Modeling a Mechanical Keyboard Switch

Progress Report

MEEN 431-501

4/10/17

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Abstract

The subject examined is a Cherry MX Blue switch on a mechanical keyboard. Mechanical keyboards are computer keyboards designed to last longer than cheaper, membrane keyboards. They also give the user audible and tactile feedback when typing. During this project, the mechanics a Cherry MX Blue mechanical keyboard switch will be examined and modeled.

Up to this point, the free body diagrams and equations of motion for the switch have been developed. The motions of the switch are broken up into three separate groups. The goal of this project is to apply the equations of motion, derived in this report, to a computer-generated model in the Unity environment.

Objective and Goals

Free-body diagrams will be drawn for the different motions within a single switch for a mechanical keyboard. Equations of motion will then be derived from the free-body diagrams. To simulate the switch in Unity, a game engine which can be used for 3D modeling and simulations, the equations of motion will be applied to bodies created in Unity. A simulation will then be made in Unity to show what happens when a key is pressed on a mechanical keyboard. For appearances, a key cover will also be made which can be hidden to show the internal mechanisms of the switch.

Current Progress

Mechanical keyboards have recently gained popularity as an alternative to conventional, average keyboards which have keys placed on a membrane bump or rubber dome. Normally when a key is pressed on a conventional keyboard, the conductive strip on the bottom of the dome touches a circuit board built into the keyboard that sends a signal to the computer saying what key has been pressed. A common description of feel with this type of keyboard is “mushy” with little to no feedback when a key is pressed.

Mechanical keyboards, on the other hand, offer feedback on keystrokes as well as durability, longevity, and stability. For stability, mechanical keyboards are heavier than rubber dome keyboards because a steel plate mounts the key switches and gives the keyboard rigidity. The longevity and durability come from the mechanics involved in pressing a key.

For this project, a Cherry MX Blue switch will be evaluated. The color in the name denotes how much feedback and noise a switch produces. A Blue switch will have a loud clicking sound when pressed as well as tactile feedback when typing. As seen in Figure 1 below, a blue plunger travels downward when the key is pressed. Then, a white slider will travel down when the force applied from the plunger is greater than the friction from the gray "lock" on the left side. The slider then hits the bottom of the key which registers a key press for the computer.

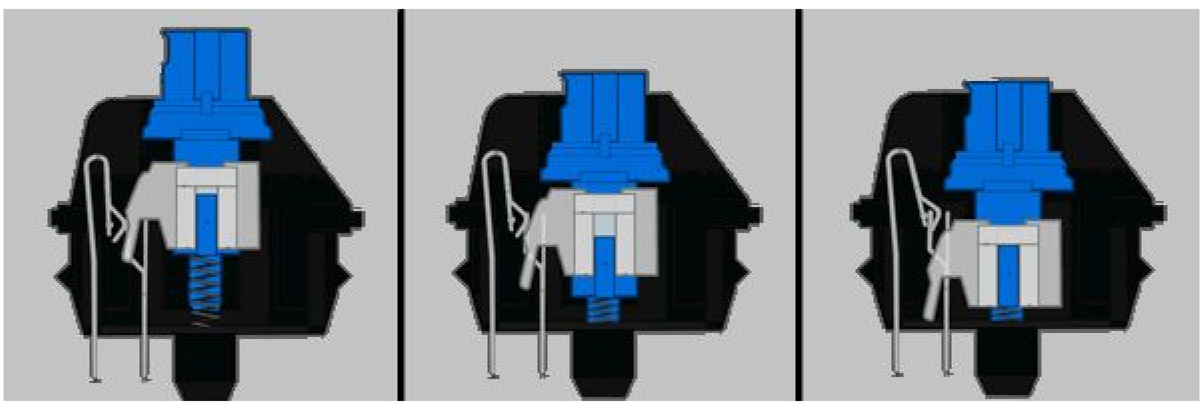
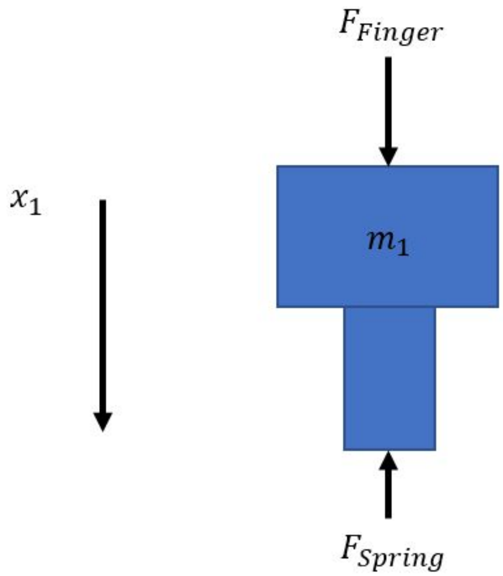


Figure 1. Cherry MX Blue switch actuation

There are three particular "motions" of the switch to be examined. The first is when the key is initially pressed. The forces applied to the plunger are from a spring and the force from a person pressing their finger on the key. The free-body diagram and equations of motion can be seen in Figure 2 on the following page.



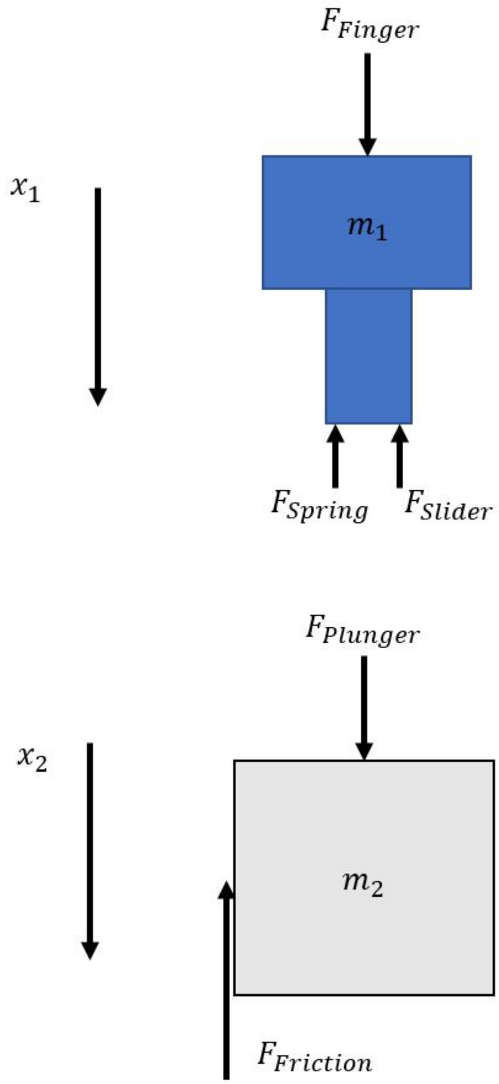
$$\sum F_{x_1} = m_1\ddot{x}_1 = F_{Finger} - F_{Spring}$$

$$F_{Spring} = k_1 x_1$$

$$m_1\ddot{x}_1 = F_{Finger} - k_1 x_1$$

Figure 2. First motion of switch

The second motion involves the white slider as well as the blue plunger. The blue plunger now has a force from the slider in addition to the spring. The white slider receives a force from the plunger above and friction which acts against the plunger force. Again, the free-body diagrams and equations of motion can be seen in Figure 3 on the following page.



$$\sum F_{x_1} = m_1\ddot{x}_1 = F_{Finger} - F_{Spring} - F_{Slider}$$

$$F_{Spring} = k_1 x_1$$

$$m_1\ddot{x}_1 = F_{Finger} - k_1 x_1 - F_{Slider}$$

$$\sum F_{x_2} = m_2\ddot{x}_2 = F_{Plunger} - F_{Friction}$$

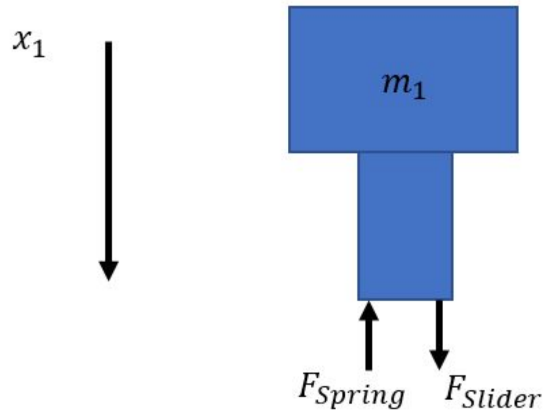
$$F_{Friction} = f(x_2)$$

$$m_2\ddot{x}_2 = F_{Plunger} - F_{Friction}(x_2)$$

$$F_{Plunger} = F_{Slider}$$

Figure 3. Second motion of switch

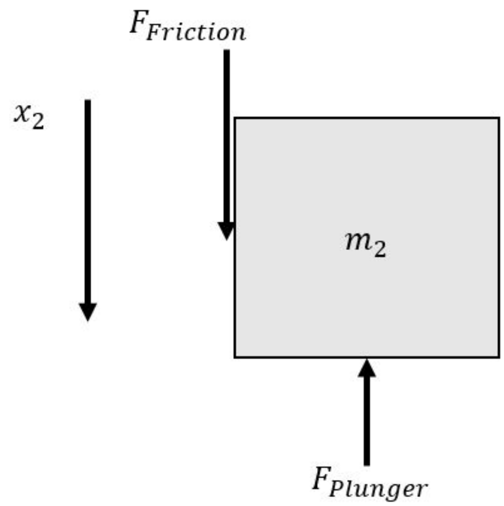
Finally, the third motion is the return of the slider and plunger when the slider hits the bottom of the key. Friction acts in the opposite direction since the motion of the whole body is moving upwards instead of downwards. The spring also stretches to push the plunger after being compressed in the first and second motions. The free-body diagrams and equations of motion can be seen in Figure 4 on the next page.



$$\sum F_{x_1} = m_1\ddot{x}_1 = F_{Slider} - F_{Spring}$$

$$F_{Spring} = k_1 x_1$$

$$m_1\ddot{x}_1 = F_{Slider} - k_1 x_1$$



$$\sum F_{x_2} = m_2\ddot{x}_2 = F_{Friction} - F_{Plunger}$$

$$F_{Friction} = f(x_2)$$

$$m_2\ddot{x}_2 = F_{Friction}(x_2) - F_{Plunger}$$

$$F_{Plunger} = F_{Slider}$$

Figure 4. Third motion of switch