Project Eva: A Virtual Assistant

Hance Paul Benny[1], Happy Sanil[2], Joju K Shibu[3], Jisha P Abraham[4]

[1,2,3] Dept. of Computer Science and Engineering, MACE, Kerala, India
[4] Professor, Dept. of Computer Science and Engineering, MACE, Kerala, India

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Abstract - *The developed android application works as a Chatbot mechanism integrated with IoT features which could be a fully functional kit for visually impaired/blind person. This application could be installed even in cheap/medium scale smartphones which could serve the very basic purpose. The application always run in background and it can be activated with voice/speech. The application stands as a voice activated interface to the blind and as a platform to interact with various inbuilt smartphone applications including weather, location, accessibility features including voice call etc. The main addition to the app include a navigation platform which uses the smartphone camera together with ultrasonic sensors to detect and classify objects, obstacles, gradient slope, pits, staircase etc. Dialogflow (api.ai) combined with TensorFlow over trained datasets are used in classifiers to identify and distinguish objects, navigation path and real-time assistance in providing necessary solutions. With authenticated Wi-Fi hotspot, the application is further connected to a nodemcu (wireless) and a relay switch which could be used to remotely access and drive home automation facilities like automated doors, home electronic devices, security systems etc. The smartphone is paired with a Bluetooth headset for the ease in real-time interactions and further to aid the Chatbot facilities.*

Key Words: Chatbot,

1. INTRODUCTION

Visual impairment, also known as vision impairment or vision loss, is a decreased ability to see to a degree that causes problems not fixable by usual means, such as glasses. Some also include those who have a decreased ability to see because they do not have access to glasses or contact lenses. Visual impairment is often defined as a best corrected visual acuity of worse than either 20/40 or 20/60. The term blindness is used for complete or nearly complete vision loss. Visual impairment may cause people difficulties with normal daily activities such as driving, reading, socializing, and walking.

In our proposed system, we have developed android application works as a Chatbot mechanism integrated with IoT features which could be a fully functional kit for visually impaired/blind person. This application could be installed even in cheap/medium scale smartphones which could serve the very basic purpose. The application stands as a voice activated interface to the blind and as a platform to interact with various inbuilt smartphone applications including weather, location, accessibility features including voice call etc. The main addition to the app include a navigation platform which uses the smartphone camera together with ultrasonic sensors to detect and classify objects, obstacles, gradient slope, pits, staircase etc.

2. EXISTING SYSTEM

Many people with serious visual impairments can travel independently, using a wide range of tools and techniques. Orientation and mobility specialists are professionals who are specifically trained to teach people with visual impairments how to travel safely, confidently, and independently in the home and the community. These professionals can also help blind people to practice travelling on specific routes which they may use often, such as the route from one's house to a convenience store. Becoming familiar with an environment or route can make it much easier for a blind person to navigate successfully.

3. PROPOSED SYSTEM

The World Health Organization (WHO) estimates that 80% of visual impairment is either preventable or curable with treatment. This includes cataracts, the infections river blind-ness and trachoma, glaucoma, diabetic retinopathy, uncorrected refractive errors, and some cases of childhood blindness. Many people with significant visual impairment benefit from vision rehabilitation, changes in their environment, and assistive devices.

As of 2015 there were 940 million people with some degree of vision loss. 246 million had low vision and 39 million were blind. The majorities of people with poor vision are in the developing world and are over the age of 50 years. Rates of visual impairment have de-creased since the 1990s. Visual impairments have considerable economic costs both directly due to the cost of treatment and indirectly due to decreased ability to work.

Eva developed as an android application as a Chatbot mechanism integrated with IoT features which could be a fully functional kit for visually impaired/blind person. This application could be installed even in cheap/medium scale smartphones which could serve the very basic purpose.

The application always run in background and it can be activated with voice/speech. The application stands as a voice activated interface to the blind and as a platform to interact with various inbuilt smartphone applications including weather, location, accessibility features including voice call etc. The main addition to the app include a navigation platform which uses the smartphone camera together with ultrasonic sensors to detect and classify objects, obstacles, gradient slope, pits, staircase etc.

Communication with the visually impaired can be more difficult than communicating with someone who doesn't have vision loss. However, many people are uncomfortable with communicating with the blind, and this can cause communication barriers. One of the biggest obstacles in communicating with visually impaired individuals comes from face-to-face interactions. There are many factors that can cause the sighted to become uncomfortable while communicating face to face. There are many non-verbal factors that hinder communication between the visually impaired and the sighted, more often than verbal factors do.

Sound is one of the most important senses that the blind or visually impaired use in order to locate objects in their surroundings. A form of echolocation is used, similarly to that of a bat. Echolocation from a person's perspective is when the person uses sound waves generated from speech or other forms of noise such as cane tapping, which reflect off of objects and bounce back at the person giving them a rough idea of where the object is.

Dialogflow (api.ai) [1] combined with TensorFlow [2] over trained datasets are used in classifiers to identify and distinguish objects, navigation path and real-time assistance in providing necessary solutions. With authenticated WIFI hotspot, the application is further connected to a nodemcu (wireless) and a relay switch which could be used to remotely access and drive home automation facilities like automated doors, home electronic devices, security systems etc. The smartphone is paired with a Bluetooth headset for the ease in real-time interactions and further to aid the Chatbot facilities.

4. IMPLEMENTATION

For the implementation for our proposed system we have used a Android Smartphone, ESPNODEMCU[3] together with a single channel relay switch and its output is connected to an IOT device. We have further used a HC-SR04 Ultrasonic Sensor (To measure the proximity of objects with the host) in an interconnected mode.

4.1 ESPNODEMCU

The ESP8266 microcontroller is a low cost cheap Wi-Fi enabled microchip with capabilities for TCP/IP stack. This ESP8266[4] was manufactured by a Shanghai based Chinese firm Espressif Systems. The expansion of the chip came into existence after introduction of ESP-01 module, produced by a third-party manufacturer, AI-Thinker.

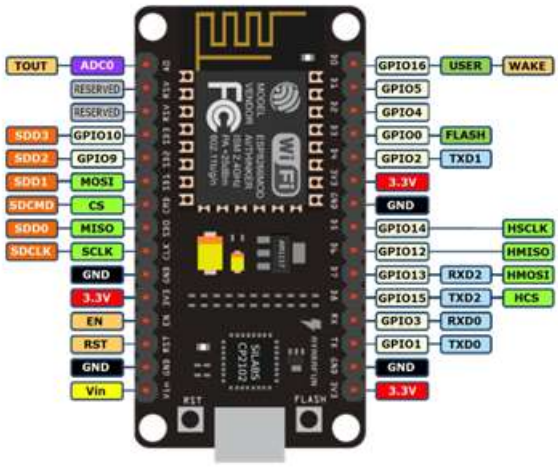

Fig 1: ESPNODEMCU pin diagram

This is a small chip with its length less than 10cm. Its capable of connecting to a Wi-Fi network and it performs TCP/IP connections using Hayes-style commands. However, at the time there was almost no English-language documentation on the chip and the commands it accepted. The very low price and the fact that there were very few external components on the module which suggested that it could eventually be very inexpensive in volume, attracted many hackers to explore the module, chip, and the software on it, as well as to translate the Chinese documentation.

The ESP8266 is a microcontroller with specification 1 MiB of built-in flash, allowing for single-chip devices capable of connecting to Wi-Fi. The successor to these microcontroller chips is the ESP32. NodeMCU is an open source IoT platform. It includes firmware which can run on the ESP8266 Wi-Fi SoC from Espressif Systems, and its hardware is completely based on the ESP-12 module. The term "NodeMCU" refers to the firmware rather than the developer kits. The firmware uses the Lua scripting language which is based on the eLua project and built on the Espressif Non-OS SDK for ESP8266.

4.2 Single Channel Relay Switch

A relay is an electromagnetic switch operated by a relatively small electric current that can turn on or off a much larger electric current. The heart of a relay is an electromagnet (a coil of wire that becomes a temporary magnet when electricity flows through it). You can think of a relay as a kind of electric lever: switch it on with a tiny current and it switches on ("leverages") another appliance using a much bigger current. Why is that useful? As the name suggests, many sensors are incredibly sensitive pieces of electronic equipment and produce only small electric currents. But often we need them to drive bigger pieces of apparatus that use bigger currents. Relays bridge the gap, making it possible for small currents to activate larger ones. That means relays can work either as switches (turning things on and off) or as amplifiers (converting small currents into larger ones).

Fig 2: Single Channel Relay Switch

4.3 HC-SR04 Ultrasonic Sensor

The HC-SR04 Ultrasonic (US) sensor is a 4 pin module, whose pin names are Vcc, Trig-ger, Echo and Ground respectively. This sensor is a very popular sensor used in many applications where measuring distance or sensing objects are required. The module has two eyes like projects in the front which forms the Ultrasonic transmitter and Receiver. The Ultrasonic transmitter transmits an ultrasonic wave, this wave travels in air and when it gets objected by any material it gets reflected back toward the sensor this reflected wave is observed by the Ultrasonic receiver module. Now, to calculate the distance using the above formulae, we should know the Speed and time. Since we are using the Ultrasonic wave we know the universal speed of US wave at room conditions which is 330m/s. The circuitry inbuilt on the module will calculate the time taken for the US wave to come back and turns on the echo pin high for that same particular amount of time, this way we can also know the time taken. Now simply calculate the distance using a microcontroller or microprocessor.

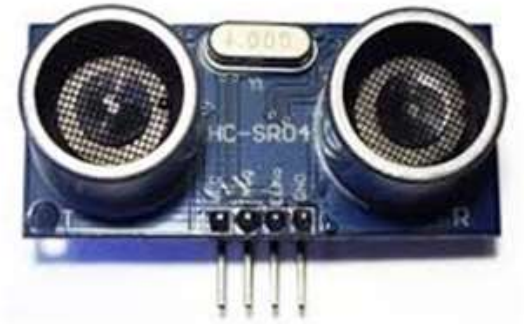

Fig 3: HC-SR04 Ultrasonic Sensors

It emits an ultrasound at 40 000 Hz which travels through the air and if there is an object or obstacle on its path It will bounce back to the module. Considering the travel time and the speed of the sound you can calculate the distance. The HC-SR04 Ultrasonic Module has 4 pins, Ground, VCC, Trig and Echo. The Ground and the VCC pins of the module needs to be connected to the Ground and the 5 volts pins on the Arduino Board respectively and the trig and echo pins to any Digital I/O pin on the Arduino Board.

4.4 IoT Device Extension

IoT devices are a part of the larger concept of home automation, also known as domotics. Large smart home systems utilize a main hub or controller to provide users with a central control for all of their devices. These devices can include lighting, heating and air conditioning, media and security systems. Ease of usability is the most immediate benefit to connecting these functionalities. Long term benefits can include the ability to create a more environmentally friendly home by automating some functions such as ensuring lights and electronics are turned off.

4.5 Working

The proposed system works as follows, a preview of the visual data is captured and pre-processes it. An Open-source software library for Machine Learning- Tensor Flow is used for numerical computation using dataflow graphs. Recognised and processed image preview is compared with the predefined computed dataset values initialised. Dialogflow or Api.ai uses ML to recognise what user might say when interacting with the app using natural language understanding. The User can interact and retrieve real time-detections in the form of interactive conversations. HC-SR04 Ultrasonic sensor values are computed with predefined algorithm and its computed values which provides the proximity of various objects (Elevation and Slope check). ESPNODEMCU connected with the Single Channel Relay Switch is used as a IoT device extension which supports home automation.

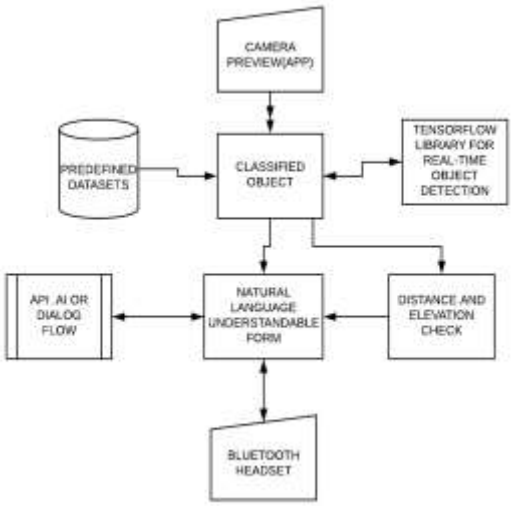

Fig 4: Data Flow Diagram

5. RESULT

The integration of IoT extension together with modern circuitry made the system less complicated. The EVA application has given a breakthrough for visual impaired/blind and will be a boon in advancement for their social life and status. The implementation of Single Channel

Relay Switch for IoT Extension with ESP8266 module reduces the need for the complex circuitry required, that reduces the implementation cost of hardware to 50% from the existing system implementation and further provides home automation.

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6. CONCLUSION

According to the National Federation of the Blind, "The real problem of blindness … is the misunderstanding [of their surrounding]". As a solution to this issue, the proposed system assists the blind in navigating their surroundings. The application will function as an obstacle avoidance system. We can offer this functionality through components including a Smartphone and a Bluetooth headset. Our avoidance system will use trained dataset to detect objects to protect users from collisions with obstacles. The system will then send a voice command to the user alerting them of upcoming obstacles. Further the home automation through voice control has been designed and implemented with voice feedback. According to the voice command the ESPNODEMCU microcontroller interconnected with the smartphone network is used to control the Single Channel Relay Switch. Voice feedbacks which are very much essential for the acknowledgement of control action has been developed for the visually impaired and physically challenged people using Dialogflow.

REFERENCES

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