolkosky D, et al. (2013) Indoor Navigation by People with Visual Impairment Using a Digital Sign System. PLoS ONE 8(10): e76783. https://doi.org/10.1371/journal.pone.0076783

[11] K. Linda, G.A Mutiara, G.I Hapsari, "Smart-Cane for the Blind with Wind Direction Position based-on Arduino,"ASAIS, Jakarta, 2015

[12] M.Hebel, G.Bricker and D.Harris, Getting Started with XBee RF Module, "a Tutorial of Basic Stamp and Propeller Microcontroller Version 1.0",[online], Available : https://www.parallax.com/sites/default/files/downloads/122-32450-XBeeTutorial-v1.0.1.pdf , [accessed 20 August 2017].

[13] G Drew, "Zigbee Wireless Networking," Newnes Zigbee Alliance, 2017

[14] H. David, "Bluetooth Low Energy (BLE) 101 : a Technology Primer with Example Use Cases, White Paper Smart Card Alliance, June 2015

[15] F.Tsai, Y-S Chiou, H.Chang, " A positioning Scheme Combining Location Tracking with Vision Assisting for Wireless Sensor Network" Journal of Applied Research and Technology, Vol 11, issue 2, April 2013, Pages 292-300.

[16] G.A Mutiara, G.I Hapsari, Periyadi, M. Ryan. "RF-based Location Awareness for Blind". IJAAS. 2017

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