Piezoelectric Haptic Feedback Actuator

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Part I. Hardware Design 1 using 9V battery

The Piezo Actuator is a product that allows a static, dime-sized area that is force-sensitive to act as a button without physically moving. Instead it uses electricity to “click” back at the user when pressed. This product can be used to replace the mechanical buttons that are susceptible to wear and the need for the parts to be replaced. It is different than ERM and LRA products since it does not contain any movable parts.

The process of haptic feedback is that the signal of user’s input on piezo actuator is sent to the microcontroller based haptic driver and then, the driver will transmit the custom signal back to apply across piezo actuator for haptic feedback.

The advantage of our piezoelectric actuator is the dynamic performance which fulfills the best quality of rich experience in haptic feedback for users. In order to achieve such outstanding haptic feedback, we conduct the electrical engineering characteristics such as bandwidth, frequency range for haptic sense, response time, slew rate or rise time.

Part I. Testing Haptic Feedback on Hardware 1

The figure below shows the actual hardware setup of Circuit 1 on breadboard and measure the output voltage (7.55V) across output piezo sensor where we sense haptic feedback.

Part II. Simulation result on LTspice for Hardware 2

It shows the output voltage is 9V and the process takes 0.4ms. Since the PWM and output voltage all are controlled by the microcontroller, it can change the output voltage and create the output “pattern.”

Part III. Microcontroller

Changing PWM to get different voltage

Control the output to create a output “pattern”

Part III. Microcontroller

After we were done with setting up the hardware, we wrote Python Script on Raspberry Pi, which will be able to read the I2C pin of Raspberry Pi and also translate the I2C data from ADC into voltage values. The figure below shows the window where we wrote the Python Script on Raspberry Pi and the console where voltage readings can be read.

Summary/Conclusions

We finished the designs for two circuits. The first circuit was built physically to analyze the haptic feedback on Piezo. The second circuit was built on Electronics Simulation software (LTspice, TINA), and we were able to analyze the different patterns of haptic feedback successfully.

Our second circuit is more compatible for real world applications, such as smartphones, since we replaced the 9V battery from circuit 1 with a boost converter. This creates a more efficient usage in power and size of our circuit design. Using the the microcontroller, we are able to produce different haptic feedback patterns by adjusting a few variables in the program.

Key References


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