SMART NAVIGATION APPLICATION FOR VISUALLY IMPAIRED PEOPLE

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Project Proposal Report

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DECLARATION

I declare that this is my own work and this proposal does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other university or Institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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The above candidate has carried out research for the B. Sc Dissertation under my supervision.

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ABSTRACT

Due to the technological advancement of various automated systems, the field of personal identification has gained a lot of attention and is currently being implemented in several sectors of the working industry such as employee verification, law enforcement activities and many others. Personal identity of an individual consists of unique biometric characteristics which enables a person to possess a unique digital identity. Aspects of an individual's facial features ranging from the face structure to even the most sensitive features such as eye color have made face verification systems more accurate in positively identifying an individual. Society consists of many gifted individuals however, when it comes to the portion of the less fortunate such as visually impaired individuals, among the many difficulties that they face in their day to day lives, it is unfortunate that they are unable to identify or locate their family members, relatives, or friends within a crowd or even their own household. If they are ever faced with a situation that requires the assistance of their beloved ones, it is important that they can locate any known person in the vicinity as soon as possible to avoid any sort of harmful situation. Although there are many facial detection systems that have been setup to assist ordinary citizens, there is a significant lack in systems to assist the less fortunate, therefore we proposed a system to assist visually impaired people to navigate safely and smartly through features such as facial recognition of family members and friends.

Keywords: Image Processing, Face Detection, Machine Learning

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

1.1 Background

One of the most important organs that we possess are our eyes, where we achieve almost eighty percent of our natural perception, and it also plays out a major supporting role to our other sensory organs. It acts as a sensory base where we build up our mobility, navigation and other important survival instincts. While most of the people in the world have been blessed with proper eyesight, there exists a community who suffers from a disability named as visual impairment and therefore struggles to build the life that they desire due to poor vision, lack of environmental identification and have trouble in navigation as well. Though this shortcoming is overcome to a certain extent by the visually impaired people through heightened other senses such as good hearing and navigation using the palms of the hands, they eventually face a roadblock when it comes to reaching further heights in their lives.

There are many supporting systems in place to assist the visually impaired community such as walking sticks and Electronic Travel Aids (ETA). With the technological advancement of the current world and the ever-growing need for improved technical devices, the concept of image

processing plays a major role in producing the next generation of ETAs with more advanced features to assist the visually impaired community. Image processing can be considered as one of the major advancements in automated systems where it allows the image to be processed under various operations to get an output of an enhanced image or to obtain valuable information from it. In the present society, the concept of image processing is applied in various sectors ranging from personal identification to making strides in medical technology as well. With the advancement of automated systems, the field of image processing has created a huge impact on the modern society allowing an individual to have a unique digital identity based on various facial features and other unique characteristics.

The current automated systems which are utilized for daily activities are mostly focused on individuals without any form of disability such as employee verification and such. However, through various research activities, it is found that this concept can be applied to assist the less fortunate as well. There is an increase in the need for automated systems to assist people with various disabilities such as vision impairment, physical disability and many others. This system is primarily focused on the concept of smart navigation for visually impaired people.

There are various systems that have been implemented to aid people with this disability but however, there are several factors that have caused only a handful of people to acquire this assistance such as the high price factor in the technology and systems only having a few useful features. This situation creates a need for a system that not only appeals to a large crowd of people with disabilities but also one that is affordable to a reasonable rate.

One of the key features of this system is to be able to identify family members or friends of the user through real time image processing where it accesses the user's database and filters through previously uploaded images of key individuals of the user and provides a confirmation signal when it successfully locates a known individual of the user. This technique allows the user to overcome problems such as being able to easily locate a known person in a crowded environment or to locate anyone if they are ever in a state of emergency. As the system is fully automated, it helps to overcome any drawbacks of any existing systems and also has many new features that the current systems do not possess in its entirety.

1.2 Literature Survey

Recent studies on global health estimate that 217 million people suffer from visual impairment, and 36 million from blindness [1]. Due to the unfortunate circumstances faced by these individuals, their daily activities such as doing everyday tasks, moving from place to place have become much more difficult to deal with. Vision is an essential factor for a person to perform activities such as survey the environment, recognize different objects and to understand the environment that they live in.

There have been several approaches undertaken by various researchers to assist the visually impaired individuals in the society. Concepts such as navigation, object detection and guidance are the primary focus of tackling these difficulties faced by visually impaired people. However, most of the systems that are in place are yet to be proved as safe, cost effective and accurate.

Over the last 70 years, researchers have worked on various prototypes of electrical obstacle detection devices for BVI people known as electronic travel aids (ETA). This was mainly caused by the fast development of radar and sonar systems, which was encouraged by the Second World War. Some of the most representative prototypes are Leslie Kay's sonar-based Sonic Torch and Binaural Sonic Guide.

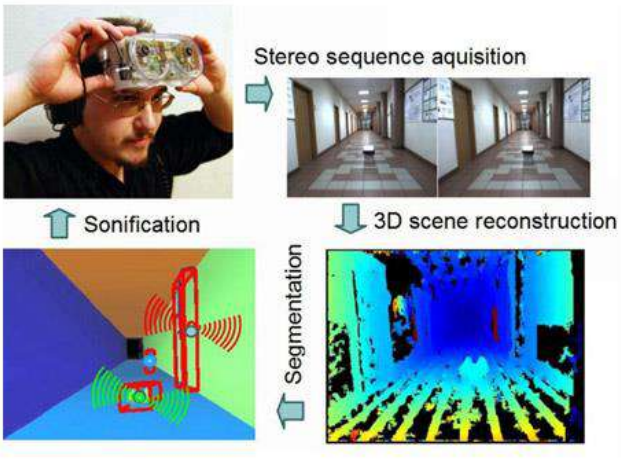


Figure 1.2.1 Electronic Travel Aid (EDA) using Sonar Concept and 3D reconstruction.

Figure 1.2.2 Prototype ETA used by visually impaired person in obstacle avoidance

The main reason why most of these first devices worked with ultrasonic signals instead of optic or radio frequency seems to lie in propagation speed [2], the large reflection delay of sound waves allowed them to be used for distance measurements (sonar). On the other hand, systems like Laser Cane [3], resorted to techniques such as optical triangulation that resulted in less precision. Other renowned sonar-based devices developed in the 1960s and 1970s were Russell's PathSounder [4], the Nottingham Obstacle Detector [5], (Blind Mobility Research Unit, Nottingham University) and the Mowat Sensor [6]. All of them had similar characteristics, differing mainly in beam width and user interface, where the latter used sounds and/or vibrations to inform the user about the presence or absence of obstacles and, sometimes, even allowed them to make range estimations. Later, in the 1980s, ETA gradually began to add processing capabilities to their designs, allowing them to further expand, filter, or make judgements about the sensors' collected data (e.g., Sonic Pathfinder [7]).Also, user interfaces were improved by making them more efficient and user-friendly (e.g., by including recording speech [8]).

Sighted people often have the best of intentions when they want to help a blind person navigate, but their well-meaning is also often coupled with a lack of knowledge and understanding about how a person navigates without vision [9].

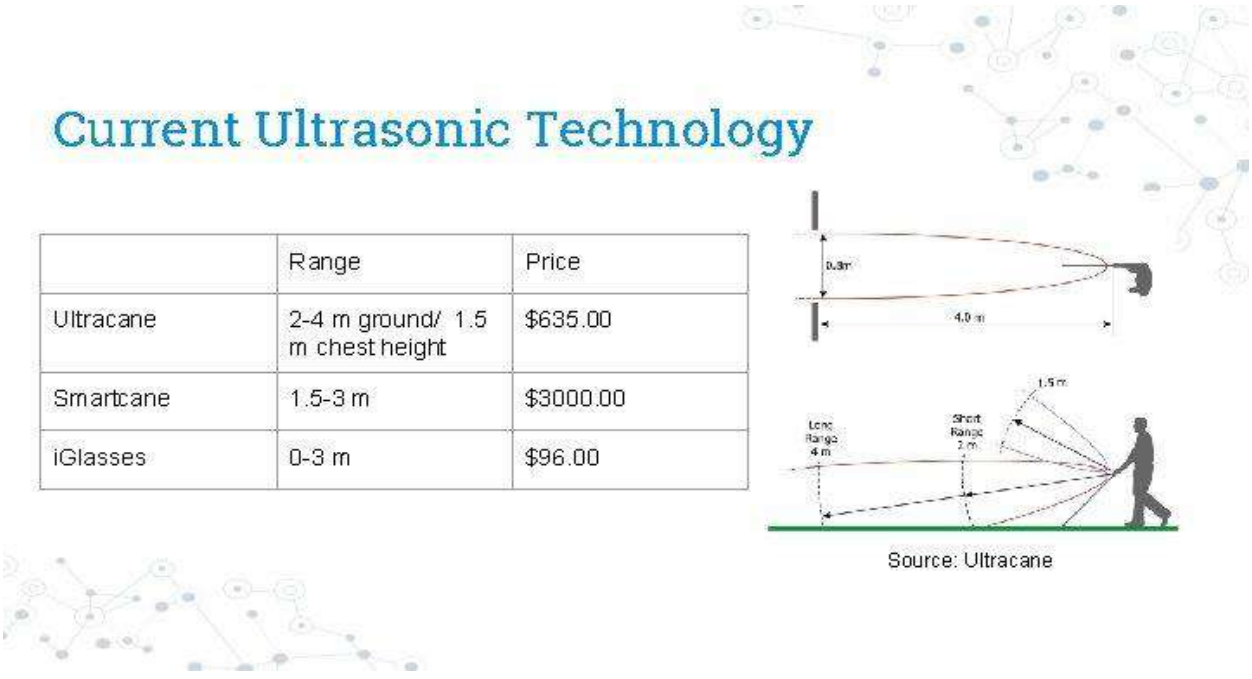


Figure 1.2.3 Comparison image for current EDAs and range for each device.

The initial systems that were introduced to assist the visually impaired people primarily focused on providing obstacle avoidance support. For instance, Bat K Cane [10] is a commercial sonar-based ETA designed by Leslie Kay et al. after SonicGuide. Other similar examples are UltraCane and MiniGuide [11], a built-in cane and hand-held device, respectively. These make use of vibrations to provide the user with adapted data from the ultrasound transductors.

1.3 Research Gap

The technological innovations during the past few decades have neglected the fact that there is still a need to assist blind people's navigational requirements. Various solutions have been to support the visually impaired community using technologies such as ultrasound, image processing and other technologies but the problem still remains as many of these devices are of high cost and only available in certain countries where there is advanced technology. Many computer-vision problems remain unsolved due to external environmental challenges caused by cluttered background, occluded objects, the change in illumination and other constraints.

Given below are some of the current technologies and devices that have been implemented to support the visually impaired people.

- **A Static Hand Gesture and Face Recognition System for Blind People -** Hand gesture recognition system and face recognition system has been implemented using which various tasks can be performed. Dynamic images are being taken from a dynamic video and is being processed according to certain algorithms.
- **Smartphone based face recognition tool for the blind -** The tool utilizes Smartphone technology in conjunction with a wireless network to provide audio feedback of the people in front of the blind user.
- **Ultrasonic smart glasses for blind -** This device includes a pair of glasses and an obstacle detection module fitted in it in the center, a processing unit, an output device i.e. a beeping component, and a power supply.
- **Intelligent eye: A mobile application for assisting blind people -** The application provides assistance to visually impaired people by providing a set of useful features: light detection, color detection, object recognition, and banknote recognition.
- **Third Eye: An Eye for the Blind to Identify Objects Using Human-Powered Technology -** The proposed solution is developing a mobile application that uses human-powered technology to help the visually impaired cope with the many challenges

they face. This application is developed using an Arabic language interface to enhance the content of Arabic mobile applications and targets Arabic blind users

Features	A	B	C	D	E	F
Face identification	✓	✓	✓	✗	✗	✓
Color detection	✓	✓	✓	✓	✗	✓
Inbuilt voice output system	✓	✗	✓	✓	✓	✓
Realtime distance estimation	✗	✗	✗	✗	✗	✓

A - Static Hand Gesture and Face Recognition System for Blind People

B - Smartphone based face recognition tool for the blind

C - Ultrasonic smart glasses for blind

D - Intelligent eye: A mobile application for assisting blind people

E - Third Eye: An Eye for the Blind to Identify Objects Using Human-Powered Technology

F – Current Research Project and Solutions

1.4 Research Problem

Vision is one of the most essential senses that an individual possesses, where they would learn to adapt to their surroundings and learn basic life skills. Visual impairment is a disability that is prevalent around many individuals in the current society and though there are several helping

tools that have been invented to assist this community, most of them require large amounts of capital and contains very few necessary features.

When considering the solutions that have been implemented to support the visually impaired community, the use of Electronic Travel Aids (EDA) has become immensely popular.

2 OBJECTIVES

2.1 Main Objectives

The main objective of this system is to provide assistance for the visually impaired people in the community so that they may be able to carry out their day-to-day activities in a more efficient and safe manner through features such as obstacle detection, safe navigation and face detection for relatives and friends.

2.2 Specific Objectives

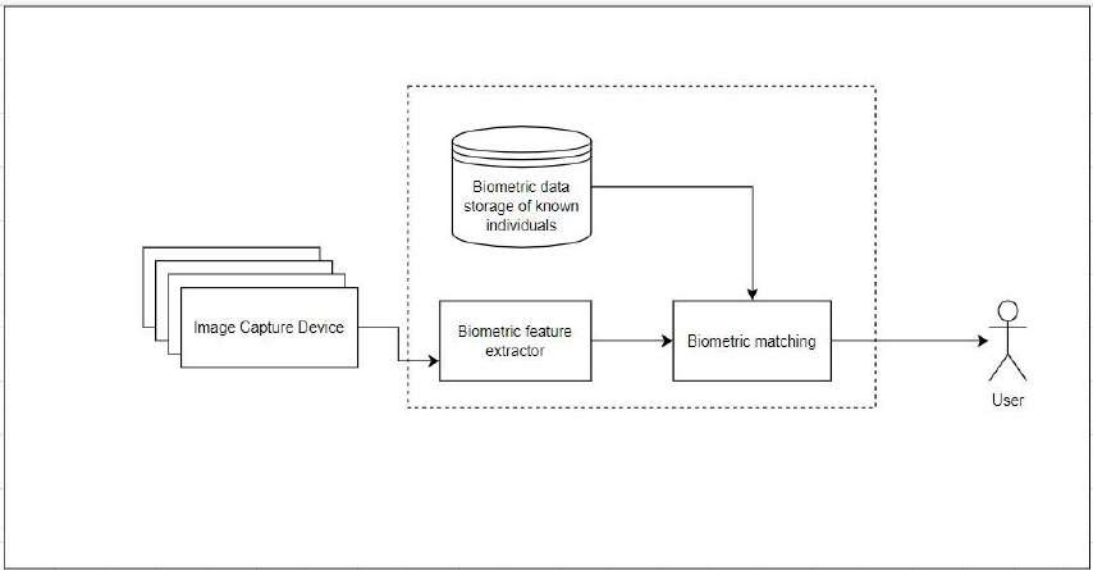
When considering the proposed system to be implemented to support the visually impaired community, the below mentioned specific objectives must be satisfied in order to ensure that the system is accurate, efficient and reliable to all users.

- Create database to store biometric features of known individuals of the user and allocate unique identities to each person.
  By assigning a unique identity to each known individual of the user, when the system accurately identifies the person in a crowd, the system informs the user about the presence of the identified individual using a beep sound and voice output of the assigned named for the person stored in the database.
- Captures images and check image quality and change resolution if necessary.
  Due to the unique biometric features possessed by each individual, it is important that the face is captured properly and at any angle as the person may not be facing the user directly. In addition, each captured image must be of high quality to ensure the accurate identification of the person therefore if image quality is not up to the required standard, the system will rescale and change resolution to satisfy the desired requirement of the input image.

- Person identification using face detection and image processing.
  Identifying individuals and cross referencing the biometric features with pre uploaded data of known individuals of the user.
- Model training to dataset to decide whether the individual is in a state of emergency or can freely communicate with the user at that moment.
  When considering the various scenarios where a person is on the street for some sort of purpose, for an example, waiting for a bus and if the user was to intrude in that moment, it would cause inconvenience to the person therefore in the training data set the algorithm seeks out background and emotion patterns of the identified individual and compare the characteristics of the input data and determines whether the individual is in a state of emergency or not and notifies the user accordingly so that the user can make the decision of wanting to meet that person or to avoid contact depending on the situation.

3 METHODOLOGY

3.1 System Architecture



3.2 Hardware Solution

For the proposed system, the main hardware components involved in the implementation are mobile phone with sufficient camera quality, an earpiece for the instructions to be relayed to the user via voice output and a pair of smart glasses installed with portable camera to relay real time images to the system. Process of submitting captured images to the system is done via the camera attached to sunglasses where the images will be subjected to image processing and cross referenced with the biometric data stored in the system to check whether a known individual is present in the crowd. If there is a known individual in the crowd, the system will notify the user using beep sound and relay instructions to the user to how to approach the individual using real time distance calculation and voice commands.

3.3 Software Solution

The software development life cycle under consideration will be an accelerated methodology, Agile is one such fast-paced methodology. Scrum is a lightweight, fast-paced project management framework with a wide range relevance for the management and control of all types of operational and development projects. This delivers and incremental and iterative development wherein each iteration builds upon the other.

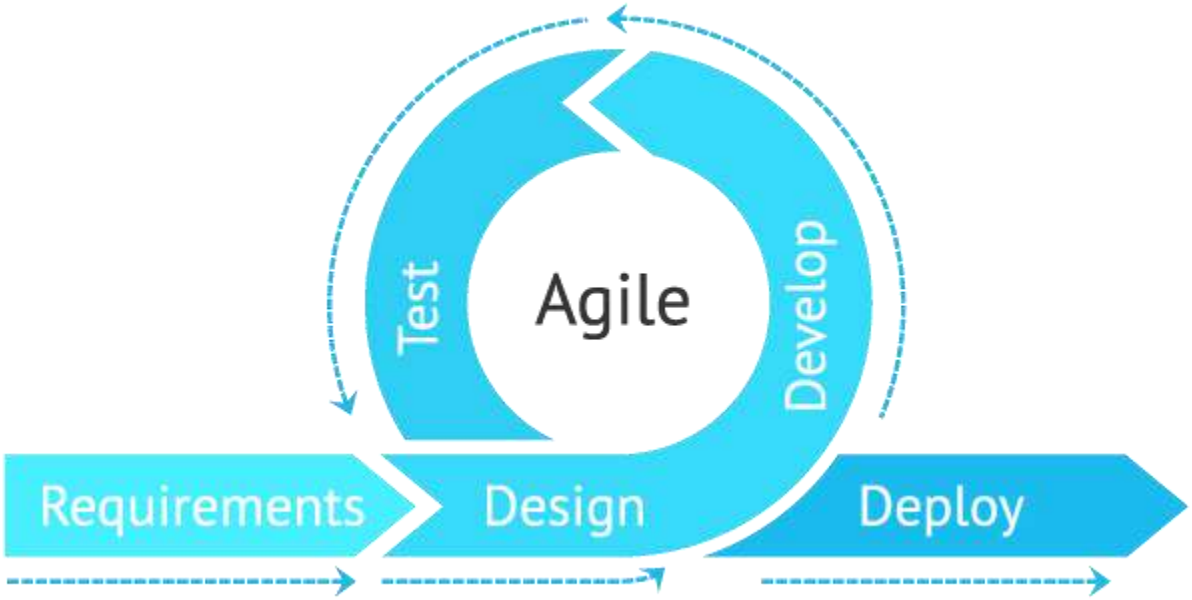


Figure 1.2.4 Agile life cycle

4 PROJECT REQUIREMENTS

4.1 Functional Requirements

Requirement ID	The Requirement	Addressing the Requirement
1	User login	User should be able to login by using user credentials.
2	Face identification of known individuals	Using biometrics data identifying know individuals
3	Distance calculation between user and known person	Detect the know person and calculate the distance between user and detect person.
5	Generate a voice notification about identified person.	After identifying the know person, convert it into voice.

4.2 Non-Functional Requirements

Requirement ID	The non-functional Requirement
1	**Security**
2	**Performance**
3	**Reliability**
4	**Scalability**
5	**User friendly**

5 DESCRIPTION OF PERSONAL AND FACILITIES

Student ID	Task Description
IT19109190	• Create database to store biometric features of known individuals of the user and allocate unique identities to each person. • Captures images and check image quality and change resolution if necessary. Due to the unique biometric features possessed by each individual, it is important that the face is captured properly and at any angle as the person may not be facing the user directly. • Person identification using face detection and image processing. Identifying individuals and cross referencing the biometric features with pre uploaded data of known individuals of the user. • Model training to dataset. System to learn and make prediction about the selected dataset.

6 GANTT CHART

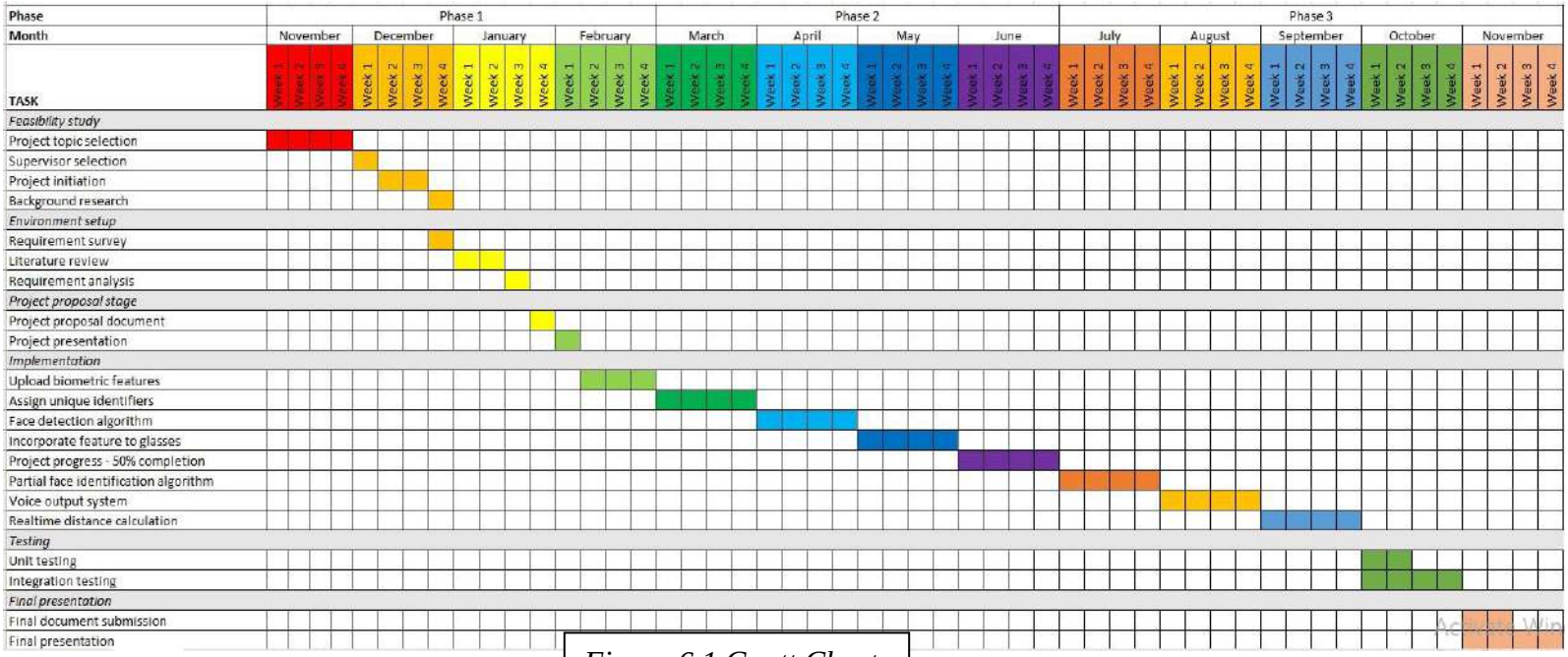


Figure 6.1 Gantt Chart

7 BUDGET AND BUDGET JUSTIFICATION

Resource Type	Price
Sunglasses with in-built camera/ Cellphone headset	Rs.8000
Earpiece or earphones	Rs.1500
Other costs (travel, data research)	Rs.5000
Total	**Rs.14500**

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