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Blind People To Find Obstacle Free Path Using GPS & GSM

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***Abstract*— This paper is intended to provide overall measures –object detection and real time assistance via Global Positioning System(GPS) and Global System for Mobile communications (GSM).This project aims Walking safely and confidently without any human assistance in urban or unknown environments is a difficult task for blind people. Visually impaired people generally use either the typical white cane or the guide dog to travel independently. Although the white stick gives a warning about 1m before the obstacle, for a normal walking speed of 1.2 m/s, the time to react is very short (only 1 s).The stick scans the floor and consequently cannot detect certain obstacles (rears of trucks, low branches, etc.).Safety and confidence could be increased using devices that give a signal to find the direction of an obstacle-free path in unfamiliar or change in environments. Electronic travel aids (ETAs) are devices that give off a warning by auditory or/and tactile signals when an obstacle is in the way and allow the user to avoid it.**

The system consists of ultrasonic sensor, Sonar sensor, GPS Module, GSM Module and vibratory circuit (speakers or head phones). The location of the blind is found using Global System for Mobile communications (GSM) and Global Position System (GPS).

***Keywords*—Electronic travel aid (ETA), Ultrasonic sensor, Sonar sensor, Global System for Mobile Communications (GSM), Global Position System (GPS), VibratoryCircuit, IDE (Integrated Development Environment)**

I INTRODUCTION

In this project we are going to interface a obstacle sensors and a speaker with the Microcontroller and the complete module will be attached with the blind person's stick. So whenever the blind reason will detect any obstacle up to a distance of 6.5 meter using sonar sensor automatically a announce will be generated through headphones as Object Detected, for shorter distances we are using ultrasonic sensors. And in this project we are going to interface GSM and GPS to detect the blind person location.

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Although the white stick gives a warning about 1 m before the obstacle, for a normal walking speed of 1.2 m/s, the time to react is very short (only 1 s). The stick scans the floor and consequently cannot detect certain obstacles (rears of trucks, low branches, etc.). Safety and confidence could be increased using devices that give a signal to find the direction of an obstacle-free path in unfamiliar or change in environments. Electronic travel aids (ETAs) are devices that give off a warning by auditory or/and tactile signals when an obstacle is in the way and allow the user to avoid it [1],[2].

In this system we are going to use an obstacle detection sensor as the heart of the system. In this module we are going to interface an obstacle sensor that will keep on emitting a signal generated by the Microcontroller. This signal after hitting the obstacle will be received back. This echo signal collected by the sensor receiver and based on computing signal thus alerting the person well in advance about the obstacle. In this system we are going to interface a obstacle sensors and a buzzer with the Microcontroller and the complete module will be attached with the blind person's stick. So whenever the blind Person will detect any obstacle up to a distance of 6.5 meter automatically a buzzer will indicate about it to the blind person using sonar sensor and an announce will be generated through headphones as Object Detected . And in this system we are going to interface GSM and GPS to detect the blind person location. The proposed architecture consists of a GPS signal receiver and GSM connected to ARM7. This complete setup will be fixed to stick. The GPS will be sending the location information to the controller continuously. The same will be routed to the GSM modem through the controller. GSM will forward this information to the pre fed mobile numbers the user after receiving the message. In this system we are using ARM7TDMI based LPC2148 microcontroller, which is having 512KB flash memory and 8 to 40 KB of SRAM and several peripherals. Here we are using Obstacle sensor, this will be interfacing with ADC. The GSM module and GPS will communicate using RS232 protocol with microcontroller. If the person want to know the location of the blind person, he has to send one message like LOCATION ,immediately he will get the blind person location coordinates.

This paper presents a theoretical model and a system concept to provide a smart electronic aid for blind people. This system is intended to provide overall measures –object detection and real-time assistance via Global Positioning System (GPS).The system consist of ultrasonic sensor, sonar sensor ,GPS Module, GSM Module and vibratory circuit(speakers or head phones). This project aims at the development of an Electronic Travelling Aid (ETA) kit to help the blind people to find obstacle free path. This ETA is fixed to the stick of the blind people. When the object is detected near to the blinds stick it alerts them with the help of vibratory circuit (speakers or head phones). The location of the blind is found using Global System for Mobile communications (GSM) and Global Position System

Artificial Vision is the most important part of human physiology as 83% of information human being gets from the environment is via sight. The statistics by the World Health Organization (WHO) in 2011 estimates that there are 285 billion people in world with visual impairment, 39 billion of people which are blind and 246 with low vision. The oldest and traditional mobility aids for persons with visual impairments are the walking cane (also called white cane or stick) and guide dogs. The drawbacks of these aids are range of motion and very little Information conveyed. With the rapid advances of modern technology, both in hardware and software front have brought potential to provide intelligent navigation capabilities. Recently there has been a lot of Electronic Travel Aids (ETA) designed and devised to help the blind people to navigate safely and independently. Also high-end technological solutions have been introduced recently to help blind persons navigate independently.

To identify the position and orientation and location of the blind person any of those solutions rely on Global Positioning System (GPS) technology. Such systems are suitable for outdoor navigation, due to the need for line of sight access to the satellites, they need additional components to improve on the resolution and proximity detection to prevent collision of the blind persons with other objects and hence subject his/her life to danger. However in comparison with other technologies many blind guidance systems use ultrasound because of its immunity to the environmental noise. Another reason why ultrasonic is popular is this technology is relatively inexpensive, and also the ultrasound emitters and detectors are small enough to be carried without the need for complex circuitry. Apart from the conventional navigation systems, a blind aid system can be provided a new dimension of Real-time assistance and artificial vision along with dedicated obstacle detection circuitry. These different units are discussed to implement the design of a ‘Smart stick’ for blind.

Figure 1: ETA assistance for blind

II HARDWARE DESIGN

The Hardware architecture in the figure 2 depicts the proposed design of an embedded smart stick. The elements of the system consist of various subsystems. The object detector circuitry consisting of sensors such as ultrasonic sensors and Led sensors. Vibratory circuitry consist of an array of mobile vibrators with logic designed to obtain different vibratory patterns. The GPS system, microcontroller and power circuitry (preferably battery-based) are the crucial systems. The proposed system can be designed to a detachable and portable device, which can be mounted on a simple white cane or blind stick. This requires a clear vision of the desired system goals. Various system parameters are thus needed to be evaluated based on the design to be practically implementable.

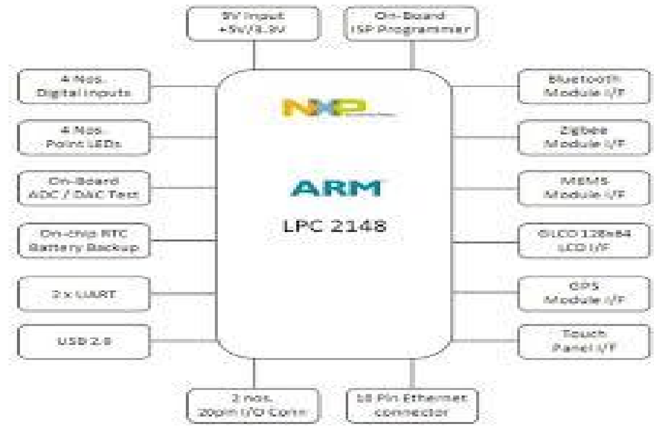

Figure 2 Hardware Architecture

MICROCONTROLLER: The microcontroller used in this GPS and GSM based device with user input interface can be preferably ARM7TDMI based LPC2148 microcontroller, which is having 512KB flash memory and 8 to 40 KB of SRAM and several peripherals. The ARM7TDMI-S is a general purpose 32-bit microprocessor. A unique accelerator architecture and a 128-bit wide memory interface enable 32-bit code execution at the maximum clock rate. The GSM module and GPS will communicate using RS232 protocol with microcontroller.

GSM AND GPS MODULES: The Global Positioning System (GPS)[3] and Global System for Mobile communications (GSM)[4] are interfaced to the microcontroller to detect the blind person location .The proposed architecture consists of a GPS signal receiver and GSM, vibratory circuitry connected to ARM7. This complete setup will be fixed to stick. The GPS will be sending the location information to the controller continuously. The same will be routed to the GSM modem through the controller.

OBJECT DETECTOR: The first class is based on sensory or artificial vision systems. The sensory systems emit ultrasonic or laser beams to the environment, which are reflected by the object; the system calculates the distance from the object according to the time difference between the emitted and received beam. The stereo-vision systems use the object tracking algorithms and calculate the distance by using grayscale method .

ARM ARCHITECTURE: The ARM core uses RISC architecture. Its design philosophy is aimed at delivering simple but powerful instructions that execute within a single cycle at a high clock speed. The RISC philosophy concentrates on reducing the complexity of instructions performed by the hardware because it is easier to provide greater flexibility and intelligence in software rather than hardware. As, a result RISC design plays greater demands on the compiler. In contrast, the traditional complex instruction set computer (CISC) relies more on the hardware for instruction functionality, AND consequently the CISC instructions are more complicated.

FEATURES

- 32/16-bit RISC architecture (ARM v4T)
- 32-bit ARM instruction set for maximum performance and flexibility
- 16-bit Thumb instruction set for increased code density
- Unified bus interface, 32-bit data bus carries both instructions and data
- Three-stage pipeline
- 32-bit ALU
- Very small die size and low power consumption
- Fully static operation
- Coprocessor interface
- Extensive debug facilities (Embedded ICE debug unit accessible via JTAG interface unit)

ADVANTAGES

- Generic layout can be ported to specific process technologies
- Unified memory bus simplifies SOC(System on chip) integration process
- ARM and Thumb instructions sets can be mixed with minimal overhead to support application requirements for speed and code density
- Code written for ARM7TDMI-S is binary-compatible with other members of the ARM7 Family and forwards compatible with ARM9, ARM9E and ARM10 families, thus it's quite easy to port your design to higher level microcontroller or microprocessor
- Static design and lower power consumption are essential for battery -powered devices
- Instruction set can be extended for specific requirements using coprocessors
- Embedded ICE-RT and optional ETM units enable extensive, real-time debug facilities

GPS (Global System for Mobile communication) is a digital mobile telephone system that is widely used in Europe and other parts of the world. GSM uses a variation of Time Division Multiple Access (TDMA) and is the most widely used of the three digital wireless telephone technologies (TDMA, GSM, and CDMA). GSM digitizes and compresses data, then sends it down a channel with two other streams of user data, each in its own time slot. It operates at either the 900 MHz or 1,800 MHz frequency band.

Global System for Mobile Communications GSM is a digital wireless network standard designed by standardization committees from major European telecommunications operators and manufacturers. The GSM standard provides a common set of compatible services and capabilities to all mobile users across Europe and several million customers worldwide. The basic requirements of GSM have been described in five aspects.

Services: The system shall provide service portability, i.e., mobile stations or mobile phones can be used in all participating countries. The system shall offer services that exist in the wire line network as well as services specific to mobile communications. In addition to vehicle-mounted stations, the system shall provide service to Mss used by pedestrians and /or on board ships.

Quality of Services and Security: The quality for voice telephony of GSM shall beat least as good as the previous analog systems over the practical operating range. The system shall be capable of offering information encryption without significantly affecting the costs to users who do not require such facility.Radio Frequency Utilization .the system shall permit a high level of spectrum efficiency and state-of-the-art subscriber facilities. The system shall be capable of operating in the entire allocated frequency band, and co-exist with the earlier systems in the same frequency band.

Network: The identification and numbering plans shall be based on relevant ITU recommendations. An international standardized signaling system shall be used for switching and mobility Management. The existing fixed public networks should not be significantly modified.

Cost: The system parameters shall be chosen with a view to limiting the cost of the complete system, in particular the Mss.

The Global Positioning System (GPS) offers the capability to accurately determine location anywhere on earth in addition to speed, altitude, heading, and a host of other critical positioning data. GPS is widely used in military, consumer, and service markets with applications ranging from container shipping to weapons systems and handheld devices.

The GPS system consists of 24 satellites orbiting in six planes around the earth. The satellites transmit a microwave signal, which is read by the GPS receiver on earth. The GPS receiver requires a successful lock onto at least four GPS satellites to gather an accurate signal for calculating position and velocity. The module triangulates its position with relation to three satellites, using a fourth satellite as a clock source.

The GPS system is designed such that at any point, a GPS module on earth has a clear view of at least four satellites, barring any obstruction such as buildings, interiors of a canyon, dense foliage, or mountains. This application note details important data considerations and implementation methods to integrate a GPS receiver with a CY8C29466 device and enable data logging through an SD card. Finally, the GPS data is parsed and displayed onto an LCD screen. This application note guides a PSoC® developer in integrating GPS applications and providing portable code that can be bolted into a user's application

III PRINCIPLE OF ULTRASONIC SENSOR AND SONAR SENSOR

The proposed system uses ultrasonic sensor which basically works on the principle of the ultrasonic sound generation and alert mechanism. The system is however having a dual feedback mechanism i.e it has an additional vibratory feedback mechanism. This enhances the overall feedback received by the blind user who receives the outputs generated in different formats of vibration i.e high, low, medium and strong vibrations. ultrasonic sensors uses propagation of acoustic energy at higher frequencies than normal hearing to extract information from the environment. Sonar is a popular sensor in robotics that employs acoustic pulses and their echoes to measure range to an object. Since the sound speed is usually known, the object range is proportional to the echo travel time. At ultrasonic frequencies the sonar energy is concentrated in a beam, providing directional information in addition to range. Its popularity is due to its inexpensive cost, light weight, low power consumption, and low computational effort, compared to other ranging sensors. In some applications, such as in underwater and low-visibility environments, sonar is often the only viable sensing modality. Sonars in robotics have three different, but related, purposes:

1. Obstacle avoidance: The first detected echo is assumed to measure the range to the closest object. Robots use this information to plan paths around obstacles and to prevent collisions.
2. Sonar mapping: A collection of echoes acquired by performing a rotational scan or from a sonar array,
3. Object recognition: A sequence of echoes or sonar maps are processed to classify echo producing structures composed of one or more physical objects. When successful, this information is useful for robot registration or landmark navigation.

SONARBEAM PATTERN: To derive a qualitative description of the sonar transducer, we apply elementary acoustics theory to a simplified model to achieve a simple analytic form . A sonar emitter is commonly modeled as circular piston surface of radius a vibrating with frequencing where c the sound speed in air, 343 m⁄s at 25 $^\circ$C . When $a > \lambda$ the emitted pressure field forms a beam consisting of a main lobe surrounded by side lobes. In the far field, or range greater than a^2/λ, the beam is described by its *directivity pattern*, which equals the two-dimensional Fourier transform of the aperture function, in this case the circular aperture produces a Bessel function. The emitted pressure amplitude at range r and angle θ relative to the piston axis can be written as where α is a proportionality constant that includes the density of air and the source strength, $k = 2\pi/\lambda$, and J_1 is the Bessel function of the first kind. The term in the brackets evaluates to one along the sonar axis, $\theta = 0$. The a^2 term indicates that the emitted pressure increases with the piston area. The frequency f appears in the numerator because the faster-moving piston generates higher pressures.

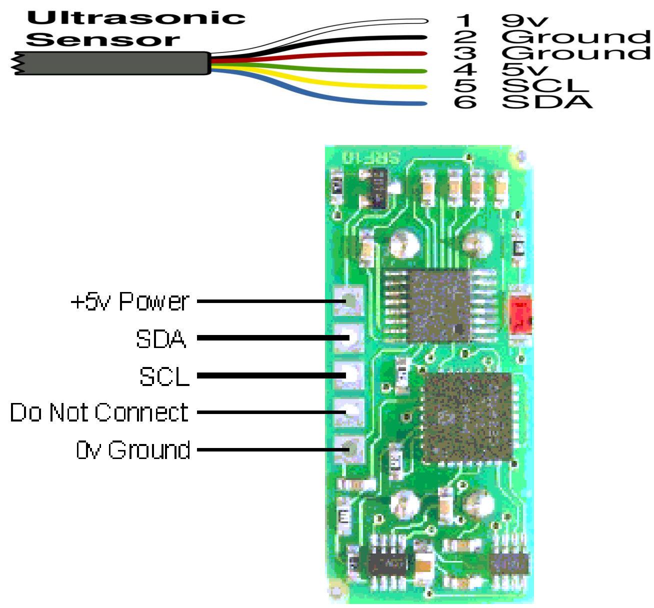

Figure 3,4: Ultra Sonic sensor

Ultrasonic sensor provides a very low-cost and easy method of distance measurement. This sensor is perfect for any number of applications that require you to perform measurements between moving or stationary objects. You will definitely appreciate the activity status LED and the economic use of just one I/O pin. The Ping sensor measures distance using ultrasonic (well above human hearing) pulse is transmitted from the unit and distance-to-target is determined by measuring the time required for the echo return. Output from the PING))) sensor is a variable-width pulse that corresponds to the distance to the target.

Ultra Sonic Sensor Features

- Provides precise, non-contact distance measurements within a 2 cm to 3 m range
- Simple pulse in/pulse out communication
- Burst indicator LED shows measurement in progress
- 20 mA power consumption
- Narrow acceptance angle
- 3-pin header makes it easy to connect using a servo extension cable, no soldering required

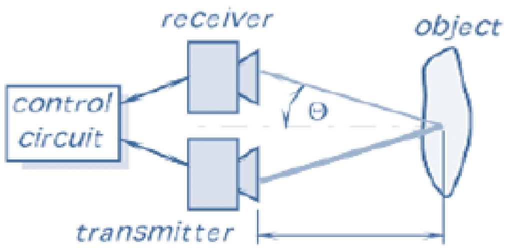

Figure 5: Operation of Ultra Sonic Sensor

IV SOFTWARE DESIGN AND DEVELOPMENT

The software we use here is Keil µvision 4 IDE (Integrated Development Environment) .This is a virtual platform where we can execute code and check our desired results. For executing the code we have to choose the controller LPC 2148. After checking the results virtually we will dump the code into controller to verify results.

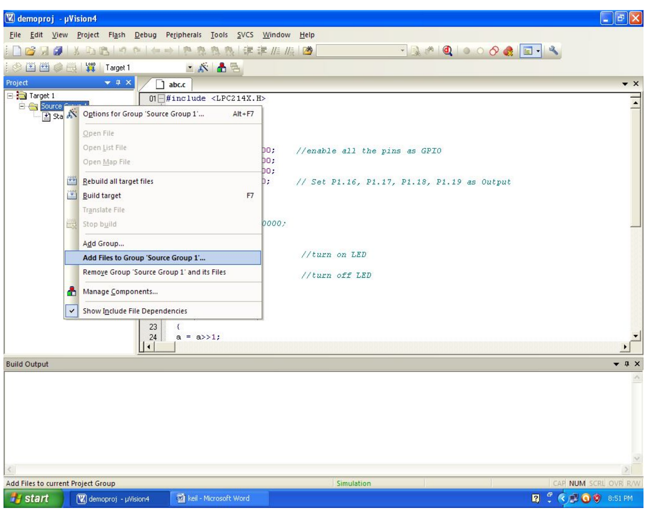

Figure 6: Selection of LPC 2148 in KEIL

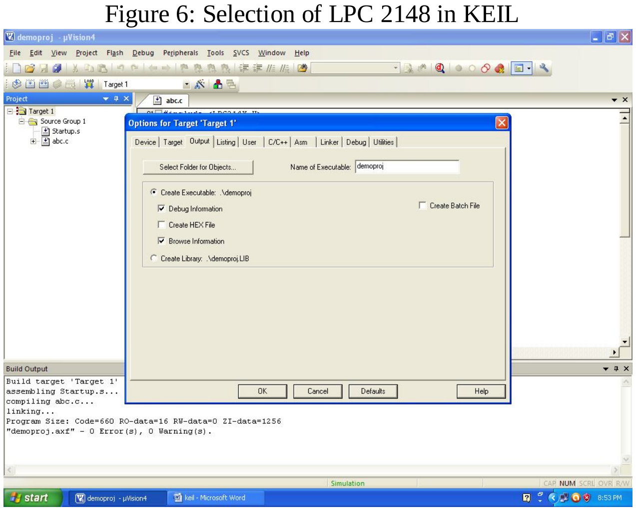

Figure 7: verifying code for bugs in KEIL

V RESULT

The ETA (Electronic Travelling Aid) system when faces an obstacle, within 1 meter distance it will sense the obstacle through ultrasonic sensor and produce voice based signal as " path guiding obstacle detected" and display the same in LCD. The objects at 6.5meter distance to the blind person will be detected by sonar sensor, gives voice based alert as "path guiding object detected" and display the same in LCD.

Whenever the care taker from external place want to know the location of blind person, he has to send an sms to ETA system then it sends the location in terms of longitude and latitude co-ordinates through GSM with the help of GPS.

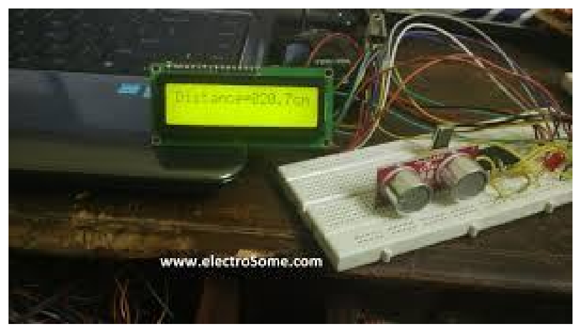

Figure 8: ETA Kit

Figure 9: Screen shots of result

VI CONCLUSION

The design and architecture of a new concept of Smart Electronic Travel Aid Stick for blind people. The advantage of the system lies in the fact that it can prove to be a very low cost solution to millions of blind persons worldwide. The proposed combination of various working units makes a real-time system that monitors position of the user and provides dual feedback making navigation more safe and secure. This system is intended to provide overall measures object detection and real-time assistance via Global Positioning System (GPS).The system consist of ultrasonic sensor, sonar sensors, GPS Module, GSM Module and vibratory circuit(speakers or head phones). When the object is detected near to the blinds stick it alerts them with the help of vibratory circuit (speakers or head phones). The location of the blind is found using Global System for Mobile communications (GSM) and Global Position System

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