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Smart White Cane – An Elegant and Economic Walking Aid

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ABSTRACT:*the main aim of this research paper is to provide a simple, affordable yet an efficient solution for the visually impaired. The idea behind the design of the stick was to keep it structurally similar i.e. thin, lightweight and easy to handle, yet give an active feedback to the user regarding hazards in his walking path. The smart white cane uses the ultrasonic sensors arranged in such a way that it detects pits, potholes, downfalls, a staircase (up and down), low lying and knee level obstacles and even those above the waist. The user is notified about the same by the pre-recorded sound messages and a haptic feedback in form of vibrations. This can considerably alleviate the risk of the user injuring himself.*

INDEXTERMS: *ATMega328,Ultrasonicsensor, Sound IC,White cane, walking aid.*

I. INTRODUCTION

There are approximately 37million people across the globe who are blind, over 15 million are from India.Even for the non-visually impaired the congestion of obstacles is sometimes problematic, it's even worse for the visually impaired. People with visual disabilities are often dependent on external assistance which can be provided by humans, trained dogs, or special electronic devices as support systems for decision making. Existing devices are able to detect and recognize objects that emerge on the floor, but a considerable risk is also includes the objects that are at a sudden depth, or obstacles above waist level or stairs. Thus wewere motivated to develop a smart white cane to overcome these limitations.The most common tool that the blind currently use to navigate is the standard white cane. We decided to modify and enhance the walking cane, since blind are only able to detect objects by touch or by cane. The user sweeps the caneback and forth in front of them. When the cane hits an object or falls off of the edge of a stair, the user then becomes aware of the obstacle –sometimes too late. We wanted to provide additional feedback to the user to warn him of objects *before* he runs into them. We accomplished this goal by adding ultrasonic sensors at specific positions to the cane that provided information about the environment to the user through audio feedback.

Smart white cane is specially designed to detect obstacles which may help the blind to navigate care-free. The vibration feedback and the audio messages will keep the user alert and considerably reduce accidents. The cane will warn whenever there are steps ahead and communicate whether they are going up or down accordingly. The intensity of vibrations is an indication of the closeness of an obstacle in the walking path of the user.

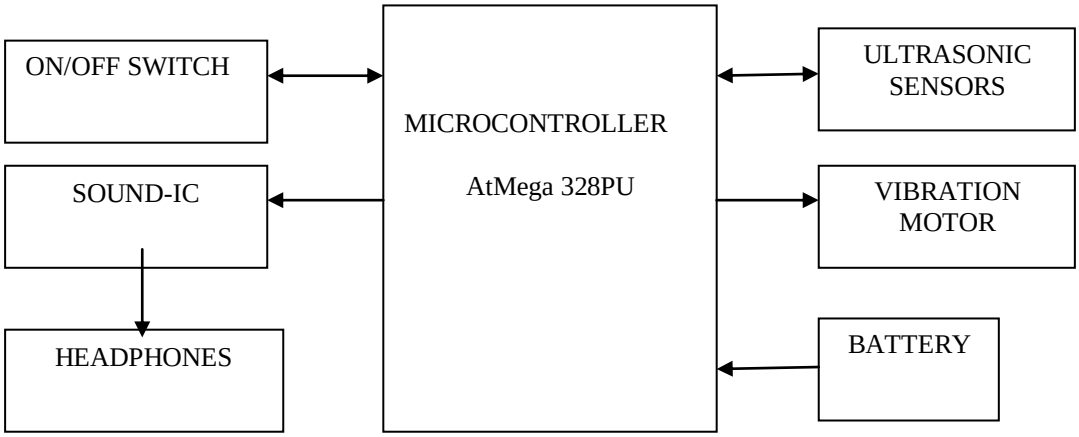
II. LITERATURE SURVEY

Numerous attempts have been made in the society to help the blind. "Project Prakash" [1] is a humanitarian mission to help the blind children especially by training them to utilize their brains to learn a set o objects around them. In [2], the stick has a ping sonar sensor to sense the distant objects. It also has a wet detector to detect the water. The micro-controller used is PIC microcontroller. The microcontroller circuit is on the outside of the stick but is protected with a code so its security cannot be breached. The only feedback given to the user is through the vibration motor.In [3], three sensors are used viz. ultrasonic, pit sensor and the water sensor. Even this is a PIC based system. The feedback given is through the vibration as well as the speaker/headphones. There is a GPS system where-in the user has to feed his location. No information on how a blind man would do that. Also they haven't mentioned anything about the size and shape of their cane and neither about the placement of their circuitry.

In [4], the author has made a detachable unit consisting of an ultrasonic sensor and a vibration motor. It can be fit on any stick. It detects obstacles up to 3m. The vibration feedback varies in the intensity as the obstacles comes nearer. Many different approaches have been taken with the primary purpose of creating a technology to aid the visually impaired. The priorities set by different authors are different leaving a scope of improvement in every application.

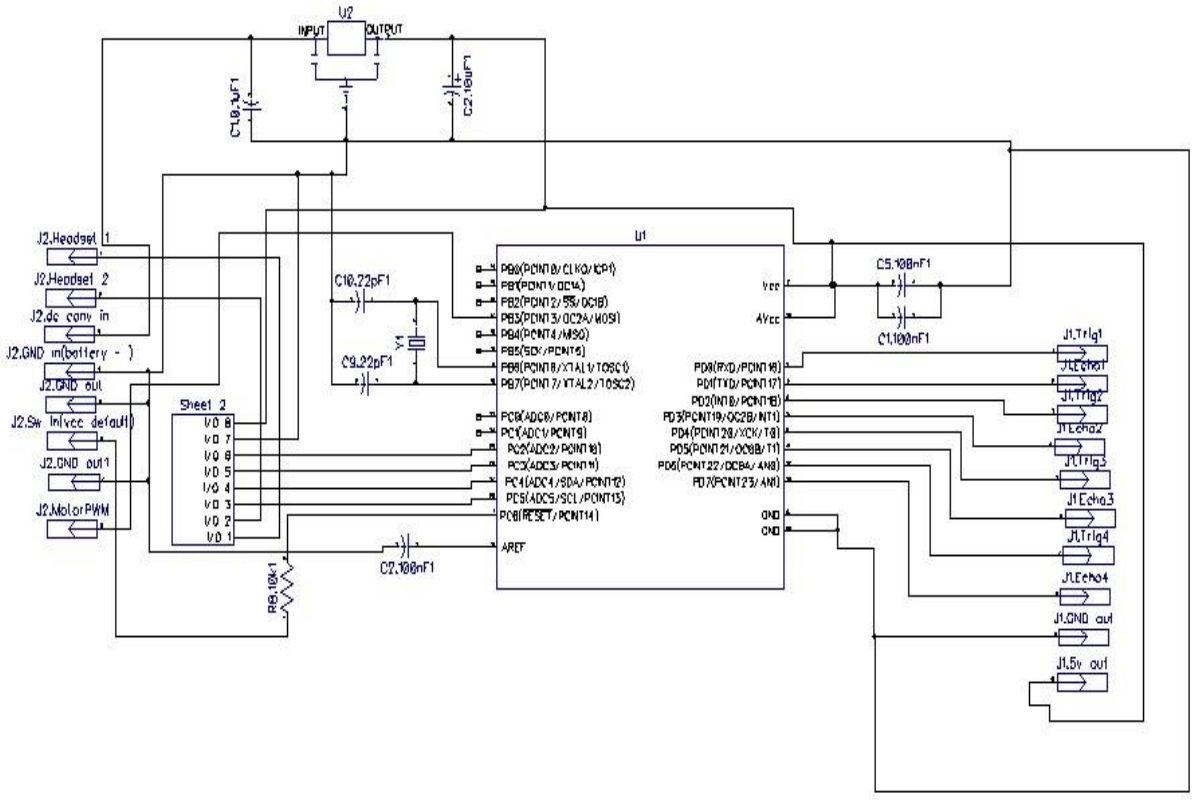
SYSTEM DESIGN AND IMPLEMENTATION

Figure 1:Block Diagram of the system

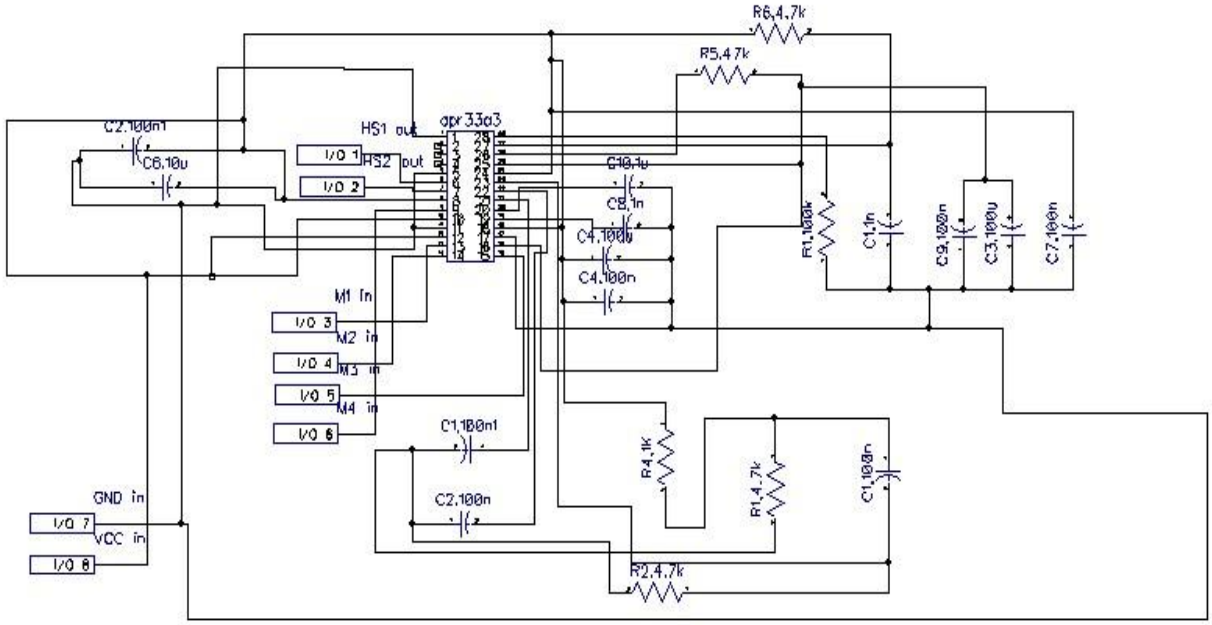


CIRCUIT DIAGRAM

SHEET 1-



Sheet 2: Sound IC (Hierarchical Block)



The major components of the Smart White Cane are as follows:

- ATMega328PU microcontroller
- HC-SR04 Ultrasonic Sensor Module
- Sound IC – APR33a3
- Vibration Motor

1. ATmega328-PU µC:

Features:
28 Pin I/O
RESET Pin NO. 1 (ACTIVE LOW)
Crystal Pins at 9-10 PIN
Software Declarable Serial Ports

2. HC-SR04 Ultrasonic Sensor module

Features:
Working Voltage - DC 5 V
Working Current - 15mA
Working Freq. - 40Hz
Max Range - 4m
Min Range - 2cm
Measuring Angle - 15 degree
Trigger Input Signal - 10uS TTL pulse
Echo Output Signal - Input TTL lever signal and the range in proportion
Dimension - 45*20*15mm

3. APR33a3

Features:
Operating Voltage Range: 3V ~ 6.5V
Single Chip, High Quality Audio/Voice Recording & Playback Solution
Voice Recording Length APR33A3- 680 sec
Audio Processor- Powerful 16-Bits Digital
Memory - Non-volatile Flash
Built-in Audio-Recording Microphone Amplifier
Resolution - 16-bits
Averagely 1, 2, 4 or 8 voice messages record & playback

III. HARDWARE DESCRIPTION

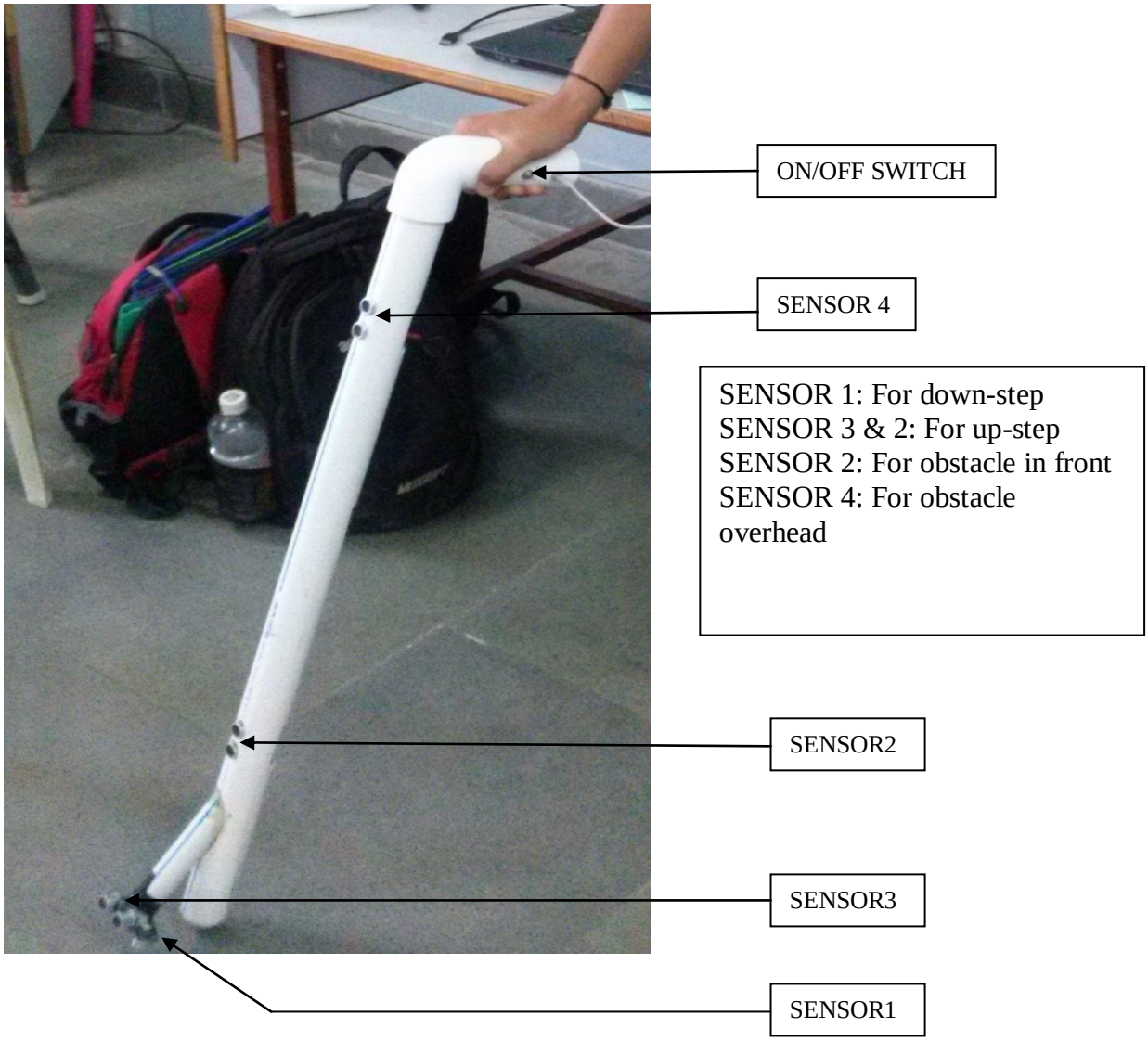
We decided to place our entire circuitry inside the cane.
The following considerations were made:

- The Stick shouldn't be bulky.
- Enough space to accommodate PCB and sensors.
- PCB should be as small as possible.
- Should be sturdy so as to protect the PCB.

Thus we choose a PVC pipe with a 3.5cm diameter and Height of 2.8feet.

To reduce the size of our PCB we choose all components as SMD with 0805 dimensions for capacitors and resistors wherever possible and also an SMD package of voltage regulator 7805(T0-252-Dpack) along with SOIC DIP packages for both Atmega328 and Apr33a3.

For vibration feedback, we provided the vibration motor at the handle (like the ones in mobile phones) and also for voice messages we have given headset port also at the handle.



IV. SALIENT FEATURES

- Affordability - The estimated price for mass production should not exceed Rs.500. As majority of blind population in the developing countries are poor, this provides an economical solution.
- Versatility – Apart from the low level obstacles even the ones above waist and types of staircases can be determined.
- Design –
  The bottom wheel – The blind generally tap while sweeping which is avoided by using a wheel.
- The entire circuitry along with the battery compartment is concealed inside the stick reducing the risk of damage to the circuit and reducing bulkiness.
  Handle – ON/OFF switch, vibration feedback and the audio jack is provided on the handle itself.
- Audio feedback – Short pre-recorded messages informing the user about the obstacles are played. The priority of the obstacles is set on the basis of the risk

V. CONCLUSION

The smart white cane is a practically feasible product and convenient to carry around like any other walking stick. This could also be considered a crude way of giving the blind a sense of vision. This also reduces the dependency on other family members, friends and guidance dogs while walking around. It can serve as a benchmark in aid for the blind like crutches are for the paraplegic.

Future Scope: A global positioning method will used to find the position of' the user using the global positioning system (GPS) and guidance to their destination will be given to the user by voice navigation.A wall-following function can also be added so that the user can walk straight along a corridor in an indoor environment. Some more applications like vehicle detection, slippery floor, on-coming vehicle detection and fire or smoke alarm can also be included.

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