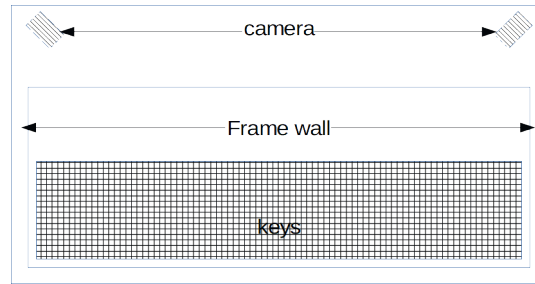


# Touchless Camera-KeyBoard User Instruction



## 1. How it works

The Touchless Camera-KeyBoard from LIGHTIO uses 2 cameras at the 2 corners away from the user to monitor the keys. When a finger or pen is getting close to a key, a key stroke is sent via the USB cable to a connected computer. The key panel is using a keyboard film for a standard laptop computer. So the size and layout of keys are compliant to the most popular standard.

## 2. Lighting condition requirement

Lighting condition is crucial for the cameras to take good pictures and affects the user experience dearly. The cameras in the keyboard reside at the 2 corners away from the user and forms 45° angles from facing the user side. This design imposes stringent requirements on the lighting environment around the keyboard.

First, the lighting needs to be bright enough. When it is too dark, the cameras cannot see anything at all. The minimum lighting requirement is comparable to that when humans can read this page or a newspaper clearly. In the case when the keyboard does not respond and the room seems dark, increasing the lighting will activate the keyboard. In our test environment, normal office lighting works well.

Second, direction wise, there has to be enough light coming from the back of the camera side, facing the user, so that the finger can be seen by the cameras as a bright object from the background. If the only light is from the side or back of the user, then the camera can only see the dark side of the finger and cannot distinguish it from the background.

If there is a strong light source from a side or back and gets in the view port of a camera, the image sensor of the camera can become saturated and stop working. In this case, use something, such as a book, to block the light from direct hitting the camera will usually work. But sometimes, the keyboard needs to be unplugged, wait 10 seconds, and connect again to reinitialize the sensors.

Third, the lighting in the room is better to be stable. If there is Sunshine present, there may be wind to cause some moving spot light that can cause unexpected behaviors of the keyboard, from wrong keys code from pressed ones to key strokes without finger present.

## 3. Recognition conditions and LED indicators

The width of the finger or stick needs to be bigger than 5mm and smaller than the size of a key, as most human finger tips and pencils and pens are within this range.

The finger or stick also need to reflect enough light so that they can be recognized as clear objects from the background in the image. Most pens, pencils, and chopsticks with bright colors have been tested to work well. If your fingers or the stick you want to use are dark colored, wrap a white tape or paper strip around it can help to increase its reflection and make it more recognizable.

When a finger or an object is seen as passed the half height of the side frame and near the key surface from the pictures taken by a camera, the corresponding green LED indicator light will be turned on. When both lights are on, a key stroke signal is sent to the host computer.

If a finger is put near or on a key, but only one LED light turns on, then it means the other camera did not see the finger, or not enough light is reflected from the finger to that camera. In this case, adjusting the keyboard direction more toward the lighting source of the room so that light can be reflected evenly from the finger to both cameras.

If none of the LEDs lights up when a finger is placed on a key, it is usually because the lighting condition is not satisfied.

#### **4. Performance issues**

Under good lighting conditions, i.e. ample and even light from the direction facing the user, and with good reflecting fingers or sticks, the response of this keyboard was tested to be comparable and slightly faster than the regular push button keyboard. If it takes more time to light up the LEDs, or needs multiple hits to enter a key, it is usually because the lighting around the keyboard is sub-optimal, and the cameras need to take multiple pictures to get a good one.

Placing a small table light in the center front of the keyboard often helps to improve the performance.

#### **5. Key Combinations**

This keyboard supports key combinations with multiple modifier keys and one character keys in a pairwise migration style. For a camera to clearly recognize multiple objects in one picture, the objects need to be well separated to avoid being considered as one and result in an unintended key. To achieve this separation purpose, only two fingers on each side of the keyboard at the same time is allowed, but then move one of the finger to another key, and then move the other finger to another key...

For example, if a user wants to input Ctrl+Shift+Alt+A, the first finger can be placed on the right Ctrl, with this finger stays on, then place another finger on left Shift; then with the left Shift finger fixed, move the finger on right Ctrl to right Alt; then with the finger on right Alt fixed, move the finger on left Shift to A.

#### **6. Starting up**

When this keyboard is plugged into a computer, the two green LEDs will turn on during the initialization process for a few seconds. The keyboard can be used when they turn off.

When this keyboard is plugged into a computer port for the very first time, the host computer will search for USB drivers to do the USB setup. This can take longer time. Very rarely but did happen once was that the USB setup took too long and made the camera initialization out of sync and stopped working. If this happens, just disconnect and reconnect again will work.