Smart Cane for Visually Impaired
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Introduction
Globally, the number of people of all ages that are visually challenged is estimated to be 39 million according to a WHO report. One of the consequences of vision loss is being uncomfortable about safety while moving around or traveling independently. Individuals with visual impairment have many difficulties in self-navigation in unfamiliar outdoor environments. Safe navigation on sidewalks is the most important requirement. To overcome this problem, we have built Smart Cane, which will provide obstacle detection. Real-time location sharing with an emergency contact, fall detection, emergency features such as GPS location sharing with the text message and call feature to the provided contact for immediate help during an emergency.

Methodology

The ESP32 has the capability to support multiple sensors and has very less latency in processing the data from them and deliver to the server through GSM functionality. The multiple sensor used in the smart cane uses different communication protocols to send and receive data to the ESP32. Accelerometer + Gyroscope sensor is connected to the ESP32 master through I2C communication protocol, Ultrasonic sensor is connected through 2 GPIO pins to the ESP32 master, GPS sensor is using UART communication protocol to communicate with the ESP32 master.

Sensor Integration
1. Accelerometer + Gyroscope and Ultrasonic Sensor

MPU6050 is a sensor that has an accelerometer and a gyroscope on the same chip with each having 3-axis, therefore, it becomes a total of 6-axis motion tracking sensor. MEMS system provide the result with better accuracy with 16-bit ADC. The Module operates on a supply voltage of 3 to 5V and has digital motion processor engine onboard to perform the computations. The module uses I2C communication protocol to communicate with the microcontroller.

HC-SR04 Ultrasonic sensor is used to sense proximity and detect distance with high accuracy. It measures distance between the object using ultrasonic waves and reflection technique. The sensor’s range is from 2cm to 400cm and uses a Transmitter and Receiver to send and receive ultrasonic waves. It also has a control circuit to compute the distance. The ultrasonic waves are generated and received through the TRIG and ECHO pin on the sensor respectively and distance of object is calculated using below equation:

\[
\text{Distance} = \frac{\text{Time} \times \text{Velocity of Sound}}{2}
\]

2. GSM/GPRS Module and GPS module

Sim800L GSM/GPRS module is a small-scale GSM modem. This module can perform all the function what a normal cell phone can perform such as sending instant messages, make or get calls, and interface with the web through GPRS, TCP/IP. The module upholds quad-band GSM/GPRS organization, which means it works anywhere on the planet.

NEO-6M GPS sensor track up to 22 satellites and can provide accurate position anywhere on the earth with the help of Trilateration operation. GPS receives NMEA standard format for location tracking.

Analysis and Results
Smart cane generates multiple notification results. Smart cane is connected to the Blinkpy cloud server which provides real-time location tracking features to the relative of visually impaired persons. Smart cane also provides emergency buttons features which allow user to send latitude and longitude of the user through text message and SOS call feature.

Ultrasonic sensor provides real-time distance of the obstacle and provide a feedback and alert the user through a beeper, when the user nears to the obstacle the buzzer goes off cautioning the user.

Smart cane is connected through the IFTTT server, and it immediately sends a text message to the user’s emergency contact whenever a fall is detected on the Smart cane through accelerometer and gyroscope.

Key References
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