Mounting PI's Access200w outdoors: Avoiding sunlight problems
30 October 2020

1. Background

Outdoor access control using the Access200w from Princeton Identity (PI) requires good iris and face imagery under all ambient lighting conditions to achieve optimal results. Direct sunlight presents a challenge to any camera. Mounting the Access200w to avoid situations in which the sun degrades iris and face images is essential to getting the best results from the system. In this application note, we discuss ways to avoid mounting problems associated with harshly sunlit areas.

2. Two sunlight problems

Photographers know that the key to good portraits is proper lighting. Indoors, portrait photographers use carefully controlled strobes to illuminate a subject's face, avoiding over- or under-exposing and preventing aversive responses like squinting or blinking. Outdoors, skilled photographers know how to orient their subjects so that they are not looking into the sun, are not strongly backlit or shadowed and need not squint. The indoor case is analogous to PI's indoor Access200, which uses strobed near infrared illumination to achieve good lighting. Outdoors or in fully glassed-in atria or entries, PI's Access200w also uses strobed infrared lighting. However, sunlight can interfere with the cameras in two ways. Direct sun shining into the iris and/or face cameras that look out from behind the Access200w faceplate will temporarily blind the cameras by saturating their image sensors with too much light (for the iris camera, too much solar infrared light.) In addition, indirect sunlight bouncing off a bright colored wall can cause certain subjects to squint, thereby hiding their irises. These two problems, direct sun into the cameras and indirect sun causing squinting, must be avoided to ensure a level of outdoor performance from the Access200w that equals the indoor performance of the Access200.

3. Avoiding sunlight problems

3.1. *Angling the Access200w away from direct sunlight*: The sun traces an arc in the sky as it rises and sets. This arc changes through the year dependent upon the latitude of the mounting site. Reorienting an Access200w by rotation about a vertical axis to a new position facing away from the sun's rays can avoid the problem of direct sun. In addition, it is possible that mounting an Access200w on an angle away from the sun can improve its user-convenience by aiming it more toward the center of the approach walkway. The installer can determine whether an angled mount is useful for avoiding direct sunlight and, if so, whether mounting the Access200w on the right or left side of the door is more convenient. Simple calculations or free apps such as Photographer's Ephemeris (https://www.photoephemeris.com/) predict the sun's position through the day and year. For more on sun tracking calculations, see Section 5. Figure 1 shows

Figure 1: Doorway entrance with Access200w on right, angled to avoid sunlight. In this solution, the Access200w faces users making it convenient for them to look at the faceplate from a position directly in front of the entrance door. The darker colored mount also reduces glare.

an example of an Access200w mounted at an angle beside a west-facing entrance door, angled to face more to the north to avoid direct sun. A subject reaching for the door handle can turn to the right conveniently to look toward the Access200w to unlock the door.

3.2. *Shading the Access200w from direct sunlight*: The iris and face cameras that look out from a biometric camera faceplate to image subjects each have a field of view that defines the area in front of them that they can see. Beyond the field of view, a subject is off-camera. If the sun is off camera, it presents no problem. But sometimes, the sun is on-camera, within the field of view of the iris and face cameras. In the case of PI's Access200, imagine a backlit subject approaching a unit mounted on a west-facing wall in the late afternoon on a sunny day as pictured in Figure 2. Under certain conditions, the sun can shine directly into the iris and face cameras over-exposing their image sensors. If the subject's head or body blocks the sun, their shadow prevents over-exposure but blocking the sun is not a certainty at all sun elevations and for all subject heights. Ideally, a sun-facing camera will be shaded by additional building infrastructure such as an entrance overhang or canopy as shown in Figure 3 or even by chance locations of neighboring buildings. Shading the Access200w from direct sun by exploiting an existing canopy or installing a new one is an effective way to avoid the problem of sunlight shining into the cameras. Figure 4 shows an annotated image of a canopy-covered building entrance in which the canopy produces a shadow that shields an Access200 from the direct rays of the sun. Such a shallow canopy is best suited to shade an Access200w in lower latitudes where the sun's elevation is often high. The Access200w of Figure 4 might also benefit from the angle-mount of Figure 1.

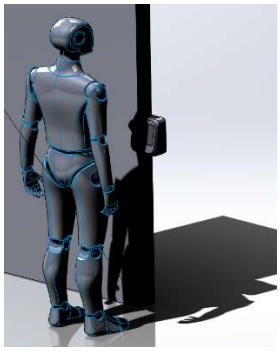

Figure 2: Sunlit subject casting shadow on Access200w.

Figure 3: Building with a canopy that shades the entrance from direct sunlight. A darkened floor further reduces glare from sunlight.

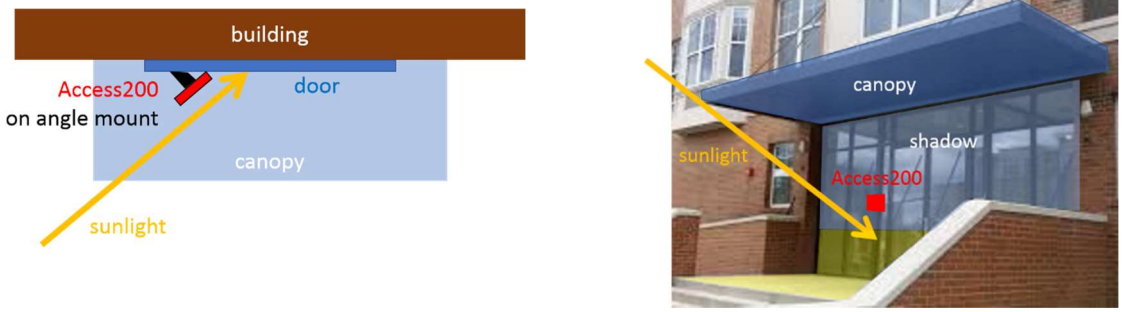

Figure 4: Top view of building entrance (left) with angle-mounted Access200 oriented to avoid direct sun. Access200 conveniently faces entering subjects in this orientation. Photo of same building entrance (right).

If no shading structures are available, then use of an angled bracket is recommended to prevent direct sunlight from entering the Access200w's cameras (see Section 5.)

3.3. Helping the user to avoid squinting: Some, but not all, people squint in bright light. People who squint cannot avoid it. When people squint and their eyes narrow, they tend to hide their irises making iris recognition difficult. So, outdoor situations that force squinting need to be avoided. A subject facing a building entrance will squint (if that is their tendency) if the surface they face reflects a lot of sunlight, for example, a white painted wall exposed to bright, direct sun. To avoid squinting, ensure that the wall to which the Access200w is mounted is not highly reflective. A dark-colored wood, concrete, brick, glass or dark-tinted glass wall will not cause squinting in most users. A bright-colored wall, for example, white stucco, will cause squinting. If the mounting wall must remain brightly colored, a next-best solution would darken the wall in the region around the Access200 (if allowed and if not, a darker colored angled mount would help.) Additional light can be scattered upward from the ground adding to the light bouncing off the wall and into the user's face, especially if the ground is brightly colored, for example, white concrete or nearby snow cover. A dark entrance mat or dark colored friction paint can provide non-skid protection and can also reduce glare into the user's face. An entrance with low glare walls and flooring is pictured in Figure 3.

4. Summary

The Access200w takes pictures of people's faces and irises. To work optimally, it must be mounted to avoid sunlight directly entering the cameras. In addition, it must be mounted on a wall that reduces glare to the users. Satisfying both conditions will optimize access control performance.

5. Appendix: Access200w iris camera and the sun's position vs. day, year and latitude

Mathematical models that predict the direction of the sun range from complex and very accurate to quick and dirty with plenty of cut corners. In this memo, we use the latter type to get a sense for the interaction of solar direction and the Access200w.[1] Input to the model includes latitude and full date including time. Model output provides an azimuthal angle (compass direction) and elevation angle (measured from the horizon). Thus, we can map the direction angles of the sun through the course of a day for any day of the year at any location on Earth. Using such a map, we can place the angular field of view of the Access200w iris camera to understand when, for a given location and orientation, the sun will enter the iris camera. We start with the location of a hypothetical Access200w customer but will show solar direction maps of other locations to illustrate the role of latitude in Access200w placement.

To start, consider a location at 41.676° N latitude. Figure 5 shows the azimuthal and elevation angles of the sun in curves that run from sunrise to sunset for seven dates spaced evenly from the Summer Solstice to a few days before the Winter Solstice. A rectangle centered on a '+' sign represents the angular FoV of the Access200w iris camera. Curves of Figure 5 trace the daily solar angular path starting with the highest summer curve and ending six months later with the lowest winter curve but no curve tracks through the iris camera angular FoV. The camera is oriented NE (azimuthal angle = 45°, elevation = 35°, due to the upward-looking Access200w camera design).

[1] See https://www.mathworks.com/matlabcentral/fileexchange/58405-solar-position-calculator.

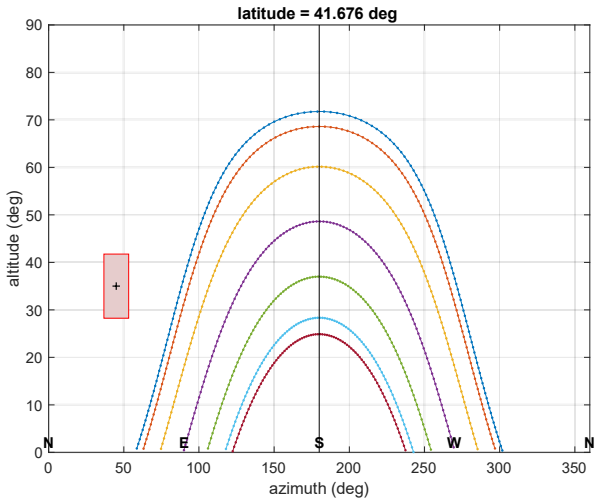

Figure 5: Angular solar paths from sunrise to sunset starting at the Summer Solstice (topmost blue) to Winter Solstice (lowest brick red) for 41.676° N latitude. Rectangle is the angular FoV of the Access200w iris camera. No solar path cuts through the NE facing camera FoV.

A safe range for the iris camera extends through a range within ±70° of North. Any further South and the sun would track through the camera FoV in the summer months. Solar directions for other latitudes are shown in Figure 6, in which we consider Key West, FL at 24.555° N latitude and Churchill, MB (Canada) at 58.768° N latitude to illustrate changes at low and high latitudes.

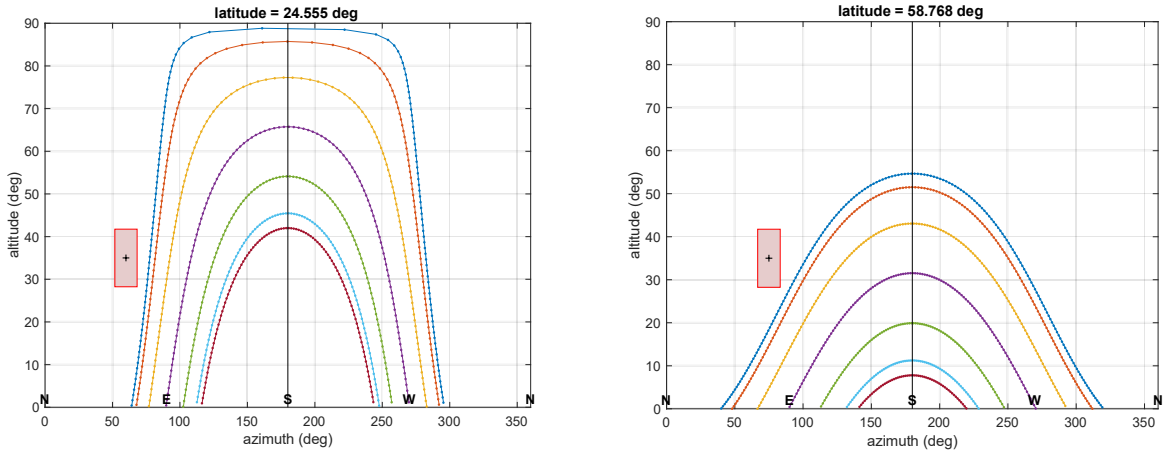

Figure 6: Angular solar paths from for Key West, FL (left) and Churchill MB (right). The Key West camera must be mounted within ±60° of North while the Churchill camera can be within ±75° of North.

Thus, for a wide range of American and Canadian latitudes, the Access200w camera should be restricted to directions roughly from NE to NW with less restriction for northern latitudes than southern latitudes. For a vertical, south-facing wall at mid-latitudes, an Access200w mounting bracket can twist its direction by 90° or more to restrict the sun from the iris camera angular FoV. A subject using an Access200w mounted on such a bracket would turn to face the camera. North-facing walls are ideal on which an Access200 can be flush-mounted. East and west facing walls might only require 30° angle mounts.