November 2020

Glare Removal From Visual Codes Using Multi-Frame Voting

Brett Barros

Alexander James Faaborg

Glare Removal From Visual Codes Using Multi-Frame Voting

Abstract
A system and method for overcoming glare in the scanning of visual codes treats each bit of a two-dimensional array defining a pattern of the visual code as discrete. As the visual code is scanned and image frames are sequentially captured, this allows the image frames to be combined to form a composite image of the visual code, and the eventual completion and resolution of the visual code.

Machine-readable visual codes, or labels, may provide additional information associated with an entity to which the visual code is attached or associated. These types of visual codes include information which, when read or scanned by a user device, may provide the user with information and/or data related to the entity, may direct the user to a website or application related to the entity, and the like. In some situations, the scanning or reading of these types of visual codes may be in some way hindered, or compromised, or incomplete, or insufficient, or inadequate, thus rendering the data payload, defined by the pattern of the visual code, incomplete, or not fully resolvable, and/or inaccessible.

For example, a scan of the visual code captured may be inadequate, or of insufficient resolution, or unclear due to, for example, environmental conditions such as glare due to, for example, lighting conditions, orientation, lens condition, and other such factors. In some situations, the incomplete), physical damage, and the like. In some situations, these types of visual codes may be susceptible to physical damage such as, for example, moisture, tearing, staining, crimping, and other types of physical damage that could affect the accurate and/or complete reading of the data contained in the visual code. To guard against physical damage, an owner or entity associated with the visual code may choose to apply protective covering to the visual code, so that the code remains visible through the protective covering, but is protected from physical damage. For example, placement of the visual code under a glass or acrylic-based

plate, lamination of the visual code and the like may protect the visual code from physical damage. Although the covering may protect the visual code from physical damage, the covering may create glare when scanning the visual code. The glare may inhibit the full resolution of the visual code.

That is, a scan of the visual code in these types of circumstances may result in an insufficient capture of the data payload defined by the pattern and associated with the visual code. The incomplete, or insufficient capture of the data payload may render the scan of the visual code unresolvable. For example, glare created by a protective covering (such as, for example, lamination) applied to a visual code may cause portions of the visual code to be indiscernible and/or incompletely read by a scan of the visual code.

An example of an intact visual code is shown in Figure 1. As noted above, a scan of the intact visual code by a user device would typically yield a data payload providing the user with information related to the entity associated with the visual code. For example, the scan of the intact visual code may provide identifying information, may direct the user to a website, may cause an application to be launched, and the like.

Figure 1

Figures 2A, 2B and 2C illustrate examples of sequential image frames of the visual code shown in Figure 1, captured in an environment in which glare affects the images captured by the

user device as the visual code is scanned. Figures 2A through 2C illustrate three example image frames, for purposes of discussion and illustration. More, or fewer, image frames may be captured by the user device in performing the scanning of the visual code.

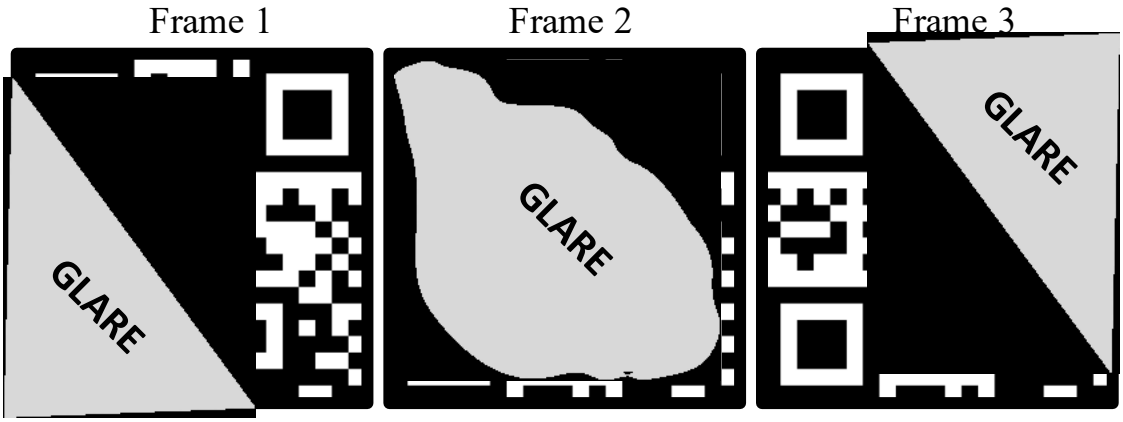

Figure 2A Figure 2B Figure 2C

As illustrated in the example shown in Figures 2A through 2C, as the visual code is scanned and image frames are captured, various factors such as movement of the user device, relative changes in incident light, and other such environmental factors may cause a shift in the portions of the visual code that are affected by glare. For example, in Frame 1 shown in Figure 2A, a lower left portion of the visual code is obscured due to glare. Data defined by the lower left portion of the visual code (corresponding to the obscured portion) may be unreadable, or irretrievable, while data defined by the remaining, unobscured portions of image Frame 1 may be retrievable. In this situation, image Frame 1 alone may return only a portion of the data associated with the visual code, and thus the visual code may be unresolvable based only on image Frame 1.

Similarly, in Frame 2 shown in Figure 2B, a central portion of the visual code is obscured due to glare. Data defined by the central portion of the visual code (corresponding to the obscured portion) may be unreadable, or irretrievable, while data defined by the remaining,

unobscured portions of image Frame 2. In this situation, image Frame 2 alone may return only a portion of the data associated with the visual code, and thus the visual code may be unresolvable based only on image Frame 2.

In Frame 3 shown in Figure 2C, an upper right portion of the visual code is obscured due to glare. Data defined by the upper right portion of the visual code (corresponding to the obscured portion) may be unreadable, or irretrievable, while data defined by the remaining, unobscured portions of Frame 3 may be retrievable. In this situation, image Frame 3 alone may return only a portion of the data associated with the visual code, and thus the visual code may be unresolvable based only on image Frame 3.

In the example described above, none of the image Frames 1, 2 or 3 taken alone yield sufficient data capture to resolve the visual code and provide the requested information to the user. A method for overcoming glare in the scanning of visual codes includes the analysis of multiple frames of image data of the visual code, and voting on the predicted outcome. In this system and method, unlike common recognition voting techniques, each bit within the pattern defined by the visual code is evaluated and voted on discretely as a digital-positional data point. This is critically different from voting on the collective outcome (for example, the probability that a particular URL is the target destination associated with the visual code), or on the visual pixels in a bitmap. In applying this method for overcoming glare to the example described above with respect to Figures 2A, 2B and 2C, data retrieved from the unobscured portions of sequential image Frames 1, 2 and 3 of the visual code can be combined to yield a substantially complete image of the visual code and a corresponding substantially complete data payload, allowing the visual code to be resolved and the requested information provided to the user.

Figure 3A illustrates a combination of image Frame 1 and image Frame 2. Figure 3B illustrates a combination of image Frame 2 and image Frame 3. Figure 3C illustrates a combination of image Frames 1, 2 and 3.

Frame 1 + Frame 2

Figure 3A

Figure 3B

Frame 1 + Frame 2 + Frame 3

Figure 3B

As shown in Figure 3A, the combination of image Frame 1 and image Frame 2 still includes a portion of the visual code that is obscured by glare. The obscured portion of the visual code shown in Figure 3A corresponds to an overlap of the obscured portion of image Frame 1 and image Frame 2. Thus, a combination of image Frame 1 and image Frame 2 still yields an incomplete data payload, which may be insufficient to resolve the visual code.

Similarly, as shown in Figure 3B, the combination of image Frame 2 and image Frame 3 still includes a portion of the visual code that is obscured by glare. The obscured portion of the visual code shown in Figure 3bA corresponds to an overlap of the obscured portion of image Frame 2 and image Frame 3. Thus, a combination of image Frame 2 and image Frame 3 may yield an incomplete data payload that is insufficient to resolve the visual code.

Figure 3C represents a combination of image Frames 1, 2 and 3. A combination of the image Frame 3 shown in Figure 2C with the combined image Frames 1 and 2 shown in Figure 3A yields the essentially complete visual code shown in Figure 3C. Thus, the combination of

data captured as each of the images are sequentially captured may provide for the resolution of the visual code.

As described above, the portion of the visual code affected by glare may move or shift as the user device moves while image frames are captured by the user device. The system and method for overcoming glare allows each bit in the two-dimensional array of defining the pattern of the visual code to be treated as discrete. This allows for the combination of image frames to form a composite image of the visual code as the image frames are captured, and the capture of sufficient data payload for resolution of the visual code.