

WMCA Database

The Wide Multi Channel Presentation Attack (WMCA) database consists of 1941 short video recordings of both bonafide and presentation attacks from 72 different identities. The data is recorded from several channels including color, depth, infra-red, and thermal.

Additionally, the pulse reading data for bonafide recordings is also provided.

Preprocessed images for some of the channels are also provided for part of the data used in the reference publication.

The WMCA database is produced at Idiap within the framework of “IARPA BATL” and “H2020 TESLA” projects and it is intended for investigation of presentation attack detection (PAD) methods for face recognition systems.

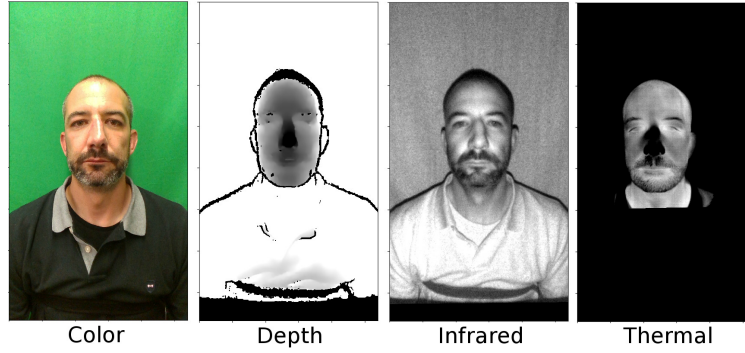


Figure 1.1: Sample images of bonafide from the database for four channels after alignment. The images from all channels are aligned with the calibration parameters and normalized to eight bit for better visualization.

1.1 Acknowledgments to reference publication:

If you use this database, please cite the following publication:

@article{George_TIFS_2019,

author = {George, Anjith and Mostaani, Zohreh and Geissenbuhler, David and Nikisins, Olegs and Anjos, André and Marcel, Sébastien},

title = {Biometric Face Presentation Attack Detection with Multi-Channel Convolutional Neural Network},

journal = {IEEE Transactions on Information Forensics and Security},

year = {2019},

publisher = {IEEE}

}

1.2 Database Description:

The image data from different channels were captured with the following sensors.

1. “Intel RealSense SR300” which captures the color, depth, and infra-red channels.

2. “Seek Thermal Compact PRO” which captures data from thermal channel.
3. “Xenics Gobi-640-GigE” that captures high quality thermal images.
4. “uEye SE USB2.0” that captures high quality infra-red images.

From the mentioned sensors the “Intel RealSense SR300”, “Seek Thermal Compact PRO”, and “Xenics Gobi-640-GigE” captures data synchronously during 10 seconds. The data from “uEye SE USB2.0” is captured during 10 seconds after the first three sensors finished their data acquisition and a LED ring is switched on providing NIR illumination.

The pulse reading from only real access data was captured at the same time as the first three sensors and it is saved in a “.txt” file with the same name. This data can be used in remote photoplethysmography (rPPG) studies for face PAD. A Blood-Volume Pulse (BVP) sensor and a respiration belt was used to collect the data.

5. BVP model “SA9308M” and respiration belt model “SA9311M”, both from Thought Technologies.

It should be mentioned that only data from the first two sensors were used for the experiments described in the reference publication. The data from other sensors can also be used by user for research, development, and testing in face-PAD provided that they agree to the corresponding EULA.

The specifications of the sensors used for image data can be found in Table 1.1.

Table 1.1: Sensor description for WMCA data collection

Sensor	Channel	Resolution	Frame rate (approx.)	Used in the reference publication
Intel RealSense SR300	Color	1920×1080	30 fps	Yes
Intel RealSense SR300	Depth	640×480	30 fps	Yes
Intel RealSense SR300	Infra-red	640×480	30 fps	Yes
Seek Thermal Compact PRO	Thermal	320×240	15 fps	Yes
Xenics Gobi-640-GigE	Thermal	640×480	25 fps	No
uEye SE USB2.0	Infra-red	1280×1024	15 fps	No

The data was captured during several sessions with different environmental conditions. Session 4 was dedicated to presentation attacks only. The information about the sessions can be found in Table 1.2.

Table 1.2: Session description for WMCA data collection

Session	Background	Illumination
1	uniform	ceiling office light
2	uniform	day-light illumination
3	complex	day-light illumination
4	uniform	ceiling office light
5	uniform	ceiling office light
6	uniform	side illumination with LED lamps
7	complex	ceiling office light

1.3 Presentations:

The presentations in the database can be grouped into different categories:

- 1. Bonafide:** Includes bonafide data from participants with and without medical glasses. Some participants were asked additionally to wear a pair of unisex glasses with black rim that had no correction (Fig. 1.2). The PPG data was captured only once, mostly when the participant did not wear any glasses.
- 2. Glasses:** Different models of disguise glasses with fake eyes (funny eyes glasses) and paper glasses. These attacks constitute partial attacks (Fig. 1.3).
- 3. Fake head:** Several models of mannequin heads were used, some of the mannequins were heated with a blower prior to capture (Fig. 1.4).
- 4. Print:** Printed face images on A4 matte and glossy papers using professional quality Ink-Jet printer

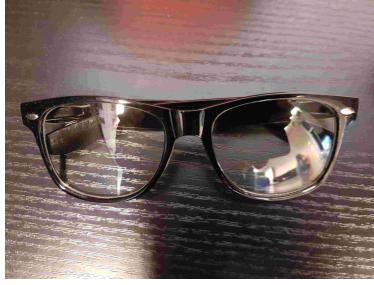


Figure 1.2: The unisex glasses with no correction used in some of the bonafide recordings.

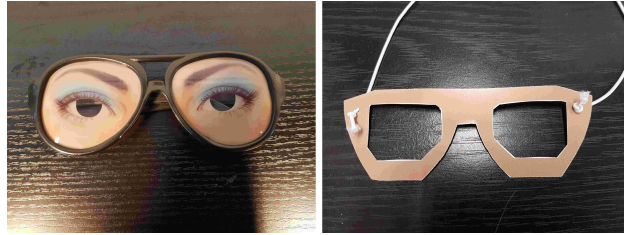


Figure 1.3: Sample images of glasses used as presentation attacks.

(Epson XP-860) and typical office laser printer (CX c224e). The images were captured by the rear camera of an “iPhone S6” and re-sized so that the size of the printed face is human like.

5. **Replay:** Electronic photos and videos. An “iPad pro 12.9in” was used for the presentations. The videos were captured in HD at 30 fps by the front camera of an “iPhone S6” and in full-HD at 30 fps by the rear camera of the “iPad pro 12.9in”. Some of the videos were re-sized so that the size of the face presented on the display is human like.
6. **Rigid mask:** Custom made realistic rigid masks and several designs of decorative plastic masks (Fig. 1.5).
7. **Flexible mask:** Custom made realistic soft silicone masks (Fig. 1.6).
8. **Paper mask:** Custom made paper masks based on real identities. The masks were printed on the matte paper using both printers mentioned in the print category (Fig. 1.7).
9. **Wig:** Several models of wigs for men and women (Fig. 1.8).

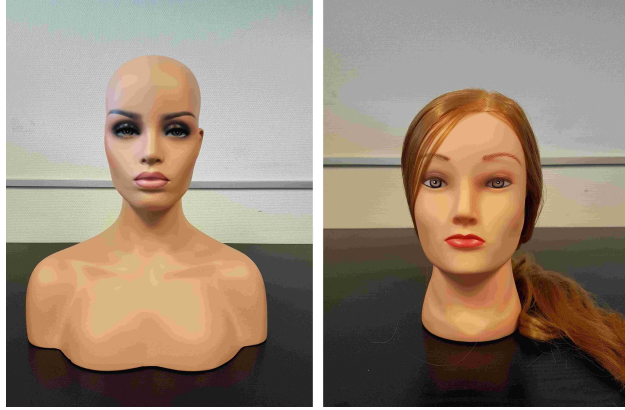


Figure 1.4: Sample images of mannequin heads.



Figure 1.5: Sample images of rigid masks.

10. Makeup: Regular makeup materials were used on the face to increase the apparent age of the participants. The design is called “Old Age” makeup. The makeup was performed gradually and the data was captured several times during the process resulting in different intensity of makeup for most of the participants. No prosthetics were used in the makeup process (Fig. 1.9).

It should be mentioned that the data from “Wig” and “Makeup” category were not used for the experiments described in the reference publication, however they can be accessed similar to the other categories.

The number of presentations in the database can be found in Table 1.3.

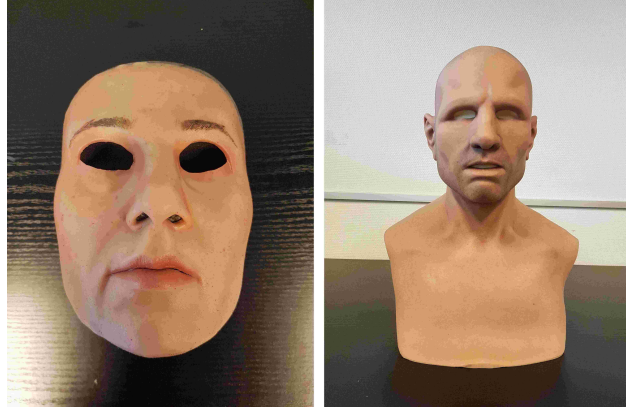


Figure 1.6: Sample images of flexible masks.

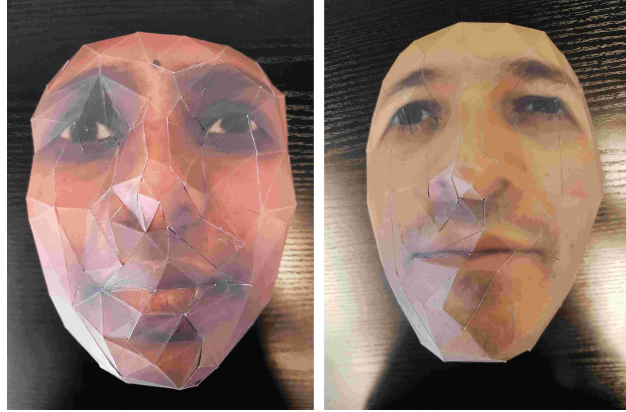


Figure 1.7: Sample images of paper masks.

1.4 File Naming Convention:

The file names in the database encode some information about the type of data they contain, for example bonafide or presentation attacks. Each saved file has the following name format:

<client_id>_<session_id>_<presenter_id>_<type_id>_<pai_id>.hdf5

- **client_id:** This three digit number presents the identity of what is presented to the system. For bonafide, it is the ID given to the subject upon arrival and for the attacks, it is a number given to a PAI. Please note that if the identity of a subject is the same as the identity of a PAI, this number is the same for both cases. One example is the silicon masks. If a silicon mask is made from subject ‘x’s’



Figure 1.8: Sample images of wigs.

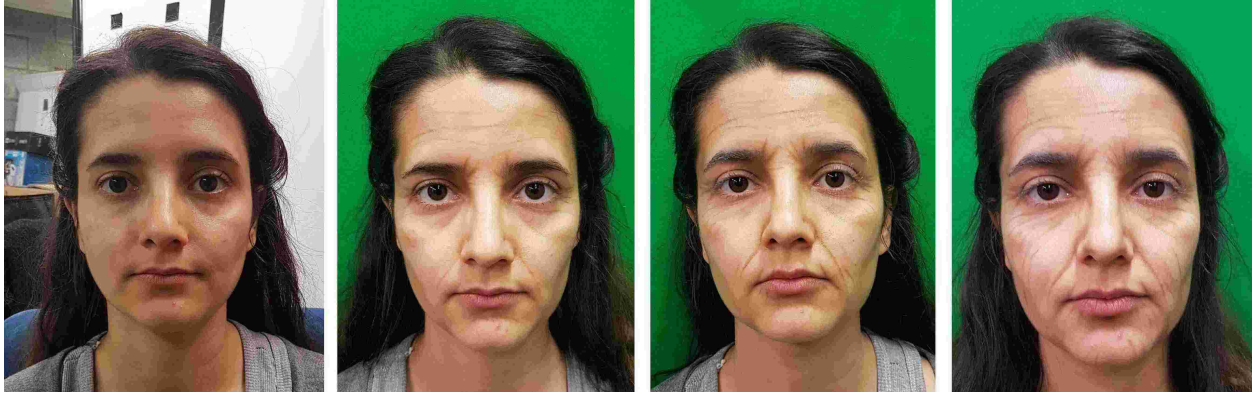


Figure 1.9: Sample images of old age makeup with different intensities. The image on the left is without makeup and the intensity of makeup increases from left to right.

face and subject ‘x’ also participated as bonafide in the data collection the ‘cline_id’ for bonafide and silicon mask is the same.

- **session_id:** A two digit number given to a session as mentioned in Table. 1.2.
- **presenter_id:** It is a three digit number that identifies who is presenting the attack to the system. If a subject is presenting an attack to the system, this number is the subject’s ‘client_id’. If the attack is presented on a support, this number is ‘000’. If the data is bonafide this number is ‘000’ as well since there is no presenter in this case.
- **type_id:** A one digit number describing the type of the attack presented to the system. The 9

Table 1.3: Statistics for WMCA database

Category	Number of presentations
Bonafide	347
Glasses	75
Fake head	122
Print	200
Replay	348
Rigid mask	137
Flexible mask	379
Paper mask	71
Wig	46
Makeup	216
TOTAL	1941

mentioned attack types are grouped into 5 categories, namely, *facial disguise*, *fake face*, *photo*, *video*, and *makeup*. The detailed information about this regrouping is available as open source code¹. For bonafide the ‘type_id’ is ‘0’.

- **pai_id**: A three digit unique number associated with each and every PAI. This number for bonafide with no medical glasses is ‘00’, for bonafide with medical glasses is ‘01’, and for bonafide with unisex glasses is ‘02’.

Here are some examples for more clarification:

- 035_01_000_0-00.hdf5 : This is the bonafide file of client number 035 in session number 1 when they did not wear medical glasses.
- 005_01_000_0-01.hdf5 : This is the bonafide file of client number 005 in session number 1 when they

¹https://gitlab.idiap.ch/bob/bob.db.bat1/blob/master/bob/db/bat1/bat1_config.py

did wear medical glasses.

- 530_03_001_2_18.hdf5 : This is a fake face attack where the identity 530 is presented to the camera by client number 001 in session 03.
- 018_02_000_3_10.hdf5 : This is a photo attack where the identity 018 is presented to the camera using stand in session 02.

1.5 Evaluation:

All four channels of data obtained from “Intel RealSense SR300” and “Seek Thermal Compact PRO” are used in the reference publication. Since the consecutive frames are correlated, only 50 frames from each video were selected. The frames are uniformly sampled in the temporal domain. The total number of 1679 presentations including bonafide and presentation attacks were grouped into three subsets, train, dev, and eval. Data from “Wig” and “Makeup” category was not used in the experiments. The data split is done ensuring almost equal distribution of PA categories and disjoint set of client identifiers in each set. Each of the PAIs had different client id. The split is done in such a way that a specific PA instrument will appear in only one set. A low level database interface is implemented that handles loading and spatial and temporal alignment of the data ². The preprocessed images for the data used in the experiments are also provided. The preprocessed method is described in details in the reference publication and the implementation is available publicly ³. The number of presentations in train, dev, and eval subset for the grandtest protocol of the reference publication is mentioned in Table 1.4.

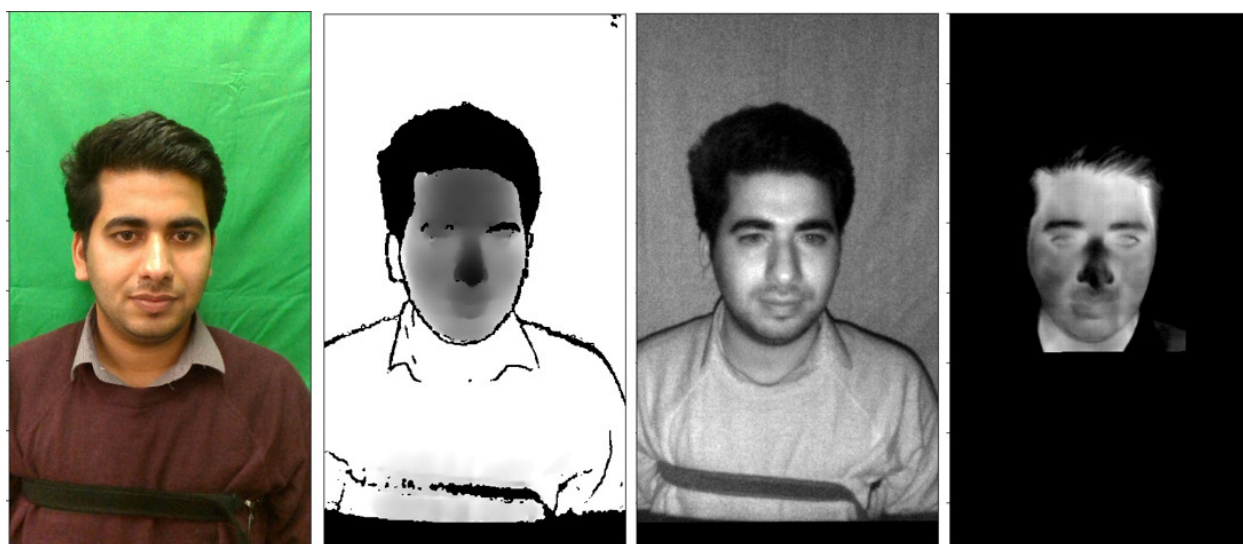
Some example images are illustrated from different channels (Fig. 1.10), different sessions (Fig. 1.11), and different presentation attacks (Fig. 1.12). An example of preprocessed data from four channels is provided in Fig. 1.13, and examples of preprocessed data from color channel for different bonafide is shown in Fig. 1.14.

²<https://gitlab.idiap.ch/bob/bob.db.bat1>

³<https://gitlab.idiap.ch/bob/bob.paper.mccnn.tifs2018>

Table 1.4: Statistics for train, dev, and eval subset of grandtest protocol

Subset	Bonafide	Presentation Attack	Both
train	124	441	565
dev	108	449	557
eval	115	442	557
TOTAL	347	1332	1679



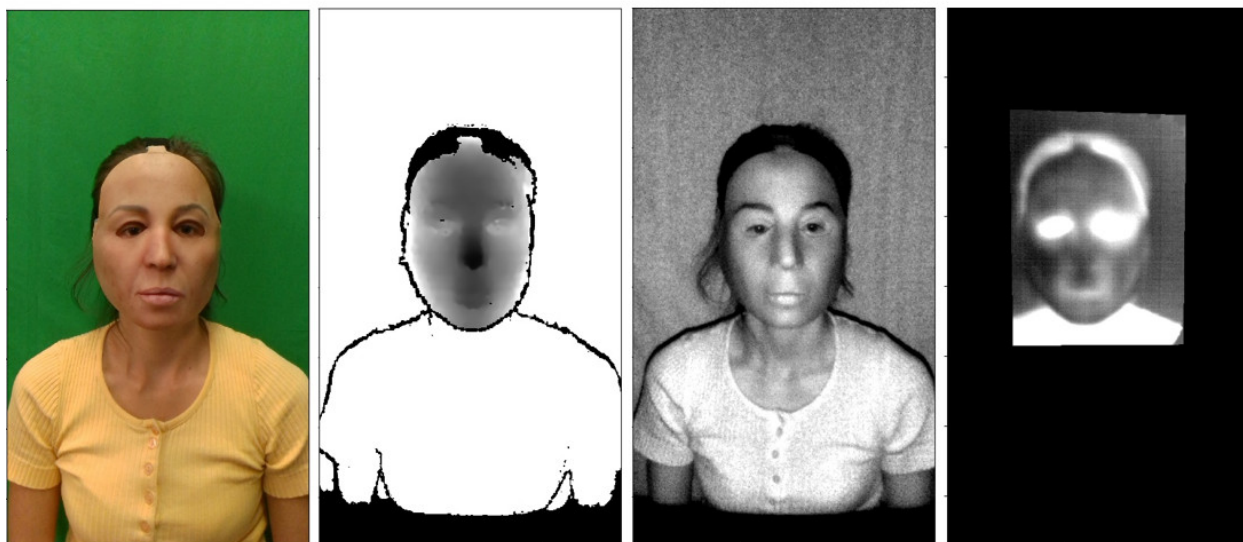
Color

Depth

Infrared

Thermal

(a) Bonafide



Color

Depth

Infrared

Thermal

(b) Presentation Attack (Custom silicone mask)

Figure 1.10: Sample images of a) bonafide and b) flexible mask attack from the database for all channels after alignment. The images from all channels are aligned with the calibration parameters and normalized to eight bit for better visualization.



Figure 1.11: Examples of bonafide data in 6 different sessions. Top left is session one and bottom right is session seven. There is no bonafide data for session four.

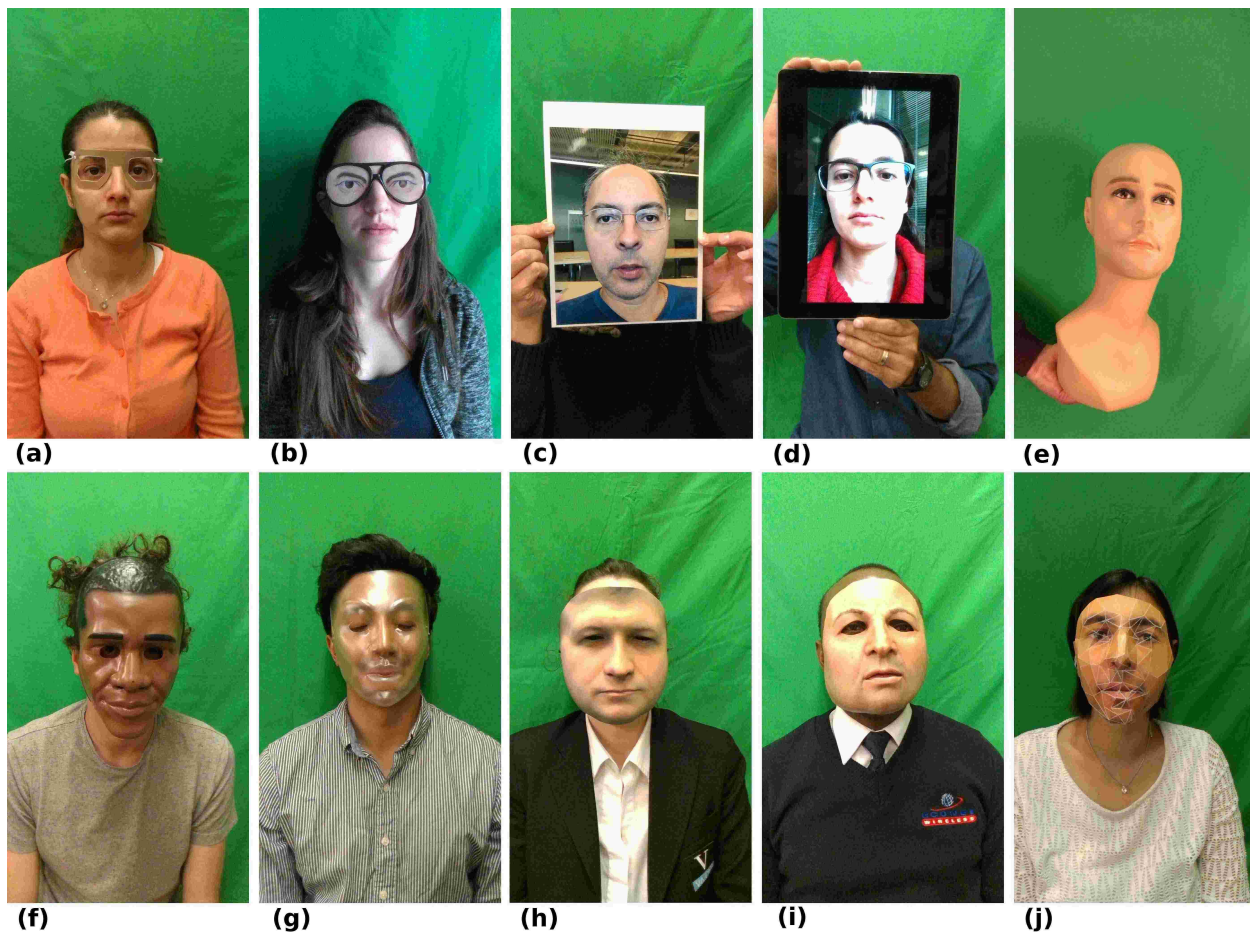


Figure 1.12: Examples of presentation attacks with different PAIs. (a): glasses (paper glasses), (b): glasses (funny eyes glasses), (c): print, (d): replay, (e): fake head, (f): rigid mask (Obama plastic Halloween mask), (g): rigid mask (transparent plastic mask), (h): rigid mask (custom made realistic), (i): flexible mask (custom made realistic), and (j): paper mask.

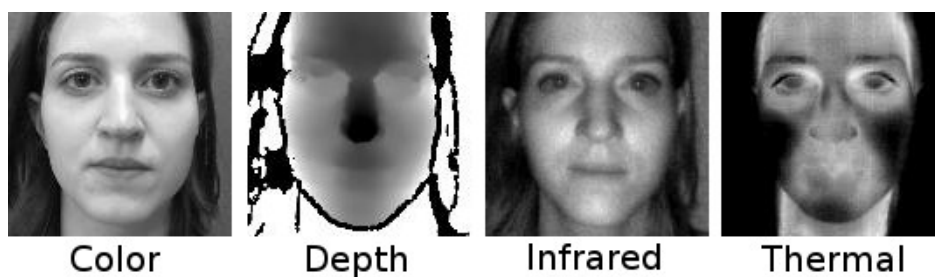


Figure 1.13: Example of preprocessed data from four channels for a bonafide presentation.



Figure 1.14: Examples of preprocessed data from color channel for different bonafide presentations.