# ASSISTIVE SYSTEM FOR VISUALLY IMPAIRED PEOPLE

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Visually impaired people face a lot of challenges in their daily life. Now, using the enhanced technological tools, a lot of devices have been designed for helping them to accomplish basic tasks as examining surrounding environment. Building an assistive system is more robust and effective than separate devices in order to make user feel more secure and safer.

System consists of two essential parts including shoe module and box module. Arduino Nano is selected as a microcontroller for this module. Module contains a water level sensor for water detection in case of puddles. Two ultrasonic sensors are used for detection on the right or left side and front side of the shoe. Two vibrating motors are also placed on the respective sides of the shoe for directing the user in case of obstacle. Buzzer is used for informing the user about the water level. Bluetooth module in the circuit enables the microcontroller to send and receive the data from the other shoe and box module.

Box module's primary functions are to improve the reliability of object detection and classify the properties of the object. To fulfill its purpose this module is comprised of the following parts: Raspberry Pi, camera, rechargeable battery and Bluetooth USB Dongle. Raspberry Pi is a small-scale SCB (Single-Board Computer) that offers high performance on image processing applications and mobility to users. It is also a low-budget device that combines CPU, memory and Input/Output ports on one circuit board. The language picked for programming on Raspberry Pi is Python. The uncomplicated syntax helping the programmer to mainly focus on the algorithm and wide choice of libraries available for interfacing with different Raspberry Pi modules make Python a common option amongst programmers.

To increase the certainty of the warning before sending it to the user, two devices, namely ultrasonic sensor and camera are involved in the process of detecting the obstacle. If ultrasonic sound waves of the sensor are interrupted by an object and reflected, the measured distance is first compared to a predefined threshold value for determining whether it is close enough to the user to be analyzed. The further examination is where the camera comes into play, its main task is to determine the size and material of the detected object by looking at the area seen by ultrasonic sensor.

According to the values of size and material received, a decision is made if the object comprises a danger to the user and should be regarded as an obstacle. If so, a command is sent to corresponding vibrator in the shoe as a warning to the user. The proposed control process helps us not only in decreasing the detection of unnecessary, negligible obstacles, but also minimizes battery consumption, as camera is not operating uninterruptedly, but when activation signal comes from Arduino.

To combine some functionalities in one system, and offer easier management to the user, controlling an application with hand controller seems reasonable since it contains only three buttons with braille letters on them. Hand controller contains three buttons including an emergency button for emergency situations marked with Braille letter E, a button for opening Google Maps using the corresponding Braille letter, M and a button for activating the microphone option in the application using a tactile microphone sign on it. Corresponding hardware of hand controller contains 3 normally open pushbuttons, a rechargeable battery, a voltage converter, a battery charger and a Bluetooth module. The Bluetooth module will be used for providing connection between the hand controller and the application. Lastly, the application has 2 main features including sending messages in an emergency case and opening Google Maps which can also be controlled by a microphone key.

To provide a clean solution for energy supply, an efficient way is to produce energy while walking with shoes. The best method to do so is to use the piezoelectric effect for energy harvesting in the designed shoes. The piezoelectric effect is a peculiar property that enables materials to transform electrical energy into mechanical energy, and vice versa, mechanical energy into electrical energy. The advantage of the piezoelectric transducer is given by the crystalline structure of piezoelectric materials. By putting piezo elements underneath feet in such a way that every time the user takes a step, the body weight is used to push on the piezoelectric elements which then, in turn, convert that energy into electricity. Produced energy is AC power, however, as DC power is required to power the system, the bridge rectifier with diodes is a solution to convert AC to DC power.

As a conclusion, to provide visually impaired people with independency and direct them safely during travel time, assistive system should be implemented in such a way that it will not impose any limitation for handling the devices of the system. In further development stages, the system can be improved by providing accurate and fast image processing that can detect undefined potential obstacles and potholes.

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