User Manual for

NASA Vestibular Chair System

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USER MANUAL DOCUMENT

1 INTRODUCTION

This manual is to be used in conjunction with the NASA Vestibular Chair as well as its external controller interface for proper use and safety measures. This manual will go over how the components are supplied with power, as well as how to supply them with power correctly. Along with that, this manual will explain the proper way to utilize the chair and its controller, as well as some general safety precautions to follow during use and testing.

1.1 Powering the NASA Vestibular Chair

The NASA Vestibular Chair is powered by a power supply rated at 24 DC volts with a maximum amperage of 25 amps, however, this upper limit is not reached due to being higher than needed for the components. This power supply is stored within the external controller, and it supplies power to the chair using an ethernet cord from the controller module.

1.2 Powering the external controller for the NASA Vestibular Chair

The external controller for the NASA Vestibular Chair is powered by an external computing device via a USB port, connecting the internal electronics to a computer. A computer with the specifications of 2 USB type-A ports, 4GB Ram, Bluetooth compatibility, runs Windows 10 OS at a minimum, or any other up-to-date OS is required to effectively utilize the external controller for the NASA Vestibular Chair. This is due to the programs that the controller is configured with meeting those specifications as of the creation of this user manual.

1.3 Powering the patient-held remote for NASA Vestibular Chair testing

The remote used by the patient is powered by a simple battery pack in the base of the controller. These batteries are replaceable, meaning they can be changed in the occurrence of a loss of power

2 USES OF HARDWARE

2.1 Interface of controller module for the NASA Vestibular Chair

1. "Confirm" button: Confirms the value set by the potentiometer, as well as starting the test and confirming the end of the test.

2. "Arm/Disarm" button: Arms the testing parameters, allowing the test to be executed. Must start in disarm position before the test can be armed.

3. "Back" button: Moves backward through the setting of parameters. (E.g., after confirming rotation speed and moving to setting the duration, back will allow change of rotation speed again.)

4. "Stop" button: Stops the test via software during execution.

5. "Emergency Stop" button: Stops the power supplied to the chair electrically.

2.2 Use of the NASA Vestibular Chair external controller for testing

1. First, plug the ethernet cable leading from the NASA Vestibular Chair into the controller module, along with plugging in the power supply.

2. Next, plug the USB cord from the controller module into the host PC to be used for data collection.

3. Using the potentiometer knob, set the speed of rotation for the chair to ramp up during the duration of the test.

4. Press the confirm button to set this speed.

5. Using the potentiometer knob, set the duration of the test for the chair. Press the confirm button to set this time.

6. Flip the arm/disarm switch to the armed position, and press the confirm button to start the test.

7. After the test has finished executing, press the confirm button to save the data file to the host PC.

2.3 Interface of patient remote for the NASA Vestibular Chair

1. “Left” button: Indicates the user believes they are spinning to the left.
2. “Right” button: Indicates the user believes they are spinning to the right.
3. “On/Off” button: Turns the remote on and off.

2.4 Uses of NASA Vestibular Chair patient held remote

1. First, turn on the patient remote. Confirm that the remote has paired to the PC/Controller.
2. Next, after beginning the test, the user will either press the left button, the right button, neither, or both to indicate which direction they believe they are spinning.
3. After the duration of the test has been completed, turn the controller off.

3 SAFETY

Human input will be necessary for the system as the input for the chair is needed to increase its voltage and by extension its speed. This interaction will cause the user to be able to adjust the chair's speed gradually through the controller and web interface, meaning there are potential safety concerns if the hardware is used improperly.

3.1 Safety when interacting with the NASA Vestibular Chair

The NASA Vestibular Chair will be operating at a relatively high speed compared to the ground it sits on, meaning individuals must stay outside of its spin radius to avoid injury during operation. The chair should also be either bolted down or placed on an elevated platform, as to stop it from tipping over during operation as this has the potential to harm individuals who are sitting in the chair during operation. The system has built-in protection from too much power being sent to the chair, as this would cause too high of a rotational velocity; however, if too much power happens to be applied, there are multiple emergency stop buttons placed in the external controller to remove power from the chair and ease its descent in speed.

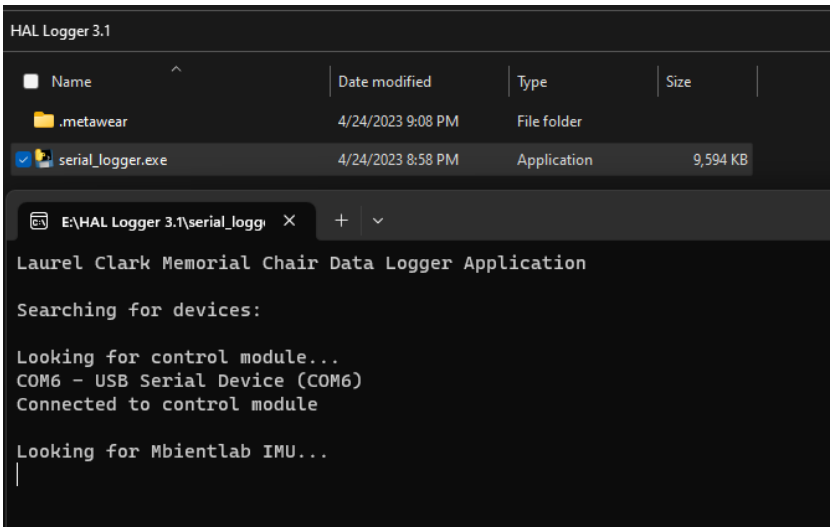
3.2 Safety when interacting with the NASA Vestibular Chair external controller.

The external controller is built with an emergency button used to stop power flow to the chair immediately if there are any prevalent issues with its use. This component is activated by applying pressure to the button until it clicks into place. When the button is not in the "open" position, power is allowed to freely flow to the chair. Fans are built into the external controller to control the temperature flow to avoid overheating; however, if there are noticed heating issues, the controller should be turned off for a few moments to regulate its temperature.

4 DATA LOGGING APPLICATION

4.1 Utilizing the application

1. Turn on the host computer and log in.
2. On the desktop locate the “HAL Logger X” folder
3. Plug in the USB cable of the controller module.
4. Locate and start the “serial_logger.exe” application.



5. Place the MbientLab IMU within 1ft of the host application.
6. Wait for the connection status to appear.
7. Once the connection status has appeared, set the speed and time using the controller module.
8. Turn on the patient remote and wait for a confirmed signal.
9. Once confirmed, arm the control module
10. Press the confirmation button.

4.2 Troubleshooting

If an error or software exception occurs in the following steps the trial should be stopped immediately. This is to prevent any harm done to the participants in the trial, the patient sitting in the chair, and or the proctor nearby conducting the test. An example of a software exception that has occurred throughout testing can be found below. The following steps should be taken before continuing the trials:

1. Escort the patient out of the chair.
2. Close the data logging application.
3. Unplug the USB cable from the controller module.
4. Repeat the steps from item 4.2 – Starting the application