Advanced Embedded Systems

RAD Team Drumset - User Manual

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Version	Notes
1.0	Initial Release of Manual

2 Setting Up the System

There are four main modules in the system: the drum set, the Raspberry Pi and Master Wizzimote, the webserver and website, and the VR program.

2.1 Drum Set

The drum set includes the following drums: bass drum, floor tom, low tom, high tom, snare, hi-hat, and cymbal. Each drum is accompanied by a Wizzimote that controls the drumsticks using motors. Each drum has two drumsticks, except for the bass drum and hi-hat, which each have only one drum stick.
To set up the drum set, follow these steps:

1. Connect the wires between the Wizzimotes, voltage stepper chips, and motor control boards as shown below.

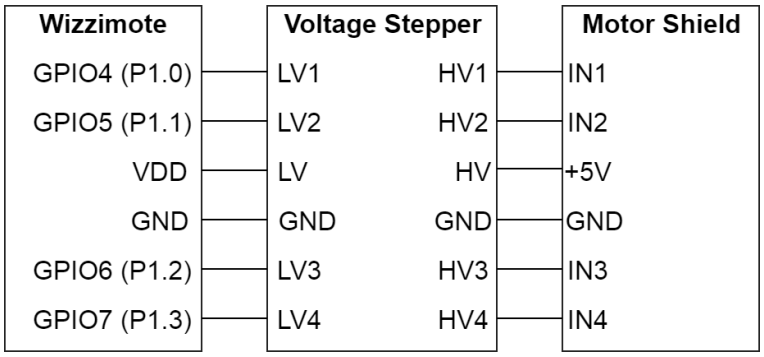

Figure 1: The connections from each Wizzimote to the associated motor shield.

2. Flash the slave code to each Wizzimote, remembering to change the ID in the config.h file to the appropriate drum for each Wizzimote. Remember to reset the Wizzimote once the upload is complete by pressing the reset button on the Wizzimote board.

3. Power all the Wizzimotes and motors. The motors plug into standard power outlets, and the Wizzimotes should be powered with the battery packs.

4. Verify that the green LED on each Wizzimote is flashing about once a second. This is a heartbeat indicator. If the green LED is not flashing, try resetting the Wizzimote by pressing the reset button.

2.2 Raspberry Pi and Master Wizzimote

The Raspberry Pi connects to the UNL-AIR internet in order to receive commands from the webserver, which it then passes on to the Master Wizzimote via a UART connection. The Master Wizzimote can then distribute the commands to the other Wizzimotes over radio. To set up the Raspberry Pi and Master Wizzimote, follow these steps:

1. Connect the Master Wizzimote to the Raspberry Pi as follows: Pi 3.3 V to Wizzimote VDD, Pi GND to Wizzimote GND, Pi RX to Wizzimote TX, Pi TX to Wizzimote RX.

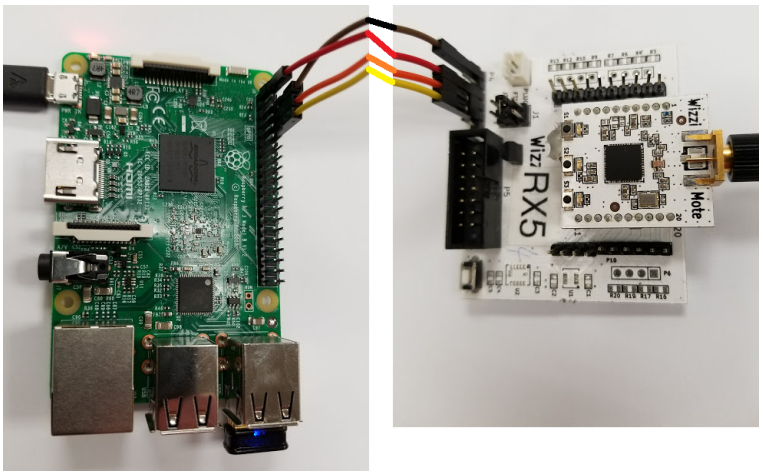

Figure 2: The connections from the Raspberry Pi to the Master Wizzimote.

2. Make sure the Raspberry Pi is in a location where it can connect to the UNL-AIR wifi network. Make sure the Master Wizzimote is within radio range of the drum set Wizzimotes; within the same room is recommended.

3. Power on the Raspberry Pi. It will automatically run the script that opens connections to the webserver and the master Wizzimote.

2.3 Webserver and Website

The webserver and website are constantly running. Long-term maintenance information for the webserver and website is provided later in this document.

2.4 Virtual Reality program

The Virtual Reality program was only tested with the HTC Vive available in Schorr Center, but since it is build using SteamVR in Unity, it should work with any VR system (such as HTC Vive or Oculus Rift) and any internet-connected computer. To set up the virtual reality program for the first time, follow these steps:

1. Follow the setup instructions for the VR system of your choice.

2. Download Steam http://store.steampowered.com/about/ and SteamVR https://steamcommunity.com/steamvr.

3. Download the "RADTeamDrumset" program from our website: www.rad-team.co.za/VRProgram. Make sure you have both the ".exe" file and the "_Data" folder.

To setup the virtual reality program each time, follow these steps:

1. Make sure your computer is connected to the internet, as the program needs an internet connection to connect to the webserver.

2. Start up Steam and SteamVR. Make sure your VR headset and controllers are tracking correctly.

3. Run RADTeamDrumset.exe.

4. The lamp in the drumset scene should turn green when a connection to the webserver has been established. If the lamp is red, try tapping the lamp with the drumstick to attempt to connect to the webserver. If the lamp still does not turn green, exit the program and verify that your computer is connected to the internet.

3 Using the System

Once the system is up and running, the drums can be played from the website or from the VR program.

3.1 Playing via the WebPage

The website can be accessed from any internet-connected device by navigating to www.rad-team.co.za. The website has a button for playing each of the drums, as shown below. Clicking a button causes the corresponding drum to be played in real-time. Clicking the "Annoy Grad Students" button causes all the drums to be played, thereby annoying any grad students working in the lab where the drum set is kept. Clicking "Simple Beat," "Complex Attack," or "Full Song" causes the appropriate pattern to be played. Clicking the "Stop" button will stop the currently playing pattern. Note that when a VR system is connected, commands from the website are ignored.

Figure 3: The website has a button for each drum and pattern that the system can play.

The webpage also displays information about the system in the box at the top of the screen, such as if a VR system is connected and the total number of times a drum has been struck since the system started up. Additional information about the drum set project, including the goals of the project, the code, and the download link for the VR program can be found by exploring the tabs at the top of the page.

3.2 Playing via VR

Inside the VR program, you will see a drumset, a colored lamp, and two menus.

Figure 4: The VR program in its classic theme.

The drumset can be played by simply hitting the drums with the drumsticks that replace your controllers. The lamp indicates if the program is connected to the webserver; green means connected and red means not connected. If the lamp is red, you can tap it with the drumstick to attempt to reconnect to the webserver. The menu on your left can be used to play and stop the simple beat, complex attack, and full song patterns by tapping the corresponding button with a drumstick. The menu on the right can be used to change the appearance of the drumset scene by tapping the corresponding button. Classic, neon, and nature themes are available.

4 Long-Term Maintenance

Although this system was designed to be as user friendly as possible, certain components will need maintenance as all projects do.

4.1 Servers

The server is currently being hosted on https://www.hostafrica.co.za/. This service is not free and costs $R89.00 \approx \$6.50$ a month. Logging into the server can be done as follows:

- ssh into the server:
  - $ ssh root@160.119.248.28
- When you are prompted for the password enter:
  - $ RAD_Team

The webserver can then be rebooted by simply typing "reboot" and hitting enter. Once the server is rebooted, log back into the webserver as explained above. You now have access to the webserver. Starting the both servers can be done as follows:

- Starting the webserver
  - $ /cd RAD_Server
  - $ ./start
- Resetting the HTTP server

- $ cd /RAD_Website
- $ ./start

NOTE: The webserver needs to be started before anything else.

4.2 Raspberry PI

The Raspberry Pi can be rebooted by simply power removing it from power, waiting 5 seconds and then plugging it in again. The Raspberry pi will do the rest for you.
In the unlikely event you do need to use the pi, it will automatically login in. The credentials are as follows:

- Username: pi
- Password: raspberry

NOTE: Leave the Raspberry Pi turned on for 30 seconds before attempting to use the system.

5 Troubleshooting

- *One of the wizzimotes is not flashing its green LED; none of the LEDs are on.* The wizzimote is likely not receiving power. Try replacing the batteries.
- *One of the wizzimotes is not flashing its green LED; its LEDs are doing something else.* The wizzimote is likely not running the correct code. Try pushing the reset button, or flash it with the correct code and then push the reset button. Note that the yellow and red LEDs also flash during normal operation; yellow indicates that a radio message was received, red on a slave wizzimote indicates that it is attempting to play the drum, and red on the master wizzimote indicates that a UART message was received.
- *One of the drum sticks is not moving correctly.* The wizzimote may be incorrectly connected, or it may be running the wrong code. Double check the connections between the wizzimote, voltage stepper, and motor control board. Double check that the proper code is uploaded to the wizzimote. Try resetting the wizzimote by pressing the reset button.
- *One of the drum sticks is not moving at all, despite have the proper connections and code.* The motor or motor shield may be damaged. Try replacing them.
- *When I click a button on the website, nothing happens.* If a VR program is connected to the drumset, this is expected behavior; the virtual reality program blocks all commands from the website. Check if the website indicates that a VR system is connected.
- *When I click a button on the website, nothing happens, even though the website doesn't indicate that a VR system is connected.* Check if the website indicates that the drumset controller is connected. If the drumset controller is not connected, try resetting the Raspberry Pi. This should cause the Pi to reconnect to the webserver, and the website should then indicate that the drumset controller is connected. If the website indicates that the drumset controller is connected, the error must be between the Pi and the drums. Double check the connections between the Pi and the Master Wizzimote. Make sure all drums, wizzimotes, and the Raspberry Pi are properly powered.
- *When I hit a drum in VR, nothing happens.* Verify that the lamp in the scene is green; a red lamp indicates that the program is not connected to the webserver. Verify that your computer is connected to the internet, and tap the lamp with a drumstick to connect the program to the webserver.
- *When I tap the VR lamp, it turns green, but as soon as I hit a drum it turns red again.* This indicates that the webserver is not connected to the Raspberry Pi. Reboot the Raspberry Pi and it will re-connect to the webserver.

- *The VR lamp is green, but the drums are still not responding.* This is due to an error somewhere between the Raspberry Pi and the drum set. Double check the connections between the Pi and the Master Wizzimote. Make sure all drums, wizzimotes, and the Raspberry Pi are properly powered. Try resetting the drums' wizzimotes by pressing the reset button.