Development of Glasses for Guiding Visually Impaired Using Ultrasonic Sensor and Microcontroller

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Abstract—**This research has developed a model of glasses to guide visually impaired using ultrasonic sensors and microcontroller. The steps of research and development include the following steps: 1) Preparation: Need assessment; 2) Development of Hardware: Study of Construction, Microcontroller, and Sensors; 3) Development of Software: Study of Algorithms and Programming; 4) Testing : Function of Module, Review, Refinement; 5) Integration: Installation of Software on the Hardware, and Packaging; 6) Final test of Product Performance; and 7) Reporting: Documentation of Results. This research is in collaboration with the Association of Indonesian Blind (ITI). The resulting glasses can detect the presence of an object through an ultrasonic sensor emits and captures infrared light. Reflected light then arrested, calculated the time reflect, and obtained the distance, subsequently forwarded to the vibrator module. Distance information is converted to the frequency of vibration. For a distance of 0-1 meters vibratory frequency is 50 hertz, the distance between 1-3 meters vibratory frequency is 30 hertz, the distance between 3-5 meters is 10 hertz vibratory frequency, and over 5 meters silent vibrator. Initially planned be installed three sensors are front, left, and right glasses with vibrator respectively, but in fact it is quite a hassle, then ultimately fitted only one in front of the sensor. To detect objects left and right, the user can perform alone or as a round head glanced left and right. The results that the user can detect the presence of the foreground object, left, and right up to a distance of 5 meters. However, users need to adapt as early habit of using a stick. Glasses blind is very helpful for users spicually Indoors.**

Keywords—Glasses, visually impaired, Ultrasonic Sensors, Microcontroller

I. INTRODUCTION

A. Background

Dysfunction of sensory organs or malfunction of any part of the body is something that is not necessarily desired by every one in the life. Individuals are part of a community that is in life can not be separated from the values and norms therein. A visually impaired persons with disabilities are also part of society in general have the same rights and obligations as citizens, and the same degree as the man of God's creation.

There are many major problems faced by the visually impaired. Visually impaired as part of a community that has limited mobility on the environment in social life. Expected by the visually impaired mobility is not limited in terms of social course, such as the acceptance of society but also of physical laws such as facilities and infrastructure so as to give ease of mobility for blind people in their activities.

Pedestrians who are blind patients must use special markers that are easily recognized by other road users. Signs for people with visual impairment can be a stick that comes with the tool reflecting light or sounds or red cloth. But when it happens, people

will always seek to heal, repair, or make tools. Various technologies to overcome the difficulties of persons with disabilities continue to be developed. One is glasses for blind people. During these blind people use stick tools for driving directions or move. As for blind people wear sunglasses usually does not function as a tool.

Blind people traditionally use a wand to detect the presence of objects that get in the way, for the information of the stick, it was decided to walk straight, turn left, or right. Reach an average of 1 m^2 with partial information where the information obtained is not at the same sequence.

Based on the principle of wall follower can be used as a tool for blind people in the form of glasses equipped with a proximity sensor capable of detecting the presence of obstacles in a wider range with richer

information in a short time so that the response / action can be done. This study intends to design and create a tool like sunglasses as guides or move for people with total blindness.

B. Objectives

The tools to be studied are the glasses that is equipped with a number of distance sensors. This tool is intended to help people with blindness in which they have difficulty when it must determine the direction to go where he wanted. Based on this, the general problem of this research is: "How to Develop a Model Glasses As A Tool untuki Blind?".

The general objective of this research to develop models of sunglasses as a tool to guide the blind in determining the direction of movement or path to be traversed. In particular, this research aims to get as follows.

1. Model construction proper glasses for the blind.
2. Adopting the principle of wall follower into glasses blind.
3. Assessing performance of blind glasses that have been made.

II. LITERATURE STUDY

A. Blindness Eyes

Definition of blindness can be viewed from two sides, according to the legal definition and according to the definition of educational / functional. The legal definition is a statutory definition that is used to determine the appropriate health facility legislation. Two things are assessed in this view is the sharpness of vision (visual acuity) and the field of view (visual field). Snellen Chart is the most common tool to determine a person's level of visual acuity []. Based on the results of the test Snellen Chart, WHO defines blindness based on visual acuity with the following ranges.

a. Vision was 6/6 to 6/18: normal vision (normal vision),

b. visual acuity <6/18 to> / = 3/60: less alert (low vision),

c. visual acuity <3/60: blind (blindness).

Meanwhile, the field of view is the area that can be seen with the eyes perpendicular to the front. Generally the normal eye has a field of view of 180 °. Definition of functional/educational is obtained according to the definition of usability or maximum function is used by the human eye. Sharp eyes healthy and can not necessarily be used properly by humans, and vice versa.

This definition is intended to help people in the use of his senses appropriately. educationally blind by definition is someone who is in need of tools and techniques to the view that he could perform his daily activities effectively. This definition blind divide into two groups, namely heavy blind if someone did not get to see or simply have a perception of light and mild blind if someone can still see if supported by optical tools aids to see. Blind certainly is a disease that has a cause and causes of blindness are generally divided into three types as follows.

Type I: refractive disorders consisting of myopia, hipermetropi, and astigmatism. Impaired vision includes errors in the eye lens that is difficult to contract and relaxation so that the shadow becomes focused on the retina. This eye disorder can still be corrected by optical aids such as glasses.

Type II: media abnormalities included refraction and refractive media it is the cornea, the eye fluid front room (Aquous humor), eyepiece, and glass objects (Corpus vitrium). This eye disorder becomes large enough obstacles in the process of seeing. For example, cataracts are common in the elderly. Eye lens made of water and protein suddenly become opaque because the attachment of the protein in the lens. This disorder can be cured with surgery.

Type III: Eye disorders of the nervous system (nerves II), such as retinal detachments, malignant myopia, and muscle atrophy caused by glaucoma. Abnormalities in the optic nerve can be very serious because of the possibility can not be cured. This leads to permanent blindness. One example of a disease that can still be addressed is where the retinal detachment retinal layers separated from the basic network attached place. This disorder can be cured with surgery. However, any recurrence disturbance in the eye will worsen the eye and can cause permanent blindness at the same total.

C. Microcontroller

Microcontroller AT89S51 is one of the MCS-51 family of Atmel output. This microcontroller in principle, could be used to process data per bit or 8-bit data simultaneously. In principle, the microcontroller program is executed gradually, so the program itself there are several sets of instructions and each instruction was executed gradually or sequentially. Some of the facilities owned by the microcontroller AT89S51 is as follows [3].

1) A Central Processing Unit 8 bits,

2) Osilatic: internal and timer circuit,

3) 128 bytes of internal RAM,

4) 4 Kbyte Flash memory + 2Kbyte Eeprom,

5) Durability 1000 times read / write,

6) Three levels of program memory key,

7) Five of the interrupt lines (two external interrupts and three interupsiinternal),

8) Four programmable I/O ports, each of which consists of delapanbuah channels of I/O,

9) A serial port with full duplex UART serial control,

10) The ability to perform arithmetic and logic operations,

11) Speed in carrying out the crop 1 microsecond instruction at a frequency of 12 MHz.

Microcontroller AT89S51 only require an additional 3 capacitors, 1 resistor dan1 crystal and 5 volt power supply. Capacitor 10 micro-fard and 10 kilo Ohm resistor is used to form a series of research. With the series of this research AT89S51 researched so the circuit automatically receive power supply. Maximum with the frequency 24MHz crystal and micro-farad capacitor 30 is used for forming circuit of osilator clock that determines the speed of microcontroller work [3].

AT89S51 has six sources of power interruptions, two of which are the interrupt signal is fed to kakiINT0 and INT1. The second leg P3.2 and P3.3 coincide invitation so it can not be used as input / output INT0 and INT1 parallelkalau used to receive signals interupsi.Port1 and 2, UART, Timer 0, Timer 1 and other means is that physically is RAM special, which was placed in the Special Function Register (SFR) [3].

Pin-Pin on Microcontroller AT89S51

Description of the pins on the microcontroller AT89S51 [1][7]::

VCC (Pin 40): Supply voltage

GND (Pin 20): Ground

Port 0 (Pin 39-Pin 32)

Port 0 can function as I/O usual, the low order multiplexed address/data/receivded of byte code in the flash progamming In function as I/O ports can deliver exceptional output to sink eight TTL inputs or can be changed as the input to provide a logic 1. In port functions as a low order multiplexed address/data, this port will have internal pull up while during program verification [3][9].

Port 2 (Pin 21 - pin 28)

Port 2 functions as an I/O ordinary or high order address, when memory access is 16 bits. At the time of accessing the memory of 8 bits, this port will remove the contents of the P2 special function registers. This belong to port internal pull-up and serves as input to provide a logic 1. As output, this port can provide output sink four TTL inputs fruit [3][9].

Port 3 (Pin 10 - pin 17)

Port 3 is an 8-bit I/O port with internal pull up bidirectional. Port 3 also has the function of each pin, as follows [1][7]:

P3.0 (pin 10) RXD (serial input port)

P3.1 (pin 11) TXD (serial output port)

P3.2 (pin 12) INTO (external interrupt 0)

P3.3 (pin 13) INT1 (external interrupt 1)

P3.4 (pin 14) T0 (external input timer 0)

P3.5 (pin 15) T1 (external input timer 1)

P3.6 (pin 16) WR (write to external memory data)

P3.7 (pin 17) RD (for external memory data read)

RST (pin 9)

Reset will be active by providing high input for 2 cycles.

ALE / PROG (pin 30)

Address Latch Enable is a pulse output for down latch bytes of external memory address in the accessing. Moreover, as the program pulse input (PROG) during flash progamming [3].

PSEN (pin 29)

Program store enable used to access external program memory.

EA (pin 31)

In conditions of low, this pin will function as an EA that akanmenjalankan microcontroller programs that exist in the external memory after a system reset. If high, this pin will be used to run programs that exist internal memory. At the time of flash progamming, this pin will receive 12 volt [3].

XTAL1 (pin 19)

The input to the internal clock.

XTAL2 (pin 18)

The output of the oscillator.

D. Ultrasonic Sensor PING)))

PING))) ultrasonic sensor is produced by Parallax (PING Sensor Ultrasonic Range Finder). PING sensor is specifically designed to be able to measure the distance of a solid object. This sensor has a value of precision measurement without contact with the measuring point from 3 cm to 500 cm [2].
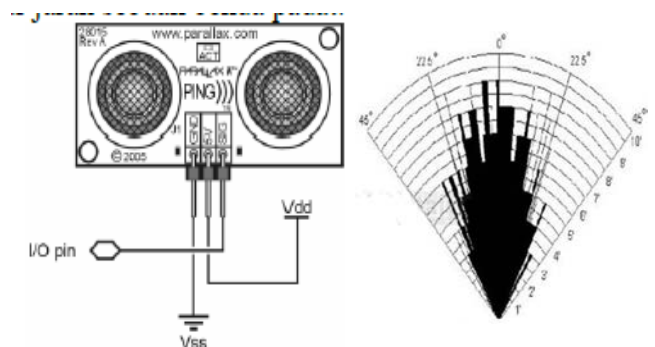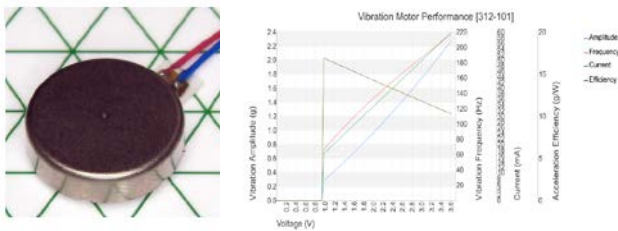

PING sensor detects an object distance by emitting ultrasonic waves (50kHz) for transmitting time and then detect the reflection. PING sensor emits ultrasonic waves in accordance with the trigger pulses from the microcontroller as controler. Figure below shows the timing diagram of the PING sensor [2][12].

PING))) Sensor Timing
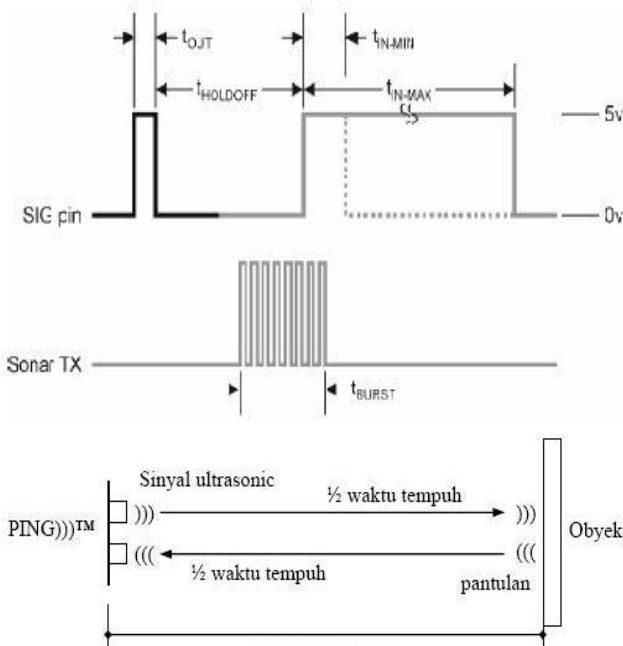
F. DC Motor Driver

Using a DC motor driver IC L293D which has four push-pull. Every two push-pull can be used as a strand H-bridge and can be activated with an enable signal. L293D IC capable of operating at a voltage of 4.5 to 36 volts. The amount of current that can be drawn is 600mA at normal conditions as well as the peak current of 1.2 A (instantaneous). IC is specifically used in the motor instead of a relay, but with the proviso enable pin 1 and 2 under the condition of high (1), can be used in the direction of the bidirectional (two-way), consisting of 16 pins. If one of the input logic 1 (high), then the output logic 1 (high) [5][9].

L293D IC can be used to drive four permanent magnet DC motor separately (independent) with a rotary direction (one-directional), ie clockwise (clock wise / CW) or counter-clockwise (counter clock wise / CCW). If we want to turn the direction of the motor in both directions (bi-directional), ie the motor can rotate clockwise (CW) and also rotates counter-clockwise (CCW), IC L293D can only move two permanent magnet DC motors only. DC motor driver in glasses used to control the vibrator with vibration (vibration) 0 hertz, 10 hertz, 30 hertz and 50 hertz [9].

III. METHODOLOGY

This study uses research and development (reseach and development) based on the experiment. The research method includes the steps as follows.

A. Preparation

This stage of collecting data by observation and interviews directly to the visually impaired community in the Blind Association of Indonesian (ITI) in Cimahi to obtain detailed data about the main difficulties encountered by persons with disabilities of blindness that was there. Doing research on the internet about any device that has been developed by other researchers who aim to make eassy life of the people with disabilities.

During the preparation of the design process is also done in this case relied on the results of observations that have been made in the previous step. The design process will be done with the help of software Autodesk Inventor 2012. In addition to the design of the shape of the glass eye itself in this process also determines what materials will be used in chasing.
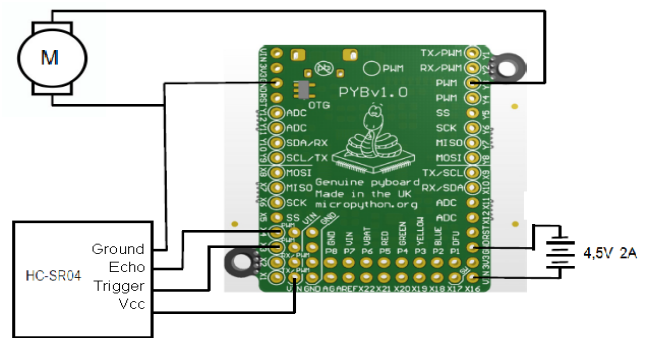
B. Development

Stage of development carried out in the form of hardware and software development blind eye glass. Stage of development begins with the preparation of the formulation implementation documents to be carried out for each module. This process consists of several sub-processes such as the construction is based on the design chasing that has been generated in the previous process along with the material to be used as a base material chasing glasses. The software development is a step in the programming of the electronic equipment that will be installed in glasses including programming of the microcontroller in order to later be able to provide guidance to the blind in the running to where he wanted [11]. Besides programming also aims to integrate various features in the design of glasses such as sensors, compass and pointer shakes as the output into a unified system.

The final step in the process of prototyping is the Assembly, where the electronic components that have been programmed diassembly with chasing glasses are ergonomically and become a perfectly integrated product and may be used by the blind.

C. Testing

Pilot phase conducted on real objects visible for object detection module. The test consists of a partial test is a test for each module there. While thorough testing conducted on the performance of glasses full. In each test phase in the research team continues to

evaluate the module and the system so that it becomes the input to the stage of completion.

Once the prototype is completed the next step is the testing of the prototype, if the prototype will function in accordance with the design and the desired design or not. In this testing process involving direct blind so that it can be seen empirically the visually impaired responses to this prototype is already satisfactory or not.

D. Integration

After partially integrated and conducted trials, the final stage of the evaluation of the performance of glasses as a whole, both in terms of the detection system as well as to response or action from the blind.

IV. RESULTS AND DISCUSSION

A. Results of Preparation

The results of the preparatory phase is a schematic panorama du blind systems that consist of 4 (four) parts, ie a voltage source module, microcontroller, proximity sensor, and the vibrator.

B. Results of Development

Stage of development carried out in the form of hardware and software development blind eye glass.

C. Testing Hardware

Device testing done after we do the testing software and programs that have been made already incorporated into the microcontroller. But before doing hardware testing as a whole, then do the test or tests per module so that errors exist in the module can be addressed per module. The modules are tested, among others:

1. Microcontroller Module Testing

This microcontroller testing just wanted to see if the oscillator circuit and resetnya work well or not as well as the micro is in good condition or not. For testing done with 1 piece LED connected to port A of the microcontroller, then made a small routine that will be turned on / off led in turn [1][7].

Set PortA.0; turn led

Waitms 1000; delayed briefly

Reset PortA.0; turn off the LED kembali8

2. Measurement of Output Power Supply

Large voltage used is 5 volts and is used as a voltage source on ATMEGA32 microcontroller module, PING, and IC L293 and DC motors. Measurements carried out on the component parts of the regulator LM 7805 on the input and output [16].

Componen	Results of Measures (volt)	
	Input	Output
LM7805	12,11	5,00

3. Testing the PING sensor.

PING ™ sensor testing performed by measuring the distance to the wall of the sensor. Sensor readings is limited to the level of 50 cm - 500 cm and the object to be measured in the form of solid objects or walls.

No	Measure Levels (cm)	Ping Sensor
1	50	50
2	100	100
3	150	150
4	200	200
5	250	248
6	300	300
7	350	345
8	400	390
9	450	440
10	500	490

For the pilot phase carried out on the wall with ultrasonic sensors. At this stage the wall with the sensor distance is limited to a distance of 50 cm, 100 cm, 300 cm, and 500 cm. Then the distance can be assumed with a very close, close, somewhat distant, distant, and very far away.

No	Distances	Vibrations	Interpretations
1	0 - 50 Cm	Very High	Very Close
2	50 - 100 Cm	High	Close
3	100 - 300 Cm	Slow	Far
4	300 - 500 Cm	Very Slow	More Far
5	More of 500 cm	No Respon	Very Far

D. Software Testing

Testing software or program is meant whether we have made the program has been completely or still have errors that must be corrected. The steps - steps involved in testing software or programs include the following.

1. Editing Program

Editing program using Bascom. This step is taken to ensure the program is still writing errors or deficiencies that need to be added. If you no longer found error, save the file with the file extension .BAS then proceed with the process of compiling the program.

2. Compiling Programs

Compiling the program is a step to get the hex file that will be needed in filling into the microcontroller chip. To perform compiling a program by pressing the F7 key on the menu Bascom [11].

3. Programming Microcontrollers

Once the program is compiled using Bascom, then proceed with charging the program into the microcontroller chip. The files are taken to be included into the microcontroller is a file with extension .hex. Program or use is Ponyprog downloader, downloader program has the ability to fill a microcontroller with many series. After performing the above program, select the file and then open the file and then enter the extension .hex file or .obj that we have had before.

Furthermore, to fill to mikrokontrolernya, select the WRITE button [11].

E. Product Results

The products produced in the form of glasses that come with sensors and connected to a circuit that is packed with a box like the picture. Test products was done indoors and outdoors. Previous users (blind)
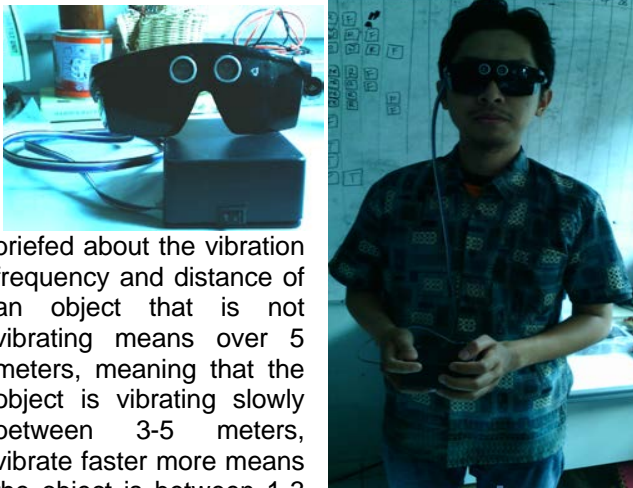
briefed about the vibration frequency and distance of an object that is not vibrating means over 5 meters, meaning that the object is vibrating slowly between 3-5 meters, vibrate faster more means the object is between 1-3 meters, and rapidly vibrating means between 0-1 meters. User (blind) method object testing with the mention approximate distance and match the reference. For indoors with a size of 4 m x 4 m result as the table below.

No.	Locations	Frontal		Right Side		Left Side		Head Below		Head Above	
		User	Ref.	User	Ref.	User	Ref.	User	Ref.	User	Ref.
1	Trees	4	3-5	>5	>5	>5	>5	2	1-3	>5	>5
2	Peoples	4	3-5	>5	>5	>5	>5	2	1-3	>5	>5
3	Buildings	3	1-3	4	3-5	4	3-5	2	1-3	4	3-5

Based on the table above, the asterisks indicate the presence of objects near the front position by reference padahak far enough. This is because the sensor beam spread at an angle so that the left and right objects reflect light and captured as an object. It can be controlled by head movement to the left or right. For directions below and above, which is detected is a distance of floor and roof remains that of a glass eye. With ongoing training, users can anticipate vibe going and become accustomed. Subsequent trials conducted in the open courtyard. The following table test results on the page.

No.	Locations	Frontal		Right Side		Left Side		Head Below		Head Above	
		User	Ref.	User	Ref.	User	Ref.	User	Ref.	User	Ref.
1	Center	2	1-3	2	1-3	2	1-3	2	1-3	2	1-3
2	Back	4	3-5	4	3-5	4	3-5	2	1-3	2	1-3
3	Right	0,5*	3-5	0,5	0-1	3	3-5	2	1-3	2	1-3
4	Left	0,5*	3-5	3	3-5	0,5	0-1	2	1-3	2	1-3
5	Door	1*	3-5	0,5	0-1	1	1-3	2	1-3	2	1-3

Based on the above table, the user can detect the presence of objects both stationary and moving objects. However, users need to familiarize yourself with this guide because the system is a new thing.

V. CONCLUSIONS

The end result of this research is based tool guides the blind control technology consists of a sensor as the input source and the microcontroller as the processor. From the series of this study can be drawn some conclusions as follows.

1. The ultrasonic sensor can be used as a source of information where good object for the blind.

2. Microcontroller is good information processing for object existence decision.

3. The system guides the blind in the form of glasses produced based proximity sensor can help the blind to detect the presence of objects in the wider environment.

4. User (blind people) need to learn (exercise) and adapt to the guide device in the form of glasses based proximity sensor.

5. The system guides the resulting need further development for instance equipped with a camera to inform the type of object.

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