Claims

1. A method, comprising:

receiving first image data relating to an unknown colour sample, colorimetry data for which is to be determined;

receiving second image data relating to a plurality of known calibration colour samples, colorimetry data for which are already known;

determining a plurality of colour calibration characteristics relating colour measurements of the known calibration colour samples from the second image data to the corresponding known colorimetry data of the calibration colour samples;

calculating colorimetry data of the unknown colour sample in dependence on colour measurements thereof from the first image data and the determined colour calibration characteristics; and

matching the determined colorimetry data of the unknown colour sample to a colour palette of paint colours to identify a matching paint colour, and providing information relating to the matching paint colour to the user.

2. A method according to claim 1, wherein the first image data and second image data is received from a remote user via a telecommunications network, and the information relating to the matching paint colour is provided to the user via the telecommunications network.

3. A method according to claim 2, wherein the first image data and second image data is received as any of: i) an email message; ii) an MMS message; and/or iii) as image data in a web page; and wherein the information relating to the matching paint colour is provided as any of i) an email message; ii) an MMS message; iii) an SMS message and/or iv) data in a web page .

4. A method according to any of claims 1 to 3, wherein the first image data and the second image data is produced by the user using an image capture device; wherein the image capture device is preferably any of: i) a digital camera; ii) a camera equipped mobile telephone; and/or iii) a digital camcorder.

5. A method according to any of claims 1 to 4, wherein the determined colorimetry data and/or the known colorimetry data are XYZ tri-stimulus values.

6. A method according to any of the preceding claims, and further comprising determining complementary colours to the matching colour, and providing information relating to the determined complementary colours to the user.

7. A method according to any of claims 1 to 6, and further comprising orienting at least the second image data into a known orientation to allow for recognition of the known calibration colour samples therein.

8. A method according to claim 7, wherein the orienting comprises performing edge detection to identify the location of the set of known calibration colour samples in the second image data.

9. A method according to claims 7 or 8, wherein the orienting further comprises identifying a plurality of pre-determined points relating to the set of known calibration colour samples in the second image data and applying a perspective transformation to the second image data in dependence on the location of the identified points to de-skew the image of the set of known calibration colour samples.

10. A method according to any of claims 7 to 9, wherein the orienting further comprises identifying pre-determined rotational orientation markings relating to the set of known calibration colour samples in the second image data; and rotating the second image data in dependence on the location of the identified rotational orientation marks such that the known calibration colour samples are placed into a known position in the second image data.

11. A method according to any of claims 1 to 10, wherein the determining of the colour calibration characteristics comprises compensating for brightness differences across the set of known calibration colour samples.

12. A method according to claim 11, wherein the compensating comprises determining a first set of one or more functions having a first set of calibration coefficients, the one or more functions relating measured colours of the known calibration colour samples from the second image data to the known colorimetry data of the calibration colour samples and the known position of each known sample in the image; and analysing the determined functions to find a second set of functions having a second set of calibration coefficients, wherein the first and second sets of functions and calibration coefficients are used in calculating the colorimetry data of the unknown colour sample.

13. A method according to claim 12, wherein the compensating further comprises, prior to the determination of the first set of functions, determining a pre-cursor set of functions having a pre-cursor set of calibration coefficients that relate measured colours of the known calibration colour samples from the second image data to the known colorimetry data of the calibration colour samples without taking into account position of the known colour samples, wherein the pre-cursor set of calibration coefficients are used as part of the first set of calibration coefficients in the determination of the first set of one or more functions.

14. A method according to any of claims 1 to 13, wherein the colour calibration characteristics are determined using *N* known calibration colour samples, wherein *N* is less than the total number of known calibration colour samples across the whole colour space.

15. A method according to claim 14, wherein the *N* known calibration colour samples are those *N* samples that are the closest in colour space to an estimated colour of the unknown colour sample.

16. A method according to claim 15, wherein the estimated colour is obtained by determining a first set of calibration characteristics using all the available known calibration colour samples, and calculating the estimated colour using the first set of calibration characteristics.

17. A method according to claim 14, wherein the *N* known calibration colour samples are those *N* samples used within a confined colour space that the second image data is known to represent.

18. A method according to claim 14, wherein the *N* known calibration colour samples are those *N* samples that have measured colour values from the second image data that are most similar to the measured colour value of the unknown sample from the first image data.

19. A method according to any of claims 14 to 18, wherein *N* is in a range of substantially 5 to substantially 250, or more preferably substantially 10 to substantially 100, or more preferably substantially 20 to substantially 85, or more preferably substantially 30 to substantially 70, or more preferably substantially 40 to substantially 60, or most preferably at or around 50.

20. A method according to any of claims 1 to 19, wherein the calculating comprises:

applying a clustering algorithm to pixel values of pixels representing the unknown colour sample in the first image to determine the number of colours in the sample image; and

returning a colour for each identified cluster.

21. A method according to claim 20, wherein the pixel values are first calibrated using the colour calibration characteristics.

22. A method according to claims 20 or 21, wherein the clustering algorithm in use operates as follows:

i) calculate the mean value of pixels in a cluster;

ii) determine the number of pixels within a predetermined threshold distance of the mean value;

iii) increase the number of clusters if the determined number of pixels is less than a predetermined fraction of the number of pixels in the first image data relating to the unknown sample.

23. A method according to claim 22, and further comprising filtering clusters to remove those clusters from consideration that do not contain a threshold number of pixels within a second threshold distance of the mean of the cluster.

24. A computer program or suite of computer programs so arranged such that when run on a computer system it/they cause the computer system to perform the method of any of claims 1 to 23.

25. A computer readable medium storing a computer program or at least one of the suite of computer programs according to claim 24.

26. An apparatus, comprising:

at least one processor; and

at least one memory including computer program code

the at least one memory and the computer program code configured to, with the at least one processor, cause the apparatus to perform at least the following:

i) receive first image data relating to an unknown colour sample, colorimetry data for which is to be determined, and second image data relating to a plurality of known calibration colour samples, colorimetry data for which are already known;:

ii) determine a plurality of colour calibration characteristics relating colour measurements of the known calibration colour samples from the second image data to the corresponding known colorimetry data of the calibration colour samples;

iii) calculate colorimetry data of the unknown colour sample in dependence on colour measurements thereof from the first image data and the determined colour calibration characteristics;

iv) match the determined colorimetry data of the unknown colour sample to a colour palette of paint colours to identify a matching paint colour, and

v) provide information relating to the matching paint colour to a user.

27. An apparatus according to claim 26, wherein the first image data and second image data is received from a remote user via a telecommunications

network, and the information relating to the matching paint colour is provided to the user via the telecommunications network.

28. An apparatus according to claim 27, wherein the first image data and second image data is received as any of: i) an email message; ii) an MMS message; and/or iii) as image data in a web page; and wherein the information relating to the matching paint colour is provided as any of i) an email message; ii) an MMS message; iii) an SMS message and/or iv) data in a web page .

29. An apparatus according to any of claims 26 to 28, wherein the first image data and the second image data is produced by the user using an image capture device; wherein the image capture device is preferably any of: i) a digital camera; ii) a camera equipped mobile telephone; and/or iii) a digital camcorder.

30. An apparatus according to any of claims 26 to 29, wherein the determined colorimetry data and/or the known colorimetry data are XYZ tri-stimulus values.

31. An apparatus according to any of claims 26 to 30, wherein the at least one memory and the computer program code are configured to, with the at least one processor, cause the apparatus to further determine complementary colours to the matching colour, and providing information relating to the determined complementary colours to the user.

32. An apparatus according to any of claims 26 to 31, wherein the at least one memory and the computer program code are configured to, with the at least one processor, cause the apparatus to further orient at least the second image data into a known orientation to allow for recognition of the known calibration colour samples therein.

33. An apparatus according to claim 32, wherein the orienting comprises performing edge detection to identify the location of the set of known calibration colour samples in the second image data.

34. An apparatus according to claims 32 or 33, wherein the orienting further comprises identifying a plurality of pre-determined points relating to the set of known calibration colour samples in the second image data and applying a perspective transformation to the second image data in dependence on the location of the identified points to de-skew the image of the set of known calibration colour samples.

35. An apparatus according to claims 32 to 34, wherein the orienting further comprises identifying pre-determined rotational orientation markings relating to the set of known calibration colour samples in the second image data; and rotating the second image data in dependence on the location of the identified rotational orientation marks such that the known calibration colour samples are placed into a known position in the second image data.

36. An apparatus according to any of claims 26 to 35, wherein the determining of the colour calibration characteristics comprises compensating for brightness differences across the set of known calibration colour samples.

37. An apparatus according to claim 36, wherein the compensating comprises determining a first set of one or more functions having a first set of calibration coefficients, the one or more functions relating measured colours of the known calibration colour samples from the second image data to the known colorimetry data of the calibration colour samples and the known position of each known sample in the image; and analysing the determined functions to find a second set of functions having a second set of calibration coefficients, wherein the first and second sets of functions and calibration coefficients are used in calculating the colorimetry data of the unknown colour sample.

38. An apparatus according to claim 37, wherein the compensating further comprises, prior to the determination of the first set of functions, determining a pre-cursor set of functions having a pre-cursor set of calibration coefficients that relate measured colours of the known calibration colour samples from the second image data to the known colorimetry data of the calibration colour

samples without taking into account position of the known colour samples, wherein the pre-cursor set of calibration coefficients are used as part of the first set of calibration coefficients in the determination of the first set of one or more functions.

39. An apparatus according to any of claims 26 to 38, wherein the colour calibration characteristics are determined using *N* known calibration colour samples, wherein *N* is less than the total number of known calibration colour samples across the whole colour space.

40. An apparatus according to claim 39, wherein the *N* known calibration colour samples are those *N* samples that are the closest in colour space to an estimated colour of the unknown colour sample.

41. An apparatus according to claim 40, wherein the estimated colour is obtained by determining a first set of calibration characteristics using all the available known calibration colour samples, and calculating the estimated colour using the first set of calibration characteristics.

42. An apparatus according to claim 39, wherein the *N* known calibration colour samples are those *N* samples used within a confined colour space that the second image data is known to represent.

43. An apparatus according to claim 39, wherein the *N* known calibration colour samples are those *N* samples that have measured colour values from the second image data that are most similar to the measured colour value of the unknown sample from the first image data.

44. An apparatus according to any of claims 39 to 43, wherein *N* is in a range of substantially 5 to substantially 250, or more preferably substantially 10 to substantially 100, or more preferably substantially 20 to substantially 85, or more preferably substantially 30 to substantially 70, or more preferably substantially 40 to substantially 60, or most preferably at or around 50.

45. An apparatus according to any of claims 26 to 44, wherein the calculating comprises:

applying a clustering algorithm to pixel values of pixels representing the unknown colour sample in the first image to determine the number of colours in the sample image; and

returning a colour for each identified cluster.

46. An apparatus according to claim 45, wherein the pixel values are first calibrated using the colour calibration characteristics.

47. An apparatus according to claims 45 or 46, wherein the clustering algorithm in use operates as follows:

i) calculate the mean value of pixels in a cluster;

ii) determine the number of pixels within a predetermined threshold distance of the mean value;

iii) increase the number of clusters if the determined number of pixels is less than a predetermined fraction of the number of pixels in the first image data relating to the unknown sample.

48. An apparatus according to claim 47, and further comprising filtering clusters to remove those clusters from consideration that do not contain a threshold number of pixels within a second threshold distance of the mean of the cluster.

CLAIMS

1. A method, comprising:

receiving first image data relating to an unknown colour sample, colorimetry data for which is to be determined;

receiving second image data relating to a plurality of known calibration colour samples, colorimetry data for which are already known;

determining a plurality of colour calibration characteristics relating colour measurements of the known calibration colour samples from the second image data to the corresponding known colorimetry data of the calibration colour samples;

calculating colorimetry data of the unknown colour sample in dependence on colour measurements thereof from the first image data and the determined colour calibration characteristics; and

matching the determined colorimetry data of the unknown colour sample to a colour palette of paint colours to identify a matching paint colour, and providing information relating to the matching paint colour to a user;

wherein the method is performed by an apparatus comprising at least one processor, and at least one memory including a computer program code, the at least one memory and the computer program code configured to, with the at least one processor, cause the apparatus to perform the method.

2. The method according to claim 1, wherein the first image data and second image data are received from a remote user via a telecommunications network, and the information relating to the matching paint colour is provided to the user via the telecommunications network.

3. The method according to claim 2, wherein the first image data and second image data are received as any of: i) an email message; ii) an MMS message; and/or iii) as image data in a web page; and wherein the information relating to the matching paint colour is provided as any of i) an email message; ii) an MMS message; iii) an SMS message and/or iv) data in a web page.

4. The method according to claim 1, wherein the first image data and the second image data are produced by the user using an image capture device; wherein the image capture device is selected from: i) a digital camera; ii) a camera equipped mobile telephone; and iii) a digital camcorder.

5. The method according to claim 1, wherein the determined colorimetry data and/or the known colorimetry data are XYZ tri-stimulus values.

6. The method according to claim 1, and further comprising determining complementary colours to the matching colour, and providing information relating to the determined complementary colours to the user.

7. The method according to claim 1, and further comprising orienting at least the second image data into a known orientation to allow for recognition of the known calibration colour samples therein.

8. The method according to claim 7, wherein the orienting comprises performing edge detection to identify the location of the set of known calibration colour samples in the second image data.

9. The method according to claim 7, wherein the orienting further comprises identifying a plurality of pre-determined points relating to the set of known calibration colour samples in the second image data and applying a perspective transformation to the second image data in dependence on the location of the identified points to de-skew the image of the set of known calibration colour samples.

10. The method according to claim 7, wherein the orienting further comprises identifying pre-determined rotational orientation markings relating to the set of known calibration colour samples in the second image data; and rotating the second image data in dependence on the location of the identified rotational orientation marks such that the known calibration colour samples are placed into a known position in the second image data.

11. The method according to claim 1, wherein the determining of the colour calibration characteristics comprises compensating for brightness differences across the set of known calibration colour samples.

12. The method according to claim 11, wherein the compensating comprises determining a first set of one or more functions having a first set of calibration coefficients, the one or more functions relating measured colours of the known calibration colour samples from the second image data to the known colorimetry data of the calibration colour samples and the known position of each known sample in the image; and analysing the determined functions to find a second set of functions having a second set of calibration coefficients, wherein the first and second sets of functions and calibration coefficients are used in calculating the colorimetry data of the unknown colour sample.

13. The method according to claim 12, wherein the compensating further comprises, prior to the determination of the first set of functions, determining a pre-cursor set of functions having a pre-cursor set of calibration coefficients that relate measured colours of the known calibration colour samples from the second image data to the known colorimetry data of the calibration colour samples without taking into account position of the known colour samples, wherein the pre-cursor set of calibration coefficients are used as part of the first set of calibration coefficients in the determination of the first set of one or more functions.

14. The method according to claim 1, wherein the colour calibration characteristics are determined using N known calibration colour samples, wherein N is less than the total number of known calibration colour samples across the whole colour space.

15. The method according to claim 14, wherein the N known calibration colour samples are those N samples that are the closest in colour space to an estimated colour of the unknown colour sample.

16. The method according to claim 15, wherein the estimated colour is obtained by determining a first set of calibration characteristics using all the available known calibration colour samples, and calculating the estimated colour using the first set of calibration characteristics.

17. The method according to claim 14, wherein the N known calibration colour samples are those N samples used within a confined colour space that the second image data is known to represent.

18. The method according to claim 14, wherein the N known calibration colour samples are those N samples that have measured colour values from the second image data that are most similar to the measured colour value of the unknown sample from the first image data.

19. The method according to claim 14, wherein N is in a range of substantially 5 to substantially 250.

20. The method according to claim 1, wherein the calculating comprises:

applying a clustering algorithm to pixel values of pixels representing the unknown colour sample in the first image to determine the number of colours in the sample image; and

returning a colour for each identified cluster.

21. The method according to claim 20, wherein the pixel values are first calibrated using the colour calibration characteristics.

22. The method according to claim 20, wherein the clustering algorithm in use operates as follows:

i) calculate the mean value of pixels in a cluster;

ii) determine the number of pixels within a predetermined threshold distance of the mean value;

iii) increase the number of clusters if the determined number of pixels is less than a predetermined fraction of the number of pixels in the first image data relating to the unknown sample.

23. The method according to claim 22, and further comprising filtering clusters to remove those clusters from consideration that do not contain a threshold number of pixels within a second threshold distance of the mean of the cluster.

24. A non-transitory computer readable medium storing a computer program or at least one of a suite of computer programs so arranged such that when run on a computer system it/they cause the computer system to perform the method of claim 1.

25. An apparatus, comprising:

at least one processor; and

at least one memory including a computer program code;

the at least one memory and the computer program code configured to, with the at least one processor, cause the apparatus to perform at least the following:

i) receive first image data relating to an unknown colour sample, colorimetry data for which is to be determined, and second image data relating to a plurality of known calibration colour samples, colorimetry data for which are already known;

ii) determine a plurality of colour calibration characteristics relating colour measurements of the known calibration colour samples from the second image data to the corresponding known colorimetry data of the calibration colour samples;

iii) calculate colorimetry data of the unknown colour sample in dependence on colour measurements thereof from the first image data and the determined colour calibration characteristics;

iv) match the determined colorimetry data of the unknown colour sample to a colour palette of paint colours to identify a matching paint colour, and

v) provide information relating to the matching paint colour to a user.

26. The apparatus according to claim 25, wherein the first image data and second image data are received from a remote user via a telecommunications network, and the information relating to the matching paint colour is provided to the user via the telecommunications network.

27. The apparatus according to claim 26, wherein the first image data and second image data are received as any of: i) an email message; ii) an MMS message; and/or iii) as image data in a web page; and wherein the information relating to the matching paint colour is provided as any of i) an email message; ii) an MMS message; iii) an SMS message and/or iv) data in a web page.

28. The apparatus according to claim 25, wherein the first image data and the second image data is produced by the user using an image capture device; wherein the image capture device is preferably any of: i) a digital camera; ii) a camera equipped mobile telephone; and/or iii) a digital camcorder.

29. The apparatus according to claim 25, wherein the determined colorimetry data and/or the known colorimetry data are XYZ tri-stimulus values.

30. The apparatus according to claim 25, wherein the at least one memory and the computer program code are configured to, with the at least one processor, cause the apparatus to further determine complementary colours to the matching colour, and providing information relating to the determined complementary colours to the user.

31. The apparatus according to claim 25, wherein the at least one memory and the computer program code are configured to, with the at least one processor, cause the apparatus to further orient at least the second image data into a known orientation to allow for recognition of the known calibration colour samples therein.

32. The apparatus according to claim 31, wherein the orienting comprises performing edge detection to identify the location of the set of known calibration colour samples in the second image data.

33. The apparatus according to claim 31, wherein the orienting further comprises identifying a plurality of pre-determined points relating to the set of known calibration colour samples in the second image data and applying a perspective transformation to the second image data in dependence on the location of the identified points to de-skew the image of the set of known calibration colour samples.

34. The apparatus according to claim 31, wherein the orienting further comprises identifying pre-determined rotational orientation markings relating to the set of known calibration colour samples in the second image data; and rotating the second image data in dependence on the location of the identified rotational orientation marks such that the known calibration colour samples are placed into a known position in the second image data.

35. The apparatus according to claim 25, wherein the determining of the colour calibration characteristics comprises compensating for brightness differences across the set of known calibration colour samples.

36. The apparatus according to claim 35, wherein the compensating comprises determining a first set of one or more functions having a first set of calibration coefficients, the one or more functions relating measured colours of the known calibration colour samples from the second image data to the known colorimetry data of the calibration colour samples and the known position of each known sample in the image; and analysing the determined functions to find a second set of functions having a

second set of calibration coefficients, wherein the first and second sets of functions and calibration coefficients are used in calculating the colorimetry data of the unknown colour sample.

37. The apparatus according to claim 36, wherein the compensating further comprises, prior to the determination of the first set of functions, determining a pre-cursor set of functions having a pre-cursor set of calibration coefficients that relate measured colours of the known calibration colour samples from the second image data to the known colorimetry data of the calibration colour samples without taking into account position of the known colour samples, wherein the pre-cursor set of calibration coefficients are used as part of the first set of calibration coefficients in the determination of the first set of one or more functions.

38. The apparatus according to claim 25, wherein the colour calibration characteristics are determined using N known calibration colour samples, wherein N is less than the total number of known calibration colour samples across the whole colour space.

39. The apparatus according to claim 38, wherein the N known calibration colour samples are those N samples that are the closest in colour space to an estimated colour of the unknown colour sample.

40. The apparatus according to claim 39, wherein the estimated colour is obtained by determining a first set of calibration characteristics using all the available known calibration colour samples, and calculating the estimated colour using the first set of calibration characteristics.

41. The apparatus according to claim 38, wherein the N known calibration colour samples are those N samples used within a confined colour space that the second image data is known to represent.

42. The apparatus according to claim 38, wherein the N known calibration colour samples are those N samples that have measured colour values from the second image data that are most similar to the measured colour value of the unknown sample from the first image data.

43. The apparatus according to claim 38, wherein N is in a range of substantially 5 to substantially 250.

44. The apparatus according to claim 25, wherein the calculating comprises:

applying a clustering algorithm to pixel values of pixels representing the unknown colour sample in the first image to determine the number of colours in the sample image; and

returning a colour for each identified cluster.

45. The apparatus according to claim 44, wherein the pixel values are first calibrated using the colour calibration characteristics.

46. The apparatus according to claim 44, wherein the clustering algorithm in use operates as follows:

i) calculate the mean value of pixels in a cluster;

ii) determine the number of pixels within a predetermined threshold distance of the mean value;

iii) increase the number of clusters if the determined number of pixels is less than a predetermined fraction of the number of pixels in the first image data relating to the unknown sample.

47. The apparatus according to claim 46, and further comprising filtering clusters to remove those clusters from consideration that do not contain a threshold number of pixels within a second threshold distance of the mean of the cluster.