CLAIMS

1. A method for preventing access to a secure system based on determining a captured image to be of an alternative representation of a live person, the method comprising:

illuminating a subject with structured light using a light source array comprising multiple light sources disposed in a predetermined pattern, wherein the predetermined pattern comprises a pattern of concentric circles;

capturing an image of the subject as illuminated by the structured light;

detecting that the image includes a reflection of the predetermined pattern;

responsive to detecting that the image includes a reflection of the predetermined pattern, identifying the subject in the image to be an alternative representation of a live person comprising a photograph of the live person printed on paper or displayed on a screen: and

responsive to identifying the subject in the image to be an alternative representation of a live person, preventing access to the secure system.

~~2. The method of claim 1, wherein the alternative representation of a live person comprises a photograph of the live person.~~

~~3. The method of claim 2, wherein the photograph is printed on paper, or presented on a display.~~

~~4~~2. The method of claim 1, wherein detecting that the image includes the reflection of the predetermined pattern ~~determining that the image includes features representative of the predetermined pattern~~ comprises:

computing a frequency domain representation of the image;

determining that an amount of energy in a target frequency range is higher than a threshold; and

responsive to determining that the amount of energy in the target frequency range is higher than the threshold, detecting that the image includes the reflection of the predetermined pattern~~determining that the image includes features representative of the predetermined pattern~~.

~~5~~3. The method of claim ~~4~~2, wherein the threshold is substantially equal to 60% of energy content of the frequency domain representation of the image.

~~6~~4. The method of claim ~~4~~2, wherein the frequency domain representation comprises one of: a two dimensional fast Fourier transform (2D-FFT) of the image or a wavelet-based decomposition of the image.

~~7~~5. The method of claim 1, wherein the light source array is configured to radiate infrared (IR) illumination.

~~8~~6. The method of claim 1, wherein detecting that the image includes the reflection of the predetermined pattern ~~determining that the image includes features representative of the predetermined pattern~~ comprises processing the image using a machine learning process trained to discriminate between images of live persons and corresponding alternative representations of the live persons.

~~9~~7. The method of claim 1, further comprising:

determining that ~~the~~ a second image does not include features representative of the predetermined pattern;

responsive to determining that the second image does not include features representative of the predetermined pattern, identifying ~~the~~ a second subject in the second image to be a live person; and

responsive to identifying the second subject in the second image to be a live person, initiating an authentication process for determining if the live person in the second image is authorized to access the secure system.

~~10~~8. The method of claim 1, wherein the secure system comprises a user-interface disposed in a kiosk, and the light source array is disposed on the kiosk.

~~11~~9. A secure system comprising:

an image acquisition device configured to:

illuminate a subject with structured light using a light source array comprising multiple light sources disposed in a predetermined pattern, wherein the predetermined pattern comprises a pattern of concentric circles, and

capture an image of the subject as illuminated by the structured light; and

an image analysis comprising one or more processing devices, the image analysis engine configured to:

detect that the image includes a reflection of the predetermined patterndetermine that the image includes features representative of the predetermined pattern;

responsive to detecting that the image includes the reflection of the predetermined patterndetermining that the image includes features representative of the predetermined pattern, identify the subject in the image to be an alternative representation of a live person comprising a photograph of the live person printed on paper or displayed on a screen; and

responsive to identifying the subject in the image to be an alternative representation of a live person, prevent access to the secure system.

12. The system of claim 11, wherein the alternative representation of a live person comprises a photograph of the live person.

13. The system of claim 12, wherein the photograph is printed on paper, or presented on a display device.

1410. The system of claim 119, wherein detecting that the image includes the reflection of the predetermined patterndetermining that the image includes features representative of the predetermined pattern comprises:

computing a frequency domain representation of the image;

determining that an amount of energy in a target frequency range is higher than a threshold; and

responsive to determining that the amount of energy in the target frequency range higher than the threshold, detecting that the image includes the reflection of the predetermined patterndetermining that the image includes features representative of the predetermined pattern.

1511. The system of claim 1410, wherein the threshold is substantially equal to 60% of energy content of the frequency domain representation of the image.

~~16~~12. The system of claim ~~11~~9, wherein the light source array is configured to radiate infrared (IR) illumination.

~~17~~13. The system of claim ~~14~~10, wherein the frequency domain representation comprises one of: a two-dimensional Fast Fourier Transform (2D-FFT) of the image or a wavelet-based decomposition of the image.

~~18~~14. The system of claim ~~11~~9, wherein detecting that the image includes the reflection of the predetermined pattern ~~determining that the image includes features representative of the predetermined pattern~~ comprises processing the image using a machine learning process trained to discriminate between images of live persons and corresponding alternative representations of the live persons.

~~19~~15. The system of claim ~~11~~9, wherein the image analysis engine is configured to:

determine that ~~the~~ a second image does not include features representative of the predetermined pattern;

responsive to determining that the second image does not include features representative of the predetermined pattern, identify ~~the~~ a second subject in the second image to be a live person; and

responsive to identifying the second subject in the second image to be a live person, initiate an authentication process for determining if the live person in the second image is authorized to access the secure system.

~~20~~16. One or more machine-readable storage devices encoded with instructions configured to cause one or more processing devices to execute operations comprising:

causing a light source array to illuminate a subject with structured light, wherein using the light source array includes multiple light sources disposed in a predetermined pattern, wherein the predetermined pattern comprises a pattern of concentric circles;

receiving an image of the subject captured under illumination by the structured light;

detecting that the image includes a reflection of the predetermined pattern~~determining that the image includes features representative of the predetermined pattern~~;

responsive to detecting that the image includes the reflection of the predetermined pattern~~determining that the image includes features representative of the predetermined~~

~~pattern~~, identifying the subject in the image to be an alternative representation of a live person; and

responsive to identifying the subject in the image to be an alternative representation of a live person, preventing access to the secure system.