

CLAIMS

What is claimed is:

1. A computer-implemented method, comprising:
 - obtaining a first image of an object oriented in a first direction and a second image of the object oriented in a second direction;
 - determining a plurality of feature points of the object in the first image;
 - determining a plurality of matching feature points of the object in the second image that correspond to the plurality of feature points of the object in the first image;
 - calculating similarity values between the plurality of feature points and the corresponding plurality of matching feature points;
 - calculating depth values of the plurality of feature points;
 - calculating weighted depth values based on the similarity values and depth values; and
 - performing 3D modeling of the object based on the weighted depth values.
2. The computer-implemented method of claim 1, further comprising:
 - determining a plurality of initial feature points of the object in the first image; and
 - matching the first image with a first grid that includes a plurality of grid cells, wherein determining a plurality of feature points of the object in the first image further comprises filtering the plurality of initial feature points until the number of feature points is the same in each grid cell, and wherein each grid cell includes at least one initial feature point.
3. The computer-implemented method of claim 2, wherein determining a plurality of feature points of the object in the first image further comprising:
 - calculating distances from the plurality of initial feature points to center points of the grid cells the plurality of initial feature points are located; and
 - determining, for each grid cell that includes at least one initial feature point, an initial feature point that is closest to the center of the grid cell as the feature point.

4. The computer-implemented method of claim 2, wherein determining a plurality of feature points of the object in the first image further comprising determining a center point of a grid cell as a feature point of the grid cell if the grid cell does not include an initial feature point.

5. The computer-implemented method of claim 3, further comprising:

determining, a plurality of pre-matching feature points in the second image that correspond to the plurality of feature points based on direction information of the object in the first image and the object in the second image; and

matching the second image with a second grid; and wherein determining a plurality of matching feature points of the object in the second image further comprises determining center points of grid cells of the second grid that include at least one pre-matching feature point as the plurality of matching feature points in the second image.

6. The computer-implemented method of claim 5, wherein determining the similarity values between the plurality of feature points and the corresponding plurality of matching feature points further comprises:

determining color values of all pixels within the grid cells of the first grid that include at least one feature point;

determining color values of all pixels within the grid cells of the second grid that include at least one matching feature point;

calculating average color value differences between all the pixels within the grid cells of the first grid that include at least one feature point and all the pixels within the grid cells of the second grid that include at least one matching feature point; and

determining the similarity values of the plurality of feature points and the corresponding plurality of matching feature points based on the average color value differences.

7. The computer-implemented method of claim 6, wherein a weighted depth value of a feature point is calculated as:

$$\text{weighted depth value} = \text{depth value} \times (\text{sum of the average color value differences of the plurality of feature points except the feature point subject to the weighted depth value calculation} / \text{sum of the average color value differences of the plurality of feature points}).$$

8. The computer-implemented method of claim 5, wherein the area of the grid cells of the second grid are smaller than the area of the grid cells of the first grid.
9. The computer-implemented method of claim 1, further comprising:
 - filtering the plurality of feature points based on the similarity values before calculating the weighted depth values.
10. The computer-implemented method of claim 9, wherein filtering the plurality of feature points further comprising:
 - determining a feature point eliminating threshold based on the similarity values; and
 - eliminating a feature point when its corresponding similarity value is less than the feature point eliminating threshold.
11. The computer-implemented method of claim 2, wherein the grid cells of the first grid have triangular shape.
12. A non-transitory, computer-readable medium storing one or more instructions executable by a computer system to perform operations comprising:
 - obtaining a first image of an object oriented in a first direction and a second image of the object oriented in a second direction;
 - determining a plurality of feature points of the object in the first image;
 - determining a plurality of matching feature points of the object in the second image that correspond to the plurality of feature points of the object in the first image;
 - calculating similarity values between the plurality of feature points and the corresponding plurality of matching feature points;
 - calculating depth values of the plurality of feature points;
 - calculating weighted depth values based on the similarity values and depth values; and
 - performing 3D modeling of the object based on the weighted depth values.

13. The non-transitory, computer-readable medium of claim 12, further comprising:
determining a plurality of initial feature points of the object in the first image; and
matching the first image with a first grid that includes a plurality of grid cells, wherein
determining a plurality of feature points of the object in the first image further comprises filtering
the plurality of initial feature points until the number of feature points is the same in each grid cell,
and wherein each grid cell includes at least one initial feature point.
14. The non-transitory, computer-readable medium of claim 13, wherein determining a plurality
of feature points of the object in the first image further comprising:
calculating distances from the plurality of initial feature points to center points of the grid
cells the plurality of initial feature points are located; and
determining, for each grid cell that includes at least one initial feature point, an initial
feature point that is closest to the center of the grid cell as the feature point.
15. The non-transitory, computer-readable medium of claim 14, further comprising:
determining, a plurality of pre-matching feature points in the second image that correspond
to the plurality of feature points based on direction information of the object in the first image and
the object in the second image; and
matching the second image with a second grid; and wherein determining a plurality of
matching feature points of the object in the second image further comprises determining center
points of grid cells of the second grid that include at least one pre-matching feature point as the
plurality of matching feature points in the second image.
16. A computer-implemented system, comprising:
one or more computers; and
one or more computer memory devices interoperably coupled with the one or more
computers and having tangible, non-transitory, machine-readable media storing instructions that,
when executed by the one or more computers, perform operations comprising:
obtaining a first image of an object oriented in a first direction and a second image
of the object oriented in a second direction;
determining a plurality of feature points of the object in the first image;

determining a plurality of matching feature points of the object in the second image that correspond to the plurality of feature points of the object in the first image;

calculating similarity values between the plurality of feature points and the corresponding plurality of matching feature points;

calculating depth values of the plurality of feature points;

calculating weighted depth values based on the similarity values and depth values;

and

performing 3D modeling of the object based on the weighted depth values.

17. The computer-implemented system of claim 16, further comprising:

determining a plurality of initial feature points of the object in the first image; and

matching the first image with a first grid that includes a plurality of grid cells, wherein determining a plurality of feature points of the object in the first image further comprises filtering the plurality of initial feature points until the number of feature points is the same in each grid cell, and wherein each grid cell includes at least one initial feature point.

18. The computer-implemented system of claim 17, wherein determining a plurality of feature points of the object in the first image further comprising:

calculating distances from the plurality of initial feature points to center points of the grid cells the plurality of initial feature points are located; and

determining, for each grid cell that includes at least one initial feature point, an initial feature point that is closest to the center of the grid cell as the feature point.

19. The computer-implemented system of claim 18, further comprising:

determining, a plurality of pre-matching feature points in the second image that correspond to the plurality of feature points based on direction information of the object in the first image and the object in the second image; and

matching the second image with a second grid; and wherein determining a plurality of matching feature points of the object in the second image further comprises determining center

points of grid cells of the second grid that include at least one pre-matching feature point as the plurality of matching feature points in the second image.

20. The computer-implemented system of claim 19, wherein determining the similarity values between the plurality of feature points and the corresponding plurality of matching feature points further comprises:

- determining color values of all pixels within the grid cells of the first grid that include at least one feature point;

- determining color values of all pixels within the grid cells of the second grid that include at least one matching feature point;

- calculating average color value differences between all the pixels within the grid cells of the first grid that include at least one feature point and all the pixels within the grid cells of the second grid that include at least one matching feature point; and

- determining the similarity values of the plurality of feature points and the corresponding plurality of matching feature points based on the average color value differences.