Smart-Cane for The Blind with Wind Direction Position based-on Arduino

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Smart-Cane for The Blind with Wind Direction Position based-on Arduino

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Abstract

Eyes are very important for us. Through the eyes, we can do a lot of activities. Unfortunately, there are some people who have a visually impaired. Blind people usually need a tool to help them doing the activity. One of the tools that often used is the blind cane. Blind cane is an ordinary stick that will only help users (blind people) to detect the presence or absence of obstructions (hitch) in their surrounding areas. This research developed an extended tool for the blind cane which is called smart guide extension. This tool can help users (blind people) to detect the direction of their position based on the position of the wind direction. The information about their position will be presented through voices. This wind direction module uses a compass sensor CMP511, DF Player as its output, the Arduino Uno and power system control that serves as a bank 3000mAh power provider. Based on trial results of questionnaire to the responder, 82.34% of responder statement stated these tools are user friendly and easily to used.

***Key Words**: smart-canes, wind direction position, blind*

1. INTRODUCTION

The Eyes is a pair of a complex and evolving photosensitive organ that enable accurate analysis of the shape, light intensity, and also the color that reflected by the object.[1] Eyes is very crucial for human being, since supporting all human activities. But, not all the people had a normal eye. Some of them have impaired vision since birth or due to an accident. We called them Blind. Blind people usually need a tool to help them doing the activity. The most useful tool is a blind cane. Blind cane is an ordinary stick that will only help users (blind people) to detect the presence or absence of obstructions in their surrounding areas. In Indonesia, there are several blind people who need a cane that equipped with the information of their position based-on direction of the wind. Besides to define the direction of the position, the cane also helps them to determine the position of western to perform their prayers.

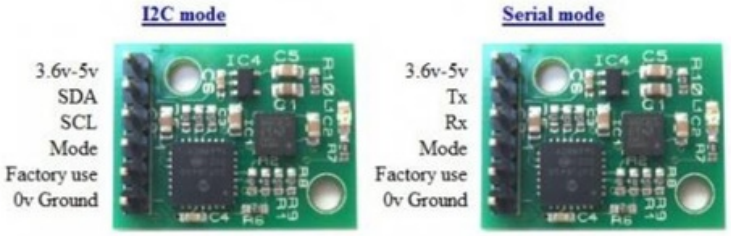
Based on that condition, we designed a prototype, called smart-cane, a device that embedded on cane as extension device. This smart-cane divided into two modules. The first module is a module which designed the detection of hitch and holes, while the second module is a module which designed the determined position of wind directions and. In this paper, we will be presented the second module. The information about their position will be presented through voices.

Some research about smart-cane are focused on detection hitch using sensors [2], and the newest technology for smart-cane are focused on face recognition software that embedded with a camera and GPS. [3,4,5]

2. THEORY

2.1 CMPS 11

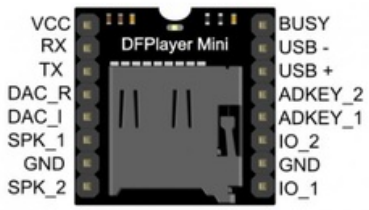
CMPS11 is an electronic compass sensor output from Devantech 3rd generation (CMPS03, CMPS10, CMPS11). The module is equipped with a 3-axis magnetometer, 3-axis and 3-axis gyro accelerometer. Additionally, this module has a functioning Kalman Filter combines gyro and accelerometer to eliminate errors which caused by the movement of the module PCB [6]. CMPS11 produces data output in the range 0-359.9, representing 0 to 359.9 or 0-255.The output of the three axes X, Y and Z is derived from components of the magnetic field with the Pitch and Roll used to calculate Bearing, each of these components are available in the form of raw data.



Pic 1 CMPS 11

2.2 DFPlayer Mini

DFPLayer Module Mini is a MP3 module series, which provides perfect integration of MP3, WMV hardware decoding. The software supports TF drivers, file systems FAT 16 and FAT 32. DFPLayer Mini Module using a simple serial commands to determine how to play music and other functions. DFPlayer mini module is also easy to use, stable and reliable [7].



Pic 2 DFPlayer Mini

DFPlayer Mini is an inexpensive MP3 module which has directly output on the speakers. This module can also be used as a stand-alone module combined with a battery, speaker, and push buttons that are embedded with Arduino Uno or by TX/RX.[8]

2.3 Arduino Uno

Arduino Uno is a microcontroller board based on Atmega 328. Arduino Uno has 14 digital input / output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a ceramic resonator 16 MHz, USB connection, power jack, ICSP header, and a reset button. Arduino Uno contains everything needed to support the microcontroller, simply connect to your computer with a USB cable or by the AC-DC adapter or battery to get started. Picture 3 is a physical description Arduino Uno.[9]

Pic 3 Arduino Uno

2.4 Likert Scale

Likert scale is a standard scale which is used to classify the variables, in order to avoid errors in data analysis and determine the next step. The fundamental principle of this scale is determining one's position in a continuum of attitudes toward an attitude object, ranging from the most

negative to very positive position. This scale using 4 scales of modified alternative answers. The alternative answers are Very Good (VG), Good (G), Not Good (NG), Bad (B). The middle alternative is eliminated, because people tend to choose and would not choose extreme response.[10]

Table 1 Likert Scale

No	Alternative answer	Abbreviation	Score (+)	Score (-)
1	Very Good	VG	4	1
2	Good	G	3	2
3	Not Good	NG	2	3
4	Bad	B	1	4

The validity of the measurement results of the questionnaire will be measured by the following formula:

$$Average\ Score = \frac{Total\ Score}{Total\ of\ Item} \quad (1)$$

$$Presentation\ Score = \frac{average\ score\ x\ 100\%}{ideal\ score} \quad (2)$$

Average score is the average score from total score divided by the total number of items that would become the input to find presentation score. Presentation score is the result of percentage category. Ideal score is the score of ideal value. The ideal value for this percentage category is 70.

The percentage of category table can be seen in table 2 below.

Table 2 Percentage Category

Category	Percentage
Good	76% - 100%
Fair	56% - 75%
Not God	40% - 55%
Bad	Less then 40%

3. METHODOLOGY

The methodology of this research conducted is using prototype model. The research began with several steps:

3.1 Identified Problem

On this step, we identified some problems. At this stage we did a survey to several foundations of the blind which is located in our city. A survey conducted through interviews the blind, then conclude the survey results and highlights the survey as a background to this research.

3.2 Study of Literature

This step is the phase of learning and finding a research which is related to smart-cane. Besides that, we also conducted the stage of the data collection and information which is related to the literature that will become the basis of the theory. This step is also carried out studies about the material and the hardware that will be implemented in this research.

3.3 Design and Analysis System

After conducting studies of literature, the next step is to determine system requirements analysis and create a block diagram of the entire system. At this step, we also did a designed of the schematic diagram of the system.

3.4 Test and Implementation

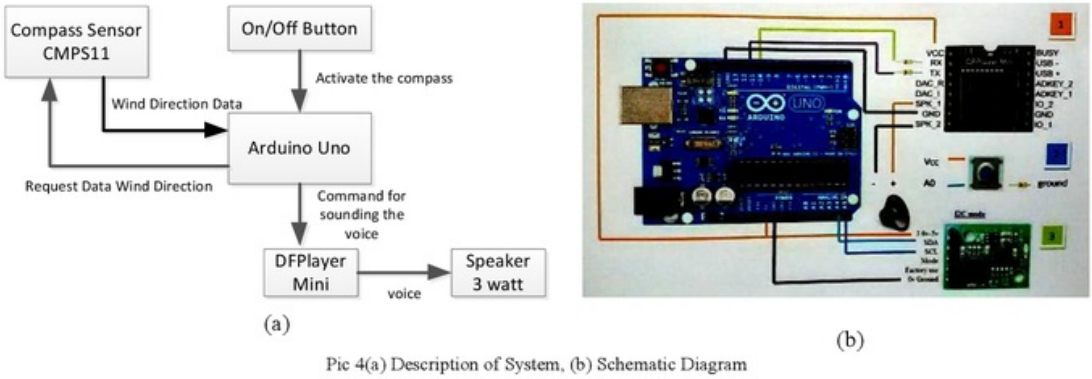
This stage is the phase of the implementation and testing of prototypes. The test was done with two scenarios. The first scenario is testing the system to determine the accuracy of the wind direction measured by the deviation degree direction. The second scenario is testing the prototype to the user to measure "how friendly" and "useful" the smart-cane for the user. Tests were performed in the Social Rehabilitation of Foundation PSBN Wyata Guna Bandung. The testing

procedure is done by testing the prototype to the user, and then the user will fill a questionnaire orally.

4. ANALYSIS AND DISCUSSION

4.1 Description of The System

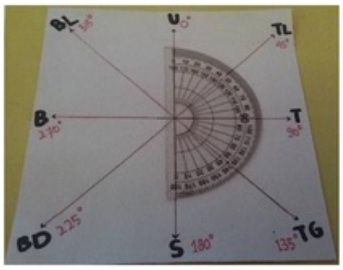
Compass sensors will triggered by on-off button and generate the screening position of user, then the system will give the position information through speaker. Design and implementation of smart-cane with information of wind direction can be seen at picture 7 (a) and 7(b) below.



Pic 4(a) Description of System, (b) Schematic Diagram

The system works when the blind push the button to activate the system. Arduino Uno will send the requesting signal to compass sensor CMPS 11. CMPS Sensor 11 then receives the data request and sends the information to the Arduino Uno through data lines I2C. Arduino Uno save the information and compare it with address of sound recording in DFPlayer. The voice recording information about wind direction will be issued through speakers.

To determine the movement of CMPS 11, we designed the track with 8 wind directions according to the degree of arc. It can be seen at picture below.



Description :
U = North (N)
TL = Northeast (NE)
T = East (E)
TG = Southeast (SE)
S = South (S)
BD = Southwest (SW)
B = West (W)
BL = Northwest (NW)

Pic 5 Movement Track of Sensor

Prototype the system can be shown at pic. 9.

Figure 6 Smart Cane

4.2 Testing Prototype

The prototype was test with two scenarios. The first scenario is testing the system to determine the accuracy of the wind direction measured by the deviation degree direction. The second scenario is testing the prototype to the user to measure "how friendly" and "useful" the smart-cane for the user. Tests were performed in the Social Rehabilitation of Foundation PSBN Wyata Guna Bandung.

4.2.1 First Scenario

The first scenario is testing the system to determine the accuracy of wind direction. We used 3^0 as a deviation degree of the system. It aims to protect the user from getting lost direction. The result can be shown at table 3. We can see that there is a delay that occurs when the system determines the position to the user. The average response time occurs when the angle of deviation of 1^0-2^0 degrees is 4.7s, while the average response time occurs when the angle of deviation 3^0 degrees is 5.5125s. The deviation angle of more than 3^0 degrees, the direction cannot be determined.

Table 3 Deviation Degree

Wind direction	Deviation $1\text{-}2^0$	Result	Response Time (s)	Deviation 3^0	Result	Response time	Deviation 4^0	Result
North (U) 0^0	358^0-359^0	x	-	356^0-359^0	√	5.12	355^0-359^0	x
Northeast (TL) 45^0	44^0-46^0	√	5.12	42^0-45^0-48^0	√	6.12	41^0-45^0-49^0	x
East (T) 90^0	79^0-92^0	√	5.53	79^0-90^0-93^0	√	5.67	78^0-90^0-94^0	x
Southeast 135^0 (TG)	134^0-136^0	√	3.45	132^0-135^0-138^0	√	4.30	131^0-135^0-139^0	x
South (S) 180^0	179^0-181^0	√	4.32	177^0-180^0-183^0	√	6.46	176^0-180^0-184^0	x
Southwest 225^0 (BD)	222^0-227^0	√	5.50	222^0-225^0-228^0	√	6.03	221^0-225^0-229^0	x
West(B) 270^0	269^0-271^0	√	4.30	267^0-270^0-273^0	√	5.11	266^0-270^0-274^0	x
NorthWest 315^0 (BL)	312^0-317^0	√	5.43	312^0-315^0-318^0	√	5.28	311^0-315^0-319^0	x

√ = detected, x = undetected

4.2.2 Second Scenario

The second scenario aimed to measure "how friendly" and "useful" the smart-cane for the user. This testing took place at Wyata Guna Bandung on Thursday, august 13, 2015 at 10.00 am. The user will be tested the prototype and answer the questionnaire orally. Six respondents tested the prototype can be seen at picture 7. The result can be seen at table 5.

Table 4 Questionnaire

No	Questionnaire	Rating			
		VG	G	NG	B
1	The prototype helps you to know the position of wind direction	2		4	
2	The Process response is good and fast		2	2	2
3	The position of the button is easy to use.	6			
4	The voice from speaker giving information heard clearly	6			
5	This prototype is easy to use.	2		4	
6	This prototype is heavy to lift		4	2	

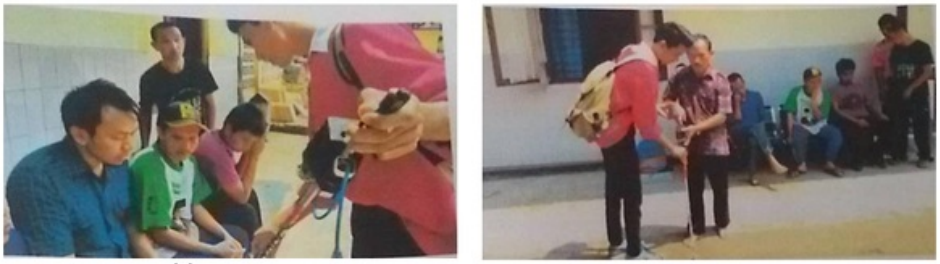
*VG = very good, G = good, NG = Not Good, B = Bad

The result of the questionnaires will be processed using Likert Scale.

$$Average\ Score = \frac{Total\ Score}{Total\ of\ Item} = \frac{2075}{36} = 57.64\ \%$$

$$Presentation\ Score = \frac{average\ score\ x\ 100\%}{ideal\ score} = \frac{57.64\ x\ 100\%}{70} = 82.34$$

Based on the result above, the presentation's score of smart cane is equal with 82.34%. So that referred to table 2 above, the percentage user friendly of smart cane can be said to be "good" category.



(a) (b)

Figure 7 Testing Prototype to Respondents

5. CONCLUSION

The smart cane prototype can be used as an aid tool to help the blind to find the position of wind directions. We can say that from the result of the questionnaire, about 82.34% of respondent said that this prototype is useful and user friendly for them. The response time of the movement of wind direction is about 4.7s and 5.5125s for deviation angle 1^0-2^0 degrees and 3^0 degrees. The deviation angle of more than 3^0 degrees cannot be determined.

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