ISSN 2319-2720
Volume 9, No.2, April - June 2020
International Journal of Computing, Communications and Networking
Available Online at http://www.warse.org/ijccn/static/pdf/file/ijccn05922020.pdf
https://doi.org/10.30534/ijccn/2020/05922019

Indoor Navigation System for Visually Impaired using Real Time 3D Depth Sensing Sensor

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ABSTRACT

This paper portrays a novel idea for aiding the visually impaired individuals to navigate indoors freely without depending on anyone but only by using a Smartphone. The system has been developed in such a way that it is feasible on any android device, having a depth sensing image sensor. The application makes use of an Indoor Positioning System (IPS), that can use different types of sensory information to locate objects or people inside a large complex.

Navigating indoors is the most challenging. It is purely an application for the android Smartphone which uses Augmented reality (AR) and the visually impaired obtains navigation instructions in the form of audio. This can help provide step by step walking independently.The proposed system works with AR Core by Google, with the help of unity engine to process the images in augmented reality to detect the obstacles while navigating indoor and sends an audio message to the user to help him/her to navigate.

Key words: AR Core, Image Processing, Unity Engine

1. INTRODUCTION

Image processing is a method to perform some operations on an image in order to extract some useful information's from it. Image processing on mobile devices has grown significantly over the past decade. This resulted in various technology like augmented technology, virtual reality object recognition and so on. Virtual reality is a 3d computer generated environment which can be explored to interact with a person or object [5]. Virtual reality headsets have restored sight to people who are blind. Augmented reality is also a computer-generated image on the user's view of the real world.[6]Machine learning is a field of study that gives the computer ability to learn without being explicitly learned. It provides the system the ability to learn from the experience. Most of the devices for the visually impaired uses computer vision and machine learning.[9] The machine learning and audio cues combination improves the lives of visually impaired people (Figure 2).

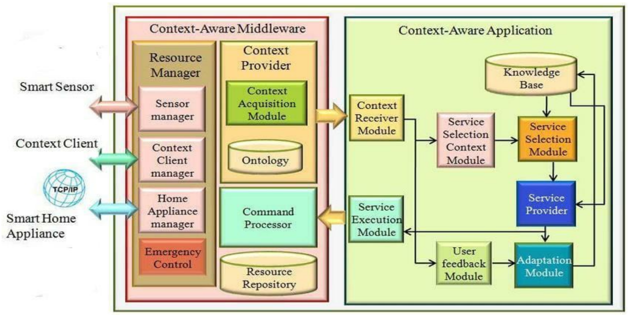

Figure 1: Application

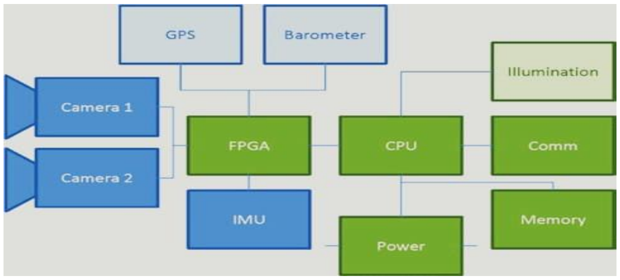

Figure 2: Image Processing

2. MOTIVATION

We all have seen and heard of struggles faced by visually impaired. We have nothing but sympathy towards them. They all wish to be independent and don't crave sympathy from others. They work and strive hard to lead a life independently [4]. They always need to search and put much effort to get everyday objects so this device is developed for such people and improve their daily chores without the aid of anyone else.[7]

3. LITERATURE SURVEY

In Table 1 we are comparing NSVI with other existing techniques to produce the best.

Table 1: Literature Review

Sl no.	Title	Key Concept	Merits	Demerits
1	HOW DOES VISUAL IMPAIRMENT AFFECT PERFORMANCE ON TASKS OF EVERYDAY LIFE?	Visual acuity, contrast sensitivity, Performance was assessed on mobility, daily activities with a strong visual Component, and visually intensive tasks.	Both contrast sensitivity and visual acuity loss contribute independently to deficits in performance on everyday tasks. It is possible to identify visual acuity and contrast loss where most are disabled.	the cutoff points depend on the task, suggesting that defining disability using a single threshold for visual acuity or contrast sensitivity loss is arbitrary.
2	SELF-REPORTS OF PHYCHOLOGICAL DISTRESS IN CONNECTION WITH VARIOUS DEGREES OF VISUAL IMPAIRMENT.	Visual Impairment, Intrusive thoughts, health,	This was one of the first ever surveys which helped to understand the mental state of VI persons	Since it is based on survey, the calculations are only nearly perfect.
3	A SPOT REMINDER SYSTEM FOR THE VISUALLY IMPAIRED BASED ON A SMARTPHONE CAMERA	spot reminder; visually impaired individuals; smartphone cameras; scale invariant feature transform; image matching; user study	Proposed a spot reminder system to assist visually impaired users in recalling memories related to spots that they visited.	---
4	OBSTACLE DETECTION AND WARNING SYSTEM FOR VISUALLY IMPAIRED PEOPLE BASED ON ELECTRODE MATRIX AND MOBILE KINECT.	Mobile Kinect · Obstacle detection · Point cloud · Assistive system for visually impaired	It is proved that people can be trained to adapt to a new sense to recover lost information due to impaired sensory modality.	Not all users can totally get used to this kind of device and the mobility still depends mainly on their natural feeling and instinct.
5	VISUAL AND IR SENSOR DATA-BASED OBSTACLE DETECTION FOR THE VI USING THE GOOGLE PROJECT TANGO TABLET DEVELOPMENT KIT AND THE UNITY ENGINE.	Visually impaired, blind, obstacle detection, obstacle avoidance, navigation, Unity, Project Tango, assistive technologies, multimodal sensors.	A novel visual and infrared sensor data-based application to assist VI users in detecting and avoiding obstacles in their path while independently navigating indoors	Needs to improve functionality and usability. User Interface need to be friendlier.

4. PROPOSED APPROACH

We name the proposed navigation system "AIDEZ" which enables users to navigate independently with the aid of an android Smartphone which uses machine learning to analyze fed data from cameras and sensors. The obstacles guide is given in the form of audio [3].

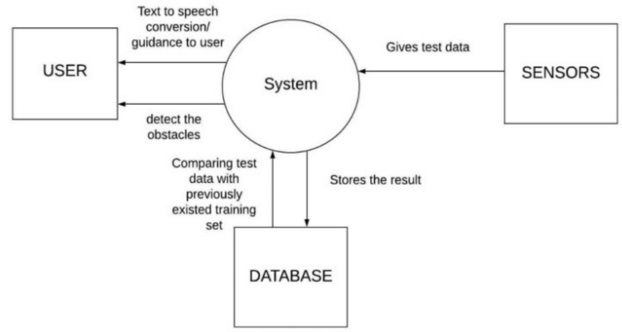

Figure 3: Block Diagram of System

In Figure 3 the app uses AR Core technology to produce the 3D depth image of the space it points to. It produces a depth image of the surroundings and if it finds any potential threat of collision, it informs the user that there is an obstacle ahead and would instruct to change the direction so as to avoid the obstacle [2]. AR Core is a project from Google which helps to visualize things in augmented reality. The images thus obtained are converted to 3D and collision course are measured.[8] The information is then passed to a database which analyses the image obtained to find out obstacles. It then converts it to an audible warning which warns the user through the headset[1].

The database stores the obtained results and data that would help in future to develop a modified version of this project. The future versions may include a dedicated application that runs on any platform, which provides the same experience for the user as this tablet does.[10] Its merits are helping to reduce accidents, works without internet and cost effective.

5. TEST CASES

Table 2: Test Cases

Test Id	Tested	Expected Result	Actual Result	Successful
1	User Interface	Opening the APP	App opens showing the desired interface	Successful
2	Detecting	Detecting using camera	Camera detects each and every object	Successful
3	Calculating distance	Using image processing	Using image processing it calculates distance for providing path	Successful

In table2., we have several test cases like the basic usage of our app as initial stage then from that camera will use image processing techniques to calculate the distance of each object and gives the desired path for visual impaired (Figure4).

Figure 4: Output of System

6. CONCLUSION AND FUTURE SCOPE

Visual and infrared sensor data-based application to assist VI users in detecting and avoiding obstacles in their path while independently navigating indoors.Providing VI users with a real-time mobile assistive stand-alone application on a cutting-edge device which allows them to detect obstacles independently in possibly unfamiliar indoor surroundings would stingingly increase their autonomy.

In future iterations of the system, we plan to enable the area learning option provided in the Unity Tango SDK which would allow the system to remember where static obstacles in the environment are located. Provide a sensation of vision for the visually impaired people by projecting the image directly to cornea of eye. We also plan to develop an independent application that can run on any platform so people can access from anywhere.

ACKNOWLEDGEMENT

We take this opportunity to express our sincere gratitude to all respected personalities who had guided and helped us in the completion of this paper. First, we express our thanks to Almighty God for guiding us in this venture and make it a huge success. We also thank the management of Mangalam College of Engineering, and Principal for permitting us to carry out this paper. Our sincere thanks to Head of Department of Computer Science and Engineering for permitting us to make use of facilities available in the department. Finally, we extend our gratefulness to all teaching and non-teaching staffs who were involved in this successful completion of this paper work and to all our friends who have patiently extended all sorts of help for accomplishing this paper.

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