Disclaimer:

As a condition to the use of this document and the information contained herein, the Facial Identification Scientific Working Group (FISWG) requests notification by e-mail before or contemporaneously to the introduction of this document, or any portion thereof, as a marked exhibit offered for or moved into evidence in any judicial, administrative, legislative, or adjudicatory hearing or other proceeding (including discovery proceedings) in the United States or any foreign country. Such notification shall include: 1) the formal name of the proceeding, including docket number or similar identifier; 2) the name and location of the body conducting the hearing or proceeding; and 3) the name, mailing address (if available) and contact information of the party offering or moving the document into evidence. Subsequent to the use of this document in a formal proceeding, it is requested that FISWG be notified as to its use and the outcome of the proceeding. Notifications should be sent to: FISWG@yahoogroups.com

Redistribution Policy:

FISWG grants permission for redistribution and use of all publicly posted documents created by FISWG, provided that the following conditions are met:

Redistributions of documents, or parts of documents, must retain the FISWG cover page containing the disclaimer.

Neither the name of FISWG, nor the names of its contributors, may be used to endorse or promote products derived from its documents.

Any reference or quote from a FISWG document must include the version number (or creation date) of the document and mention if the document is in a draft status.

This document includes a cover page with the FISWG disclaimer
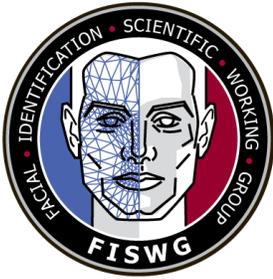
Section 5

Capture and Equipment Assessment for Face Recognition Systems

Introduction

The purpose of this document is to provide an overview of the considerations a practitioner should take when making decisions for the capture of facial images. This document is not intended to replace or supercede any existing standards documents. Instead, this document is intended to summarize the most important elements of existing standards, provide an introduction for new users, and provide pointers to more detailed guidance available elsewhere. The document outlines best practices for collection to ensure the images captured are suitable for FR system use.

Best Practices for Capture

This section addresses the image capture process as it relates to a controlled, semi-controlled, and ad hoc acquisition environment. In controlled acquisition environments, all variables and decisions can be controlled by the photographer, including equipment, the photographic environment (camera position, lighting, distance, background, and resolution), and the pose and positioning of the subject. Semi-controlled acquisition environments are scenarios where not all capture variables can be equally controlled (e.g., choke points and border crossings). Ad hoc settings are conditions in which neither the environment nor the subject can be controlled (e.g., surveillance, cell phones, and third party imagery).

Section 1

Controlled Acquisition

Controlled acquisition occurs when all imaging parameters can be adjusted as needed to optimize the resulting image. The subject can be directed or positioned, the environment can be arranged to provide ideal illumination, and suitable equipment is available. The best practice for equipment is covered in section two. Figure 1 illustrates optimal settings for a controlled environment, which includes, but is not limited to, photography studios, booking environment/custody suite, passport offices, or Department of Motor Vehicles (DMV). Table 1 presents similar information in tabular form.

This document includes a cover page with the FISWG disclaimer

Figure 1. Ideal Controlled Photographic Environment
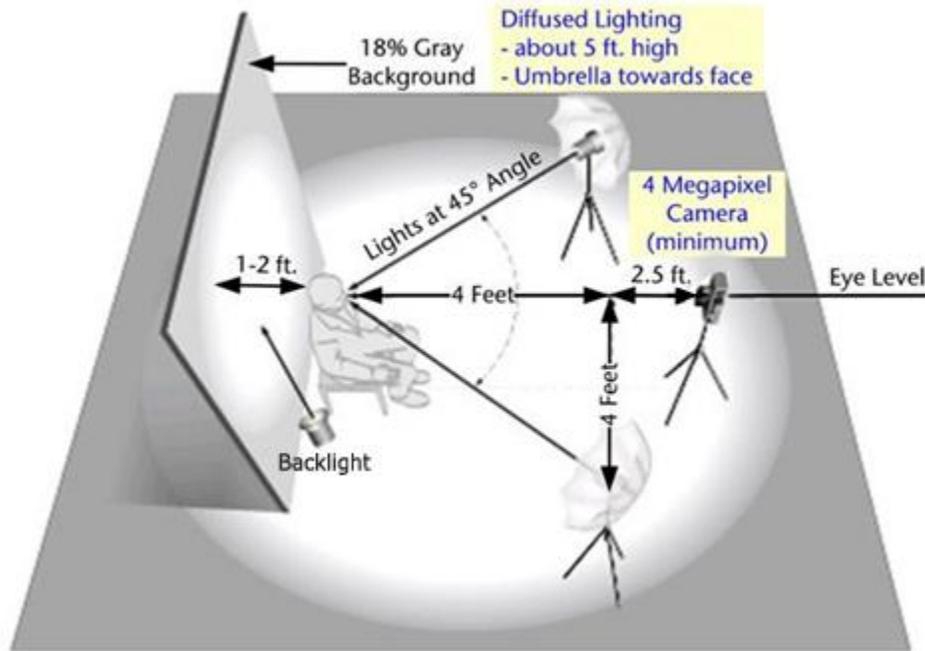
Table 1. Description of Ideal Controlled Photographic Environment

No.	Item	Best Practices	Guidelines
1	Lighting	Lighting shall uniformly illuminate the subject and the background. Hot spots or reflections shall be minimized.	Although a minimum of three photo lights have been recommended by previous guidelines for illuminating the subject's face, two of these lights should be sufficient. Use of a third light as a backlight generally requires about three feet of additional floor space behind the subject. Backlight is used to remove shadows. Unnaturally colored lighting (e.g. yellow, red) is not allowed. Care shall be taken to correct the "white balance" of image capture devices. The lighting shall produce a face image with natural looking flesh tones when viewed in typical examination environments. "Red-eye" is not acceptable. Red-eye can be eliminated by raising the elevation of the lights.
2	Camera position	The camera shall be mounted in a level position with no tilt. The camera height shall be positioned at the same height as the subject's eyes and positioned about two meters (approximately 6.5 feet) from the subject.	Possible solutions are to place subject in a vertically adjustable seated position or to mount the camera on a vertically adjustable pole or tripod. Avoid the use of hand-held cameras.

This document includes a cover page with the FISWG disclaimer

No.	Item	Best Practices	Guidelines
3	Background	Background shall be uniform, plain, smooth, flat, and 18% gray.	Ensure that the background completely fills the image frame behind the subject. If possible, avoid the presence of visible shadows and other objects in the background, such as a clock face. If no suitable wall surface is available, an 18%, neutral gray matte surface can be prepared[1].

Current standards offer slightly different recommendations for the distance from the subject to the background. The 1-2 foot distance shown here is intended to accommodate a backlight to help reduce background shadows and ensure the face is not washed out. The intent is to ensure there is sufficient, uniform lighting to capture all visible skin characteristics (i.e., blemishes, moles, marks, etc.) and to avoid hot spots and shadows. The standards document ISO/IEC 19794-5 provides additional lighting considerations.

Optimal Subject Positioning

The composition consists of a subject's head, partial shoulders, and plain background. For a frontal-facing pose, the width of the subject's head shall occupy approximately 50% of the width of the captured image. This width shall be the horizontal distance between the mid-points of two imaginary vertical lines. Each imaginary line shall be drawn between the upper and lower extremities of each ear and shall be positioned where the external ear connects to the head. A template and an example is shown in Figure 2. For other poses, the composition shall be rotated about an imaginary axis extending from the top of the head though the base of the neck.
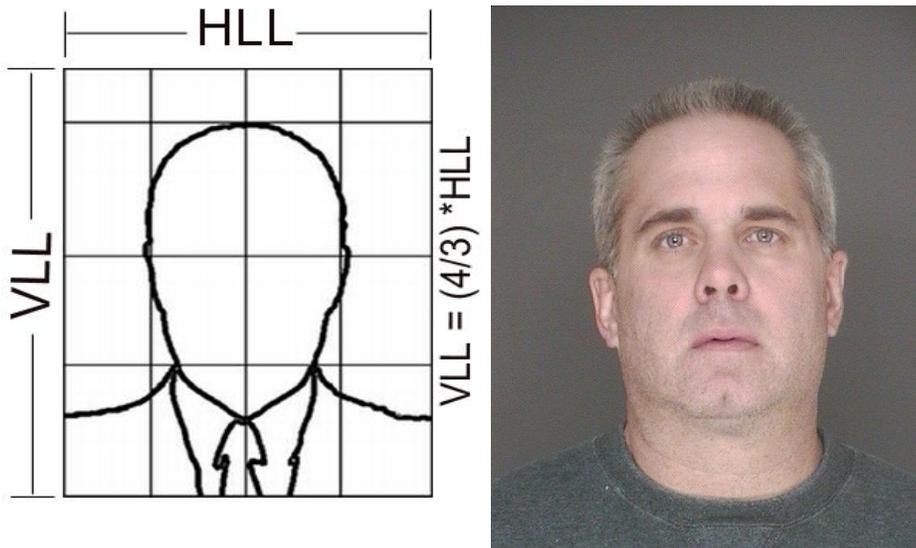

Figure 2 Source: ANSI/NIST-ITL 1-2011

Table 2 below describes optimal subject positioning and appearance. While the information pertains mostly to frontal images, right and left profile images, and angled images should also be captured. The guideline column provides suggestions for how to achieve conformance.

---

[1] An example of a paint formula that will approximate an 18% gray (on matte surface) is; one quart Olympic Premium Interior Latex Eggshell, Base 3 - 72403, 101-1Y31.5, 109-8.5, or one quart Benjamin Moore & Co. Premium Interior Latex Flat Finish Wall Satin, Medium Base 215 2B, Formula: OY-8½ RX-3/4 BK-21 GY-4 WH-10, Area/Tint Code: B

Table 2. Optimal Subject Positioning

No	Item	Best Practices	Guidelines
1	Subject Position	The subject shall be positioned 1-2 feet in front of the background.	Possible solutions include shoe prints, a toe line, or position indicators. If subject is seated, then the seat shall be in a fixed position in relation to the camera.
2	Facing	Frontal: Subject should face directly towards the camera with no more than +/- 5 degrees variance from frontal in roll, pitch, and yaw. (ISO/SC37 19794-5) Profile: When there is a requirement for profile shots, the body should be turned 45 degrees and 90 degrees right and left. (ANSI/NIST)	The operator is responsible for checking the image. Visual cues that can assist the operator with determining "forward orientation" are: 1. Both eyes are level on an imaginary horizontal line (zero roll angle) 2. Both ears are equally visible if unobstructed by hair) and nose is forward (zero yaw angle) 3. The chin is neither elevated or dropped (zero pitch angle). Image Quality Software may be used to automate this process. Note: ISO has now relaxed the figure for roll to +/- 8 degrees, although 'best practice' remains at +/- 5.
3	Head coverings	Head coverings, including hats and scarves, shall not be worn, unless for religious reasons or medical purposes. The full face and ears must be displayed.	Where possible, instruct subject to move any obstruction behind ears.
4	Hair	When capturing both frontal and profile images, the subject's hair shall be moved to reveal the full face and ears.	
5	Glasses	If the subject wears glasses, at least one frontal image shall be captured with glasses and one image without glasses.	If the subject is wearing glasses, glare should be avoided. A possible solution is to adjust the lighting. Eye patches are allowed only for medical reasons.
6	Eyes	Eyes shall be open and looking directly at the camera.	
7	Expression	Subject shall have a neutral expression.	Operator and subject's responsibility to ensure there are no smiles or grimaces.
8	Mouth	Mouth shall be closed with teeth together	
9	Shoulder Position	Shoulder position shall be square and forward facing for frontal images. Shoulder position shall be perpendicular for profile images.	
10	Accessories	If the subject is wearing accessories, at least one frontal image shall be captured without accessories and one image with accessories.	Accessories refer to 'studs, piercings, etc'
11	Make-up and cleanliness	The subject's face should not be presented with heavy make-up or dirt.	Use of a disposable wipe cloth is recommended to remove excessive make-up or surface dirt. This may not be practical in non-criminal image capture.

12	Face count	Only one face per image is allowed.	Take measures to ensure that other subjects are not captured, such as a baby in arms.
13	Scars, Marks, and Tattoos (SMT)	Scars, marks, and tattoos (SMTs) to include location and size shall be captured as additional image information.	This applies to criminal image capture.
14	Medical conditions	If bruising, injuries, bandages, or medical conditions are present, these shall be presented as is.	Where such medical conditions are transient in nature (e.g. cuts or bruising) and where legislation and business processes permit, the best practice is to capture a second image once the face has healed.

Semi-Controlled Acquisition

Semi-controlled acquisition refers to when some aspects of the environment or subject can be controlled, but not all aspects of both. This document assumes that the images will primarily be used for enrollment or galleries.

- Environment: In addition to camera position, consideration should be given to illumination. It is generally preferable to use controlled artificial lighting than to rely on ambient lighting, which may vary with time. Angle and height should be based on pedestrian flow through the specific location.

- Subject-base: Consideration should be given to optimize pedestrian flow through specific locations (e.g., port of entry or roadside stop). Subject's face can be positioned for image capture but environmental elements are uncontrolled (e.g., background, time of day, lighting, or weather conditions).

In a semi-controlled environment, use the guidelines in Table 2 for subject position and appearance wherever possible. When not possible, use the following priorities:

- Frontal pose and open eyes
- Illumination
- Elimination of distortion (subject should be more than 2.5 feet, or .7 meters, from the camera)
- Elimination of occlusions
- Neutral expression

Where practical, the factors described in Table 3 should be considered.

The best practice for equipment is covered in section two. Consideration should be given to capture resolution. Pictures with fewer than 40-60 pixels between the eyes are unlikely to produce usable results in automated systems.

Table 3. Description of Semi-Controlled Imaging Environment

No.	Item	Guidance
1	Lighting	Lighting should uniformly illuminate the subject and the background. Hot spots or reflections should be minimized. Examine illumination conditions for the area in which the cameras will be installed; control or install lighting to provide even illumination and prevent shadows or hotspots on the face. If a flash is used, where possible, either diffuse the light or bounce the light off a neutral-colored ceiling to avoid harsh, uneven lighting. Consideration should be made to the color of the ceiling to avoid casting unnatural color on the subject. Where possible, there should be no light sources, including the sun, in the background of the image.
2	Camera position	The camera should be mounted in a horizontal position with no tilt. The camera height should be positioned at the same height as the subject's eyes. Installing the camera to operate in portrait mode can accommodate variations in subject height and minimize need to reposition the camera. This is likely to be more important in a semi-controlled environment as the subject is likely to be standing rather than seated.
3	Background	To the extent possible, the background should be uniform and free of reflective surfaces. Semi-controlled environments may have other people in the field of view. The operator should ensure that the subject is in focus, nearest the camera and where possible, the only face in the picture. If there are multiple faces in the photo, post-processing will be required to ensure the correct face is being processed

Ad Hoc Acquisition

Ad hoc settings are conditions in which neither the environment nor the subject can be controlled (e.g., surveillance, cell phones, and third party imagery). Ad hoc acquisition is subject to high variations in quality and content, and typically requires human review and specialized tools to identify and extract usable facial content.

When selecting third-party images, provide as many as possible with consideration for recent photographs and clearly visible faces. Multiple images can potentially be fused to create a single composite template.

Section 2

Equipment Assessment

Table 4 addresses equipment considerations for two dimensional (2D) conventional still image acquisition.

Table 4. Equipment Considerations

No.	Item	Best Practices	Guidelines
1	Camera Type	Use a DSLR (digital single-lens reflex) or a point & shoot camera with manual exposure override features.	Digital cameras that lack manual exposure override are less suitable. The use of webcams or cell phone cameras is not recommended.
2	Camera Resolution	Camera resolution should be four megapixels or above. Effective resolution as opposed to total resolution - neither interpolation nor digital zoom must be used to generate 4 MP. Instead, 4 MP should reflect the actual number of pixels on the camera detector/focal plane.	This exceeds the NIST Subject Acquisition Profile (SAP) 40 image size requirement. However, cameras with at least four megapixel sensors are readily available and allow optional cropping of the image. Cameras offering multiple resolution modes should be set to their maximum resolution.
3	ISO Rating	If the ISO setting on the camera is adjustable, it shall be set to the lowest value that also meets shutter and aperture requirements (per item 7 and 8 in this table).	Operators should be familiar with, but not be dependent on, the camera's automated features that may help simplify the adjustment of ISO, shutter speed, and f-stop to compensate for low light conditions.

This document includes a cover page with the FISWG disclaimer

No.	Item	Best Practices	Guidelines
4	Focus	The operator shall use auto focus or manually focus the camera.	Do not use fixed focus (e.g., cell phones or disposable cameras).
5	Face priority auto focus	Optional.	If the camera supports face priority auto focus, its use is recommended. If there are multiple subjects, it should be verified that the correct face is in focus.
6	White Balance	The white balance setting on the camera should be adjustable in order to capture natural colors.	The white balance should be calibrated using 18% gray background or gray card.
7	Aperture f/stop	The recommended aperture setting is f/5.6 – f/11.	This range of f/stop values will usually provide sufficient depth of field to obtain a focused picture that extends from the nose to the ear (with subject two meters from the camera). Note that, in general, the aperture and shutter speed should be set using the camera's automatic feature.
8	Shutter Speed	Use a fast enough shutter speed to prevent motion blur, yet slow enough to ensure the whole frame is illuminated (example flash).	When a flash is used, the camera shutter speed should be slower than, or equal to, the camera's flash synch speed. As stated above, most operators should use the camera's automatic feature to control the aperture and shutter speed. The slowest recommended speed is a 60th of a second.
9	Focal Length	For digital camera sensors, the recommended focal length is two to three times the diagonal of the sensor.	The focal length should be between 90mm and 130mm 35 mm film equivalent. Refer to camera user manual for more information.
10	Flash	Flash required if no external light sources are available.	Subjects may blink in anticipation of flash. Use flash only if necessary (e.g., existing illumination is insufficient to meet shutter speed and f/stop requirements).
11	Histograms	Optional.	Histograms can provide a guide to the operator for setting exposure levels that make the best use of the available color space. Many modern digital cameras currently provide this feature.
12	File Format	Use an industry standard acceptable format. High quality JPEG with EXIF data (i.e., choose "highest quality" image settings).	Most digital cameras support the use of EXIF data. While RAW images will represent the highest quality output from a digital camera, they may pose conversion problems for less skilled operators. In addition, RAW formats do not usually support a standardized method for inclusion of EXIF data. A future document will expand on this.
13	Color Space	The recommended color space is sRGB, because it is a device-independent specification.	Refer to camera user manual for more information.
14	Camera Support	Required.	Mount the camera on a support such as a vertical pole or tripod. It is not a best practice to use a hand-held camera.

This document includes a cover page with the FISWG disclaimer

No.	Item	Best Practices	Guidelines
15	Memory Interface	USB, memory card, or HDMI.	Memory card and USB is usually used for file transfer. HDMI is optional for a remote viewer and capture station.
16	Remote Capture	Optional.	Remote capture software with appropriate connections allows computers to remotely control a digital camera.
17	Orientation	Images should be captured using a portrait orientation. The images shall be rotated so the face is upright.	

- ***Video (future topic)***

Many cameras provide a video mode that may be used in addition to still photographs. Note that national law enforcement data repositories currently do not support video imagery, only stills from video. The major considerations with video are similar to those with semi-controlled capture environment. Additional considerations include angle and lighting when setting up equipment. Video will be addressed in more detail in a future document.

- ***Scanning Passport Photos***

Passport Photos should be scanned with a high-resolution color scanner at 600 pixels per inch (ppi).

Scanning of other types of photos (e.g. criminal registrants) are beyond the scope of this document.

Reference List

- National

    - US
        - ANSI/NIST-ITL 1-2011
        - NIST ITL 2007 Part 1 & 2
        - INCITS 385
        - FBI EBTS 8.1
        - DOD EBTS 1.2 & 2.0
        - DHS IXM
        - AAMVA (DL)
        - Pass ID (DL)
        - PIV
        - SWGIT documents
        - NIST Special Publication 500-280 Mobile ID Device Best Practice Recommendation version 1.0

    - UK
        - "Police Standard for Still Digital Image Capture and Data Interchange of Facial/Mugshot and Scars, Marks, and Tattoo Images" V2.0 - National Policing Improvement Agency, May 2007
        - "CCTV Operational Requirements Manual" V5.0 - HOSDB Publication 28-09
        - "Digital Imaging Procedure" V2.1 – HOSDB Publication 58-07

- International

    - INTERPOL INT-I
    - ICAO
    - ISO/IEC 19794-5 (International Standard)
    - ISO/IEC 19794-5
    - ISO/IEC 29794-5 Facial Image Sample Quality

This document includes a cover page with the FISWG disclaimer

FISWG documents can be found at:

This document includes a cover page with the FISWG disclaimer