

CLAIMS

1. A method for generating a mathematical model corresponding to a first condition, the method
5 executable by at least one processor of a computer system, the method comprising:
 receiving a plurality of datasets of labelled retinal signal data corresponding to a plurality
of patients, wherein each dataset comprises retinal signal data of a patient and a label, wherein the
label indicates whether the patient is subject to the first condition;
 extracting a set of features from the retinal signal data;
10 selecting a subset of features from the set of features, wherein the subset of features
corresponds to biomarkers of the first condition; and
 determining, based on the subset of features, one or more classifiers that distinguish the
first condition from a second condition.
- 15 2. The method of claim 1, wherein the set of features comprises voltage, circuit impedance, signal
collection time, sampling frequency, light stimulation synchronization time, light stimulation
offset, or indications of which retinal areas were illuminated.
3. The method of any one of claims 1–2, wherein the set of features comprise eye position, pupil
20 size, intensity of applied luminance, frequency of light stimulation, frequency of retinal signal
sampling, wavelength of illumination, illumination time, background wavelength, or background
luminance.
4. The method of any one of claims 1–3, wherein the one or more classifiers distinguish a
25 biosignature of the first condition from a biosignature of the second condition.
5. The method of claim 4, further comprising ranking the set of features based on a relevance of
each feature to the biosignature of the first condition, and wherein selecting the subset of features
comprises selecting highest-ranked features of the set of features.
- 30 6. The method of any one of claims 1–5, further comprising:

receiving clinical information cofactors corresponding to the plurality of patients, wherein each dataset comprises clinical information cofactors of the patient; and

selecting a subset of the clinical cofactors, wherein the clinical cofactors in the subset of clinical cofactors influence detection of the biomarkers.

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7. The method of claim 6 wherein the clinical information cofactors indicate an age, gender, skin pigmentation, or iris color of the respective patient.

8. The method of any one of claims 6–7, wherein determining the one or more classifiers comprises
10 determining, based on the subset of the clinical cofactors, the one or more classifiers.

9. The method of any one of claims 1–8, further comprising generating, based on the one or more classifiers, the mathematical model.

15 10. The method of any one of claims 1–9, further comprising:

inputting, to the mathematical model, retinal signal data and clinical information cofactors corresponding to a patient; and

outputting, by the mathematical model, a predicted likelihood that the patient is subject to the first condition.

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11. The method of any one of claims 1–9, further comprising:

inputting, to the mathematical model, retinal signal data and clinical information cofactors corresponding to a patient; and

25 outputting, by the mathematical model, a predicted likelihood that the patient is not subject to the first condition.

12. The method of any one of claims 1–11, wherein the first condition is schizophrenia, bipolar disorder, major depression disorder, or psychosis.

13. The method of any one of claims 1–12, wherein the first condition is post-traumatic stress disorder, stroke, substance abuse, obsessive compulsive disorder, Alzheimer's, Parkinson's, multiple sclerosis, autism, or attention deficit disorder.
- 5 14. The method of any one of claims 1–13, wherein the retinal signal data has a sampling frequency between 4 to 24 kHz.
15. The method of any one of claims 1–14, wherein the retinal signal data is collected for a signal collection time of 200 milliseconds to 500 milliseconds.
- 10 16. The method of any one of claims 1–15, wherein the retinal signal data comprises an impedance component of a receiving circuit recorded continuously while capturing the retinal signal data.
17. The method of any one of claims 1–16, wherein the retinal signal data comprises one or more optical parameters.
- 15 18. The method of claim 17, wherein the optical parameters comprise luminance of retinal light stimulation or pupil size.
- 20 19. The method of any one of claims 1–18, wherein the retinal signal data comprises a light wavelength component recorded while capturing the retinal signal data, a light spectrum component recorded while capturing the retinal signal data, a light intensity component recorded while capturing the retinal signal data, or an illuminated retinal surface component recorded while capturing the retinal signal data.
- 25 20. A method for predicting a probability that a patient is subject to one or more conditions, the method executable by at least one processor of a computer system, the method comprising:
- receiving retinal signal data corresponding to the patient;
 - extracting, from the retinal signal data, one or more retinal signal features;
 - 30 extracting, from the retinal signal features, one or more descriptors;

applying the one or more descriptors to a first mathematical model and a second mathematical model, wherein the first mathematical model corresponds to a first condition and the second mathematical model corresponds to a second condition, thereby generating a first predicted probability for the first condition and a second predicted probability for the second condition; and
5 outputting the first predicted probability and the second predicted probability.

21. The method of claim 20, further comprising displaying an interface comprising the first predicted probability and the second predicted probability.
- 10 22. The method of any one of claims 20–21, further comprising storing the first predicted probability and the second predicted probability.
23. The method of any one of claims 20–22, further comprising collecting the retinal signal data.
- 15 24. The method of any one of claims 20–23, further comprising:
 obtaining clinical information cofactors extracted from clinical information corresponding to the patient; and
 applying the clinical information cofactors to the first mathematical model and the second mathematical model.
- 20 25. The method of claim 24 wherein the clinical information cofactors correspond to an age, gender, skin pigmentation, or iris color of the patient.
26. The method of any one of claims 20–24, wherein the retinal signal data has a sampling
25 frequency between 4 to 24 kHz.
27. The method of any one of claims 20–26, wherein the retinal signal data is collected for a signal collection time of 200 milliseconds to 500 milliseconds.

28. The method of any one of claims 20–27, wherein the retinal signal data comprises an impedance component of a receiving circuit recorded continuously while capturing the retinal signal data.

5 29. The method of any one of claims 20–28, wherein the retinal signal data comprises one or more optical parameters.

30. The method of claim 29, wherein the optical parameters comprise luminance of retinal light stimulation or pupil size.

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31. The method of any one of claims 20–30, wherein the first condition is a medical condition and wherein the second condition is a control condition.

15 32. The method of any one of claims 20–31, wherein the first condition or the second condition is schizophrenia, bipolar disorder, major depression disorder, or psychosis.

33. The method of any one of claims 20–31, wherein the first condition or the second condition is post-traumatic stress disorder, stroke, substance abuse, obsessive compulsive disorder, Alzheimer's, Parkinson's, multiple sclerosis, autism, or attention deficit disorder.

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34. The method of any one of claims 20–33, further comprising receiving user input indicating a selection of the first condition and the second condition.

35. The method of any one of claims 20–34, further comprising:

25 selecting, based on the first predicted probability and the second predicted probability, a medication; and
 administering the medication to the patient.

30 36. A method for determining a biosignature of a condition, the method executable by at least one processor of a computer system, the method comprising:

receiving a plurality of datasets of labelled retinal signal data corresponding to a plurality of patients, wherein each dataset comprises retinal signal data of a patient and a label, wherein the label indicates whether the patient is subject to the condition;

extracting a set of features from the retinal signal data;

5 selecting a subset of features from the set of features, wherein the subset of features corresponds to biomarkers of the condition; and

determining, based on the subset of features, one or more classifiers that identify the biosignature of the condition.

10 37. The method of claim 36, further comprising:

receiving clinical information cofactors corresponding to the plurality of patients, wherein each dataset comprises clinical information cofactors of the patient; and

15 selecting a subset of the clinical cofactors, wherein the clinical cofactors in the subset of clinical cofactors influence detection of the biomarkers, and wherein determining the one or more classifiers comprises determining, based on the subset of clinical cofactors, the one or more classifiers.

38. The method of any one of claims 36–37, further comprising ranking the set of features based on a relevance of each feature to the biosignature of the first condition, and wherein selecting the
20 subset of features comprises selecting highest-ranked features of the set of features.

39. A system comprising at least one processor and memory storing a plurality of executable instructions which, when executed by the at least one processor, cause the system to perform the method of any one of claims 1–38.

25 40. A non-transitory computer-readable medium containing instructions which, when executed by a processor, cause the processor to perform the method of any one of claims 1–38.

41. A system for predicting a probability that a patient is subject to one or more conditions, the
30 system comprising:

a light stimulator;

one or more sensors;

a computer system comprising at least one processor and memory storing a plurality of executable instructions which, when executed by the at least one processor, cause the computer system to:

- 5 cause the light stimulator to provide light stimulation signals to retina of the patient;
collect, via the one or more sensors, electrical signals responsive to the light stimulation;
generate, based on the electrical signals, retinal signal data corresponding to the patient;
extract, from the retinal signal data, one or more retinal signal features;
extract, from the retinal signal features, one or more descriptors;
10 apply the one or more descriptors to a first mathematical model and a second mathematical model, wherein the first mathematical model corresponds to a first condition and the second mathematical model corresponds to a second condition, thereby generating a first predicted probability for the first condition and a second predicted probability for the second condition; and
output the first predicted probability and the second predicted probability.

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42. A system for predicting a probability that a patient is subject to one or more conditions, the system comprising a computer system comprising at least one processor and memory storing a plurality of executable instructions which, when executed by the at least one processor, cause the computer system to:

- 20 receive retinal signal data corresponding to the patient;
extract, from the retinal signal data, one or more retinal signal features;
extract, from the retinal signal features, one or more descriptors;
apply the one or more descriptors to a first mathematical model and a second mathematical model, wherein the first mathematical model corresponds to a first condition and the second
25 mathematical model corresponds to a second condition, thereby generating a first predicted probability for the first condition and a second predicted probability for the second condition; and
output the first predicted probability and the second predicted probability.

43. The system of claim 42, further comprising a light stimulator and one or more sensors, and
30 wherein the instructions, when executed by the at least one processor, cause the computer system to:

cause the light stimulator to provide light stimulation signals to retina of the patient;
collect, via the one or more sensors, electrical signals responsive to the light stimulation;
and
generate, based on the electrical signals, the retinal signal data.

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44. The system of any one of claims 42–43, further comprising a display, and wherein the instructions, when executed by the at least one processor, cause the computer system to output, via the display, an interface comprising the first predicted probability and the second predicted probability.

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45. A method for monitoring a condition of a patient, the method executable by at least one processor of a computer system, the method comprising:

receiving retinal signal data corresponding to the patient;
extracting, from the retinal signal data, one or more retinal signal features;
15 extracting, from the retinal signal features, one or more descriptors;
applying the one or more descriptors to a mathematical model corresponding to the condition, thereby generating a predicted probability for the condition; and
outputting the predicted probability.

20 46. The method of claim 45, further comprising:

selecting, based on the predicted probability, a medication; and
administering the medication to the patient.

47. The method of claim 45, wherein the retinal signal data comprises retinal signal data captured
25 during treatment of the patient for the condition.

48. The method of any one of claims 45–47, wherein the condition is schizophrenia, bipolar disorder, major depression disorder, psychosis, post-traumatic stress disorder, stroke, substance abuse, obsessive compulsive disorder, Alzheimer's, Parkinson's, multiple sclerosis, autism, or
30 attention deficit disorder.