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SMART VISION SYSTEM FOR BLIND

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***Abstract*—Visual impairment and blindness caused by various diseases has been hugely reduced, but there are many people who are at risk of age-related visual impairment. Visual information is the basis for most navigational tasks, so visually impaired people are at disadvantage because necessary information about the surrounding environment is not available. With the recent advances in inclusive technology it is possible to extend the support given to people with visual impairment during their mobility. In this context we propose a system, named Smart Vision, whose objective is to give blind users the ability to move around in unfamiliar environment, whether indoor or outdoor, through a user friendly interface. This paper is focused mainly in the development of the computer vision module of the Smart Vision system.**

Keyword*— *Obstacle detection, Blind people, Camera, RFID, GPS, LPC2148, Voice circuit

I INTRODUCTION

— The objective of this project is to design a product which is very much useful to those people who are visually impaired and are often has to rely on others. It allows the user to walk freely by detecting obstacles. The obstacle will be detected by using various image processing techniques such as pre-processing, segmentation, adaptive thresholding, and piece wise linear approach. This project is based on ARM7 LPC2148. Image will be captured using a camera and the camera is connected to the PC. If any obstacle comes in front of blind person, he will get to know about the obstacle by hearing the sound generated by the speaker for which we will use APR9600. For outdoor environment we will use GPS. Coordinates of various locations will be stored in EEPROM and if the blind person reaches that location he will get to know the location using voice circuit. Similarly for indoor environment he will use RFID.

It is based on the use of new technologies to improve visually impaired person's mobility. Our paper focuses on obstacle detection, and finding location in order to enhance navigation facilities for visually impaired people. Moving through an unknown environment becomes a real challenge when we can't rely on our own eyes. Since dynamic obstacles usually produce noise while moving, blind people develop their sense of hearing to detect them. Various techniques are there which a visionless person commonly uses such as a white cane or walking cane for navigation. The walking cane is a simple and purely mechanical device to detect static obstacles on the ground, uneven surfaces, holes and steps through simple tactile-force feedback. This device is light in weight, portable, but its range is limited due to its own size and is not usable for dynamic components. Another option that provides the best travel aid for the blind is the guide dogs. In this technique the dog is able to detect and analyze complex conditions: cross walks, stairs, potential danger, know paths and more. Most of the information is passed through tactile feedback by the

handle fixed on the animal. The user is able to feel the attitude of his dog, analyze the situation and also give him appropriate orders. But guide dogs are still far from being affordable,and their average working time is limited, an average of 7 years. This system presents a concept to provide a smart electronic aid for blind people. The system is intended to provide overall measures artificial vision and object detection, and also assistance via global positioning system (GPS). The aim of the overall system is 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 objects around them.Various technologies can be used to reduce many barriers that people with disabilities face. These kinds of technologies are referred to as assistive technology (AT). There are many types of disabilities, such as physical disabilities, hearing impaired, and visually-impaired. AT has been used in assisting them. However, developing an AT is expensive, making their selling price high.

According to Mazo and Rodriguez the blind Cane is one of the assisting tools for the visually-impaired and it is really important. According to Herman , one of the main problems of the visually-impaired, is that most of these people have lost their physical integrity. Also, they do not have confidence in themselves. This statement has been proven by Bouvrie, in which an experiment name "Project Prakash" has been carried out. It was intended at test the visually-impaired to make their brain to identify set of objects. According to Chang and Song , this can also be applied to different situation. When the visually-impaired move into a new environment, they will find it difficult to memorize the locations of the object or obstacles. These examples show the difficulties of visually impaired people. The Guide Cane is made to help the visually-impaired users move safely and quickly among obstacles and other difficulties. Guide Cane is used like the mostly used white cane, where the user holds the Guide Cane in front of the user while walking. The Guide Cane is heavier than the white cane, because it uses a servo motor. The wheels are provided with encoders to determine the relative motion. The servo motor, controlled by the built-in computer, can steer the wheels left and right relative to the cane. To detect obstacles, the Guide Cane is provided with ten ultrasonic sensors. A small joystick located at the handle allows the user to give a desired direction of movement. Guide Cane is lot heavier than the ordinary white cane and also it is hard to keep because it cannot be folded. Smart Cane invention is originally the creation of a common blind cane but it is provided with a sensor system. This invention is like Guide Cane where this invention has a number of ultrasonic sensors and servo motors. This invention is designed with the objective of helping the blind in free movement. Ultrasonic sensors used to detect and avoid obstacles or objects located in front of the user.Also the fuzzy controller is needed to determine the instructions that will be executed for example to turn right, left or stop. Likewise Guide Cane, this invention also has a control button on the handle, and the button has four different directions. This invention has the same shortcomings as the Guide Cane where there will be a difficulty to save space or to place the smart cane. Other than that, cost is also a problem in this project as it uses ultrasonic sensors and many servo motors. If the cost is high, users may not be able to afford for it\ because the average income of the visually-impaired people is usually less. Smart Cane has been designed by students from Central Michigan University where this invention uses Radio Frequency Identification (RFID). RFID is used to detect objects or obstacles in front of the user and detects the RFID tag that has been placed in several locations to navigate the users. This invention is just like a normal stick but is provided with a bag, which the user to wear. The bag provides electrical power to the invention and informs the user through speakers inside the bag. For users who cannot hear, there are special gloves that will vibrate at every finger, in which different vibrations in each finger have different meanings. However, this invention has several shortcomings and is only suitable for small areas. This is because it only detects the area with RFID tag otherwise this invention only works as a regular blind cane. In addition, this invention requires a high cost if it is used in the external environment because their will be larger area that will be needed to be tagged, the higher cost is needed. Mechatronics Blind Stick is a guiding system, designed to facilitate the daily work among the visually-impaired people. This invention has many similarities with the Smart Blind Cane. In which this invention uses ultrasonic sensors and sound vibrations. However, this invention also has several weaknesses; it cannot be folded and difficult to keep. In addition, this invention is not equipped with sensors to detect the water areas.

II PROPOSED SYSTEM

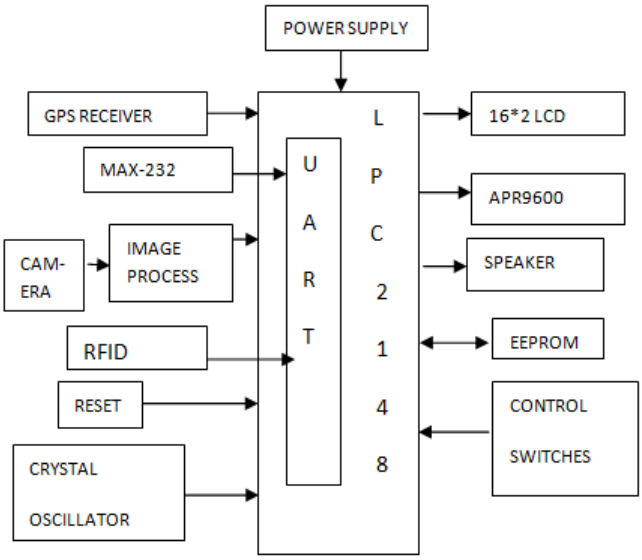


Fig: Block diagram of smart vision system for blind

III HARDWARE IMPLEMENTATION

A. SYSTEM ARCHITECTURE

The proposed system consist of LPC2148, RFID, APR9600, GPS, EEPROM, 16*2 LCD display, control switches, camera speaker.

B. OPERATION

This section explain the operation and interfacing each modules present in the smart vision system architecture.

The whole circuit can be divided into following section:-

1. POWER SUPPLY

This module is basically designed to achieve 12V, 1A and 5V, 500mA and 3.3V. The design consist of transformer which will step down the AC voltage, IN4007 diode used to form bridge rectifier to convert AC to DC, capacitor of 1000uF which is used as a filter circuit, 7812 regulator to obtain a 12V DC and followed by 7805 regulator to obtain a 5V DC at the output of the regulator a 330 ohm resistance and LED is connected as power on indicator

2. LPC2148

The LPC2148 microcontrollers are based on a 16/32-bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combine the microcontroller with 32 kB, 64 kB, 128 kB, 256 kB and 512 kB of embedded high-speed flash memory. A 128-bit wide memory interface and a unique accelerator architecture enable 32-bit code execution at maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30 % with minimal performance penalty.Due to their tiny size and low power consumption, these microcontrollers are ideal for applications where miniaturization is a key requirement, such as access control and point-of-sale. With a wide range of serial communications interfaces and on-chip SRAM options of 8 kB, 16 kB, and 32 kB, they are very well suited for communication gateways and protocol converters, soft modems, voice recognition and low-end imaging, providing both large buffer size and high processing power. Various 32-bit timers, single or dual 10-bit 8-channel ADC(s), 10-bit DAC, PWM channels and 47 GPIO lines with up to nine edge or level sensitive external interrupt pins make these microcontrollers particularly suitable for industrial control and medical systems.

3. GPS

GPS receiver calculates its position by precisely timing the signals sent by the GPS satellites high above the Earth. Each satellite continually transmits messages containing the time the message was sent, precise orbital information, and the general system health and rough orbits of all GPS satellites. The receiver measures the transit time of each message and computes the distance to each satellite. Geometric trilateration is used to combine these distances with the location of the satellites to determine the receiver's location. The position is displayed, perhaps with a moving map display or latitude and longitude; elevation information may be included. Many GPS units also show derived information such as direction and speed, calculated from position changes. [6]

it might seem three satellites are enough to solve for position, since space has three dimensions. However a very small clock error multiplied by the very large speed of lightthe speed at which satellite signals propagate- results in a large positional error. The receiver uses a fourth satellite to solve for *x*, *y*, *z*, and *t* which is used to correct the receiver's clock. While most GPS applications use the computed location only and effectively hide the very accurately computed time, it is used in a few specialized GPS applications such as time transfer and traffic signal timing.

Although four satellites are required for normal operation, fewer apply in special cases. If one variable is already known (for example, a ship or plane may have known elevation), a receiver can determine its position using only three satellites. Some GPS receivers may use additional clues or assumptions (such as reusing the last known altitude, dead reckoning, inertial navigation, or including information from the vehicle computer) to give a degraded position when fewer than four satellites are visible.

RFID is a method of remotely storing and retrieving data using devices called RFID tags. An RFID tag is a small object, such as an adhesive sticker, that can be attached to or incorporated into a product. RFID tags contain antennae to enable them to receive and respond to radio-frequency queries from an RFID transceiver.

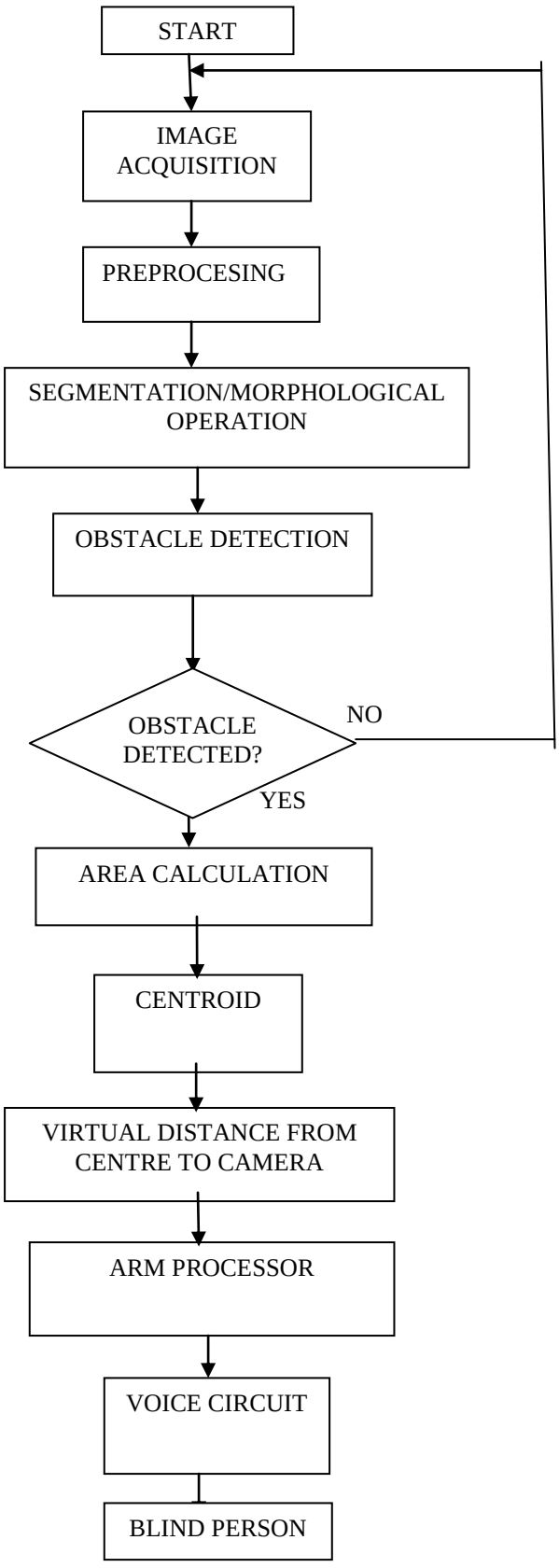
It offers very high security. Each tag is identified by a Unique Identification Number (UIN), which can be either factory or manually programmed and then password protected. The excellence of this tag is that the data on the chip that uses sophisticated algorithm techniques cannot be duplicated or manipulated. Hence making it the perfect tool for Secure Access Control.

IV SOFTWARE IMPLEMENTATION

1. MATLAB

MATLAB is a software package for high performance numerical computation & visualization. It provides an iterative environment with hundreds of built in function for technical computation, graphics & animations. MATLAB is an abbreviation of Matrix Laboratory. It is a popular Mathematical Programming Environment used extensively in Education as well as in Industry. The trick behind MATLAB is that everything is represented in the form of arrays or matrices. Mathematical Operations starting from simple algebra to complex calculus may be conveniently carried out using this environment. The main use of MATLAB in Software Development is Algorithm Design and Development. Code developed in MATLAB can be converted into C, C++ or Visual C++. Additionally MATLAB may be called as ActiveX Object from still higher level languages like Visual Basic, etc. Using MATLAB it is easy to manipulate matrices by addressing of individual element, complete row addressing, and complete column addressing and transposing one matrix to another required matrix. Saving and loading data, defining functions and m-files is user friendly in MATLAB. Commonly used commands in MATLAB are Who's, Help, Clear, Path, Cd etc.

2. FLOWCHART



Flowchart of obstacle detection

V EXPERIMENTAL RESULTS

Fig. represents processing of images and detects obstacles.

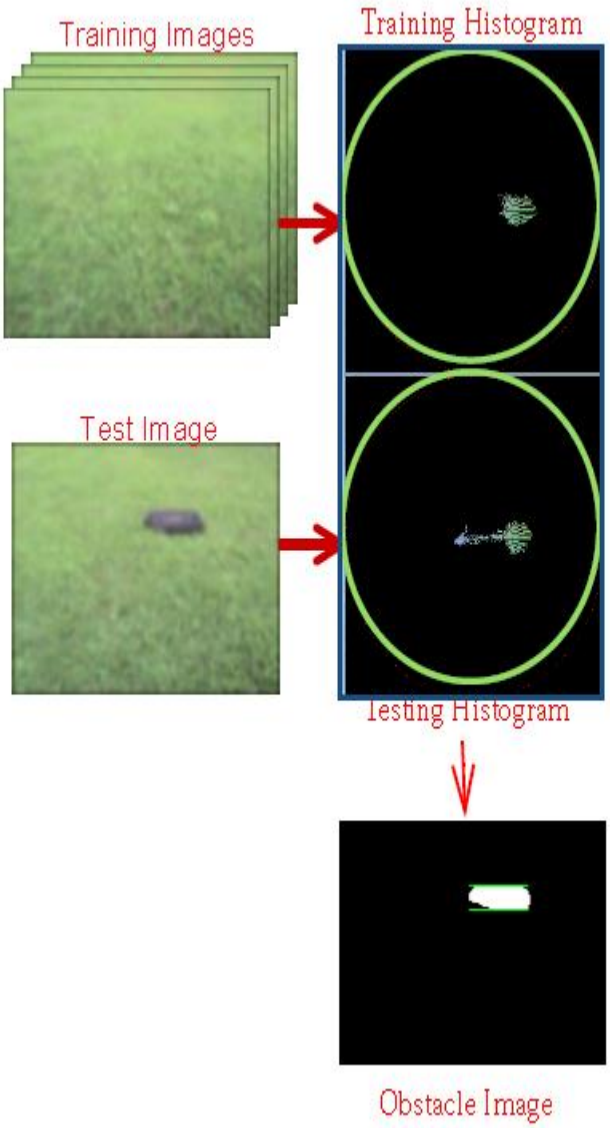


Fig. represents obstacle detection.

Below figures represents two images of the same area acquired simultaneously by a stereo vision system. The images look similar; however they have a small displacement. Based on that displacement, the system is capable of determining the distance of the objects present in the scene to the cameras.

Fig. shows that two similar images have small displacement.

Distance is inversely proportional to disparity. So, as seen in Figure above, pixels with higher intensity values (brighter) represent objects closer to the cameras and lower intensity values (darker) represent objects far from the cameras.

VI CONCLUSION

With the proposed system, if developed with at most accuracy, the blind people will able to move from one place to another without others help. If such a system is developed, it will act as a basic platform for the generation of more such devices for the visually impaired in the future which will be cost effective. And as far as the localization is concerned it will be able to provide accurate details of the location of the blind if in case they lost with help from the GPS. It will be real boon the blind. The developed prototype gives good results in detecting obstacles paced at distance in front of the user.

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