CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Yahvin Gali

Project Number

S1009

Project Title

Rethinking Braille with Pi Reader: Raspberry Pi Based Optical Reader for the Blind and Visually Impaired Using OCR & TTS

Abstract

Objectives

The scope of this project is to design an easy to operate low-cost Raspberry Pi based Optical Reader using Open Source Optical Character Recognition (OCR) and Text-To-Speech (TTS) modules to provide a technical solution to assist the Blind and Visually Impaired (VI) in gaining access to various text resources.

Methods

The device uses a Raspberry Pi connected to a Pi Camera and an audio output device; Open Source Tesseract OCR and Pico2Wave TTS modules; and Python. With a single button press, the Pi Camera acting as the main vision captures the image of the document or book placed in front of it. The image is then passed onto the Raspberry Pi with the loaded OCR which enables the recognition and automatic conversion of printed characters in the image into machine-encoded digital format. Next, the digital text is passed on to TTS which uses predefined libraries to convert it into audible speech waveforms that can be played through an audio output device for a visually disabled to hear. Approximately 170 lines of python code were written for automation.

Results

The device was evaluated using metric proposed by Information Science Research Institute at UNLV for the Fifth Annual Test of OCR Accuracy. Although the accuracy of the TTS depends on the OCR, it was observed that some words were mispronounced despite correct extraction. Out of 60 documents tested, Plain-Text showed an avg. of 99.73% and 97.23%; Different-Fonts 89.17% and 87.37%; Text-on-Image 70.84% and 62.36%; Text-with-Images 63.43% and 59.25%; Text-on-Colored-Background 45.14% and 44.61%; and Handwriting 21.59% and 18.79% OCR and TTS accuracy respectively. The Plain-Text books with 430 and 459 pages showed an avg. of 93.42% OCR and 90.07% TTS accuracy.

Conclusions

Since the OCR and TTS are downloaded onto the Raspberry Pi, the Pi Reader can operate as a standalone without the need for internet or WiFi, making it suitable for remote areas. At a total cost of $59 when compared to similar devices that run into 1000s of dollars, it is cost effective. It gives the visually disabled more self-sufficiency in accessing printed text without assistance. Finally, it can be used in schools for ELA and students with learning disabilities; learning a new language; for the illiterate; and general multi-tasking.

Summary Statement

I designed a simple low-cost Optical Reader to assist the Blind and VI to access various text resources, without the learning of any new concepts.

Help Received

My mentor, Mr. Roice, educated me on Raspberry Pi and Python; my parents provided funds for materials and adult supervision.