A PROJECT REPORT ON

SMART-PHONE BASED OBSTACLE DETECTION FOR VISUALLY IMPAIRED PEOPLE

SUBMITTED TO THE SAVITRIBAI PHULE PUNE UNIVERSITY , PUNE IN THE PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE

BACHELOR OF ENGINEERING
(Computer Engineering)

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2016 - 17

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CERTIFICATE

This is to certify that the Project Entitled

SMART-PHONE BASED OBSTACLE DETECTION FOR VISUALLY IMPAIRED PEOPLE

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is a bonafide work carried out by them under the supervision of Prof. T. J. Parvat and it is approved for the partial fulfillment of the requirement of Savtribai Phule Pune university, Pune for the award of the degree of Bachelor of Engineering (Computer Engineering).

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PROJECT APPROVAL SHEET

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SMART-PHONE BASED OBSTACLE DETECTION FOR VISUALLY IMPAIRED PEOPLE

Is verified for its originality in documentation, problem statement, proposed work and implementation successfully completed by

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Abstract

A blind person walking in an unfamiliar environment faces many problems, this problem may be of identifying true obstacle or may be of identifying potholes, bumps in his way. In past few years,different types of ETAs have been developed for helping visually impaired people. Regardless of various ETAs available,they are still not affordable to the majority of blind people. And most of these ETAs only focuses on only one problem i.e. either pothole detection or obstacle in front of the user. Apart from that, they do not provide information about the environment in which user is present. This paper describes a real-time system which makes use of the ultrasonic sensor, camera, and smart-phone for detection, recognition and processing of objects that hinders the path of visually impaired person. Ultrasonic sensors detect and measure the distance of obstacle while image captured from a camera is used for object recognition. The output given to the user is in form of vibration and audio. The intensity of output depends upon the distance of an object from the user. The motivation of the project came from the fact that According to W.H.O (World Health Organization), there are approximately 285 million people who are visually impaired out of which 39 million are blind and 246 million have low vision. About 90% of the worlds visually impaired have low income [1], as there are many blind people who lives with low income settings they cannot afford various ETAs(Electronic Travel Aid) available in the market and there is a constant need of an assistive device for them, so the main paradigm that we focus on is to find the balance between the affordability and efficiency of the ETAs and thus providing assistance to more and more visually impaired individuals, with our approcach user can detect various obstacles as well as get familiar to the surrounding.

Acknowledgements

It gives us great pleasure in presenting the preliminary project report on **'SMART-PHONE BASED OBSTACLE DETECTION FOR VISUALLY IMPAIRED PEOPLE '**.

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SMART-PHONE BASED OBSTACLE DETECTION FOR VISUALLY IMPAIRED PEOPLE

1.2 Project Option

Internal project

1.3 Internal Guide

Prof. T. J. Parvat

1.4 Technical Keywords

- Visually impaired
- Ultrasonic sensors
- Smart-phone
- Electronic Travel Aids (ETA)
- Real-time
- System image processing

1.5 Problem Statement

A blind person walking in an unfamiliar environment faces many problems, this problem may be of identifying true obstacle or may be of identifying potholes, bumps in his way.

1.6 Abstract

A blind person walking in an unfamiliar environment faces many problems, this problem may be of identifying true obstacle or may be of identifying potholes, bumps in his way. In past few years,different types of ETAs(Electronic

Travel Aid) have been developed for helping visually impaired people. Regardless of various ETAs available,they are still not affordable to the majority of blind people. And most of these ETAs only focuses on only one problem i.e. either pot-hole detection or obstacle in front of the user. Apart from that, they do not provide information about the environment in which user is present. This paper describes a real-time system which makes use of the ultrasonic sensor, camera, and smart-phone for detection, recognition and processing of objects that hinders the path of visually impaired person. Ultrasonic sensors detect and measure the distance of obstacle while image captured from a camera is used for object recognition. The output given to the user is in form of vibration and audio. The intensity of output depends upon the distance of an object from the user. The motivation of the project came from the fact that According to W.H.O (World Health Organization), there are approximately 285 million people who are visually impaired out of which 39 million are blind and 246 million have low vision. About 90% of the worlds visually impaired have low income [1], as there are many blind people who lives with low income settings they cannot afford various ETAs available in the market and there is a constant need of an assistive device for them, so the main paradigm that we focus on is to find the balance between the affordability and efficiency of the ETAs and thus providing assistance to more and more visually impaired individuals, with our approcach user can detect various obstacles as well as get familiar to the surrounding.

1.7 Goals and Objectives

- To develop a low cost ETA for obstacle detection and object recognition.
- Real-time system.
- Reliable and Efficient system.
- Hepatic and audio output.

1.8 Relevant mathematics associated with the Project

System Description:
Let, S be the System Such that:
$A = S, E, I, O, F, DD, NDD, Fmin, success, failure$

- S = Start state,
- E = End State,
- I = Set of Inputs : Reflected Ultrasonic Wave, Image Captured
- O = Set of Output : Haptic Feedback, Audio Feedback
- F = Set of Function : Arduino- readUltraSonicSensors(),sendAndroidValues(), readADXL()
- DD = Deterministic Data : True
- NDD = Non Deterministic Data : False
- FMin = Main Function : setup()
- Success Case : It is the case when all the inputs are given by system are entered correctly.
- Failure Case : It is the case when the input does not match the validation Criteria.

1.9 Names of Conferences

- 2017 International Conference on Innovations in information Embedded and Communication Systems (ICIIECS)

1.10 Review of Conference/Journal Papers supporting Project idea

Ref. No.	Proposed Work	Advantages	Disadvantages
[1]	This System made use of two Ultra-sonic sensors attached to conventional eyeglasses. The data from these sensors where down-converted to a stereo audible sound using microprocessor and A/D converter.	• Simplicity • Portability	• Users can identify and discriminate objects in some limited cases. • Users required a lot of training.
[2]	Navbelt is a guidance system which uses a mobile robot obstacle avoidance system. The system consisted of ultrasonic range sensors, a computer, and earphones. The computer receives information from the eight ultrasonic sensors and creates a map of the angles and the distance of any object at this angle.	• The Guidance mode. • The Image mode.	• Bulky prototype. • Users are required extensive training periods. • Use of audio feedback exclusively.
[3]	A guide cane consists of a handle which is connected to the main device which contains wheels, a steering mechanism, ultrasonic sensors, and a computer. The user moves the Guide cane, and when an obstacle is detected the obstacle avoidance algorithm chooses a different direction until the obstacle is cleared and a route is resumed.	• It can detect small obstacles at the ground and sideways obstacles like walls. • It does not block the users hearing with audio feedback. • No need for extensive training.	• The limited scanning area. • Prototype is Bulky.
[4]	The prototype is consisted of two subsystems: the sonar and compass control unit, which is consisted of six ultrasonic range sensors pointing in the six radial directions around the user and a microcontroller; and the 3-D sound rendering engine, which is consisted of headphones and a personal digital assistant (PDA) equipped with software capable of processing information from the sonar and compass control.	• The algorithm uses head-related transfer functions (HRTF), creates a 3-D sound environment that represents the obstacles detected by the sensor. • The system is small and wearable.	• The navigation speed was slow. • The design of the ranging unit is not ergonomic.

Ref. No.	Proposed Work	Advantages	Disadvantages
[5]	This wearable device converts visual information into the tactile signal to help visually impaired people self-navigate through obstacle avoidance. The prototype consisted of a tactor-belt with 14 vibrator motors spaced laterally, a camera belt with two web cameras attached and a portable computer carried in a backpack.	• It is wearable. • It operates in real time. • It gives user free hands without blocking hearing.	• The device cannot differentiate between hanging and ground obstacles.
[6]	A cheap guidance system based on a micro-controller for facilitating visually impaired people. Ultrasonic sensors are used to anticipate distance of the obstacles around the blind person to advise the user towards the available path.	• Low cost ETA's • Character recognition can also be done.	• System blocks the daily routine hearing of visually impaired individuals.
[7]	This device provides a binaural acoustic image representation. The environmental information acquisition system is based on an array of lx64 CMOS Time-of-Flight sensors.	• Portable device and constructed by commercially available components. • Users are able to detect obstacles and navigate through unknown and known environments safety and confidently.	• System uses CMOS sensor which is insensitive in low light.
[8]	It is a wrist-mounted device which uses an ultrasonic sensor to detect an obstacle on the ground level or above ground level. Whenever an obstacle is found, the device sends haptic tactile feedback or audio feedback to warn the user about the proximity of the obstacle.	• This system is simple and effective. • Pot-holes and bumps can be detected easily. • Individuals can quickly learn to use this system, and easily adapt to using it.	• The user has to raise his arm constantly to know about any obstacle in his way.

1.11 Plan of Project Execution

Please refer Annexure C for the planner

CHAPTER 2
TECHNICAL KEYWORDS

2.1 Area of Project

Embedded Systems

2.2 Technical Keywords

- Visually impaired
- Ultrasonic sensors
- Smart-phone
- Electronic Travel Aids (ETA)
- Real-time
- System image processing

CHAPTER 3
INTRODUCTION

3.1 Project Idea

To develop a low cost ETA for obstacle detection and object recognition. The basic idea of the project is to provide travelling aid to the people living in low income setting.

3.2 Motivation of the Project

To assist visually impaired people while travelling in an unfamiliar environment.
Though there are many devices available in the market but they are not available to most of the visually impaired persons.
Most of them have low income or their family condition are not good enough
The main paradigm that we focus on is to find the balance between the affordability and efficiency of the ETAs and thus providing assistance to more and more visually impaired individuals.

CHAPTER 4

PROBLEM DEFINITION AND SCOPE

4.1 Problem Statement

According to W.H.O (World Health Organization), 285 million people are estimated to be visually impaired worldwide [1]. A blind person walking in an unfamiliar environment faces many problems, this problem may be of identifying true obstacle or may be of identifying potholes, bumps in his way.

4.1.1 Goals and objectives

Goal and Objectives:

- To develop a low cost ETA for obstacle detection and object recognition.
- Real-time system.
- Reliable and Efficient system.
- Hepatic and audio output.

4.1.2 Statement of scope

- Two major input given to the system are reflected ultrasonic wave and the image captured. Image captured is jpeg encoded, Size of this image can vary with the Smart-phone used. general size of the image may vary between 500kb to 2-3mb.
- For ground based obstacle detection, Value of sonic sensor depends upon the angle of inclination.
- Output given by the system is in form of audio and vibration. Audio can be beep sound or talk-back feature of smart-phone.
- Developed system can help user to detect potholes and bumps on ground-level and also help to detect obstacle in front of him/her. System also provides facility to capture image on the click of volume button. System then provides the detail of objects in the image using talk-back.

4.2 Major Constraints

- Ultrasonic sensor only works when the angle of inclination from the ground is between 0-30 degrees

- Image recognition can not work in low light.
- System can not detect soft objects as they absorb the ultrasonic waves.

4.3 Methodologies of Problem solving and efficiency issues

There are a number of methods for Problem Solving.

- Association: There are three types of associative thinking. This type of thinking is basically a linking process either through similarity, difference, or contiguity.
- Analogy: This thinking method is a way of finding solutions through comparisons. The process is based on comparing the different facets of the problem with other problems that may or may not have similar facets.
- Brainstorming: This thinking method is based on a free, non-threatening, anything goes atmosphere. You can brainstorm alone or with a group of people. Most often a group of people from diverse backgrounds is preferable. The process works like this: The problem is explained to the group and each member is encouraged to throw out as many ideas for solutions as he or she can think of no matter how ridiculous or far-fetched they may sound.
- Intuition: This mode of thinking is based on hunches. It is not, as some think, irrational. Intuition or hunches are built on a strong foundation of facts and experiences that are buried somewhere in the subconscious. All the things you know and have experienced can lead you to believe that something might be true although you've never actually experienced that reality. Use your intuition as much as possible but check it against the reality of the situation.
- Analytical Thinking: This thinking method is based on analysis. It is the most conventional and logical of all the methods and follows a step by step pattern.

4.4 Outcome

- System developed can help blind individuals to identify the obstacle in his way

- System can also provide detail information about his surroundings.
- This can help them while travelling to an unknown environment.

4.5 Applications

- Sole application of the system is to provide assistance to the blind person while walking in an unfamiliar environment.
- System can be used to identify the object. This can help a blind person to identify the currency or the landmarks near him.

4.6 Software Resources Required

Platform :

1. Operating System: windows 10
2. IDE: Android Studio,Arduino IDE
3. Programming Language: Java, Arduino Sketch

4.7 Hardware Resources Required

Hardware:

Table 4.1: Hardware Requirements

Sr. No.	Hardware Req.	Specification
1	Ultrasonic sensor(SR-04)	1 - 10 M
2	Arduino Board(Nano)	Atmega-328
3	Bluetooth(HC-05)	transceiver
4	Accelerometer	ADXL-335
5	Smart-Phone	Android(6.0)

CHAPTER 5
PROJECT PLAN

5.1 Project Estimates

Waterfall Model
The waterfall model is a sequential design process, used in software development processes, in which progress is seen as flowing steadily downwards (like a waterfall) through the phases of Feasibility Study, Requirement analysis, Planning, Design, construction, testing, production/implementation and maintenance.In case of of our project titled SMART-PHONE BASED OBSTACLE DETECTION FOR VISUALLY IMPAIRED PEOPLE" this model is used because of simplicity and ease of development.

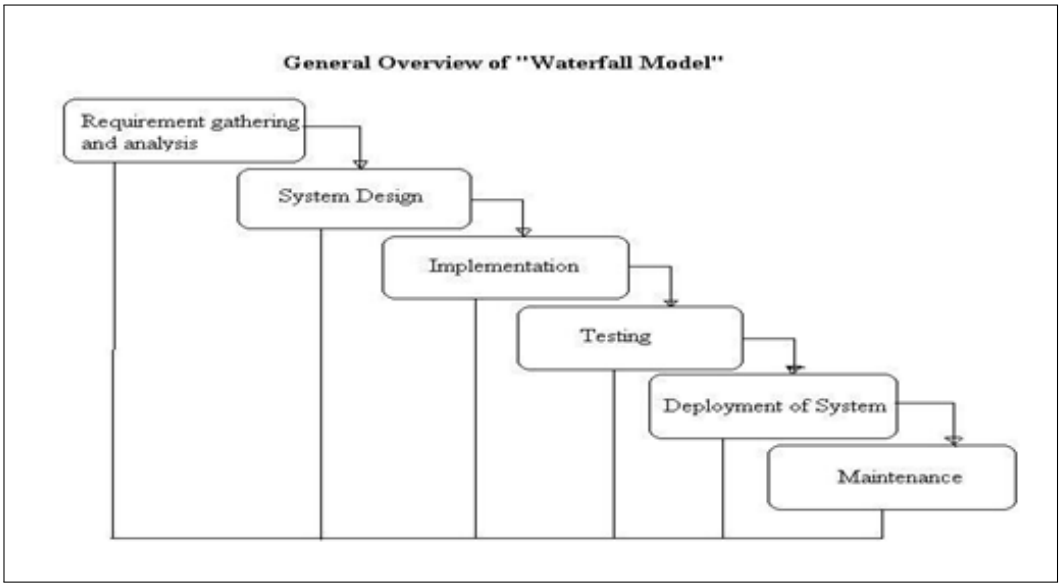

Figure 5.1: Waterfall Model

5.1.1 Reconciled Estimates

5.1.1.1 Cost Estimate

The project cost can be found using any one of the model.
COCOMO-1 Model
COCOMO-2 Model
Model -1: The basic COCOMO model computes software development efforts as a function of program size expressed in estimated lines of code.

Model-2: The intermediate COCOMO model computes software development efforts as a function of program size and a set of cost drivers that include subjective assessment of the product, hardware, personnel, project attributes
Model-3: The advanced COCOMO model incorporates all characteristics of the intermediate version with a assessment of the cost drivers impact on each step of the software engineering process. Following is the basic COCOMO -2 model.

Table 5.1: COCOMO Model

Software Project	A(b)	B(b)	C(b)	D(b)
Organic	2.4	1.05	2.5	0.38
Semi-detached	3.0	1.22	2.5	0.35
Embedded	3.6	1.20	2.5	0.32

Like all estimation model, the COCOMO model requires sizing information. This information can be specified in the form of

- Object Point(OP)
- Function Point(FP)
- Lines of code(KLOC)

For our project, we use the sizing information in the form of Lines of source code. Total Lines of source code in our project KLOC = 36K (approx.)

Effort Applied (E):
> Effort Applied (E) = A(b) * $KLOC^{B(b)}$
> E = 3.6 * $36^{1.20}$
> E = 265.37 [man-months]

Development Time (D):
> Development Time (D) = C(b)* $E^{D(b)}$ [months]
> D = 2.5 * $265.37^{0.32}$
> D = 14.91

People required (P):
> People required (P) = Effort Applied / Development Time [count]
> P = 265.37 / 14.91

> P = 18

Table 5.2: Hardware Cost Estimation

Sr. No.	Hardware Req.	Estimated Cost (Rs.)
1	Ultrasonic sensor(SR-04)	2 X 240
2	Arduino Nano	310
3	Bluetooth (HC-05)	325
4	Accelerometer(ADXL-335)	220
5	Total Estimated Cost	1335

5.1.1.2 Time Estimates

Project can be completed in 10 months.

5.1.2 Project Resources

People:

- People with the knowledge of hardware (Arduino), and Android Studio.

Hardware:

- Arduino, Bluetooth, Ultrasonic sensors, Accelerometer, Smart-phone, Laptop.

Software And Tools:

- Android Studio, Arduino IDE, Latex.

5.2 Risk Management w.r.t. NP Hard analysis

1. P- Class.

2. NP-Hard Class.

3. NP-Complete Class.

- A decision problem is in P class if there is known as polynomial time algorithm to get that answer.

- A decision problem is in NP class if there is known as polynomial time algorithm for a non-deterministic machine to get the answer. Problems known to be in P are trivially in NP the non-deterministic machine just never troubles itself to fork another process and acts just like a deterministic one.

A problem is NP-hard if solving it in polynomial time would make it possible to solve all problems in class NP in polynomial time. Some NP-hard problems are also in NP (these are called "NP-complete"), some are not. If you could reduce an NP problem to an NP-hard problem and then solve it in polynomial time, you could solve all NP problems. Also, there are decision problems in NP-hard but are not NP-complete, such as the infamous halting problem.

5.2.1 Risk Identification

Project Risk Management includes the processes of conducting risk management planning, identification, analysis, response planning, and controlling risk on a project. The objectives of project risk management are to increase the likelihood and impact of positive events, and decrease the likelihood and impact of negative events in the project. Project Risk identification is the most important process in the Risk Management Planning. Risk Identification determines which risks might the project and documents their characteristics. However, we should not spend too much time in identifying risks. After the list is made, qualitative and quantitative analysis is done to out which risks you spend time and/or money on. In our project the requirements of user is fully understood which minimizes the risk. To develop the system the development team is skilled and have appropriate knowledge about the tools which we are using to develop the software. Each team member is equally involved in the development of project in each stage. The number of people

required for developing are sufficient. The requirement gathered is constant or stable which minimizes the risk of developing a inaccurate project.

1. Have top software and customer managers formally committed to support the project?
2. Are end-users enthusiastically committed to the project and the system/product to be built?
3. Are requirements fully understood by the software engineering team and its customers?
4. Have customers been involved fully in the definition of requirements?
5. Do end-users have realistic expectations?
6. Does the software engineering team have the right mix of skills?
7. Are project requirements stable?
8. Is the number of people on the project team adequate to do the job?
9. Do all customer/user constituencies agree on the importance of the project and on the requirements for the system/product to be built?

5.2.2 Risk Analysis

The risks for the Project can be analysed within the constraints of time and quality

Table 5.3: Risk Table

ID	Risk Description	Probability	Impact		
			Schedule	Quality	Overall
1	Burning out micro controller	Low	High	–	High
2	Not obtaining parts on time	Medium	High	–	High
3	Battery malfunction	Medium	Low	Medium	Medium
4	Cane does not stay together, durability failure	Medium	Medium	High	High
5	Haptic forces not being strong enough	Low	–	Medium	Medium
6	Detection is ineffective	Medium	Medium	Medium	Medium
7	Cane is dropped repeatedly on the ground	Medium	–	–	Medium

Table 5.4: Risk Probability definitions

Probability	Value	Description
High	Probability of occurrence is	$> 75\%$
Medium	Probability of occurrence is	$26 - 75\%$
Low	Probability of occurrence is	$< 25\%$

Table 5.5: Risk Impact definitions

Impact	Value	Description
Very high	$> 10\%$	Schedule impact or Unacceptable quality
High	$5 - 10\%$	Schedule impact or Some parts of the project have low quality
Medium	$< 5\%$	Schedule impact or Barely noticeable degradation in quality Low Impact on schedule or Quality can be incorporated

5.2.3 Overview of Risk Mitigation, Monitoring, Management

Risk ID	1
Risk Description	Micro controller can burn out due to heavy and long usage
Category	Hardware
Source	Software requirement Specification document.
Probability	Low
Impact	High
Response	Mitigate
Strategy	use of quality product
Risk Status	Not Occurred

Risk ID	2
Risk Description	Not obtaining parts on time can increase the project delivery time
Category	Requirements
Source	Software Design Specification documentation review.
Probability	Medium
Impact	High
Response	Search for the parts from various other sources
Strategy	Early requirement gathering can help in avoid such risks
Risk Status	Identified

Risk ID	3
Risk Description	Battery malfunction can cause the device to give wrong sensor values which may result in an accident
Category	Technology
Source	This was identified during testing.
Probability	Low
Impact	Very High
Response	Accept
Strategy	use quality product
Risk Status	Identified

Risk ID	4
Risk Description	Cane does not stay together, durability failure
Category	Hardware
Source	This was identified during repeated testing.
Probability	Medium
Impact	Very High
Response	Accept
Strategy	use quality product
Risk Status	Identified

Risk ID	5
Risk Description	Haptic forces are different on different devices which may result in confusion between different feedbacks
Category	Hardware and Software
Source	This was identified during testing on different devices
Probability	Low
Impact	Medium
Response	Adapt accordingly
Strategy	increase vibration strength of device
Risk Status	Identified

Risk ID	6
Risk Description	Detection is ineffective in some conditions like reflection from soft surfaces, when battery is low, etc.
Category	Hardware
Source	This was identified during testing on different surfaces
Probability	Medium
Impact	Medium
Response	Move device in different directions
Strategy	use of different sensors like TOF
Risk Status	Identified

Risk ID	7
Risk Description	Cane is dropped repeatedly on the ground can cause device to malfunction
Category	Hardware
Source	This was identified during testing on different users
Probability	Medium
Impact	Medium
Response	Learning is required
Strategy	Training sessions should be conducted for users
Risk Status	Identified

5.3 Project Schedule

5.3.1 Project task set

Major Tasks in the Project stages are:

- Task 1: Requirement Analysis(Selection of proper hardware based upon the compatibility and availability)
- Task 2: Learning embedded programming to program Arduino nano board.
- Task 3: Interfacing Hardware.
- Task 4: Developing android application.
- Task 5: Testing and modification.

5.3.2 Timeline Chart

Please refer Annexure C for the planner

5.3.3 Task network

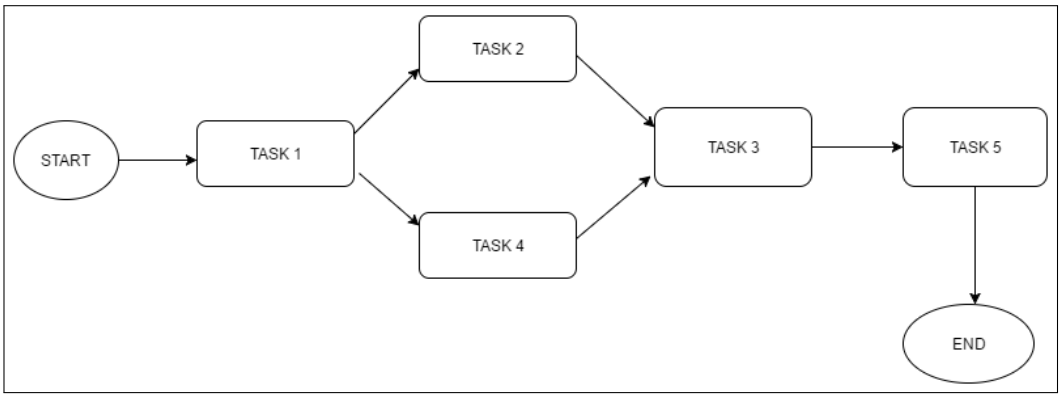

Figure 5.2: Task Network

5.4 Team Organization

There is regular communication between the team members and the respective project guide. Meetings are conducted at regular time intervals. There is a good co-ordination between team members and the guide. Discussions and research are done at every stage.

5.4.1 Team structure

- Amit Kumar: Requirements gathering.
- Pradeep Yadav: UML diagrams other related figures.
- Samir Patel: Software requirements and Hardware requirements.
- Jay Desai: Requirements gathering,and Synopsis.

5.4.2 Management reporting and communication

Proper communication is necessary between the team members and the project guide. There is regular communication between the team members and the respective project guide. According to the schedule the meetings are conducted at regular time intervals. There is a good co-ordination between team members and the guide. Discussions and inspections of the code are done at every stage.

CHAPTER 6

SOFTWARE REQUIREMENT SPECIFICATION

6.1 Introduction

Software requirements specification establishes the basis for an agreement between customers and contractors or suppliers (in market-driven projects, these roles may be played by the marketing and development divisions) on what the software product is to do as well as what it is not expected to do.

6.1.1 Purpose and Scope of Document

- Purpose of the document is to provide a detailed and clear requirements of the stakeholders to the developers.
- SRS also helps in estimation of project schedule, project effort, Human resource, project cost.

6.1.2 Overview of responsibilities of Developer

If you are considering a job as Software Developer here is a list of the most standard responsibilities and duties for the Software Developer position.
• Evaluate, assess and recommend software and hardware solutions.
• Develop software, architecture, specifications and technical interfaces.
• Develop user interfaces and client displays.
• Design, initiate and handle technical designs and complex application features.
• Develop, deliver and test software prototypes.
• Assist software personnel in handling ongoing tasks as required.
• Build flexible data models and seamless integration points.
• Innovate and develop high-value technology solutions to streamline processes.
• Initiate and drive major changes in programs, procedures and methodology.

6.2 Usage Scenario

A usage scenario, or scenario for short, describes a real-world example of how one or more people or organizations interact with a system. They describe the steps, events, and/or actions which occur during the interaction. Usage scenarios can be very detailed, indicating exactly how someone works with the user interface, or reasonably high-level describing the critical business

actions but not the indicating how they're performed.
Various usage usage scenario are:
• user power-on the cane and connects to the mobile device via bluetooth
• user press volume-down button for capturing image of the environment and listen to the description

6.2.1 User profiles

Users profiles:

- User is visually impaired.
- User is partially blind.

6.2.2 Use-cases

- A scenario where a user is walking and there is a pothole or bump on the ground in front of him.
- A scenario where a user is walking and there is a obstacle in front of him.
- A scenario where a user want to know about his surrounding.

6.2.3 Use Case View

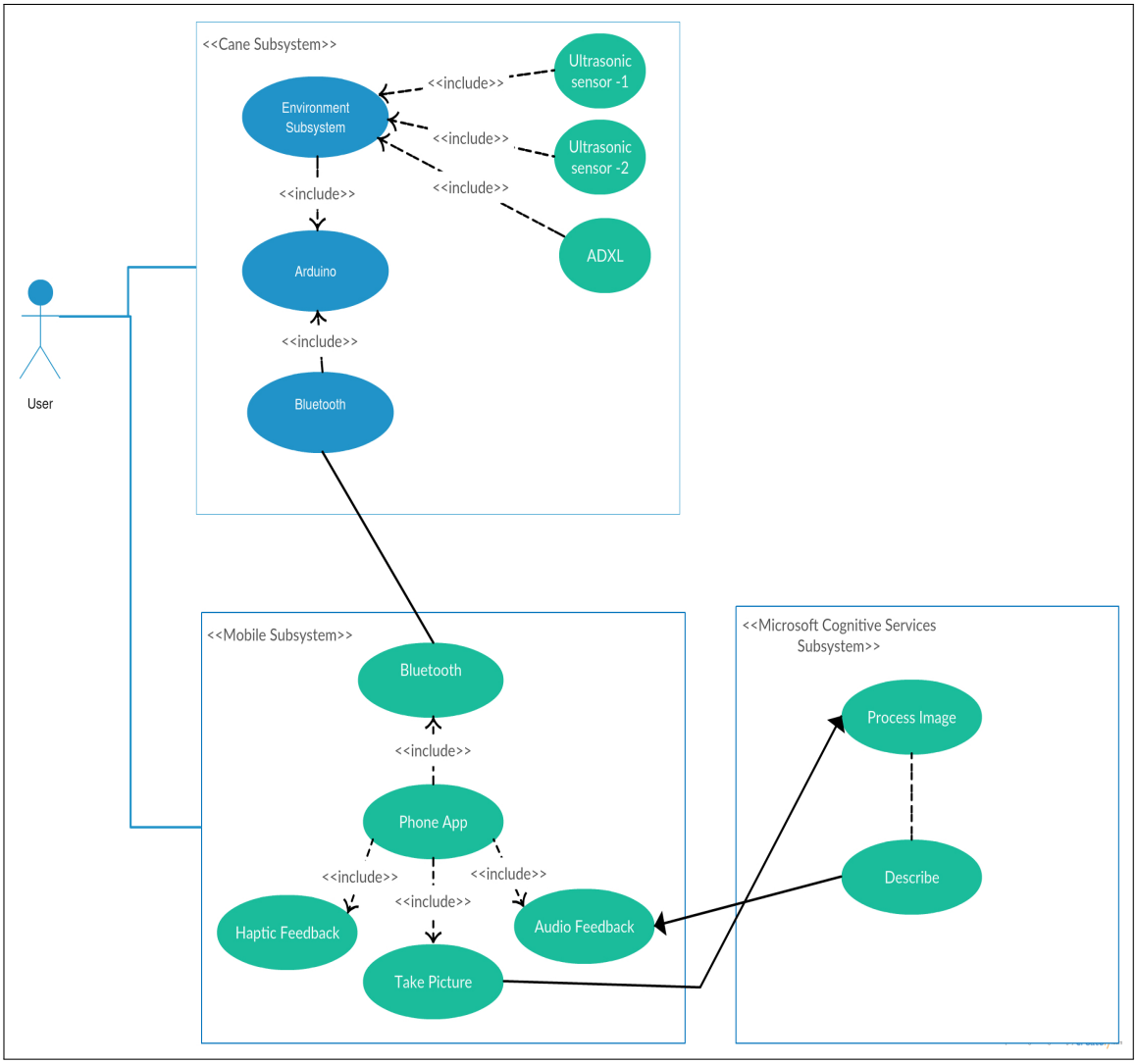

Figure 6.1: Use case diagram

6.3 Data Model and Description

The main aim of data models is to support the development of information systems by providing the definition and format of data. According to West and Fowler (1999) "if this is done consistently across systems then compatibility of data can be achieved. If the same data structures are used to store and access data then different applications can share data. The results of this are indicated above. However, systems and interfaces often cost more than they should, to build, operate, and maintain. They may also constrain the business rather than support it. A major cause is that the quality of the data models implemented in systems and interfaces is poor"

6.3.1 Data Description

Describing and documenting data is essential in ensuring that the researcher, and others who may need to use the data, can make sense of the data and understand the processes that have been followed in the collection, processing, and analysis of the data.
Research data are any physical and/or digital materials that are collected, observed, or created in research activity for purposes of analysis to produce original research results or creative works.

6.4 Functional Model and Description

A description of each major software function, along with data flow (structured analysis) or class hierarchy (Analysis Class diagram with class description for object oriented system) is presented.

6.4.1 Data Flow Diagram

6.4.1.1 Level 0 Data Flow Diagram

6.4.1.2 Level 1 Data Flow Diagram

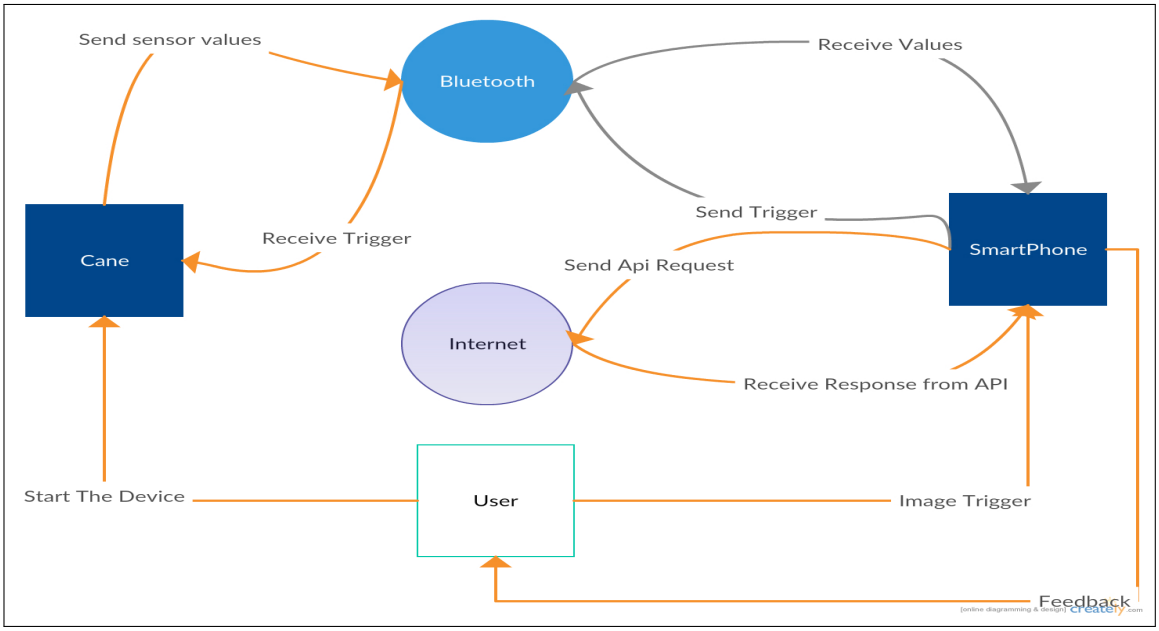

Figure 6.2: Level 0 Data Flow Diagram

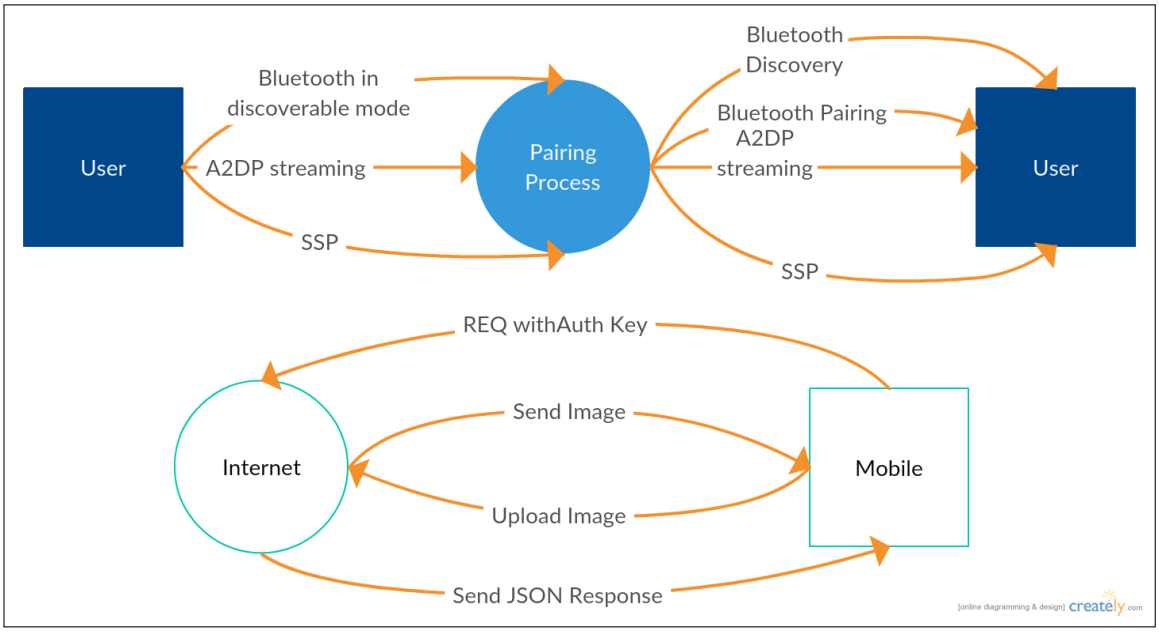

Figure 6.3: Level 1 Data Flow Diagram

6.4.2 Activity Diagram:

- The Activity diagram represents the steps taken.

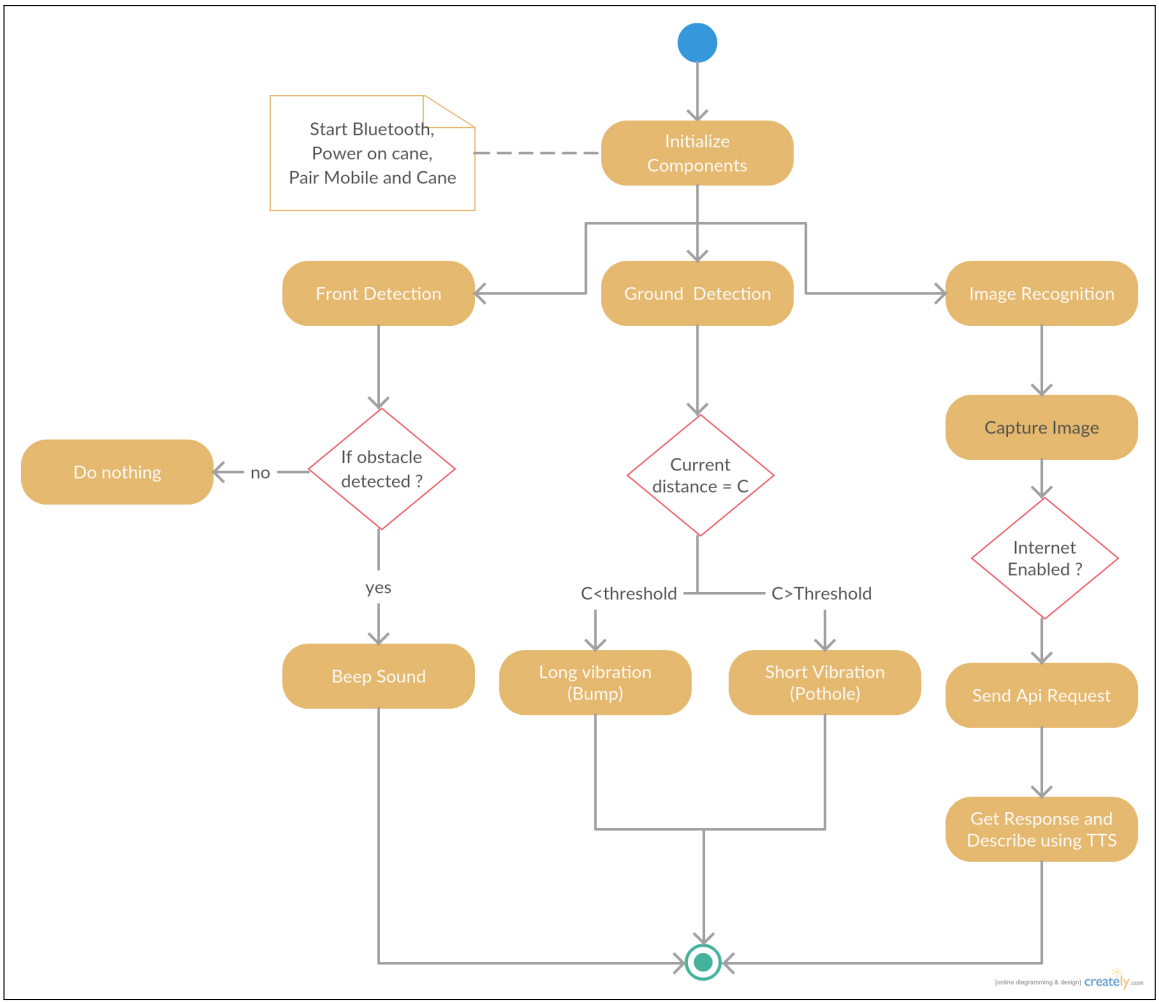

Figure 6.4: Activity diagram

6.4.3 Non Functional Requirements:

- Quality Of Service
- Reliability Of System
- Durability of System

6.4.4 State Diagram:

State Transition Diagram
Fig.6.5 example shows the state transition diagram of Cloud SDK. The states are represented in ovals and state of system gets changed when certain events occur. The transitions from one state to the other are represented by arrows. The Figure shows important states and events that occur while creating new project.

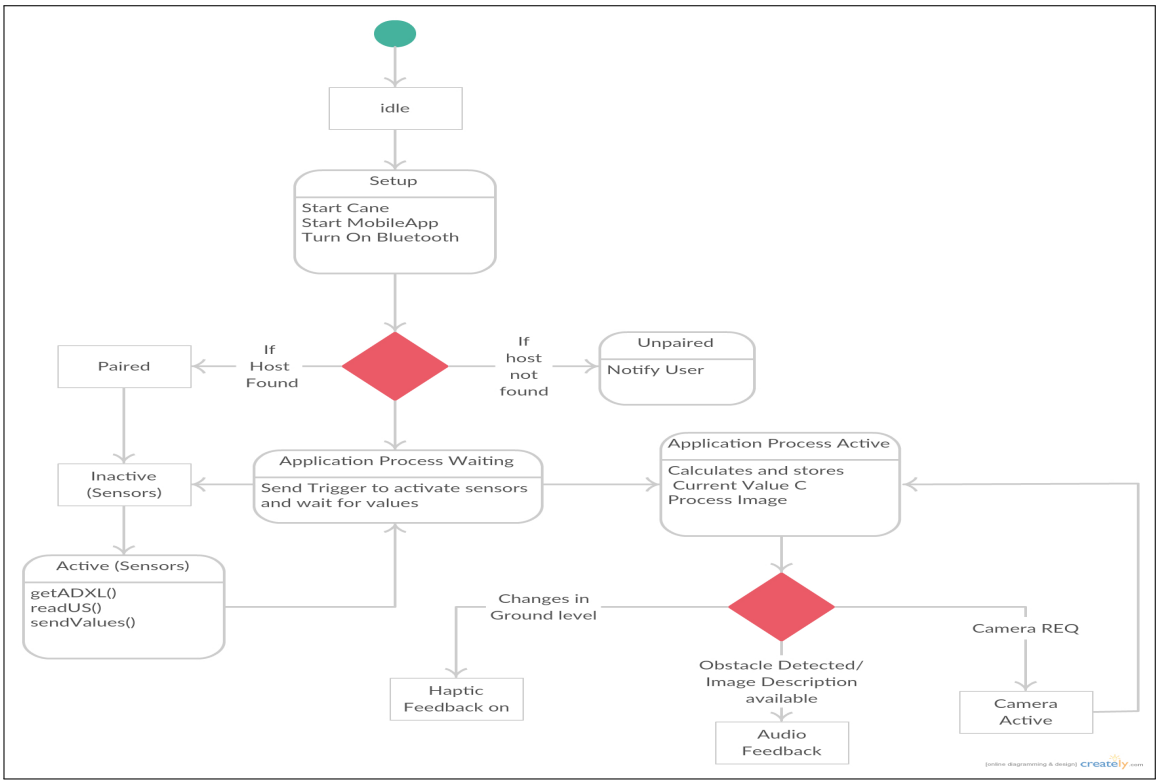

Figure 6.5: State transition diagram

CHAPTER 7
DETAILED DESIGN DOCUMENT

7.1 Introduction

According to W.H.O (World Health Organization), there are approximately 285 million people who are visually impaired out of which 39 million are blind and 246 million have low vision (Fig.1). About 90% of the worlds visually impaired have low income. There is a constant need of an assistive device for them. There is a broad range of navigation system and ETAs are available for visually impaired individuals. White cane and Guide Dogs are the primary tools preferred by a visually impaired person. But they have some limitations, For example- Guide Dogs are not allowed in some places. White canes have a shorter range. They cannot detect obstacle above ground level such as tree branches or open window etc. Apart from that there are various ETAs (Electronic Travel Aids) available in the market. But the problem with ETAs is that if it is effective then it is very costly and is not affordable by 90% of visually impaired individuals as they have low income. If it is affordable, then it is not effective.

7.2 Architectural Design

This problem motivates us to develop a Low Cost ETA for blind person. The main paradigm that we focus on is to find the balance between the affordability and efficiency of the ETAs and thus providing assistance to more and more visually impaired individuals. The main concept simply focuses on the calculation of the distance of the obstacle from the user and providing the haptic and audio to the user. Apart from that using Smart-phone camera, the user can be made familiar to the surrounding.

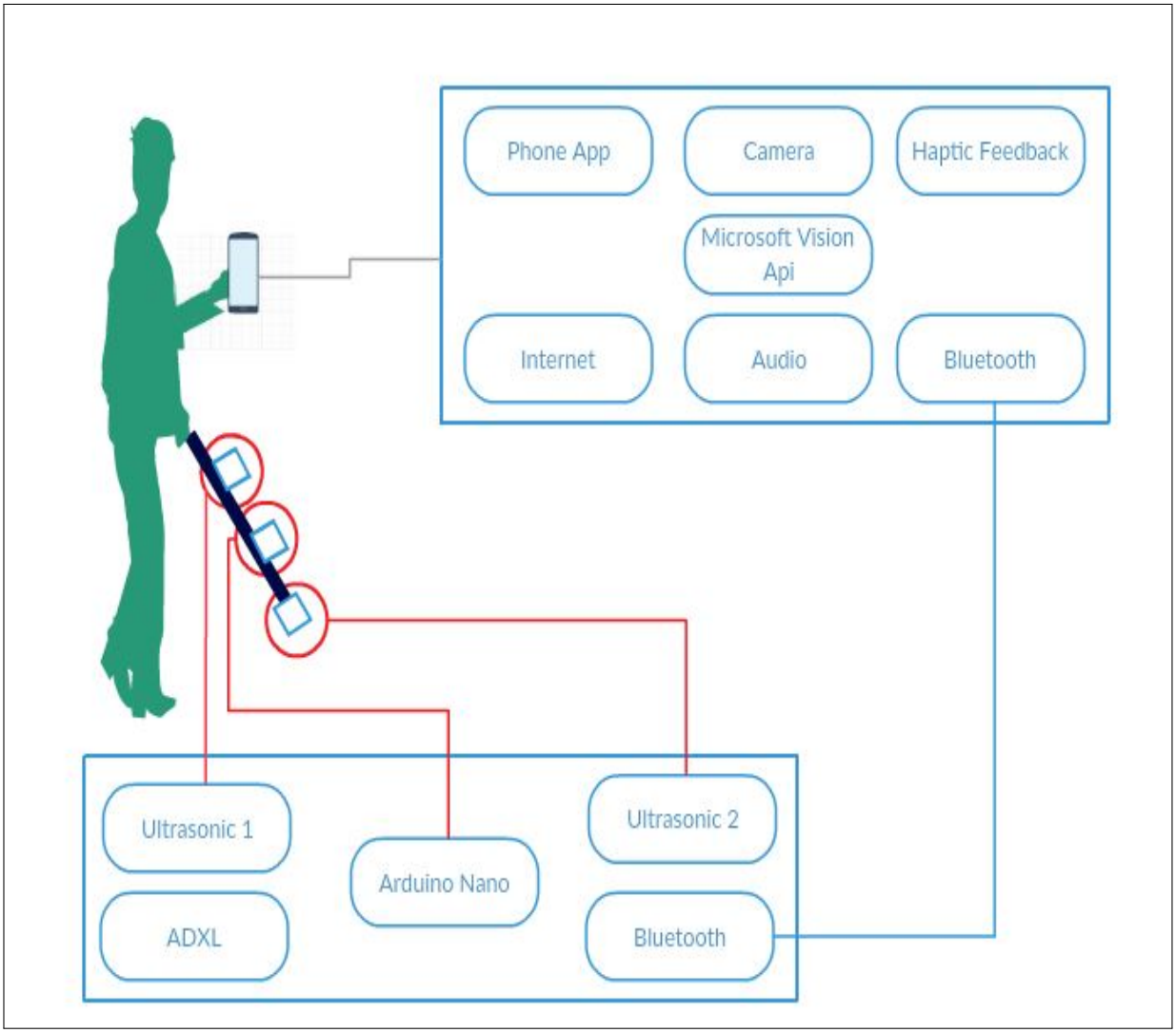

Figure 7.1: Architecture diagram

7.3 Data design

A description of all data structures including internal, global, and temporary data structures, database design (tables), file formats.

7.3.1 Internal software data structure

Input Buffer is used to store the value received from the Arduino.

7.3.2 Global data structure

Bitmap Array is used to store and transfer image to the Cloud.

7.3.3 Temporary data structure

Jpeg file to used to store the image on the system. Byte Array is used to temporarily store the message.

7.4 Component Design

Class diagrams, Interaction Diagrams, Algorithms. Description of each component description required.

7.4.1 Class Diagram

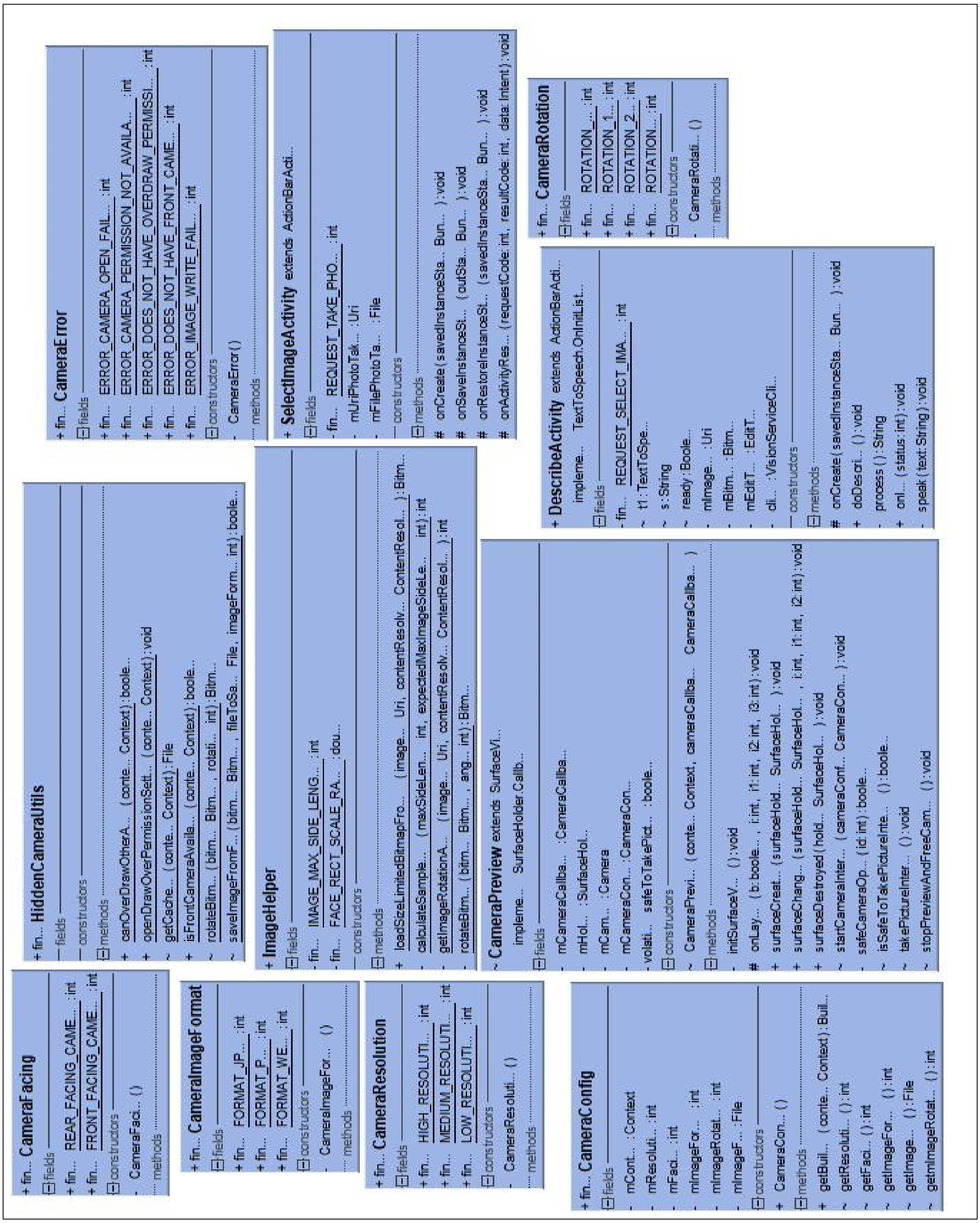

Figure 7.2: Class Diagram-1

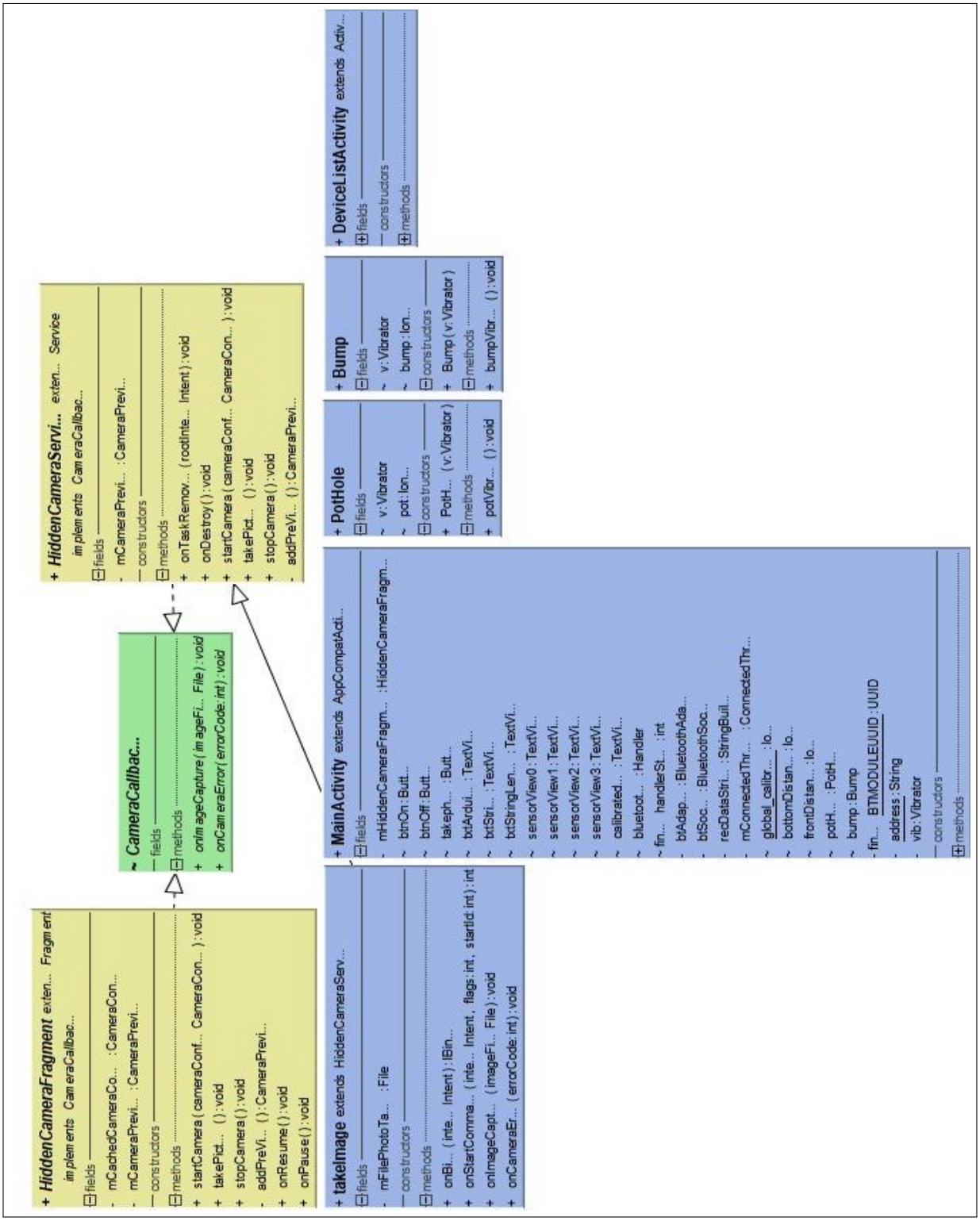

Figure 7.3: Class Diagram-2

CHAPTER 8
PROJECT IMPLEMENTATION

8.1 Introduction

Developed System is used to detect the obstacle in front of user, Ground level detection and for recognizing objects in the image using image processing API provided by microsoft.

- Embedded System transmits ultrasonic wave and starts the timer. When the receiver receive the reflected ultrasonic wave timer stops. Using this timer value and the knowledge of speed of sound we can calculate the distance of obstacle using time and distance formula. then the distance calculated is send to the android application using bluetooth. then the android application sends the audio output to the user, notifying and the obstacle.
- Second Ultrasonic sensor is used for ground level detection. actual value of ground(AD) from the cane is stored in the system. Then using the value obtained from the ultrasonic sensor and accelerometer are manipulated to find the current distance(CD) of ground. This value is compared with the stored value.
  - if AD > CD: bump is detected.
  - if AD < CD: pothole is detected.
  - if AD == CD: Ground is even.
- For image recognition, Image captured by the user. Captured image is converted into bitmaps then API request is made to Microsoft Vision API. Response form the server comes in json file. This json file is manipulated and description about the image is conveyed to the user using Google Talk Back.

8.2 Tools and Technologies Used

- Arduino IDE is used for programming the Arduino.
- Android Studio is used for developing the Android application.
- Microsoft Vision API is used for image recognition.

8.3 Methodologies/Algorithm Details

8.3.1 Algorithm 1/Pseudo Code

Front Detection Algorithm:

- start
- Front Ultrasonic sensor (FUs) transmits ultrasonic wave and starts the timer (t).
- if reflected ultrasonic wave is received the sensor then stops the timer (t).
- else retransmit the ultrasonic wave after some time interval.
- distance(d) in cm = (t/ 2) / 29.1;
- if(d > 0)
- send the value of d to android app using bluetooth.
- END IF
- Android app then sends the audio output(Beep sound).
- stop

8.3.2 Algorithm 2/Pseudo Code

Ground Level detection:

- Start
- actual distance from the ground AD.
- current distance from the ground at certain angle is d.
- current distance from the ground CD.
- Angle from the ground A.
- During calibration AD is stored.
- d calculated using Algorithm 1.
- d is sent to android app using bluetooth.

- CD = d*Math.cos(A).
- if AD > CD then bump is detected.
- else if AD < CD then pothole is detected.
- else Ground is even.
- Stop

8.3.3 Algorithm 3/Pseudo Code

Image Recognition Algorithm

- Start
- capture image from the camera.
- convert to bitmap.
- API request is made to the Microsoft Vision API.
- Response from the server is given in json format.
- This json file is manipulated and output is given by Google talk back.
- Stop

CHAPTER 9
SOFTWARE TESTING

During the process of software development, software has to be tested at every significant step. This process is carried out to check the effective output of the system. After a software product has been successfully built, it must be tested before deployment. Informally software testing can be defined as The process of exercising a program with the specific intent of finding errors prior to delivery to the end user. **The main purpose of testing is to:**

- Debug and rectify the ERRORS in code.
- See that the product CONFORMS to the requirements specified.
- Ensure that the product meets certain PERFORMANCE requirements.
- It is also an indication of the QUALITY of the software.

The input database should be in a format that can be processed efficiently. The segmentation has to be accurate and the tables within the database must be classified according to the characteristics. The input to the processing engine, i.e., Natural language Query must be the relation with the database provided otherwise unwanted output will be obtained by system. The meaningful representation obtained after processing the Natural Language Query must be characteristic in nature. The level of testing in processing Natural Language Query into Meaningful Representations and to produce appropriate schema design according to provided database. Processing out SQL query out of the Meaningful Representation produced and the database provided requires very high testing probabilities. Graphical or Tabular representation of SQL output doesnt require a lot of high testing.

9.1 Type of Testing Used

9.1.1 Unit testing

Unit testing focuses verification effort on the smallest unit of the software design the software component or module. The important control paths are tested to uncover errors within the boundary of the module. The unit test is white-box oriented. In our software product the following components would undergo unit testing:

- Testing accuracy of image description received from vision API.
- Testing accessibility of the Android App.
- Testing on different devices for compatibility.
- Testing the hardware

9.1.2 Integration testing

Integration testing is a systematic technique for constructing the program structure while at the same time conducting tests to uncover errors associated with interfacing. The objective is to take unit tested components and build a program structure that has been dictated by design. Therefore after the unit testing of the individual modules, the integration of these modules would be carried out. The integration strategy used will be Bottom-Up Integration. Activities performed in integration of the system.

- Testing for communication failure.
- Testing for reliability
- Testing for real-time response of the system.

9.1.3 User acceptance testing

User Acceptance Testing is concerned with what is to be tested from the USERS viewpoint of what the system does. This is not a technical description of the software, but a USERS view of the functions.Activities performed in User acceptance of the system.

- Training the user and get feedback.
- Testing for the accessibility of the user
- Testing for efficiency in real-world environments.

CHAPTER 10

RESULTS

10.1 Screen shots

Outputs / Snap shots of the results

Figure 10.1: Prototype

10.2 Outputs

Outputs / Snap shots of the results

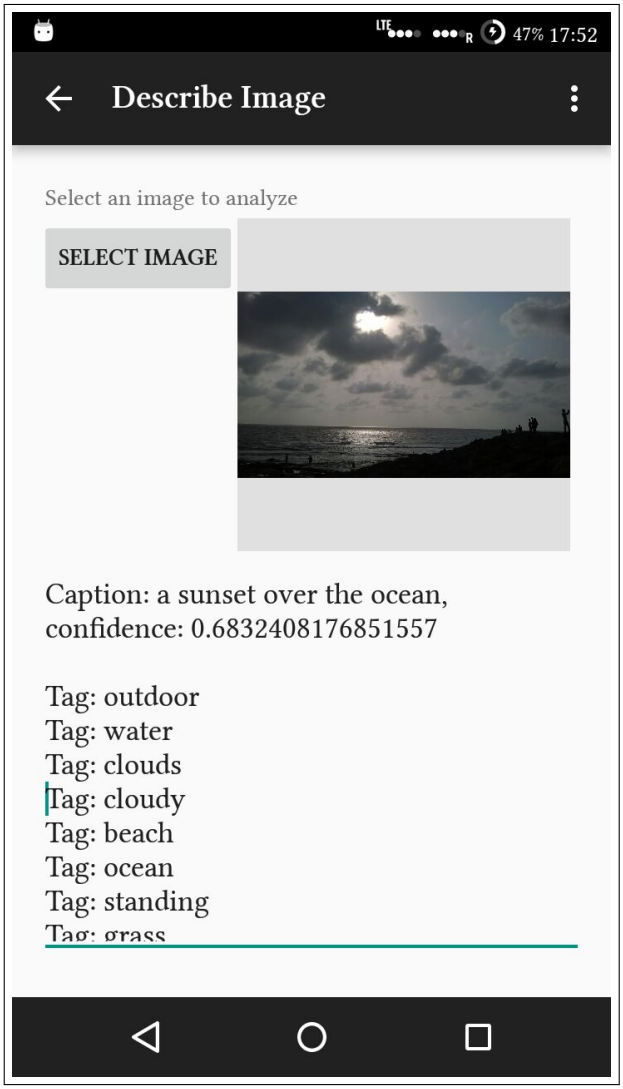

Figure 10.2: Output Given By Microsoft Vision API

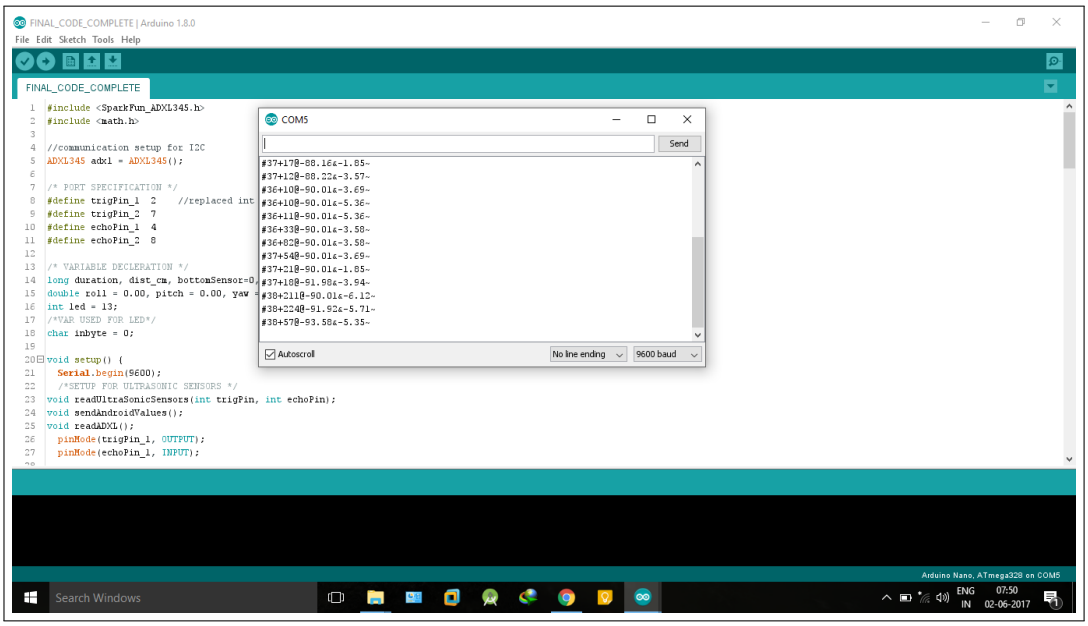

Figure 10.3: Data Send By Arduino

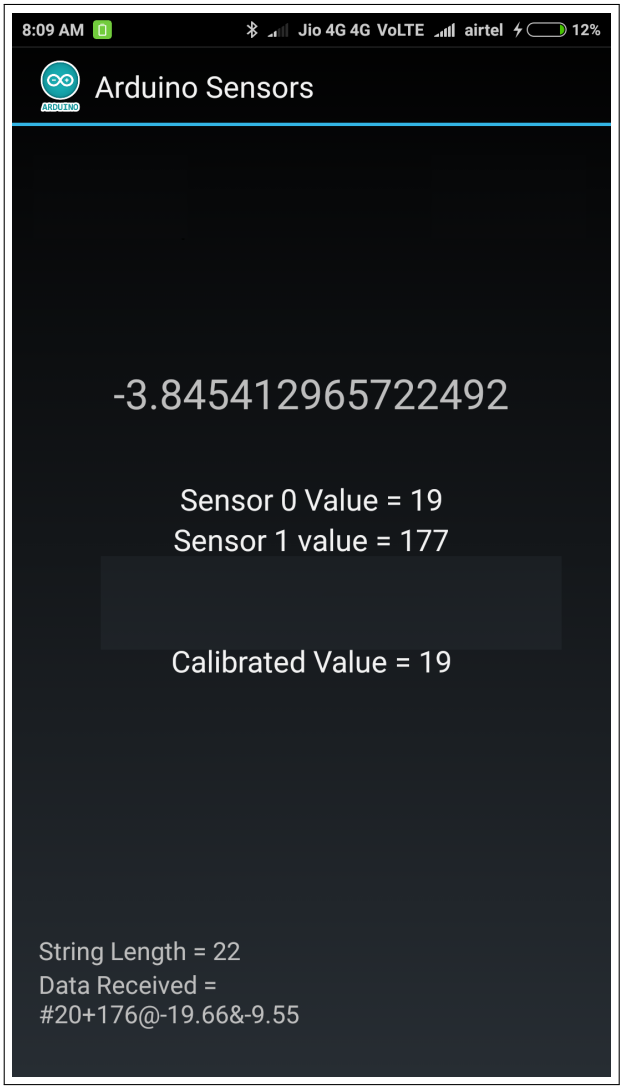

Figure 10.4: Data Received By Android

CHAPTER 11

DEPLOYMENT AND MAINTENANCE

11.1 Installation and un-installation

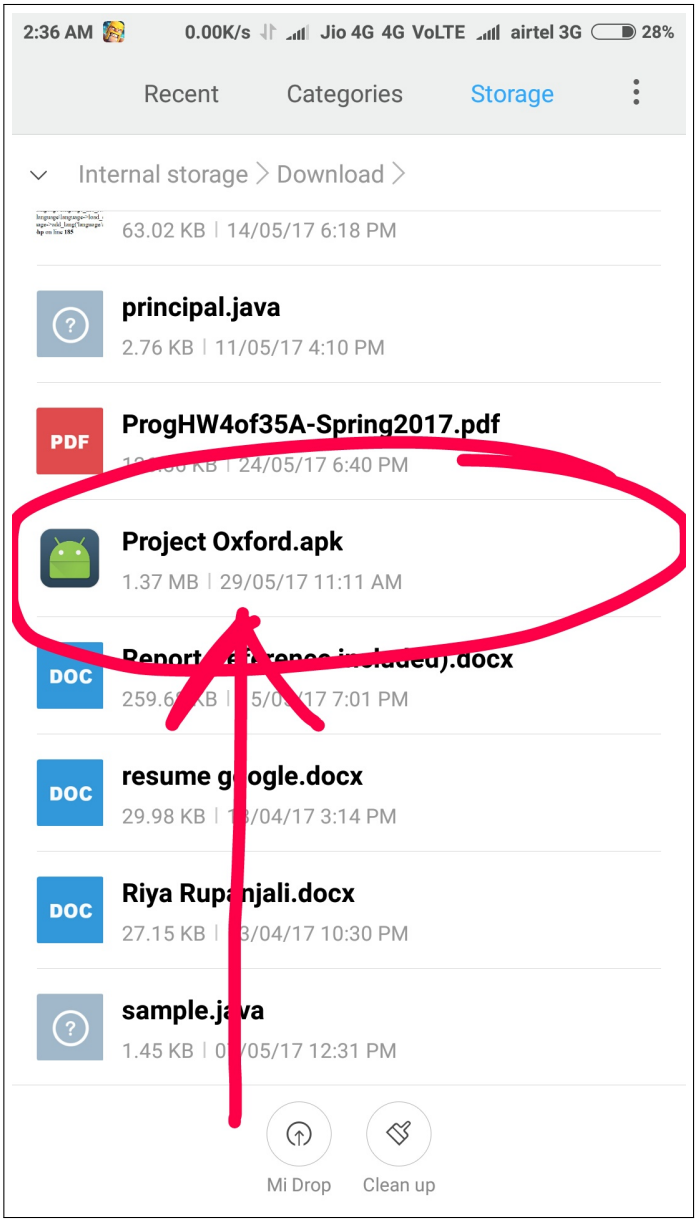

Figure 11.1: Installation Step 1

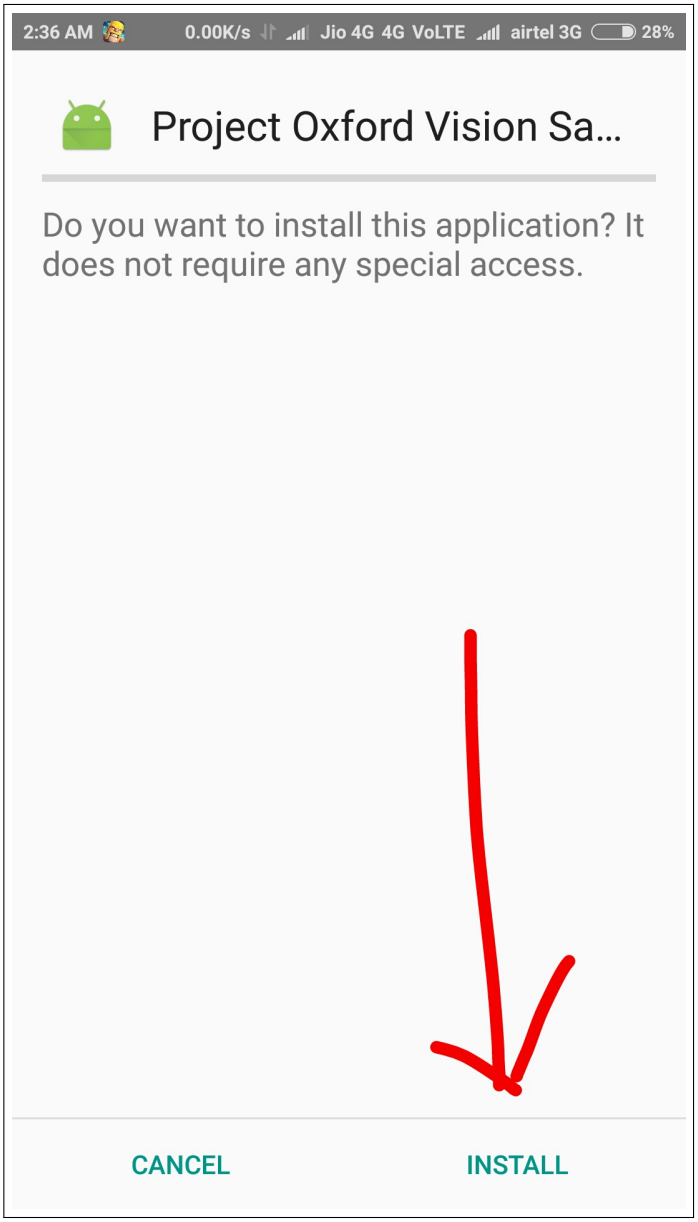

Figure 11.2: Installation Step 2

Figure 11.3: Installation Step 3

11.2 User Manual

- To use the cane, you need to power on the cane.
- Open android application, App will automatically pair it with the cane.
- Then calibrate the ground value by keeping cane straight facing downloadward.
- If there is beep sound then there is an obstacle in front of the user.
- If there is a sort vibration then there is bump.
- If there is a long vibration then there is a pothole.
- You can capture the image any time by pressing the volume down button to recognise the object in front of you.

CHAPTER 12

CONCLUSION AND FUTURE SCOPE

Summary

The system proposed, consist of two ultrasonic Sensor, accelerometer, blue-tooth,Smart-phone. Ultrasonic sensors are used to detect potholes, bumps on the ground, and obstacles in front of the user. Data from sensor are send to the Smart-phone via blue-tooth module mounted on the arduino board. Smart-phone the calculate the distance of the object and sends hepatic or audio output to the user. The User can take the snapshot of his surrounding using smart-phone camera. This image can be processed to Recognise the object in the image and can notify the user about it.

Conclusion

- This paper mainly focuses on to find the right balance between the affordability and efficiency of the ETAs.

- The system proposed in this paper is not only affordable but also efficient and simple in many ways.

- As the size of the stick is small it does not affect the mobility of the user.

- It overcomes some drawbacks of traditional mobility aids, which only focused on either potholes detection or on detecting objects in the front of the user.

- It overcomes some drawbacks of traditional mobility aids, which only focused on either potholes detection or on detecting objects in the front of the user.

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ANNEXURE A
LABORATORY ASSIGNMENTS

Assignment No:1

Title: Design suitable assignment for mobile programming Objectives:

- To learn the concept that how to create mobile application
- To study the representation and implementation of java and android studio

Theory:

1. Linux Kernel

The basic layer is the Linux Kernel. The whole Android OS is built on top of the Linux Kernel with some further architectural changes. Please don't get confused by the terms Linux and Linux Kernel. The term Kernel means the core of any Operating System. By saying Android is based upon Linux

Kernel, it doesn't mean that it is another Linux distribution. It is not like that. It simply means, Android at its core is Linux. But you can't run any linux packages on Android. It is a totally different OS. It is this Linux kernel that interacts with the hardware and it contains all the essential hardware drivers. Drivers are programs that control and communicate with the hardware. For example, consider the Bluetooth function. All devices has a Bluetooth hardware in it. Therefore the kernel must include a Bluetooth driver to communicate with the Bluetooth hardware. The Linux kernel also acts as an abstraction layer between the hardware and other software layers. As the Android is built on a most popular and proven foundation, the porting of Android to variety of hardware became a relatively painless task.

2. Libraries

The next layer is the Android's native libraries. It is this layer that enables the device to handle different types of data. These libraries are written in c or c++ language and are specific for a particular hardware.

Some of the important native libraries include the following:

Surface Manager: It is used for compositing window manager with off-screen buffering. Offscreen buffering means the apps can't directly draw into the screen, instead the drawings go to the off-screen buffer. There it is combined with other drawings and form the final screen the user will see. This off screen buffer is the reason behind the transparency of windows.

Media framework: Media framework provides different media codecs allowing the recording and playback of different media formats

SQLite: SQLite is the database engine used in android for data storage purposes

WebKit: It is the browser engine used to display HTML content

OpenGL: Used to render 2D or 3D graphics content to the screen

3. Android Runtime

Android Runtime consists of Dalvik Virtual machine and Core Java libraries.

Dalvik Virtual Machine

It is a type of JVM used in android devices to run apps and is optimized for low processing power and low memory environments. Unlike the JVM, the Dalvik Virtual Machine doesn't run .class files, instead it runs .dex files. .dex files are built from .class file at the time of compilation and provides hifger efficiency in low resource environments. The Dalvik VM allows multiple instance of Virtual machine to be created simultaneously providing security, isolation, memory management and threading support.

ART

Google has introduced a new virtual machine known as ART (Android Runtime) in their newer releases of Android. In Lollipop, the Dalvik Virtual Machine is completely replaced by ART. ART has many advantages over Dalvik VM such as AOT (Ahead Of Time) compilation and improved garbage collection which boost the performance of apps significantly.

Core Java Libraries

These are different from Java SE and Java ME libraries. However these libraries provides most of the functionalities defined in the Java SE libraries.

4. Application Framework

These are the blocks that our applications directly interacts with. These programs manage the basic functions of phone like resource management, voice call management etc. As a developer, you just consider these are some basic tools with which we are building our applications. Important blocks of Application framework are:

Activity Manager: Manages the activity life cycle of applications

Content Providers: Manage the data sharing between applications

Telephony Manager: Manages all voice calls. We use telephony manager if we want to access voice calls in our application.

Location Manager: Location management, using GPS or cell tower

Resource Manager: Manage the various types of resources we use in our Application

5. Application

Applications are the top layer in the Android architecture and this is where our applications are gonna fit into. Several standard applications comes pre-installed with every device, such as:

Conclusion:

Hence, we have successfully studied and implemented a simple application in mobile programming

Program :

```
import android.app.Activity; import android.net.wifi.WifiInfo;  import
android.net.wifi.WifiManager;  import android.os.Build;  import
android.os.Bundle;  import android.view.Menu;  import android.widget.TextView;


 public class MainActivity extends Activity {


 @Override  protected void onCreate(Bundle savedInstanceState) {
super.onCreate(savedInstanceState);  // setContentView(R.layout.activity_main);
TextView infoView = new TextView(this);  setContentView(infoView);

 WifiManager myWifiManager = (WifiManager) getSystemService(WIFI_SERVICE);
WifiInfo myWifiInfo = myWifiManager.getConnectionInfo();  int ipAddress =
myWifiInfo.getIpAddress();

 System.out.println("WiFi address is "

 + android.text.format.Formatter.formatIpAddress(ipAddress));


 String info = "System Info:\n".toUpperCase();


 info += "BOARD: " + Build.BOARD + "\n" + "BOOTLOADER: "  + Build.BOOTLOADER
+ "\n" + "BRAND: " + Build.BRAND + "\n"

 + "CPU_ABI: " + Build.CPU_ABI + "\n" + "CPU_ABI2: "

 + Build.CPU_ABI2 + "\n" + "DEVICE: " + Build.DEVICE + "\n"

 + "DISPLAY: " + Build.DISPLAY + "\n" + "FINGERPRINT: "

 + Build.FINGERPRINT + "\n" + "HARDWARE: " + Build.HARDWARE

 + "\n" + "HOST: " + Build.HOST + "\n" + "ID: " + Build.ID

 + "\n" + "MANUFACTURER: " + Build.MANUFACTURER + "\n"
```

```
+ "MODEL: " + Build.MODEL + "\n" + "PRODUCT: " + Build.PRODUCT
+ "\n" + "SERIAL: " + Build.SERIAL + "\n" + "TAGS: "
+ Build.TAGS + "\n" + "TIME: " + Build.TIME + "\n" + "TYPE: "
+ Build.TYPE + "\n" + "USER: " + Build.USER + "\n"
+ "My IP Address:" + ipAddress + "\n" + "Network ID: "
+ myWifiInfo.getNetworkId() + "\n" + "Mac Address: "
+ myWifiInfo.getMacAddress() + "\n" + "SSID: "
+ myWifiInfo.getSSID() + "\n"

+ "RadioVersion: " + Build.getRadioVersion() + "\n" + " \n";

infoView.setText(info);
}
```

ANNEXURE B
LABORATORY ASSIGNMENTS

Assignment No: 2

1. TITLE

A Mobile App for Calculator having Trigonometry functionality is to be designed and tested. The data storage uses 1.text files, 2. XML Use latest open source software modeling, Designing and testing tool/Scrum-it. Implement the design using HTML-5/Scala/Python/ Java/C++/Rubi on Rails. Perform Positive and Negative testing.

2. PREREQUISITES

- Android Studio
- Testing tool
- JAVA, XML

3. OBJECTIVE

- To study testing tool.
- To perform Positive and Negative testing.

4. THEORY Android Studio Overview

Android Studio is the official IDE for Android application development, based on IntelliJ IDEA.

On top of the capabilities you expect from IntelliJ, Android Studio offers:

- Flexible Gradle-based build system
- Build variants and multiple apk file generation
- Code templates to help you build common app features
- Rich layout editor with support for drag and drop theme editing
- lint tools to catch performance, usability, version compatibility, and other problems
- Pro Guard and app-signing capabilities
- Built-in support for Google Cloud Platform, making it easy to integrate Google Cloud Messaging and App Engine

- And much more

Android Project Structure

By default, Android Studio displays your project files in the Android project view. This view shows a flattened version of your project's structure that provides quick access to the key source files of Android projects and helps you work with the Gradle-based build system. The Android project view:

- Shows the most important source directories at the top level of the module hierarchy.
- Groups the build files for all modules in a common folder.
- Groups all the manifest files for each module in a common folder. • Shows resource files from all Gradle source sets.
- Groups resource files for different locales, orientations, and screen types in a single group

per resource type .java/ - Source files for the module.

manifests/ - Manifest files for the module.
res/ - Resource files for the module.
Gradle Scripts/ - Gradle build and property files.

Software testing is process of verifying and validating the software or application and checks whether it is working as expected. The intent is to find defects and improve the product quality. There are two ways to test the software viz, **Positive Testing** and **Negative Testing**.

Positive testing can be performed on the system by providing the valid dataas input. It checks whether an application behaves as expected with the positive input. This is to test to check the application that does what it is supposed to do so. There is a text box in an application which can accept only numbers. Entering values up to 99999 will be acceptable by the system and any other values apart from this should not be acceptable. To do positive testing, set the valid input values from 0 to 99999 and check whether the system is accepting the values.

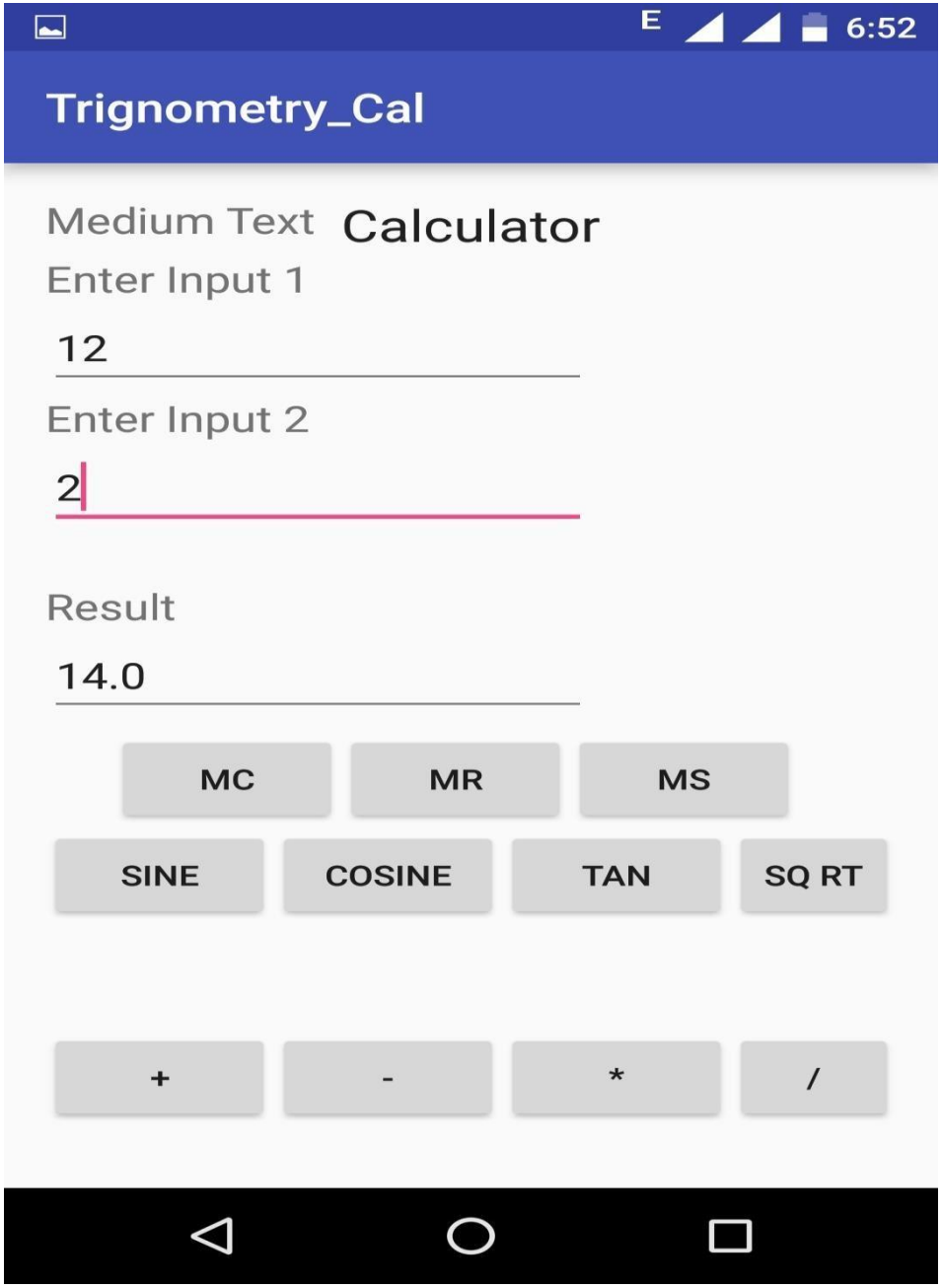
Negative Testing can be performed on the system by providing invalid data as input. It checks whether an application behaves as expected with the negative input. This is to test the application that does not do anything that it is

not supposed to do so. For example - Negative testing can be performed by testing by entering alphabets characters from A to Z or from a to z. Either system text box should not accept the values or else it should throw an error message for these invalid data inputs.

Program :

```
package com.example.dypiemr_.trignometry_cal;
import
android.support.v7.app.AppCompatActivity;
import android.os.Bundle;  import
android.view.View;  import android.widget.Button;
import android.widget.EditText;
public class MainActivity extends AppCompatActivity implements View.OnClickListener
{  private
Button
btnsin,btncos,btntan,btnadd,btnsub,btnmul,btndiv,btnSqrt,btnatan,btnSav,btnRec,btnClr;
private EditText etnum,etres,etnum2;  private static double memoryValue,inputvalue;
@Override
protected void onCreate(Bundle savedInstanceState) {
super.onCreate(savedInstanceState);
setContentView(R.layout.activity_main);
init();  }
private void init(){
btnsin=(Button)findViewById(R.id.btnSin);
btncos=(Button)findViewById(R.id.btnCos);
btntan=(Button)findViewById(R.id.btnTan);
btnadd=(Button)findViewById(R.id.btnAdd);
btnsub=(Button)findViewById(R.id.btnSub);
btnmul=(Button)findViewById(R.id.btnMult);
btndiv=(Button)findViewById(R.id.btnDiv);
btnSqrt=(Button)findViewById(R.id.btnsqrt);
btnClr=(Button)findViewById(R.id.btnclr);
btnRec=(Button)findViewById(R.id.btnmr);
btnSav=(Button)findViewById(R.id.btnms);
etnum=(EditText)findViewById(R.id.etNum);
etnum2=(EditText)findViewById(R.id.etNum2);
etres=(EditText)findViewById(R.id.tvResult);
btnsin.setOnClickListener(this);
btncos.setOnClickListener(this);
btntan.setOnClickListener(this);
btnadd.setOnClickListener(this);
btnsub.setOnClickListener(this);
btnmul.setOnClickListener(this);
btndiv.setOnClickListener(this);
btnSqrt.setOnClickListener(this);
btnClr.setOnClickListener(this);
```

```
btnRec.setOnClickListener(this);
btnSav.setOnClickListener(this);
}
public void onClick(View view){  String
num1=etnum.getText().toString();
switch(view.getId()){  case R.id.btnSin:
double sin= Math.sin(Double.parseDouble(num1));
etres.setText(String.valueOf(sin));     break;     case
R.id.btnCos:
double Cos=Math.cos(Double.parseDouble(num1));
etres.setText(String.valueOf(Cos));  break;  case
R.id.btnTan:
double Tan=Math.tan(Double.parseDouble(num1));
etres.setText(String.valueOf(Tan));
break;  case R.id.btnSub:
double sub=Double.parseDouble(etnum2.getText().toString())-Double.parseDouble(num1);
etres.setText(String.valueOf(sub));  break;  case R.id.btnAdd:  double
add=Double.parseDouble(etnum2.getText().toString())+Double.parseDouble(num1);
etres.setText(String.valueOf(add));  break;  case R.id.btnMult:
double mul=Double.parseDouble(etnum2.getText().toString())*Double.parseDouble(num1);
etres.setText(String.valueOf(mul));  break;  case R.id.btnDiv:
double div=Double.parseDouble(etnum2.getText().toString())/Double.parseDouble(num1);
etres.setText(String.valueOf(div));  break;  case R.id.btnsqrt:
double sqrt=Math.sqrt(Double.parseDouble(num1));
etres.setText(String.valueOf(sqrt));
break;  case R.id.btnclr:
memoryValue = Double.NaN;  etres.setText("data
cleared");  break;  case R.id.btnmr:
if (Double.isNaN(memoryValue)) {
etres.setText("no data");
}  else
etres.setText(String.valueOf((int)memoryValue));  break;
case R.id.btnms:  inputvalue=
Double.parseDouble(etres.getText().toString());  if
(Double.isNaN(inputvalue)){  etres.setText("no data");}
else {
memoryValue = inputvalue;
etres.setText(String.valueOf(memoryValue));}  break;
}
}
            }
```


6:52
Trignometry_Cal
Medium Text
Calculator
Enter Input 1
12
Enter Input 2
2
Result
14.0
MC
MR
MS
SINE
COSINE
TAN
SQ RT
+
-
*
/

ANNEXURE C
PROJECT PLANNER

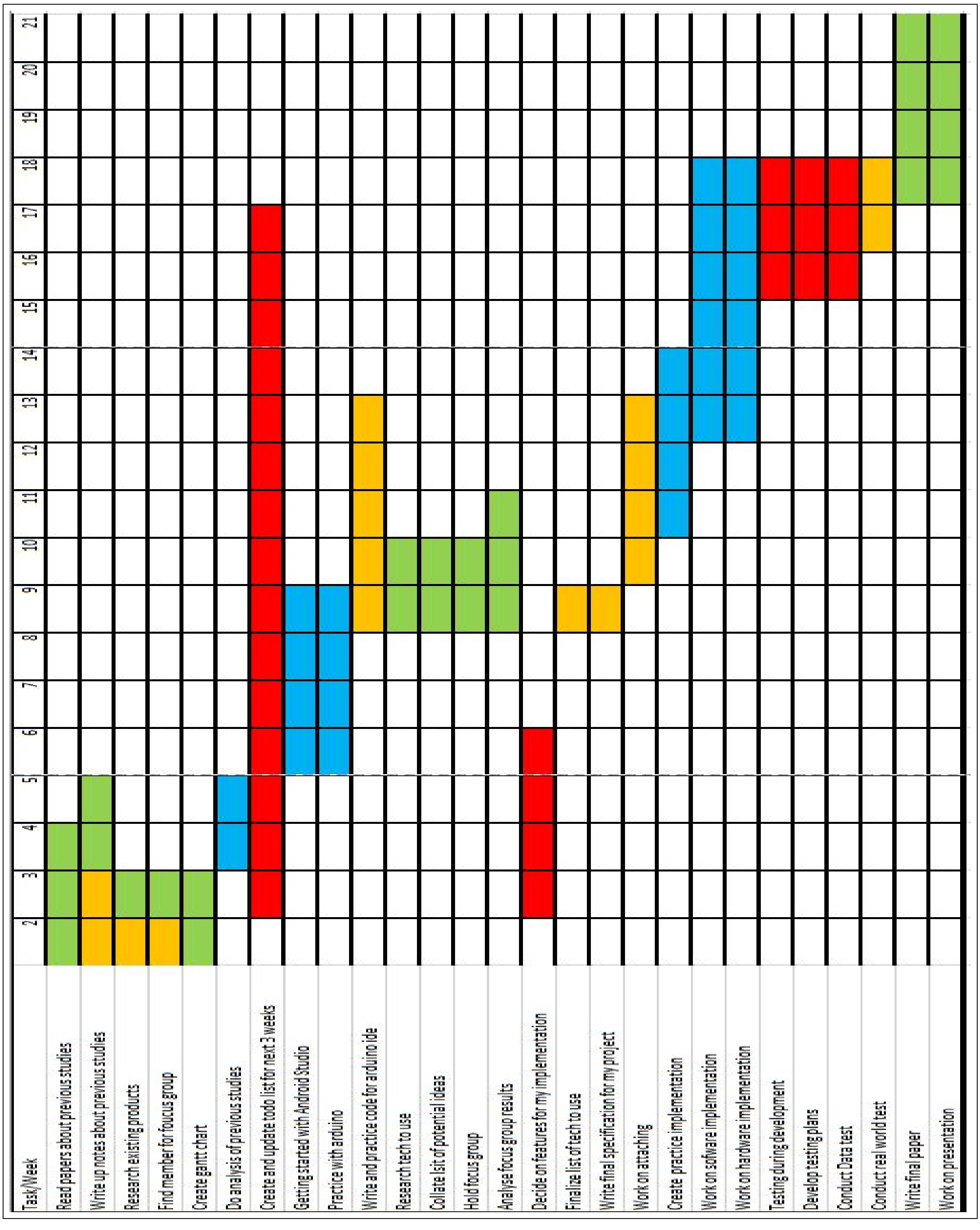


Figure C.1: Project Plan

ANNEXURE D

REVIEWERS COMMENTS OF PAPER SUBMITTED

1. Paper Title: Smart-Phone Based Obstacle Detection For Visually Impaired People
2. Name of the Conference/Journal where paper submitted : ICIIECS,2017
3. Paper accepted/rejected : Accepted
4. Review comments by reviewer :
   (a) Add more reference to the paper (if possible)
   (b) All the reference must be cited properly
   (c) The UNIQUENESS of the paper should be increased up to 80% by reducing the plagiarism, to set a better chance of publishing your paper in IEEE Digital Library.

ANNEXURE E
PLAGIARISM REPORT

Plagiarism Checker X Originality Report

Similarity Found: 18%

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Smartphone-based Obstacle Detection for Visually Impaired People 1. Samir Patel Department of Computer Engineering, Sinhgad Institute of Technology, Lonavala Affiliated to Savitribai Phule Pune University Pune (City), Maharashtra, India patelsamir24@hotmail.com 3.

Pradeep Yadav Department of Computer Engineering, Sinhgad Institute of Technology, Lonavala Affiliated to Savitribai Phule Pune University Pune (City), Maharashtra, India pradeep.yadav1405@gmail.com 5. Dipali Patil Professor, Department of Computer Engineering, Sinhgad Institute of Technology, Lonavala Affiliated to Savitribai Phule Pune University Pune (City), Maharashtra, India dipalipatil539@gmail.com 2.

Amit Kumar Department of Computer Engineering, Sinhgad Institute of Technology, Lonavala Affiliated to Savitribai Phule Pune University Pune (City), Maharashtra, India amitkumar457@hotmail.com 4. Jay Desai Department of Computer Engineering, Sinhgad Institute of Technology, Lonavala Affiliated to Savitribai Phule Pune University Pune (City), Maharashtra, India jmd.desai08@gmail.com Abstract — A blind person walking in an unfamiliar environment faces many problems, this issue may be of identifying true obstacle or may be of identifying potholes, bumps in his way. In pa stfewydifferetyes ETA's ve endop helping visually impaired people. Regess vus savabl stillnot affordable to the majority of blind people.

And most of these ETA's uses n nlyonprm i.e. either pot-hole detection or obstacle in front of the user. Apart from that, they do not provide information about the environment in which user is present. This paper describes a real-time system which makes use of the ultrasonic sensor, camera, and smartphone for detection, recognition and processing of objects that hinders the path of visually impaired person.

Ultrasonic sensors detect and measure the distance of obstacle while image captured from a camera is used for object recognition. The output given to the user is in the form of vibration and audio. The intensity of the output depends on the distance of an object from the user. Keywords — Visually impaired, Ultrasonic sensors, Smartphone,Electronic Travel Aids (ETA), Real-time System. I. INTRODUCTION According to W.H.O

(World Health Organization), there are approximately 285 million people who are visually impaired out of which 39 million are blind and 246 million have low vision (Fig.1). About 90% of the world ' s visually impaired have low income [1]. There is a constant need of an assistive device for them. There is a broad range of navigation sm ndEA's e ailabfo lliair individuals. White cane and Guide Dogs are the primary tools preferred by a visually impaired person.

But they have some limitations, For example- Guide Dogs are not allowed in some places. White canes have a shorter range. They cannot detect obstacle above ground level such as tree branches or open window etc. Apart from that there are various EA's (Electro nic rAid ailabin mar ut he polem h T t if it is effective then it is very costly and is not affordable by 90% of visually impaired individuals as they have low income. If it is affordable,then it is not effective.

The main paradigm that we focus on is to find the balance bweethe fraby ndeffy f EA'andtus providing assistance to more and more visually impaired individuals. The main concept simply focuses on the calculation of the distance of the obstacle from the user and providing the haptic and audio to the user. Apart from that using Smartphone camera, the user can be made familiar to the surrounding.

Image Processing approach such as edge detection or texture detection combined with machine learning concept for recognizing the objects in the image. Fig. 1 Visually impaired of Disability population This paper is categories as follows: Section 2 is for Literature Survey, Section 3 is for System Overview, Section 4 is for Conclusion. II.

LITERATURE SURVEY Ithe thrdes, EThave een introduced that aimed at improving the lifestyle of their blind userin ms f bandrecoobjects their surrounding. This section mainly concentrates on the study of dif ferent ETavailabin mar A. Echolocation This System made use of two Ultra-sonic sensors attached to conventional eyeglasses [2].

The data from these sensors where down-converted to a stereo audible sound using microprocessor and A/D converter. The different intensities andtime ifferothe e?ec undwa transmitted by the sensors give the different directions and sizes of obstacles,

creating a form of localized sound images. But the problem was that it required a lot of training. B.

Navbelt Navbelt is a guidance system which uses a mobile robot obstacle avoidance system [3]. The system consisted of ultrasonic range sensors, a computer, and a headset. The computer receives data from the eight ultrasonic sensors and creates a map of the angles and the distance of any object at this angle.

Different sounds were produced for each mode depending upon the direction of the obstacle. The disadvantage of this system is that it is bulky and user required extensive training period. C. Guide Cane Guidecane is an updated version of Navbelt [4].A guide cane consists of a handle which is connected to the main device which contains wheels, ultrasonic sensors, a steering mechanism and a computer.

The user moves with Guidecane, and when an obstacle is found the obstacle avoidance algorithm selects a different direction until the obstacle is cleared and a route is resumed. The disadvantages are the limited scanning area since, small or hanging objects like pavements or tables cannot be identified and that the prototype is bulky ,dfult toho rcarwhn d. D.

FIU Project This project is an obstacle detection system that uses 3-D spatialized sounds (HRTF), based on readings from a multidirectional sonar system [5]. The prototype consist of two subsystems: the sonar and compass control unit, which content six ultrasonic sensors pointing in the six radial directions around the user, a microcontroller; and the 3-D sound translation engine, which is consisted of headphones and PDA equipped with software capable of processing information from the sonar and compass control. This system lacks navigation speed and the design of the ranging unit is not ergonomic. E.

Tactile Vision System This wearable device converts visual information into the tactile signal to help visually impaired people self-navigate through obstacle avoidance [6].The prototype consisted of a tactor-belt with 14 vibrator motors spaced laterally, a camera belt with two web cameras attached and a portable computer carried in a backpack.

The drawback is that it cannot differentiate between hanging and ground obstacles. F. AVSB A cheap guidance system based on a microcontroller for facilitating visually impaired people [7]. Ultrasonic sensors are used to anticipate distance of the obstacles around the blind person to advise the user towards the available path.

The output is in the form of voice which the blind person can hear e.g., right, left. The

disadvantage of this system is that it blocks the daily routine hearing of visually impaired individuals. G. 3-D CMOS sensor based ETA This device provides a binaural acoustic image representation [8].

The environmental information acquisition system is based on an array of lx64 CMOS Time-of-Flight sensors. The disadvantage is that it uses CMOS sensor which is insensitive in low light. III. SYSTEM OVERVIEW The proposed system consists of two ultrasonic sensors, Arduino Nano, a Bluetooth module, an accelerometer and a smartphone application, smartphone camera. Two ultrasonic sensors are attached to 1 feet long stick.

One at the bottom of the stick and a Second sensor is attached to the stick facing the front side of the user (Fig. 2). There is two type of detection taking place in this system. First is for potholes and bumps detection on the ground level. In this we store the distance of ground from the stick during calibration process in database using accelerometer and ultrasonic sensor and then while using this device whenever the distance stored in the database is more than the current value obtained by the sensor then we say that there is a bump on the ground and if the current distance is more than the value stored in the database then we say that a pothole is there.

In the second type of detection, we just use the second ultrasonic sensor to calculate the distance of obstacle in the front of the user. The Smartphone camera is used to recognize the object in the surrounding of the user using image processing technique. A. System Architecture Fig. 2 System Architecture In this system, ultrasonic sensors are mounted on Arduino Nano board, which also consists of Bluetooth module and accelerometer.

The data from the ultrasonic sensor is sent to the smartphone via Bluetooth module. Then the application on the smartphone processes this data using obstacle detection algorithm and provides vibration or audio feedback to the user as an output. The User can also take a picture of the environment to know about the surrounding. This is done by using smartphone camera.

The picture taken from the smartphone is then processed to recognize the object in the image using various image-processing techniques such as edge detection or texture detection algorithms. B. Working During the calibration process, the user is asked to move his arm while carrying the stick from 0-45 degree so that the distance of the ground from the stick at each angle using accelerometer can be stored in the database of the mobile application.

Now when next time user uses this stick, the ultrasonic sensor attached to the stick facing the front side of the user will calculate the distance of an obstacle from the user and notify the user about the distance using an audio signal. At the same time the Second ultrasonic sensor will find the distance of the ground from the user and send it to the application via Bluetooth this distance will be compared with the stored value in the database to decide whether it is a bump or a pothole.

After the detection of potholes or bumps vibrational output will be given to the user. Apart from that, whenever the user wants to know about the surrounding environment he can just take a picture using his smartphone and the application will process that image to provide him the detailed information about his surroundings. IV.

CONCLUSION This paper mainly focuses on to find the right balance between the affordability an defy f he Ts. The system proposed in this paper is not only affordable but also efficient and simple in many ways. As the size of the stick is small, it does not affect the mobility of the user. A user can easily carry the stick with him.

It overcomes some drawbacks of traditional mobility aids, which only focused on either potholes detection or on detecting objects in the front of the user. This system can detect both of the obstacles efficiently and can also provide the information about the surrounding of the user. V. ACKNOWLEDGEMENTS In this paper, we thank our guide Prof. Dipali Patil for the valuable information, feedback and comments. We would also like to thank Prof.S.D.Babar and Prof T.J.Parvat who have helped us immensely and contributed their time and idea to this research. REFERENCES [1] WHO Fact Sheet of Visual impairment and blindness.

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ANNEXURE F

TERM-II PROJECT LABORATORY ASSIGNMENTS

Assignment No: 3

TITLE

To understand Arduino IDE and implement the blinking of LEDs .

Parts Needed

- 1x Breadboard
- 1x RedBoard or Arduino Uno R3
- 1x LED
- 1x 330Ω Resistor
- 2x Jumper Wires

THEORY

LEDs are small, powerful lights that are used in many different applications. To start off, we will work on blinking an LED, the Hello World of microcontrollers. That's right - it's as simple as turning a light on and off. It might not seem like much, but establishing this important baseline will give you a solid foundation as we work toward more complex experiments.

Arduino is an open source, computer hardware and software company, project, and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical world. The project's products are distributed as open-source hardware and software, which are licensed under the GNU Lesser General Public License (LGPL) or the GNU General Public License (GPL), permitting the manufacture of Arduino boards and software distribution by anyone. Arduino boards are available commercially in preassembled form, or as do-it- yourself kits.

Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (*shields*) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers. The microcontrollers are typically programmed using a dialect of features from the programming languages C and C++. In addition to using traditional compiler toolchains, the Arduino project provides an integrated development environment (IDE) based on the Processing language project.

The Arduino project started in 2003 as a program for students at the Interaction Design Institute Ivrea in Ivrea, Italy, aiming to provide a low-cost and easy way for novices and professionals to

create devices that interact with their environment using sensors and actuators. Common examples of such devices intended for beginner hobbyists include simple robots, thermostats, and motion detectors.

The name *Arduino* comes from a bar in Ivrea, Italy, where some of the founders of the project used to meet. The bar was named after Arduin of Ivrea, who was the margrave of the March of Ivrea and King of Italy from 1002 to 1014.

Software Development

A program for Arduino may be written in any programming language for a compiler that produces binary machine code for the target processor. Atmel provides a development environment for their microcontrollers, AVR Studio and the newer Atmel Studio.

The Arduino project provides the Arduino integrated development environment (IDE), which is a cross-platform application written in the programming language Java. It originated from the IDE for the languages *Processing* and *Wiring*. It includes a code editor with features such as text cutting and pasting, searching and replacing text, automatic indenting, brace matching, and syntax highlighting, and provides simple *one-click* mechanisms to compile and upload programs to an Arduino board. It also contains a message area, a text console, a toolbar with buttons for common functions and a hierarchy of operation menus.

A program written with the IDE for Arduino is called a *sketch*. Sketches are saved on the development computer as text files with the file extension *.ino*. Arduino Software (IDE) pre-1.0 saved sketches with the extension *.pde*.

The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub *main()* into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution. The Arduino IDE employs the program *avrdude* to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware.

A minimal Arduino C/C++ sketch, as seen by the Arduino IDE programmer, consists of only two functions:

- *setup()*: This function is called once when a sketch starts after power-up or reset. It is used to initialize variables, input and output pin modes, and other libraries needed in the sketch.
- *loop()*: After *setup()* has been called, function *loop()* is executed repeatedly in the main program. It controls the board until the board is powered off or is reset.

Most Arduino boards contain a light-emitting diode (LED) and a load resistor connected between pin 13 and ground, which is a convenient feature for many tests and program functions. A typical program for a beginning Arduino programmer blinks a LED repeatedly.

```
#define LED_PIN 13          // Pin number attached to LED.

void setup() {
   pinMode(LED_PIN, OUTPUT);   // Configure pin 13 to be a digital output.
}

void loop() {
   digitalWrite(LED_PIN, HIGH);    // Turn on the LED.
   delay(1000);              // Wait 1 second (1000 milliseconds).
   digitalWrite(LED_PIN, LOW);    // Turn off the LED.
   delay(1000);              // Wait 1 second.
}
```

This program uses the functions *pinMode()*, *digitalWrite()*, and *delay()*, which are provided by the internal libraries included in the IDE environment. The program is usually loaded in the Arduino by the manufacturer.

PROGRAM

```
void setup()
{
    pinMode(13, OUTPUT);
}
void loop()
{
  digitalWrite(13, HIGH);   // Turn on the LED
  delay(1000);              // Wait for one second

  digitalWrite(13, LOW);    // Turn off the LED

  delay(1000);              // Wait for one second
}
```

CONCLUSION

We learned about the Arduino ide and implemented blinking of leds on Arduino.

ANNEXURE G

INFORMATION OF PROJECT GROUP MEMBERS

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8. Paper Published : Smart-Phone Based Obstacle Detection For Visually Impaired People (ICIIECS)

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