TRANSIT LOCATION SYSTEMS AND METHODS USING LIDAR

CROSS REFERENCE TO RELATED APPLICATIONS

(01) The present application claims priority to U.S. Provisional Patent Application No. 62/924,017, filed October 21, 2019, entitled "LIDAR RTLS PROJECT," and U.S. Provisional Patent Application No. 62/945,785, filed December 9, 2019, entitled "TRANSIT LOCATION SYSTEMS AND METHODS USING LIDAR," the disclosures thereof incorporated by reference herein in their entirety.

BACKGROUND

(02) The present disclosure relates generally to transportation intelligence, and more specifically to systems and methods for identification of transit location.

SUMMARY

(02a) According to a first aspect of the present invention, there is provided a system, comprising:

a hardware processor; and

a non-transitory machine-readable storage medium encoded with instructions executable by the hardware processor to perform a method comprising:

receiving a 3D image comprising LIDAR data, the 3D image captured from a vehicle on a pathway;

transforming the 3D image into a first 2D image by converting the LIDAR data for a point in the 3D image into color data in a color space for a corresponding point in the first 2D image, wherein the LIDAR data for the point includes a distance value and a reflectivity value, and wherein converting the LIDAR data for the point comprises:

mapping the distance value for the point to a value of a first component of the color space, and

mapping the reflectivity value for the point to a value of a second component of the color space; and

determining a location of the vehicle along the pathway, comprising:

comparing the first 2D image to a plurality of second 2D images each captured at a respective known location along the pathway,

selecting one or more of the second 2D images based on the comparing, and

determining the location of the vehicle along the pathway based on the known location where the selected one or more of the second 2D images was captured.

(02b) According to a second aspect of the present invention, there is provided a non-transitory machine-readable storage medium encoded with instructions executable by a hardware processor of a computing component, the machine-readable storage medium comprising instructions to cause the hardware processor to perform a method comprising:

receiving a 3D image comprising LIDAR data, the 3D image captured from a vehicle on a pathway;

transforming the 3D image into a first 2D image by converting the LIDAR data for a point in the 3D image into color data in a color space for a corresponding point in the first 2D image, wherein the LIDAR data for the point includes a distance value and a reflectivity value, and wherein converting the LIDAR data for the point comprises:

mapping the distance value for the point to a value of a first component of the color space, and

mapping the reflectivity value for the point to a value of a second component of the color space; and

determining a location of the vehicle along the pathway, comprising:

comparing the first 2D image to a plurality of second 2D images each captured at a respective known location along the pathway,

selecting one or more of the second 2D images based on the comparing, and

determining the location of the vehicle along the pathway based on the known location where the selected one or more of the second 2D images was captured.

(02c) According to a third aspect of the present invention, there is provided a computer-implemented method comprising:

receiving a 3D image comprising LIDAR data, the 3D image captured from a vehicle on a pathway;

transforming the 3D image into a first 2D image by converting the LIDAR data for a point in the 3D image into color data in a color space for a corresponding point in the first 2D image, wherein the LIDAR data for the point includes a distance value and a reflectivity value, and wherein converting the LIDAR data for the point comprises:

mapping the distance value for the point to a value of a first component of the color space, and mapping the reflectivity value for the point to a value of a second component of the color space; and

determining a location of the vehicle along the pathway, comprising:

comparing the first 2D image to a plurality of second 2D images each captured at a respective known location along the pathway,

selecting one or more of the second 2D images based on the comparing, and

determining the location of the vehicle along the pathway based on the known location where the selected one or more of the second 2D images was captured.

(03) Embodiments of the present disclosure provide systems and methods for tracking information relating to transportation vehicles. For example, some embodiments of the disclosure provide a system for enhanced location and data collection from vehicles traveling along a vehicle pathway. For example, the vehicle may be a light rail train, a commuter train, a freight train, an automobile, an airplane, a ship, a space vehicle, a ski lift, a gondola, or other forms of transportation as known in the art. The transportation pathway may be any pathway along which the respective vehicle moves, such as a train track, a road, a canal or shipping lane, a runway, an airway, or other vehicle pathways as known in the art.

(04) The method may include capturing a 3D image from the vehicle on the pathway the vehicle is traveling. The vehicle may employ Light Detection and Ranging (LIDAR) technology to generate the 3D image of the pathway. In one

CLAIMS

What is claimed is:

1. A system, comprising:

a hardware processor; and

a non-transitory machine-readable storage medium encoded with instructions executable by the hardware processor to perform a method comprising:

receiving a 3D image comprising LIDAR data, the 3D image captured from a vehicle on a pathway;

transforming the 3D image into a first 2D image by converting the LIDAR data for a point in the 3D image into color data in a color space for a corresponding point in the first 2D image, wherein the LIDAR data for the point includes a distance value and a reflectivity value, and wherein converting the LIDAR data for the point comprises:

mapping the distance value for the point to a value of a first component of the color space, and

mapping the reflectivity value for the point to a value of a second component of the color space; and

determining a location of the vehicle along the pathway, comprising:

comparing the first 2D image to a plurality of second 2D images each captured at a respective known location along the pathway,

selecting one or more of the second 2D images based on the comparing, and

determining the location of the vehicle along the pathway based on the known location where the selected one or more of the second 2D images was captured.

2. The system of claim 1, the method further comprising:

capturing the 3D image.

3. The system of claim 2, wherein capturing the 3D image comprises:

capturing the LIDAR data with a LIDAR unit mounted on the vehicle.

4. The system of claim 1, the method further comprising:

deselecting one or more of the selected second 2D images as false positive matches prior to determining the location of the vehicle.

5. The system of claim 1, wherein comparing the first 2D image to the plurality of second 2D images comprises:

extracting a plurality of keypoints from each of the first and second 2D images;

generating a respective descriptor for each of the first and second 2D images based on the respective keypoints; and

comparing the descriptor of the first 2D image to the descriptors of each of the second 2D images.

6. The system of claim 1, wherein the vehicle on a pathway is a train on a track.

7. A non-transitory machine-readable storage medium encoded with instructions executable by a hardware processor of a computing component, the machine-readable storage medium comprising instructions to cause the hardware processor to perform a method comprising:

receiving a 3D image comprising LIDAR data, the 3D image captured from a vehicle on a pathway;

transforming the 3D image into a first 2D image by converting the LIDAR data for a point in the 3D image into color data in a color space for a corresponding point in the first 2D image, wherein the LIDAR data for the point includes a distance value and a reflectivity value, and wherein converting the LIDAR data for the point comprises:

mapping the distance value for the point to a value of a first component of the color space, and

mapping the reflectivity value for the point to a value of a second component of the color space; and

determining a location of the vehicle along the pathway, comprising:

comparing the first 2D image to a plurality of second 2D images each captured at a respective known location along the pathway,

selecting one or more of the second 2D images based on the comparing, and

determining the location of the vehicle along the pathway based on the known location where the selected one or more of the second 2D images was captured.

8. The non-transitory machine-readable storage medium of claim 7, the method further comprising:

capturing the 3D image.

9. The non-transitory machine-readable storage medium of claim 8, wherein capturing the 3D image comprises:

capturing the LIDAR data with a LIDAR unit mounted on the vehicle.

10. The non-transitory machine-readable storage medium of claim 7, the method further comprising:

deselecting one or more of the selected second 2D images as false positive matches prior to determining the location of the vehicle.

11. The non-transitory machine-readable storage medium of claim 7, wherein comparing the first 2D image to the plurality of second 2D images comprises:

extracting a plurality of keypoints from each of the first and second 2D images;

generating a respective descriptor for each of the first and second 2D images based on the respective keypoints; and

comparing the descriptor of the first 2D image to the descriptors of each of the second 2D images.

12. The non-transitory machine-readable storage medium of claim 7, wherein the vehicle on a pathway is a train on a track.

13. A computer-implemented method comprising:

receiving a 3D image comprising LIDAR data, the 3D image captured from a vehicle on a pathway;

transforming the 3D image into a first 2D image by converting the LIDAR data for a point in the 3D image into color data in a color space for a corresponding point in the first 2D image, wherein the LIDAR data for the point includes a distance value and a reflectivity value, and wherein converting the LIDAR data for the point comprises:

mapping the distance value for the point to a value of a first component of the color space, and mapping the reflectivity value for the point to a value of a second component of the color space; and

determining a location of the vehicle along the pathway, comprising:

comparing the first 2D image to a plurality of second 2D images each captured at a respective known location along the pathway,

selecting one or more of the second 2D images based on the comparing, and

determining the location of the vehicle along the pathway based on the known location where the selected one or more of the second 2D images was captured.

14. The computer-implemented method of claim 13, further comprising:

capturing the 3D image.

15. The computer-implemented method of claim 14, wherein capturing the 3D image comprises:

capturing the LIDAR data with a LIDAR unit mounted on the vehicle.

16. The computer-implemented method of claim 13, further comprising:

deselecting one or more of the selected second 2D images as false positive matches prior to determining the location of the vehicle.

17. The computer-implemented method of claim 13, wherein comparing the first 2D image to the plurality of second 2D images comprises:

extracting a plurality of keypoints from each of the first and second 2D images;

generating a respective descriptor for each of the first and second 2D images based on the respective keypoints; and

comparing the descriptor of the first 2D image to the descriptors of each of the second 2D images.

18. The computer-implemented method of claim 13, wherein the vehicle on a pathway is a train on a track.