Silicon Eyes: GPS-GSM based Navigation Assistant for Viually Impaired using Capacitive Touch Braille Keypad and Smart SMS Facility

B. R. Prudhvi, Rishab Bagani
Department of Electronics and Communication Engineering
SRM University
Chennai, India
{brprudhvi, rbstarwars}@gmail.com

ABSTRACT: *This paper proposes an aim to provide blind navigation information via audible messages and haptic feedback, helping the visually disabled to localize where they are and their mobility path way. This also proposes a method that allows blind people to enter notes and control device operation via Braille capacitive touch keypad instead of sending SMS by entering the number and text. An emergency button triggers an SMS from the GSM module that will send the present location (GPS coordinates) of the user to a remote phone number asking for help. In addition, the device provides the information needed to the user, in audio format using audio codec, including time, calendar, and object color using a 24-bit color sensor, obstacle distance using SONAR, navigation direction, ambient light and temperature conditions.*

Keywords: Color Sensor, Haptic Feedback, GPS, GSM, SONAR

Received: 1 March 2013, Revised 29 March 2013, Accepted 4 April 2013

1. Introduction

Worldwide, there are over 314 million of visually impaired and 45 million of them are blind. About 87% of the visually impaired live in the developing countries. According to EU reports for every 1000 Europeans 4 are blind or visually impaired [2]. These statistics indicate the global scale of this sensory impairment that poses severe limitations to the individuals and creates a serious burden to societies and economies. In the USA the cost related to blindness and visual impairment amounts to $68 billion annually. The indicated numbers will increase due to aging demographics (about 82% out of all visually impaired are aged Over 50). Vision loss is the most serious sensory disability that causes approx. 90% depravation of entire multi sense perception for a human. According to American Medical Association's (AMA) guides to evaluation of permanent impairments, blindness accounts for approx. 80% of Whole Person Impairment (WPI) rating .For many visually impaired people, a cane or a stick is a close friend helping them to detect and avoid obstacles in their pathway. During walking with the cane going from place to place, they sense and guess directions, locate places by hearing sounds surrounding, sniffing smells in the air, feeling touches on skin, counting footsteps they walk, and memorizing events in time and spaces.

However, it is difficult for them to guess where they are when surrounding environment is new or when they forget the locations.

2. Featureseatures and Description

2.1 Microcontroller

This system is supported by a 32-bit ARM cortex –M3 microcontroller which controls the overall system operations of the device.

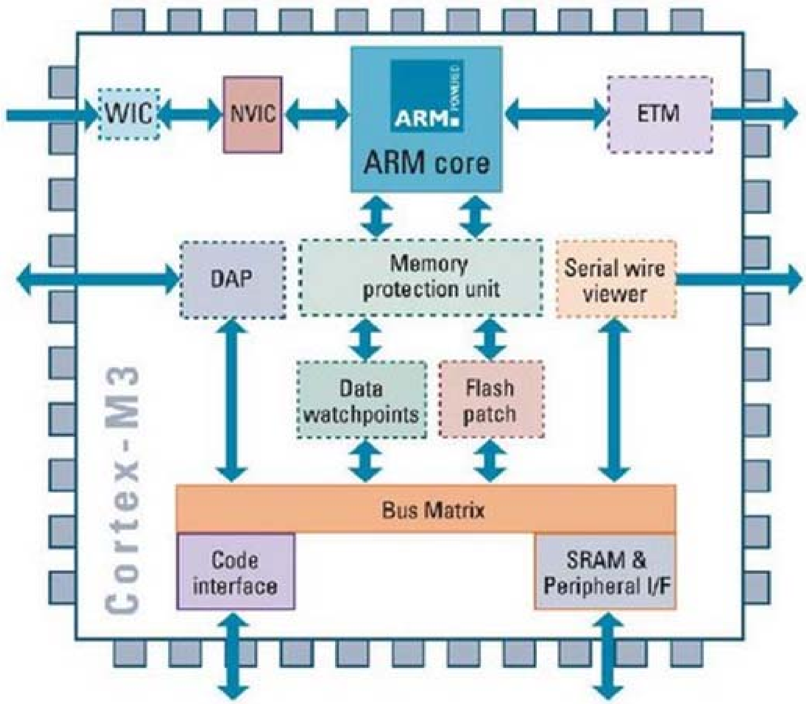


Figure 1. ARM Cortex-M3 Block Diagram

2.2 Global Positioning System(GPS)

The Global Positioning System (GPS), triangulates the position of the person carrying the device [2] [3], and sends the exact location to the responder through SMS.

The smart antenna can track up to 66 satellites at a time. It has a superior sensitivity and has an accuracy of less than 10m. It has a built-in micro battery to preserve system data for rapid satellite acquisition.

2.3 GSM Module

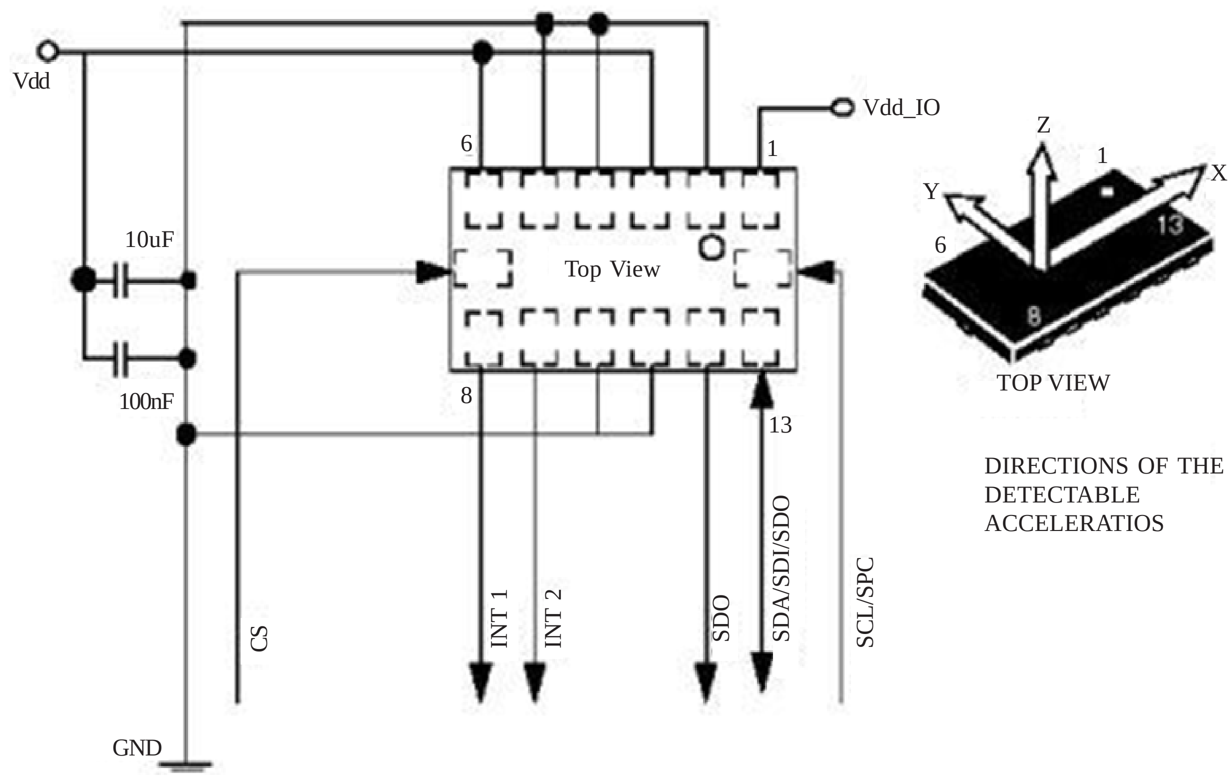
The on-board GSM module is responsible for sending the SMS containing the information about the location of the visually disabled person who is carrying the device. The SMS is sent to the person, whose number is already preloaded, depending upon the request of the user.

Figure 2. GSM Module

2.4 MEMS Magnetometer and MEMS Accelerometer

MEMS Magnetometer and MEMS Accelerometer is used as a direction sensor and is responsible for directing the person in his/ her pathway.

(a)



(b)

Figure 3. (a) 3-axis digital MEMS magnetometer (b) Pin connections and directions of detectable accelerations

2.5 Braille Capacitive Touch Keypad

The Braille capacitive touch keypad allows the user to enter notes and helps in controlling the device operations. It supports upto 12 electrodes and has a continuous independent auto-calibration feature for each electrode input. Separate touch and release trip thresholds for each electrode are present that provides hysteresis and electrode independence.

2.6 SONAR

Sound Navigation and Ranging (SONAR), helps the user by identifying the obstacles and notifies him about it. This has a range

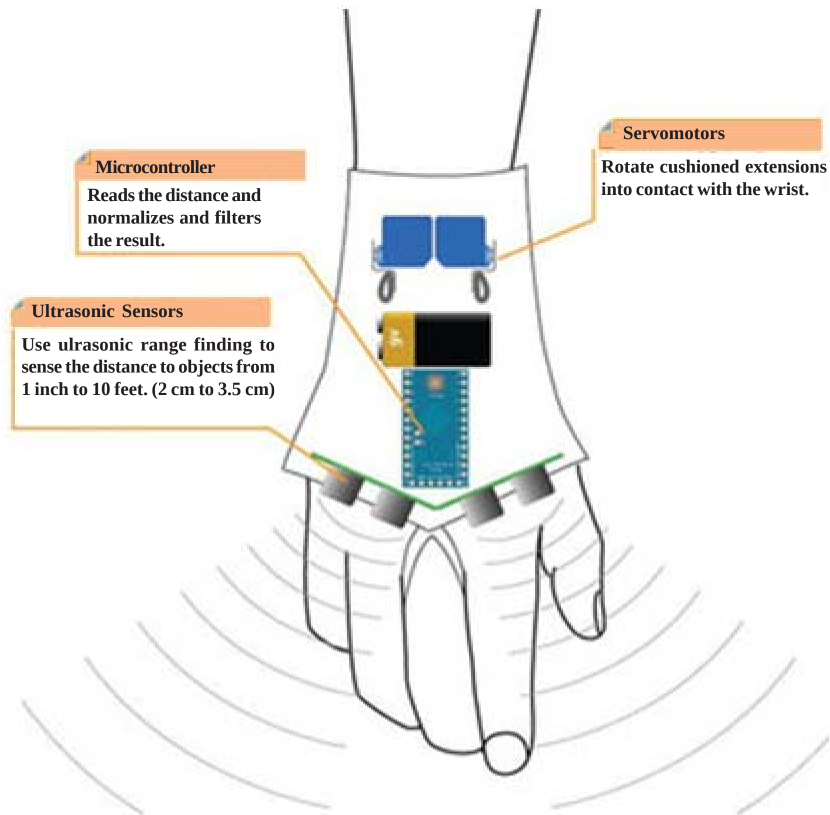


Figure 4. Sensored Glove

of about 3m. The vibrator provides a haptic feedback [1] [2] [4], for the obstacle detected.

2.7 Color Sensor

A color sensor is used, to help the person to distinguish between various objects depending on the color variations.

2.8 MP3 Audio Decoder

The audio codec decodes the audio signal and outputs the voice in headphone. It decodes multiple formats such as MP3, AAC, WMA, FLAC, Ogg Vorbis, WAV and MIDI. It has an ear speaker spatial processing system with volume, bass and treble controls that operates at low-power.

In addition a 16.5 KB on-chip RAM is present for user code and data.

2.9 Micro-SD Card

A 2GB Micro-SD card id utilized, that allows FAT-32 formatting for easy file management with a maximum data rate of 25Mbps. This is responsible for storing all the system configurations, audio library, GPS location libraries and maps.

3. Conclusions

• The proposed solution describes a talking navigation assistant that helps the visually disabled in their movement.

• Low power 32-bit ARM Cortex-M3 microcontroller enables highly deterministic operation using battery power only.

• 66-channel GPS module gives highly accurate position information and universal time

• Automatic Emergency SMS service helps in providing immediate aid when required where SMS can be sent to many numbers.

• The Capacitive Touch keypad eliminates finger pain while using older Braille keys and allows blind people to enter notes

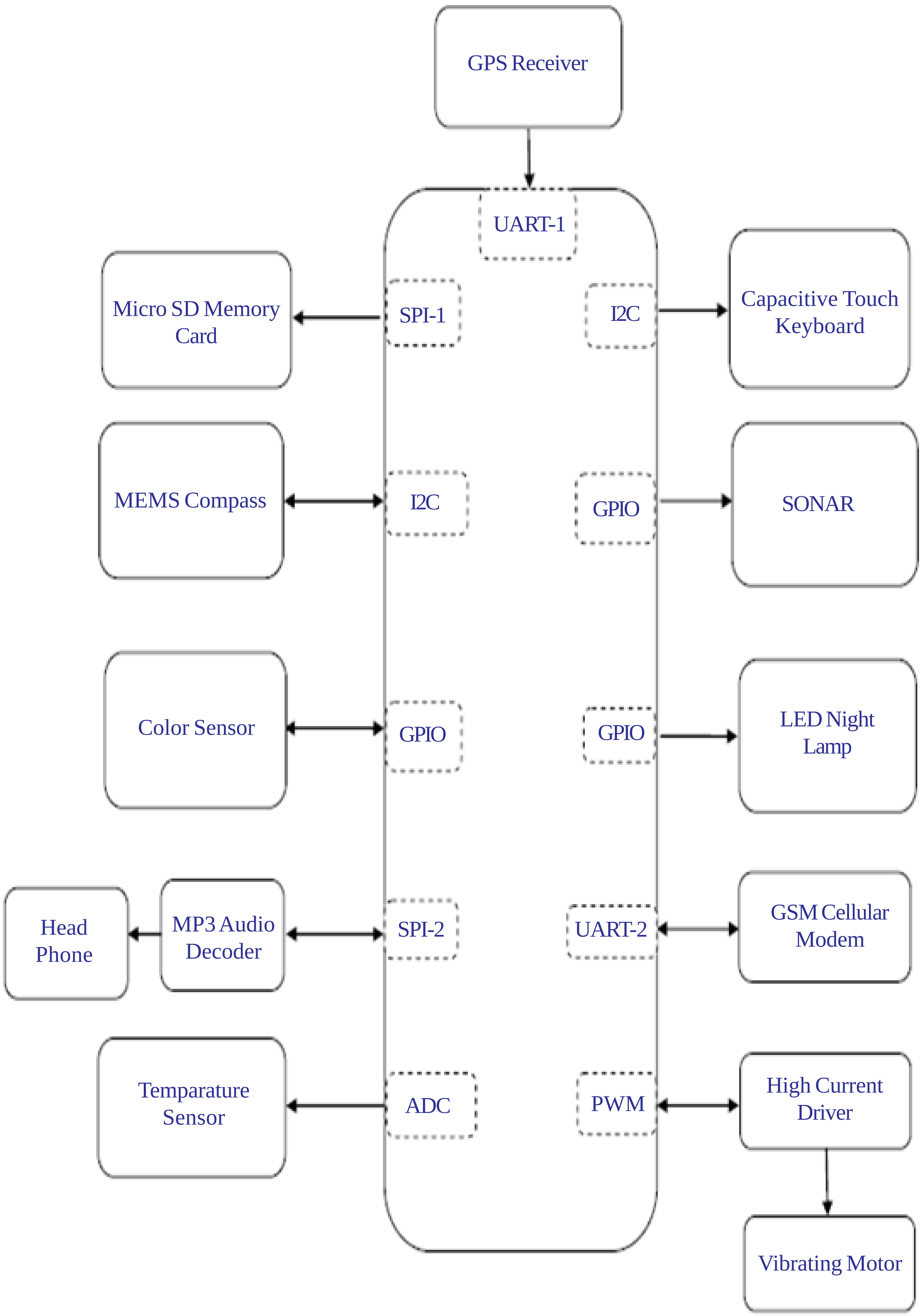


Figure 5. System Block Diagram

and control device operation easily. Notes written are digitally stored in a compact 2GB micro-SD card for future computer access.

• SONAR is capable of measuring object distance up to 3m. 24-bit Color Sensor capable of recognizing multitude of colored objects

• The device has a finger messaging module based on DC Servo Motor that rotates an actuator for direction recognition.

• Navigation information is provided through Natural MP3 quality voice interface via head phone.

• In addition, the device provides the information needed to user, in audio format, including time, calendar, object color, alarm, obstacle distance, navigation direction, ambient light and temperature condition.

References

[1] Takeshi Ando, Ryota Tsukahara, Masatoshi Seki, Masakatsu G. Fujie. (2012). A Haptic Interface, Force Blinker for Navigation of the visually impared, *IEEE Transactions on Industrial Electronics*, 59 (11), November.

[2] Pawel Strumillo. (2010). Electronic Interfaces Aiding the Visually Impaired in Environmental Access, Mobility and Navigation, Rzeszow, Poland , May 13-15.

[3] Sai Santhosh, S., Sasiprabha, T., Jeberson, R. BLI-NAV Embedded Navigation System for Blind People.

[4] Garcia, A. R., Fonseca.A.Duran. Electronic long cane for locomotion improving on visual impaired people. A case study, Pan American Health Care Exchangess-PAHCE. Conference, Workshops, and Exhibits. Cooperation/Linkages.

Author Biography

B.R.Prudhvi was born in Bangalore, Karnataka, India, on 3rd November 1991. He is currently pursuing his final year B.Tech at SRM University, Chennai, India, with Electronics and Communication as his major of study. His research areas include Satellite Communication, Embedded Systems, Transmission Lines and Networks.

Rishab Bagani was born in Kolkata, West Bengal, India, on 14th August 1990. He is currently pursuing his final year B.Tech at SRM University, Chennai, India, with Electronics and Communication as his major of study. His research areas include Bio-Engineering, Robotics and Embedded Systems.