USB Dictation Device

Project Proposal

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1. Introduction

1.1 Objective

Many people with disabilities have trouble typing on their own. Although many mobile phones support dictation, it is complicated to setup on a PC or other platforms. The prothesis which utilize bionic arm technology is really expensive. People with disabilities might not be able to afford it and moreover it is hard for them to get used to using prothesis.

Our solution to this problem is a portable USB dictation device supporting common platforms. From the PC's perspective, the device functions as a common keyboard. To the user, instead of typing, it recognizes sounds of English characters (or sounds of words in a different working mode) and sends the corresponding characters' keycodes to the connected host device.

1.2 Background

Countless people are suffering from the limb loss or hands disabilities. As the National Center for Health Statistics indicated, there are 50,000 new amputations every year in USA [1]. Those people really need something that can help them use computers without the keywords.

Difference from original solution:
Our solution solves the original problem in a fundamentally different way from the original solution in many aspects. First, it serves different customers. The original prosthetic hand mostly helps the people without one or both hands while our solution is beneficial to many other customers such as blind people. Second, the physical appearance and working process are vastly different from the original. Our solution is a simple plug-in USB device that powered by the USB ports. The users only need to plug the device into their PC, and it will be recognized as a regular keyboard. Once the device is connected and the driver is installed, the user can start "typing" with ease. Third, the design is fundamentally different from the original. In the original solution, inputs are collected through the four buttons controlled by users' feet. The outputs are displayed by motors moving five fingers on the prosthetic hand. In our solution, inputs are collected via microphone and processed by the microprocessor, outputs are sent to other devices through USB ports.

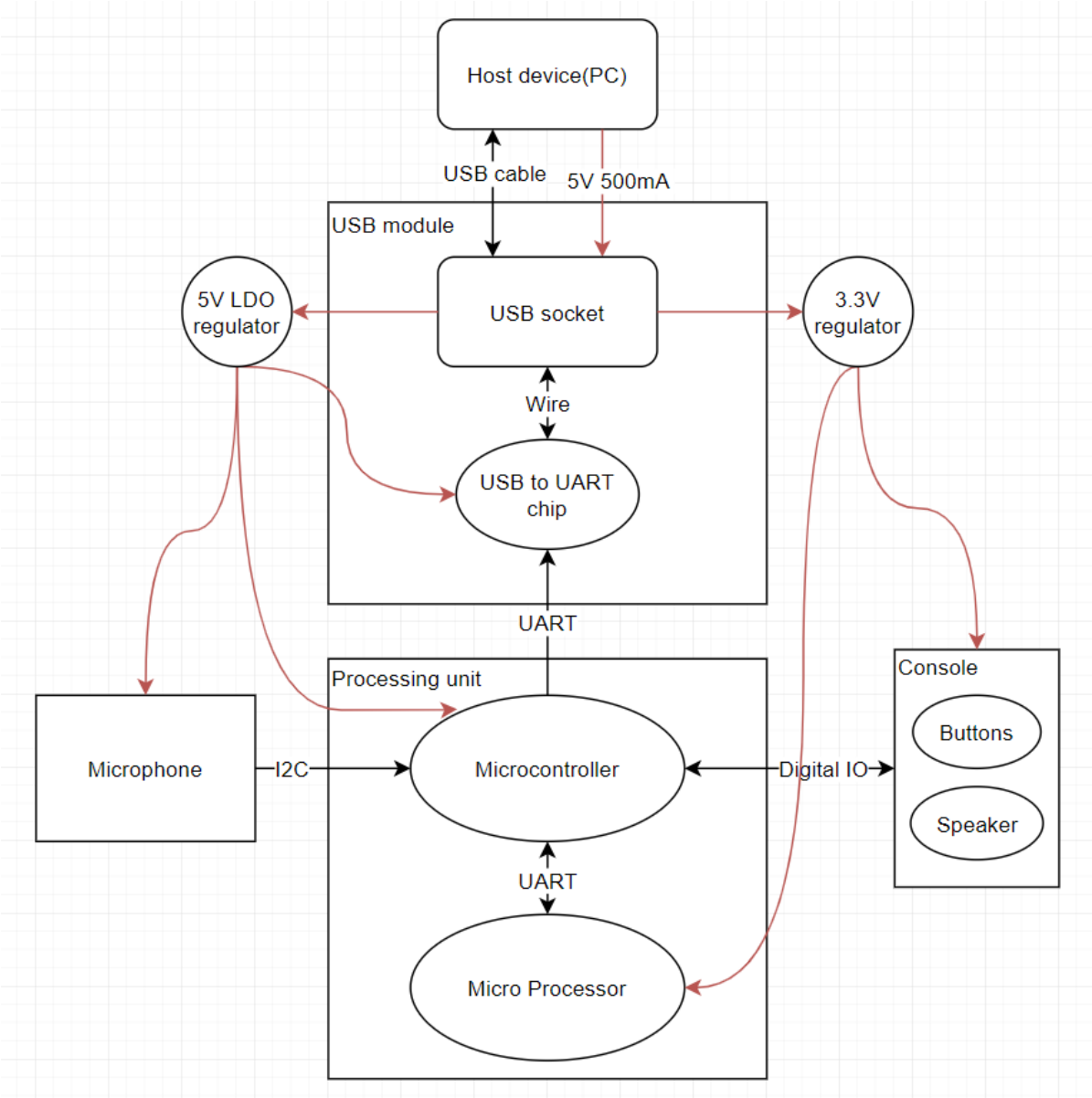
1.3 High-level Requirements List

- Be able to collect the user's voice through microphone, recognize the characters/words spoken by the user and convert them to the correct keycodes.
- OS can successfully detect the device, install generic drivers and receive keycodes sent from the device.

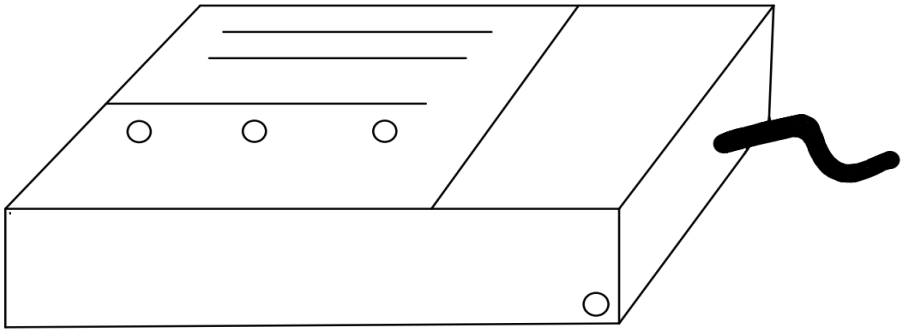
- Be able to switch between different states which perform different functionalities such as pausing, recognizing or different recognition modes with a maximum of 5V 1.5A (7.5W) power from a single USB 3.1 connection.

2. Design

2.1 Block Diagram



2.2 Physical Design



2.3 Functional Overview

2.3.1 Processing Unit

The processing unit consists of two components, a microcontroller and a high-speed voice recognition module. The microcontroller responds to the console for user's interactions such as starting input and pausing input. Upon working state, the voice recognition module. will keep analyzing the input from the microphone, and once it recognizes any char that corresponds to any key on a keyboard it then transmits the key code through USB protocol to the computer.

2.3.2 Microphone

The microphone is connected directly to the processing unit and is used to pick up the user's voice.

2.3.3 Console

The console is used to control the system. It has some buttons on it to control the different states of the system like start, pause or stop. There is a buzzer to indicate when the diction starts or stops. It has some basic function keys such as "delete", "space" to better control the typing. It may have a full keyboard layout to correct any char that couldn't be recognized through voice for several times.

2.3.4 USB Module (Power and Communication)

The whole system is powered by USB connection to the PC, and the USB protocol is also used to transmit the key code to the PC.

2.4 Block-level Requirement

2.3.1 Processing Unit

It should be able to receive the complete voice data, transmit it to the voice recognition module and get back the processed result from it as the core functionality. It should also be able to read input from the buttons for switching states and various interactions between the user and the system.

2.3.2 Microphone

It should be able to convert the sound to the digital signal and send it to the processing unit or directly to the voice recognition module.

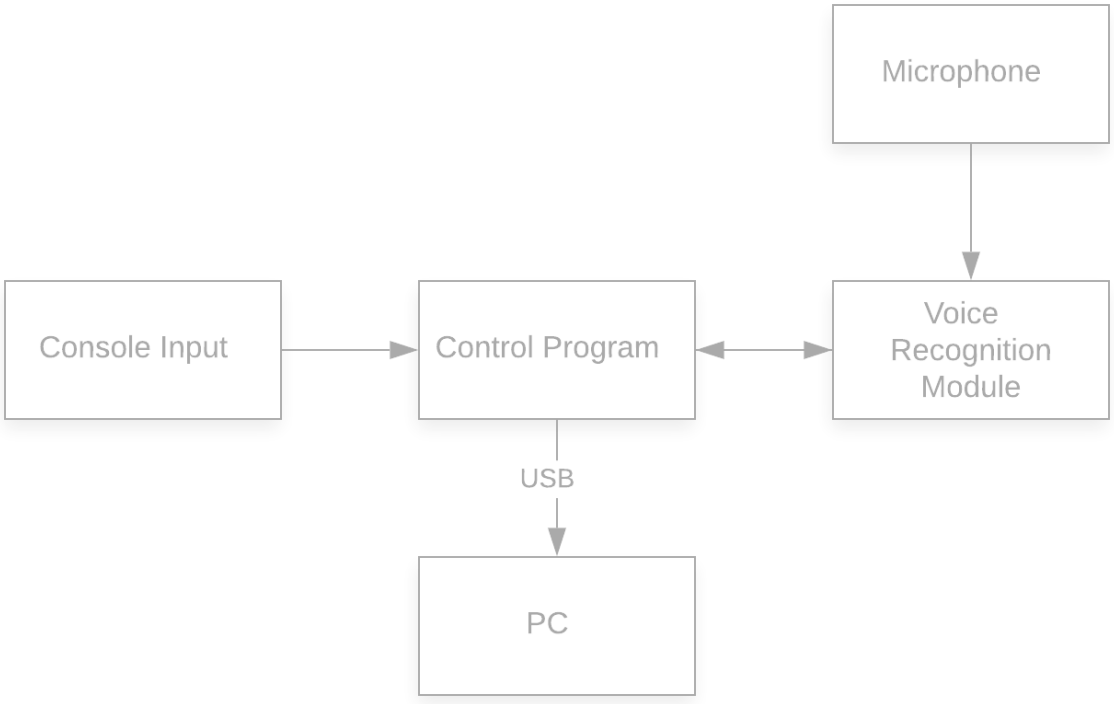
2.3.3 Console

It should be able to generate digital or analog signal in correspondence to the buttons or keys pressed. It should also be able to notify the user about the state of the system.

2.3.4 USB Module (Power and Communication)

It should be able to draw enough current with 5V from the computer and transfer data between the system and the PC.

2.4 Data Flow



2.5 Risk Analysis

The Processing Unit is a very important risk to the successful completion of our project. It serves to correctly and efficiently transmit input data from the microphone to the voice recognition module and transmit the processed characters from that module to the PC through the USB connection. The whole system relies on this part.
Another part that is of high risk is the voice recognition module. For now, our choice is the Raspberry Pi Zero. It will have to run some open source network to output a word or a character given a duration of voice input. We are mainly concerned with the accuracy and efficiency of this part in order to have optimal performance for our system.

3. Ethics and Safety

There might be some potential safety problems with our projects. The data of the input voice and the output characters might be hacked by people with some evil purposes. We do not currently have a perfect solution to this, so under most of the circumstances, users are not recommended to say their private information like password of the bank account, personal address, etc. to this device.

We thoroughly went over the 10 ethics mentioned on the IEEE Code of Ethics and we firmly believe that we will obey the rules of these ethics.

1. We hope that we can make people's life much easier and incorporate their lives with advanced technology, especially those people with disabilities who have trouble typing on their own. This fulfills the IEEE Code of Ethics, #5: "to improve the understanding by individuals and society of the capabilities and societal implications of conventional and emerging technologies, including intelligent systems" [2].
2. "to hold paramount the safety, health, and welfare of the public, to strive to comply with ethical design and sustainable development practices, and to disclose promptly factors that might endanger the public or the environment;" [2]
    - Our project will not affect the safety of the public. It uses electricity as its main power supply, so it will not have a negative effect on the environment.
3. "to avoid real or perceived conflicts of interest whenever possible, and to disclose them to affected parties when they do exist;" [2]
    - Our project will not have conflict of interest and even if the conflict exists, we will inform the affected parties.

References

[1] Statistics on Hand and Arm Loss. [Online]. Available: http://www.aboutonehandtyping.com/statistics.html. [Accessed: 02-Apr-2020].

[2] Ieee.org, "IEEE IEEE Code of Ethics", 2016. [Online]. Available: http://www.ieee.org/about/corporate/governance/p7-8.html. [Accessed: 29- Feb- 2020].