vehicle moves to another area together with the drone and performs further home delivery (Patent Literature 1). However, this delivery system does not include any special means for accurately reaching a home delivery destination, and it is not clear whether accurate delivery is possible.

[0004]

As a further conventional technology, a system is present in which to secure a drone that delivers a package of goods to a delivery destination, the drone can receive a purchase code associated with purchase of the package of goods, and the drone can land in a landing zone at the delivery destination, when the purchase code is authenticated (Patent Literature 2). This system can be set up in a landing site at a known position of a wireless access point determined and detected with GNSS positioning, by means of recognition of a camera base, a wireless beacon, or the like (paragraph 0019). However, this system does not include any special means for accurately lowering a delivery object down to a target location, and it is not clear whether accurate delivery to the target location is possible.

Citation List

Patent Literature

[0005]

Patent Literature 1: Japanese Patent Laid-Open No. 2016-153337

Patent Literature 2: Japanese Translation of PCT International Application Publication No. 2017-534101

Summary

[0006]

As described above, in conventional technologies, it has been difficult to quickly and accurately specify a target location by use of an unmanned aircraft and to accurately deliver a delivery object to the target location. First of all, this is because a position sensor that senses a flight position as in

GPS has a very large error and hence it is extremely difficult to accurately specify the target location. Furthermore, it is considered that an exterior of the unmanned aircraft is monitored with a camera, and the target location is specified based on an image obtained from the camera, but it is difficult to reliably and accurately specify the target location from the image.

[0007]

The present disclosure has been developed in view of problems described above, and has the following characteristics. That is, according to the present disclosure , provided is an unmanned aircraft including a cord having a predetermined position to which a specific mechanism having a predetermined function is attached, said tether including an extending/retracting mechanism, comprising:

a position sensor that detects a flight position of the unmanned aircraft,

a camera that obtains an image below the unmanned aircraft,

a memory that stores coordinate information of a target location that is a location to operate the specific mechanism, and a target location marker pattern representing an appearance of a target location marker that identifies the target location and is disposed to have a predetermined relative position relationship with the target location,

an automatic flight control unit that controls the unmanned aircraft to fly from a departure position toward the target location, based on the flight position detected by the position sensor,

a flight position correction unit that refers to the target location marker pattern, detects an image portion corresponding to the target location marker from the image obtained by the camera, obtains a relative position between the unmanned aircraft and the target location marker based on the

detected image portion of the target location marker, and controls the automatic flight control unit to guide the unmanned aircraft directly above the target location based on the relative position, and

a tether control unit that controls the extending/retracting mechanism to adjust a length of the tether,

wherein the tether control unit extends the tether to an operating position where the specific mechanism is controlled to perform a specific operation, when a position of the unmanned aircraft is directly above the target location,

wherein the specific mechanism is an attaching/detaching mechanism having a function of holding a delivery object,

the operating position is a release altitude to release the delivery object from the attaching/detaching mechanism,

the attaching/detaching mechanism is adapted to release the delivery object by the specific operation, and

the target location is a position of a delivery destination of the delivery object, and

wherein the delivery object has an upper surface to which a delivery object marker that identifies the delivery object is attached,

the memory further stores a delivery object marker pattern representing an appearance of the delivery object marker, and

the flight position correction unit refers to the delivery object marker pattern while the tether control unit extends the tether, and controls the automatic flight control unit to guide the unmanned aircraft so that the delivery object is lowered down to the target location based on an image portion of the delivery object marker that is included in the image obtained by the camera. In an embodiment, it is characterized by referring to a target location marker pattern representing an appearance of a target location marker disposed to have a predetermined relative position relationship with a target location, detecting an image portion corresponding to the target

location marker from an image obtained by a camera that obtains the image below the unmanned aircraft, and guiding the unmanned aircraft directly above the target location based on the image portion.

[0008]

In the present disclosure, the cord can be a tether including an extending/retracting mechanism. The present disclosure may have a configuration that extends the tether to an operating position where the specific mechanism is controlled to perform a specific operation, when a position of the unmanned aircraft is directly above the target location. The present disclosure may have a configuration that extends the tether to the operating position based on the image obtained by the camera.

[0009]

The present disclosure may have a configuration where an

attaching/detaching mechanism having a function of holding a delivery object operates as the specific mechanism to release the delivery object from the attaching/detaching mechanism at a release altitude that is the operating position, in the target location that is a position of a delivery destination of the delivery object. The present disclosure may have a configuration that further stores a delivery object marker pattern representing an appearance of a delivery object marker attached to an upper surface of the delivery object, refers to the delivery object marker pattern while the tether is extended, and guides the unmanned aircraft so that the delivery object is lowered down to the target location, based on an image portion of the delivery object marker that is included in the image obtained by the camera.

[0010] The present disclosure may have a configuration where the delivery object marker is a code pattern, and have a configuration that specifies a three-dimensional position of the delivery object based on a position and size of the image portion of the delivery object marker in the image obtained by the camera. The present disclosure may have a configuration where the release altitude is a ground altitude at which the delivery object is grounded, and the attaching/detaching mechanism includes an automatic release mechanism that releases the held delivery object, when the delivery object is grounded. The present disclosure may have a configuration that senses decrease in lift required to keep the unmanned aircraft at a constant ground altitude, to determine that the delivery object is released from the attaching/detaching mechanism.

[0011] The present disclosure may have a configuration where the release altitude is a ground altitude at which the delivery object is grounded, and a configuration that releases the attaching/detaching mechanism, when sensing that the delivery object is grounded. The present disclosure may have a configuration that senses decrease in lift required to keep the unmanned aircraft at a constant ground altitude, to determine that the

delivery object is grounded. The present disclosure may have a configuration that detects a distance between the unmanned aircraft and the delivery object marker, based on a size of the image portion of the delivery object marker that is included in the image obtained by the camera. The present disclosure may have a configuration that releases the attaching/detaching mechanism when the delivery object is lowered down to the release altitude, based on the detected distance between the unmanned aircraft and the delivery object marker, and a ground altitude of the unmanned aircraft. In the present disclosure, the release altitude may be the ground altitude at which the delivery object is grounded. The present disclosuremay have a configuration where the target location marker is a two-dimensional code pattern, and a configuration that specifies a three-dimensional relative position with the target location, based on a position and size of an image portion of the target location marker in the image obtained by the camera.

[0012]

The present disclosure may be the unmanned aircraft having the above described characteristics, a method to be executed by the unmanned aircraft, a computer program that achieves the unmanned aircraft when executed by a computer, or a recording medium in which the program is stored.

[0013] The present disclosure has a configuration of referring to a target location marker pattern representing an appearance of a target location marker disposed to have a predetermined relative position relationship with a target location, detecting an image portion corresponding to the target

Claims

[Claim 1]

An unmanned aircraft including a tether having a predetermined portion to which a specific mechanism having a predetermined function is attached, said tether including an extending/retracting mechanism, comprising:

a position sensor that detects a flight position of the unmanned aircraft,

a camera that obtains an image below the unmanned aircraft,

a memory that stores coordinate information of a target location that is a location to operate the specific mechanism, and a target location marker pattern representing an appearance of a target location marker that identifies the target location and is disposed to have a predetermined relative position relationship with the target location,

an automatic flight control unit that controls the unmanned aircraft to fly from a departure position toward the target location, based on the flight position detected by the position sensor,

a flight position correction unit that refers to the target location marker pattern, detects an image portion corresponding to the target location marker from the image obtained by the camera, obtains a relative position between the unmanned aircraft and the target location marker based on the detected image portion of the target location marker, and controls the automatic flight control unit to guide the unmanned aircraft directly above the target location based on the relative position, and

a tether control unit that controls the extending/retracting mechanism to adjust a length of the tether,

wherein the tether control unit extends the tether to an operating position where the specific mechanism is controlled to perform a specific operation, when a position of the unmanned aircraft is directly above the target location,

wherein the specific mechanism is an attaching/detaching mechanism having a function of holding a delivery object,

the operating position is a release altitude to release the delivery object from the attaching/detaching mechanism,

the attaching/detaching mechanism is adapted to release the delivery object by the specific operation, and

the target location is a position of a delivery destination of the delivery object, and

wherein the delivery object has an upper surface to which a delivery object marker that identifies the delivery object is attached,

the memory further stores a delivery object marker pattern representing an appearance of the delivery object marker, and

the flight position correction unit refers to the delivery object marker pattern while the tether control unit extends the tether, and controls the automatic flight control unit to guide the unmanned aircraft so that the delivery object is lowered down to the target location based on an image portion of the delivery object marker that is included in the image obtained by the camera.

[Claim 2]

The unmanned aircraft according to claim 1, wherein the tether control unit extends the tether to the operating position based on the image obtained by the camera,

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[Claim 3]

The unmanned aircraft according to claim 1 or 2, wherein the delivery object marker is a code pattern, and

the flight position correction unit specifies a three-dimensional position of the delivery object, based on a position and size of the image portion of the delivery object marker in the image obtained by the camera.

[Claim 4] The unmanned aircraft according to any one of claims 1 to 3, wherein the release altitude is a ground altitude at which the delivery object is grounded, and

the attaching/detaching mechanism includes an automatic release mechanism that releases the held delivery object, when the delivery object is grounded.

[Claim 5] The unmanned aircraft according to claim 4, wherein the tether control unit senses decrease in lift required to keep the unmanned aircraft at a constant ground altitude, to determine that the delivery object is released from the attaching/detaching mechanism.

[Claim 6] The unmanned aircraft according to any one of claims 1 to 5, wherein the release altitude is a ground altitude at which the delivery object is grounded, and

the tether control unit releases the attaching/detaching mechanism, when sensing that the delivery object is grounded.

[Claim 7] The unmanned aircraft according to claim 6, wherein the tether control unit senses decrease in lift required to keep the unmanned aircraft at a constant ground altitude, to determine that the delivery object is

grounded.

[Claim 8] The unmanned aircraft according to any one of claims 1 to 7, wherein the tether control unit detects a distance between the unmanned aircraft and the delivery object marker, based on a size of the image portion of the delivery object marker that is included in the image obtained by the camera.

[Claim 9]

The unmanned aircraft according to claim 8, wherein the tether control unit releases the attaching/detaching mechanism when the delivery object is lowered down to the release altitude, based on the detected distance between the unmanned aircraft and the delivery object marker, and a ground altitude of the unmanned aircraft.

[Claim 10]

The unmanned aircraft according to claim 9, wherein the release altitude is the ground altitude at which the delivery object is grounded.

[Claim 11]

The unmanned aircraft according to any one of claims 1 to 10, wherein the target location marker is a two-dimensional code pattern, and

the flight position correction unit specifies a three-dimensional relative position with the target location, based on a position and size of an image portion of the target location marker in the image obtained by the camera.