بسم الله الرحمن الرحيم

Sudan University of Science and Technology

Collage of Graduate Studies

Design of Interactive cane for blind Using Microcontroller

تصميم عصا تفاعليه للمكفوفين بإستخدام المتحكم الدقيق

A Thesis Submitted in Partial Fulfillment of the Requirement of M.Sc. Degree in Biomedical Engineering

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الآية

قال تعالى:

بسم الله الرحمن الرحيم

{وَقُلِ اعْمَلُواْ فَسَيَرَى اللّهُ عَمَلَكُمْ وَرَسُولُهُ وَالْمُؤْمِنُونَ وَسَتُرَدُّونَ إِلَى عَالِمِ الْغَيْبِ وَالشَّهَادَةِ فَيُنَبِّئُكُم بِمَا كُنتُمْ تَعْمَلُونَ}

صدق الله العظيم

سورة التوبة الآية (105)

DEDICATION

To the candle of my life (My Mother)

To my Father & Brothers and Sister

To my Teacher

To my colleagues & Friends

To those who are searching knowledge

I dedicate this work

ACKNOWLEDGEMENTS

*I would like to express my deep sense of gratitude and respect to my supervisor, **Dr. Mohammed Yagoub**, in department of Biomedical Engineering for his excellent guidance, suggestions and constructive criticism. He has been very kind, supportive and patient to me while suggesting the outlines of the project and has also been very helpful in the successful completion of the same. I appreciate his overall support.*

Finally, I would like to thank my family members, and my friends for their support and help. Without their cooperation, it was Impossible for me to achieve this goal in my life.

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Abbreviations:

ADC	Analog to Digital Converter
ALU	Arithmetic Logic Unit
CMOS	Complementary Metal Oxide Semiconductor
DC	Direct Current
EEPROM	Electrically Erasable Programmable Read Only Memory
IAPB	International Agency for Prevention of Blindness
IR	Infrared
KHz	Kilohertz
LCD	Liquid Crystal Display
LLR	Lunar Laser Ranging
MLF	Micro Lead Frame
PTFE	Polytetrafluoroethylene
QFN	Quad Flat No leads
RAM	Random Access Memories
RISC	Reduced Instruction Set Computer
SLR	Satellite Laser Ranging
SPI	Serial Peripheral Interface bus
TQFP	Thin Quad Flat Package
USART	Universal Synchronous/Asynchronous Receiver /Transmitter
V	Velocity of sound in air
VSM	Virtual System Modeling
WHO	World Health Organization

المستخلص

يواجه المكفوفين العديد من الصعوبات يوميا مثل المشي على الطريق، وإيجاد الطريق الصحيح. في هذا المشروع تأتي العصا التفاعليه كحل لتمكينهم من التعرف على العالم من خلال دمج عصا أبيض تقليدي مع دائره تتكون من المتحكم الدقيق وأجهزة الاستشعار بالموجات فوق الصوتية للكشف عن العقبات (الاماميه، العليا) والمنخفضات ، بالاضافه الى جهاز استشعار المياه للكشف عن المياه على الأرض. نتيجة أجهزة الاستشعار بالموجات فوق الصوتية إنذار مع نغمات مختلفة لكل جهاز استشعار، والاهتزازات للكشف عن المياه في الطريق وسوف تتوقف كل هذه الإنذارات عند ابعاد العصا من العقبات والمياه. وهذا يمكن أن يخفف إلى حد كبير من المخاطر التي يتعرض لها الاشخاص فاقدى البصر.تم تصميم الدائره اولا ببرنامج نمذجه النظام الظاهري البروتوس ثم تم تجميع العصا فعليا والتى وجدنا بعدالاختبار ان حساساتها تعمل بكفائه87%.

ABSTRACT

Blind people daily encounter many difficulties such as walking on the road, finding right path. In this project the interactive cane comes as a solution to enable them to identify the world around by integrate the traditional white cane with circuit consisting of microcontroller and ultrasonic sensors to detect obstacles (forward ,above knee) and pits .In addition there is water sensor to detect water on the ground. The result of ultrasonic sensors is alarm with different rings for each sensor, and vibrations for water in the path. All these alarms and vibrations will be stopped once the guide cane is taken away from obstacles and water. This can be considerably decreases the risk of the blind people injuring themselves. The circuit designed firstly by Proteus Virtual System Modeling then after the guide cane sensors are actually assembled. After test we found the sensors are working at efficiently of 87%.

Chapter One

Chapter One

Introduction

1.1 Introduction

Blindness is a state of lacking the visual perception due to physiological or neurological factors. The partial blindness (visually impaired) represents the lack of integration in the growth of the optic nerve or visual center of the eye, and total blindness is the full absence of the visual light perception [1]. A report by World Health Organization (WHO) and International Agency for Prevention of Blindness (IAPB) stated that there are approximately 285 million persons around the world who are visually impaired, out of which 39 million are completely blind. 90% of the world's visually impaired live in developing countries [2].The lack of visual observation is a loss of freedom to those people. This means they are dependent on other human being or white cane for navigation in both indoor and outdoor areas. A white cane is one of the most common mobility aids for the visually impaired. However, it does not help users who have visual impairments to find obstacles at head- or knee-level, or at distances greater than 1 m, generally allows the detection of obstacles only at a distance equal to the cane's length [3]. The interactive cane with buzzer and vibration motor is designed.

The white cane (folding canes) is long and light cane. It comprises three parts, namely a handle (grip), a straight shaft (or articulated shaft), which works as an extension of the user's body, and the tip, which makes direct contact with an object or the ground, as shown in Figure(1.1) below.

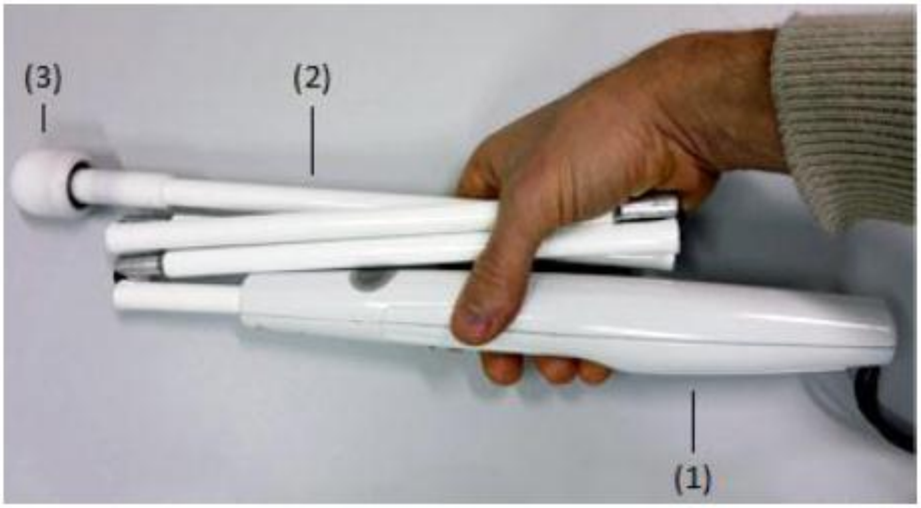


Figure 1.1: Long cane components. [4].

1.2 Problem statement:

Conventional cane can only sense an obstacle up to 1 meter, it is unable to warn the user when there is an obstacle, pit and water on the ground in their path until the user has touched them. Some incidents happen due to blind people cannot sense their surroundings. The incidents might lead to serious injury.

1.3 Objective:

Here we will introduce the general and specific objectives of the project

1.3.1 General Objective:

To design an electric cane to help blind people to walk more confidently (independent), and to maintain its structurally similar to white cane i.e. thin, lightweight and easy to handle, yet it gives an active feedback to the user regarding hazards in his walking path.

1.3.2Specific Objectives:

1. To detect potential obstacles (above knee and forward) and pits at an extended distance from the user.
2. To detect water on the ground at an extended distance from the user.
3. To design guide cane with low cost and highly efficient navigation system.

1.4 Thesis Outline

This thesis consists of five chapters. Chapter 2 is Literature Review discussing previously used methods and some smart cane related works. Chapter 3 Materials and Method it explains all materials used in this project and the flow of the project and also the methods to implement the project. Chapter 4 Results and Discussion, the output of the design will be discussed in this chapter. Chapter5 will be Conclusion. It will conclude the whole project and also recommendation for the improvement of the project.

Chapter Two

Chapter Two
Literature Review

2.1 Traditional Mobility Aids

Traditional mobility aids have acted as an important and effective tool for helping visually impaired travelers detect objects in their local environment, Three widely used traditional aids exist, are described below:

2.1.1 Human guide

A human guide is a person serves as a guide to a person who is blind, but practically it's not a permanent solution for aiding the blind in mobility and navigation. A blind person lacks privacy and can have a feeling of being a burden to his or her guide [5].

2.1.2 Long cane:

The traditional long cane (passive), is widely used by blind and visual impaired people detects ground irregularities and obstacles. But fails to detect potential collisions above the user waist line or detect obstacles or drop-offs in the path approximately 1 m (meter) in front of them [6] standards colors for it are white with red in the middle and tip as shown in Figure (2.1) below[7]

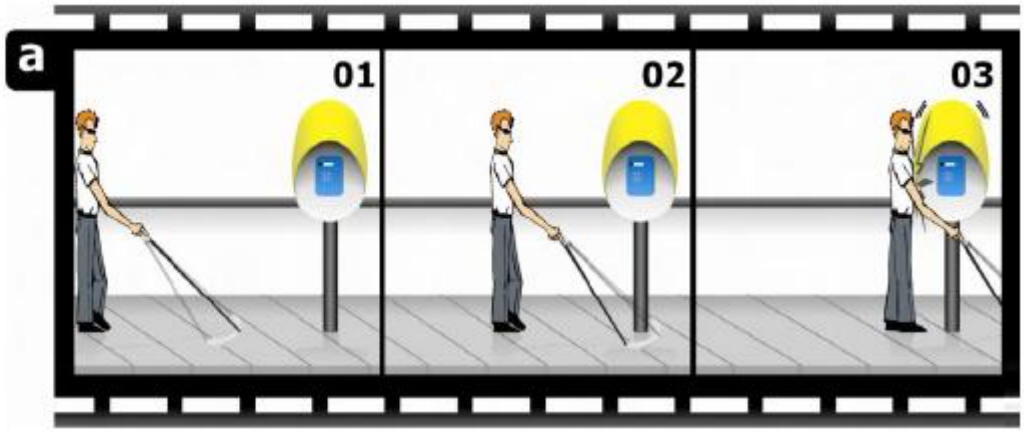


Figure 2.1: Long cane limitations [5].

Advantages: cheap, light weight constructions available, effectively informs of shorelines, landmarks and obstacles at ground-level, and notifies others about visual disability of its user.

Disadvantages: does not protect from obstacles at torso and face level [5].

2.1.3 Dog guide.

The puppy trained to be a guide. It is carefully selected and trained at special schools, and the guide dog user also has to be trained [8].

Advantages: good in following familiar paths, good overall obstacle avoidance, trained for selective disobedience when sensing danger to his owner.

Disadvantages: Its very costly (training cost approx. $40 in the USA), guide dog service period is on average 6 years [5].

2.2 Technology Canes:

The term technology cane is used for a group of obstacle detection canes that are constructed on long cane principles but use additional technology to detect obstacles and relay information about the obstacles to the cane bearer. The following two main technologies are used in the obstacle detection component of these modern technology canes:

2.2.1 The Laser Cane:

The Laser cane is a primary mobility aid that combines a long cane with a laser obstacle detection system. Short pulses of laser are transmitted and then reflected from obstacles in its path. This reflected light detected by the sensors mounted on the cane. Information about the presence of obstacles is provided to the user through both vibrations and beeps.

Disadvantages: Not all materials can be detected by laser. For example, light will pass straight through transparent glass, it will not be reflected (like infrared), so the laser sensors will not detect it , whereas an ultrasound system can do. The user is informed only by close objects , that's due to short pulses of laser [8].

2.2.2 Infrared cane (IR):

It's a cane with infrared sensor which is an electronic instrument that emits and receives infrared radiation to detect the objects in the vicinity [9].

IR emitter will emit infrared continuously when power is supplied to it. On the other hand, the IR receiver will be connected and perform the task of a voltage divider [10].

The ultrasonic has a better range detection compared to infrared [11].

Table2.1: General characteristics of above active sensors [12].

#	Laser	Infrared	Ultrasound
Principle	Transmission and reception of light wave	Transmission and reception of pulse of IR light	Transmission and reception of acoustic waves
Range	SLR: 15cm to 120cm LLR: about 10 -50 m	From 20 cm to 150cm	From 3 cm to 10 m
Beam width	Narrow	fairly thin	Wide
Cost	Very high	Low	Low

Chapter Three

Chapter Three

Materials and Method

This chapter focuses on discussion of the project flow and the method to implementation. Hardware devices and software used to control each part of the devices will be discussed as well.

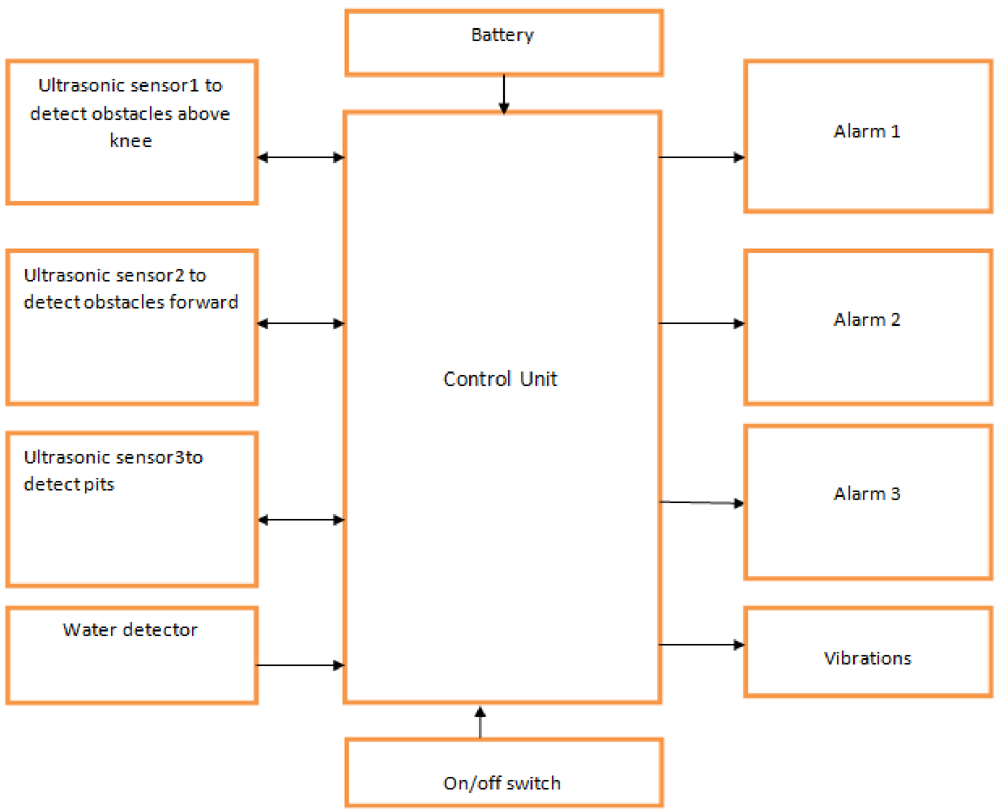


Figure 3.1: Block diagram of the interactive cane

In the above figure (3.1) the control unit consists of an ATmega8L microcontroller code which receives input signal from ultrasonic sensors and water sensor and its output is an alarm from buzzer and vibrations from dc motor.

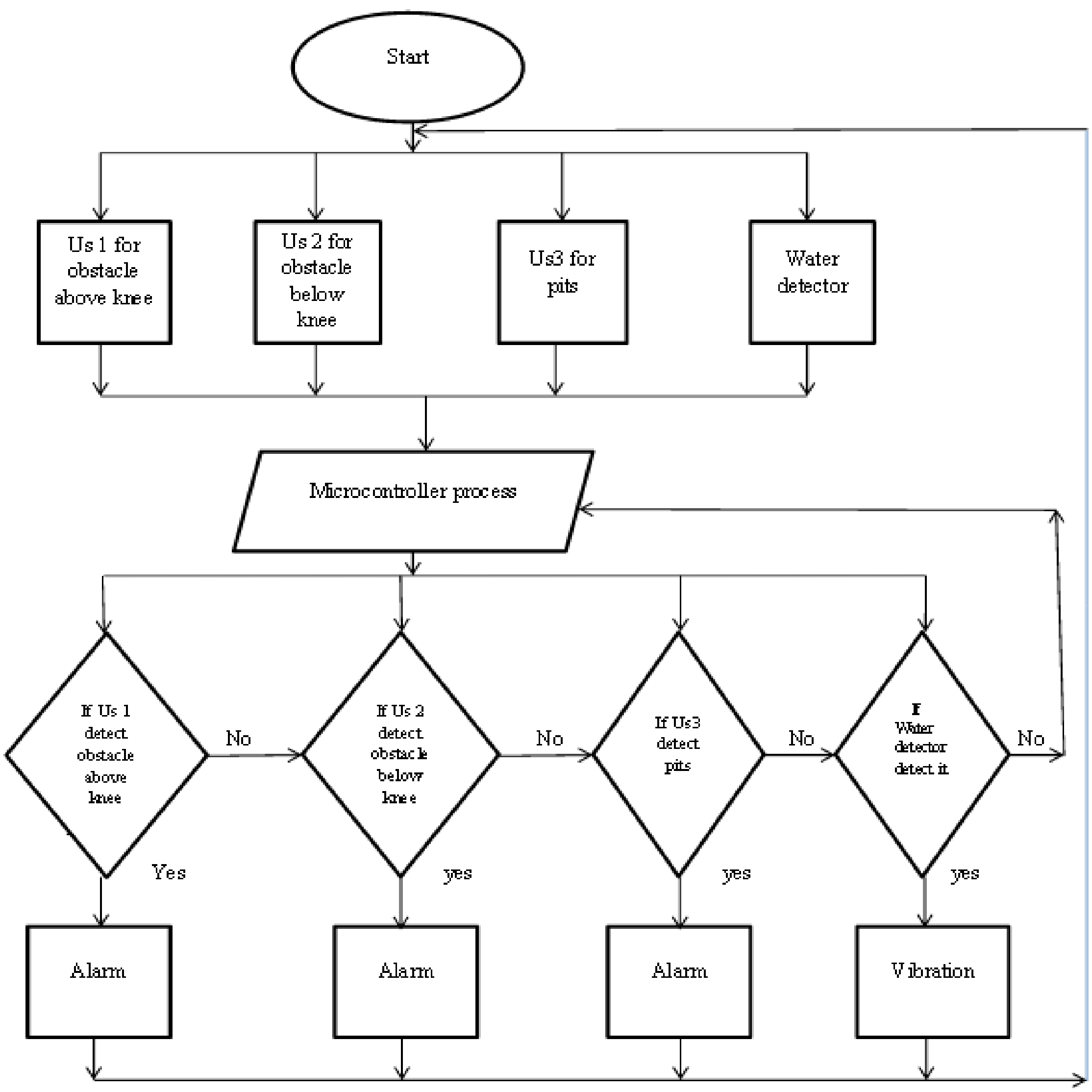


Figure 3.2: Flow chart of the interactive cane

In above figure (3.2) all sensors outputs are sent to microcontroller which is controlled by them through a code the output result is alarm for ultrasonic sensors with different tones for each one and vibration for water ,this infinity loop doesn't end unless the power is cut (out of battery) or the power switch is shutdown.

3.1 Software implementation

In this project we choose Proteus Virtual System Modeling (VSM) software to develop and test the circuit control before physical prototype. Proteus is software for microprocessor simulation, schematic capture, and printed circuit board (PCB) design. Proteus-VSM (Virtual System Modeling) permits the co- simulation of the embedded software for popular microcontrollers alongside with the hardware design [13].

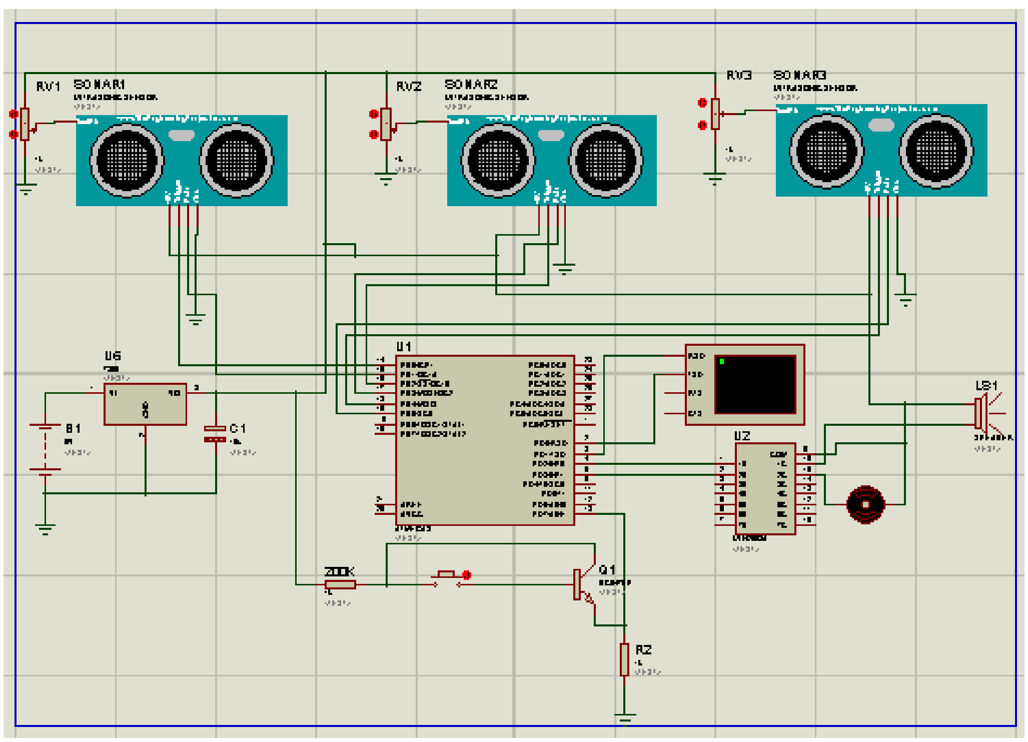


Figure 3.3: The whole circuit design using proteus simulation.

In this simulation button switch works as water. If it closed it will give vibration .Potentiometer work as close or far object from sensor and the distance is viewed in LCD. Before the running the simulation AT mega 8L was loaded by suitable code in format of (.hex) file which was written by the Bascom software (basic language).

3.2. Materials:

The major components of the guide Cane are as follows:

- AT Mega 8L microcontroller.
- 3 HC-SR04 Ultrasonic Sensors Module
- Power Stage
- DC Vibration Motor
- buzzer
- PTFE.

3.2.1 AT mega8 (L):

Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, implantable medical devices, remote controls, office machines, appliances, power tools, toys and other embedded systems [14].

The Atmel® AVR® ATmega8 is a low-power CMOS 8-bit microcontroller based on the AVR RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega8 achieves throughputs approaching 1MIPS per MHz, allowing the system designer to optimize power consumption versus processing speed. The Atmel AVR core combines a rich instruction set with 32 general purpose working registers. All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in one single instruction executed in one clock cycle. The resulting architecture is more code efficient while achieving throughputs up to ten times faster than conventional CISC microcontrollers.

The ATmega8 provides the following features:

8 Kbytes of In-System Programmable Flash with Read-While-Write capabilities, 512 bytes of EEPROM, 1 Kbyte of SRAM, 23 general purpose I/O lines (port B, port C and port D), 32 general purpose working registers, three flexible Timer/Counters with compare modes, internal and external interrupts, a serial programmable USART, a byte oriented Two-wire Serial Interface, a 6-channel ADC (eight channels in TQFP and QFN/MLF packages) with 10-bit accuracy, a programmable Watchdog Timer with Internal Oscillator, an SPI serial port, and five software selectable power saving modes [15].

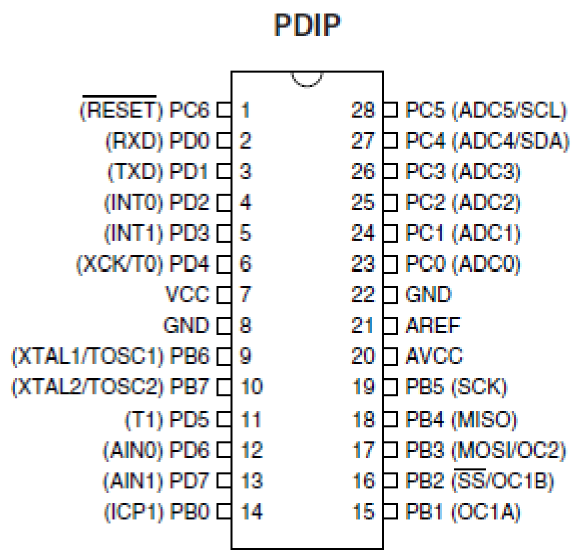


Figure3.4: AT mega 8l pin configurations

In this project, digital input and output port is used to connect to the embedded system. The ports used are Port B and Port D.

3.2.2. HC-SR04 Ultrasonic Sensor:

Ultrasonic sensors are very popular for range detection. This sensing technique is a SONAR technique which can also be seen in some animals like dolphins and bats. We have used HC-SR04 by Cytron Technologies. This sensor offers very high accuracy for range detection. Also the stability of the readings is found to be high. They are capable of finding hard as well as soft materials, is not affected by sunlight or black material like Sharp rangefinders are (although acoustically soft materials like cloth can be difficult to detect) [16].

3.2.2.1. Design:

HC-SR04 Ultrasonic-sensor is made of a 40kHz transmitter and receiver piezo-electric ceramic discs with a metal uni-cone horn to focus the ultrasonic beam produced by Ceramic Transducer . The transmitter requires high driving voltage, which is mostly generated by a MAX232 line driver chip. The receiver is interfaced to the input of an active multi-stage band-pass filter made of LM324. The transmitter and receiver circuits are interfaced to the trig and echo terminal pins by a 14 pin STC11 (8051 core) microcontroller[17], Also it has four pins ,two pins ensure the power supply whereas one pin is for transmission and one for echo reception. It works on a 5v voltage supply. Figure 3.5, given below, shows us the structure of the sensor. We have both transmitter and receiver on the same chip. When we give a high pulse to the transmit pin, it triggers a chirp signal, which get reflected back from the object and received by the echo pin [16].

Figure 3.5: HC-SRO4 ultrasonic sensor.

3.2.2.2. Specifications:

- It works on a power supply of 5V DC.
- Frequency of operation is 40KHz.
- Typical Quiescent current is less than 2mA.
- Typical operating current is 15mA.
- Range is from 2cm to 400cm.
- The typical measuring angle is 300 where it can deviate depending upon the surface.
- Maximum effectual angle is 150.
- It generates a trigger pulse of 10µS.

3.2.2.3. Performance and Operation:

Practical test performance of the sensor system by cytron is pretty good within the angular range of 30.

Connect the power supply to the sensor. When transmitting pin receives a 5V supply for 10µS, it gives a burst of eight cycles at 40 KHz. When this wave reflects back from the object, echo pin shows a high value that is 5V for a time depending upon the distance it travelled. Time for travel is the time taken by pulse to reach to the object and reflect back to reach receiver. If ‘d’ is the distance, and ‘t’ is the time of flight, then the distance can be calculated as follows,

$$d = \left(\frac{t}{2}\right) * v \tag{3.1}$$

Where v is the velocity of sound in air at room temperature, typical value of v is 340m/S. The distance is calculated in meters.

The triggering operation can be explained using the Figure 3.6, given below. The width of the received pulse decides the distance of an object from the sensor. Larger is the distance , larger is the width of the pulse [16].

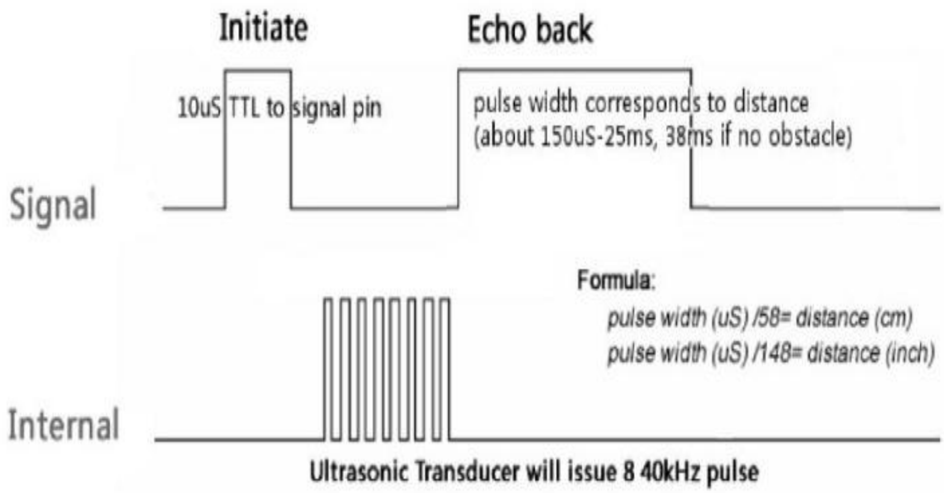


Figure 3.6: Ultrasonic Trigger and echo pulse

Specifications and limitations of the sensor can be explained using the table given below :

Table3.1: Specifications and limitations of HC-SR04[18].

Parameter	Min	Typ.	Max	Unit
Operating Voltage	4.50	5.0	5.5 V	V
Quiescent Current	1.5	2	2.5	mA
Working Current	10	15	20	mA
Ultrasonic Frequency	–	40	–	kHz

3.2.3. Power Stage:

The power stage, as shown in figure 3.8, supplies 5V to power all the components in other stages. It contains a 9V battery which is connected to a voltage regulator (LM7805 available in the market) which regulates the voltage to 5V which is the required voltage to power the other component ,a resistor is connected to reduce the Current entering to the circuit while a capacitor is connected to filter this voltage. The 5V enters the microcontroller (ATmega8l) via the positive supply pin [19].

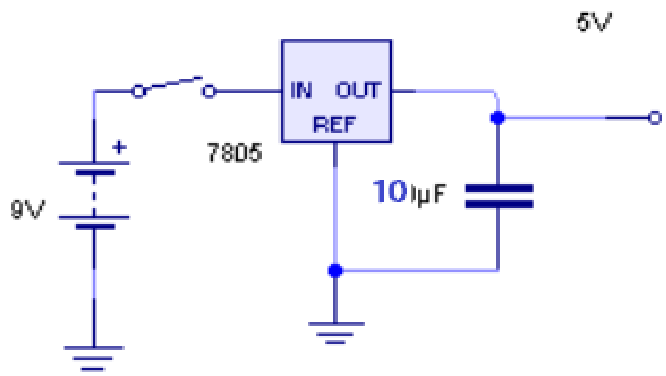


Figure 3.7: The power stage of interactive cane

3.2.4. DC Vibration Motor:

This is the type of DC vibration motors used in mobile phones. It working by a voltage 5 v with current around 125 mA, this type of motors can be programmed to control the speed of it by using the PWM (Pulse Width Modulation) method. The speed of the motor is 13500 rpm [20].

3.2.5. Buzzer HYT-3015A:

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers and confirmation of user input such as a mouse click or keystroke [21]. In this project we use piezoelectric buzzer named HYT-3015A, which it Operating by 5V DC , and Current 20mA [22].

3.2.6. Poly tetra fluoro-ethylene (PTFE):

The Poly tetra fluoro-ethylene (PTFE) material is also known as Teflon, the molecular structure of PTFE is based on a linear chain of carbon atoms which are completely surrounded by fluorine atoms. The carbon-fluorine bonds are among the strongest occurring in organic compounds [23].Teflon ®PTFE resins are fabricated to form parts by a number of techniques, including ram extrusion, screw extrusion, compression molding, and paste extrusion with an extrusion aid. Although different, these techniques have three basic steps in common: cold forming, sintering, and cooling. These fabricating steps refer to operations that involve, respectively: compacting molding powder to shape by pressing, bonding adjacent surfaces of particles by heating, and controlling crystallinity content of the article by cooling [24], As a result, PTFE has self-lubricating capabilities, unlimited shelf life and it has a very high electrical resistance, so we designed it as a joint between the parts of the shaft to let an easy folding of the guide cane. We made a filter to protect water detector from Clay and dust.

Figure 3.8: PTFE powder, semi-finished shape and final machined product [23]

3.3. METHOD:

The prototype guide cane was made of a lightweight aluminum as main support (articulated shaft), PTFE material as joint support to make an easy folding and a filter in order to protect the water electrode. It painted in red and white (standard color for blind people white cane).

The interactive cane includes 3 an ultrasonic sensors to detect potential obstacles (above knee), forward and pits at an extended distance from the user, water detector circuit in below figure (3.9) is used to sense any water present in the path. Witch it include two electrode connected to control unit to detect water on the ground. It will run the circuit and this will cause a closed circuit when water found then vibration to alert the user of these dangers, The water sensor and distance sensors buzzer will be stopped once the cane is taken away from the hazard .

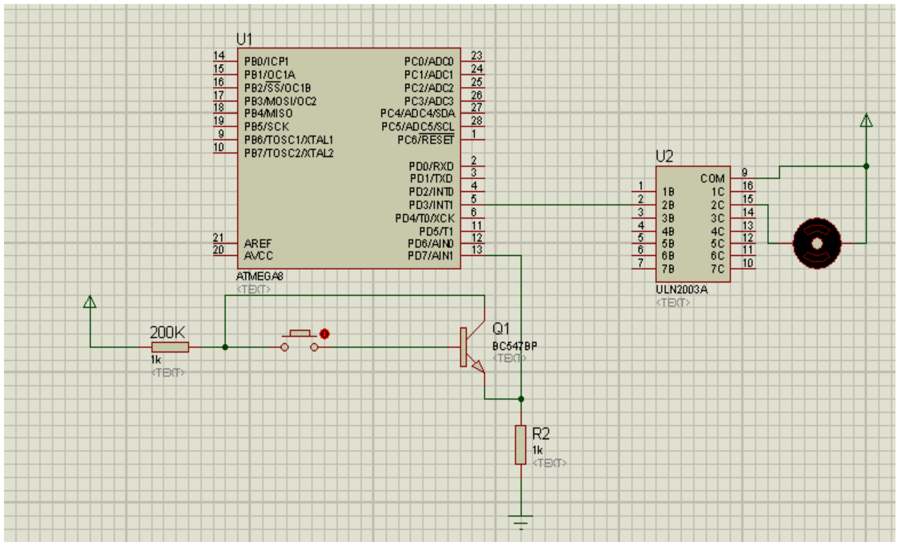


Figure 3.9: water detector circuit

The control unit in figure (3.10) below include (AT mega 8L) microcontroller which is a low-power CMOS 8-bit .I have chosen it because it has small size that can be easily entered inside the cane, which control the other components. Transistor BC547 works as switch, it biased so it remains fully ON if there is a signal at the base (water on the ground). In the absence of base signal, it gets completely OFF (no water), the UNL2003A driver was connected between ATmega8L microcontroller and vibration motor to prevent the reverse current. 9volt battery was connected to voltage regulator IC 7805 to reduce the voltage to 5V required to power the circuit, and capacitor (10μF) connected to smooth the current.

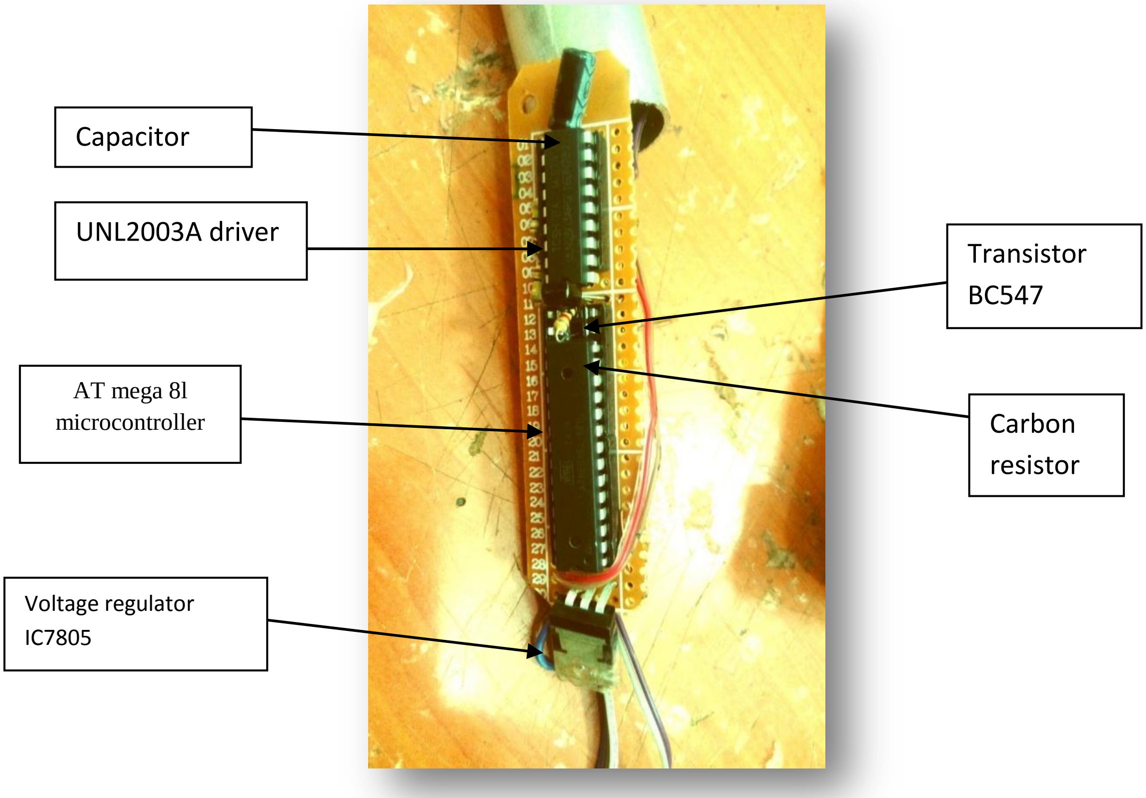


Figure 3.10: The control unit

According to ultra cane Company the tall of cane measured from the center of blind breastbone down to the ground.

If the Cane is too short, the user will hold it at too steep angle, and the sensors will point downwards towards the floor, which will give constant obstacle detection vibrations from the ground. If the cane is too long it will be held at too shallow angle and it may not detect objects on the ground forward [25].

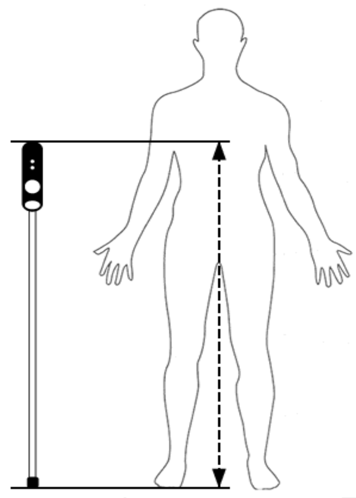


Figure 3.11: Size of ultra cane.

The interactive cane is chosen according to standard length specified by ultra cane company. It length is 130cm for a person whose height is 170cm. This length would help to develop and add water detector and pits sensor to make it function in a good manner according to average height of blind people.

Chapter Four

Chapter Four

Results and Discussion

4.1 Dimension of the interactive cane:

Through the archicad, the dimension and length of the cane were determined.

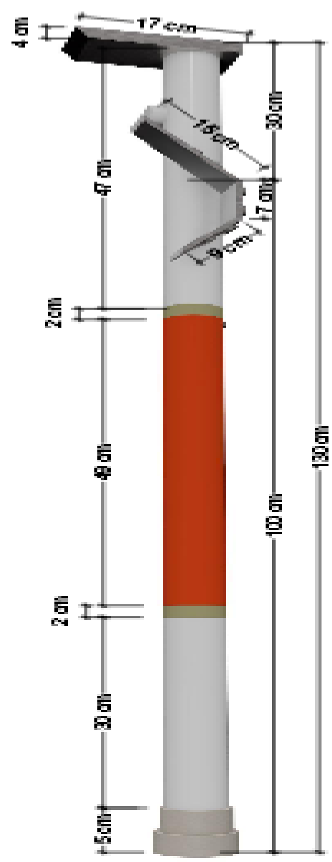


Figure 4.1: Dimension of guide cane

In above figure (4.1) the dimensions represent the actual dimensions of the cane we developed.

4.2Major component of the interactive cane:

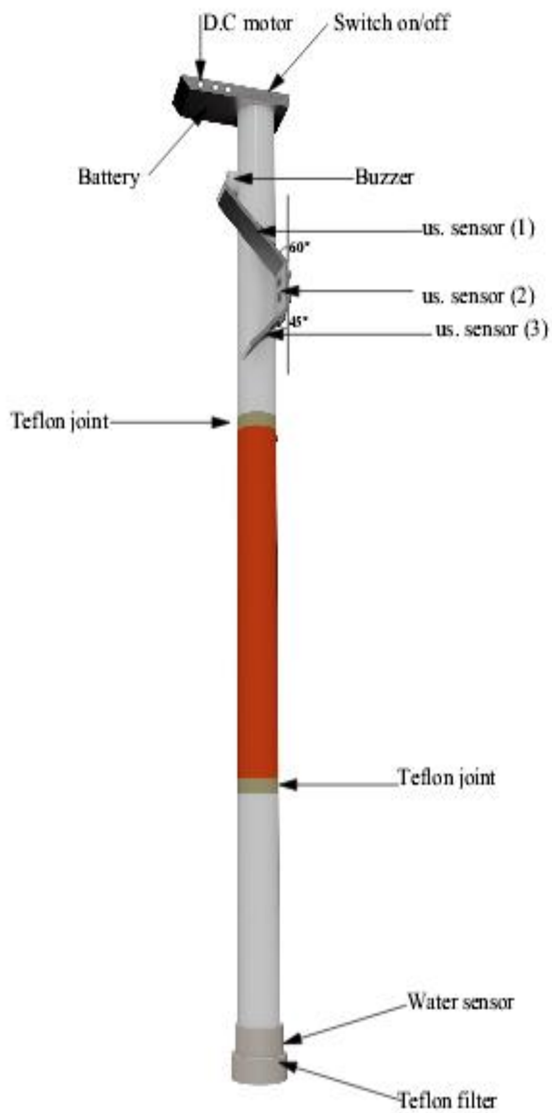


Figure 4.2: Major component of interactive cane.

Figure (4.2) shows the following details:

US sensor 1: Ultrasonic SENSOR to detect obstacles above knee to head level in range (≤ 64cm) at outer angle of60°.

US sensor 2: ULTRASONIC SENSOR to detect forward obstacles in rang (≤ 64cm).

US sensor 3: ULTRASONIC SENSOR to detect uneven surface (pits) in rang(115cm-130cm) at outer angle of45°.

Water detector: to detect water on ground (2cm and more)

Teflon joint: to make easy folding the cane

Teflon filter: to protect water sensor from Clay and dust.

4.3 side elevation of the interactive cane and tall of person:

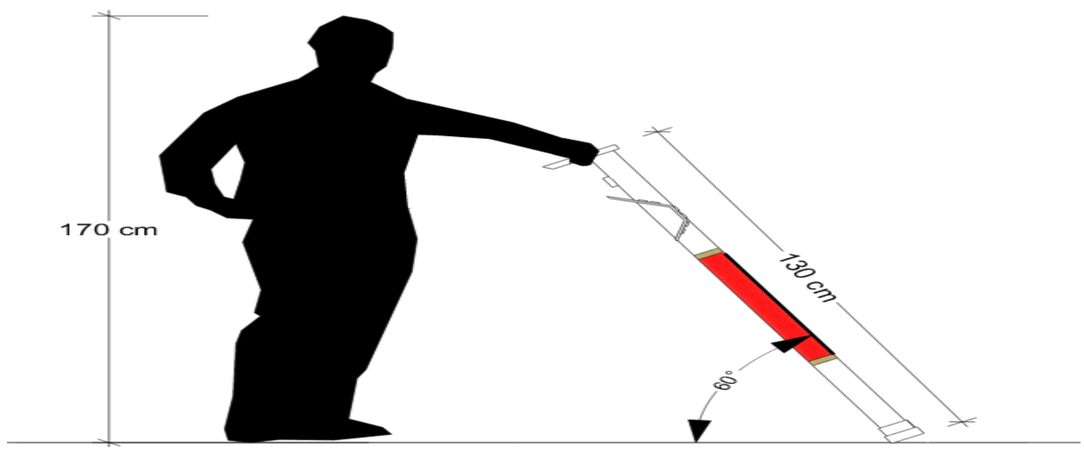


Figure 4.3: Side elevation of guide cane and height of blind person.

The figure 4.4 explain the right angle to hold the interactive cane (60°) and how blind person can move using the guide cane

4.4: Prototype design of the interactive cane:

Figure 4.4: Prototype design of guide cane.

Figure 4.4 show the actual design of this interactive cane for blind people by standard color of white cane and length adopted from ultra cane company.

4.5 HCSR04 sensor longitudinal distances test:

In this test the actual distance is measured by scale and the measured distance is by ultrasonic sensor, through moving the object around the HCSR04 sensor. See more in figure (4.5).

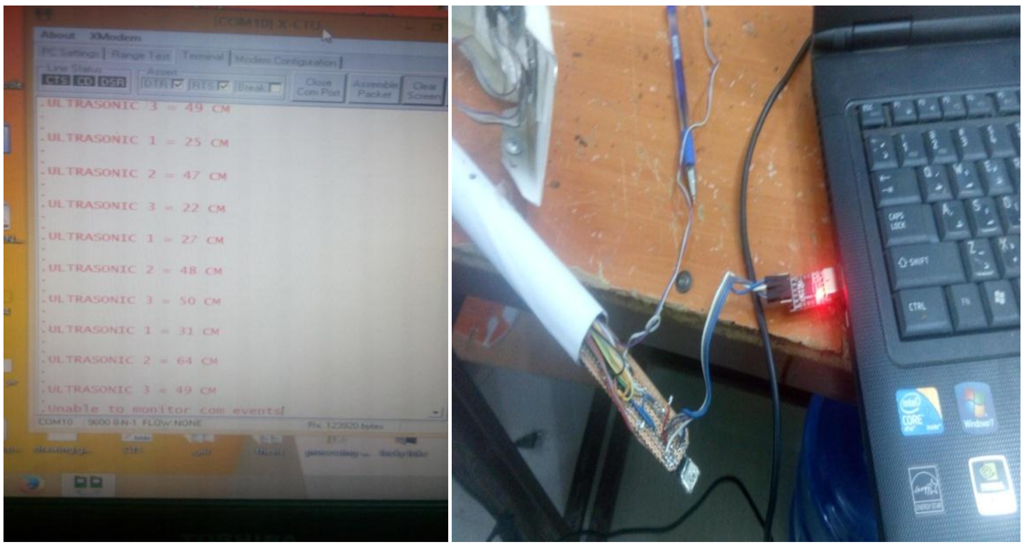


Figure 4.5:HCSR04 sensor distance test

Table 4.1: Result of distance measurement by HCSR-04

Set no	Actual distance in cm	Measured distance in cm	Error %
1	20	18	10
2	40	36	10
3	60	52	13
4	80	70	13
5	100	86	14
6	120	102	15
7	140	118	16

Table 4.1 shows us the mapping between actual and measured distance. So we calculated Mean of Error ($\dot{x}$)

$$\dot{x} = \frac{\sum_{i=1}^{n} xi}{n} \qquad (4.1)$$

The symbol $\sum_{i=1}^{n} xi$ summation all values of the error from the first to the last, n to indicate the number of values in the sample [26].

ẋ=13% that's lead to the guide cane sensors work by efficiently 87%, this value is almost accurate which makes the system more reliable.

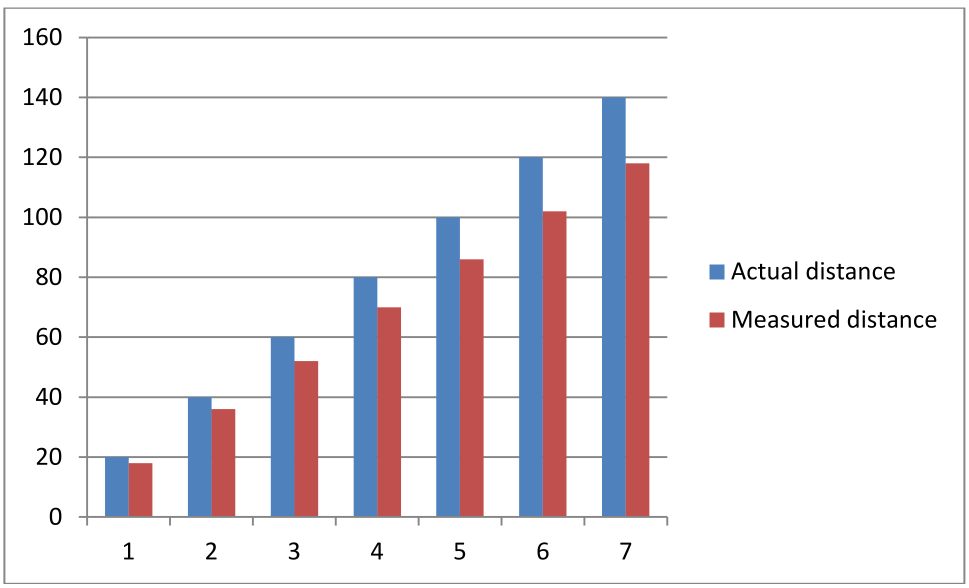


Figure 4.6: Relationship between actual distance and measured distance.

The graph b/w actual value and measured value is almost linear. I observed that there was considerable error in the measured distance as compared to actual distance. Error increases as the distance increases.

I used Standard Deviation to calculate the closer or scatter measured distance around the mean by equation:

$$s = \sqrt{s^2} = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1}} \qquad (4.2)[26]$$

$xi = the\ measured\ destance$

$\dot{x} = the\ mean\ of\ measured\ distance$

$\dot{x} = \frac{482}{7} = 69$

Table 4.2: calculation of standard deviation

n	xi	xi-ẋ	$(x\,i\ - \dot{x})^2$
1	18	51	2601
2	36	33	1089
3	52	17	289
4	70	1	1
5	86	17	289
6	102	33	1089
7	118	49	2401
			7246

n-1 =6

A cording to equation (4.2) value of S= 35

ẋ+ S =69+35=104

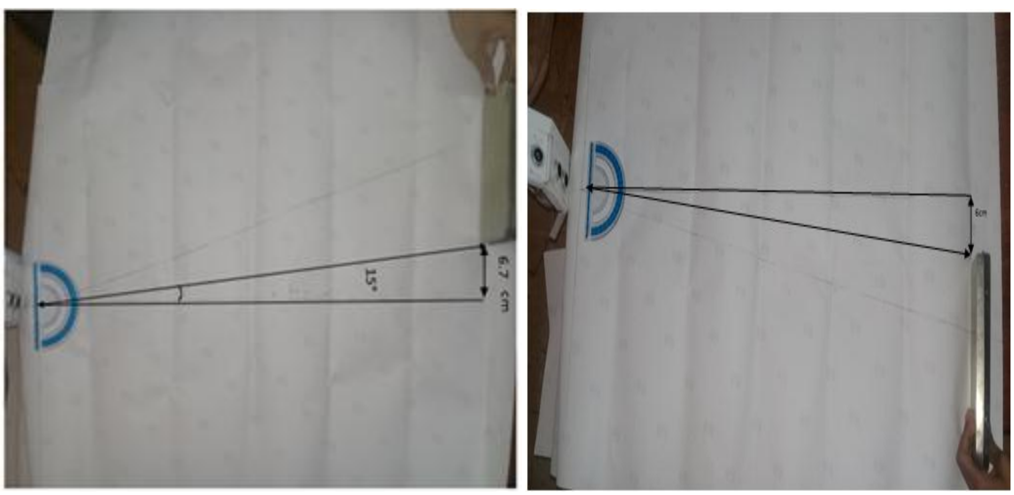
ẋ- S =69-35=34

That means the distribution of majority data extends between 34- 104 cm, because in standard deviation number one all data are not included in the range .

4.6 detection zone at angle 15° left and right:

Ultrasonic sensors have an angle represents a cone that the sensor can detect objects at. For the HC-SR04 this angle is 30 ° (measurement angle) and effective angle 15°.

During the test we found the acceptable detection zone is at angle 15° left and right horizontally at distance 64cm. in first trail, we placed an obstacle on the right hand side of the sensor. Similarly, we did the experiment for the obstacle at left hand side. The experimental setup can be shown in the figures below.



(a) Left side (b) Right side

Figure4.7: Detection zone at specific distance and angle

After carrying out number of experiments, the average value for both of the measurements was calculated. For the right hand side obstacle, the detection zone at 15 degrees angle and longitudinal 64cm was found 6.7cm see (figure a) where as the left hand side obstacles was found 6cm ,see (figure b) that means the total zone for single HCSR04 at angle 30° and distance 64cm equal 12.7cm.

According to distance test and detection zone test the ultrasonic sensor is better than IR sensor and laser which were determined in Table2.1.

4.7 Result of analyzing the water sensor:

There were few details that had been obtained when analyzing the water sensor as listed below:

1. The water sensor is fully functioning.
2. The water sensor can detect if only the water depths is 2 cm and above.

4.8Specification of the interactive cane:

1. Cheap mobility cane
2. Lightweight components integrated to the cane which makes it friendly to the user.
3. Fast response to obstacles, pits and water.
4. Easley handled, folded and maintained.
5. It stays working without replacing the battery at least for 8 hours (by experimental).

4.9Estimated cost:

The estimated cost of the components required are shown in below table

Table 4.3: Estimated cost

S. No	Component	No. Required	Cost (SDN)
1	Distance Measuring Sensors	3	750
2	Control unit	1	200
3	Aluminum cane	1	200
4	Vibration motor	1	50
5	buzzer	1	20
6	PTFE	1	50
			Total=1.270

In comparison with ultra cane price which is (€ 635.00) =24.130 SDN the interactive cane is more cheaper (1.270SDN) .

Chapter Five:

Chapter Five:

Conclusion and Recommendation

1.5 Conclusion

Blind people are facing difficulties every day; they need assistance to help them to move from one place to another .There are many traditional methods to help a blind person to navigate. Today, technological methods are being used to guide blind people. The system was simulated successfully firstly. As a conclusion, this project includes 3 ultrasonic sensors to detect obstacles (forward, above knee) and pits , and water sensor to detect water on the ground. The result of ultrasonic sensors alarm with different ring for each sensor, and vibrations for water in the path, all these alarm buzzers will be stopped once the cane is taken away from obstacles and water. This can considerably alleviate the risk of the user injuring himself .

The interactive cane developed by us is the most proper cane that can be used from shaping, technical and technological point of view.

2.5 Recommendation

- Pits ultrasonic sensor must be placed above but near to the water detector to increase his efficiency.
- lighter material other than aluminum should be used in the structure of the interactive cane .

3.5 Future work:

- A global positioning system (GPS) can be added to find the position of' the user in addition the guidance of the user destination will be given by voice navigation.
- Some more applications like fire or smoke alarm can also be included.

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Appendices

Code

```
$regfile = "m8def.dat"

$crystal = 8000000

$baud = 9600

Config Com1 = Dummy ,Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0

Config Portb.0 = Output                                         'TRIG

Config Pinb.1 = Input                                           'ECHO

Config Portb.2 = Output                                         'TRIG

Config Pinb.3 = Input                                           'ECHO

Config Portb.4 = Output                                         'TRIG

Config Pinb.5 = Input                                           'ECHO

Config Portd.3 = Output                                         'vibration

Config Portd.2 = Output                                         'buzzer

Config Pind.7 = Input                                           'water

Dim I As Word

Dim S1 As Long

Dim Cm1 As Long

Dim S2 As Long
```

```
Dim Cm2 As Long

Dim S3 As Long

Dim Cm3 As Long

Do

Gosub Ultrsonic1

Print "                              "

Print "ULTRASONIC 1 = " ; Cm1 ; " CM"

Print "                               "

Gosub Ultrsonic2

Print "                              "

Print "ULTRASONIC 2 = " ; Cm2 ; " CM"

Print "                               "

Gosub Ultrsonic3

Print "                              "

Print "ULTRASONIC 3 = " ; Cm3 ; " CM"

Print "                               "

                      'ultrasonic distance printed in cm


If Pind.7 = 1 Then

Portd.3 = 1

End If


If Pind.7 = 0 Then


Portd.3 = 0
```

```
                    'water  condition
End If

 If  Cm1  <=  64  Then
 Portd.2  =  1
Waitms  300
 Portd.2  =  0
Waitms  300
 End If

  If  Cm2  <=  64  Then
  For  I  =  1  To  3
 Portd.2  =  1
Waitms  100
 Portd.2  =  0
Waitms  100
  Next  I
 End If

 If  Cm3  >=  115  And  Cm3  <=  130  Then
  For  I  =  1 To  5
 Portd.2  =  1
Waitms 10
 Portd.2  =  0
Waitms  10
```

```
   Next I
                 'ultrasonic conditions

 End If

Waitms 100
S1 = 0
S2 = 0
S3 = 0
Loop

Ultrsonic1:
Ff1:
Portb.0 = 0
Waitus 100
Portb.0 = 1
Waitus 10
Portb.0 = 0
If Pinb.1 = 0 Then
Gosub Ff1
End If
Dd1:
If Pinb.1 = 1 Then
Incr S1
Goto Dd1
```

```
End If
Cm1 = S1 / 13
Cm1 = Cm1 / 35
Cm1 = Cm1 * 10
   Return

      Ultrsonic2:
Ff2:
Portb.2 = 0
Waitus 100
Portb.2 = 1
Waitus 10
Portb.2 = 0
If Pinb.3 = 0 Then
Gosub Ff2
End If
Dd2:
If Pinb.3 = 1 Then
Incr S2
Goto Dd2
End If
Cm2 = S2 / 13
Cm2 = Cm2 / 35
Cm2 = Cm2 * 10
```

```
Return

Ultrsonic3:
Ff3:
Portb.4 = 0
 Waitus 100
Portb.4 = 1
 Waitus 10
Portb.4 = 0
If Pinb.5 = 0 Then
Gosub Ff3
End If
Dd3:
If Pinb.5 = 1 Then
Incr S3
Goto Dd3
End If
Cm3 = S3 / 13
Cm3 = Cm3 / 35
Cm3 = Cm3 * 10
   Return
' reading distance
```

B. Data sheet of AT mega 8l microcontroller

Features

- High-performance, Low-power AVR® 8-bit Microcontroller
- Advanced RISC Architecture
  - 130 Powerful Instructions – Most Single-clock Cycle Execution
  - 32 x 8 General Purpose Working Registers
  - Fully Static Operation
  - Up to 16 MIPS Throughput at 16 MHz
  - On-chip 2-cycle Multiplier
- High Endurance Non-volatile Memory segments
  - 8K Bytes of In-System Self-programmable Flash program memory
  - 512 Bytes EEPROM
  - 1K Byte Internal SRAM
  - Write/Erase Cycles: 10,000 Flash/100,000 EEPROM
  - Data retention: 20 years at 85°C/100 years at 25°C[1]
  - Optional Boot Code Section with Independent Lock Bits
    In-System Programming by On-chip Boot Program
    True Read-While-Write Operation
  - Programming Lock for Software Security
- Peripheral Features
  - Two 8-bit Timer/Counters with Separate Prescaler, one Compare Mode
  - One 16-bit Timer/Counter with Separate Prescaler, Compare Mode, and Capture Mode
  - Real Time Counter with Separate Oscillator
  - Three PWM Channels
  - 8-channel ADC in TQFP and QFN/MLF package
    Eight Channels 10-bit Accuracy
  - 6-channel ADC in PDIP package
    Six Channels 10-bit Accuracy
  - Byte-oriented Two-wire Serial Interface
  - Programmable Serial USART
  - Master/Slave SPI Serial Interface
  - Programmable Watchdog Timer with Separate On-chip Oscillator
  - On-chip Analog Comparator
- Special Microcontroller Features
  - Power-on Reset and Programmable Brown-out Detection
  - Internal Calibrated RC Oscillator
  - External and Internal Interrupt Sources
  - Five Sleep Modes: Idle, ADC Noise Reduction, Power-save, Power-down, and Standby
- I/O and Packages
  - 23 Programmable I/O Lines
  - 28-lead PDIP, 32-lead TQFP, and 32-pad QFN/MLF
- Operating Voltages
  - 2.7 - 5.5V (ATmega8L)
  - 4.5 - 5.5V (ATmega8)
- Speed Grades
  - 0 - 8 MHz (ATmega8L)
  - 0 - 16 MHz (ATmega8)
- Power Consumption at 4 Mhz, 3V, 25°C
  - Active: 3.6 mA
  - Idle Mode: 1.0 mA
  - Power-down Mode: 0.5 µA

ATMEL®

8-bit AVR® with 8K Bytes In-System Programmable Flash

ATmega8
ATmega8L

Summary

C. Datasheet of ultrasonic sensor HC-SR04

1.0 INTRODUCTION

The HC-SR04 ultrasonic sensor uses sonar to determine distance to an object like bats or dolphins do. It offers excellent non-contact range detection with high accuracy and stable readings in an easy-to-use package. From 2cm to 400 cm or 1" to 13 feet. It operation is not affected by sunlight or black material like Sharp rangefinders are (although acoustically soft materials like cloth can be difficult to detect). It comes complete with ultrasonic transmitter and receiver module.

Features:

- Power Supply :+5V DC
- Quiescent Current : <2mA
- Working Currnt: 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