Visually Impaired Indoor Assistant

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Abstract

Visually impaired people can't live without assistance yet can't face any aspect of life alone, in this proposed project we aim to create a mobile application called "Guide Me". The proposed application aims to facilitate the process of indoor guidance for visually impaired people as well as reduce the hazard of them living alone and detect needed objects when asked for, The mobile application receives a video stream from mobile camera that scans the given frames then the user has two options, either to give a voice command with an object's name and if the object is detected in the frame the user is notified that he is looking for the object in the right direction or to choose safe navigation so the mobile notifies him that his path is blocked by an obstacle and that he should move in another direction.

1 Introduction

1.1 Background

Nowadays visually impaired people are in outrageous growth due to the leading causes of vision impairment uncorrected refractive errors and cataracts. Globally, it is estimated that approximately 1.3 billion people live with some form of vision impairment According to the latest survey of World Health organization (WHO)[10]. Due to the huge number that they've in our society many technologies have been founded that aim to substitute human vision, these systems are efficient but doesn't have high accuracy or they're trained to identify certain type of objects or they require equipment that aren't available to most people or in some cases they have late recognition of objects which may not be enough or might put the ones who depend on it in hazards therefor can't be a substitution in natural environments. This project aims to introduce a function that acts as core function of visual system and substitutes any need of assistance as it facilitates usability of the one using it and increase availability of assistance to those who are visually impaired as most people nowadays own a smartphone. System consists of two main steps; information acquisition and analysis which happens through the video captured then object classification in it and information presentation which is identification of the surrounding objects and provide

audio output to help the user either navigate the surroundings safely or find the object he is looking for.

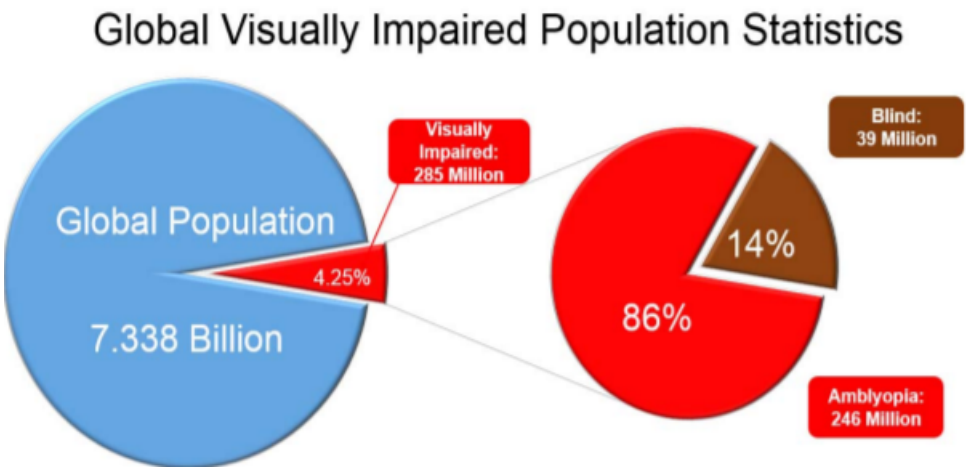

Figure 1

1.2 Motivation

1.2.1 Market Motivation

According to European Blind Union (EBU) [2] blind or partially sighted people shall have a part in society as well as work independently, The Peoples Advocate Institution is the only public institution in Albania that managed in constructing a building that has contributed to create a warm, non-discriminating and barrier-free building for all employees with or without sight. But what if we created a mobile application that provide that for all people of the world ? According to a survey done in 23 May 2019 by Juliana Damasio Oliveira, Rafael H. Bordini [3] on 27 respondents who are visually impaired asking about the receptivity of having a virtual assistance at home and these were their answers.

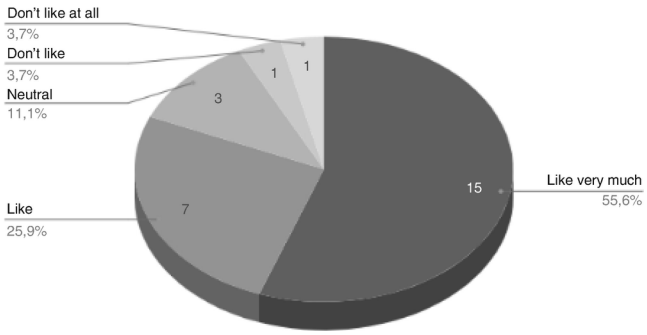

Figure 2

1.2.2 Academic Motivation

Our work is motivated by both application domain and previous work. Intelligent Eye is a proposed system that helps visually impaired to have better usability of objects by doing four functions[9]. Sagar Mahurkar [8] proposed a study that focuses on integrating YOLO Object Detection with Augmented Reality for IOS Apps they used YOLO as it combines between both the location of the object and what is the detected object. Meanwhile another proposed system is pair of wearable smart glasses and an intelligent walking stick for visually impaired/blind[7] people the glasses purpose is to detect front obstacles on the other hand the stick is in case of fall down it saves the current location and notifies the family of the user.

1.3 Problem Definitions

Blind people suffer multiple problems in their everyday lives specially if they live alone or don't get extensive assistance from other people, One of the main problems they encounter is finding an object on their own, another is that while navigating their house they are in danger of hurting themselves by hitting an obstacle or encountering stairs or touching sharp objects.

2 Project Description

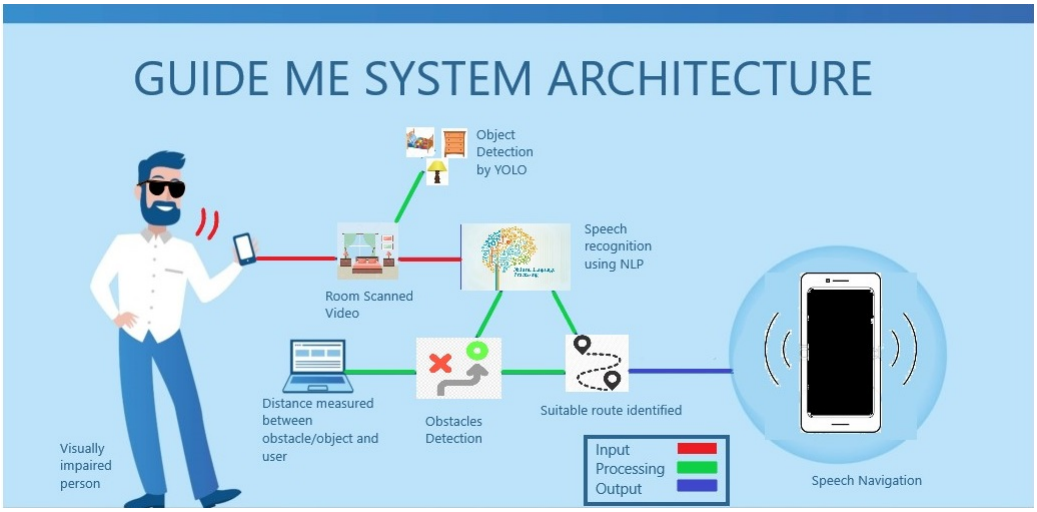

Figure 3

The proposed system uses mobile camera to act as the eyes of the blind person, it sends the captures stream to the main model which is object detection using YOLO library with a pretrained dataset of house items, the user then chooses between the system's two main functionalities using speech input by translating it through natural language processing either to safely navigate the room or to look for an item he seeks. If the user chooses safe navigation the objects in the frame are detected and distance to reach them is calculated and the user is notified by speech output if the object is too close to the other and is blocking their path and where he could move to avoid that obstacle. If the users chooses finding objects, he then is prompted to say the objects name and moves his phone to capture as many frames as possible and if the object is detected in the frame the mobile vibrates meaning that the object is in that direction, and the closer he gets to the object the more intense the vibration becomes, if the object is not found after a certain time period of searching frames the user is notified by speech that the object is not found.

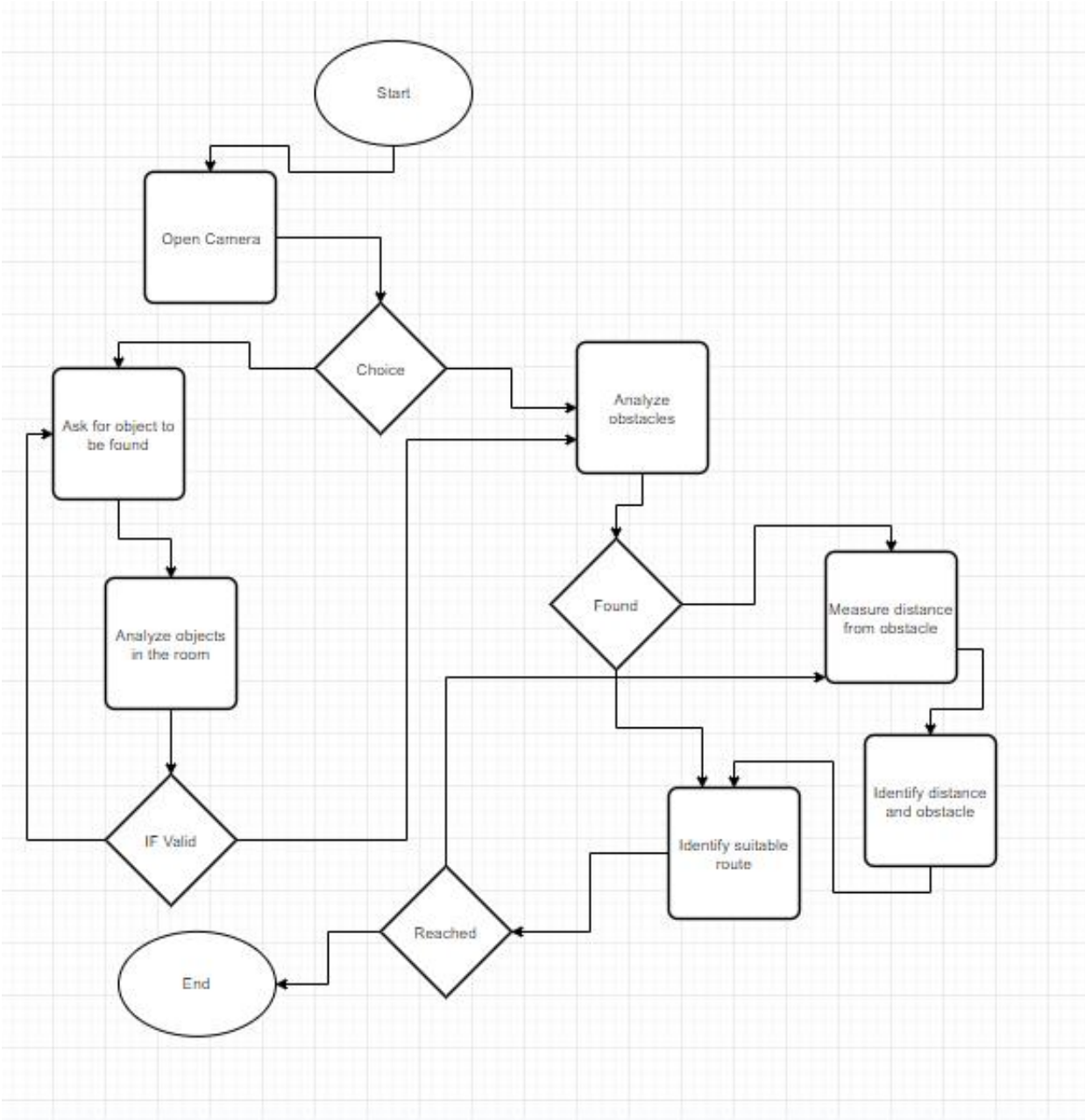
Start
Open Camera
Choice
Ask for object to be found
Analyze obstacles
Analyze objects in the room
Found
Measure distance from obstacle
IF Valid
Identify distance and obstacle
Identify suitable route
Reached
End

Figure 4

2.1 Objective

The project's main objective is to make visually impaired or partially sighted people life's easier by helping them to become more independent and decrease the problems they face, so that they can function normally and have a role in society with virtual assistance, using a streaming video as his eye to scan the room then detecting required objects asked by the user as well as navigate them in a hazard free environment and warn them by speech if they're about to walk into an object or might harm himself on a dangerous object, In addition to that system can if the object they're looking for is in the direction the mobile is facing.

2.2 Scope

The system will cover in its scope:

1. Scanning frames captured by user for any hazards.
2. Search for required objects when asked to.
3. Safe navigation for the user to allow him to freely roam his surroundings.
4. Alert user if there's near objects that he's about to hit.

2.3 Project Overview

The proposed system Guide Me uses Mobile camera to obtain a video as the eye sight of the person and the frames are enhanced using image processing techniques then using object detection techniques the objects in the frames are detected and by using camera calibration we are able to acquire the distance between the object and the mobile held by the user, the user is then prompted to input functionality to preform either:

1. safe navigation while free roaming.
2. safe navigation to an object which the user chooses by speech.

The first functionality alerts the user using voice commands that he is about to hit an obstacle and the direction where he is able to roam freely, the second is achieved by searching the frame for the required object and if the object is found the user is alerted that it is in the frame and proceeds in that direction and as the object gets closer the intensity of the alert increases till he reaches it and if the object is not found in a given time frame the system alerts him that the object is not found.

3 Similar System Information

1.Intelligent eye [9] is a system proposed to perform usability through four functions:

1. Light detection: Which is done through the embedded light sensor in the phone to read light intensities

2. Color Detection: They obtain the image through the back camera and detect the color using OpenCV library, the RGB color of area touched by user color name is then spoken to the user using text to speech engine available in the smart phone.

3. Object recognition: Allows recognizing objects from images captured by the camera of a mobile device, they developed the activity using CNNdroid library the system then displays top five results.

4. Banknotes recognition: Enables blind users to identify banknotes through CraftAR SDK for android.

they tested their system by 10 people using a survey the results are good in general and the application is well accepted.

2.Another proposed system [7]is a wearable glasses for detecting front objects and a walking stick to guide them through their route, mobile devices application, and on-line information platform to get help in case of collision to the user by sharing their GPS to close friends or family members through mobile device application. Lastly they mentioned that in the future they'll integrate deep learning techniques for recognizing images and to develop intelligent walking guiding related functions

3.This paper[1] is a proposed methodology for automatic identification of public surroundings. They divided their system into two objects First one is by creating their template of popular street signs(Pharmacy, special people..etc), Second step is template matching using SURF (Speeded Up Robust Features) which detects signs from captured images and relevant points from the template. Eventually they reached accuracy of 91.67% their problem was variation in color and illumination in captured image or in the template. Their future work includes increasing their accuracy as well as number of common signs and implementing same concept in the indoor navigation

4.Another proposed system is a two parts wearable devices First is a pair of glasses and a helmet to get data acquisition of the environment, Second part is mini laptop and FPGA hand on the user back[4] with an adjustable volume control according to the user's need it's based on stereo-vision technology Moreover the system is able to classify the danger of the surrounding objects based on their speed, direction of motion and their position in case no objects were present in the scene the user doesn't hear anything in case of more than one object the user is notified by the positions of these objects. They made an evaluation by 25 blind users they confirmed that travelling using this prototype made them more confident than using only white cane.

5.Another proposed system is Assisting Application[5] it consists of the mobile phone itself and external devices for higher accuracy which are an Arduino Nano board and one Raspberry PI board as well as three ultrasonic sensors which are found at the head, the trunk and the legs. to detect obstacles this sensors are connected to the Arduino board and the information of the detected obstacle is transmitted to the smartphone via Bluetooth. On the other hand the camera is controlled by linux using OpenCV libraries to detect objects in real time which makes it a real time usable system for indoor as well as outdoor navigation. After testing their proposed system they concluded that they needed to enhance obstacle detection which will happen in future due to availability of more powerful and cheaper smartphones and that will increase the effectiveness of the assistance

6.This paper is a system developed using smartphone sensors and additional two sensory modules used [6], First one is based on RaspberryPi platform with arm processor and the other one is based on very popular Arduino platform. In outdoors it uses GPS modules to detect coordinates and move from one point to another then speaks to the user using TTS technology to speak to the user, from the other hand mobile can recognize user commands using google's Voice recognition technology. Inside the building GPS isn't available therefor it uses light sensors present in the phone to do indoor navigation, it also uses accelerometer in the phone to detect the fall of the person and help the call someone to help.Tests made show the efficiency of the system, which can be improved with the development of android based portable devices.

3.1 Comparison with Proposed Project

Points of Comparison	Method	Accuracy achieved	Objectives	Classifier	Sensors
Intelligent Eye	Mobile phone	good in general and the application is well accepted	Detecting color, light, objects and banknotes	CNN	Embedded light sensor
Intelligent assistance system	Wearable smart glasses and walking stick	Not mentioned	Detecting objects while navigation	Not mentioned	An infrared (IR) transceiver sensor module, 6-axis (Gyro + accelerometer) micro-electromechanical (MEM) sensor module
Automated identification of public signs	Images taken from the internet	91.67%	Detecting common public signs	Speeded Up Robust Features (SURF)	sensory system, 3D CMOS linear sensor and 6dof inertial sensor
Our proposed system	Mobile phone	-	Guide user to required object, provide safe navigation	YOLO	Mobile sensors only.

Figure 5

4 Project Management and Deliverables

4.1 Tasks and Time Plan

Task	Start Date	End Date
Idea discussion	25-7-2019	30-8-2019
Idea research	1-9-2019	25-9-2019
Proposal presentation	26-9-2019	10-10-2019
Implementing prototype	26-9-2019	10-10-2019
Design Application	11-10-2019	1-11-2019
Dataset collecting	11-10-2019	1-11-2019
Dataset classification	1-11-2019	11-11-2019
SRS Writing	12-11-2019	12-12-2019
SRS presentation	12-11-2019	12-12-2019
Implementing application	13-12-2019	20-1-2019
SDD writing	25-1-2019	21-2-2019
SDD presentation	25-1-2019	25-2-2019
Final prototype implementation	26-2-2019	20-3-2019
Writing paper	20-3-2019	1-4-2019
Deliver paper	2-4-2019	2-4-2019
Writing thesis	2-4-2019	20-5-2019
Final presentation	24-6-2019	24-6-2019

Figure 6

4.2 Budget and Resource Costs

• Any mobile device but must have those sensors:

1. Accelerometer.
2. Gyroscope.

5 References

References

[1] M. K. D. K. P. K. Dhruv Dahiya, Ashish Issac, "Computer vision technique for scene captioning to provide assistance to visually impaired," *2018 41st International Conference on Telecommunications and Signal Processing (TSP)*, p. 4, 2018.

[2] EBU, "17 examples of good practice," 2019.

[3] R. H. B. Juliana Damasio Oliveira, "A survey on the needs of visually impaired users and requirements for a virtual assistant in ambient assisted living," *16th International Conference on Information Technology-New Generations (ITNG 2019)*, 2019.

[4] I. T. F. B. S. Larisa Dunai Dunai, Ismael Lengua Lengua, "Obstacle detectors for visually impaired people," *2014 International Conference on Optimization of Electrical and Electronic Equipment (OPTIM)*, p. 8, 2014.

[5] A. G. Laviniu Ţepelea, Ioan Gavriluţ, "Smartphone application to assist visually impaired people," *2017 14th International Conference on Engineering of Modern Electric Systems (EMES)*, p. 4, 2017.

[6] P. S. A. G. Laviniu Ţepelea, Virgil Tiponuţ, "Multicore portable system for assisting visually impaired people," *2014 14th International Workshop on Cellular Nanoscale Networks and their Applications (CNNA)*, p. 2, 2014.

[7] M.-C. C. W.-J. C. C.-H. Y. C.-Y. S. Liang-Bi Chen, Jian-Ping Su, "An implementation of an intelligent assistance system for visually impaired/blind people," *2019 IEEE International Conference on Consumer Electronics (ICCE)*, p. 2, 2019.

[8] S. Mahurkar, "Integrating yolo object detection with augmented reality for ios apps," *2018 9th IEEE Annual Ubiquitous Computing, Electronics Mobile Communication Conference (UEMCON)*, p. 5, 2019.

[9] E. Y. E. K. J. E. H. M. M. Milios Awad, Tarek Mahmoud, "Intelligent eye: A mobile application for assisting blind people," *2018 9th IEEE Annual Ubiquitous Computing, Electronics Mobile Communication Conference (UEMCON)*, p. 6, 2018.

[10] W. H. Organization, "Blindness and vision impairment," 2019.