

User Manual
For
NASA VESTIBULAR CHAIR

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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. 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 this component. This power supply is stored within the external controller; however, it is also possible to power it using an ethernet cord to a device able to provide sufficient power of no more than 12 volts at 5 amps.

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 loss of power.

2 USES OF HARDWARE

2.1 Use of the NASA Vestibular Chair

The NASA Vestibular Chair is to have power applied up to, but no more than 12 volts at a rate of 5 amps. The rotational change of motion shall not exceed a rate of 100 degrees a second, or approximately 1 full rotation every 3.5 seconds. This means the maximum rate that the chair shall operate at during use is 17 RPM and no higher. This rate is limited by the software implementation for the motor controller and micro controller found within the external controller for the NASA Vestibular Chair.

2.2 Use of the NASA Vestibular Chair external controller for testing

The external controller for the NASA Vestibular Chair will be operated via 5 different buttons, as well as a potentiometer which is used for control of the applied power to the chair itself. The first of these buttons, the black “on/off” switch, is utilized to allow the proctor defined testing constraints to be committed to the system. When the switch is set to “off”, the system is disarmed, meaning that there is no power currently being applied to the chair, and that the proctor’s test setup has not been committed to the system. When the switch is set to “on”, the testing setup is armed, and will be committed to the system when the proctor presses the green button to the right of the “on/off” switch. The second of these buttons is the green button, or the “confirm” button. This button is used to confirm testing specifications displayed on the LCD screen, such as setting the speed of rotation and the duration of the test. The third of these buttons is the red button, or the “back” button. This button is used to move backwards through the testing setup process, as to reassign values for the testing specification. The fourth of these buttons is the yellow button, which is used as a software emergency stop. Opposed to the mechanical stop also found on the external controller, this stop button will slow the chair at a faster rate and serves as one of the only ways to stop the proctor test of the chair once it is confirmed via the controller. Next to the yellow button is the potentiometer, which is used to set the values for the testing process, with clockwise rotation increasing values and counterclockwise rotation decreasing values. Finally, there is the emergency stop button, which also serves as the button that allows power to be applied to the chair. When the emergency stop button is not pressed in, power is able to flow to the chair, and this is its default state. When the emergency stop button is pressed in, it will cut power to the chair, allowing it to slow down gradually.

2.3 Uses of NASA Vestibular Chair patient held remote

The remote used by the patient for testing is built with two component buttons as well as wireless receivers that communicate the button presses to the external controller for recording data of the time the button is pressed through different states. The initial state is when none of the buttons are pressed by the patient, which indicates that they do not believe they are spinning, state one when the left button is pressed, indicating that the patient believes they are spinning to the left, state two when the right button is pressed,

indicating that the patient believes they are spinning to the right, and state 3 when both buttons are pressed which indicates a state not covered by the other situations.

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 device, meaning there is 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 is applied, there are multiple emergency stop buttons placed in the external controller to remove power from the chair and ease it's 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 with simple pressure of 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 is noticed heating issues, the controller should be turned off for a few moments to regulate its temperature.

