SHADOWSENSE PERFORMANCE REPORT: INFRARED FREQUENCY

1.0 Objective

The purpose of this experiment is to determine the relationship between the frequency of the infrared (IR) LEDs used within a ShadowSense touch frame and the frequency of the IR LEDs in other devices commonly found in boardroom and classroom settings.

1.1 Equipment

The equipment used during the entire test:

- Display equipped with Baanto SDW759W1 ShadowSense touch frame running firmware version 10.01
- Baanto Dashboard software
- AVer VC520 Generation 2 camera

1.2 Setup

To examine the effect of varying the LED off-time on a nearby IR-dependent device, a third-party AVer VC520 Generation 2 conference room camera and a ShadowSense SDW759W1 frame were used. The goal of the experiment was to test the distance at which the camera was still correctly receiving commands from its remote with various IR frequency configuration settings. The screen was vertically oriented, approximately 90° with respect to the ground, with the bottom of the display 88.4 cm above the ground. The camera was placed so that its receiver was 26.2 cm below the bottom of the base of the screen and flush with the outer face of the ShadowSense frame. The camera was on top of a brushed stainless steel plate similar to what could be found on a standard display mount. The plate in turn was placed on a dark piece of felt on top of a wooden stand. The illuminance of the room in front of the camera IR receiver was 395.4 lx facing upwards. The setup is shown in Figure 1 and Figure 2.

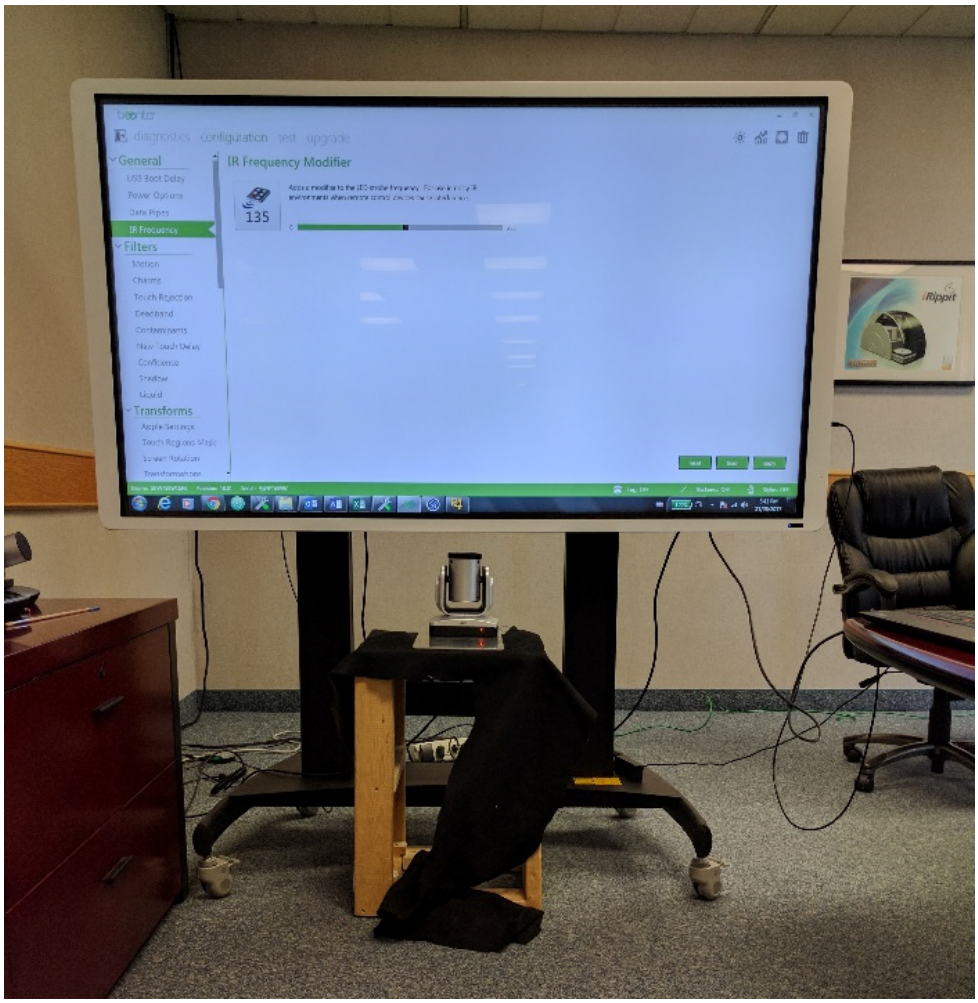

Figure 1: Setup of the Camera and the ShadowSense screen

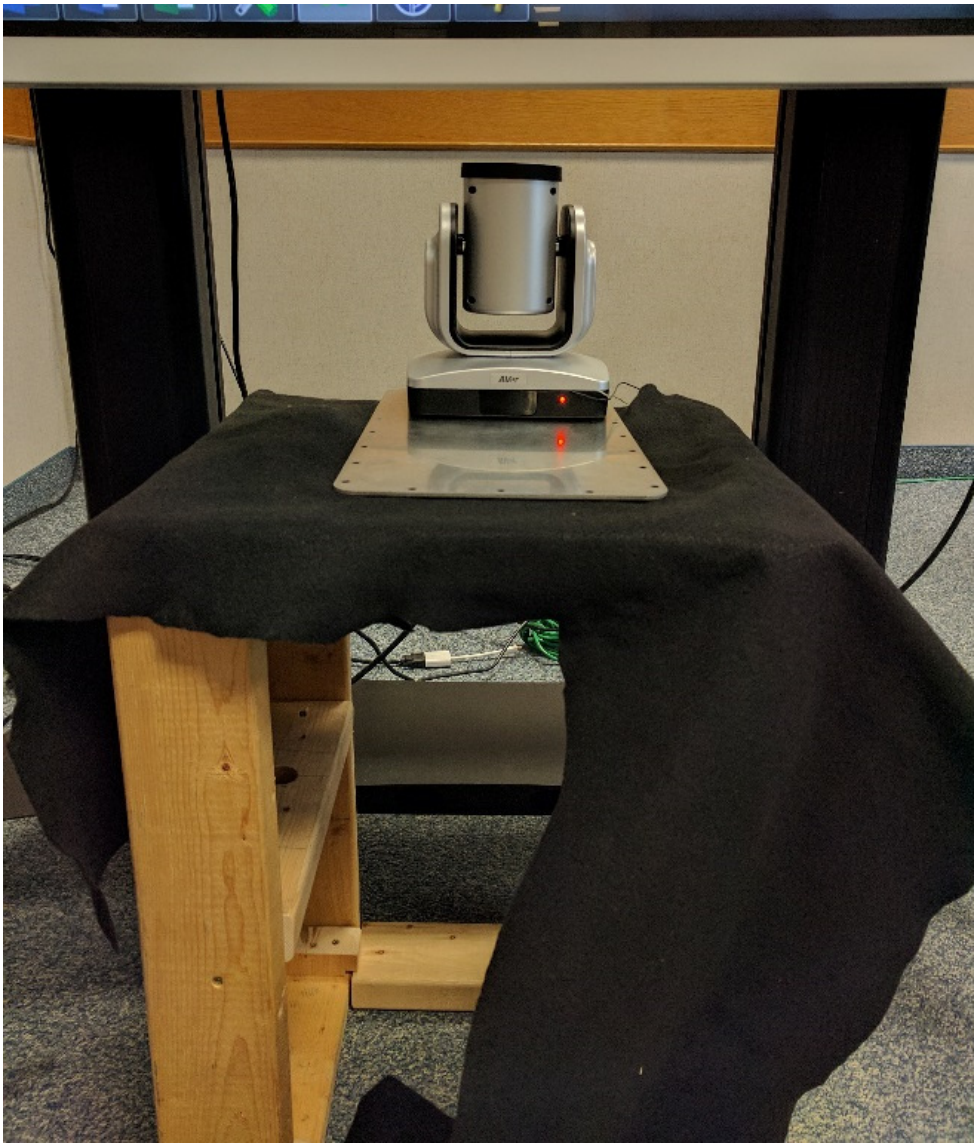

Figure 2: Placement of the camera on stainless steel plate and dark colored felt

2.0 Method

IR light is essential to the operation of ShadowSense touch screens and allows for effective touch detection. IR light is also a common method of transferring information or commands and is often used in remote controls for devices such as televisions, cameras, and sound systems. It may be of some concern that stray light rays from ShadowSense screens might interfere with these devices' ability to correctly receive and respond to commands from IR remotes, thus hindering their operation. This will only be possible if the devices are located close to the ShadowSense screen and operate using IR light at around the same frequency as the IR light that the ShadowSense screen is emitting. To ensure that this is never the case, an IR frequency configuration setting has been placed in Dashboard which should ensure that IR dependent devices are still operable when located close to a ShadowSense screen.

The frequency of IR light that the ShadowSense screen is emitting is dependent on the rate at which it is strobing its LEDs. Each LED will turn on for a very short time in each frame. This on-time will be followed by an off-time in which all LEDs are off, before the next LED turns on. Together this on-time and off-time determine the frequency of the IR light emitted by the ShadowSense screen. If this frequency is close to the frequency that nearby devices depend on, it will reduce the relative strength of the signal received by the device from its remote. By altering this period, emitting IR light at frequencies close to that of any close-by devices can be avoided and normal operation of the devices and the ShadowSense touch screen is expected.

The IR Frequency configuration setting in Dashboard allows users to adjust the frequency of emitted IR light by extending the off-time of the LEDs. The on-time should not be changed as it controls the effective brightness of the LEDs. Decreasing the on-time would lower the brightness which could result in poor performance in areas of the screen far from the top sensor bar. Increasing the on-time may cause more power to flow through the LEDs than they can handle, possibly resulting in failure. Decreasing the off time is not possible as the sensors need some time to reset after measuring the brightness of one LED. Increasing the setting value by 9 units will increase the off-time for all LEDs by 1 µs. By default, the off-time is 14.4 µs, and the on-time is 10.0 µs which results in an emitted frequency of 40.983 kHz.

2.1 Results

For each configuration setting tested, a measurement for maximum distance for 100% operation was taken. This is defined as the maximum distance at which the camera would respond correctly to each of 10 input commands from the remote. The commands were move left, move right, move right, move left, move left etc. The remote was always approximately in line with the receiver and pointing directly at it as this orientation was found to produce the most consistent results. These results are summarized in Table 1 and illustrated in Figure 3.

Table 1: Maximum distance for operation for various IR configuration settings

Emitted IR Frequency (kHz)	IR Configuration Setting	LED Time (µs)			Distance for Operation (cm)	
		On	Off	Total	100%	0%
40.98	0	10.0	14.4	24.4	538.8	700.0
37.88	18	10.0	16.4	26.4	515.9	552.7
35.21	36	10.0	18.4	28.4	518.4	542.6
32.89	54	10.0	20.4	30.4	575.6	599.7
30.86	72	10.0	22.4	32.4	602.3	646.7
29.07	90	10.0	24.4	34.4	972.8	993.1
28.25	99	10.0	25.4	35.4	990.6	1103.6
27.47	108	10.0	26.4	36.4	1014.7	1144.3
26.74	117	10.0	27.4	37.4	1073.2	1204.0
26.04	126	10.0	28.4	38.4	1083.3	1188.7
25.38	135	10.0	29.4	39.4	1090.0	1210.3
24.75	144	10.0	30.4	40.4	1083.3	1183.6
24.15	153	10.0	31.4	41.4	657.9	1063.0

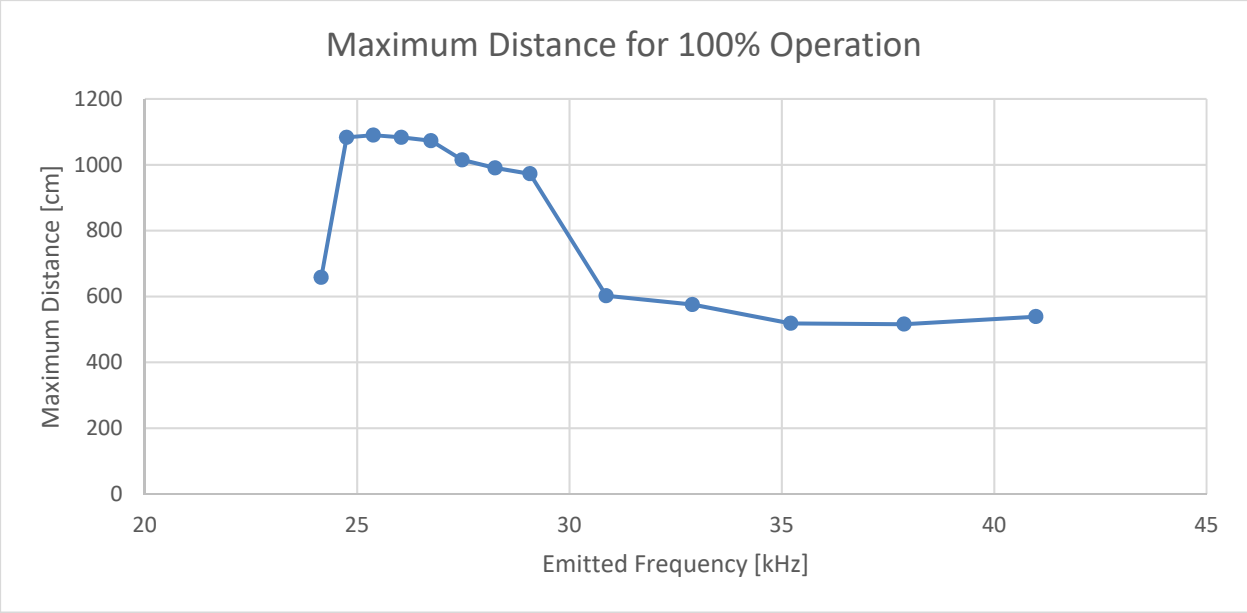

Figure 3: Maximum distance for 100% operation vs. emitted IR frequency

3.0 Conclusion

The operation distance for the device without the ShadowSense touch screen powered on was measured to be 14.7 m. Without the IR configuration setting, having this device near the screen reduced this range to 5.4 m. This is a significant drop in performance, however with some frequency adjustment it was found that the device was fully operable from distances up to 10.9 m. While this is not as far as the distance when the screen is powered off, it is a significant improvement over the default frequency setting and should certainly be a usable range for most applications.

It is quite common that IR receiver modules depend on a frequency of approximately 38 kHz, which is believed to be the case with the camera in the experiment. Therefore, it is likely that similar experiments featuring a variety of other devices would produce similar results, with the optimal IR configuration setting remaining the same.

It is recommended that this setting be changed to a value between 117 and 144 (approximately 24.5-27 kHz) if IR dependent devices are to be used close to the ShadowSense screen.