AUTOMATED AIR TRAFFIC COMMUNICATIONS

BACKGROUND

[0001] Autonomous and semi-autonomous vehicles can operate in different environments such as in the air, on the ground, underwater, and in space. Aerial autonomous vehicles may be referred to as unmanned aerial systems ("UASs") or unmanned aerial vehicles ("UAVs").

[0002] Various types of communication systems can be used by autonomous, semi-autonomous, and human-controlled aerial vehicles, and/or by ground-based or other non-aerial systems that communicate with aerial vehicles. In some cases, a UAS may have to communicate with manned aerial vehicles, related legacy support system entities (e.g., a manned air-traffic controller station), other UASs, and/or wholly or partially computer-automated air traffic control systems.

SUMMARY

[0003] Techniques and apparatus are provided for aviation communications. When an aircraft travels from point to point, the aircraft can be in communication with a number of different entities, including air traffic control entities that guide the aircraft while taking off, landing, and in flight, and ground control entities that guide the aircraft on land, such as while taxing to or from a runway. The aircraft can determine these communications based on an airspace related to the aircraft. The airspace can be divided into different classifications, such as classifications associated with airports, classifications associated with uncontrolled flight, and other classifications. The aircraft can determine an airspace classification based on position data. Then, the aircraft can use the airspace classification to select a communication repository that store data for generating communications based on the airspace classification and then generate communications with another entity, such as an air traffic control entity, another aircraft, or a ground control entity, using the selected communication repository.

[0003a] According to a first aspect of the present invention, there is provided a computer-implemented method comprising:

receiving (i) position information for an unmanned aerial vehicle, and (ii) audio data encoding one or more aviation communications;

determining an airspace classification based on the position information for the unmanned aerial vehicle;

obtaining, by an automated speech recognizer, a transcription of the audio data based at least on the airspace classification; and

providing the transcription of the audio data for processing by the unmanned aerial vehicle.

[0003b] According to a second aspect of the present invention, there is provided a non-transitory computer-readable storage device encoded with a computer program, the computer program comprising instructions that, when executed by one or more computers, cause the one or more computers to perform operations comprising:

receiving (i) position information for an unmanned aerial vehicle, and (ii) audio data encoding one or more aviation communications;

determining an airspace classification based on the position information for the unmanned aerial vehicle;

obtaining, by an automated speech recognizer, a transcription of the audio data based at least on the airspace classification; and

providing the transcription of the audio data for processing by the unmanned aerial vehicle.

[0003c] According to a third aspect of the present invention, there is provided a computer-implemented method comprising:

receiving position information for an unmanned aerial vehicle;

determining an airspace classification based on the position information for the unmanned aerial vehicle;

generating, by an automated speech synthesizer, audio data based at least on the airspace classification; and

providing the audio data for output.

[0003d] According to a fourth aspect of the present invention, there is provided a non-transitory computer-readable storage device encoded with a computer program, the computer program comprising instructions that, when executed by one or more computers, cause the one or more computers to perform operations comprising:

receiving position information for an unmanned aerial vehicle;

determining an airspace classification based on the position information for the unmanned aerial vehicle;

generating, by an automated speech synthesizer, audio data based at least on the airspace classification; and

providing the audio data for output.

[0004] A method is provided. A computing device receives position data indicating a position of an aerial vehicle, where the position includes an altitude. A first airspace classification at the position of the aerial vehicle is determined from a plurality of possible airspace classifications. Each airspace classification specifies one or more communication parameters for communication within an associated airspace. The computing device selects a first communication repository that is associated with the first airspace classification from a plurality of communication repositories. Each communication repository specifies a set of pre-defined communication components for at least one associated airspace

classification. The computing device generates a communication related to the aerial vehicle using the first communication repository. The generated communication is sent to at least one recipient.

[0005] A computing device is provided. The computing device includes one or more processors; and data storage including at least computer-executable instructions stored thereon that, when executed by the one or more processors, cause the computing device to perform functions. The functions include: receiving position data indicating a position of an aerial vehicle, where the position includes an altitude; determining, from a plurality of possible airspace classifications, a first airspace classification at the position of the aerial vehicle, where each airspace classification specifies one or more communication parameters for communication within an associated airspace; selecting, from a plurality of communication repositories, a first communication repository that is associated with the first airspace classification, where each communication repository specifies a set of pre-defined communication components for at least one associated airspace classification; generating a communication related to the aerial vehicle using the first communication repository; and sending the generated communication to at least one recipient.

[0006] A non-transitory computer readable medium is provided. The non-transitory computer readable medium has stored thereon instructions, that when executed by one or more processors of a computing device, cause the computing device to perform functions. The functions include: receiving position data indicating a position of an aerial vehicle, where the position includes an altitude; determining, from a plurality of possible airspace classifications, a first airspace classification at the position of the aerial vehicle, where each airspace classification specifies one or more communication parameters for communication within an associated airspace; selecting, from a plurality of communication repositories, a first communication repository that is associated with the first airspace classification, where each communication repository specifies a set of pre-defined communication components for at least one associated airspace classification; generating a communication related to the aerial vehicle using the first communication repository; and sending the generated communication to at least one recipient.

[0007] A computing device is provided. The computing device includes: means for receiving position data indicating a position of an aerial vehicle, where the position includes an altitude; means for determining, from a plurality of possible airspace classifications, a first airspace classification at the position of the aerial vehicle, where each airspace classification specifies one or more communication parameters for communication

within an associated airspace; means for selecting, from a plurality of communication repositories, a first communication repository that is associated with the first airspace classification, where each communication repository specifies a set of pre-defined communication components for at least one associated airspace classification; means for generating a communication related to the aerial vehicle using the first communication repository; and means for sending the generated communication to at least one recipient.

[0008] A system is provided: The system includes an aerial vehicle and a computing device. The aerial vehicle computing device is configured to perform aerial-vehicle functions. The aerial-vehicle functions include: sending position data indicating a position of the aerial vehicle, where the position includes an altitude. The computing device includes one or more processors and data storage including at least computer-executable instructions stored thereon that, when executed by the one or more processors, cause the computing device to perform computing-device functions. The computing-device functions include: receiving the position data indicating the position of the aerial vehicle, where the position includes the altitude; determining, from a plurality of possible airspace classifications, a first airspace classification at the position of the aerial vehicle, where each airspace classification specifies one or more communication parameters for communication within an associated airspace; selecting, from a plurality of communication repositories, a first communication repository that is associated with the first airspace classification, where each communication repository specifies a set of pre-defined communication components for at least one associated airspace classification; generating a communication related to the aerial vehicle using the first communication repository; and sending the generated communication to at least one recipient.

[0009] The foregoing summary is illustrative only and is not intended to be in any way limiting. In addition to the illustrative aspects, embodiments, and features described above, further aspects, embodiments, and features will become apparent by reference to the figures and the following detailed description and the accompanying drawings.

CLAIMS

1. A computer-implemented method comprising:

receiving (i) position information for an unmanned aerial vehicle, and (ii) audio data encoding one or more aviation communications;

determining an airspace classification based on the position information for the unmanned aerial vehicle;

obtaining, by an automated speech recognizer, a transcription of the audio data based at least on the airspace classification; and

providing the transcription of the audio data for processing by the unmanned aerial vehicle.

2. The method of claim 1, wherein the one or more aviation communications are directed to the unmanned aerial vehicle.

3. The method of claim 1, wherein the position information for the unmanned aerial vehicle comprises an altitude of the unmanned aerial vehicle.

4. The method of claim 1, wherein the position information for the unmanned aerial vehicle comprises GPS coordinates for the unmanned aerial vehicle.

5. The method of claim 1, wherein obtaining the transcription of the audio data based at least on the airspace classification comprises:

selecting one or more topics of communication associated with the airspace classification.

6. The method of claim 1, wherein obtaining the transcription of the audio data based at least on the airspace classification comprises:

limiting a vocabulary associated with the automated speech recognizer based at least on the airspace classification.

7. The method of claim 6, wherein limiting the vocabulary comprises selecting a subset of communication data from among a universal set of possible communication data.

8. The method of claim 1, wherein obtaining the transcription of the audio data based at least on the airspace classification comprises:

selecting a subset of a universal set of communications data based at least on the airspace classification.

9. The method of claim 1, wherein the automated speech recognizer comprises speech recognition software.

10. A non-transitory computer-readable storage device encoded with a computer program, the computer program comprising instructions that, when executed by one or more computers, cause the one or more computers to perform operations comprising:

receiving (i) position information for an unmanned aerial vehicle, and (ii) audio data encoding one or more aviation communications;

determining an airspace classification based on the position information for the unmanned aerial vehicle;

obtaining, by an automated speech recognizer, a transcription of the audio data based at least on the airspace classification; and

providing the transcription of the audio data for processing by the unmanned aerial vehicle.

11. The device of claim 10, wherein the one or more aviation communications are directed to the unmanned aerial vehicle.

12. The device of claim 10, wherein the position information for the unmanned aerial vehicle comprises an altitude of the unmanned aerial vehicle.

13. The device of claim 10, wherein the position information for the unmanned aerial vehicle comprises GPS coordinates for the unmanned aerial vehicle.

14. A computer-implemented method comprising:

receiving position information for an unmanned aerial vehicle;

determining an airspace classification based on the position information for the unmanned aerial vehicle;

generating, by an automated speech synthesizer, audio data based at least on the airspace classification; and

providing the audio data for output.

15. The method of claim 14, wherein the audio data comprises a spoken air traffic control message from the unmanned aerial vehicle.

16. The method of claim 14, wherein the position information for the unmanned aerial vehicle comprises an altitude of the unmanned aerial vehicle.

17. The method of claim 14, wherein the position information for the unmanned aerial vehicle comprises GPS coordinates for the unmanned aerial vehicle.

18. The method of claim 14, wherein generating the audio data comprises:

selecting one or more topics of communication associated with the airspace classification.

19. The method of claim 14, wherein generating the audio data based at least on the airspace classification comprises:

limiting a vocabulary associated with the automated speech synthesizer based at least on the airspace classification.

20. The method of claim 19, wherein limiting the vocabulary comprises selecting a subset of communication data from among a universal set of possible communication data.

21. The method of claim 14, wherein generating the audio data based at least on the airspace classification comprises:

selecting a subset of a universal set of communications data based at least on the airspace classification.

22 The method of claim 14, wherein the automated speech synthesizer comprises speech synthesis software.

23. A non-transitory computer-readable storage device encoded with a computer program, the computer program comprising instructions that, when executed by one or more computers, cause the one or more computers to perform operations comprising:

receiving position information for an unmanned aerial vehicle;

determining an airspace classification based on the position information for the unmanned aerial vehicle;

generating, by an automated speech synthesizer, audio data based at least on the airspace classification; and

providing the audio data for output.

24. The device of claim 23, wherein the audio data comprises a spoken air traffic control message from the unmanned aerial vehicle.