Somatosensory Enhancement FPS Gun Controller Proposal

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1. Introduction

1.1 Problem:

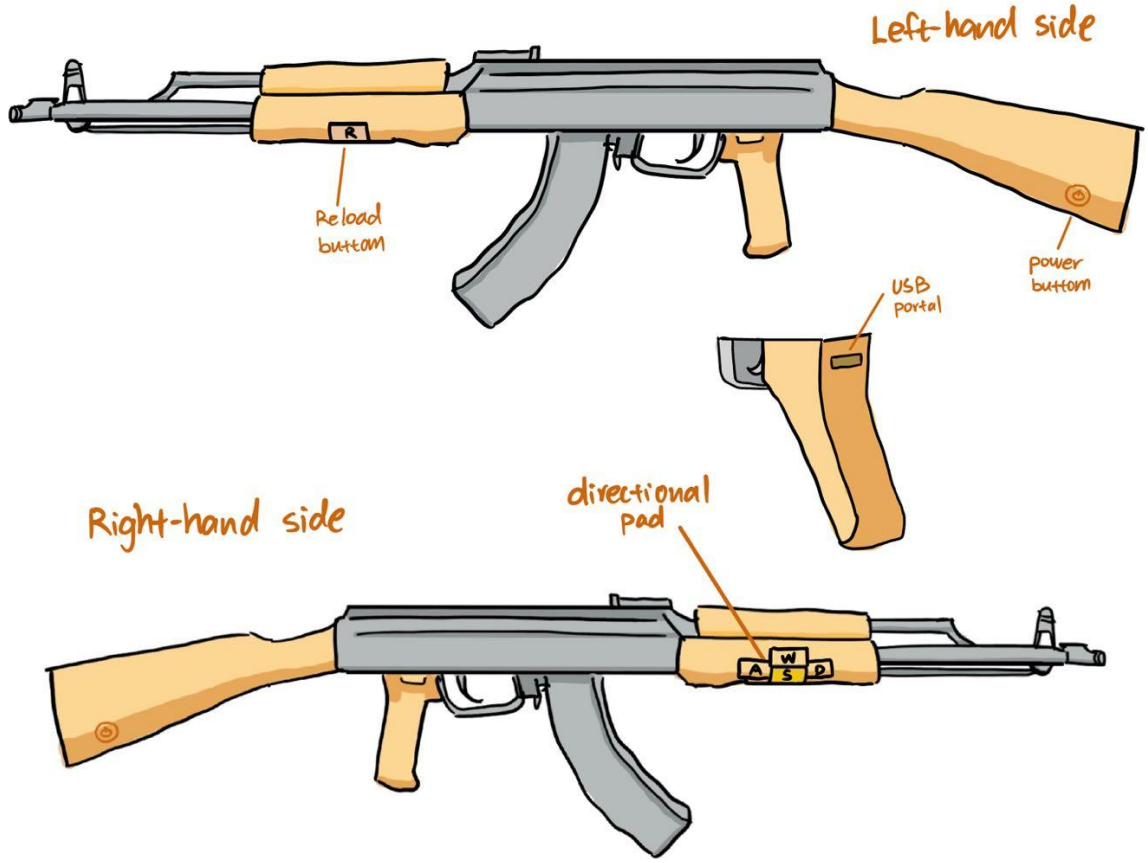
The functions of video game controllers nowadays are very limited to the gaming machine, and are mostly in the form of joy-stick or gamepad. Playing FPS(First-person shooter) games on PC with a mouse or joystick can lower an user's gaming experience, making it difficult for users to feel realistic and fully immersed during games. Not only do traditional controllers lack realism, they also involve very limited physical movement, where players often sit down for hours which lead to negative effects on player's health. Prolonged sedentary activities can lead to poor blood circulation, risk of weight gain, back pain and many other increased health risks. Especially when VR games slowly occupy the video game market, a non-traditional controller, or a somatosensory enhancement gun-shaped controller will be necessary.

1.2 Solution:

A gun shaped gaming controller is designed to bring a new level of immersion and realism to FPS video games, such as Call of Duty, Halo and Counter-Strike: Global Offensive. Unlike any traditional controller, the shape of our product mimics that of a real gun, allowing players to perform aiming and shooting in a similar way to how they would actually hold a gun in real life making gaming more exciting and enjoyable. This type of controller offers 3 main benefits to players. Firstly, a more realistic game play, a gun controller with the ability to mimic real life aim and shoot movements can increase the realistic aspect of game play; Second, Improved control, The gun shaped and trigger button replacement can provide players with better control over their movements; Third, increased physical activity. A gun shaped controller can encourage players to stand up and be more active as they aim and shoot, eliminating the risk of negative health problems from prolonged sitting.

1.3 Visual Aid:

A pictorial representation of your project that puts your solution in context. Include other external systems relevant to your project (e.g. if your solution connects to a phone via Bluetooth, draw a dotted line between your device and the phone). Note that this is not a block diagram and should explain how the solution is used, not a breakdown of inner components.



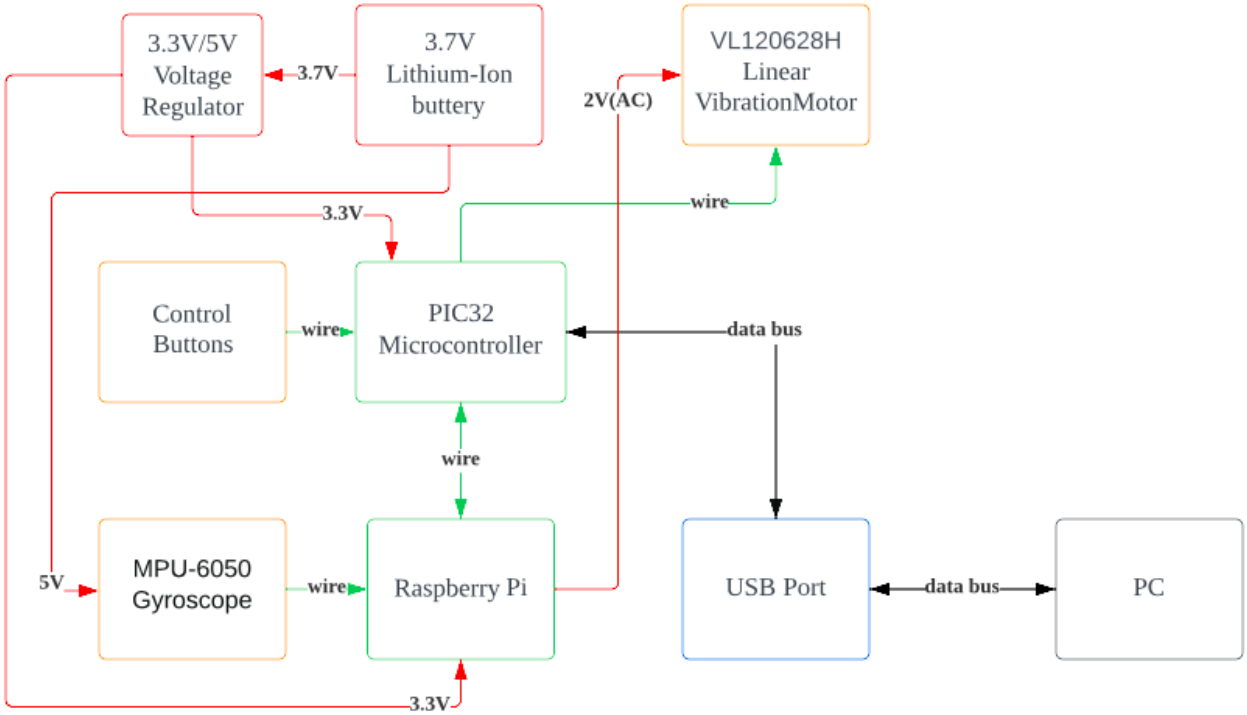
1.4 High-level requirements list: A list of three *quantitative* characteristics that this project must exhibit in order to solve the problem. Each high-level requirement must be stated in complete sentences and displayed as a bulleted list. Avoid mentioning "cost" as a high level requirement.

Our controller works properly when

a. Aiming function works: shoot 10 targets in 50 seconds
b. Recoil function works: 5mm vibration amplitude
c. Battery works：30 minutes continuous usage

2. Design

2.1 Block Diagram: Break your design down into blocks and assign these blocks into subsystems. Label voltages and data connections. Your microcontroller can live in multiple subsystems if you wish, as in the example below.



2.2 Subsystem Overview: A brief description of the function of each subsystem in the block diagram and explain how it connects with the other subsystems. Every subsystem in the block diagram should have its own paragraph.

- Control unit: this is the control unit subsystem consist of a micocontroller which will incharge of controlling all the other subsystems. (PIC32 microcontroller)
    - Button & Trigger: The control unit or the microcontroller is able to control the button&trigger which means it we press a key, the microcontroller needs to detect the keypress then it needs to send the signal to computer.
    - Linear Vibration motor: The main function of the vibration motor is once you pull the trigger, the motor needs to vibrate and simulates a recoil force as a real gun in real life. This needs to be under the charge of microcontroller; the microcontroller needs to read the signal when the trigger is pulled and send a signal or a current to the motor so that the motor can vibrate.
    - MPU-6050 Gyroscope: The Gyroscope plays a role of motion detection. It means we need to use the Gyroscope to capture the data of how we move the model gun in real life and use some algorithum to transport the data into computer so that the aiming cursor in the game will know if we are moving left or right. In order to

achieve this goal, we decide to use Raspberry Pi to do the algorithm.

- Power Supply: A power supply is required for the model gun to function. We will put a 3.7V lithium battery in our model gun to supply the current and voltage. The power supply unit (the battery) will also give current and voltage to the microcontroller and Raspberry Pi in order for it to function. Notice that the Raspberry Pi and the microcontoller only need 3.3V; therefore, a DC-to-DC voltage transformer is needed in order to conver 3.7V to 3.3V.

- USB Port: A USB port unit is required for for data transformation from the model gun to PC. We would create a USB port on our PCB so the the USB cable would directly connect to the PCB and transform the data into PC.

2.3 Subsystem Requirements: For each subsystem in your block diagram, you should include a highly detailed block description. Each description must include a statement indicating how the block contributes to the overall design dictated by the high-level requirements. Any interfaces with other blocks must be defined clearly and quantitatively. Include a list of requirements where if any of these requirements were removed, the subsystem would fail to function. Good example: Power Subsystem must be able to supply at least 500mA to the rest of the system continuously at 5V +/- 0.1V.

- Power Supply: The power supply We choose has a 5000mah battery tank with 3.7V and 2.5A maximum output. Out estimate power usage is 2.14A*3.7V=9.25W. The estimated time of usage of 5000mah*3.6J/mah/9.25W/60s = 37.3min. Our first high-level requirement "30 minutes continuous usage" is fulfilled.

- Vibration Motor: The motor has vibration force larger than 1.5 grms. Our second high-level requirement "5mm vibration amplitude" should be fulfilled. Further testing is needed to make that sure.

- Microcontroller & Raspberry Pi: In order to achieve the aiming function goal (shoot 10 targets in 50 sec), first of all the Raspberry Pi needs to do the algorithm within time; too much delay would not achieve the goal. The Raspberry Pi 3 model B has a Cortex-A53 (ARMv8) 64-bit SoC processor which would achieve this goal.

- Button & Trigger: The WASD buttons are placed on the right side of the handguards in the same arrangement as that is on regular keyboards. This design is ergonomic. It helps the players to quickly get familiar with the operation method. Besides that, the reload

button is placed at the Magazine, and the trigger button is placed at the Trigger. These intuitive designs help the player easily finish the last requirement “shoot 10 targets in 50 sec.” The average time to finish this goal by traditional keyboard and mouse is 45 sec.

- GYROSCOPE: The delay time of Gyroscope could not be high. From the datasheet it has 16-bit ADCs enabling simultaneous sampling of gyros which would be sufficient to use.

2.4 Tolerance Analysis: Identify an aspect of your design that poses a risk to successful completion of the project. Demonstrate the feasibility of this component through mathematical analysis or simulation.

- For power supply, the 3.7V lithium battery supplies 3.7V of electricity with a maximum current of 2.5A.

- The VL120628H Linear Vibration Motor needs 130mA current and a 2V voltage.

- The PIC32MK1024MCM100 Microcontroller will have a minimum operational voltage of 2.8V and a maximum operational voltage of 3.3V.

- The GY-521 THREE AXIS ACCELEROMETER/GYROSCOPE will need an input voltage of 5V. Connecting to a voltage of 3.3V might cause irregular output values. Also, it needs an operational current of 3.6mA

- Raspberry Pi 3 model B+ will need an input power of 5V/2A DC.
- The total current added up through all the components is 2A+130mA+3.6mA = 2.1336A; therefore, by far we can see the battery would be able to supply the current needed.

3. Ethics and Safety

Assess the ethical and safety issues relevant to your project. Consider both issues arising during the development of your project and those which could arise from the accidental or intentional misuse of your project. Specific ethical issues should be discussed in the context of the IEEE and/or ACM Code of Ethics. Cite, but do not copy the Codes. Explain how you will avoid ethical breaches. Cite and discuss relevant safety and regulatory standards as they apply to your project. Review state and federal regulations, industry standards, and campus policy. Identify potential safety concerns in your project.

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- Our biggest safety issue relevant to our project is when a user uses too much force when swinging the aim, or holding the controller with one hand, it could fall out of the user's

hand and hit computers or people around. In reference to 7.8 IEEE code “ to hold paramount the safety, health, and welfare of the public, to strive to comply with ethical design and sustainable development practices, to protect the privacy of others, and to disclose promptly factors that might endanger the public or the environment”, we need to eliminate any possibility of risk to harm public’s safety and welfare, therefore we will add a wristband to prevent gun controller from swinging out of hand.