CLAIMS:

1. A lightshow control system for generating a lightshow across a plurality of pixel devices, the lightshow control system comprising:

a controller configured to receive input from a lightshow operator and to generate a plurality of lightshow parameters based on such input, wherein the plurality of lightshow parameters include location-based display actions;

a beacon transmitter in communication with the lightshow controller and configured to receive the plurality of lightshow parameters from the lightshow controller, encode the plurality of lightshow parameters on a beacon signal, and broadcast the beacon signal to the plurality of pixel devices, wherein each of the plurality of pixel devices is configured to receive and decode the beacon signal to perform selected location-based display actions for the lightshow; wherein the beacon transmitter is configured to encode a timing reference on the beacon signal to synchronize initiation of the location-based display actions across the plurality of pixel devices; and

a positioning signal transmitter and a plurality of speaker nodes in communication with the positioning signal transmitter, wherein to each one of the plurality of speaker nodes the positioning signal transmitter transmits a tone generation signal and in response to receiving the tone generation signal the speaker node emits an audio signal for trilateration and/or multilateration by the plurality of the pixel devices enabling each of the plurality of pixel devices to determine its pixel location and select the location-based display actions to perform.

2. The system according to claim 1 wherein the timing reference comprises a time since a starting reference point.

3. The system according to claim 2 wherein the starting reference point comprises a first beat of the lightshow or a first beat of the current lightshow scene.

4. The system according to any one of claims 1 to 3 wherein the beacon transmitter is configured to broadcast the beacon signal as one or more batches of repeated data

packets.

5. The system according to claim 4 wherein the beacon transmitter is configured to broadcast the beacon signal so that the time between transmission of successive data packets in each batch is t_m, wherein t_m is between 15 ms to 30 ms, and the timing reference encoded in each of the data packets subsequent to the first data packet is incremented by t_m from the timing reference encoded in the preceding data packet.

6. The system according to either one of claims 4 and 5 wherein each batch of repeated data packets comprises 15 to 25 data packets.

7. The system according to any one of claims 4 to 6 wherein the beacon transmitter is configured to update the transmitter's Media Access Control (MAC) address to encode a new MAC address for each batch of data packets.

8. The system according to any one of claims 4 to 7 wherein the beacon transmitter is configured to encode a new identification number on the beacon signal for each batch of data packets.

9. The system according to any one of claims 1 to 8 wherein based on the plurality of lightshow parameters, the beacon transmitter is configured to encode a play scene command on the beacon signal, wherein the play scene command is defined by one or more of: a scene type, a set of color IDs, a gradient speed, a scene transition, and Beats Per Minute (bpm).

10. The system according to any one of claims 1 to 9 wherein based on the plurality of lightshow parameters, the beacon transmitter is configured to encode a heartbeat message on the beacon signal, wherein the heartbeat message is defined by the timing reference and one or more of: Beats Per Minute (bpm), a beat mode type, a time signature and a speed of sound.

11. The system according to any one of claims 1 to 10 wherein the audio signal is an ultrasonic audio signal.

12. The system according to any one of claims 1 to 11 wherein the audio signal is characterized by a frequency in the range of 16 kHz to 24 kHz.

13. The system according to any one of claims 1 to 12 wherein each one of the plurality of speaker nodes is configured to emit the audio signal simultaneously with the other speaker nodes.

14. The system according to claim 13 wherein each one of the plurality of speaker nodes comprises a tone generator, an amplifier and an omnidirectional speaker array which are configured to produce the audio signal, wherein the audio signal comprises a tone that is characterized by a frequency which is different from the other speaker nodes.

15. The system according to claim 13 wherein each one of the plurality of speaker nodes comprises a tone generator, an amplifier and an omnidirectional speaker array which are configured to produce the audio signal, wherein the audio signal comprises a chirp that is characterized by increasing and/or decreasing frequency over time which is different from the other speaker nodes.

16. The system according to any one of claims 1 to 15 wherein the positioning signal transmitter comprises a Radio Frequency (RF) transmitter configured to transmit the tone generation signal as an RF signal, and each one of the plurality of speaker nodes comprises an RF receiver for receiving the RF signal from the positioning signal transmitter.

17. The system according to claim 16 wherein the positioning signal transmitter is configured to transmit the tone generation signal as a plurality of RF signals at equally spaced time

intervals to the plurality of speaker nodes, and upon receiving each RF signal, each of the speaker nodes is configured to clock the time elapsed since the start of the preceding time interval and determine a signal generation time period based on a set of clocked times.

18. The system according to claim 17 wherein each of the speaker nodes is configured to take the lowest of the set of clocked times as the signal generation time, wherein the speaker node generates and emits the audio signal when the signal generation time period following the start of the next time interval has elapsed.

19. The system according to either one of claims 17 or 18 wherein each of the speaker node is configured to refrain from emitting an audio signal if the times within the set of clocked times have a spread of more than a certain predetermined threshold.

20. The system according to any one of claims 1 to 19 wherein the plurality of speaker nodes comprises four or more speaker nodes.

21. The system according to claim 20 wherein the plurality of speaker nodes comprises six speaker nodes.

22. The system according to either one of claims 20 or 21 wherein at least one of the plurality of speaker nodes is positioned at a different height from the other speaker nodes.

23. The system according to any one of claims 1 to 22 wherein based on the plurality of lightshow parameters, the beacon transmitter is configured to encode a venue configuration message on the beacon signal, wherein the venue configuration message is defined by one or more of: a set of speaker node locations, a set of speaker node tone IDs, and an origin offset.

24. The system according to any one of claims 1 to 23 wherein based on the plurality of lightshow parameters, the beacon transmitter is configured to encode a locate pixel

message on the beacon signal, wherein upon receiving the locate pixel message each one of the plurality of pixel devices starts recording for audio signals emitted by the plurality of speaker nodes.

25. The system according to any one of claims 1 to 24 wherein the beacon transmitter comprises a Bluetooth Low Energy (BLE) beacon transmitter configured to transmit the beacon signal as a BLE signal.

26. The system according to any one of claims 1 to 25 wherein the controller comprises a display and is configured to provide a graphical user interface via the display to receive input from the lightshow operator and enable dynamic and real time generation and modification of the plurality of lightshow parameters based on such input.

27. A method performed by a pixel device for contributing to a lightshow display across a plurality of such pixel devices, the method comprising:

scanning for and receiving at the pixel device a beacon signal broadcast from a beacon transmitter;

decoding the beacon signal to determine a plurality of lightshow parameters, wherein the plurality of lightshow parameters include location-based display actions; and

performing the selected location-based display actions for the light show;

wherein the method further comprises: scanning for and receiving a heartbeat signal broadcast from a beacon transmitter; decoding a timing reference from the heartbeat signal; and initiating the location-based display actions at a start time based on the timing reference

recording a plurality of audio signals emitted concurrently from a plurality of speaker nodes, wherein each speaker node emits an audio signal in a frequency distinct from the other speaker nodes;

filtering and processing the audio signals based on their distinct frequencies to determine differences between time of arrival for each audio signal (TDOA);

receiving location information for each of the plurality of speaker nodes; and

based at least in part on the TDOA and the location information, determining the location of the pixel device using trilateration and/or multilateration and selecting the location-based display actions to perform based on the location of the pixel device.

28. The method according to claim 27 wherein the location-based display actions comprises one or more of: displaying at least one image or a series of images on a display screen of the pixel device; flashing a light source on the pixel device; and vibrating the pixel device.

29. The method according to claim 28 wherein the location-based display actions comprises displaying a scene for the lightshow, wherein the scene comprises a sequential display of colors displayed on a display screen of the pixel device.

30. The method according to claim 29 wherein the scene is characterized by one or more of: a scene type, a set of color IDs, a gradient speed, a scene transition, and Beats Per Minute (bpm).

31. The method according to any one of claims 27 to 30 wherein the pixel device comprises a Bluetooth receiver and scanning for the beacon signal comprises scanning for a BLE beacon signal.

32. The method according to any one of claims 27 to 31 comprising: in response to not receiving the heartbeat signal within a heartbeat timeout period, stopping the one or more display actions and/or restarting the Bluetooth receiver.

33. The method according to any one of claims 27 to 32 wherein the timing reference comprises a time since a starting reference point.

34. The method according to claim 33 wherein the starting reference point comprises a first

beat of the lightshow or a first beat of the current lightshow scene.

35. The method according to any one of claims 27 to 34 wherein the pixel device comprises a handheld mobile device, such as a smartphone or a tablet.

36. The method according to any one of claims 27 to 35 wherein the location information is decoded from a beacon signal transmitted by the beacon transmitter.

37. The method according to any one of claims 27 to 36 wherein the plurality of sound signals is emitted by at least four sound speaker nodes.

38. The method according to claim 37 wherein the plurality of sound signals is emitted by six speaker nodes.

39. The method according to any one of claims 27 to 38 wherein selecting the location-based display actions to perform comprises receiving display commands for an animated scene and identifying the one or more display actions to be performed by the pixel device based on its corresponding location in a display representation of the animated scene.