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ASSISTIVE NAVIGATION FOR BLIND PEOPLE: A REVIEW

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Abstract - *Our proposed solution approach is to design a mobile embedded device that will help visually impaired individuals with their independent mobility. The device will direct them to and from specified locations (mall, grocery store etc.), and alert the user of any potential obstructions in their path. A technological approach would be useful because access to internet and GPS will help increase their independence by helping them get to locations they don't normally travel to. The scope of the project is to provide user directions to locations when they are outdoors and also alert the user of obstacles in their path while they are trying to get to those locations. The blind assist project will be the integration of sensors (ultrasonic sensors, Bluetooth, etc.), GSM internet, GPS, and the ATOM processor. After we integrate all the hardware we will create a software function that translates information gathered by the hardware into directions and obstacle alerts. The device will not analyze and identify objects within the field of view of the user. The device will not be designed to replace any human senses. For example, the device will not use a camera to describe a scene to the user as if to replace sight. We will also limit the scope of our device to just being used only outdoors. We do not intend to eliminate use of walking canes, guide dogs, or personal aides.*

Key Words: Embedded system, Blind assist, IMU, Oblu Navigation system, motion sensing.

1. INTRODUCTION

Problems faced by visually impaired people are many, among them many have trouble maintaining a proper circadian rhythm due to lack of visual input to their brains, critical in reading, writing, navigation and identifying objects. Reading and writing can be accomplished to a great extent through development of Braille language. People with complete blindness or low vision often have a difficult time self- navigating outside well-known environments. In fact, physical movement is one of the biggest challenges for blind people, travelling or simply walking down a crowed street may pose great difficulty for blind people, hence they need an assistive device that will allow blind user to navigate freely and this requirement become crucial. Based on this real context or condition we focused the work on developing assistive technologies that may help blind individuals in becoming independent and contributing actively towards the development of the country.

1.1 Problem formulation

A good solution will be a device that is portable and is able to provide directions to new locations and alert the user of obstacles in their path when the user is walking. For the purpose of this project, we streamlined the problem defined above to assisting blind individuals with getting around outdoors. We believe a project like this will create the case for further investment in creating smarter electronic devices to assist visually impaired individuals with getting around. By smarter we mean that the device is able to provide directions to unvisited locations, while ensuring safe navigation.

1.2 Assistive Technology

All the systems, services, devices and appliances that are used by disabled people to help in their daily lives, make their activities easier, and provide a safe mobility are included under one umbrella term: assistive technology. In the 1960s, assistive technology was introduced to solve the daily problems which are related to information transmission (such as personal care), navigation and orientation aids which are related to mobility assistance. This assistive technology became available for the blind people through electronic devices which provide the users with detection and localization of the objects in order to offer those people with sense of the external environment using functions of sensors.

The vision replacement category is more complex than the other two categories; it deals with medical and technology issues. Vision replacement includes displaying information directly to the visual cortex of the brain or through an ocular nerve. However, vision enhancement and vision substitution are similar in concept; the difference is that in vision enhancement, the camera input is processed and then the results will be visually displayed. Vision substitution is similar to vision enhancement, yet the result constitutes non-visual display, which can be vibration, auditory or both based on the hearing and touch senses that can be easily controlled and felt by the blind user. The main focus in this literature survey is the vision substitution category including its three subcategories; Electronic Travel Aid (ETAs), Electronic Orientation Aid (EOAs) and Position Locator Devices (PLDs). My in-depth study of all the devices that provide the after mentioned services allows us to come up with a fair taxonomy that can classify any proposed technique among others.

2. LITERATURE REVIEW OF LAST 15 YEARS ASSISTIVE NAVIGATION BASED APPROACH.

Reference paper [1]: S.Gangwar (2013) designed a smart stick for blind which can give early warning of an obstacle using Infrared (IR) sensors. After identifying the obstacles, the stick alerts the visually impaired people using vibration signals. However, the smart stick focused only for obstacle detection but it is not assisting for emergency purposes needed by the blind. And also the IR sensors are not really efficient enough because it can detect only the nearest obstacle in short distance.

Reference paper [2]: S.Chew (2012) proposed the smart white cane, called Blind spot that combines GPS technology, social networking and ultra-sonic sensors to help visually impaired people to navigate public spaces. The GPS detects the location of the obstacle and alerts the blind to avoid them hitting the obstacle using ultra-sonic sensors. But GPS did not show the efficiency in tracing the location of the obstacles since ultra-sonic tells the distance of the obstacle.

Reference paper [3]: Benjamin Etal (2014) had developed a smart stick using laser sensors to detect the obstacles and down curbs. Obstacle detection was signalized by a high pitch "BEEP" using a microphone. The design of the laser cane is very simple and intuitive. The stick can only detect obstacle, but cannot provide cognitive and psychological support. There exists only beep sound that triggers any obstacle and there is no any assistance to direct them.

Reference paper [4]: Central Michigan University (2009) developed an electronic cane for blind people that would provide contextual information on the environment around the user. They used RFID chips which are implanted into street signs, store fronts, similar locations, and the cane reads those and feeds the information back to the user. The device also features an ultrasound sensor to help to detect objects ahead of the cane tip. The Smart Cane, which has an ultrasonic sensor mounted on it, is paired with a messenger-style bag that is worn across the shoulder. A speaker located on the bag strap voice alerts when an obstacle is detected and also directs the user to move in different direction.

Reference paper [5]: Mohd Helmyabd Wahab and Amirul A. Talibetal (2013) developed a cane could communicate with users through voice alert and vibration signal). Ultrasonic sensors are used to detect obstacle in front, since ultrasonic sensors are good in detecting obstacle in few meters range and this information will be sent in the form of voice signal. This voice signal is send via speaker to the user. Here blind people might find it difficult in travelling without any emergency alert rather than having only ultrasonic sensors.

Reference paper [6]: Alejandro R. Garcia Ramirez and Renato Fonseca Livramento da Silvaetal (2012) designed an assistive technology device called the electronic long cane to serve as a mobility aid for blind and visually impaired people. The author implements the cane with an ergonomic design and an embedded electronic system, which fits inside the handle of a traditional long cane. The system was designed using haptic sensors to detect obstacles above the waistline. It works in such a way when an obstacle is detected; the cane vibrates or makes a sound. However, this system only detects obstacle above the waistline.

Reference paper [7]: Joao José, Miguel Farrajota, Joao M.F. Rodrigues (2013) designed a smart stick prototype. It was small in size, cheap and easily wearable navigation aid. This blind stick functions by addressing the global navigation for guiding the user to some destiny and local navigation for negotiating paths, sidewalks and corridors, even with avoidance of static as well as moving obstacles. Rather than that, they invented a stereo camera worn at chest height, a portable computer in a shoulder-strapped pouch or pocket and only one earphone or small speaker. The system is inconspicuous, and with no hindrance while walking with the cane. Also it does not block normal sound in the surroundings.

Reference paper [8]: Shruti Dambhare and A.Sakhare (2011) designed an artificial vision and object detection with real-time assistance via GPS to provide a low cost and efficient navigation aid for blind which gives a sense of artificial vision by providing information about the environmental scenario of static and dynamic objects around them.

Blind and visually impaired people are at a disadvantage when they travel because they do not receive enough information about their location and orientation with respect to traffic and obstacles on the way and things that can easily be seen by people without visual disabilities. The conventional ways of guide dog and long can only help to avoid obstacles not to know what they are. Navigation system usually consist of three parts to help people travel with a greater degree of psychological comfort and independence sensing the immediate environment for obstacles and hazards, providing information about the location and orientation during travel. Today in market different technologies are used to navigate visually impaired people.

3. GAP IDENTIFICATION AND SUMMARY

1. Guidance of dog: A specially trained dog assisting the blind in obstacle avoidance, but usually not aiding in way finding, e.g. the dog is trained to stop before obstacles, reacts to commands on walking directions. In spite of their great usefulness, guide dogs are a rarely used aid- only about 1% of the visually impaired use it. Advantage: Good in following familiar paths, good overall obstacle avoidance, trained for selective disobedience when sensing danger to his owner. Disadvantage: Very costly, guide dog service period in on average 6 years, regular dog up-keeping cost and lifestyle changes.

2. Human guide: A blind person walks hand in hand with a sighted guide. Advantage/Disadvantage: The most obvious, but in practice not a permanent solution for aiding the blind in mobility and navigation. A blind lacks privacy and can have a feeling of being a burden to his or her guide.

4. CONCLUSIONS

I have gained insight about the various parameters associated with Navigation systems. I got an opportunity to work and develop a remedy for one of the major crisis the world is facing in terms of blind people. I learned about various sensors and their interfacing.

I learned various software tools. I also got hands-on experience of soldering and PCB designing. With this project, I conclude that the proposed system would prove to be cost efficient, time saving and yet produce the results with high accuracy and quality.

Hence, it can be concluded that this project is able to play a great contribution to the state of the art and will play a great role to assist the blinds to walk easily.

5. FUTURE SCOPE

Future work will be focused on enhancing the performance of the system and reducing the load on the user by adding the camera to guide the blind exactly. Images acquired by using web camera and NI-smart cameras helps in identification of objects as well as scan the entire instances for the presence of number of objects in the path of the blind person. It can also detect the material and shape of the object.

Matching percentage has to be nearly all the time correct as there no chance for correction for a blind person if it is to be trusted and reliable one. The principles of mono pulse radar can be utilized for determining long range target objects. The other scope may include a new concept of optimum and safe path detection based on neural networks for a blind person.

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