

CLAIMS

1. An oral hygiene system for monitoring compliance with an oral hygiene regimen comprising:
 - 5 an oral hygiene device comprising a handle and a head;
an optical sensor; and
a control system which determines a position of the oral hygiene device based on at least the data output by the optical sensor.
- 10 2. The oral hygiene system according to claim 1, wherein the oral hygiene device comprises a pattern, and the control system determine an orientation and position of the oral hygiene device based on at least analysis of the pattern in the data output by the optical sensor.
- 15 3. The oral hygiene system according to claim 1, wherein the pattern is on an add-on attachment to the oral hygiene device.
4. The oral hygiene system according to claim 1, wherein the pattern is on the head.
- 20 5. The oral hygiene system according to claim 1, wherein the pattern is on the handle.
6. The oral hygiene system according to claim 1, wherein the oral hygiene device is a toothbrush.
- 25 7. The oral hygiene system according to claim 1, wherein the position of the oral hygiene device is determined with respect to the user's mouth.
8. The oral hygiene system according to claim 1, wherein the position of the oral hygiene device is determined by determining a position of the head, handle, or a pattern on
30 the oral hygiene device.

9. The oral hygiene system according to claim 1, wherein an orientation of the oral hygiene device is determined by the control system based on at least the data output by the optical sensor.
- 5 10. The oral hygiene system according to claim 1, wherein the oral hygiene device further includes a motion sensor that outputs data relating to orientation of the oral hygiene device and wherein the control system determines an orientation of the oral hygiene device in space additionally based on the data output from the motion sensor.
- 10 11. The oral hygiene system according to claim 1, wherein control system also determines relative positional changes of the oral hygiene device using data output from the camera.
12. The oral hygiene system according to claim 11 wherein the control system utilizes
15 the data output from the optical sensor to determine an estimated distance window within which the oral hygiene device has changed position.
13. The oral hygiene system according to claim 1, wherein the control system utilizes a statistical analysis to determine orientation.
- 20 14. The oral hygiene system according to claim 1, wherein the control system utilizes a statistical analysis to determine positional changes.
15. The oral hygiene system according to claim 14, wherein the statistical analysis is
25 performed using relative positional changes based on a reference coordinated system determined during each session of brushing.
16. The oral hygiene system according to claim 15, wherein the statistical analysis is performed by fitting the data from the camera to calibration data after the processor
30 determines a completed brushing session.

17. The oral hygiene system according to claim 1, wherein the control system additionally determines the orientation of the oral hygiene device by analyzing data from a motion sensor representing the strength and direction of the earth's magnetic field.
- 5 18. The oral hygiene system according to claim 10, wherein the motion sensor is a gyroscope or accelerometer.
19. An electronic oral hygiene device system for monitoring brushing and compliance with a tooth brush regime comprising:
- 10 a oral hygiene device including a handle and a head;
an attachment that is configured to be attachable to a handle of the toothbrush, that includes a first visual pattern;
an optical sensor for detecting visual data related to the visual pattern;
a memory for storing the data output by the camera and in data communication with
- 15 the controller; and
a control system which determines a relative distance and direction of positional movement of the oral hygiene device based on at least the data output by the optical sensor.
20. The tooth brushing system according to claim 19, wherein the head includes a second
- 20 visual pattern different from the first visual pattern.
21. The tooth brushing system according to claim 19, wherein the controller utilizes the data output from the optical sensor to determine an estimated distance window within which the oral hygiene device has changed position.
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22. The tooth brushing system according to claim 19, wherein the oral hygiene device further includes a motion sensor that outputs data relating to orientation of the oral hygiene device and wherein the controller calculates an orientation of the oral hygiene device in space additionally based on the data output from the camera.
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23. A method for determining the orientation of an oral hygiene device, the method comprising:

recording, during a calibration session, calibration data from an optical sensor that represents an image of the oral hygiene device in a fixed orientation;

storing the calibration data in a memory;

recording, during a use session, usage data from the optical sensor; and

5 performing a statistical analysis on the usage data and the calibration data to determine at least one orientation of the oral hygiene device.

24. The method of claim 23, wherein the statistical analysis is performed using a regression analysis.

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25. The method of claim 23, wherein the statistical analysis is performed using a reference starting position in the user's mouth recorded during the use session.

26. The method of claim 23, wherein the performing the statistical analysis on the usage
15 data and the calibration data also includes determining a relative positional movement of the oral hygiene device.

27. The method of claim 23, wherein the calibration session records data representing a user's face.

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28. The method of claim 27, wherein the calibration session compares the size of a visual pattern on the oral hygiene device to the size of the user's face.

29. An electronic oral hygiene device system for monitoring brushing and compliance
25 with a tooth brush regime comprising:

a oral hygiene device including a handle and a head, wherein the oral hygiene device contains a visual pattern;

a base station including an optical sensor;

a motion sensor configured to output motion data related to motion of the toothbrush;

30 a memory for storing the data output by the motion sensor and in data

communication with the motion sensor; and

a control system which determines the position of a head of the oral hygiene device in a user's mouth by comparing the motion data to previously recorded calibration data using

a statistical analysis and by periodically correcting the drift of the position determination using data output from the optical sensor.

30. An oral hygiene system for monitoring brushing and compliance with a tooth brush
5 regime comprising:
a oral hygiene device including a handle and a head;
an optical sensor;
a memory containing machine readable medium comprising machine executable
code having stored thereon instructions for performing a method of determining a position
10 and orientation of the toothbrush;
a control system coupled to the memory, the processor configured to execute the
machine executable code to cause the processor to determine an orientation and position of
an oral hygiene device based on at least data output by the optical sensor comprising optical
data representing the oral hygiene device.
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31. The oral hygiene system according to claim 30, wherein the oral hygiene device
further includes a gyroscope that outputs data relating to orientation changes of the oral
hygiene device and wherein the control system determines an orientation of the oral hygiene
device additionally based on the data output from the gyroscope.
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32. The oral hygiene system according to claim 30, wherein the control system also
determines relative positional changes of the oral hygiene device using data output from the
optical sensor.
- 25 33. The oral hygiene system according to claim 32 wherein the control system utilizes
the data output from the optical sensor to determine an estimated distance window within
which the oral hygiene device has changed position.
34. The oral hygiene system according to claim 30, wherein the control system utilizes a
30 statistical analysis to determine orientation.
35. The oral hygiene system according to claim 30, wherein the control system utilizes a
statistical analysis to determine positional changes.

36. The oral hygiene system according to claim 35, wherein the statistical analysis is performed using relative positional changes based on a reference coordinated system determined during each session of brushing.

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37. The oral hygiene system according to claim 35, wherein the statistical analysis is performed by fitting the data from the camera to calibration data after the control system determines a completed brushing session.

10 38. The oral hygiene system according to claim 30, wherein the control system additionally determines the orientation of the oral hygiene device by analyzing data from a magnetometer representing the strength and direction of the earth's magnetic field.

15 39. The oral hygiene system according to claim 30, wherein the control system additionally determines the orientation of the oral hygiene device by analyzing data from a motion sensor connected to the oral hygiene device.

40. The oral hygiene system according to claim 30, wherein the oral hygiene device contains a visual pattern.

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41. The oral hygiene device system according to claim 30, wherein the control system determines a position of the oral hygiene device by identifying an orientation of a longitudinal axis of the oral hygiene device relative to the mouth based on the optical data representing the toothbrush.

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42. The oral hygiene device system according to claim 41, wherein the control system determines the position of the oral hygiene device with respect to a user's mouth based on the optical data representing the oral hygiene device and optical data representing the user's mouth output from the optical sensor and combines that information with the orientation information determined from the data output by a gyrometer to identify which of the user's teeth are being brushed.

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43. The oral hygiene system according to claim 39, wherein the data from the motion sensor is at least one of acceleration data or orientation data.

44. A non-transitory, computer-readable storage medium having stored thereon
5 instructions for performing a method comprising machine executable code which when executed by at least one machine, causes the machine to:
determine a spatial position of an oral hygiene device based on at least data output by an optical sensor comprising optical data representing the toothbrush;
determine an angular orientation of the oral hygiene device based on at least data
10 output by a motion sensor; and
determine a section of a user's teeth being brushed by the oral hygiene device by combining the position and orientation information.

45. The non-transitory, computer-readable storage medium of claim 44, wherein the
15 section of the user's teeth comprises the outside face of upper molars, or the inside face of lower molars.

46. The non-transitory, computer-readable storage medium of claim 44, wherein the
20 section of the user's teeth comprises the outside face of upper incisors or the outside face of lower incisors.

47. The non-transitory, computer-readable storage medium of claim 44, wherein the
optical data representing the oral hygiene device comprises optical data representing a
pattern on the toothbrush.

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48. The non-transitory, computer-readable storage medium of claim 44, wherein the data output by the motion sensor is orientation data.

49. The non-transitory, computer-readable storage medium of claim 44, wherein the data
30 output by the motion sensor is acceleration data.