DETECTION OF ENVIRONMENTAL CHANGES TO DELIVERY ZONE

TECHNICAL FIELD

[0001] This disclosure relates generally to detection of environmental changes of a geographic area, and in particular but not exclusively, relates to use of unmanned aerial vehicles (UAVs) for detection of environmental changes to delivery zones.

BACKGROUND INFORMATION

[0002] An unmanned vehicle, which may also be referred to as an autonomous vehicle, is a vehicle capable of travel without a physically-present human operator, in an autonomous mode, or in a partially autonomous mode.

[0003] When an unmanned vehicle operates in a remote-control mode, a pilot or driver that is at a remote location can control the unmanned vehicle via commands that are sent to the unmanned vehicle via a wireless link. When the unmanned vehicle operates in autonomous mode, the unmanned vehicle typically moves based on pre-programmed navigation waypoints, dynamic automation systems, or a combination of these. Further, some unmanned vehicles can operate in both a remote-control mode and an autonomous mode, and in some instances may do so simultaneously. For instance, a remote pilot or driver may wish to leave navigation to an autonomous system while manually performing another task, such as operating a mechanical system for picking up objects, as an example.

[0004] Various types of unmanned vehicles exist for different environments. For instance, unmanned vehicles exist for operation in the air, on the ground, underwater, and in space. Unmanned aerial vehicles (UAVs) are becoming more popular in general and provide opportunities for delivery of goods between locations (*e.g.*, from retailer to consumer).

SUMMARY

[0004a] According to a first aspect of the present invention, there is provided a computer-implemented method for detecting an environmental change to a delivery zone via an unmanned aerial vehicle (UAV), the method comprising: obtaining an anchor image and an evaluation image, each representative of the delivery zone, and wherein a first timestamp of the anchor image is earlier than a second timestamp of the evaluation image; providing the anchor image and the evaluation image to a machine learning model to determine an embedding score associated with a distance between representations of the anchor image

and the evaluation image within an embedding space, and wherein the distance is proportional to a degree of similarity between the anchor image and the evaluation image; and determining an occurrence of the environmental change to the delivery zone when the embedding score is greater than a threshold value.

[0004b] According to a second aspect of the present invention, there is provided a non-transitory computer-readable storage medium having instructions stored thereon that, in response to execution by one or more processors of a computing system, cause the computing system to perform actions comprising: obtaining an anchor image and an evaluation image, each representative of a delivery zone, and wherein a first timestamp of the anchor image is earlier than a second timestamp of the evaluation image; providing the anchor image and the evaluation image to a machine learning model to determine an embedding score associated with a distance between representations of the anchor image and the evaluation image within an embedding space, and wherein the distance is proportional to a degree of similarity between the anchor image and the evaluation image; and determining an occurrence of an environmental change to the delivery zone when the embedding score is greater than a threshold value.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] Non-limiting and non-exhaustive embodiments of the invention are described with reference to the following figures, wherein like reference numerals refer to like parts throughout the various views unless otherwise specified. Not all instances of an element are necessarily labeled so as not to clutter the drawings where appropriate. The drawings are not necessarily to scale, emphasis instead being placed upon illustrating the principles being described.

[0006] FIG. 1 illustrates an aerial map of a geographic area at different instances of time, in accordance with an embodiment of the disclosure.