Automating WrightSim at Museums and other venues
(So you don't need a Operator/Attendent)

Skill Level: Intermediate

Helpful skills: Soldering, Drilling

Tools/Consumables Required:

1) Soldering pencil with thin pencil Tip
2) Rosin core solder (Under .032 diameter)
3) Small Electric drill (Dremel Tool or equivalent works great)
4) Small drill bits (1/16-Inch dia., 3/32-inch dia., etc)
5) About 6-feet of 22 gauge (#22AWG) stranded, insulated hookup wire
6) Tiny Round Needle File (1/8-inch dia. or smaller)
7) Small Slotted and Phillips Screw Drivers
8) Circuit tester such as a Volt-Ohm Multimeter

The following procedure describes the way we automated the operation of WrightSim, NASA's 1903 Wright Flyer Simulation. It has been tested and proven reliable by over 6 months of continuous operation at several museums.

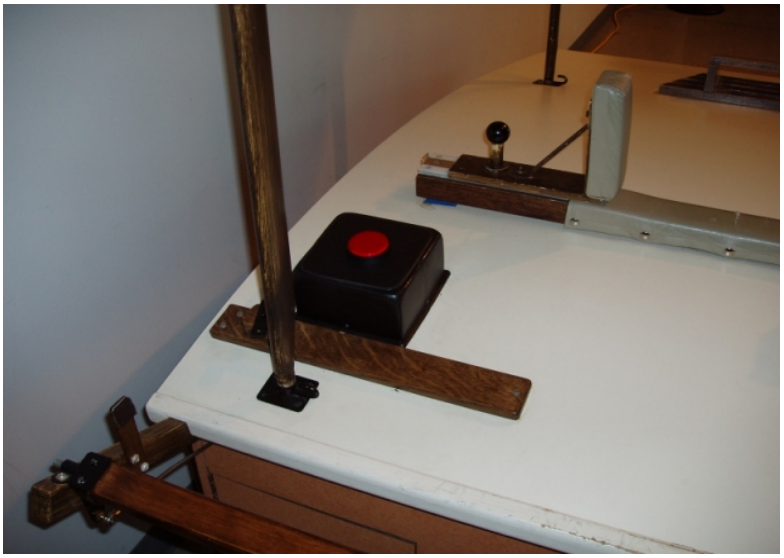

Illustration 1 – Here is a picture of the pushbutton we installed on our hip cradle to automate the operation of our WrightSim Software.

In the past, an operator needed to be present at all times to manually start each simulation for guests at an exhibit by pressing the "Enter" key on a computer keyboard. The operator would also be required to press the "Enter" key to cycle students through multiple flight attempts, to obtain flight statistics, and to reset

the simulation for the next guest. The equipment fabricated in this procedure completely eliminates the requirement for an operator/attendant to be present.

WrightSim is particularly easy to automate because only one key (the “Enter” key) is used to cycle guests through an entire simulation experience. The strategy we used to automate WrightSim involved finding a method to enable guests to remotely press the “Enter” key. We chose to solder wires to the switch contacts that connect to the “Enter” key in a low cost USB keypad. While most any keypad should work using this procedure, we used a Kensington USB Pocket Keypad, Model # 33006 in the illustrations that follow. After many months of field testing at two different exhibit sites, we have found this method to be very reliable, and fairly easy to implement.

Step 1 – Opening the Case

Turn the case over and remove one or several of the small screws on the back of the unit. In rare instances, these screws may be covered by rubber feet or a manufacturer’s label. Place these tiny screws in a cup or bag to avoid losing them. Next, using a very thin slotted screwdriver, very carefully pry the top and bottom part of the case apart as shown in Illustration 1. You shouldn’t have to use excessive force. If you find that you have to, check to assure you removed all screws.

Illustration 2 – After screws are removed from back of unit, carefully pry the top and bottom of the case apart.

Step 2 – Locating and Identifying the connections to the “Enter” Switch

Due to the way the keyboard is constructed, it WILL NOT be possible for you to solder wires directly to the “Enter” Switch contacts. Instead, locate a multi-pin connector that connects the entire keyboard to the circuit board as shown in Illustration 3. It is useful to have a partner help you as you perform the next step. Have your partner press the enter key on the keypad while you use an analog or digital multimeter on the “Ohms” setting, or any other circuit tester that can check circuit continuity.Test every possible 2-pin combination in the multi-pin connector. There should be ONLY ONE 2-pin combination that provides a complete circuit

when the “Enter” key is pressed. To verify your connection after you locate the two pins that cause a complete circuit, have your partner repeatedly press the enter key. You should observe that the connection is repeatedly opened and closed while looking at the display on the multimeter or other circuit tester.

Illustration 3 – locate the keyboard connections that the two wires will be soldered to. In this illustration above, it is circled.

Step 3 – Soldering Wires to Contacts

Cut two 24-inch lengths of #22 stranded, insulated hookup wire. If the two wires aren’t already twisted, twist the two wires together to keep them in a neat bundle.

Illustration 4 - Very carefully solder wires to the two connections that go to the “Enter” Key. Note the Orange and Black wire.

Strip approximately 1/8th. Inch of insulation from each end. Use a low wattage (About 30 watts) soldering iron and thin solder (Under .032 inch diameter) in the steps that follow. Very carefully, solder one end of each of the two wires you prepared to the two contacts on the connector you identified in the previous step. Due to the close spacing between the contacts on the connector, extra special care most be taken to assure that you do not bridge two adjoining contacts.

Step 4 – Drilling hole for the wires to exit

First, carefully plan the location where you are going to drill your hole for the two wires to exit. The hole should be away from any obstructions such as the top, and bottom of the case, the circuit board, or other connectors and should be located to assure that the wires have a clear and short path to the circuit board connector. To prevent from damaging the circuit board during drilling, it is advisable to partially or fully remove it if possible. In addition, since you are drilling through plastic, it is better to start with a very tiny drill bit and then use larger drill bits until the hole is almost the correct size for the wire to pass through. Using a small drill bit and a tiny drill such as a dremel tool, drill a small hole in the back of the case to allow the two wires to exit. Finally, finish off by using a needle file to enlarge the hole to the correct size and file any rough edges. As can be seen in Illustration 5, tie a little knot on the wires that are inside the case to prevent them from coming off if they are tugged.

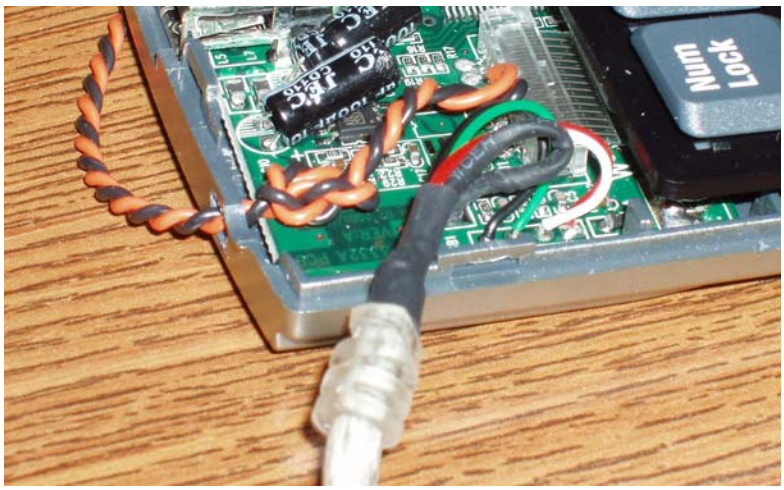

Illustration 5 – Using a small drill bit, very carefully drill a hole for the two wires to exit the case.

Step 5 – Reassemble the case

Once the two wires are routed through the hole you just made in the case, route the USB cable through its existing hole and snap the case together. Reinsert any screws.

Illustration 6 – Reassemble case by routing all wires and pressing top and bottom half of the case together, then screw in the screws.

Step 6 – Solder wires to Pushbutton switch

Solder each wire to a Normally-Open contact of the pushbutton switch. Don't connect to normally-closed contacts if the switch has them.

Step 7 – Mount Keypad and Switch, and plug USB cable into computer

Mount the keypad near the computer. A great idea is to attach the keypad to the side of the computer using a strip of Velcro. Mount the pushbutton switch near the front of the exhibit where it will be easily accessible to guests who fly the simulation. Finally, connect the keypad's USB connector into a USB port on the back of the computer.

Step 8 – Test the switch.

Power on the computer, and the display and start WrightSim. Select "Start a new flight" from the main menu and then press the button to verify that it functions correctly.