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MODERN BLIND STICK

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MODERN BLIND STICK

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MODER BLIND STICK

ABSTRACT

The study focus on a simple method of detecting the obstacle and route by using an *ultrasonic sensor* that can detect a hole or stair with maximum range about 2 meter. As we can see, blind people is having their trouble to do their life routines because they can't see even a single things. With our idea, we want to help this kind of people to live their life freely. This modern blind stick have a several feature that surely can help this blind people to navigate routes and detect an obstacle that surely can make their life routines easier. The user just need to use the blind the normal blind stick , the different is , blind people can detect a hole or stair more faster and easily . Besides that , guardian or parent also can locate the location of the stick user using *Global Positioning System(GPS) and Global System for Mobile Communication (GSM)* module .

Keywords: *ultra sonic sensor, Global Positioning System(GPS), Global System for Communication (GSM)*

CHAPTER 1

INTRODUCTION

1.1 TITLE

- Modern Blind Stick .

1.2 INTRODUCTION

Nowadays, visually impaired person suffer from serious visual impairments preventing them from travelling independently. Accordingly, they need to use a wide range of tools and techniques to help them in their mobility. One of these techniques is orientation and mobility specialist who helps the visually impaired and blind people and trains them to move on their own independently and safely depending on their other remaining senses. Recently, many techniques have been developed to enhance the mobility of blind people that rely on signal processing and sensor technology. According to the literature, the mainly classified into two major aspects: sonar input (infrared signals, or ultrasonic signals). The way these devices operate just like the radar system that uses ultrasonic fascicle or sonar to detect the obstacle of fixed and moving objects. The distance between the person and the obstacles is measured by the time of the wave travel. However, all existing systems inform the blind of the presence of an object at a specific distance in front of or near to him. Information about the object characteristics can create additional knowledge to enhance space manifestation and memory of the blind. To overcome the above-mentioned limitations, this work offers a simple, efficient, configurable electronic guidance system for the blind and visually impaired persons to help them in their mobility regardless of where they are, outdoor or indoor. The originality of the proposed system is that it utilizes an embedded vision system of three simple ultrasonic sensors and brings together all reflective signals in order to codify an obstacle through PIC microcontroller(Arduino Uno R3). Hence, in addition to distance the proposed guidance system enables the determination of two main characteristics of the obstacle which are material and shape. Furthermore, to assist in tracking the location, this modern blind stick utilizes GPS to determine the location and send it via SMS to locate the location of the user Modern Blind Stick.

1.3 OBJECTIVE

I. To develop a prototype hardware for modern blind stick.

II. To help the blind people navigate the route at their best.

III. To reduce the risk of injuries and lost for the visually impaired person.

IV. To creating a suitable software for the visually impaired person.

1.4 PROBLEM STATEMENT

I. Blind people can't easily recognize obstacles or stairs while using normal blind stick .

II. No safety features on the normal blind stick .

III. Can't locate the location of the normal blind stick user when they are having an emergency problem or lost in a public area .

1.5 SIGNIFICANT OF PROJECT

- To prevent and reduce the risk of injuries and lost of the visually impaired person.

1.6 SCOPE OF PROJECT

- Visual impaired person that having trouble to navigate.

1.7 OVERVIEW

The purpose of this project is to detecting the obstacle and route by using ultrasonic sensor that can detect a hole or stair with maximum range about 2 meter. With our idea, we want to help this kind of people to live their life freely. This modern blind stick have a several feature that surely can help this blind people to navigate and detect an obstacle that surely can make their life routines easier. The user just need to use the blind the normal blind stick , the different is , visually impaired person can detect a hole or stair more faster and easily. Besides that, guardian or parent can locate the location of the stick user using GPS and GSM module by sending SMS to the stick**.**

1.8 COST OF THE PROJECT

COMPONENTS	QUANTITY	PRICE(RM)
Arduino Uno + Data Cable	1	40.00
Light Dependent Resistor(LDR)	1	3.00
GPS Module	1	19.00
GSM Module	1	35.00
LED Strip	1	4.00
Vibration Motor	1	2.00
Ultra Sonic Sensor	1	8.00
Relay	1	2.00
Buzzer	1	2.00
Jumper Wire	1	5.00
Switch	1	2.00
Battery Holder	1	3.00
Component Box Battery	1	5.00
Blind Stick	1	50.00
Battery	2	40.00
TOTAL	16	220.00

CHAPTER 2

LITERATURE REVIEW

2.1 Smart Walking Stick Using Ultrasonic Sensors and Arduino.

This project was developed by (M.H. Mahmud, R. Saha and S. Islam). The author proposes a function of a microcontroller that have code protected so its security bridge cannot be override except the vendor or owner. It produces different Pulse Width Modulation (PWM) based on the sensors output to operate pager motor. The author focused on the easy way to use the stick and it's maintain, cheap and it is very comfortable to use for blind people. The author approach with subsystems fundamentally sensor based with integral scheme is designed with a circuitry fundament on a PIC microcontroller. The power consumption is low and can be operated easily. The stick is very economic over the conventional one. The Smart Stick acts as a basic platform for the coming generation of more aiding devices to help the visually impaired to navigate safely both indoor and outdoor. It is effective and affordable. It leads to good results in detecting the obstacles on the path of the user in a range of three meters. This system offers a low-cost, reliable, portable, low power consumption and robust solution for navigation with obvious short response time.[1]

M.H. Mahmud, R. Saha and S. Islam (February 2015)

2.2 A computerized Travel aid for the Active Guidance for the Blind Pedestrians.

The author convinced a stick which allowed a sighted assistant to steer the Guide Cane remotely. A sightless subject would then walk with the Guide Cane, "steered" by the assistant radio-control joystick. The author focused on how to steer the stick so the sensor head is mounted on a steerable with two unpowered wheeled steering axle. The author approach with the ultrasonic sensors that detect any obstacle in a 120o wide sector ahead of the user. Using UM's previously developed, patented obstacle avoidance technique called "Vector Field Histogram" (VFH) in combination with UM's patented "Error Eliminating Rapid Ultrasonic Firing" (EERUF) method for firing the sonars, allows for travel at fast walking speeds.[2]

Johann Borenstein and Yoram Koren (April 21-27)

2.3 A Multidimensional Walking Aid for Visually Impaired Using Ultrasonic Sensors with Voice Guidance.

The author propose that voice can being consequently activate by microcontroller when detect any obstacle to warn the sightless subject. The author approach using with a 40 KHz signal sent out by the ultrasonic transmitter. This will be reflected back to the ultrasonic receiver in case there is an obstacle along the pathway of the stick, and this activates one of the input pin of the microcontroller. Once this happened, the microcontroller will consequently activate the voice recording microchip which then gives the relevant output via the speaker. The author focused on how to make the voice guidance as a platform to ease and help the sightless subject.[3]

Olakanmi (August 2014)

2.4 Obstacle Detection, Artificial vision and Real-time assistance via GPS

The author convinced the Global Positioning System (GPS) is to identify the position and orientation and location of the blind person any of those solutions rely on GPS technology. The author focused on the GPS to make use of the data stored to compare with the destination location of the user. By this it can trace out the distance from the destination and produce an alarm to alert the user in advance. The author conclude The proposed combination of various working units makes a real-time system that monitors position of the user and provides dual feedback making navigation more safe and secure. The author approach with Microcontroller that intergrated using Global Positioning System(GPS).[4]

Dambhare, Shruti and A.Sakhare (2011)

2.5 Implementation of Microcontroller Based Mobility Aid for Visually Impaired People

The author conviced the proposed that LDR gives a very high resistance value ranging up to 2MΩ and in the day time or when there is sun light it give a low resistance ranging to 100Ω and sometimes below. From the voltage divider network at day time the voltage from the LDR is lower there by making pin 2 lower than pin 3 of the comparator giving an output voltage of 0V and at night the VLDR is high making pin 2 greater and the comparator output 5V. The author focused on how LDR can function on white cane with the proper circuit. The system consists of an ultrasonic sensor for obstacle detection, a and a light dependent resistor for dark detection. Each sensor is differentiated from one another through pattern of sounds.[5]

E. J. Chukwunazo and G. M. Onengiye (2015)

CHAPTER 3

METHODOLOGY

3.1 BACKGROUND

The methodology is the general research strategy that outlines the way in which research is to be undertaken and among other things, identifies the methods to be used in it. These methods, described in the methodology, define the means or modes of data collection or, sometimes how a specific result is to be calculated.

For our project the information about the visually impaired people has been collected throughout every source that leads to our project. All of this information has been used to do our project which is Modern Blind Stick.

3.2 PLANNING OF PROJECT FOR MODERN BLIND STICK

In ensuring the Modern Blind Stick can be done appropriately, a project planning by using Gantt charts has been prepared. In this Gantt chart, schedule of plan and subsequently report progress within the project environment has been stated clearly. Initially, in this project, the scope is defined with the appropriate methods for completing the project are determined.

3.3 GANTT CHART

No	Task	Week											
		1	2	3	4	5	6	7	8	9	10	11	12
1	Do schematic circuit in proteus												
2	Troubleshoot problem												
3	Make a connection between all the components												
4	Make more research on the project												
5	Make a questionnaires about the project												
6	Slide present to our supervisor												
7	Make a survey about visually Impaired person												
8	Identify & solve the problems of the programs												
9	We searching a suitable casing & stick for our project												
10	We apply all of the components to the stick												

Table : Gantt chart

3.4 FLOW CHART

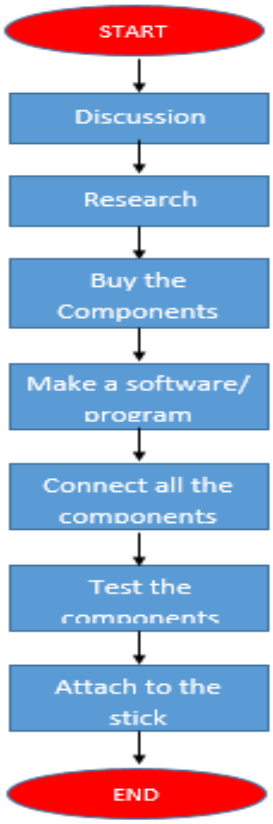
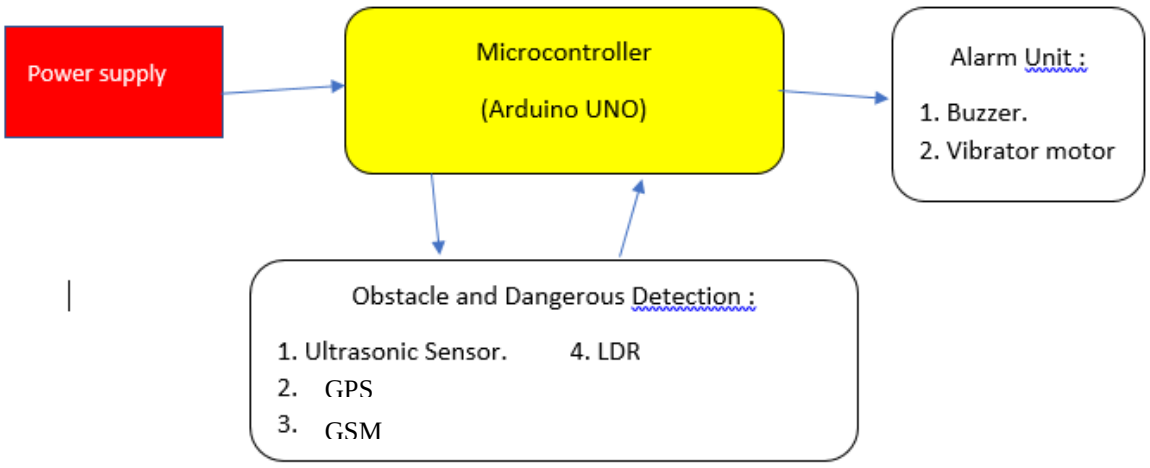


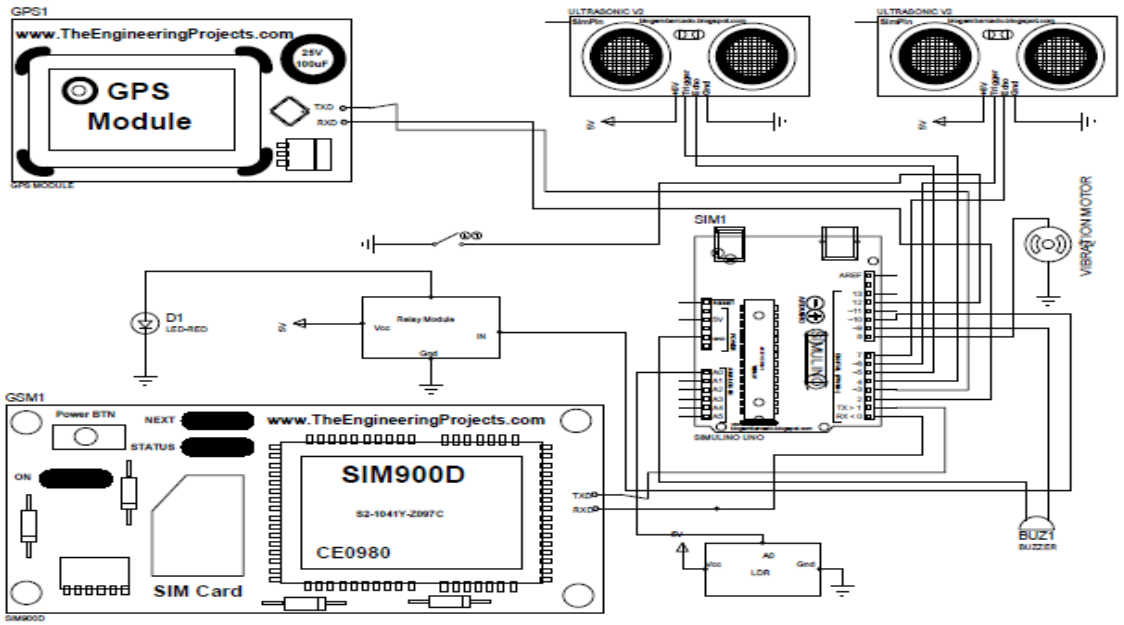
Figure : Flow Chart of process to develop progression of Modern Blind Stick.

3.5 BLOCK DIAGRAM

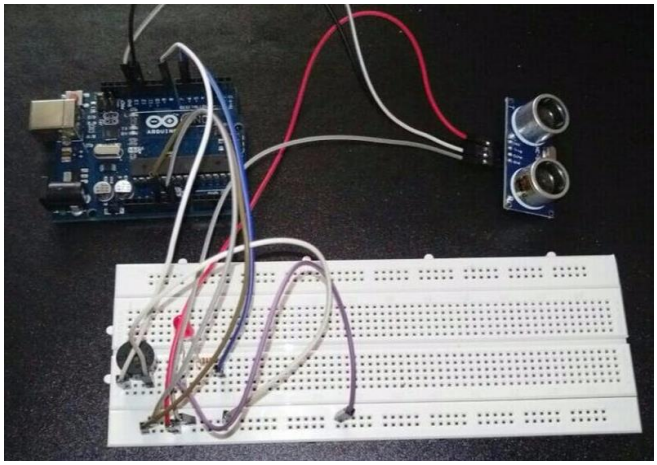
I. Block diagram



II. Schematic Diagram.

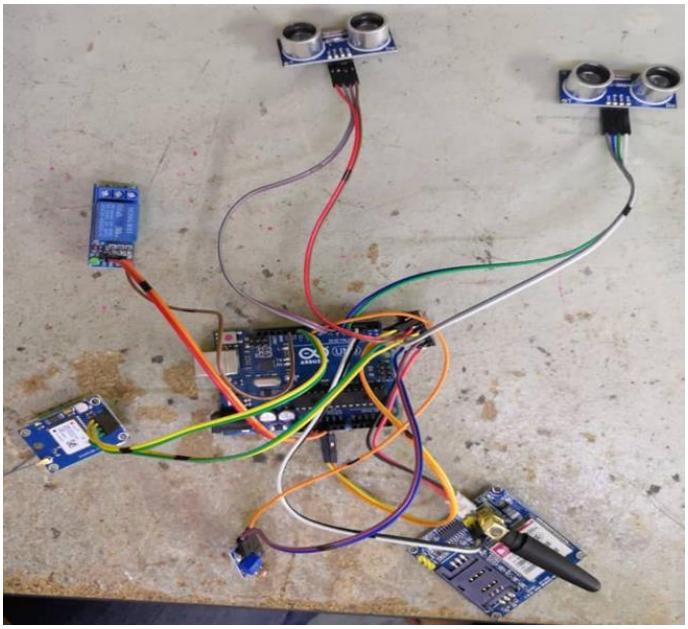


HALFWAY PROJECT DESIGN - SEMESTER 4



1. Arduino UNO R3
2. Protoboard
3. Jumper Wires
4. LED
5. Buzzer
6. Ultrasonic Sensor

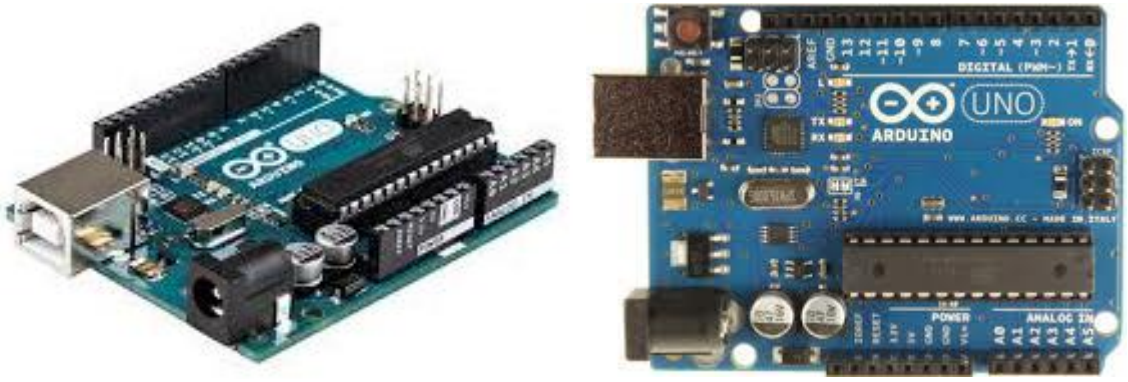
HALFWAY PROJECT DESIGN - SEMESTER 5



1. Arduino UNO R3
2. Relay Module
3. Jumper Wires
4. LED
5. Buzzer
6. Ultrasonic Sensor
7. GSM Module
8. GPS Module
9. LDR Module

3.6 LIST OF COMPONENTS

1. Arduino UNO R3

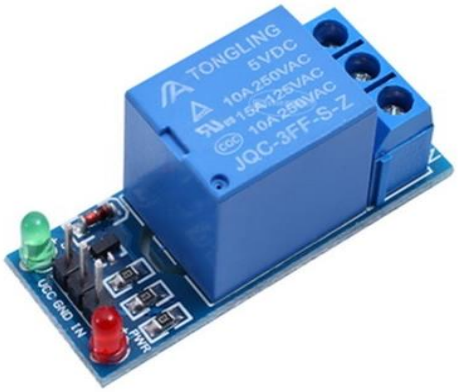


The Arduino UNO R3 is a microcontroller board based on a removable, dual-inline-package (DIP) ATmega328 AVR microcontroller. It has 20 digital input/output pins (of which 6 can be use as PWM outputs and 6 can be used as computer program. The Arduino has an extensive support community, which makes it a very easy way to get started working with embedded electronics. The R3 is the third and latest revision of the Arduino UNO.[6]

General Specfications.

Microcontroller	ATmega328
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	6
DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328) of which 0.5 KB used by boot loader
SRAM	2 KB (ATmega328)
EEPROM	1 KB (ATmega328)
Clock Speed	16 MHz

2. Relay Module



Relay Module is an electrically operated switch that can be turned on or off, letting the current go through or not, and can be controlled with low voltages, like the 5V provided by the Arduino pins. Controlling a relay module with the Arduino is as simple as controlling any other output.[7]

Specifications:

- 5V 4-Channel Relay interface board.
- Requires 15-20mA signal drive Current.
- TTL logic compatible.
- High-current AC250V/10A, DC30V/10A relay.
- Status LED.
- Equipped with 3.1mm screw holes for easy installation.
- 61g.
- 75 x 55 x 19.3mm (2.95 x 2.16 x 0.76″)

3. Light Emitting Diode(LED)

A light-emitting diode (LED) is a semiconductor light source that emits light when current flows through it. Electrons in the semiconductor recombine with electron holes, releasing energy in the form of photons. The color of the light (corresponding to the energy of the photons) is determined by the energy required for electrons to cross the band gap of the semiconductor.[5] White light is obtained by using multiple semiconductors or a layer of light-emitting phosphor on the semiconductor device.[8]

Specification of LED.

WAVELENGTH RANGE (NM)	COLOUR	V_F @ 20MA	MATERIAL
< 400	Ultraviolet	3.1 - 4.4	Aluminium nitride (AlN) Aluminium gallium nitride (AlGaN) Aluminium gallium indium nitride (AlGaInN)
400 - 450	Violet	2.8 - 4.0	Indium gallium nitride (InGaN)
450 - 500	Blue	2.5 - 3.7	Indium gallium nitride (InGaN) Silicon carbide (SiC)
500 - 570	Green	1.9 - 4.0	Gallium phosphide (GaP) Aluminium gallium indium phosphide (AlGaInP) Aluminium gallium phosphide (AlGaP)
570 - 590	Yellow	2.1 - 2.2	Gallium arsenide phosphide (GaAsP) Aluminium gallium indium phosphide (AlGaInP) Gallium phosphide (GaP)
590 - 610	Orange / amber	2.0 - 2.1	Gallium arsenide phosphide (GaAsP) Aluminium gallium indium phosphide (AlGaUInP) Gallium phosphide (GaP)
610 - 760	Red	1.6 - 2.0	Aluminium gallium arsenide (AlGaAs) Gallium arsenide phosphide (GaAsP) Aluminium gallium indium phosphide (AlGaInP) Gallium phosphide (GaP)
> 760	Infrared	< 1.9	Gallium arsenide (GaAs) Aluminium gallium arsenide (AlGaAs)

4. Buzzer

A buzzer is a small yet efficient component to ad sound features to our project/system. It is very small and compact 2-pin structure hence can be easily used on breadboard, Perf Board and even on PCB which makes this a widely used component in most electronic applications. This Buzzer can be used by simply powering it using DC power supply ranging from 4V to 9V. A simple 9V battery can also be used, but it is recommended to use a regulated +5V or +6V DC supply.[9]

Buzzer Features and Specifications

- Rated Voltage: 6V DC.
- Operating Voltage: 4-9V DC.
- Rated current: <30mA.
- Sound Type: Continuous Beep.
- Resonant Frequency: ~2300 Hz.
- Small and neat sealed package.
- Breadboard and Perf board friendly.

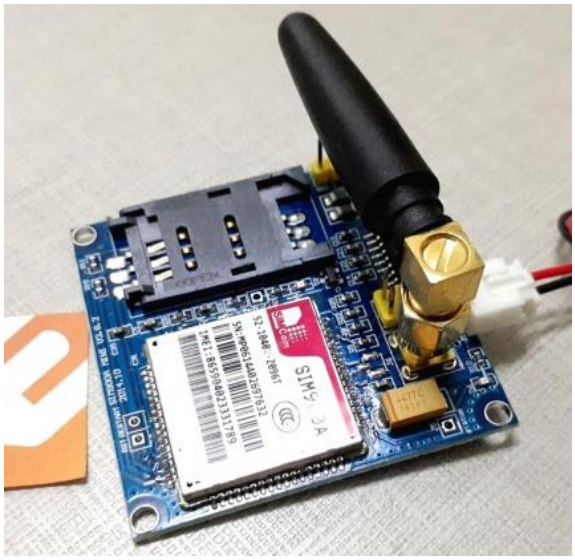
5. Ultrasonic Sensor

The HC-SR04 ultrasonic sensor uses SONAR to determine the distance of an object just like the bats do. It offers excellent non-contact range detection with high accuracy and stable readings in an easy-to-use package from 2 cm to 400 cm or 1" to 13 feet. The operation is not affected by sunlight or black material, although acoustically, soft materials like cloth can be difficult to detect. It comes complete with ultrasonic transmitter and receiver module.[10]

Specifications

- Power Supply :+5V DC
- Quiescent Current : <2mA
- Working Current: 15mA
- Effectual Angle: <15°
- Ranging Distance : 2cm – 400 cm/1″ – 13ft
- Resolution : 0.3 cm
- Measuring Angle: 30 degree
- Trigger Input Pulse width: 10uS
- Dimension: 45mm x 20mm x 15mm

6. GSM Module



A GSM Module is basically a GSM Modem (like SIM 900) connected to a PCB with different types of output taken from the board – say TTL Output (for Arduino, 8051 and other microcontrollers) and RS232 Output to interface directly with a PC (personal computer). The board will also have pins or provisions to attach mic and speaker, to take out +5V or other values of power and ground connections. These type of provisions vary with different modules.[11]

Specification.

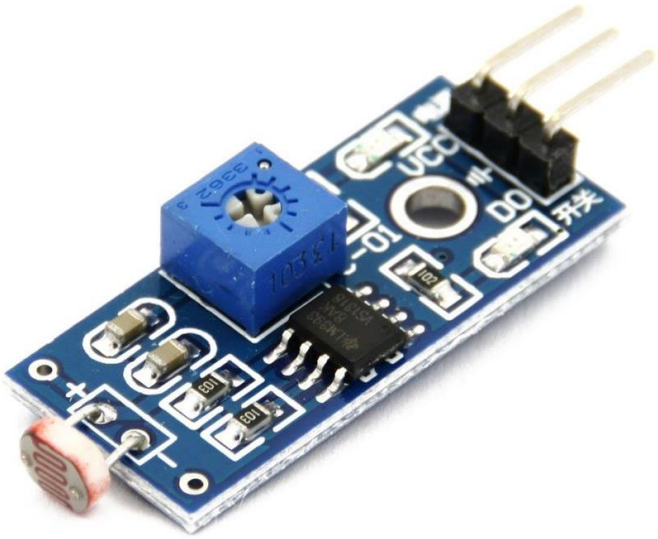
- Dual-Band 900/ 1800 MHz
- GPRS multi-slot class 10/8GPRS mobile station class B
- Compliant to GSM phase 2/2+
- Dimensions: 24*24*3 mm
- Weight: 3.4g
- Control via AT commands (GSM 07.07 ,07.05 and SIMCOM enhanced AT Commands)
- Supply voltage range : 5V
- Low power consumption: 1.5mA (sleep mode)
- Operation temperature: -40°C to +85 °

7. GPS Module

The heart of the module is a NEO-6M GPS chip from u-blox. It can track up to 22 satellites on 50 channels and achieves the industry's highest level of sensitivity i.e. -161 dB tracking, while consuming only 45mA supply current. The u-blox 6 positioning engine also boasts a Time-To-First-Fix (TTFF) of under 1 second. One of the best features the chip provides is Power Save Mode(PSM). It allows a reduction in system power consumption by selectively switching parts of the receiver ON and OFF. This dramatically reduces power consumption of the module to just 11mA making it suitable for power sensitive applications like GPS wristwatch. The necessary data pins of NEO-6M GPS chip are broken out to a "0.1″ pitch headers. This includes pins required for communication with a microcontroller over UART.[12]

GPS Module Specification	
GPS Chipset :	Media Tek MT 3318, 51 Channels
Frequency :	L1,1575.42MHz; C/A Code
Sensitivity :	Acquisition:-146dBm(Cold State),Tracking:-158dBm,Reaquisition:-156dBm
Position accuracy :	<3 CEP(50%)without SA(horizontal)
TTFF(Time To First) Fix :	Cold Start : <36 Seconds(Typical) Warm Start: <34Seconds(Typical) Hot Start: <1Seconds(Typical)
Protocol :	NMEA 0183 v3.01,MTK NMEA Command
DGPS :	RTCM protocol WAAS,EGNOS,MSAS
AGPS :	Supported (Offline Mode)
Interface :	UART
Baud Rate :	Baud Rate 9600 bps(Default)
Update Rate:	1~5 Hz
Working Temperature	-40 °C to +85 °C

8. Light Dependent Resistor(LDR) Module



The LDR Sensor Module is used to detect the presence of light / measuring the intensity of light. The output of the module goes high in the presence of light and it becomes low in the absence of light. The sensitivity of the signal detection can be adjusted using potentiometer.[13]

Specification:

- Input Voltage: DC 3.3V to 5V
- Output: Analog and Digital
- Sensitivity adjustable

CHAPTER 4

RESULT AND DISCUSSION

4.1 ANALYSIS PROJECT

After we designed and programmed the Modern Blind Stick to the needed standard, this innovation product has been functioning well. We tested the Modern Blind Stick with certain obstacles, hazard , range and distance and it work successfully as we programed the Modern Blind Stick.

Analysis about the point of view about the visually impaired person walk at the public. First analysis is the visually impaired person to walk at the public independently. Second, the real time location of the visually impaired person at the public. Third, the safety of the visually impaired person at the public. The analysis shows the problems as the visually impaired person the risk when walking at the public .

4.2 LAYOUT SPECIFICATION

1. External view

View from front.

View from side

2. Internal View

4.3 DISCUSSION

Based on the theory, Visual impaired person or also known as vision impairment or vision loss, is a decreased ability to see to a degree that causes problems not fixable by usual means, such as glasses Some also include those who have a decreased ability to see because they do not have access to glasses or contact lenses. Visual impairment is often defined as a best corrected visual acuity of worse than either 20/40 or 20/60. The term blindness is used for complete or nearly complete vision loss.[6] Visual impairment may cause people difficulties with normal daily activities such as driving, reading, socializing, and walking.

The most common causes of visual impairment globally are uncorrected refractive errors (43%), cataracts (33%), and glaucoma (2%). Refractive errors include near-sightedness, far-sightedness, presbyopia, and astigmatism. Cataracts are the most common cause of blindness. Other disorders that may cause visual problems include age-related macular degeneration, diabetic retinopathy, corneal clouding, childhood blindness, and a number of infections. Visual impairment can also be caused by problems in the brain due to stroke, premature birth, or trauma among others. These cases are known as cortical visual impairment. Screening for vision problems in children may improve future vision and educational achievement. Screening adults without symptoms is of uncertain benefit. Diagnosis is by an eye exam.

The World Health Organization (WHO) estimates that 80% of visual impairment is either preventable or curable with treatment. This includes cataracts, the infections river blindness and trachoma, glaucoma, diabetic retinopathy, uncorrected refractive errors, and some cases of childhood blindness. Many people with significant visual impairment benefit from vision rehabilitation, changes in their environment, and assistive devices.

As of 2015 there were 940 million people with some degree of vision loss. 246 million had low vision and 39 million were blind. The majority of people with poor vision are in the developing world and are over the age of 50 years. Rates of visual impairment have decreased since the 1990s. Visual impairments have considerable economic costs both directly due to the cost of treatment and indirectly due to decreased ability to work.

The solution for visually impaired person to walking is by using ‘White Cane’. A white cane is a device used by many people who are blind or visually impaired. A white cane primarily allows its user to scan their surroundings for obstacles or orientation marks, but is also helpful for onlookers in identifying the user as blind or visually impaired and taking appropriate care. The latter is the reason for the cane's white color, which in many jurisdictions is mandatory.

While the white cane is commonly accepted as a "symbol of blindness", different countries still have different rules concerning what constitutes a "cane for the blind". In the United Kingdom and also in Malaysia, the white cane indicates that the individual has a visual impairment but normal hearing; with red bands added, it indicates that the user is deafblind.

Based on our research, many visually impaired person suffer from serious visual impairments preventing them from travelling independently. They need to use a wide range of tools and techniques to help them in their mobility. One of these techniques is orientation and mobility specialist who helps the visually impaired and blind people and trains them to move on their own independently and safely depending on their other remaining senses.

Nowadays, as a parent or guardian, we don't want our children or our care's get into trouble when walking at public or somewhere else. Vision loss has a significant impact on their lives for those who experience it as well as on their families, their friends, and society. The complete loss or the deterioration of existing eyesight can feel frightening and overwhelming, leaving those affected to wonder about their ability to maintain their independence, pay for needed medical care, retain employment, and provide for themselves and their families. It's a high risk to live in a lifetime.

So we create a product that can help the visually impaired person to walk at the public independently. The Modern Blind Stick function is to help the visually impaired person walk more easier and more independent. Modern Blind Stick also can help this blind people to navigate routes and detect an obstacle that surely can make their life routines easier. The user just need to use the blind the normal blind stick , the different is , blind people can detect a hole or stair more faster and easily . Besides that , guardian or parent also can locate the location of the stick user using Global Positioning System(GPS) and Global System for Mobile Communication (GSM) module. To assist in tracking the location, this Modern Blind Stick utilizes GPS to determine the location and send it via SMS to locate the location of the user Modern Blind Stick.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

In the end of our project, we can conclude that our project can reduce the number of risk and injuries for the visually impaired person when walking at public. Nowadays, even at young age experience the visually impairment. This thing cannot be taken so lightly as they know how much risk could it be. If the number of risk and injuries increasing rapidly, the kid or the person will loss their spirit to walk independently.

The Modern Blind Stick acts as a basic platform for the coming generation of more aiding devices to help the visually impaired to navigate safely both indoor and outdoor. It is effective and affordable. It leads to good results in detecting the obstacles on the path of the user in a range of two meters. Though the system is hard-wired with sensors and other components, it's light in weight. Further aspects of this system can be improved via wireless connectivity between the system components, thus, increasing the range of the ultrasonic sensor and implementing a technology for determining the speed of approaching obstacles.

5.2 RECOMMENDATION

In the future, we hope that our project can be commercialize as there are many benefit such as to reduce the number of risk and injuries for the visually impaired people. Our life are very priceless and cannot be replace. Because we all just live only once, so seize our life with positive vibes. We hope we can improvise our project if there is a thing that can make our product more quality than before.

5.3 REFERENCE

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5.4 APPENDICES

POLITEKNIK MALAYSIA

SULTAN SALAHUDDIN ABDUL AZIZ SHAH

MODERN BLIND STICK

MANUAL BOOK

TEAM MEMBERS :

1. SYED HAZIQ AFIF BIN SYED MOHD FAZLI (08DEP17F2017)
2. MUHAMMAD HAIKAL IQMAL BIN JAMALUDDIN (08DEP17F2018)

SUPERVISOR NAME :

1. PN AKMARYA SYUKHAIRILNISAH BT MOHD AKHIR
2. PN ZAITUN BINTI TAAT
3. PN ASTRAHUDA KAMARULAINI BT MOHF FAHMI
4. EN KHAIROL NAPISHAM BI ABD RAZAK

SOP OF OPERATION TO USE THE MODERN BLIND STICK

1.0 OBJECTIVE : -Develop a hardware prototype for modern blind stick

-To help the blind people navigate the route at their best
-Design and construct the stick to build a "modern blind stck"
- Build software that suitable with the blind people

2.0 SCOPE : -Visual impaired person that having trouble to navigate.

3.0 CAUTION : **-BEFORE READING THE PROCEDURE, MAKE SURE READ EVERY LINE FOR THE MODERN BLIND STICK TO WORK PROPERLY**

4.0 PROCEDURE :

OPERATIONAL PROCEDURE

1. Make sure the stick have been put the enough power supply
2. Is easier to use the stick at the crowd place
3. Make sure the led turn red to make sure the system is ready
4. Make sure the GSM and GPS is activate to locate the location
5. To change the "MODE" pull the switch button
6. Modern Blind Stick buzzer will sound when the system is started
7. Modern blind stick will sound when its detect a hole
8. The LED will be on when at the dark place
9. To locate the location , send sms to the modern blind stick
10. Make sure the both sim have enough credit to get the feedback

TURNING OFF THE MODERN BLIND STICK

11. To turn off the modern blind stick , just pull of the power supply.
12. Put it at the safe place to avoid any excident.

APPENDIX B – POSTER

KEMENTERIAN PENDIDIKAN MALAYSIA

POLITEKNIK PITEX

INVENTION & INNOVATION TECHNOLOGY EXPOSITION

Tajuk

MODERN BLIND STICK

Logo Pertandingan Jabatan

EEEiC

Ketua Penyelidik / Pencipta
(Main Researcher / Inventor)

PUAN AKMARYA SYUKHAIRILNISAH BT MOHD AKHIR

PUAN ZAITUN BINTI TAAT

PUAN ASTRAHUDA KAMARULAINI BINTI MOHD FAHMI

PUAN NUR HADIANA BINTI NASARUDDIN

Nama Kumpulan Penyelidik / Pencipta Bersama
(Researchers/Inventors Groups)

HAIKAL IQMAL BIN JAMALUDDIN (08DEP17F2018)

SYED HAZIQ AFIF BIN SYED MOHD FAZLI (08DEP17F2017)

E-Mel
(E-mail)

haikaliqmal99@gmail.com

hazic15199@gmail.com

Info Grafik
(Graphical Information)

Deskripsi Produk Abstrak
(Product Description/Abstract)

Independence is the building methodology in achieving dreams, goals and objectives in life. Visually impaired peoples find themselves challenging to go out independently. With our innovation, we want to help the visually impaired people to live their life more easier. The main purpose this project is to focus on a simple method of detecting the obstacle and route by using ultrasonic sensor that can detect obstacle with maximum range about 10 meter. Beside that, we also use GPS and GSM module to get their real -time locations . So, It can be easily traced by sending SMS to the MODERN BLIND STICK and it will send back SMS to you which is have the location of the stick .. This project target to visually impaired people , parents which have visually impaired kids and also the guardian of home care for the visually impaired people .This project equipped with piezo buzzer and vibrator motor which it will produce loud buzzing and vibration if the sensor detect an obstacles. Other than that , this MODERN BLIND STICK also equipped with LDR sensor which is function to triggered the light on the stick during night . With this safety features, the citizen will be more alert of existing user of the MODERN BLIND STICK .

Pernyataan Masalah
(Problem Statement)

- Currently , we can see blind people is scared to walk at the busy road because they can't navigate freely
- They cant navigate and detect an obstacle with the faster way . With their normal blind stick , they must "knock-knock" the road slowly .
- They also don't have a suitable direction to navigate their self . If they new at that place , that was a big problem for them to navigate.
- The normal blind stick don't have any safety features .

Objektif
(Objectives)

- Develop a hardware prototype for modern blind stick.
- To help the blind people navigate the route at their best.
- To enhanced the GPS & GSM technology.

Metodologi
(Methodology)

Potensi Market
(Market Potentials)

-To make more easier for visually impaired person to walk independently in public.
-To located the location of the user MODERN BLIND STICK .

Harta Intelek (IP)
(Intelectual Property)

Industrial Design :

Copyright :

Kolaborasi Industri / Institusi
(Industrial / Institution Collaboration)

Hubungi
(Contact)

DR. Noordini Abdullah
Ketua Pusat Penyelidikan & Inovasi
Politeknik Sultan Salahuddin Abdul Aziz Shah
Tel : 03-51634000

Nama Pemilik IP / Alamat
(Owner IP Name / Address)

Pengarah
Politeknik
Sultan Salahuddin Abdul Aziz Shah
40150 Shah Alam
Selangor

APPENDIX C – GHANT CHART (SEM 5)

No	Task	Week											
		1	2	3	4	5	6	7	8	9	10	11	12
1	Do schematic circuit in proteus												
2	Troubleshoot problem												
3	Make a connection between all the components												
4	Make more research on the project												
5	Make a questionnaires about the project												
6	Slide present to our supervisor												
7	Make a survey about visually Impaired person												
8	Identify & solve the problems of the programs												
9	We searching a suitable casing & stick for our project												
10	We apply all of the components to the stick												

APPENDIX D – AKUAN SUMPAH

COPYRIGHT ACT 1987

IN THE MATTER OF Section 26A (3) (b), Copyright Act 1987 (Act 332)

and

IN THE MATTER of the Copyright (Voluntary Notification) Regulations 2012 [P.U.(A) 160]

STATUTORY DECLARATION

I, **WAN ROSEMEHAH BINTI WAN OMAR *(*NRIC No.:740506-03-6080)**of full age and care of **Politeknik Sultan Salahuddin Abdul Aziz Shah, Persiaran Usahawan, Seksyen U1, 40150 Shah Alam, Selangor, Malaysia** sincerely and solemnly declare as follows:

1. I am the **Head of Research and Innovation Unit, Politeknik Sultan Salahuddin Abdul Aziz Shah**, a higher learning institution incorporated under the laws of Malaysia with an address at **Persiaran Usahawan, Seksyen U1, 40150 Shah Alam, Selangor, Malaysia** (hereinafter referred as "PSA").

2. I am duly authorized to make this Statutory Declaration on behalf of PSA. Unless otherwise stated, the fact herein are within my knowledge or derived from the records of PSA to which I have access.

3. I am advised and verily believe that copyright subsists in the following works title **"MODERN BLIND STICK"** (hereinafter referred as "the Works") identified accordingly below:

Exhibit No.	Author and IC No.	Date Completed
PSA- MODERN BLIND STICK -JKE	**1) SYED HAZIQ AFIF BIN SYED MOHD FAZLI (990115086445)** **2) MUHAMMAD HAIKAL IQMAL BIN JAMALUDDIN (991004045581)**	**01/03/2019**

The authors listed above shall collectively be referred to as the "Authors".

4. I am advised and verily believe that copyright subsist in the Works by virtue of the following facts:
   i. The authors, were and are at all material times citizens of Malaysia, and the Works were created and completed in Malaysia on the date set out in paragraph 3 above. The Works

qualify for copyright protection under the Copyright Act 1987 by virtue of Section 3 and 10 of the copyright Act, 1987.

ii. That sufficient and substantial skill, effort and time has been expanded on the Works by the Authors to render them original in character under Section 7(3)(a) of the Copyright Act 1987.

iii. That the Works have been reduced to material form as required under Section 7(3) (b) of the Copyright Act 1987 as at the date of completion as set out in paragraph 3 above.

5. I am advised and verily believe that at all material times PSA is the owner of the copyrights subsisting in the said Works by virtue of the following facts:

i. that at all material times, the Authors were and are employees of PSA and the Works were created by the Authors in the course of employment with PSA,

ii. that at all material times, the Authors were and are students of PSA and the Works were created by the Authors in the course of fulfilment the study with PSA,

iii. that at all material times, the Works were created, developed, generated using material, funds and other resources owned by PSA.

iv. that at all material times, the Works were created with support and supervision of employees of PSA, and

v. that at all material times, the Works were commissioned or created under direct request of PSA.

By virtue of Section 26(2)(a) and (b) of the Copyright Act 1987, the copyright of the said Works are deemed to be transferred to PSA.

6. PSA now asserts copyright in the Works and hereby claims ownership in the copyright subsisting in the Works at all material times.

7. The Works is eligible for copyright protection as literary work under the Copyright Act 1987 and by the virtue of the Copyright (Application to Other Countries) Regulations 1990, the Berne Convention for the Protection of Literary and Artistic Works 1886 extends copyright protection for the Works to all member countries of the Berne Convention.

8. PSA not at any time authorized any third party in Malaysia or elsewhere to reproduce any part of the Works,

and I make this solemn declaration conscientiously believing the same to be true and by virtue of Section 26A(3)(b) Copyright 1987 and the Statutory Declaration 1960.

Subscribed and solemnly declared by the abovenamed)
WAN ROSEMEHAH BINTI WAN OMAR *(*NRIC No.: 740506-03-6080)
at Shah Alam on)

Before me,

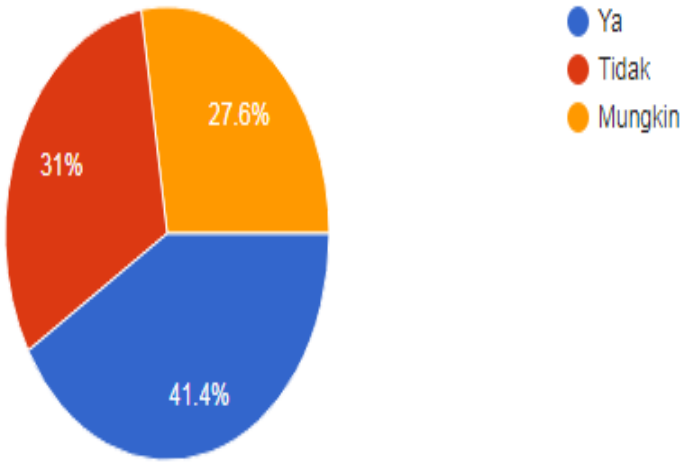
Commissioner for Oaths

COPYRIGHT ACT 1987
IN THE MATTER OF Section 26A (3) (b), Copyright Act 1987 (Act 332)
and
IN THE MATTER of the Copyright (Voluntary Notification) Regulations 2012 [P.U.(A) 160]

APPENDIX E – SURVEY QUESTION

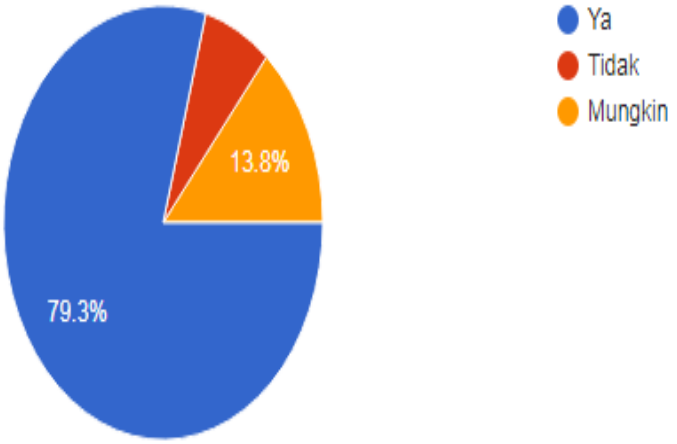
Adakah orang cacat penglihatan mengalami masalah ketika menggunakan tongkat putih ?

29 responses



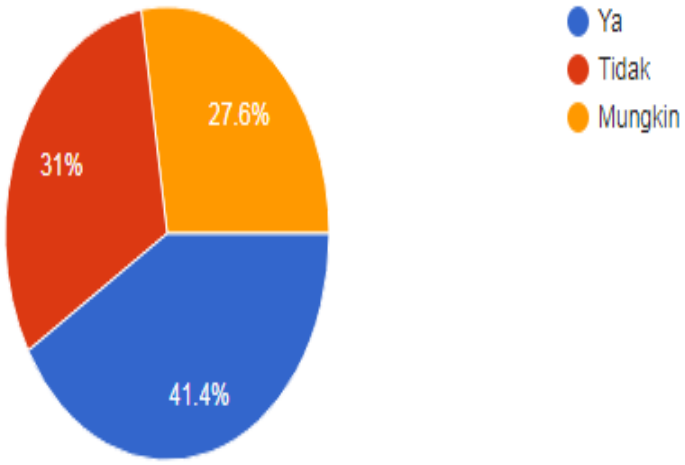
Adakah orang cacat penglihatan menghadapi masalah ketika berjalan di tempat awam?

29 responses



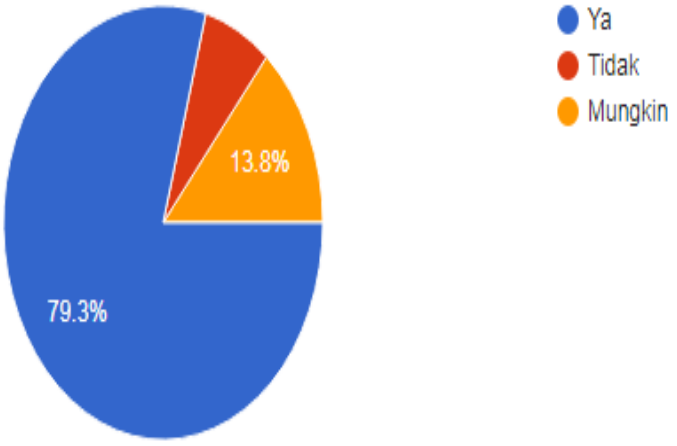
Adakah orang cacat penglihatan mengalami masalah ketika menggunakan tongkat putih ?

29 responses



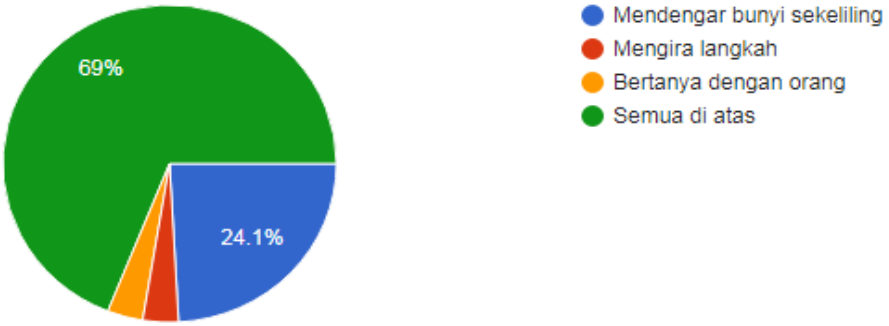
Adakah orang cacat penglihatan menghadapi masalah ketika berjalan di tempat awam?

29 responses



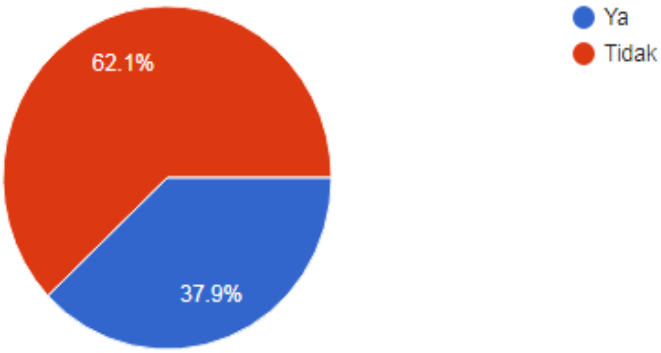
Pada pendapat anda , Bagaimanakah orang cacat penglihatan mengenal pasti sesuatu keadaan / tempat itu ?

29 responses



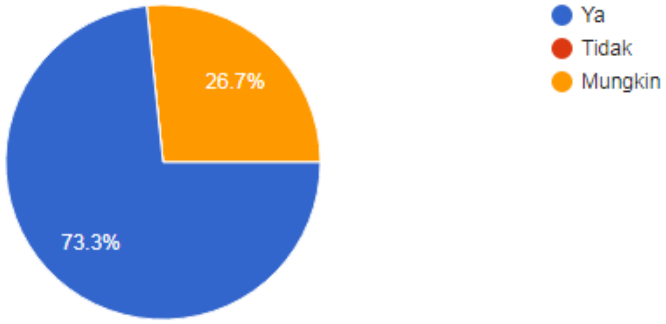
Sebagai pengguna jalan raya, Adakah anda sedar kehadiran orang buta di jalan raya pada waktu malam ?

29 responses



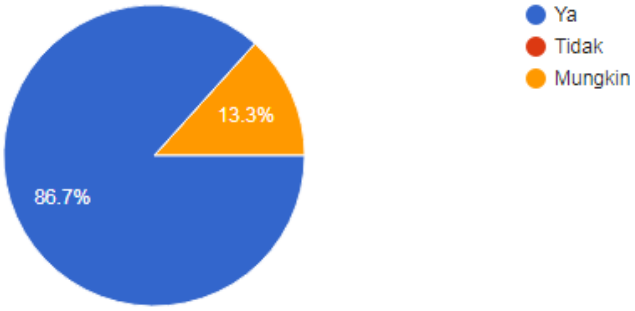
Pada pendapat anda, Dengan menggunakan Ultrasonic sensor berfungsi untuk mengesan jarak . Adakah ia dapat membantu dalam urusan harian mereka ?

30 responses



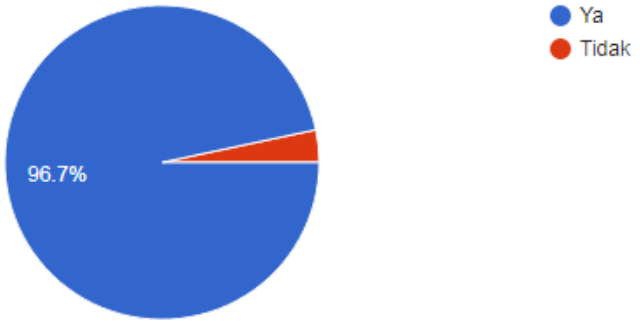
Adakah Global Positioning System(GPS) tracker dapat membantu keluarga atau penjaga untuk mengetahui lokasi pengguna Smart Blind Stick ini ?

30 responses



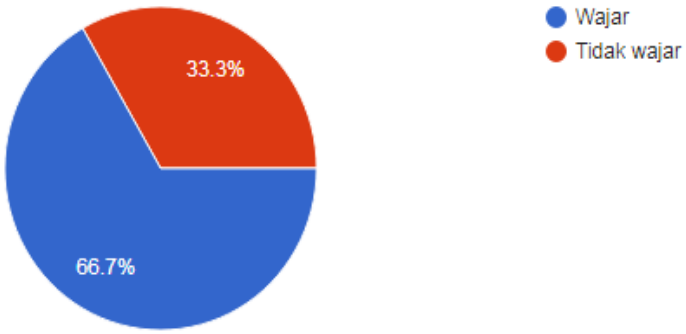
Light Dependent Resistor(LDR) berfunsi untuk mengesan cahaya pada waktu pagi dan malam. Adakah ia wajar diletakkan pada Smart Blind Stick untuk memberi isyarat tentang kehadiran orang cacat penglihatan pada waktu malam ?

30 responses



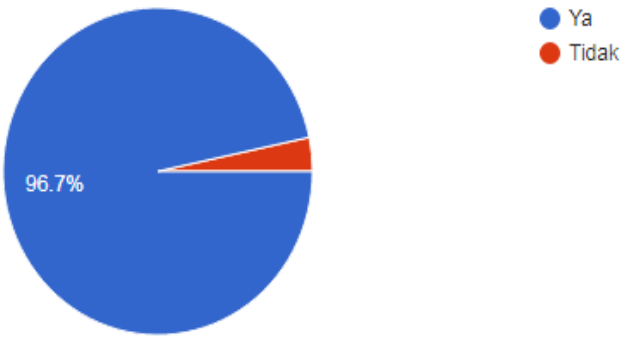
Pada pendapat anda, adakah wajar kami mengubah reka bentuk dan saiz tongkat putih ini berbanding dengan tongkat yang sedia ada

30 responses



Adakah wujud nya Smart Blind Stick ini dapat memudahkan urusan dan aktiviti harian orang cacat penglihatan ?

30 responses



APPENDIX F – PICTURE

EXTERNAL VIEW

INTERNAL VIEW

APPENDIX G – PROGRAMMING

PROGRAMMING FOR MODERN BLIND STICK

```
#include <TinyGPS++.h>
#include <SoftwareSerial.h>

SoftwareSerial GPSx(10,11); // RX, TX
TinyGPSPlus gps;// create gps object

char str[70];
String gpsString="";
char *test="$GPGGA";
String latitude="No Range      ";
String longitude="No Range    ";
int temp=0,i;
boolean gps_status=0;
int led1 = 2;
int led = 12;
int BZ =9;
int Vib =8;
int sw =3;
int sensorPin = A0;
float LDR;
const int TrigPin1  = 6;
const int EchoPin1  = 7;
float cm1;
const int TrigPin2  = 4;

const int EchoPin2  = 5;

float cm2;


void setup()
{
  pinMode(sensorPin, INPUT);
  pinMode(TrigPin1, OUTPUT);
  pinMode(EchoPin1, INPUT);
  pinMode(TrigPin2, OUTPUT);
```

```
  pinMode(EchoPin2, INPUT);
  pinMode(led, OUTPUT);
  pinMode(BZ, OUTPUT);
  pinMode(Vib, OUTPUT);
  pinMode(sw, INPUT_PULLUP);
  pinMode(led1, OUTPUT);

  Serial.begin(9600);
  GPSx.begin(9600);
  Serial.print("BLIND STICK");
  delay(4000);
  gsm_init();

  Serial.println("AT+CNMI=2,2,0,0,0");
  Serial.print("GPS Initializing");
  Serial.print("  No GPS Range  ");
  get_gps();
  delay(2000);
  Serial.print("GPS Range Found");
  Serial.print("GPS is Ready");
  delay(2000);
  Serial.print("System Ready");
  delay(400);
  digitalWrite(led1,HIGH);
  temp=0;

}

void loop(){

  sensor();
  serialEvent();
  if(temp)
  {
    get_gps();
    tracking();
  }
}
```

```
void sensor(){
LDR = analogRead(sensorPin);
  //Serial.print("LDR=");
  //Serial.print(LDR);
  //Serial.println();
  //delay(50);
  //************************************************************

  digitalWrite(TrigPin1, LOW);
  delayMicroseconds(2);
  digitalWrite(TrigPin1, HIGH);
  delayMicroseconds(10);
  digitalWrite(TrigPin1, LOW);
  cm1 = pulseIn(EchoPin1, !(LOW)) / 58.0; //map the time to centimeter//
  cm1 = (int(cm1 * 100.0)) / 100.0; //keep two digits after the decimal point
  //Serial.print("cm1=");
  //Serial.print(cm1);
  //Serial.println();
// delay(500);
//************************************************************

  digitalWrite(TrigPin2, LOW);
  delayMicroseconds(2);
  digitalWrite(TrigPin2, HIGH);
  delayMicroseconds(10);
  digitalWrite(TrigPin2, LOW);
  cm2 = pulseIn(EchoPin2, !(LOW)) / 58.0; //map the time to centimeter//
  cm2 = (int(cm2 * 100.0)) / 100.0; //keep two digits after the decimal point
  //Serial.print("cm2=");
  //Serial.print(cm2);
  //Serial.println();
// delay(500);


if (cm1<=50){

  if (digitalRead(sw)==1){
    digitalWrite(Vib,LOW);
    digitalWrite(BZ,HIGH);
      }
  else{
    digitalWrite(Vib,HIGH);
    digitalWrite(BZ,LOW);
```

```
  }
}

if (cm2>=15){
  if (digitalRead(sw)==1){
    digitalWrite(Vib,LOW);
    digitalWrite(BZ,HIGH);
      }

else{
    digitalWrite(Vib,HIGH);
    digitalWrite(BZ,LOW);
  }
}

if (((cm1>51)&&(cm2<15))||((cm2<15)&&(cm1>51))){
    digitalWrite(BZ,LOW);
    digitalWrite(Vib,LOW);

      }
if (LDR >300){
  digitalWrite(led,HIGH);
}
else {
  digitalWrite(led,LOW);
}

}

void serialEvent()
{
  while(Serial.available())
  {
    if(Serial.find("LOCATION"))
    {
      temp=1;
      break;
    }
    else
    temp=0;
  }
}
```

```
void gpsEvent()
{
 gpsString="";
 while(1)
 {
 while (GPSx.available()>0)           //checking serial data from GPS
 {
  char inChar = (char)GPSx.read();
  gpsString+= inChar;                    //store data from GPS into gpsString
  i++;
  if (i < 7)
  {
   if(gpsString[i-1] != test[i-1])        //checking for $GPGGA sentence
   {
    i=0;
    gpsString="";
   }
  }
  if(inChar=='\r')
  {
  if(i>65)
  {
   gps_status=1;
   break;
  }
  else
  {
   i=0;
  }
  }
 }
 if(gps_status)
  break;
 }
}

void gsm_init()
{
 Serial.print("Finding Module..");
 boolean at_flag=1;
 while(at_flag)
 {
  Serial.println("AT");
```

```
    while(Serial.available()>0)
    {
      if(Serial.find("OK"))
      at_flag=0;
    }

    delay(1000);
  }

Serial.print("Module Connected..");
  delay(1000);
  Serial.print("Disabling ECHO");
  boolean echo_flag=1;
  while(echo_flag)
  {
    Serial.println("ATE0");
    while(Serial.available()>0)
    {
      if(Serial.find("OK"))
      echo_flag=0;
    }
    delay(1000);
  }

  Serial.print("Echo OFF");
  delay(1000);
  Serial.print("Finding Network..");
  boolean net_flag=1;
  while(net_flag)
  {
    Serial.println("AT+CPIN?");
    while(Serial.available()>0)
    {
      if(Serial.find("+CPIN: READY"))
      net_flag=0;
    }
    delay(1000);
  }

  Serial.print("Network Found..");
  delay(1000);

}
```

```
void get_gps()
{
  while(1)
  {
  while (GPSx.available() > 0)
  { gps.encode(GPSx.read()); }

      if (gps.location.isUpdated())
      {
      latitude=gps.location.lat();
      longitude=gps.location.lng();
      break;
      }
}

    delay(1000);
    delay(2000);

}



void send_data(String message)
{
  Serial.println(message);
  delay(200);
}

void tracking()
{
    Serial.println("AT+CMGF=1");
    delay(400);
    Serial.println("AT+CMGS=\"0124712056\"");  // use your 10 digit cell no. here
    delay(400);
    Serial.print("location : www.google.co.in/maps/place/");
    //send_data("location : www.google.co.in/maps/place/");
    Serial.print(latitude);
    Serial.print(",");
    Serial.print(longitude);
    Serial.write(26);
    delay(2000);
}
```

APPENDIX H – DIGEST PAPER

MODERN BLIND STICK

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Name : i) Syed Haziq Afif Bi Syed Mohd Fazli ii)Muhammad Haikal Iqmal Bin Jamaluddin

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ABSTRACT :

The study focus on a simple method of detecting the obstacle and route by using a ultrasonic sensor that can detect a hole or stair with maximum range about 15 meter. As we can see, blind people is having their trouble to do their life routines because they can't see even a single things . With our idea , we want to help this kind of people to live their life freely. This modern blind stick have a several feature that surely can help this blind people to navigate routes and detect an obstacle that surely can make their life routines more easy. The user just need to use the blind the normal blind stick , the different is , blind people can detect a hole or stair and more faster and early . Beside that , guardian or parent can know the location of the stick user using GPS and GSM module .

1.0 INTRODUCTION

Nowadays , as we can see , we can see visual impared person always use their normal blind stick to do their activity like normal person. They use the stick to navigate their route because they cant even see a single things . As a community , we aware and really want to help them to make their life more easy and faster. With the normal blind stick , they will use it and bring it wherever they go . The stick is most important to them in their life . Some community feel uneasy with them because they are not like normal person . To them they just make their life more complicated . The result with this statement , it make visual impared person didn't have a place like normal person.

2.0 SCOPE OF PROJECT

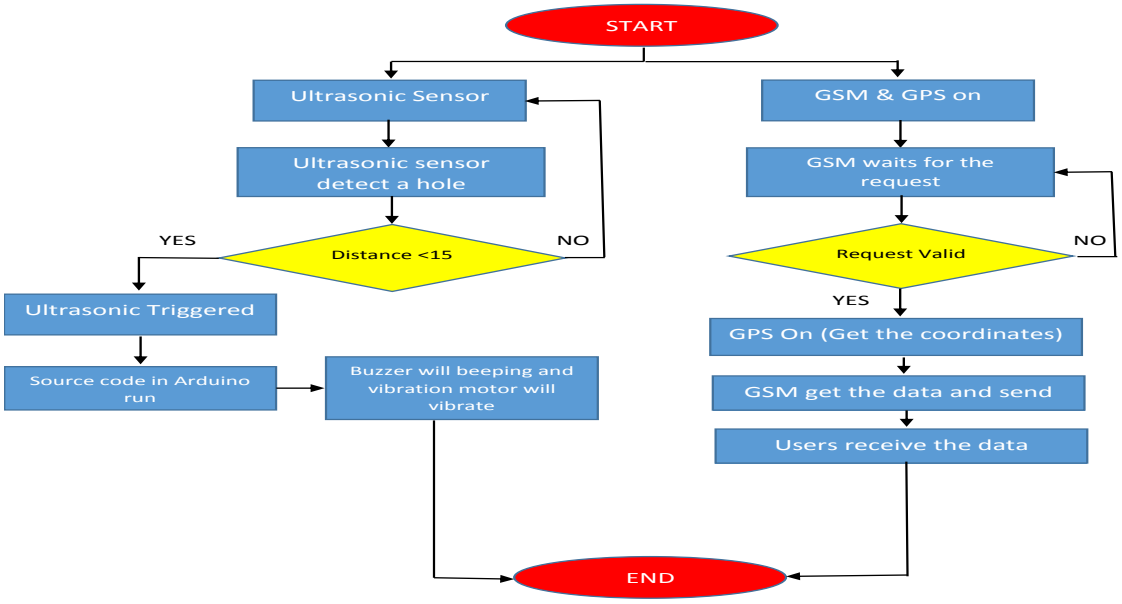
Currently , we can see blind people is scared to walk at the busy road because they can't navigate freely .With this fear , blind people can't live their life freely . They also a human , they need to live as a normal person. The main problem is , they cant navigate and detect an obstacle with the faster way . With their normal blind stick , they must use the stick to navigate on the road slowly . Usually , visually impaired person difficult to identify a hole on the road.Beside that the normal blind stick don't have safety features . For example , at night , car driver or motorcycle can't see them at the road . This is a big dangerous for them.

3.0 OBJECTIVE

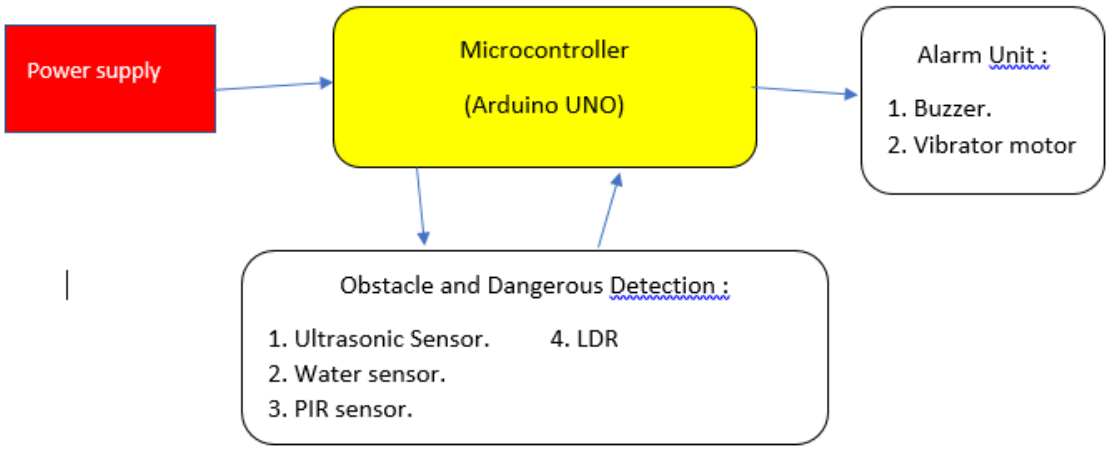
1) Develop a hardware prototype for modern blind stick
2) To help the blind people navigate the route at their best
3) Design and construct the stick to build a "modern blind stck"
4) Build software that suitable with the blind people

METHODOLOGY

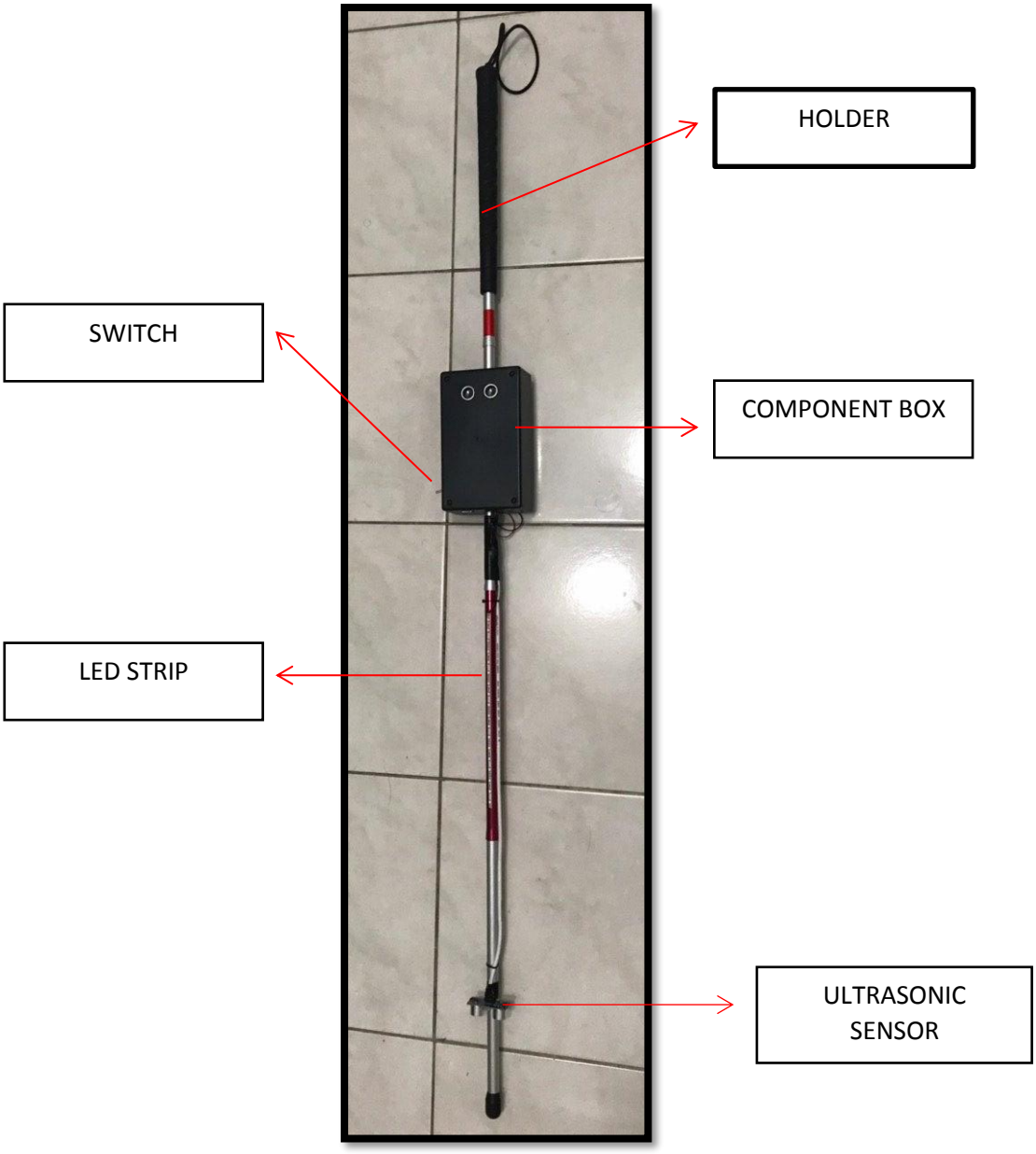
FLOWCHART :



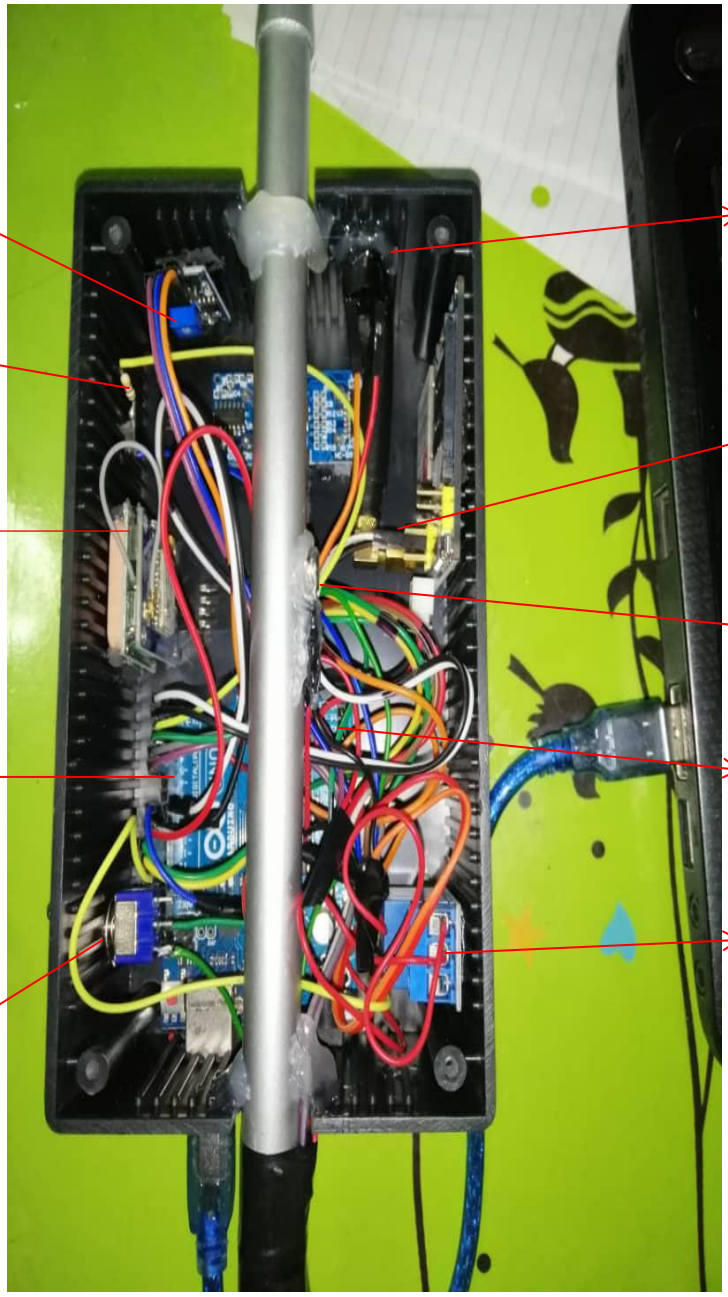
BLOCK DIAGRAM



COMPLETED PROJECT DESIGN



INTERNAL VIEW



LIST OF COMPONENT USED

1. **Arduino uno**

   The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc.The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits.[1] The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment), via a type B USB cable. It can be powered by the USB cable or by an external 9-volt battery, though it accepts voltages between 7 and 20 volts. It is also similar to the Arduino Nano and Leonardo.The hardware reference design is distributed under a Creative Commons Attribution Share-Alike 2.5 license and is available on the Arduino website. Layout and production files for some versions of the hardware are also available.

2. **Ultrasonic Sensor**

   As the name indicates, ultrasonic sensors measure distance by using ultrasonic waves. The sensor head emits an ultrasonic wave and receives the wave reflected back from the target. Ultrasonic Sensors measure the distance to the target by measuring the time between the emission and reception.

3. **GPS**

   The Global Positioning System (GPS), originally NAVSTAR GPS,is a satellite-based radionavigation system owned by the United States government and operated by the United States Space Force It is one of the global navigation satellite systems (GNSS) that provides geolocation and time information to a GPS receiver anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites.Obstacles such as mountains and buildings block the relatively weak GPS signals.

4. **GSM**

   The Global System for Mobile Communications (GSM) is a standard developed by the European Telecommunications Standards Institute (ETSI) to describe the protocols for second-generation (2G) digital cellular networks used by mobile devices such as mobile phones and tablets. It was first deployed in Finland in December 1991.[2] By the mid-2010s, it became a global standard for mobile communications achieving over 90% market share, and operating in over 193 countries and territories.

5. **Buzzer**

A buzzer or beeper is an audio signalling device,[1] which may be mechanical, electromechanical, or piezoelectric (piezo for short). Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke.

6. **LED**

A light-emitting diode (LED) is a semiconductor light source that emits light when current flows through it. Electrons in the semiconductor recombine with electron holes, releasing energy in the form of photons. The color of the light (corresponding to the energy of the photons) is determined by the energy required for electrons to cross the band gap of the semiconductor.[5] White light is obtained by using multiple semiconductors or a layer of light-emitting phosphor on the semiconductor device

7. **Switch**

In electrical engineering, a switch is an electrical component that can disconnect or connect the conducting path in an electrical circuit, interrupting the electric current or diverting it from one conductor to another.[1][2] The most common type of switch is an electromechanical device consisting of one or more sets of movable electrical contacts connected to external circuits. When a pair of contacts is touching current can pass between them, while when the contacts are separated no current can flow.

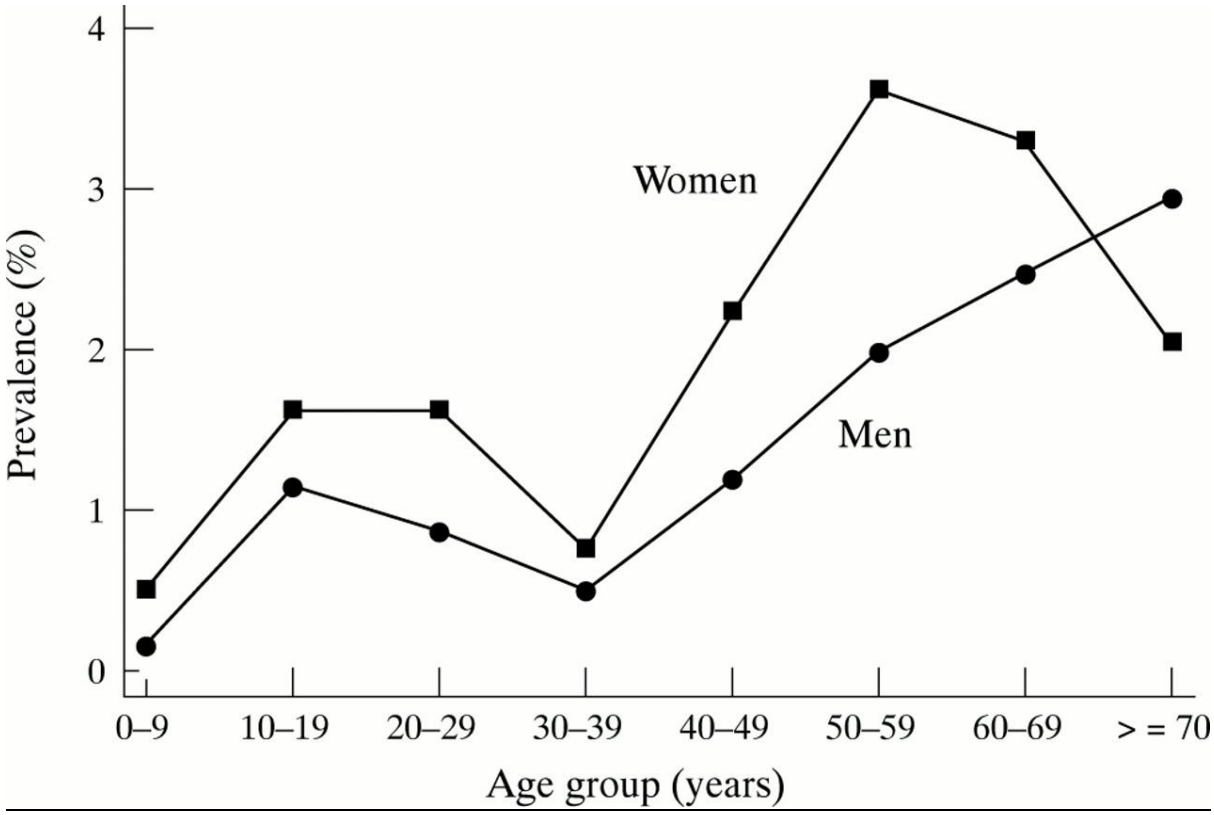
8. **LDR**

A photoresistor (acronymed LDR for Light Decreasing Resistance, or light-dependent resistor, or photo-conductive cell) is an active component that decreases resistance with respect to receiving luminosity (light) on the component's sensitive surface. The resistance of a photoresistor decreases with increase in incident light intensity

LITERATURE REVIEW

STATISTICS :

STATISTIC OF VISUAL IMPARED PERSON IN MALAYSIA



Background

Population-based data on prevalence, causes of blindness and extent of ophthalmological coverage is required for efficient implementation and evaluation of ocular health programs. In view of the scarcity of prevalence data for visual impairment and blindness in Malaysia, this study aims to estimate the prevalence and causes of visual impairment (VI) in the elderly, using Rapid Assessment of Avoidable Blindness (RAAB) survey technique.

Methods

Malaysia was divided into six regions, with each region consisting of 50 clusters. Multistage cluster sampling method was used and each cluster contained 50 residents aged 50 years and above. Eligible subjects were interviewed and pertinent demographic details, barriers to cataract surgery, medical and ocular history was noted. Subjects had visual acuity assessment with tumbling 'E' Snellen optotypes and ocular examination with direct ophthalmoscope. The primary cause of VI was documented. Results were calculated for individual zones and weighted average was used to obtain overall prevalence for the country. Inter-regional and overall prevalence for blindness, severe VI and moderate VI were determined. Causes of VI, cataract surgical coverage and barriers to cataract surgery were assessed.

Results

A total of 15,000 subjects were examined with a response rate of 95.3%. The age and gender-adjusted prevalence of blindness, severe visual impairment and moderate visual impairment were 1.2% (95% Confidence Interval: 1.0–1.4%), 1.0% (95%CI: 0.8–1.2%) and 5.9% (5.3–6.5%) respectively. Untreated cataract (58.6%), diabetic retinopathy (10.4%) and glaucoma (6.6%) were the commonest causes of blindness. Overall, 86.3% of the causes of blindness were avoidable. Cataract surgical coverage (CSC) in persons for blindness, severe visual impairment and moderate visual impairment was 90%, 86% and 66% respectively.

CONCLUSSION

We conclude that our project are useful to the visually impaired person and family or guardian that have visually impaired kids. This project help the visually impaired person to walk at the public more easily and safely . With our safety features, we can reduces the risk of the visually impaired walk in public. Therefore, we creating this project is to help the visually impaired person to live as a normal person.

REFFERENCE

1) https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0198799
2) http://www.ghrnet.org/index.php/IJOR/article/view/2068/2425
3) https://en.wikipedia.org/wiki/Photoresistor
4) https://en.wikipedia.org/wiki/Switch
5) https://en.wikipedia.org/wiki/Light-emitting_diode