

each control command can be clearly identified and send to the control side 920 for vehicle movement control.

Use of the 3D control card 500 for real-time control of a virtual drone is illustrated in Figure 10. As shown in Figure 10(a), a control system 1000 comprises the 3D-control card 500 for two-channel control signal generation, a processing circuit 1010 for triboelectric output to square wave output conversion, MCU 1012 for counting the number of output peaks in both channels and sending the corresponding control commands, and a computer 1014 for generating the respective movements of the drone after receiving the control commands. Figures 10(b-g) depict the finger operations of the 3D-control card 500 on its two surfaces, the generated signals from the two channels after the processing circuit, and the corresponding movements of the drone in virtual space with six degrees of freedom (up/down, forward/backward, left/right, horizontal left/right rotation, diagonal left/right rotation, and vertical up/down rotation).

In further embodiments, the grid structure may be configured using information coding. In a first example of this type of configuration, the grid structure may be encoded with large/small electrode width, where the output patterns can be differentiated through the relative amplitude of output peaks (also referred to herein as L/S coding). The second type of configuration is based on information coding with and/or without a strip electrode at a pre-defined position (also referred to herein as 0/1 coding). Accordingly, the output signal patterns can be interpreted from the positions of the generated signal peaks in the time domain.

Advantageously, by the use of L/S or 0/1 coding, it is possible to reduce the number of grid lines required to differentiate between different directions in the plane of the sensor, resulting in a more compact device design. Embodiments therefore enable the realisation of highly scalable and single-electrode triboelectric interfaces, for various applications including 3D control, security, VR/AR, human-machine interaction, robotics, etc.