

Claims

1. A system for face authentication or recognition comprising:
 - ~~a flash illumination unit having a flashtube, the flash illumination unit configured to output a flash illumination pulse having a spectral content and a pulse duration;~~
 - ~~a set of spectral filters configured to receive a flash illumination pulse generated by the flash illumination unit and configured to pass a spectrally filtered flash illumination pulse that includes optical wavelengths within at least one of a near-infrared (NIR) and an infrared (IR) portion of the optical spectrum;~~
 - ~~an image sensor configured to receive reflected illumination from a subject having a face, the reflected illumination corresponding to the spectrally filtered flash illumination pulse, the image sensor further configured to capture an image during an image capture interval and generate a corresponding facial image dataset;~~
 - ~~a memory configured to store the facial image dataset; and~~
 - ~~a processing unit configured to perform one of face authentication operations and face recognition operations upon the stored facial image dataset to respectively one of authenticate and recognize an identity of the subject.~~
2. The system of claim 1, wherein the pulse duration is less than approximately 500 microseconds.
3. The system of claim 1, wherein the pulse duration is between approximately 10—250 microseconds.
4. The system of claim 1, wherein the image capture interval is approximately equal to or less than the pulse duration.
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5. The system of claim 1, wherein the set of spectral filters is configured to block spectral content corresponding to optical wavelengths shorter than NIR wavelengths.
6. The system of claim 1, further comprising a flash illumination control circuit configured to

~~drive the flash illumination unit in a manner that preferentially shifts the spectral content of the flash illumination pulse toward the IR portion of the optical spectrum.~~

~~7. The system of claim 6, wherein the flash illumination control circuit is configured to drive the flash illumination unit at a reduced power level that is between approximately 5%—50% of a maximum power level corresponding to the flash illumination unit.~~

~~8. The system of claim 1, wherein within a spatial region that is proximate to the flash illumination unit the spectrally filtered flash illumination pulse has an intensity that is at least approximately equal to an intensity of ambient sunlight within an outdoor scene that is brightly lit as a result of the ambient sunlight.~~

~~9. The system of claim 8, wherein the spatial region exists at a distance of less than approximately 1 meter from the flash illumination unit.~~

~~10. The system of claim 1, wherein a vertical separation distance between the image sensor and one of the flash illumination unit and the set of spectral filters is less than approximately 25 cm.~~

~~11. The system of claim 1, wherein the flash illumination unit, the set of spectral filters, and the image sensor comprise portions of a local system, and the processing unit comprises a portion of a remote system configured for network communication with the local system.~~

~~12. The system of claim 1, wherein the flash illumination unit, the set of spectral filters, and the image sensor form portions of one of an entryway access control system, a computer access control system, a user identity consistency verification system, a financial transaction authorization system, a portable communication device usage authorization system, an automotive vehicle operation authorization system, a mechanized equipment operation authorization system, a firearm usage authorization system, a portable facial image capture system, and a wearable facial image capture system.~~

13. The system of claim 1, wherein the flash illumination unit, the set of spectral filters, and the image sensor are coupled to one of a computer display device, an automated teller machine (ATM), a point of sale authorization device, a mobile phone, an automotive vehicle, a piece of mechanized equipment, and a firearm usage authorization system.

14. A system for face authentication or recognition comprising:

- a flash illumination unit having a flashtube configured to generate a flash illumination pulse by way of a glow discharge process, the flash illumination pulse having a pulse duration of less than approximately 500 microseconds and spectral content that includes near-infrared (NIR) optical wavelengths and visible optical wavelengths;

- a set of spectral filters configured to receive a flash illumination pulse generated by the flash illumination unit and configured to pass a spectrally filtered flash illumination pulse that at least substantially excludes optical wavelengths shorter than NIR optical wavelengths, the spectrally filtered flash illumination pulse having within a target illumination region less than approximately 1 meter from the set of spectral filters an intensity that is at least approximately equal to the intensity of ambient sunlight within an outdoor scene that is brightly lit as a result of the ambient sunlight;

an image sensor configured to receive reflected illumination corresponding to the spectrally filtered flash illumination pulse from a subject disposed within the target illumination region and configured to generate an image dataset corresponding to the subject; and

- at least one of communication resources and memory resources that enable the transfer of the image dataset to a processing unit configured for performing one of face authentication operations and face recognition operations upon the image dataset.

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15. The system of claim 14, wherein an image capture plane of the image sensor is tilted relative to a planar surface from which the spectrally filtered flash illumination pulse exits the set of spectral illumination filters by approximately 5–15 degrees.

161. A method for face authentication or recognition comprising:

generating a flash illumination pulse by way of an electric glow discharge process, the flash illumination pulse having a spectral content and a pulse duration;

generating a spectrally filtered flash illumination pulse that includes optical wavelengths within at least one of a NIR and an IR portion of the optical spectrum;
capturing reflected illumination from a subject having a face, the reflected illumination corresponding to the spectrally filtered flash illumination pulse;
generating a facial image dataset corresponding to the reflected illumination; storing the facial image dataset in a memory; and

performing one of face authentication and face recognition operations ~~using~~ by processing the set of stored facial image dataset to respectively one of authenticate and recognize an identity of the subject,

wherein the processing the facial image dataset comprises:

processing the facial image dataset to identify a face rectangle;

processing the face rectangle to identify a set of candidate positions corresponding to a pair of eyes on the subject's face;

processing the face rectangle to determine a best candidate position for the pair of eyes;

generating a query dataset corresponding to the face rectangle and the best candidate position for the pair of eyes; and

processing the query dataset using a plurality of matching techniques relative to at least one enrollment dataset.

~~172.~~ The method of claim ~~161~~, wherein the pulse duration is less than approximately 500 microseconds.

~~183.~~ The method of claim ~~161~~, wherein the pulse duration is between approximately 10 - 250 microseconds.

~~194.~~ The method of claim ~~161~~, wherein the image capture interval is approximately equal to or less than the pulse duration.

~~205.~~ The method of claim ~~161~~, wherein generating the spectrally filtered flash illumination pulse comprises blocking spectral content having a wavelength that is shorter than NIR wavelengths.

216. The method of claim 161, further comprising driving the flash illumination unit in a manner that preferentially shifts the spectral content of the flash illumination pulse toward the IR portion of the optical spectrum.

227. The method of claim 216, wherein driving the flash illumination unit comprises driving the flash illumination unit at a reduced power level that is between approximately 5% - 50% of a maximum power level corresponding to the flash illumination unit.

238. The method of claim 161, wherein within a spatial region that is proximate to the flash illumination unit the spectrally filtered flash illumination pulse has an intensity that is at least approximately equal to an intensity of ambient sunlight within an outdoor scene that is brightly lit as a result of the ambient sunlight.

249. The method of claim 161, wherein the spatial region exists at a distance of less than approximately 1 meter from the flash illumination unit.

2510. The method of claim 161, further comprising disposing the image sensor and one of the flash illumination unit and the set of spectral filters less than approximately 25 cm apart.

2611. The method of claim 161, further comprising controlling one of subject access to an entryway, subject operation of a computer, subject financial transaction authorization, subject operation of a portable communication device, subject operation of an automotive vehicle, subject operation of a piece of mechanized equipment, and subject operation of a firearm based upon one of the face authentication and face recognition operations.

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~~27. The method of claim 16, wherein processing the facial image dataset comprises:
processing the facial image dataset to identify a face rectangle;
processing the face rectangle to identify a set of candidate positions corresponding to a pair of eyes on the subject's face;
processing the face rectangle to determine a best candidate position for the pair of eyes; and~~

~~generating a plurality of enrolment datasets corresponding to the facial image dataset based upon an accuracy of an eye finder.~~

~~28. The method of claim 16, wherein processing the facial image dataset comprises:
processing the facial image dataset to identify a face rectangle;
processing the face rectangle to identify a set of candidate positions
corresponding to a pair of eyes on the subject's face;
processing the face rectangle to determine a best candidate position for the pair of eyes;
generating a query dataset corresponding to the face rectangle and the best candidate position
for the pair of eyes; and
processing the query dataset using a plurality of matching techniques relative to at least one
enrollment dataset.~~

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~~29~~12. The method of claim ~~28~~1, wherein processing the facial image dataset to identify a face rectangle comprises processing the facial image dataset using a Haar cascade face finder.

~~30~~13. The method of claim ~~28~~1, wherein processing the face rectangle to identify a set of candidate positions corresponding to a pair of eyes comprises processing the face rectangle using a Haar cascade filter.

~~31~~14. The method of claim ~~30~~13, wherein processing the face rectangle to identify the best candidate position for the pair of eyes comprises processing the face rectangle using a Gabor eye finder.

~~32~~15. The method of claim ~~28~~1, wherein processing the query dataset using a plurality of matching techniques comprises:

processing the query dataset using a first matching technique relative to the at least one enrollment dataset;

generating a first distance measure corresponding to the first matching technique;

determining whether the first distance measure indicates an accept or reject condition; and

generating one of an amended query dataset an amended enrolment dataset in the event that the first distance measure fails to indicate an accept or reject condition.

3316. The method of claim ~~281~~, wherein processing the query dataset using a plurality of matching techniques comprises:

processing the query dataset using a first matching technique relative to the at least one enrollment dataset;

generating a first distance measure;

processing the query dataset using at least one of a second matching technique and a third matching technique relative to the at least one enrollment dataset;

generating at least one of a second distance measure corresponding to the second matching technique and a third distance measure corresponding to the third matching technique;

generating a consensus distance measure using at least two of the first distance measure, the second distance measure, and the third distance measure; and

determining whether the consensus distance measure indicates one of an accept condition and a reject condition.

3417. The method of claim ~~3316~~, wherein the first matching technique has a higher computational efficiency than at least one of the second matching technique and the third matching technique.

3518. The method of claim ~~161~~, wherein performing one of face authentication and face recognition operations comprises determining a likelihood that the subject is a live person.

~~36. A method for face authentication or recognition comprising:~~

~~generating a flash illumination pulse by way of an electric glow discharge process, the flash illumination pulse having a pulse duration of less than approximately 500 microseconds and a spectral content that includes near-infrared (NIR) optical wavelengths and visible optical wavelengths;~~

~~generating a spectrally filtered flash illumination pulse that includes optical wavelengths within at least one of a NIR and an IR portion of the optical spectrum and which at least substantially excludes optical wavelengths shorter than NIR optical wavelengths, the spectrally filtered flash illumination pulse having within a target illumination region less than~~

~~approximately 1 meter from the set of spectral filters an intensity that is at least approximately equal to the intensity of ambient sunlight within an outdoor scene that is brightly lit as a result of the ambient sunlight;~~

~~capturing reflected illumination from a subject having a face, the reflected illumination corresponding to the spectrally filtered flash illumination pulse;~~

~~generating a facial image dataset corresponding to the reflected illumination;~~

~~transferring the facial image dataset to at least one of memory resources configured for storing the facial image dataset and processing resources configured for performing one of face authentication operations and face recognition operations upon the facial image dataset.~~

19. A method for face authentication or recognition comprising:

generating a flash illumination pulse by way of an electric glow discharge process, the flash illumination pulse having a spectral content and a pulse duration;

generating a spectrally filtered flash illumination pulse that includes optical wavelengths within at least one of a NIR and an IR portion of the optical spectrum;

capturing reflected illumination from a subject having a face, the reflected illumination corresponding to the spectrally filtered flash illumination pulse;

generating a facial image dataset corresponding to the reflected illumination; storing the facial image dataset in a memory; and

performing one of face authentication and face recognition operations by processing the stored facial image dataset to respectively one of authenticate and recognize an identity of the subject,

wherein the processing the facial image dataset comprises:

processing the facial image dataset to identify a face rectangle;

processing the face rectangle to identify a set of candidate positions corresponding to a pair of eyes on the subject's face;

processing the face rectangle to determine a best candidate position for the pair of eyes; and

generating a plurality of enrolment datasets corresponding to the facial image dataset based upon an accuracy of an eye finder.