Scholarship Technology Assessment Schedule 2011

The student has presented a **reflective report** with **supporting evidence** and:		
1	**2**	**3**
Demonstrated some synthesis and integration of technological experiences in bringing together knowledge skills, ideas and methods to allow their technological outcome(s) to be realised. (2 marks)	Explained how some of the complexities of the situation(s) have been identified and explored Explained why the outcome(s) address the problem(s). (2 marks)	Some reflection on information or understandings or practice(s) that were used to inform the development of their technological outcome. (1 marks)
Demonstrated synthesis and integration of technological experiences in bringing together knowledge skills, ideas and methods to allow their technological outcome(s) to be realised. (4 marks)	Explained how the complexities of the situation(s) have been identified and explored. Justified why the outcome(s) address the problem(s) or **justified** the technological practice undertaken. (4 marks)	Some reflection on information, understandings and practice(s) of others that were used to inform the development of their technological outcome. (2 marks)
Demonstrated synthesis and integration of technological experiences in bringing together knowledge skills, ideas and methods to allow their technological outcome(s) to be realised. Demonstrated: - elegance in terms of ingenuity, simplicity, optimisation and polish of their technological practice and its resulting outcome(s) or - originality in terms of inventiveness, innovation and elements of unconventionality in the technological practice they undertake and its resulting outcome(s). (6 marks)	Explained how the complexities of the situation(s) have been identified and explored Justified the technological practice undertaken and why the outcome(s) address the problem(s). (6 marks)	Reflected on information, understandings and practice(s) of others that were used to inform the development of their technological outcome. (4 marks) Critically reflected on information, understandings and practice(s) of others, that were used to inform the development of their technological outcome. (6 marks)
Demonstrated synthesis and integration of technological experiences in bringing together knowledge skills, ideas and methods to allow their technological outcome(s) to be realised. Demonstrated: elegance in terms of ingenuity, simplicity, optimisation and polish of their technological practice and its resulting outcome(s) - originality in terms of inventiveness, innovation and elements of unconventionality in the technological practice they undertake and its resulting outcome(s). (8 marks)	Explained how the complexities of the situation(s) have been identified and explored. Justified comprehensively the technological practice undertaken and why the outcome(s) address the problem(s). (8 marks)	**Critically reflected** on information, understandings and the practice(s) of others, ***across a range of contexts,*** that were used to inform the development of their technological outcome. (8 marks)
Sub Total 8	**Sub Total 7**	**Sub Total 4**
		Overall Level of Performance 19

Electronic Scholarship Report

Issue and issue research

My client's name is He is a blind man who cannot see at all. His issue is that he frequently bumps into objects that are at chest and head height. This is because he has nothing to warn him of objects that are present in front of him at those heights. After interviewing him he informed me that he does have the aid of a walking stick. And from our discussions I found out that the blind people are taught to use the walking stick to help them to detect objects around just above waist height. However they are not taught to detect objects at their shoulder or head height. also tells me that it is quite ineffective to use the walking stick to detect objects about his waist as it is too inconvenient to do so. This is because it is not practical and not possible for a blind person to be lifting the stick every few seconds to detect objects at the head and chest height as they will get tired of continuously lifting the stick after a while. They may hit other people in their path while trying to detect any objects at head and chest height. Also if the blind person tries to use the stick in detecting objects at chest and head height then he or she may not detect objects on the ground and may fall over and possibly injure themselves. So it is very impractical for my client to use the stick to detect objects head and chest level. Therefore he approached me with this issue as he is concerned for his personal safety and his confidence while walking around. He is concerned for his safety as he has bumped into objects at head and chest height, particularly bumped his head on all sorts of objects. Sometimes these objects have been soft or he has just brushed past these objects. However there have been times when the objects that he has bumped into are hard like cupboard doors and overhanging braches and he has hurt himself quite badly, colliding into all sorts of objects. He told me his confidence has decreased because he has been vary of objects that he might bump into at head and chest height. Therefore he has not been walking at his normal pace and has been hesitant to walk long distances.

Blind people are faced with many problems such as not having the luxury of independent and graceful travel. Blind people run the risk of colliding with an obstacle only when they are in movement relatively to their environment. A simple definition of blindness refers to a loss of vision resulting in a person being unable to walk unaided. A proper definition of blindness is having a visual acuity of less than 3/60 or corresponding visual field loss in the better eye with best possible correction Most blind people are provided with a long cane or stick to extend their range of touch sensation. It is usually swung in a low sweeping motion, across the intended path of travel, to detect obstacles at ground level. Most of blind people use a cane stick to find the obstacles in their path but this cannot help the blind people to sense an object at head and chest height as discussed previously.

The main causes of blindness are cataract (47.8%), glaucoma (12.3%) and age related macular degeneration (8.7%). Other causes include corneal opacity (5.1%), diabetic retinopathy (4.8%),

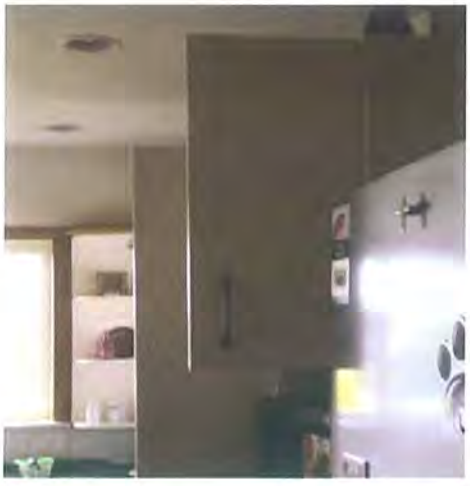
childhood blindness (3.9%), trachoma (3.6%) and onchocerciasis (0.8%). (B) Blindness is most prevalent in developing countries where malnutrition, inadequate health and education services, poor water quality and a lack of sanitation leads to a high incidence of eye disease. Every five seconds one person in the world goes blind and a child goes blind every minute. Around 25% of the world's blindness is permanent and cannot be treated.

has a leadership role in the blind foundation in NZ and he has informed me that he is not the only blind person to face this problem of bumping into objects. All blind people face this problem. Therefore I made the device that I made. It did solve the problem of and basically for any other blind people bumping into objects at head and chest height by detecting those objects and having a peizo sound warning sounds to warn the user of the object present in from of him or her at those heights.

Physical Situation

When is walking on a footpath or in a park, bushes or branches that are overhanging from the sides of fences or from above are an unexpected and dangerous hazard him. This is made even worse when the branches are wet as they usually hang lower into the path of travel.

also told me that while walking at home and especially while moving around in other people's homes he keeps on bumping into objects like open kitchen cabinets at a height and other object inside home such as low hanging chandeliers.



basically has great difficulty in detecting any objects at the chest and head height and frequently bumps into these objects.

There is no specific physical situation for the use of my device. My client walks a lot and walks to a numerous number of places. Therefore the physical situation will be dependent on where my client decides to walk to. This could virtually be anywhere therefore my physical situation would include any place where overhanging objects are present. This would involve me making my device and using sensors which do detect any sort of objects.

Objects such as overhanging chandeliers, high protruding door knobs, open windows, hanging cloth lines, traffic and road signs at head and chest level amongst others are obstacles that informs me of which he bumps into.

Research

The two most common types of distance sensors used to measure distances are ultrasonic and infrared sensors. There are also laser rangefinders and sonar.

Lasers:

These send out a pulse of light. They work similar to ultrasonic sensors where light is emitted and the time taken for or the angle at which the light returns is used to calculate distances. However they only work in a straight line. Therefore I will not be able to use this sensor as my Client requires a narrow area of space to be detected at his head and shoulder level. This is to ensure any objects in that area will be detected. This issue will not be satisfied by the laser rangefinder as objects that are exactly in front of the sensor will be detected and not objects slightly to the sides therefore increasing risk of my client getting injured. Also it is not safe for my client to be walking around with lasers as means to measure distance as the lasers may harm other people if shone into their eyes and can be harmful to the wider community.

Sonar sensing:

Sonar sensors work by emitting a short burst of ultrasonic sound (often 40 khz). Then, if any signals are reflected and the sensor can detect these reflected signals, the sensor can compute the object distance by using the time that it took for the signal to be reflected.

One of the difficulties with sonar, is that if the front face of the object in front of the sensor is too far from perpendicular to the sensor, then the signals will not be reflected back towards the sensor, and thus, the object will not be detected.

However this problem has been fixed by placing sensors at various places on the object. However I don't think it would be practical or even possible to cover all angles produced by the sonar sensor as it will be quite impractical to place sonar sensors at a number of different positions on my client as this will be quite inconvenient and impractical.

Infrared

Infrared sensors work by sending out a beam of IR light, and then computing the distance to any nearby objects from characteristics of the returned (reflected) signal.

Advantages:

They are cheaper in cost and faster in response time than ultrasonic (US) sensors.

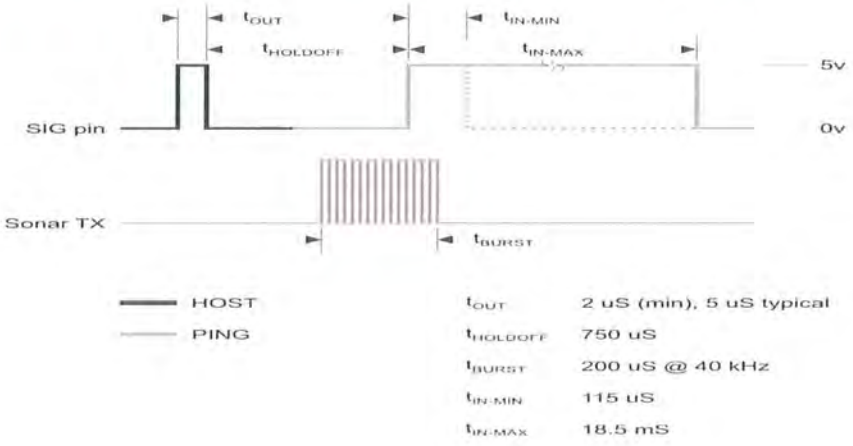
Drawbacks:

- They depend on the reflectance properties of the object surfaces. So knowledge of the surface properties must be known as distance readings will vary depending on the surface the infrared light bounces off.
- US sensors have limitations due to their wide beam-width.

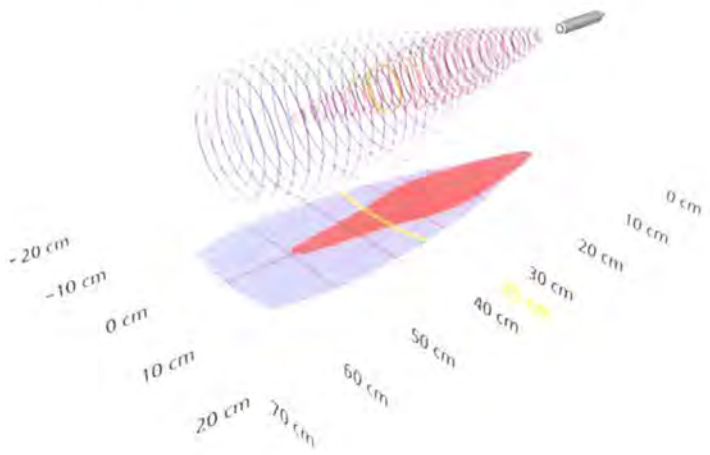
Ultrasonic sensors:

Operation

The ultrasonic sensor detects objects by emitting a short ultrasonic burst and then "listening" for the echo.Under control of a host microcontroller (trigger pulse), the sensor emits a short 40 kHz (ultrasonic) burst.This burst travels through the air at about 1130 feet per second, hits an object and then bounces back tothe sensor. The ultrasonic sensor provides an output pulse to the host that will terminate when the echois detected; hence the width of this pulse corresponds to the distance to the target.



This image gives us a 3D idea of how the beam pattern looks -



Ultrasonic sensors are industrial control devices that use sound waves above 20,000 Hz, beyond the range of human hearing, to measure and calculate distance from the sensor to a specified target object.

Ultrasonic sensors (also known as transceivers when they both send and receive) work on a principle similar to radar or sonar. Ultrasonic sensors generate high frequency sound waves and evaluate the echo which is received back by the sensor. Sensors calculate the time interval between sending the signal and receiving the echo to determine the distance to an object.

Ultrasonic sensors are used to detect the presence of targets and to measure the distance to targets and are a great solution for clear object detection.

Advantages:

Long range detection: Ultrasonic sensors detect over long ranges up to forty feet.

Broad area detection: While some photo electric sensors can detect over long distances they lack the ability to detect over a wide area without using a large number of sensors. The advantage of ultrasonic sensors is that both wide and narrow areas can be covered. All it takes is the proper ultrasonic transducer selection.

Widest range of target materials: Only ultrasonic sensors are impervious to target material composition. The target material can be clear, solid, liquid, porous, soft and wood and any colour because all can be detected.

Drawbacks:

One of the drawbacks to ultrasonic sensors is that there's no way to tell the difference between small objects and large objects because the pulse that's emitted is cone shaped.

The ultrasonic sensor (USS) seems ideal for me to use as my sensor. This is because it is able to detect distance at quite a range depending on one's budget as well as being able to detect an area of space. The drawback for ultrasonic sensors does not really apply to my client as he does not care how big the objects in front of him are as long as they are detected by the sensors. Also he does tend to travel a lot daily, and as the ultrasonic sensor has the widest range of target materials which can be detected, this significantly reduces the chance that objects may not be detected by the USS sensor compared to other sensors resulting in a lower chance of any harm being caused to my client.

Decision making on which Sensor to work with:

Based on my research and other factors I have chosen the ultrasonic sensor as the best sensor for my project to detect distance. First of all based on my research the ultrasonic sensor has all that my client requires to detect distance such as long distance and a wide width beam. The infrared is faster at returning the readings to the MC. However it is

unreliable as its readings depend on the different surfaces it gets reflected off. I need the device to read off objects I have therefore chosen the ultrasonic sensor over the infrared sensor as reliability and the safety of my client are more important than processing speed of data. The USS also processes data with reasonable speed and this is not a disadvantage of the USS sensor therefore making it the better choice to work with.

Apart from weighing my choices of which sensor to use based on my research I did so based on other factors as well. Mr had a range of USS which I could test and work with whereas he had only 1 infrared sensor which could not measure a range of 2.5 meters which was specified by my client. He did not have any of the other sensors. Therefore if I were to use those sensors, I would have had to order them and therefore wait for about 2 weeks resulting in wastage of precious time which is quite important when it came to finishing this project before the deadline.

All this research up till now helped in my decision making on which sensor to choose to work with. The next part of my research has been done on other devices that have been created for blind people to detect objects in front of them.

Similar devices to my project that have been created

The **Sensory 6** detects objects that are farther away than a long cane, and the user hears tones that indicate the distance to the objects. As objects are approached, the tones become higher pitched. The Sensory 6 is not intended to be the only travel aid. It should probably be used in conjunction with another aid, such as a cane. Price: $975

The **MOWAT Sensor** is a small hand-held device that uses high frequency sound to detect objects within a narrow beam. The entire sensor vibrates if an object is present. To avoid confusion, the sensor responds only to the closest object within the beam and the vibration rate increases as the user approaches the object. Price: $995

The **Polaron** is a compact aid that utilizes ultrasonic technology to detect objects within four, eight, or sixteen feet. The Polaron may be used as a secondary aid to a standard long cane, or with a guide dog. When an obstacle is within range, the Polaron either vibrates or emits a sound. The Polaron is designed specifically for the blind, visually impaired.

The **Laser Cane** operates with three lasers that emit invisible beams of light from the cane. The beams detect drop offs and obstacles at different heights and distances. In this way, the cane provides the user with advance warning of obstacles in his/her path through an audible and tactual alarm system. There are three distinctly different audible tones: high, middle, and low pitched. The vibrating unit, known as the tactile stimulator, signals the index finger when there is an obstruction straight ahead. Price: approximately $200.

The **Sonic Pathfinder** is a head mounted ultrasonic mobility device designed for outdoor use in conjunction with either a long cane, dog guide or residual vision. The Sonic Pathfinder

gives the user advance warning of objects which lie within the travel path. The distance and position of a detected object is signalled via the ear pieces using the eight tones of the musical scale. Price: $1695

Key Stakeholders

- who is my main stakeholder for whom this device is being made. He is the main driving force behind what features the project should consist of which are then discussed by both of us.

- My father as he is very good with the mechanical side of things and will be a part of helping me finish this project. He will be assisting me with the planning of the casing for the device and helping me to make it.

  MR as he is our electronics teacher who has a vast knowledge of AVR – Programming and has a considerable amount of knowledge on electronics and electronic jargon and terms. Therefore he is one of my key stakeholders as if I am unsure about how to approach a problem he will be able to assist me through it.

- Other blind people which this device could be used to assist in their day to day transportation. It would do so be increasing their confidence while walking around as they will be a lot less likely to collide with objects and will make their day to day transportation more convenient.

- My grandfather who has agreed to help me with my funding for my project. He has always been interested in electronics and has always supported the helping of people in need. Therefore he has agreed to fund my project and is one of my wider stakeholders in terms of the cost of materials I use for my project.

Wider Community (other stakeholders included)

My wider community includes all those people on the streets, shopping malls, libraries and other places that would travel to. It also includes people like family who live with him as well as other blind people.

One of the main wider community issues is that people around my client are not adversely affected by my device. This means that if they were to by chance make contact with the device or bump into it then if it were to result in a shock or anything of that sort then that would be dangerous for them as well as my client.

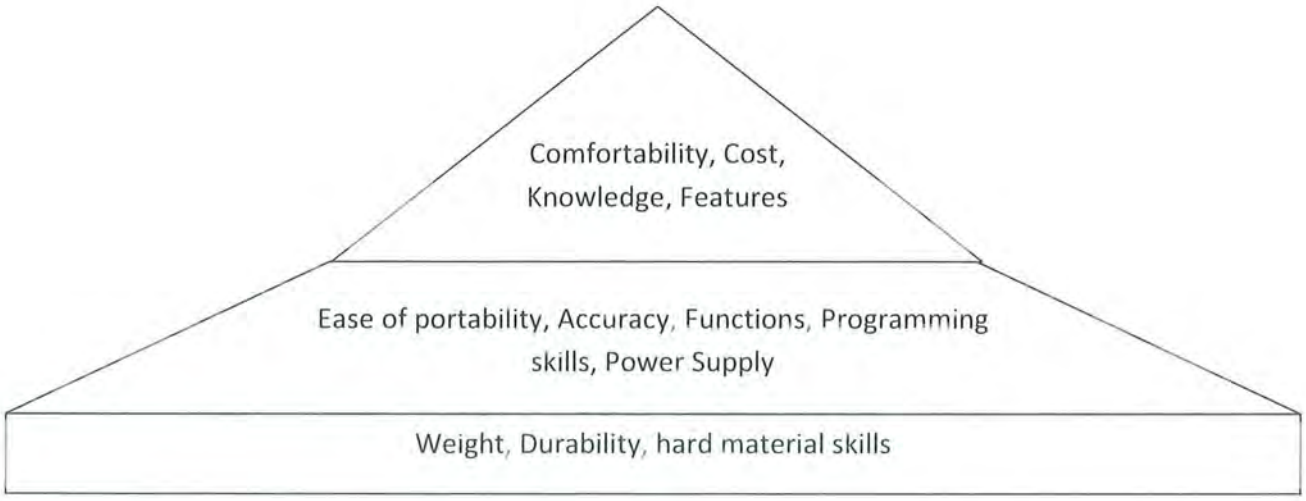
Also people around my client should not be disturbed by the sounding of the peizo or speaker that I use to alert of any objects in his path. Therefore I may have to install a

variable resistor so that the volume is able to me adjusted so people are not disturbed or I could attach the peizo so that the sound is muffled enough not to disturb others.

People around my stakeholder will benefit from such a device as my stakeholder will be able to detect people around him and be careful not to crash into them preventing possible injuries to the wider community.

My device also will affect the wider community as it can be used by other blind people in the community as well as other people with varying levels of visibility impairments to detect and avoid objects at chest and head level. The most common devices such as sticks and dogs are only useful at detecting objects below waist height. This I have found through research and by my client who is completely blind as well as the head of the blind foundation. Therefore a device like the one I am making will greatly appeal to these people and will be able to help them out greatly to lead safer and more confident lives especially while travelling. I will manage contact with the wider community by talking to them about my device and seeing what they think about the effectiveness of it.

Key Factors present, prioritised and justified



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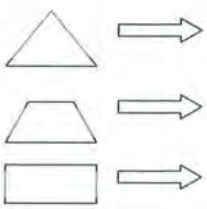


Justification

How comfortable my client is when he puts on the device is critical for me. This is because he will only use the device if it is comfortable for him to put on himself. It must we something that one can wear on for a long period of time without getting uncomfortable as my client will be wearing it for quite a period of time as he likes travelling a lot.

I have justified cost as critical for this project because without the funds to purchase the components and the other electronic devices needed no work will be done no matter what your level of knowledge is or how skilful you are. Since we have just come out of recession it is hard to come by money as people are still cautious about their money therefore costs of my project are very critical especially at this point in time. My grandfather has agreed to fund my project and is happy to fund for the raw materials and equipment used as long as I do not waste any of his money and avoid overspending where possible.

Knowledge is definitely my most critical factor as one might have all the money in the world or the latest level of technology, they will still not be able to accomplish anything if they do not have the knowledge on how to use those components and technology. With me my level of knowledge is low and therefore it is critical that I acquire the amount and level of knowledge that is required for me to complete this project to a satisfying level.

The features of the device are most critical as it's very important for only those features that are required to be included in the device. My client wants a simple yet effective device. This will involve me having to be very careful with the features that I place in as these features cannot be too complicated nor can there be too many features yet the features that do have to be in place have to be necessary yet effective. It is also most critical as other key factors relate to features such as functions. The number of features present will determine the number of functions that the device can perform.

Ease of Portability is an important key factor. This is because it is important for the device to not only be portable but also be easy to move around from one place to another and be easy to transport. It is important for the device to be portable as without this key factor the whole purpose of creating such a device would be defeated. This is because my client requires this device which he is travelling and therefore it is imperative that the device is portable and is easy to be transported.

The functions of the device are an important key factor. The device should be able to function properly and for a long period of time. The functions of the device have to be simple yet effective. There cannot be too many functions as they may over-complicate things for my user therefore it is very important as to which functions I program the device to have. Functions are not critical as these are dependent of the features that I place in the device therefore features are critical as they will determine the functions present on the device.

Accuracy is an important key factor as the device should be accurate enough to warn my user of objects that are in his path. This is very important as if my device is not accurate enough to detect objects in from of the user then the implications on my client will be severe. However this key factor is not critical as even if the device is slightly inaccurate it is fine. If the device detects objects at a distance of 4.1 meters instead of at 4 meters then it is okay as long as the device does detect the object somewhere around the specified range.

Power Supply is an important key factor because without it the device simply would not work. It is critical for the power supply to be small and something that will last long which can keep on providing power to the device over long periods of time. Therefore it is important as it is a significant part of this project where I will have to choose what power supply to use for my project and will take up quite a lot of time.

My programming skill level I have listed as an important key factor. This is because I reckon that most of my time will go into programming the device which will consist of components that I have never used. Therefore it is very important that I am at a good level with my programming. The functions that my device is capable of will all depend on my programming level. This justifies why my programming skill level is listed as important. As I already have a good base in programming my skill level is not critical as I will not struggle with the programming.

Weight is one of my not so important key factors. This is because the device should be light enough for to wear it without straining any part of his body. However the device will be attached to his body and therefore its weight will not be as significant as it will be attached to his waist through a belt or to some other part where he does not have to strain at all.

Durability is one of my not so important key factors. This is because will be used this device in his day to day travel only while walking. He will have the device securely attached to him and therefore in will not be able to fall off, people around him will know that he is blind and therefore the likelihood of people bumping into the device is very low and has a stick as well as the device to warn him of oncoming objects. All these things means that the likelihood of the device colliding is very very low and therefore durability is not a very important key factor.

Even though my hard material skill level will determine the aesthetic appearance of the device and the durability of the device I have listed it down as a not so important key factor. This is because durability is not important and nor is aesthetic appearance important to a certain degree as my client is blind. Also I don't think I will have to be doing so much hard material work as such as all I may have to do is place the device in a box of some sort and attach it to the user somehow. These things will not take that much time therefore justifying me putting hard material skills as a key factor.

Complexities

- Having a blind person as a client
- Size of the device
- Detecting objects based on light level
- Have a warning system that warns user as objects come closer
- Power supply

Having a blind person as a client

My first complexity was having a client that has a disability of being blind. He is completely blind and cannot see anything. The complexity over here was that I could not take for granted a lot of things that I would have normally taken for granted if I were communicating with a client who could see properly. As soon as I decided to solve my client's problem of bumping into objects because of not being able to see, I realised that I would have to change the way I would communicate with my client in some ways. This was quite a straightforward complexity to identify as it is quite obvious that communicating with a person who is blind will have to be slightly different in the fact that there will be some limitations as to what I can and cannot communicate with my client.

I realised that I could not show my client what the device would look like. In the past whenever I have made something for someone, I have shown them the device as I make it and get constant feedback as to how they find it and what changes they would like for me to make. Stakeholders with good vision have been able to tell me things such as how aesthetically pleasing they find the device to be. I have been able to send clients with good vision pictures of my work or things such as surveys for them to complete amongst other things online.

However, having a blind client meant that I was not able to send my client things such as pictures of my device as I was making it, pictures of other things related to my project, surveys and other things through email. I was not able to show him my finished device to know what he thought of it. Therefore, feedback from my client on the aesthetics of my device is limited. One may think that because my client is blind it does not matter what the device looks like as long as it works. However it did matter to my client because he said that he wanted to look good when in front of other people. He did not want to be wearing a device that is very bad to look at and makes him look bad. I did not think of such a thing and was under the impression that aesthetics did not matter as he was blind. Things like these where some things which I thought I knew but actually did not while dealing with my client were a complexity.

The way I explored this complexity was by talking to a friend of mine who works at a blind school. I asked her how she communicated with her students. She told me that she basically did not assume anything related to vision when talking to them. For example, if instructing

them on how to operate a remote she would say something like press the top most button on the left on the emote instead of saying something like press the red button. She advised me to basically be very careful as to how I put things across so that I understand what he actually wants and what his actually needs are and so that I do not offend him. Another way I explored this complexity was by going online and researching the different ways of communicating with the blind. This was not as helpful because it suggested things such as communicating in brail with my client. However this was not practical as I am typing up my journal on the computer. For me to first of all learn brail and then transfer things that I wanted to communicate with my client to brail will be very time consuming. I would not be able to finish project if I choose to communicate in Brail. I also found out that things such as Brail computers are present where the keyboard letters are in Brail. However this will not enable me to communicate my ideas with my client. Therefore I used some other simple yet effective methods to communicate with my client.

An idea that displayed originality was to communicate with my client through the phone. This displays my originality as it is one of the most common means of communication. I would have preferred to have just sent work to my client and communicate through the computer but I decided to use the phone as it enabled me to get an exact idea as to what my client wanted. A method that I applied before communicating with my client was to just write down all the things that I wanted to communicate with him and think about if these would offend him and if I was overlooking anything that a person with good vision would overlook which a blind person may not understand.

Using this method, my knowledge on the fact that I had to be very careful about how I asked my client questions so I don't offend him and that I have to not assume things that I would normally take for granted and my idea of communicating with my client through the phone I synthesised all these things together and called my client through the phone. I was very patient while dealing with him. I asked him to elaborate on everything he said so that I did not miss out on anything. I was very elegant in my manner of speech when communicating with him by communicating clearly and patiently. I did not put my client under any pressure on my client regarding the amount of time we spoke while communicating and I did not mind spending that any amount of time with him on the phone as long as I clearly understood what he was trying to say.

Reflection

The method I used has been quite effective in communicating with my client. This is because I applied it in the many client consultations that I had with my client. Writing down the points I wanted to communicate with my client helped not only to be sensitive to my client and understand what it is he wanted but also helped me to better understand what exactly I wanted to ask him and cleared my speech of any uncertainties. This improved the elegance of the way I communicated with my client by helping me be clearer in my speech. Also the fact that I spoke to my friend (who teaches in the blind school) about how to communicate

with bind people was quite helpful. This is because my client and I were on friendly terms throughout our consultations and interactions which may have been due to me not offending him by being careful in what I asked him. The fact that we were friendly with each other helped me to understand exactly what it was that my client wanted. It also helped me as he felt comfortable enough to suggest to me to do things differently and not agree with some things that I suggested. This helped me to develop the project the way I did and come up with such a successful outcome. For example when I initially suggested programming the device to detect objects at a distance of 2 meters he objected and after discussing for a while we decided to have the distance at which the objects are detected at 2.5 meters. If I had not talked to this friend who taught in the blind school then I may have offended my client as I would not have known to be extra sensitive when talking to him. This would not have made him feel comfortable enough to disagree with me or converse with me properly. This would have resulted in the standard distance an object is detect to be 2 meters and this would have been too close a distance. This is because my client may have crashed into an object even if the object is detected because for him to stop from normal walking pace to a standstill in the space of two meters and taking into account the reaction time for people to realise that they have to do something may just not be enough. Adding 50 cm more to this distance however would ensure that my client has enough time to hear the sound from the peizo, process the fact that he has to stop and stop from a normal walking pace and therefore avoid the abject. Using the phone was quite effective as it was quite impractical to go meet him every time I wanted to discuss something as he lived to far. Therefore by using the phone we could talk for however long we wanted as landline to landline is free and could therefore communicate properly and take our time to understand what each other were trying to communicate.

Have a warning system that warns user as objects come closer

One of the complexities in my project was the fact that my client required the device to inform him of objects that were of different distances away from him. This was identified by me through my consultations with my client. The complexity was to somehow get the device to inform my client of objects that are closer to him and warn him of those devices compared to objects that are further away and have a different warning for objects that are further away. This was a complexity as I did not have enough knowledge to program my device to actually inform the user of how far an object is.

However I did some research and I found out that the Sonic Pathfinder as shown previously in my report helps to inform the user how far an object is by sounding one of eight musical tones via ear phones. It then occurred to me that I too could use different sounds to inform my user of the different distance ranges that the object is present from my device. I liked this idea as it is the simple yet it is effective thus making it quite elegant. I used my previous knowledge on select cases in BASCOM to get my device to carry out the function. Previously I had used select cases to sound an alarm when the alarm time is equal to the set time. Now

I had it use my innovation and creativity to use my previous knowledge to getting the peizo to beep for objects between various distances.

The program where the device detects objects at a constant distance without indicating that the object is getting closer is shown below:

```
'-----------------------------------------------------------------------
' Title Block
' Author  A Pillai
' Date    26 5 11
' File Name  uitrtest5.bas
'-----------------------------------------------------------------------
' Program Description
' Getting the USS to interact with peizo
' Hardware Features
' 128x64 GLCD
' 2 * Ui USS
' 2 * peizo
'-----------------------------------------------------------------------
' Compiler Directives  these tell Bascom things about our hardware
$regfile = "m16DEF.dat"                                    'specify the used micro
$crystal = 8000000                                         'used crystal frequency
$lib "glcdKS108.lib"                                       'library of display routines
'-----------------------------------------------------------------------
' Hardware Setups
' Configure KS0108 GLCD interface
' CE      CSi select     pin15   CE      A.3
' CE2     CS2 select2    pin16   CE2     A.4
' CD      DI             pin4    CD      A.7
'RD       Read           pin5    RD      A.6
'RESET    reset          pin17   R       A.2
'ENABLE   Chip Enable    pin6    En      A.5
Config Graphlcd = 128 * 64sed   Dataport = PORTB   Controlport = PORTD   Ce = 4   Ce2 = 3   Cd = 0   Rd = 1
Reset = 5   Enable = 2
Config PINA.0 = Input
'Hardware Aliases
'-----------------------------------------------------------------------
' Declare Constants
Const Lcd_width = 16                                       'number of characters wide the lcd is
Const Scroll_delay = 250
'-----------------------------------------------------------------------
' Declare Variables
Dim Pulse As Integer
Dim Pulse2 As Integer
Dim Distance As Integer
Dim I As Single
Dim J As Single
```

```
' Initialise Variables
Piezoone Alias PINA 0
Piezotwo Alias PINA 1
Ultr2_t Alias PORTC 2
Ultr2_r Alias PINC 2
Ultr1_t Alias PORTC 3
Ultr1_r Alias PINC 3
'-----------------------------------------------------------------------
' Program starts here
Cls
Setfont Font 8x8

Do
    Config PORTC 2 = Output                          'to transmit USS wave
    Waitms 10
    Set PORTC 2                                      'turn USS on to generate wave
    Waitms 60
    Reset PORTC 2                                    'turn off
    Waitus 50

    Config PINC 2 = Input                            'to recieve reflected wave
    Pulsein Pulse  PINC  2  1                        'transmit data to pin C.2
    I = Pulse
    I = I * 1.724137931
    I = I - 10                                       'make adjustments to raw data read by USS
    Waitms 60
    Reset PORTC 2

    Lcdat 1  1  I                                    'display the modified reading on LCD
    Waitms 100

    Config Ultr2_t = Output                          'to transmit USS wave to 2nd USS
    Waitms 10
    Set Ultr2_t                                      'turn USS on to generate wave
    Waitms 60
    Reset Ultr2_t
    Waitus 50
```

```
Config Ultr2_r = Input                               'to recieve reflected wave
   Pulsein Pulse2  PINC  2  1                        'transmit data to pin C.2
   J = Pulse2
   J = J * 1.724137931
   J = J - 10                                        'make adjustments to raw data read by USS
   Waitms 60
   Reset Ultr2_t

   Lcdat 2  1  J

   If I  30 Then                                     'if dist  30 make sound from Peizo 1 for USS 1
   Sound Piezoone  500  800
   End If

   If J  30 Then                                     'dist  30 make sound from Peizo 2 for USS 2
   Sound Piezotwo  500  800
   End If

Loop

'-----------------------------------------------------------------------
'the font and graphic files must be in the same directory as the bas file
'these lines put the fonts into the program flash
$include "font8x8.font"
```

In this program I have programmed the each of the two USS to sound a different peizo when detecting an object closer than 30 cm. I then solved the complexity on giving the user an indication of objects getting closer to him as he walks towards them or as they get closer to him if he is standing still. I did this using my skills in BASCOM programming, my knowledge on select cases, my past experience in having to deal with a similar idea of getting something to happen at a certain time and my idea of getting the peizo to sound differently as the object gets closer and synthesising all these things together to fulfil my clients need.

I used originality in programming my device to get the peizo to sound with a shorter wavelength as the object gets closer to the device. I had two peizos previously, one for each

```
Select Case J                                        'red USS high frequency
   Case 0 To 10   Sound Piezoone   500   2000        'as object gets closer to to the sensor peizo beeps faster
   Case 11 To 20   Sound Piezoone   1000   2000
   Case 21 To 30   Sound Piezoone   1500   2000
   Case 31 To 40   Sound Piezoone   2000   2000
End Select

Select Case I                                        'blue USS low frequency
  Case 0 To 10   Sound Piezotwo   500   1000         'as object gets closer to to the sensor peizo beeps faster
  Case 11 To 20   Sound Piezotwo   1000   1000
  Case 21 To 30   Sound Piezotwo   1500   1000
  Case 31 To 40   Sound Piezotwo   2000   1000
End Select
```

USS. Therefore if USS1 detected an object then peizo 1 will sound. The same thing applies for the second USS and peizo. Instead of the peizo sounding length decreasing gradually as the distance between the user and the objects gets closer, I got the peizo length to decrease after the objects gets closer than a certain distance. For example if the object got closer than 20 cm I would get the sound length to shorten, if it gets closer than 20 cm I would get the sound length to decrease even more and if closer than 10 cm then I shortened the peizo length even more. Therefore this made it easy for the user to know that objects are getting closer to him as the sound length will decrease as the distance between the user and object gets closer. This displays the elegance in my device in terms of my programming as there are no complexities with this and the detecting of objects as they get closer to my user is quite user friendly as it is easy for my user to understand that as he gets closer the peizo beep length is decreasing. The following bit of program shows all my skills, knowledge and ideas being synthesised and integrated together.

This bit of program shows how I used the select case function for the two ultrasonic sensors (USS) and peizos. As the distance to an object decreases to between 40 and 30 cm, the peizo sounds. When the distance decreases to between 20 and 30 cm, the beep length produced by the peizo, decreases. As the distance length decreases to between 10 and 20 cm the beep length again decreases and when the distance decreases to between 0 and 10 cm the beep length again decreases. Therefore as the distance gaps decrease the beep length produced by the peizo decreases effectively warning the user that he is getting closer to the object or that an incoming object is getting closer to him. This is a simple yet effective bit of programming where I have used my past knowledge along with some innovation and ingenuity to get the device to have this feature therefore showing the elegance of the device.

```
Select Case J                                          red USS high frequency
   Case 0 To 10   Sound Piezoone   500   2000
   Case 11 To 20   Sound Piezoone   1000   2000        as object gets closer to to the sensor peizo beeps faster
   Case 21 To 30   Sound Piezoone   1500   2000
   Case 31 To 40   Sound Piezoone   2000   2000
End Select

Select Case I                                          blue USS low frequency
  Case 0 To 10   Sound Piezotwo   500   1000
  Case 11 To 20   Sound Piezotwo   1000   1000         as object gets closer to to the sensor peizo beeps faster
  Case 21 To 30   Sound Piezotwo   1500   1000
  Case 31 To 40   Sound Piezotwo   2000   1000
End Select
```

The following bit of program below show the final implementation of the select case part of my final program for standard light detection.

```
Standardlightdetection
        Select Case J                                  SRF-005 2 low frequency
          Case 0 To 85   Sound Piezoone   20   2000
          Case 86 To 170   Sound Piezoone   60   2000
          Case 171 To 252   Sound Piezoone   100   2000
        End Select

        Select Case I                                  SRF-005 1 high frequency
          Case 0 To 85   Sound Piezoone   20   1000
          Case 86 To 170   Sound Piezoone   60   1000
          Case 171 To 252   Sound Piezoone   100   1000
        End Select
Return
```

For the final part of my select case program I only changed the numbers whereas the layout has remained the same.

Reflection

I have adequately used my knowledge from last year to get the peizo to make different sounds. I have been quite innovative in being able to apply last year's knowledge to suite the programming requirements so that my device does do what my client requires it to do. It was really good for me to have done research on similar devices made by others. This is because this research helped me to explore the complexity and provide an idea which I used to provide a solution for this complexity. I also kept a log of all the programs that I had written up to date which I had backed up on multiple memory sources at home and at school. This enabled for me to work on any of these programs and play around with the select case program until it actually worked to suite my client s needs whenever I wanted. This helped me optimise the amount of time I spent on programming as I could do it both at home and at school therefore further adding to the elegance feature on my programming for my device. The select cases also reduced the length of my program and optimised the efficiency of the program. It added to the final polish of the program. Instead of having four if, then statements the select case feature allowed me to write up the same programming in less lines and also the program looked a lot clearer and easy to understand.

Detecting objects based on light level

Another complexity that fell under the programming part of my device was where the distance at which an object is detected is based on the light level. This complexity was identified by both my stakeholder and I while we were discussing the progress of my report. This stakeholder consultation is show below.

Stakeholder Consultations

My client and I were discussing about how the project was coming along when the issue of how it is safer to travel during the day compared to at night time came up. My client was of the opinion that travelling at night or when it was nearing darkness was a lot more dangerous compared to in broad daylight as people tend to be a bit more careless as the light fades away into the evening and night. In order to solve this issue I suggested using an LDR, a light dependent resistor to vary the multiple distance ranges to which the peizo will sound to. At night I could make the peizo beep when objects were more far away than in broad daylight. My client was happy for me to go ahead with this modification.

I explored this complexity by first just thinking which component would be able to detect the light level which I could then use to add this function to my device. I straightaway thought of an LDR which is a Light Dependent Resistor which basically detects the light intensity

LDR Testing

Connecting the LDR was not hard. It was a simple case of connecting the positive leg to the pin whereas the other leg to ground. A 470K ohm resistor has to be connected in parallel to the resistor from the pin to VCC.

Test Planning

In order to see if the LDR is working I will write a simple program which will enable the LDR readings to come on the LCD. I will then cover the LCD and this value should change. It's the value changes as different amounts of light falls on the LDR; we can successfully conclude that the LDR works.

LDR Testing Program -1

```
' Title Block
  Author  A Pillai
  Date  8/07/11
  File Name  ldrtesting bas
'-----------------------------------------------------------------
  Program Description
' Testing LDR reading
' Hardware Features
'LDR
'-----------------------------------------------------------------
' Compiler Directives (these tell Bascom things about our hardware)
$regfile = "m16DEF dat"                                     ' specify the used micro
$crystal = 8000000                                          ' used crystal frequency
$lib "glcdKS108 lib"                                        ' library of display routines
'-----------------------------------------------------------------
' Hardware Setups
'Configure KS0108 GLCD interface
'CE       CS1 select      pin15   CE      A 3
'CE2      CS2 select2     pin16   CE2     A 4
'CD       DI              pin4    CD      A 7
'RD       Read            pin5    RD      A 6
'RESET    reset           pin17   R       A 2
 ENABLE   Chip Enable     pin6    En      A 5
Config Graphlcd = 128 * 64sed   Dataport = PORTB   Controlport = PORTD   Ce = 4   Ce2 = 3   Cd = 0   Rd = 1   Reset = 5   Enable = 2
Config PINA 0 = Input
Config ADC = Single   Prescaler = Auto
Config PORTA 2 = Input                                      'ldr
Start ADC
'Hardware Aliases
'-----------------------------------------------------------------
  Declare Constants
Const _off = 0
Const _on = 1
Const Lcd_width = 16                                        ' number of characters wide the lcd is
Const Scroll_delay = 250
'-----------------------------------------------------------------
  Declare Variables
Dim Pulse As Integer
Dim Pulse2 As Integer
Dim Distance As Integer
Dim I As Single
Dim J As Single
Dim Sound_sv As Byte
Dim Lightlevel As Word

  Initialise Variables
Soundsv Alias PIND 7
Piezoone Alias PINA 0
Piezotwo Alias PINA 1
'-----------------------------------------------------------------
Cls
Setfont Font 8x8

Do
   Lightlevel = Getadc 0
   Lcdat 3 , 1 , Lightlevel                                 ' display on LCD

Loop
End
'-----------------------------------------------------------------
' the font and graphic files must be in the same directory as the bas file
' these lines put the fonts into the program flash
$include "font8x8 font"
```

For some reason this program did not work so I checked my LDR connections again and realised that the LDR leg is actually connected VCC and not GND. Also the resistor to be used was not a 470K ohm resistor but a 10K resistor which has to be connected in parallel to the LDR from the MC pin to GND.

I then did another program which is present on the next page where all the errors have been taken care off.

LDR Testing Program -2

```
' Title Block
  Author  A Pillai
  Date    :: 07 11
  File Name  ldrtesting working.bas
 ------------------------------------------------------------
  Program Description
  Testing LDR reading
  Hardware Features
 LDR
 ------------------------------------------------------------
  Compiler Directives  these tell Bascom things about our hardware
$regfile = "m16DEF.dat                                  specify the used micro
$crystal = 8000000                                      used crystal frequency
$lib "glcdKS108.lib                                     library of display routines
 ------------------------------------------------------------
' Hardware Setups
'Configure KS0108 GLCD interface
'CE       CS1 select      pin15   CE      A.3
'CE2      CS2 select2     pin16   CE2     A.4
'CD       DI              pin4    CD      A.7
'RD       Read            pin5    RD      A.6
'RESET    reset           pin17   R       A.2
'ENABLE   Chip Enable     pin6    En      A.5
Config Graphlcd = 128 * 64sed   Dataport = PORTB   Controlport = PORTD   Ce = 4   Ce2 = 3   Cd = 0   Rd = 1   Reset = 5   Enable = 2
Config PINA.0 = Input
Config ADC = Single   Prescaler = Auto   Reference = Avcc
Config PINA.2 = Input                                   ldr
Start ADC
'Hardware Aliases
 ------------------------------------------------------------
  Declare Constants
Const _off = 0
Const _on = 1
Const Lcd_width = 16                                    number of characters wide the lcd is
Const Scroll_delay = 250
 ------------------------------------------------------------
  Declare Variables
Dim Pulse As Integer
Dim Pulse2 As Integer
Dim Distance As Integer
Dim I As Single
Dim J As Single
Dim Sound_sv As Byte
Dim Lightlevel As Word

  Initialise Variables
Soundsv Alias PIND.7
Piezoone Alias PINA.0
Piezotwo Alias PINA.1

 ---------------------
Cls
Setfont Font 8x8

Do
   Lightlevel = Getadc(2)
   Lcdat 3 , 1 , Lightlevel
   Wait 1

Loop
End
'-------- ------------------ ------------------------------
' the font and graphic files must be in the same directory as the .bas file
 these lines put the fonts into the program flash
$include "font8x8.font"
```

The problem in the program was that I had specified getadc as 0 in the previous program. I didn't know we had to specify the pin it was connected to and thought it was zero always because in the past I have always put getadc as zero but that may have probably been because I always had the ldr connected on a pin.0

I had had past knowledge on LDR's as I had used them previously in year 12 where I got LED's to turn on and off depending on the light level. Once I got this LDR working I again just had to use my innovation to get the LDR to this time have the distance at which an object is detected change depending on the light level.

Then I had to get a toggle switch so that I had two settings, one where the distance at which an object is detected is dependent on the light level while the other state is just standard distance measurements for object detection which are independent to anything. Therefore I decided to test the toggle switch.

Toggle Switch Testing Program

```
' Title Block
' Author  A Pallai
' Date  6 07 11
' File Name  switchtest working bas
'-----------------------------------------------------------------
' Program Description
' testing toggle switch using peizo
' Hardware Features
' peizo
' toggle switch
'-----------------------------------------------------------------
' Compiler Directives (these tell Bascom things about our hardware)
$regfile = "m16DEF.dat"                                    ' specify the used micro
$crystal = 8000000                                         ' used crystal frequency
$lib "glcdKS108.lib"                                       ' library of display routines
'-----------------------------------------------------------------
' Hardware Setups
'Configure KS0108 GLCD interface
'CE       CS1 select      pin15   CE      A.3
'CE2      CS2 select2     pin16   CE2     A.4
'CD       DI              pin4    CD      A.7
'RD       Read            pin5    RD      A.6
'RESET    reset           pin17   R       A.2
'ENABLE   Chip Enable     pin6    En      A.5
Config Graphlcd = 128 * 64sed   Dataport = PORTB   Controlport = PORTD   Ce = 4   Ce2 = 3   Cd = 0   Rd = 1   Reset = 5   Enable = 2
Config PINA.0 = Input
'Hardware Aliases
'-----------------------------------------------------------------
' Declare Constants
Const _off = 0
Const _on = 1
Const Lcd_width = 16                                       ' number of characters wide the lcd is
Const Scroll_delay = 250
'-----------------------------------------------------------------
' Declare Variables
Dim Pulse As Integer
Dim Pulse2 As Integer
Dim Distance As Integer
Dim I As Single
Dim J As Single
Dim Sound_sv As Byte

' Initialise Variables
Soundsv Alias PIND.7
Piezoone Alias PINA.0
Piezotwo Alias PINA.1
Ultr2_t Alias PORTC.2
Ultr2_r Alias PINC.2
Ultr1_t Alias PORTC.3
Ultr1_r Alias PINC.3
'-----------------------------------------------------------------
Cls
Setfont Font 8x8

Do

   If Soundsv = _off Then Reset Piezoone                   ' switch is off then turn off peizo

   If Soundsv = _on Then Sound Piezoone , 250 , 700        ' switch is on then turn on peizo

Loop
'-----------------------------------------------------------------
' the font and graphic files must be in the same directory as the bas file
' these lines put the fonts into the program flash
$inclue "font8x8.font"
```

The peizo did turn on and off when I turned the switch on and off respectively as well. This showed the two switch legs that I had chosen to attach my two wires two were the right wires.

Now that the LDR and switch do work separately I integrated the two programs into a main program to get it all to work together. I did a couple of test programs that are present in my journal and finally came up with the final program with the toggle switch and the distances which are dependent on the light level at which object is detected and the user is warned.

Shown below are parts of the main program which directly relate to the distances at which objects are detected being dependent on the light level.

```
' Program starts here      USS - ultrasonic sensor
Cls

Do
 Gosub Readdistance

 If Soundsv = _on Then                          'when switch is on the light level does affect alarm for different distances

     Lightlevel = Getadc(3)                     'Read light level of surrounding environment
     Waitms 200

   If Lightlevel < 700 Then
    Gosub Darklightdetection

   Else
    Gosub Brightlightdetection
   End If

 Else
   Gosub Standardlightdetection                 'light level does not affect alarm for different distances
 End If

Loop
End
```

```
Standardlightdetection
        Select Case J                                          SRF-005 2 low frequency
          Case 0 To 85    Sound Piezoone    20    2000
          Case 86 To 170    Sound Piezoone    60    2000
          Case 171 To 252    Sound Piezoone    100    2000
        End Select

        Select Case I                                          SRF-005 1 high frequency
          Case 0 To 85    Sound Piezoone    20    1000
          Case 86 To 170    Sound Piezoone    60    1000
          Case 171 To 252    Sound Piezoone    100    1000
        End Select
Return

Brightlightdetection
        Select Case J                                          SRF-005 2 low frequency
          Case 0 To 80    Sound Piezoone    20    2000
          Case 81 To 160    Sound Piezoone    60    2000
         Case 161 To 232    Sound Piezoone    100    2000
        End Select

        Select Case I                                          SRF-005 1 high frequency
          Case 0 To 80    Sound Piezoone    20    1000
          Case 81 To 160    Sound Piezoone    60    1000
          Case 161 To 232    Sound Piezoone    100    1000
        End Select
Return

Darklightdetection

        Select Case J                                          SRF-005 2 low frequency
          Case 0 To 90    Sound Piezoone    20    2000
          Case 91 To 180    Sound Piezoone    60    2000
          Case 181 To 272    Sound Piezoone    100    2000
        End Select

        Select Case I                                          SRF-005 1 high frequency
          Case 0 To 90    Sound Piezoone    20    1000
          Case 91 To 180    Sound Piezoone    60    1000
          Case 181 To 272    Sound Piezoone    100    1000
        End Select
Return
```

The numbers after case under select case J and select case I represent distances in centimetres. Therefore one can see that when it is dark the device does detect objects that are further away then when it is bright.

This program works properly. This program shows my originality as I had come up with the idea to use the LDR as a tool to install the function of the device detecting objects at distances which are dependent on the light level. There were a number of methods I used to get this function to work. I first drew up flowcharts and state charts which helped me to planning of how I would go about programming the device. My second method involved the testing of each component separately until each component functioned properly in an independent program. My third method was one of trial and error. I integrated all the programs together and tried to get the device working. However the first time I did it did not work. Therefore I kept on fixing errors and faults with the program until it did work.

I optimised the trialling and working of my device by doing numerous tests – all of which are present in my journal. This added to the elegance of my project as these tests helped make my device reliable in its functioning and elegant in terms of programming.

Reflection

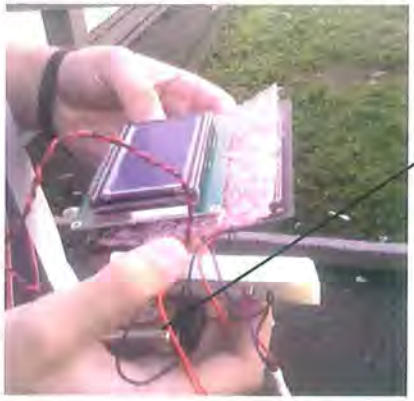
I did not take as much time as I expected to take in trying to solve this complexity. I had already used an LDR before and therefore integrating the LDR, switch, USS and switch was not that hard. This was because up till now I already had some experience in working with USSs and peizos interacting with each other. Therefore integrating the LDR and toggle

switch (which behaves like any other switch) with the other components for the device to meet the stakeholder's need was not that hard. The methods I used in the programming of this of my device to have the function of detecting objects at distances which are dependent on the light level were quite effective. All the methods put together helped in the planning stages. These methods made programming simple because by following all the methods together I got a thorough idea of what it was that I exactly needed to do in terms of programming. For example the method of testing components in individual programs helped to accurately zero in on any problems with the workings of those components as well as knowing what the faults present in the program were and how I would go about fixing them. I have shown originality by using the LDR to detect light level and to use it get this function of light level manipulating the distance at which objects are detected to work. This is original as I have never seen it done before and I thought of it all by myself. I have improved on the elegance of the program by placing most of the program into gosubs and therefore polishing it to make it simple to understand and easy to follow. Another aspect of my device that was innovative was the using of a toggle switch to change states between standard distances when detecting objects and having distances dependent on light level when detecting objects. This showed simplicity as it allows for an easy transmission between the two states. I synthesised my knowledge on LDR's, the methods I mentioned above, my BASCOM programming skills and my idea on using the LDR to manipulate the distance at which objects are detected depending on the light level to creatively get this function to work and meet my stakeholders desires. Overall this was one of the easier complexities to solve even though it seemed like more work had to be done.

Battery Casing

A major complexity in the making of my device is the battery supply. The complexity was getting the device to be powered by a power supply that is portable and light. He wants batteries that are easily found and cheap to be used because these batteries can easily be replaced and are a cheap power source as my client does not want to incur high costs while using the device. This was a complexity because all of these specifications are really hard to find in a battery.

I initially decided to use a 9 volt battery to power the device as the device could comfortably run on 9 volts as well as the battery being small light and relatively cheap.



Here is a picture of my friend and me testing the device in terms of portability. It is being powered by the 9 volt battery and is working properly.

The problem with the 9 – Volt battery was that it did not have a casing. Therefore this battery was not safe as it would be exposed to the elements or may just fall off

and can stop working. In order to solve this problem I decided to look for alternative power sources.

After a bit of research, I decided to use AA batteries to power my device. I was sceptical at first because with the casing I was using only 4 batteries could fit in giving the device a total of 6 volts while the ideal voltage would have been between 9 and 10 volts. However after trialling the device with 6 volts I found that that voltage was sufficient to power up the device. The advantage with this was that it already had its own casing with an inbuilt. The disadvantage from using this casing was that it was quite bulky for my liking.

Stakeholder Consultation

I consulted my stakeholder on this matter and he did not like the AA battery casing idea. He preferred the 9 volt battery idea better as it was a lot more compact and involved using just one cell to power the device instead of 4 cells. But he wanted the switch to be in place as well as a casing to atleast hold the battery cell in place.

After this stakeholder consultation with my main client I had to find a power source that had a casing, a switch and was a single celled power source.

I had however made changes to the casing of the device and instead of being attached to the waist as well as being mounted on a hat, the device was now all going to be present on a hat. Therefore the power source had to change. These changes were made by my thorough a lot of stakeholder consultations, trialling, reflections and research. This **complexity** has been explored in great detail below.

New Portable Power Source

I had changed my power supply source from the 9 volt battery to the casing with three double A batteries. This was because I could turn the circuit on and off with this power supply and while testing it was quite more easy to use as the AA batteries were in abundance and could therefore be replaced easily. In the end I was going to use the 9 volt battery as my final power source because it is a lot more compact then the three AA batteries and relatively lighter. It is also easy to find a

replacement for this 9 volt battery. The only problem with this power source is that it did not have a readymade switch attached to it.

Stakeholder Consultation

While communicating with my stakeholder I showed him the battery I was going to use and he casually asked if it was rechargeable. I told him it was not but asked him if he wanted a rechargeable battery to be used. He said that he would have liked to have had a rechargeable battery but it was not that important. I told him that I would look into it.

Reflection

Looking at the amount of time I have left and the practicality of having a rechargeable battery I concluded that I would have enough time to be able to at least look into installing the rechargeable battery. This idea of a rechargeable battery would be quite efficient as my client will not have to keep on replacing batteries once they run out. It will save him the time of travelling to the store and purchasing extra batteries. Travelling will not be convenient for him because he is blind and therefore a rechargeable battery is a good idea as all that he will have to do is charge it.

Key Factor Reprioritisation - Power Supply

The power supply is now a very significant key factor and I have reprioritised it from important to very important. This is because I just realised that the power supply that I will be providing for my client's device to work will be quite unique and that this will time. Also this power supply does have to be rechargeable and light. To find such a power supply along with providing a casing for it will take me quite a lot of time and will require me to be innovative. Therefore as the power supply has become a significant part of the project I reprioritised it.

Research

According to rechargeable battery makers Uniross, rechargeable batteries have 32 times less impact on the environment and use less than 1/23rd the natural resources of their disposable counterparts. Therefore this information was important as it strengthened the fact of me getting a portable charging source as it is less harmful to the environment as well.

These are the type of AA batteries that I used to power the device for my client and it is the power source that was rejected by my client. This device would be quite efficient and easy to use, especially for my client as he is blind and this device does not involve any complexities. However multiple batteries

are required to power my client's device and multiple AA batteries would be too heavy a power source to carry around in a hat. So I can't use this design.

Here is another interesting rechargeable power source for my device. The rechargeable USB battery is meant to be used for small electronic devices and basically works just like an AA battery except it has to be connected to a USB port. I could simple attach a USB port to my device and charge it using this device. Also this device is quite light weighing only 32 grams. However three together would weigh about 0.1 grams which is not light. Also these would take anywhere between 7 to 15 business days to be shipped over. This would not give me enough time to test it and see if it actually could work.

This rechargeable battery is too big to be used by my client. It is a reliable rechargeable power source. However it is too bulky and impractical for my client to use especially in a hat. Also it gives out 12 volts when my device requires 5 volts to function.

These 9 volt recharable batteries would have been ideal for me, to use as my new power supply. However my board only requires 5 volts to function now. Also the cost to buy this power supply is $40 which is a significant amount.

All of this research especially the bit about the USB batteries inspired me to think of out of the box solutions for the power source for the device. It resulted in me starting to think about using other non-conventional power supplies as all the conventional ones had a variety of problems like being too heavy, providing too much voltage or not being practical in terms of usage. While browsing through the internet I suddenly thought of using a mobile phone battery as my power source as it is both rechargeable and light.

Using the Nokia Battery

The very fact of using a mobile phone battery was quite unthinkable for me and a thousand possible problems with using a nokia battery as a power source came up in my head starting with the fact that I had absolutely no idea how the battery worked except for the fact that it was used to charge my phone.

Test Planning - I don't know if I am even going to be using the nokia battery, but if I am to be using it then I will be testing it by treating it as a normal power source. By this I mean I will locate the negative and positive terminal and connect these via wires to a component such as an Led to see if it works. I will be applying a method called the touch test where I will connect the led to the power source for a second or two just to see if it works. By doing this I am ensuring that the component does not stop working due to being exposed to high voltages for a period of time.

However I still experimented with the battery (BL-5F) just to get a feeling as to how it worked and realised that it was not that complicated. I continued testing the battery after finding out that my client did have a nokia phone. He could use both his mobile phone and object detecting device at the same time as he will have two nokia batteries and not just one. I will be providing him with the extra battery and the charger for it. Also a phone battery would be desirable because it is quite light weight.

So I started my testing the nokia battery provided to me by one of my other stakeholders.

Here is what the nokia battery that I started testing looked like. The first thing I did was to identify the positive and negative terminals of the battery as shown on the cover.

Negative terminal

Positive Terminal

This helped me determine which one of the three sockets was positive, negative, and neutral.

Sockets

I placed an LED into this rechargeable battery to see if it worked. I was just sceptical of it working simply because of the fact that I had never thought of phone batteries as a power source before. The LED much to my delight turned on.

This is the charger that is used to charge this nokia battery up. It is quite simple to use and my client can easily use it in spite of him being blind. The red light signaling that the battery is charging.

One problem that I faced however was making a casing for this battery. I do not have such a high level of hard material skills that I am able to make a casing from scratch for the battery.

Stakeholder Consultation

I spoke to my client and informed him that I would be able to add in a rechargeable battery and that battery was a nokia phone battery. He informed me that he was quite glad that I was able to add in this extra feature especially considering the fact that it was not part of his initial specifications. He also suggested using the battery that his mobile phone runs on. He said that if I could use the same battery it would be useful as if one his phone battery he can use the battery in the device to get it to function if in an emergency and vice versa. I expected him to have the same battery as I was using currently but decided to look into which battery he exactly had. To my shock I found out it was not the BL-5F but the BL-5C.

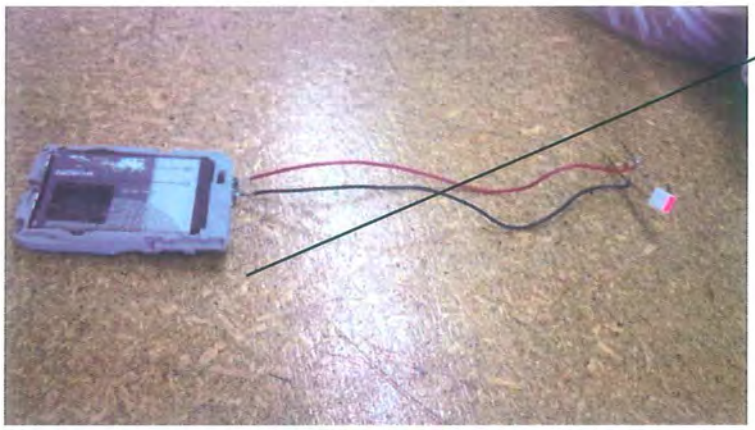
BL-5C

The difference between the two batteries was only in size. They both provide the same voltage of 3.7 volts and similar levels of current. Another barrier to using this battery is that it does not have any sockets to stick the wires into. It only has flat ends like this.

There were also terminal markings on this battery which helped to differentiate which of the flat sides was positive, negative and neutral.

I was still at a loss as to how to make a casing for this battery when I realised a friend of mine had two old nokia phones which did not work anymore each which were compatible with the BL-5C. Both therefore had the casing for the BL-5C I decided to cut up the phone until just the casing was left. Therefore I did and the casing came out perfectly. I was still at a loss as to how I was going to connect the flat sides to the positive and negative terminal of the device to get it to work. Again the answer to this dilemma I found in the phone. A small piece connected to the power supply in the phone had three copper plates sticking out. I stuck that object to the casing in such a way that when the battery was placed into the casing the flat sides would be pressing into the copper plates which was attached from behind by wires to the device.

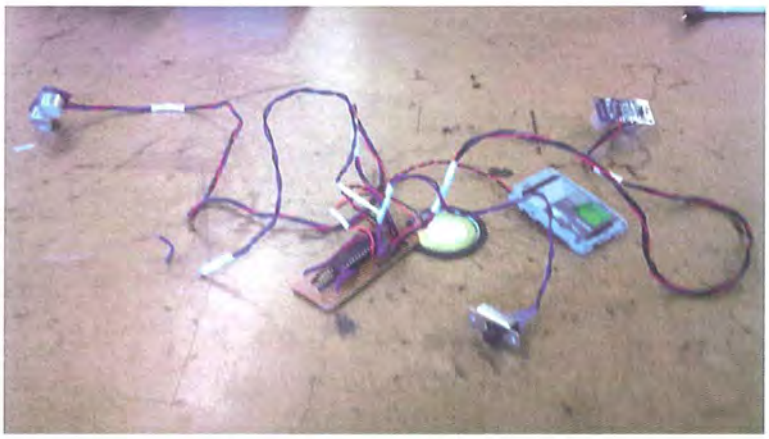
This is the BL-5C in the casing that I took out from one of the other mobile phones. The arrow shows us the copper plates where the flat of the battery are pressing into.



Another angle showing where the flat of battery pressing into and how wiring is connected to copper plates from the back and are connected to an LED at this instance

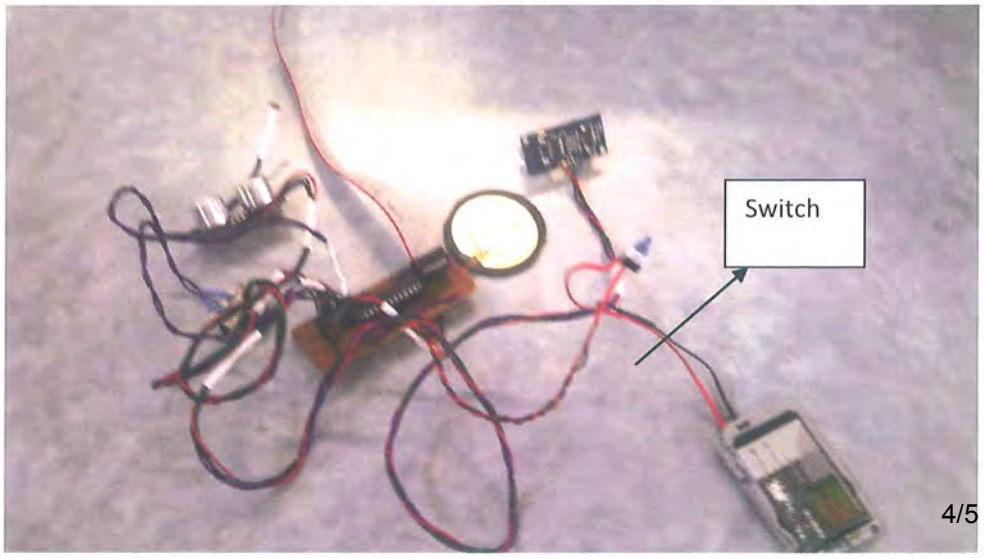
This was the big moment of truth where I would find out whether my design worked or not and it did! The LED turned on. Therefore I attached it to my device.

In this picture I was deciding as to where I would connect this battery thorough to my device.



At this stage I have finally connected the battery to the circuit board. It was a moment of anticipation and nervousness as to whether the device would work or not. However my fears were subdued when the sweet sound of the peizo confirmed that the device was working as the USS had detected an object that was closer than the minimum safe distance specified in my program.

I wanted to connect a small switch so it would not protrude and poke into my client's head making the device



uncomfortable. I connected the switch so that the two red wires were connected to two legs which were connected when switch was pressed and not connected when switch not pressed. Here is what the final device looks like without being in a casing

In terms of elegance, the power supply that I have chosen to power my device is quite elegant in a number of ways. This device is quite elegant in terms of optimisation where I had trialled tested a lot of batteries and after rejecting a number of power supplies due to them not meeting some of my clients requirements I finally chose the perfect power supply which did meet all my clients requirements. The power supply has everything that my client wants and is optimised as it has everything required within its specifications. The power supply is also quite simple to operate and therefore elegant in that respect. All one has to do is place the battery in the battery casing that present on top of the hat and press the push button switch to turn on the device. And to charge the device one simply has to place the nokia battery in a charger or my client, can charge it through his mobile phone. The power supply that I have used does reflect elegance due to the ingenuity behind using such a power supply. I have never seen a nokia battery being used to charge anything else but nokia phones and therefore for me to think out of the box and use a nokia battery as the power supply is quite innovative. Also the casing that I made for the battery is an example of elegance as it gives the device quite a polished look. This polished look results from there being a proper casing present, a casing which actually looks aesthetically pleasing and looks part of the device.

Using this power supply does represent originality because I thought of using this power supply all by myself and did not get this idea from anyone else. All the research carried out it mine as well as all the tests that I did. I did all these things based on m own merit and did not get any help from other for it therefore making it a very original aspect of my project. Using a Nokia Battery is quite unconventional to be used as a power supply for any other device apart from a nokia phone but I have used it as it did meet the needs of my client and it did power my device properly and this makes my power supply meet the criteria for originality.

Reflection

This stage of the production process of my device is a vital one as the battery supply is one of the main components of the device. Without it the device is completely useless. I took as much time as I had put aside for the figuring out of the power supply to be used and actually making the casing and everything else for it. The thing that helped me the most in choosing the nokia battery as my power supply was my research. The bit of research about USB rechargeable batteries made by Philip amongst many other companies especially encouraged me to think out of the box. This bit of research helped me realise that there are so many other power supplies and that one should not only look at conventional power sources to power their devices. Because of this, I thought out of the box, displayed

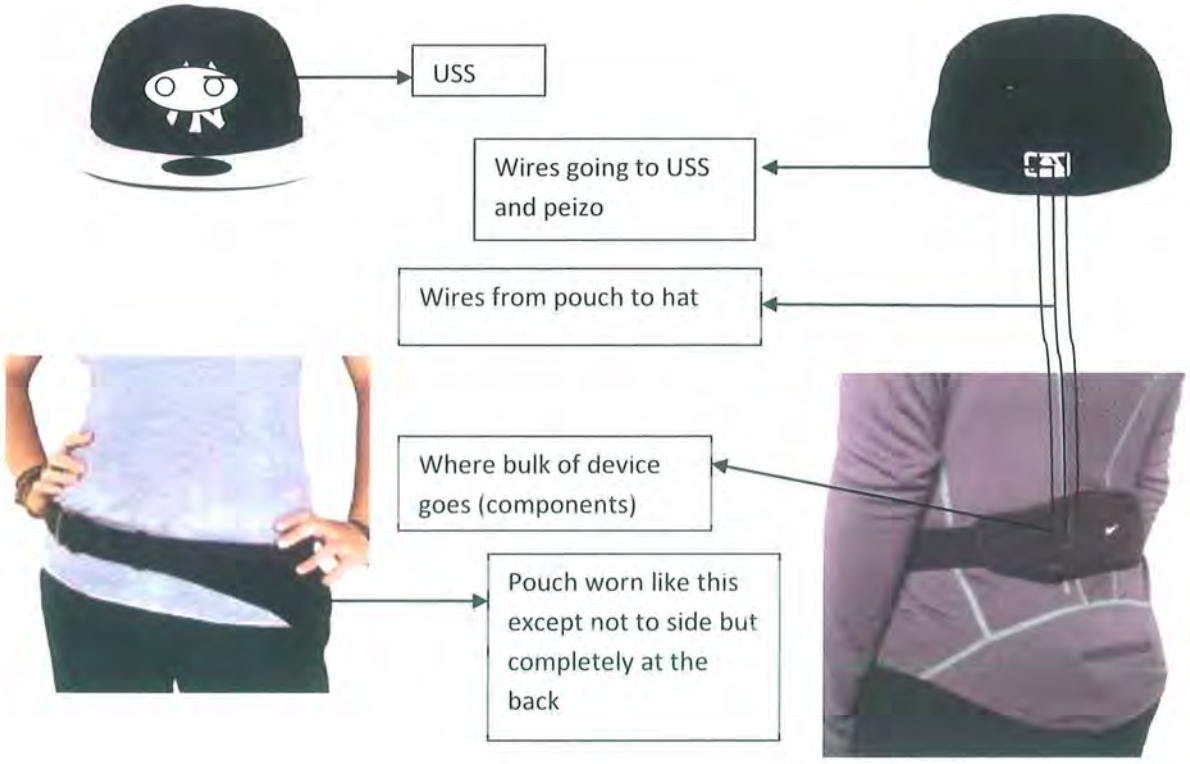
originality and creativity and used the Nokia phone as the power supply. There are a number of things that I have integrated here in order for this stage of my device to successfully have been made. I did not have any knowledge on batteries prior to this project apart from a very basic level that most other people have. However I gained a lot of knowledge on the different types of batteries available in the market and how most batteries function. I had to synthesise this newly earned knowledge among with my hard material skills in making the casing for the battery source, my innovative ideas on the different power sources that could have been used to power the device and my trial and error methods which helped me to zero in on what would best suite my client. This allowed for the battery casing to have been made as well as the device being powered by a nokia battery power source i.e., the BL – 5Cas that is the battery he uses for his mobile phone. This part of my device didresemble a significant amount of elegance and innovation in a number of ways as discussed previously before the reflection.

Compact/Easily Portable Casing

A major complexity identified is the size of the device. This was one of the most significant complexities faced in the production of my device and took up quite a lot of time in solving this complexity. The device could not be too big as it would have been very inconvenient to carry around. The casing had to be both portable and compact. By compact it should be small where everything fits within a small space and by portable it means that the device should be easy to carry around and must be comfortable enough for the user. This is because if the device is not comfortable then the user will not wear it therefore not making the device portable as it is just too uncomfortable to be portable properly.

Here is the initial casing that I came up with based on my client's initial specificaions

Front view Back view



However my stakeholder was not too pleased by this design as can be seen from the stakeholder consultation below:

I consulted my main stakeholder, showing him the fundamental case design around which the device was going to be placed into and asked him for his opinion on it. was not too happy with it. He was not too happy because he did not like the idea of wearing two accessories for this device. He wanted the whole device to consist of just one accessory as its casing. He either wanted a belt or a hat. This was because he told me that it was quite impractical to wear and remove a belt and a hat everyday together and to constantly make sure that the wires connecting the two accessories were not damaged. He also told me that he did not want the device to be 4 kilograms as that was too much. He wanted the device to be less than 2 kilograms.

layout for my casing rather than going into the specifics and details only to find out that my client didn't like it. That would have resulted in a major loss of time.

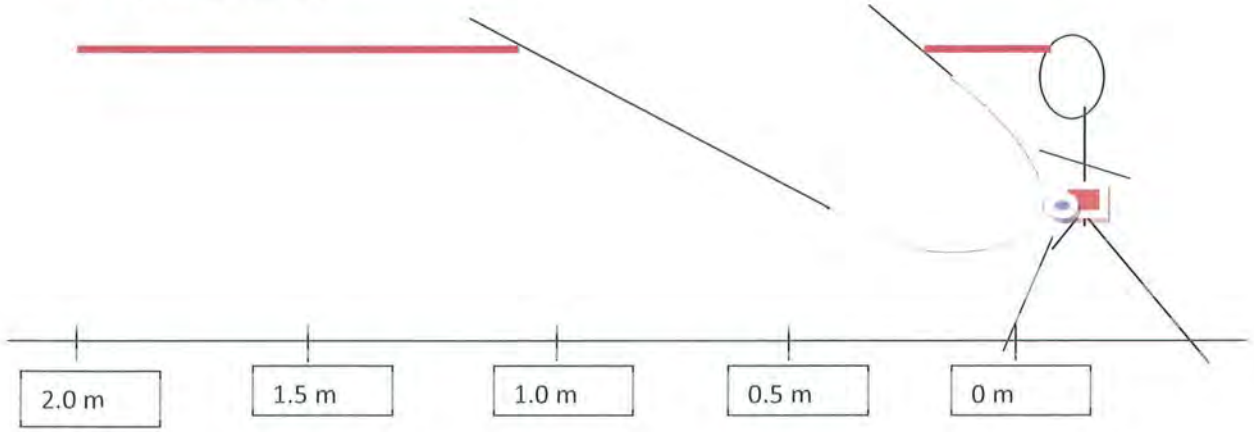
From now on I started to fully explore the complexity of size and portability being an issue. I started to evaluate the complexity by evaluating the advantages and disadvantages of using the hat as a casing compared to using the waist pouch/belt.

Advantages:

Both the USS's can point out relatively parallel to the ground. One will point out straight ahead in front of my client and will not have to be adjusted in terms of angle. The second USS will have to point slightly downward by an angle of about 8 degrees in order to be as accurate as possible in detecting objects at chest level. However with the waist band due to the large angles that the USSs will have to be turned to face upward, they will not be able to detect all objects within 2.5 meter range in front of the client. This is illustrated from the diagram below.

General idea of ineffective use of USS on waist

Diagram not to scale



Therefore we can see that due to having to be turned upwards by a large angle the USS will not detect objects on the red line. And will only be able to detect objects at certain places in front of the person's head.

Another advantage would be that the device would completely meet the compact requirement that wanted if the whole thing could fit in a hat compared to its current state.

Also a hat would weigh a lot less with everything on it instead of a waist and head device attachment.

Disadvantages:

It will be difficult to fit the current circuit board inside a hat. Infact it won't be possible to do so. Take more time to finish project.

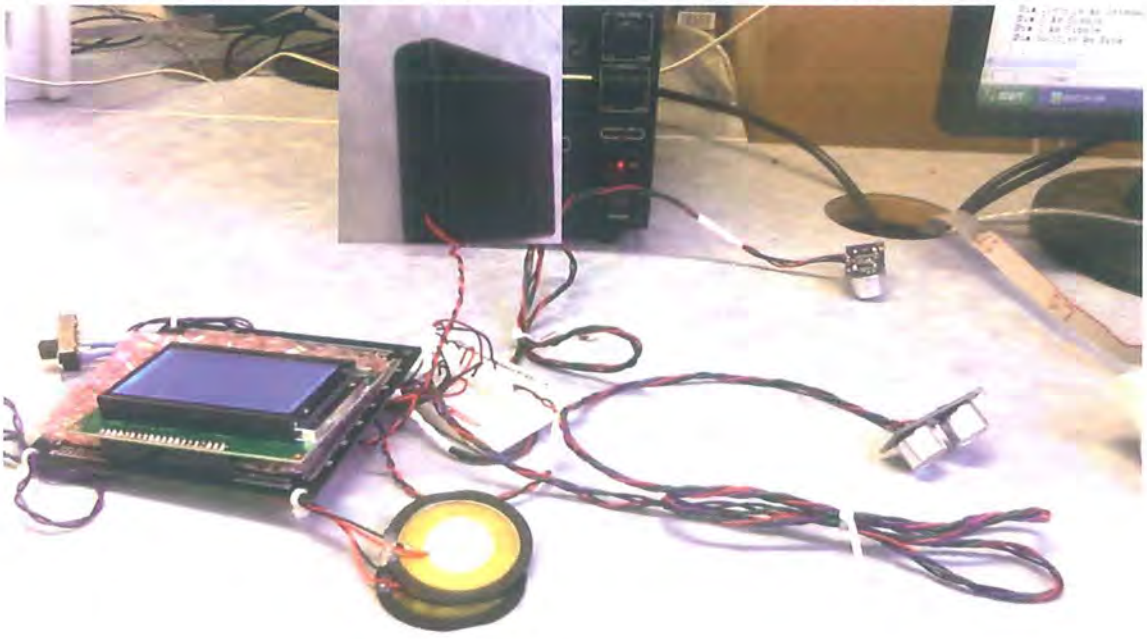
It may be a little more uncomfortable for my client if the device was inside a hat.

From my comparisons of using the hat compared to using the waist pouch I have concluded that the best casing to be used is the hat. It will allow for a more compact casing and will be a lot simpler to use.

Modifications to make the Circuit Board Compact

Therefore I immediately started working on the hat casing. By working on it I identified that the current device was much too big and all the extra unnecessary bits would have to come out. I informed about it being in a hat and he was fine with the idea.

Out of this entire circuit there were quite a number of things that I could do without:



Firstly I could do without the LCD. Now that I have my calculations for the USSs right I don't need to see the distance displayed. My client is blind and he will have no use for those readings as well. All he will be concerned with will be the peizo sounding and warnings him of objects in his path. So the LCD can be removed.

I have no need for such a large board. At the end of everything all I need are about 6 main components and these do not require so much space to be connected. So a smaller board is going to com into use.

Thirdly the MC that I am using is not needed. This is because I need about a maximum of about 10 pins to connect all my components whereas my current MC has 40.

Another thing that is really not required is the situation of two peizos. One peizo can help my client distinguish as to where the object is. If the beep is of a low frequency then the object is at chest height and if it beeps with a high frequency then object is at head height.

The power supply had to be reduced from a 4 battery pack to a 3 battery case. This was obviously lighter and smaller.

I also needed to get rid of the breadboard and actually connect all my components directly to the circuit board.

I can reduce the length of the wiring through which I have connected my components to the board. This is because they were quite long because they had to run from the waist to the head as well as I made them extra long as it makes it easier to test with initially. But now initial tests were over.

By now I had explored the complexity in great detail and had identified all the things that I would have to do in order to make my device more compact and I have justified why those things are being done.

The following pages will give you an insight as to all that I did to reduce the size of the device in order to make it as compact as possible and therefore making it as comfortable and portable as possible.

New circuit board

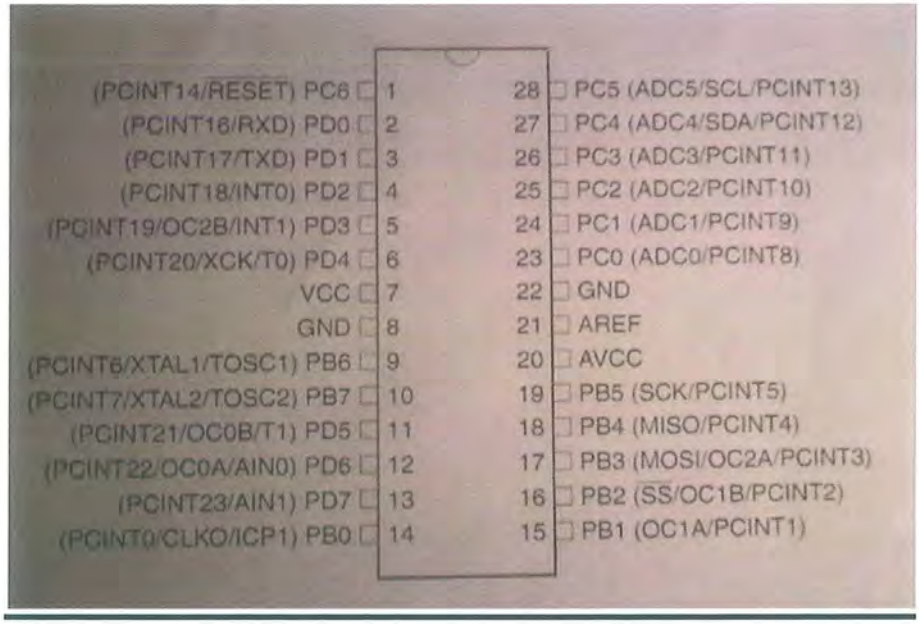
I changed my MC to the M48. This MC's speed was similar to my old MC in many ways. The crystal frequencies matched. Here is the size of my new circuit board. It is significantly smaller and so is the MC.

I powered the MC using 3 1.5 volt batteries and started to program it to see how much of my previous program it would allow for me to store inside the MC. I knew I would have to compromise on my old program's length as one of my other stakeholder's had informed me that this new MC has a smaller storage memory space

Stakeholder Consultation

I consulted my stakeholder about removing the moderate light detection option in the program. My stakeholder agreed with me that it should be removed and told me that he had never specified it. This was because as we both agreed it was quite similar to standard light detection which my stakeholder could switch to through the push of the switch.

New MC (M48) layout



This layout helped me to figure out which pins get connected to what and what pins I can connect my different components and hardware to.

These steps show me exploring the complexity of the issue. I realised that because I was reducing the size of the casing and therefore the hardware, I would also need to reduce the size of my program due to using a smaller Micro-Controller. This resulted in my program being polished to a certain degree as I had to go through it and get rid of all the unnecessary things that were present in it and make it as compact as possible. This polishing of my program bought out the elegance in the programming of the device due to everything being set out so well.

I now set out to actually placing the device within the hat. I did a lot of planning before I went to this step which can be seen in my journal. I had to also change the hat casing that I was using. This should have but did not hinder the progress of the making of my casing.

I was going to use the hat shown below:

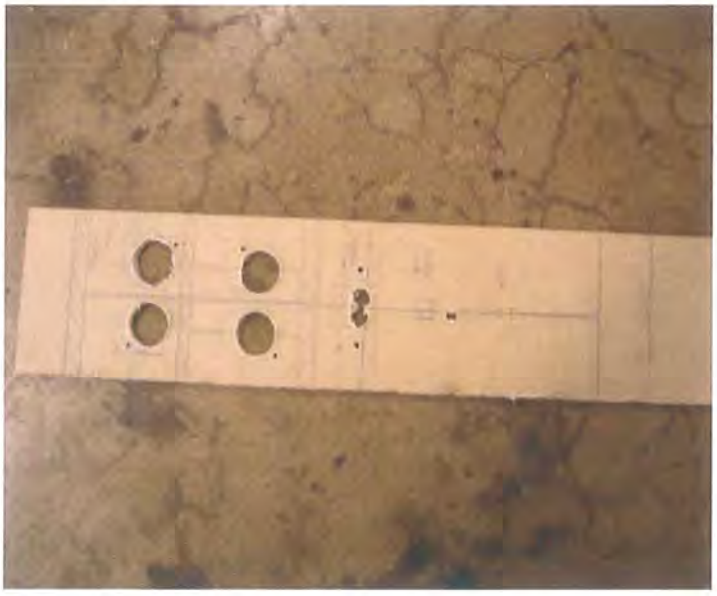
The first thing that I did was to further reduced the size of the board. This involved the removal of the programming cable connector. This meant that my final program had to be completed with no faults , be working and compiled onto the MC. I spent a fair bit of time making sure that the final program was indeed fool proof and that every aspect of it worked. Then after much testing to make sure that the final program worked I chopped of the programming connector and unsoldered all the wires that were connected to it. I kept on reducing the size of the board until it could fit inside the inside of the hat as shown

Then, due to a number of reasons I realized that I would not be able to use this hat. The first reason was that when I did place the MC inside the hat along with the battery the hat became uncomfortable to wear. This was because the battery casing kept on sticking out so that it rubs against the users head which makes this hat extremely uncomfortable to wear. This goes against my client's specifications. Also the battery keeps of falling out of its casing.

Even with the hat's covering placed over the battery casing, the casing could still be felt and the hat was quite

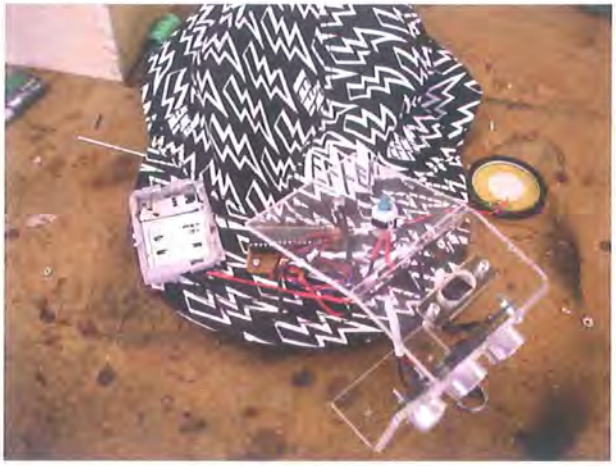
Also the hat did not belong to me. It was my friend's hat. He had lent it to me to plan my casing because he was under the impression that I did not have a hat. However I was under the impression that he had lent it to me for me to. After this misunderstanding was cleared I realized I needed to use another hat.

I therefore decided to use another hat, a hat with a flat covering in the front. This is because after much thought I realised that by placing components on the inside of the hat I would be restricting my client in terms of comfortability and therefore not make the device completely portable as it may just be too uncomfortable to wear the device. I had to therefore place all the components on the outside of the hat, on the hard covering which is meant to shade us. I could not place the battery casing or the board on the soft material which one places around their head as they will have to be screwed on to the material which will again prod into the users head making it uncomfortable for the user to wear. I therefore decided to start the casing on the new hat shown in the following pages.



Once I drew up the measurements of the acrylic casing on paper I transferred these measurements onto the actual acrylic piece. The acrylic has a covering on top on which I drew up the measurements. I had to be very careful doing this as I had to make sure that the outlines of all m components that I did draw up were all parallel to each other so that when I set out to cut the acrylic piece the casing would look aesthetically pleasing as the casing and components would be uniform in relation to everything else.

The next step was to actually drill all the holes on the actual acrylic which was to be the casing. I drilled out all the holes for the USSs, switches, LDR and for all the screws. I needed to do this before I started to bend the acrylic into the shape required.

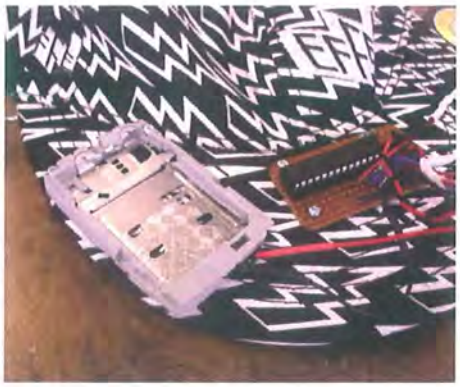


I then started bending the acrylic to resemble the cardboard mock up casing that I had designed previously. Bending the acrylic took very little time and was quite easy to do. The only tricky thing with bending the acrylic is that it needs to be done quickly and once you bend the acrylic you cannot undo what you have done (I came to know all of this from my testing when I bended unwanted bits of acrylic before I started on the actual casing).

Planning – I was not sure how all the components would be attached onto the hard covering of the hat. I thought about using hot glue but I did not want to do so as it may destroy the MC or other components. I thought of using screws but could not use it for things such as the peizo. I also was not sure where on the hard covering I would be attaching all the hardware to.

Planning – After putting much thought into it I decided to place the board in the center behind the casing. This is because it is the most important part of the hardware as it contains the MC which controls how everything works and it connects all the components together. II decided to place the battery casing on the right side of the acrylic casing and the peizo on the left side. The peizo is not being connected on the inside of the hat as it would be uncomfortable for the user as it will protrude into his or her head. Also I do not want to connect it to the soft covering of the hat as it keeps on moving and this may result in the peizo coming off. I therefore decided to connect it to the hard bit of the hat. It would also look better being connected on the hard covering of the hat as the device would look more uniform.

Planning – I decided to use both hot glue and nuts and screws to attach the hardware to the hat. For the battery casing, board and the acrylic casing I decided to use screws as these are a secure means of attaching these pieces of hardware to the hat and there is space on these pieces of hardware to drill screws through without damaging the hardware. I could not attach the peizo using screws as that would damage the peizo. I therefore decided to use the hot glue gun for the peizo.



The next step was attaching all the hardware to the hat. I attached the battery casing to the right side of the hard covering of the hat via screws. I then attached the board along with the MC in the center on the hat.

Connection of the peizo on the left side of the hat

I connected the acrylic casing to the hat using screws as shown here. The casing was quite sturdy alongside the batery casing peizo the board. As can be seen from the picture the board is directly under the casing and is the most portected out of all the hardware present.

Here you can see how all the components are connected to the acrylic casing. The two USSs are both screwed on along with the toggle (black) switch on the top of the acrylic casing. The push button switch (blue) has been hot glued on the acrylic casing on the top behind the toggle switch. The LDR is behind the push button switch and cannot be screwed on or hot glues to the acrylic as these might damage it. However it is naturally very firmly attached to the acrylic.

Through the extensive amount of ongoing planning, stakeholder consultations, evaluations and other methods, the complexity of the casing needing to be compact and portable has been thoroughly described and explored. All the extra planning, stakeholder consultations and other sorts of planning and reviews are present in the journal. Please refer to it.

There are many cases of elegance and originality in making the device portable and compact. The first case of originality was when I used my innovativeness to come up with using the hat as a casing. From all the research I had done on similar devices created by other people I found only one device that remotely resembled my device but it did not have a hat as a casing. There is no device which helps blind people detect objects in front of them that has a hat as it casing. Therefore using my innovation I created a device with a hat as the casing which showed originality on my part.

Removing all those extra components showed elegance as I made the device simpler but more effective and user friendly by removing all those components. Removing the unnecessary components like the peizo for instance also helps to make my device look more aesthetically pleasing and polished. I also removed all the unnecessary bits of programming. By doing this I made the program a lot simpler to understand and follow. All these things add to the elegance of my device.

The making of the battery casing and attaching it to the hat as shown again adds to the aesthetics of the device. The colour of the battery casing of grey looks really nice when stuck on the black and white background of the hat. The nokia battery provided 3.7 volts to the device when it can take up to 5 volts. Therefore the optimisation of the device would have improved due to the removal of all the unnecessary components. This would have reduced the power requirements of the device allowing for more power to be distributed to the other components allowing them to function efficiently.

I have shown many instances of elegance in my casing. There is simplicity in my casing as all it constitutes of is a hat with the necessary components on top of it for the device to work. I have taken into account that my client is blind and have therefore focused greatly on the simplicity of the device. All my client has to do is press a button turn the device on and off, toggle a button for the two different states and place the nokia battery in the casing on the attached on the top of the hat. The device is not required to be seen to be operated. Therefore my device is quite elegant in its simplicity.

Another aspect which added to the aesthetics of my device was the reduction of the length of wiring which connects the components to the MC. I did this to ensure that no extra lengths of wiring protruded from the hat. This involved me having to cut off the extra lengths of wiring and then re-solder those wires. This made the device look more polished adding to the elegance of the device. The decreasing of wire lengths added to the aesthetics of the device as in meant that no extra wiring will be hanging out of the hat. This is quite a simple thing to do but it goes a long way in giving the device a more polished look.

I decided to use a peizo instead of a speaker as my sounding device because I peizo is a lot thinner than a speaker and therefore will not stand out from the device as much as a speaker might, giving the device a more aesthetic appearance. Also I chose to use the peizo over the speaker as the peizo is definitely much lighter than the speaker. Using the peizo helped me keep the weight below 2 kgs which may have been exceeded if a speaker were to be used. Also the peizo can produce its own tones depending on how you program it compared to a speaker which will only play other soundtracks that need to be installed or played. The peizo also produced a soft sound in terms of amplitude which will suit my client as the peizo will be located very close to his ear. However it has to be loud enough hear it and the peizo is loud enough for that. Therefore I used a peizo instead of a speaker.

Critical Reflection

Reducing the size of the device in order to make it more compact and portable took a significant amount of time. This part of the production process was not necessarily the most time consuming but it was definitely the most challenging. This was because it involved me having to do a lot of hard materials as well as even more programming. With the hard materials, some of the things such as bending of acrylic I already had some experience in doing it last year but some of the things I had practically no experience in such as making the battery casing for the battery or attaching the components onto my hat. These aspects of the hard materials were quite challenging and they involved me having to be very careful with the cutting up of things such as the battery casing and this took up a significant amount of my time. I had to do a lot more programming once I decided to reduce the size as I used a smaller Micro-Controller, the M48 (MC). This meant that I had to configure all my components to suite this new MC and this took up quite a lot of time. I also had to cut up a new, smaller board and re-soldered all the components onto that board which took up a lot more time. I also had to reduce the length of all the wires that connect the components to the MC. This resulted in a lot of time going into this process. However the benefit of reducing the wire lengths for the device to look better far outweighs the cost which is represented by the time spent on reducing the length of the wires.

I had to integrate both my hard material and programming skills to get this final stage of making the device finished. Both were required for the outcome to be successful. To reduce the hardware sizes I did need to know the programming to program the smaller MC. I had to synthesise a range of ideas such as how I was going to connect the components to the hat, the shape of the acrylic covering amongst others, knowledge on how to program the M48, how much time to leave the acrylic on the heating device which is used to bend it amongst others, skills of how to properly solder components to the board, shaping the acrylic to a sturdy shape, drilling holes into the hat for screws amongst others and methods involving the tinning of wires before soldering them amongst other methods to make the device more compact and comfortable and therefore easily portable.

Justification of Outcome

My outcome does meet the basic need of detecting objects in front of my client and warning him of those objects. It is does meet most of my client's specifications such as:

My device does fulfil almost all of my clients specifications and functions properly. It is **powered by a single battery (nokia BL-5C preferably)**. This did take me some time but it was done and now it does meet my client's want of the power supply being rechargeable and light and easily replaceable. The whole device does **not weigh more than 2 kilograms** therefore not making it too inconvenient to carry around. I did this by reducing the size of my device to the best of my ability and using the smallest components possible.

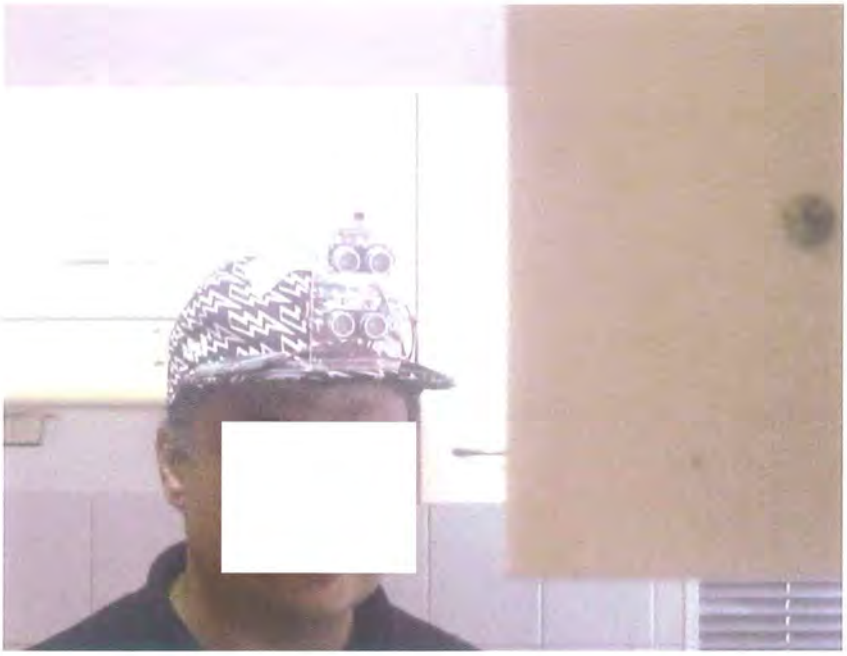
The device is **attached through a hat** that people would wear normally. I did this by screwing and hot gluing the hardware onto the hat. The hardest bit was drilling the holes accurately on the hat but I did a good job of it. The device is as **simple** as possible as there are only two basic functions for my client to carry out and these only involve the turning on and off of a switch.

The device is **able to detect objects and warn him** in some manner (preferably through producing a sound) that there is an obstacle present in his path (at **head/chest** height). The device does this quite efficiently. The device does **detect objects** at a distance of **2.5 meters** as well. As the object gets closer to the user, the sound length produced by the peizo, decreases. This helps users determine approximately how far an object is from them as the beep length will indicate this.

The device does **have two settings:** one where the peizo will beep for fixed distances depending on where the object is and the other where the light level will determine when the peizo beeps for an object that is the same distance apart. The device does have a switch to turn the device on and off and both its switches are to be on the outside of the hat. The USSs sensors on the device are also quite small and are therefore less susceptible to damage.

Fitness for Purpose - The device is fit for its purpose as it does do what it is supposed to do. It does detect objects in front of the user via two USSs, one for objects at head height and the other at chest level. The device warns the user of these objects present on front of him by making a sound through a sounding device called a peizo. The device is present on the front of the hat and therefore where ever the user walks then that will be the direction in which is head is turned and therefore the area that the device will detect objects if any are present. The device does detect objects no matter the material of the object or its shape.

It basically meets all of my client's specifications and does meet the needs of my client.



USS does detect objects like open cabinet doors at head height

(My family testing my device)

Here the car is at chest height and the high pitch sound is sounded showing that the lower USS is detecting an object therefore showing that the lower USS does fulfill its function of detecting objects at chest height.

This testing showed that both USS's are working as both objects at head height (kitchen cabinet door) and at chest height (a part of the car was at chest height are being detected by the device and the user is being warned of these objects. These measurements were accurate as when the toggle switch is switched to the left side then the peizo will make a sound (of long duration) when there is an abject closer than 250 meters, the duration of that sound will decrease by half when the object is closer than 170 meters and finally the duration of that sound will again decrease half when the object is closer than 85 meters.

When the lighting is dark/dim - for objects:

Between 180 and 270 cm – peizo beeps with a long sound length.

For distances between 90 and 180 cm – the peizo beeps and its sound length decreases by half.

For distances between 0 and 90 cm the peizo beeps and its sound length decreases by half again.

Here my dad is looking at the same object at a distance of 2.6 meters. The environment is a lot darker than what it looks like in the picture and USS did detect the object

When the lighting is bright - for objects:

Between 160 and 230 cm – peizo beeps with a long sound length.

For distances between 80 and 160 cm – the peizo beeps and its sound length decreases by half.

For distances between 0 and 80 cm the peizo beeps and its sound length decreases by half again.

I then drew the curtains and exposed the device to light. My dad stood at the same distance of 2.6 meters and the device did not detect the object. I did this when the device was on the light detecting mode where objects are detected based on the light level. And the light did affect the devices ability to detect the object the way my client and I wanted it to happen where when it is dark it will detect further off objects then when it is bright. This justifies that the option where detecting distances for objects where it should be dependent on the light level does work.

When I am far away from the object, a overhanging tree branch at head height the peizo did beep with long sound lengths. And when I got closer as shown below it sounded shorter sound lengths. This showed that the device does indeed work to warn the user as to whether the object in front of him is far away or close by.

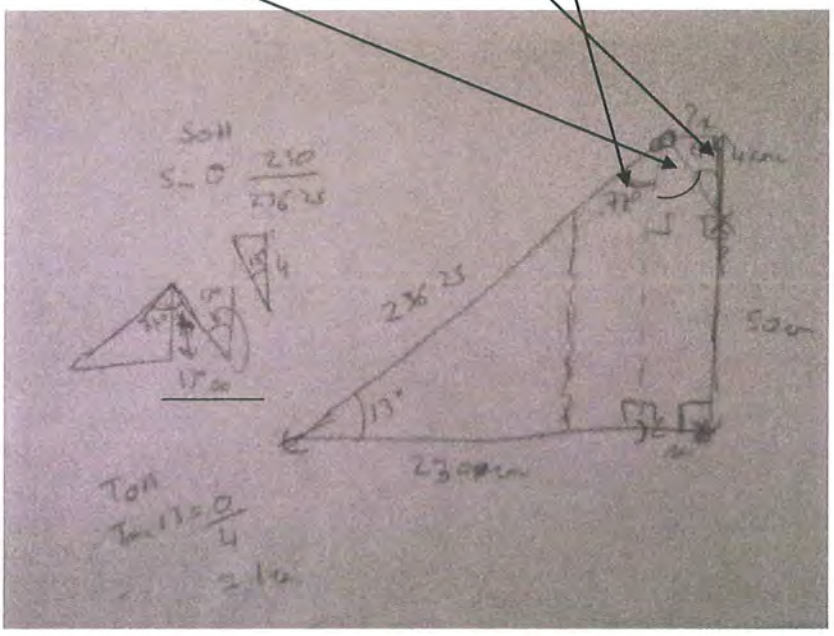
The device has been mounted on a hat and this is justified by looking at the many pictures present in my journal and in this scholarship report showing that this is true. The device also runs on the nokia battery. You can see this from the pictures where it is always the nokia battery present in the battery casing which provides power to the device. The device is light enough to be worn and used on a day to day business. This information I have gathered from a lot of other people such as my friends and family who all tell me that the device is quite practical in terms of weight and is not too heavy.

This picture shows that the device is being powered through the nokia battery. This justifies that the device is powered through a nokia battery source which meets the need to have a light, reliable, single celled, rechargeable battery source.

These calculations show that the 13 degree bend in the acrylic will cover the objects present at chest height and will detect those objects and warn the user of these objects.

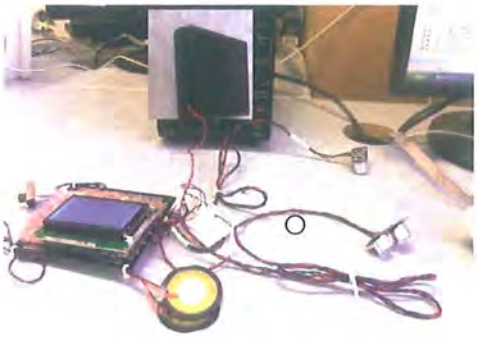
Angle Calculations for the second USS

I first drew a draft drawing as shown on the right just to get an idea of the figures that I would need to calculate. I then drew a proper sketch up in order to find the actual angle at which to bend the acrylic for the second USS in order for it to point downwards towards the chest area. After a few calculations where I first calculated this angle ___ I could figure out ___ this angle. That helped me determine the angle ___ which I had to bend the acrylic in order to cover as much area as possible at chest level.



These calculations justify that the device does meet my client's needs as these measurements allow for the device to also detect objects at head height.

The device has reduced in size and compacted throughout the making of this project. This is justified and can be seen from the differences in size between the initial and final circuit board as well as the difference in size of the main casings as shown below:



There is an obvious difference in the size of the two circuits where the circuit with the smaller MC, M48 is definitely smaller, lighter, less bulky and at the same time is able to do all that the circuit with the bigger MC can do.

Here we can see a huge difference between the initial main casing and the final one. I different hat was used in the end but its dimensions were about the same.

Both a decrease in the size of the circuit board along with the amount of components and everything as well as a significant decrease in the size of the main casing that is meant to provide the housing for the circuitry provide justification that I have significantly made the device more compact and have significantly managed to increase ease of portability of the device therefore meeting my clients needs.

Here the device did detect the object, a pole as part of it is at head height. And the object is of a different geometric shape showing that the device can detect objects of a variety of shapes and sizes.

The device is viable as it is a sturdy device which will not break easily. The casing is made of acrylic which is a hard material. All the components are securely attached on to this casing and therefore are secure and protected. Also the battery casing and peizo are securely attached to the hat and are therefore protected to a certain degree. The MC and the board which are the main and most important parts of this device are securely attached beneath the acrylic casing and are the most protected out of all the components. The device will not stop functioning if it falls and is durable.

This device does have marketing potential. From my research I know that there is no device that has a hat as its casing and a nokia battery powered device as its power source in the market. This device is unique in those ways. The nokia battery does last for a long time, its durable, its small, its light and its rechargeable therefore making my product an unique one which can be marketed because of its uniqueness. My product is also very competitive with other similar products in terms of its price as its cost price is approximately $150 compared to other electronic device for the blind which are all a lot more expensive. If I could further reduce the size of the acrylic casing on top of the hat, make it water proof and if I could replace my ultrasonic sensors for other ones that would serve my purpose better and not have a limited range when working together (these would be more expensive) then this

product would definitely be marketable. However in its current state it still has marketing potential but with the added changes it would be a device to reckon with.

This device does have a significantly **positive impact** on its users assuming that they are blind. This device will help the user by stopping him from bumping into objects at head or chest height therefore **reducing the chances of the user injuring** him/her self. This device will also **improve the user's confidence** as he or she will be able to walk without being very of what is in front of them at head or chest height because the device will warn them of any such objects present.

The device also has a positive effect on the **wider community**. It can be used to help other blind people and other people with visibility impairments to avoid objects and prevent injury. This device also does affect the other people present in our society. It will help blind people (the user) to stop bumping into these people therefore reducing the chances of injury on the wider community.

My device is elegant in a number of ways. The board on which I have attached all my components to, has been cut up and sanded until it was as compact as possible and has a nice finished look about it. The battery casing that I used was from a phone and looks quite elegant as there are no disturbances or cracks on it. The acrylic casing was bent and measured with a lot of care. The acrylic casing's unique design along with its smooth yet defined curves; again add to the elegance of the overall device. The hat used is not an outdated one but one that is considered quite trendy and in fashion. The white background on the hat combined with the acrylic casing; add to the elegant look of the hat. The placing of all the components right in the centre of the acrylic casing give the device a finished look and further add to the devices elegance.

Ultrasonic sensors (USS) are used to measure the distance to an object. I have displayed flair by using them to help sound a peizo when the object gets within a certain distance from my client. I have also used a peizo as it is not too loud and therefore will not annoy the user or people around the user by beeping too loudly. However it is loud enough to be heard by the user for him to be alerted of objects that are present in his path. I have displayed flair by using an LDR which is used to measure the light level to determine the different distances that an object will be from the user at which the peizo will go off depending on how bright it is. I have gotten the peizo to beep when the USS detects objects further from the user at dark as it is more dangerous at night time compared to when it is day (bright). The placing of the entire hardware within the confined spaces of a hat is quite original and displays flair as it has not been done before like how I did it.

I have shown innovation in a number of ways. My client wanted a portable, light and rechargeable battery and to satisfy this specification I used a nokia battery as the power source for the device. This is unique and innovative as I have never seen any other device having a nokia battery as its power source apart from a mobile phone. I have also been

innovative in getting the peizo to beep faster and faster as one get closer and closer to an object. I have also been innovative in providing my user with the option of having the distance measurements dependent on the light readings or whether they would prefer the standard 250 max reading arrangement.

Overall my device has met the main requirements by my client and does fulfil its purpose by helping my client detect and avoid objects at head and shoulder height. I have thoroughly justified and explained how all the needs have been met and have explained in great detail the five main stages of my project making along with critically reflecting on each of those stages. My device and myself have has displayed originality and elegance which I have discussed in great detail in this report.

My Finished Device