"AKSHI":

Automated Help aid for Visually Impaired People using Obstacle Detection and GPS Technology

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Abstract- There is an immense population of the visually impaired around the globe. Several research has been carried out to provide a technical aid to such people. The motivation of the system is to help blind people where they can move along without a dependent. Since there were existing on blind stick navigation, Akshi compose some unique features. Overall this research providing a solution for a blind person to move independently and securely with the use of as Raspberry Pi 2, HC-SR04 Ultrasonic Distance Measuring Transducer Sensor, 5V 2V Rechargeable Battery, GSM module, RFID Reader, RFID Tags. Some of the sub-problems that we faced during the course of our research were deciding on cost- effective and interoperable solutions, integrating the obstacle detection mechanism with location detection and implementing open source code and efficient coding techniques. An economically viable product which used open source was the key element to developing our prototype.

Index Terms- Raspberry Pi 2, HC-SR04 Ultrasonic Distance Measuring Transducer Sensor, 5V 2V Rechargeable Battery, GSM module, RFID Reader, RFID Tags.

I. INTRODUCTION

The blind often try to use routes that are known and have the least obstructions in their daily commute. A visually impaired person usually relies on feeling floor surfaces with their feet or using footstep echo's to detect obstructions which is not a fool-proof mechanism. By integrating augmented reality with obstacle detection the visually impaired person can be given location and orientation information instantly. This research aims at improving the conventional navigation system that is used.

According to the World Health Organization (WHO), 285 million people are estimated to be visually impaired: 39 million are blind and 246 million have low vision. Moreover, 90% of this population live in a low income setting [1]. Visually impaired people are dependent on a cane stick, specially trained guide dogs or, in certain circumstances, a Good Samaritan to help them navigate. There are a variety of obstacle avoidance mechanisms that can be used such as electromagnetic tracking devices to detect obstacles, RF (Radio Frequency) localization or ultrasonic SONAR (Sound Navigation and Ranging) sensors. None of these techniques, if used independently can offer a concrete solution to aid the visually impaired. Even though there are numerous prototypes and product designs available, none of them are economically feasible for a majority of the blind population.

Wearable and portable assistive technologies are also used for assisting people with disabilities such as the blind. The system is used to enable blind people to move with the same ease and confidence as a sighted people without any dependent.

Akshi system uses several technologies which detects obstacles, Pedestrian crossing, and guidance for GPS navigation system and voice commands. This will help user to move independently. Also in an emergency there will be an alert sent to guardian and guardian always can observe blind person's location.

This system will surround technologies such as Global Positioning System (GPS) device based navigation and tracking, wireless transmits with Bluetooth, Sensors which is going to be used for obstacle detection, RFID readers and cards which detects pedestrian crossing and voice command to guide the users.

At present numerous devices are available for offering guidance to a distant location but these are either costly or make use of Braille interface. Blind people can get data from the unwilling interaction with entities, persons or animals, by exploring the environment and using their hands to recognize the shape of an object, moreover, blind people can sense other features of the objects as temperature, texture, weigh and though the tact has certain limits in confront of sight, it has a very significant function to unveil to blind persons the world around them.

The simplest and most widely used travelling aid used by all blinds is the white cane. The reason of this system is to be implemented is because blind people cannot move along the road without any dependent. Most is they are dependent on a white cane which they carry to protect themselves on earth and to specifically say they are blind. To enhance the facility of the cane is considered as the research problem.

This model will ensure a safe and accurate navigation mechanism. Akshi is a replacement to the conventional navigation tool like the white cane. Being independent and healthy are the primary needs for the visually disabled and this device can help them achieve that goal.

The main objectives of the research are

- Combining many technologies together to create a safer system for the person.
- Implementing a system where blind people move independently and creating a healthy mentality

- Helping visually impaired people to move safely where they are not aware of environments.
- Guardian of the visually impaired person can easily assure the security of the user by check at the system without interrupt user.

This research consists of six major sections. It includes background Literature review, methodology, Results and Discussion sections.

II. Literature Review

For the blind to travel safely and independently, two levels of navigation, macro-navigation and micro-navigation, are essentially performed. Macro-navigation or way finding is broadly explained as the process of knowing the current position and orientation, finding a route to the destination, and maintaining a heading toward that destination. On the other hand, micro-navigation or mobility is concerned with detecting and avoiding obstacles while walking through immediate environment. In order to accomplish the tasks in both levels, navigation aid devices are required. Way finding devices use global positioning system (GPS) to locate places, whereas mobility aid devices use sensors to detect obstacles.

One of the main system which starts with RFID - technology is "Ways4all" an Indoor navigation based on a smartphone for visually impaired people which has been invented by Kiers & Sovec takes the destination from the user and in the server calculate the optimal route based on the location. Give the directions to the user using passive RFID-tags to identify indoor routes, barriers and means of public transport for visually impaired and blind people. The basis for the project is the tactile guidance system [2].

According to Sangami et.al talkative assistance to blind people let them to avoid obstacles and reach their destination without the help of sighted person. Additionally, for the indoor activities RFID used to assist the user. The system offers true single chip voice recording, nonvolatile storage and playback capability. In an emergency case GSM-GPS may helpful to find the user and send his/her location to the guardian. GPS only use to find the location of the user. The scope of this system is to develop a low-cost system that assist the blind and visually impaired without the help of sighted person. [3].

Gilson et.al invention contained two parts and the system implemented by using prototype methodology. First part mainly concerns with the obstacle detection mechanism. The second part focusses on the tracking function and requires Communication with the web application by connecting to the Internet gateway though the Wi-Fi module. Collect the person's current location send it to the web application every 10 seconds. The main drawback is when connecting to the Internet gateway though the Wi-Fi module country like Sri Lanka may not have free Wi-Fi zone in every place [4].

"Smart Eye" Mane, proposes a prototype which uses RFID technology to provide location-based services and navigation to the blind, or visually impaired By keeping the user on safe paths, lacked some of the versatility that normally sighted users had while navigating. But the system only design to indoor activities. So do not provide much help of traveling unfamiliar places [5].

In Every instance, aided Navigation System have been built or guide to building for smart cars, precision farming vehicles, smart weapons, unmanned aircraft, mobile robots, and other advanced application mentioned by Farrell [6][7], According to mobile phone and GPS combination navigation system an automated online personal guidance implemented by [8] Makino, and according to [9] Jack. Navigation system for the blind says the systems is portable self-contained for blind to travel through familiar or unfamiliar environment without any helps.

Mohajeri et .al research with two cameras taking images from different slides to identify obstacles. Laser scanners, radar and computer vision & online image processing have been used [10]. Phirke et. al research based on electronic and contemporary version of common blind stick. Obstacle detection, staircase detection, formal distance scaling scheme are applied. Does not protect from obstacles at face levels [11].

Voice based navigation system for blind using voice recognition module and GPS module implemented on Arduino board which implemented by [12] Gawari, & Bakuli consist of GPS, Navigation, and Voice Recognition. Track the movement of the Blind person. Singh et. al Allow the differently persons navigate independently in the indoor and outdoor environment GPS, IR, LFR, LED, SD, ultrasonic sensor [13].

Research Gap

Overall some of the research papers, focused on indoor navigation or a location based navigation system. Most of them do not identify the pedestrian crossings. Some of them don't have a proper obstacle detection system that used to be a main requirement of visually impaired people. And especially in mobile based applications there can have some practical issues when using mobile phones.

To overcome these issues, The Akshi has used, Sensor systems for obstacle detection. Use GPS technology & provide device based voice command to inform the directions. Identify the places user go frequently and mark them on the map. Identify pedestrian crossings by image processing. Tracking by using GSM. Specially the Akshi is focused about the safety of the visually impaired people and has given the solutions for the problems that they face in their day-to-day life from above technologies.

III. Methodology

Throw-away prototyping is used where a small part of the system is developed and then given to the end user to try out and evaluate. The user provides feedback which can quickly be incorporated into the development of the main system.

Planning

The fundamental process of AKSHI, Research project for visually impaired person which is based on the navigation and obstacle detection planning phase was done by understanding why an automation system should be built and determining how the project team would go about building it. A proper literature review was carried on to understand the value of the project. Project initiation was done by creating a work plan, staff the

project and put techniques in place to help to control and direct the project through the entire software development life cycle.

Analysis

This phase answered the question of who will use the system, what the system will do, and where and when it will be used. During this phase, the project team investigates current systems by analyzing the past research work identified improvement opportunities, and developed a concept for the system.

Analysis began with the development of an analysis strategy that guides the project team efforts. Such a strategy included an analysis of the current systems available and its problems and then an analysis of ways to design a new system AKSHI. The next step of information gathering was done by interviews with blind and visually impaired people who studied and who was teaching at Ceylon School of Blind and deaf which is situated at Rathmalana.

The analysis of the information in conjunction with the input from the secondary data gathering literature review leads the development of a concept for the developed system. Finally a data model is developed to describe the information that was needed to support the process. The analyses, system concept, process model, and data model are combined into the system proposal.

Design

This phase decided how the system will operate, in terms of the hardware, software and network infrastructure, the user interfaces, design of the cane, libraries, API, and specific programs databases that was needed. Although most of the strategic decisions about the system were made in the development of the system concept during the analysis phase, the steps in the design phase determined exactly how the system would operate.

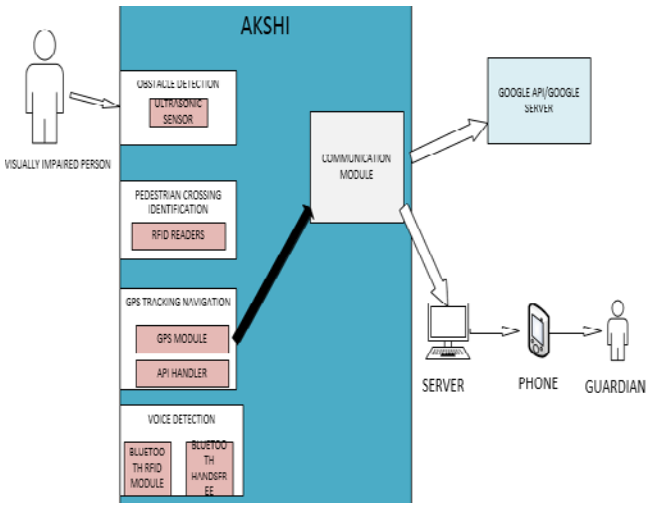

Figure 1 Software Specification Diagram

Illustrate the high level structures of the system AKSHI, Each structure comprises software and hardware elements which used in AKSHI device, relations among them, and properties of both elements and relations.

The system developed using Client-Server architecture because of the reliability and the easiness of increasing or decreasing the storage and processing capability of the server hence the implemented system is responsible of having the location of the device all the time. This support different types of clients with different android versions (Jellybean, Gingerbread, Ice-cream Sandwich etc.)

Figure 2 Raspberry Pi 2 Model B w/ARMv7 Quad Core 1GB RAM is the main hardware component of Akshi. Which unable faster programming. Allow to run more applications simultaneously without compromising processing speed.

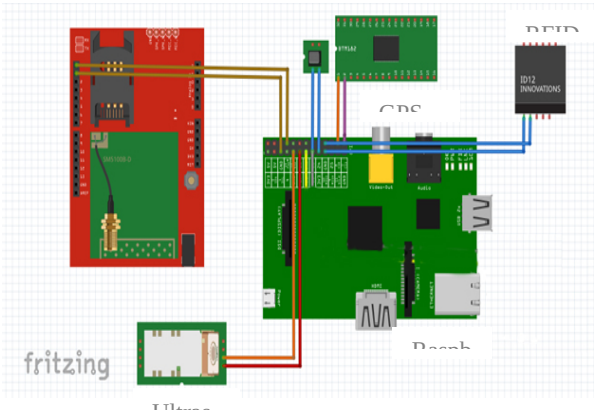

Figure 2 : Circuit Diagram

Implementation

During which the proposed system is actually built to ensure it performs as designed. System AKSHI developed by using Python 3.5.2. Operation System for Raspberry pi 2 model are NOOBS Version 1.9.1, Debian “Jessie”, For Voice Detection and Text –to speech, “Pocketsphinx” , “PyAudio, “Espeak” python Library,MFRC-522 RFID Reader Python Library for RFID Reader.

Testing

The process of trying to discover every conceivable fault or weakness in AKSHI system which focused on finding as yet undiscovered errors will be done by Unit testing, integration testing and system testing.

Those testing will be tested on,

System function, Correctness of operation.

Non-functional qualities: Reliability, Usability, Maintainability, Reusability, Testability, etc.

Unit Testing

Focused on one unit a program or a program module that performs a specific function that can be tested and ensure that the module or program performs its functions as defined in the program specification.

Integration Testing

After the modules have passed unit tests integration tests assess whether a set of modules or programs that must work together do so without error. Ensure that the interfaces, hardware modules and linkages between different parts of the system work

properly. And the focus is on the flow of control among modules, and on the data exchange among them.

System Testing

Conducted to ensure that all modules and programs work together without any error. Much broader in scope. Examine how well the system meets objectives and its usability, security, and performance, under heavy load.

IV. Results

The results describes basically about the output of the system including the accuracy and the reliability of the system. Test results with the respective test cases are to be built in future. There are numerous disabled caused to humans in Sri Lanka. Hence, "AKSHI" will consider only the blind human.

Figure 3. Design of the Stick

Figure 3 shows the model of the AKSHI device which is combined with the circuit. At the bottom of the stick RFID reader is placed which can detect pedestrian crossing through RFID tag and below the circuit box sensor is placed under the direction of 450 where it can detect obstacle. There is a box placed in the stick which contains all the circuits including Raspberry pi, GSM, GPS Modules.

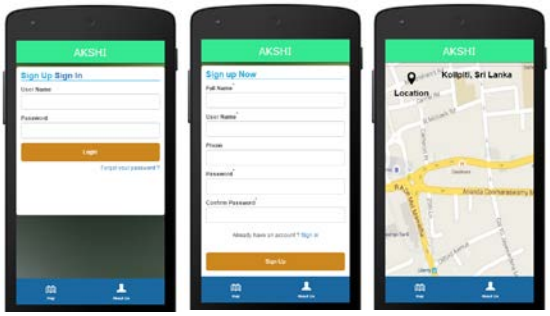

Figure 4: Akshi Tracker

Figure 4 shows the sign in interface where Guardian should login with his username and a password. He can access to the GPS location interface which always shows where the blind person is currently situated.

Signup interface can be used to create a new user which is combined with the akshi device. The user name will be provided along with the device and per device there can be multiple users.

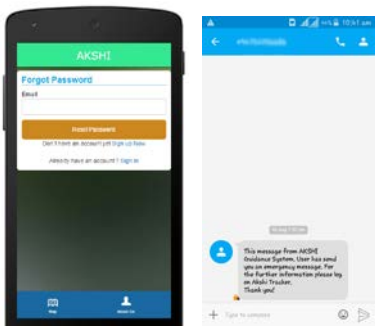

Figure 5 : Sign Up

Figure 5 if user forgets the password he/she can recover it using his email address which is used previously to the signup

If user of the AKSHI device met an emergency, user will press a button in the circuit and a message will pass to guardian's phone.

Reliability

The reliability of the system rely on 60% to 70% depending on the components and in case if any defect cause, Location of the visually impaired person will be stored in the server time to time. Guardian can find out the exact location through the database where user previously visited.

To ensure a high reliability to the system, following process are followed. Powerful open source tools were used such as Android, MySQL database, python, Raspberry pi. And Provide suggestions to customers through Manuals. Use of RFID identification to recognize where the pedestrian. Password oriented login for guardian account to ensure maximum security. Guardian only has the permission only to view where the blind person is.

Efficiency

Efficiency of the system is 60% to 65% because of the Bandwidth and noise of the environment. Some areas has a low internet bandwidth while others has a high. If the internet connection dropped or slow data communication will be stopped with the mobile application. And when identifying the place names efficiency of detecting voice will inverse on the noise of the environment.

Availability

Our system is available for users according to their processes. It will be independently processed all the time. The system is running during 24 hours of the day using high performance server will improve the availability of the system. All the functions and the algorithms are running on fully automated at schedule. The backup system used in this system can recover the data when having some critical situations in the server side (Server down).

Security

Security acts a main part in this system. Because it is the main key which allows the blind person to move independently.

The guidance for navigation should be navigated properly and the way of placing the device in the stick plays a major role. The sensors which detects the obstacle should be properly activated and the Bluetooth which is very important for the user to get the alert properly. The full system is response for blind person security which plays to stay alive. As a team, the team ensures the security of the blind person.

V. Discussions

Different types of systems help the society in various ways, though, some disadvantages come along. Mostly, the existing systems were not much considered on future awareness. Forecasting future predictions by analyzing and observing the current status, is a big challenge and a good service. There are several over comes from the proposed solution compared to the existing systems. Usable device anywhere at any time can provide necessary detections, Future awareness, less cost and secured.

Akshi focused mainly on the technology advancement which would be a helping hand for the blind and disable human to avoid these major troubles. The research has been accomplished by developing the System and mobile application for the clients, blind person and guardian besides providing necessary actions. It is a prototype system done in object oriented approach.

Major limitations of the product would be the hardware components used. Since we are using 13.5MHZ RFID readers and tags, we are unable to capture distance for long distance. Currently the Reading distance will be 5cm to 7cm.The battery life of the Akshi is 8 hr. It should be recharged each 8hrs. If the sensors on the stick is covered with dirty and muddy, the stick will not function properly.

As future work, developing a model with the flexibility of the user. Constructing a light weighted stick and developing the system to find the bus halts and shops to the given place.

The end results of the research is a vast advantage to blind people in reducing their time on wasting on road for another person's help to travel, guardian also no need to travel with blind person through the app can track where he or she is, strong guardian-blind person relation and many other. We believe that, the Akshi system will play a big part in the disable medical industry within local perspective.

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