Project Report
On
Autonomous Audio Tour Guide

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Chapter 1

Introduction

1.1 Background

There are many places like museum, supermarket, park etc where different information regarding things placed there should be given to visitor/customer. In order to give information, either infromation shoul be printed and kept there or few persons are required. Printing information requires more space and also damages aesthetic of museum. Giving information to every visitors/customers by same person is boring job. Autonomous audio tour can be used in that case so when person walks along, information regarding object palced or proucts is played automatically thereby eliminating printed information and need of person. This type of device can also be used by visually impaired person so that he/she can feel what is around him/her.

1.2 Autonomous Audio Tour Guide

Autonomous Audio Tour Guide is a device that provides information when he/she walks along. This type of tour guide can be used in different places such as museum, supermarket, park etc. This device gives information via audio. First task of this device is to locate the approximate position of person. Different technique can be used to locate the position of person such as using IMU unit, using beacon, WiFi module etc. System complexities and cost varies accordingly. Here, we've used WiFi module to locate position of the person. After locating position of person, appropriate audio file is played which is saved in the database. In this way, this device give information.

1.3 Outline of report

This is the final report of *Autonomous Audio Tour Guide*. It contains our approach in designing the device.

This report also briefly presents about the main components used in the device.

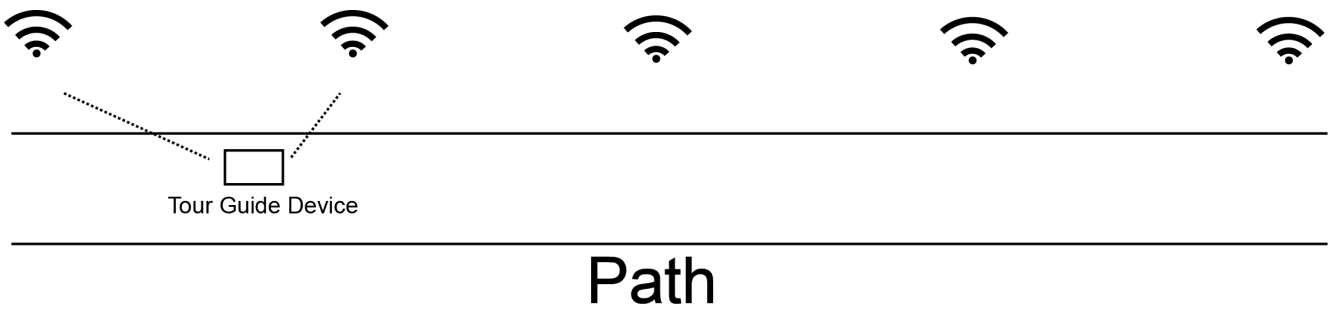

Figure 1.1: Simple Layout of Autonomous Audio Tour Guide

Chapter 2

Working Principle

2.1 WiFi

Wi-Fi or WiFi is a technology for wireless local area networking with devices based on the IEEE 802.11 standards[1].The IEEE 802.11 standard is a set of media access control (MAC) and physical layer (PHY) specifications for implementing wireless local area network (WLAN) computer communication in the 2.4, 3.6, 5, and 60 GHz frequency bands. It can be used to transmitt data wirelessly. Different type of network can be formed under WiFi protocol.

2.2 Working

Working of *Autonomous Audio Tour Guide* can be divided into following steps:

1. Locating person's position.
2. Finding and playing appropriate audio file.

2.2.1 Locating Person's Position

In order to locate person's approximate position, WiFI modules was used. WiFi module was placed in different places on the path. When a person walks along path, WiFi signal the device recieves has different strength. The module nearest to the device has highest signal strength. The device scans all the available WiFi signal. After that, it extracts signal strength of only those WiFi signal whose MAC address is in database.Then, it compares signal strength of the WiFi signal and finds out with highest strength. In this way, person's approximate position can be found.

2.2.2 Playing Audio File

When person's approximate position is found, playing audio file is straightforward. If same WiFi has highest signal strength previously as now, audio file should not be replayed, it should be played continuously.

When finding WiFi with largest strength, WiFi with second largest strength should also be calculated. It is because when a person is between two WiFi module, strength of both are nearly equal but because of noise, sometimes strength of one module is found largest and sometimes that of other. So, audio file should be changed only when magnitude of difference between those two(highest and second highest) is greater than certain threshold value.

Working of *Autonomous Audio Tour Guide* can be summarized in following flow chart:

[1]Source: Wikipedia https://en.wikipedia.org/wiki/Wi-Fi

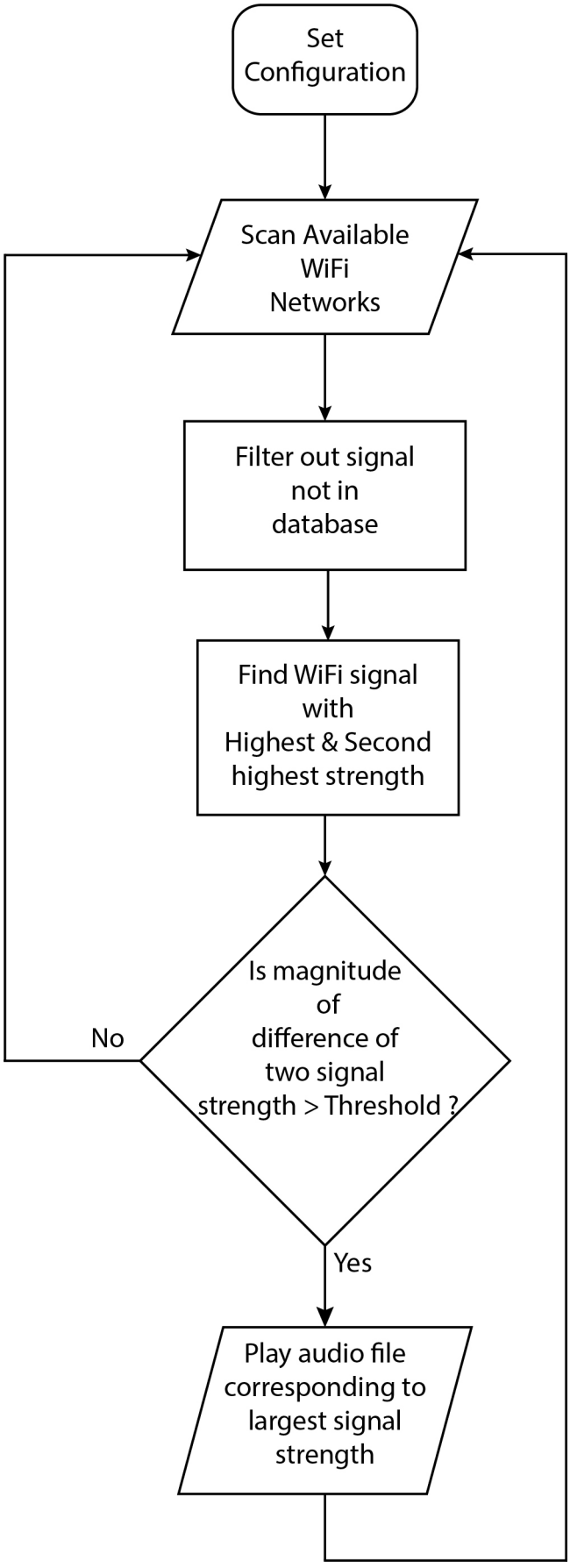

Figure 2.1: Flow chart for working of Autonomous Audio Tour Guide

Chapter 3

Hardware and Algorithm

3.1 Hardware Components

Following are the main hardware components used in this project:

1. **ESP8226:** The ESP8266 WiFi Module is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. This module can works in AP mode, server mode and client mode. In this project, this module was used in AP mode(as a router).

2. **Raspberry PI Zero:** Raspberry PI is small computer board. It has all the components in its board to be operated as computer. Raspberry PI has 1GHz single-core CPU (BCM2835 processor). It has 512 MB of RAM. However, it doesn't have an auPidio jack. Audio output can be obtained from PWM pin which can be filtered to obtain audio of good quality.

   Different programming language can be used to program raspberry pi. We've used python 3.6.

3. **ATMega8:** Beside raspberry PI Zero, ATMega8 has also been used. As Raspberry PI has OS which takes time to start and shutdown, it won't be user interactive before completely booting up and just after shutdown. To make the device user interactive in this case, ATMega8 has been used. It controls startup, shutdown and indicator LED.

3.2 Raspberry Pi Zero GPIO Configuration

Configuration of Raspberry Pi Zero configuration is given in next page. Description of each pin is given below:

1. PI State: This is output pin. It indicates whether raspberry pi is on or off. If raspberry pi is on and program is running, output on this pin will be digital low. If raspberry pi is off, this pin will be in high impedance state.

2. Shutdown: This is input pin. Normally, this pin is held low. When raspberry pi needs to be shut down, digital high input is given (by ATMega8) which shuts down raspberry pi.

3. Skip Audio: This is input pin. Normally, this pin is held low. When certain audio file needs to be skipped, digital high input is given (via push button).

4. English and Nepali: These are input pins. These pins are used to select language. Language selection is available only one time when device is started.

5. Reset: Besides GPIO pin used, reset pin of raspberry pi is also used. This pin is used so that raspberry pi doesn't boot automatically when power is available.

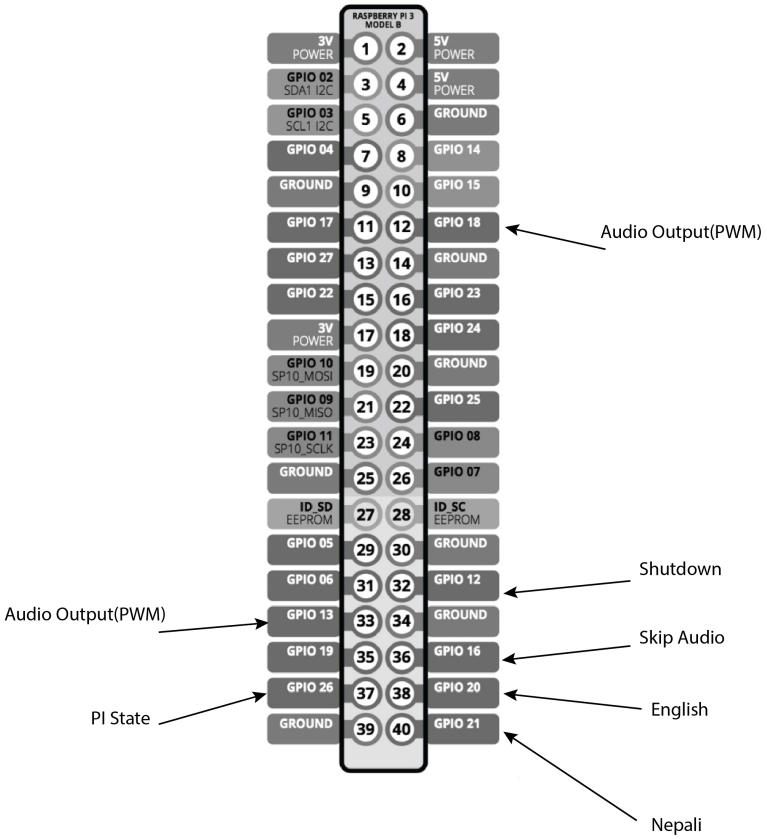

Figure 3.1: Raspberry Pi Zero GPIO pin

3.3 Filter Circuit

Filter circuit has been used to filter out high frequency component of PWM signal.

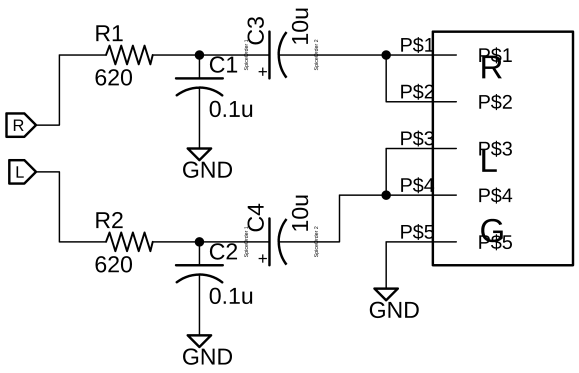

Figure 3.2: Filter for Raspberry Pi Zero Audio

3.4 ATMega8

ATMega8 is 8-bit AVR microcontroller. Raspberry pi takes some time to boot or shutdown. So, it won't be user interactive. Also, raspberry pi boots automatically when power is available. To overcome these problems, ATMega8 has been used.

3.5 Working Algorithm

Working of device has been discussed briefly in previous chapter. Working algorithm is same. However, in this chapter, it will be discussed in detail.

Flowchart has already been given in previous chapter. Explanation of each block has been given below:

1. Set Configuration: Different configuration should be setup such as that of GPIO pin, language selection, etc. GPIO configuration is set automatically by software. System asks for preferred language everytime system starts and user should choose language by pressing button.

2. Scan Available WiFi Networks: Available WiFi networks should be scanned in order to know person's approximate position. In Linux system, WiFi network can be scanned by using command *"sudo iwlist scanning"*. This can also be accessed from python using *subprocess* module. Output of the command is converted to string. String handling function is used to extract the signal strength of all the wifi signal.

3. Filter Out Signal not in Database: MAC address of WiFi module being used should be saved in database. Data regarding WiFi signal whose MAC address is not in database should be removed.

4. Finding Signal of Highest and Second Highest Strength: When signal strength of required WiFi module is found, next step would be to find signal with highest and second highest strength.

5. Playing Audio File: When magnitude of difference between strength of highest and second highest stength signal is greater than certain threshold value, new audio file should be played. Reason behind this has been discussed in previous chapter.

3.6 Hardware Schematic

Hardware schematic for audio filter and raspberry pi startup and shutdown controller is given below:

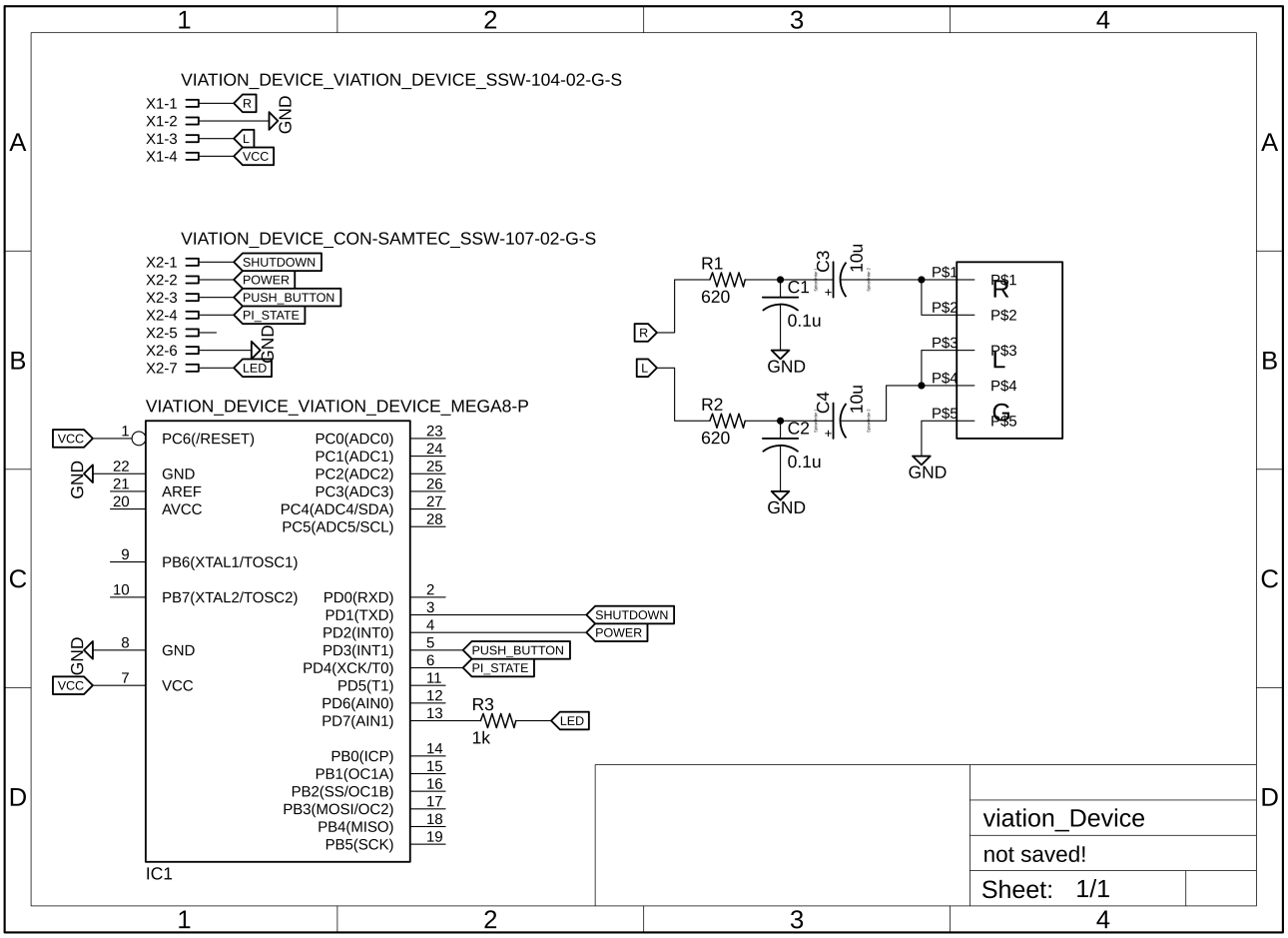

Figure 3.3: Schematic for audio Filter and raspberry pi startup and shutdown controller

3.7 Wiring Diagram

Wiring diagram of the system is given in the next page.

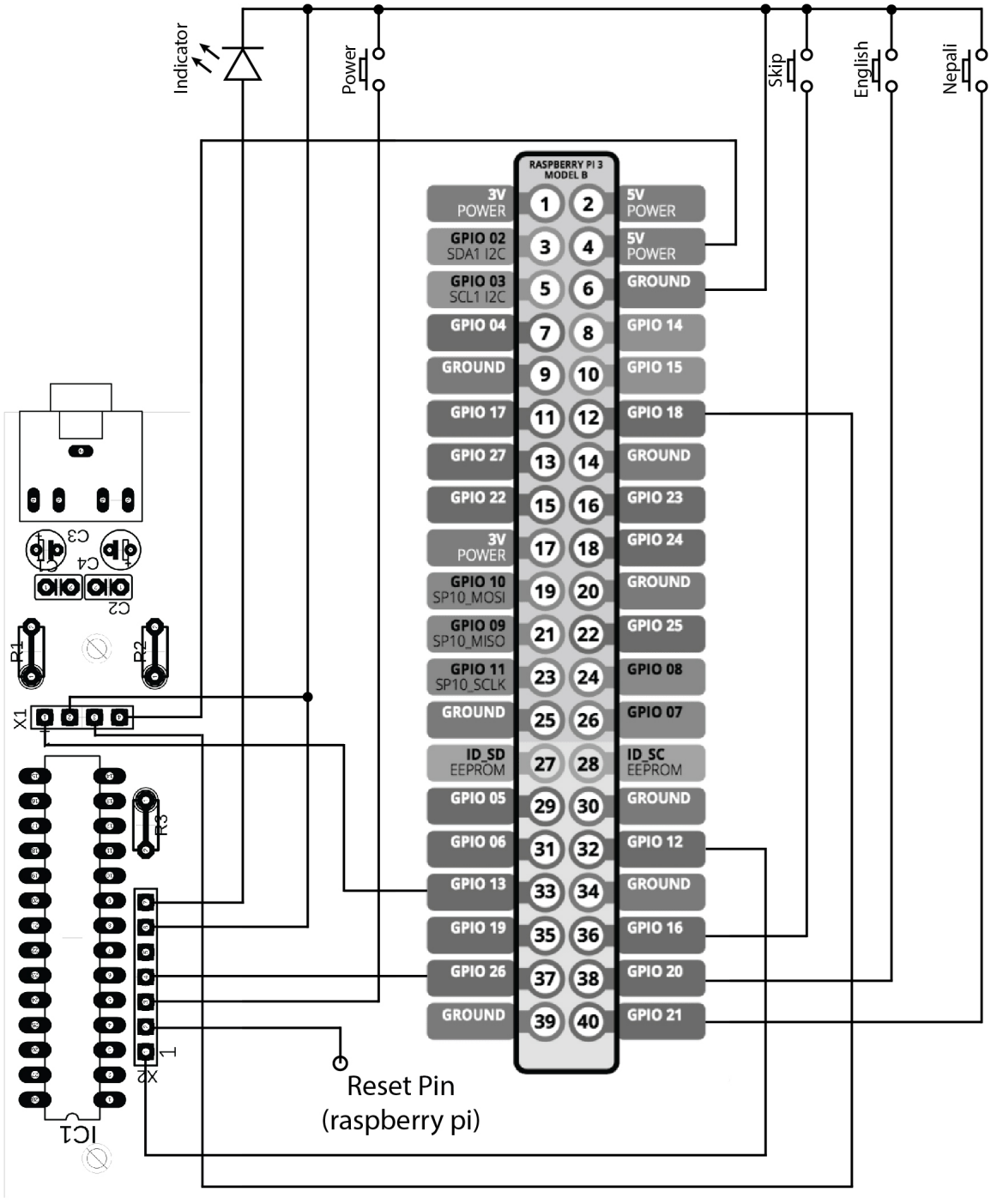

Figure 3.4: Wiring diagram