Echo-Feather: A Controlled Acoustic Levitation Platform for Electronics Manufacturing

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With the global electronics market projected to double in the next decade, the need for faster-printed circuit board (PCB) assembly methods is more apparent than ever. This study aims to develop a new acoustic levitation platform that could be used to suspend and transport small electronic components for contactless PCB populating. For that purpose, a custom two-layer circuit board was developed, which included 64 emitters and amplifiers with the ability to control each of them individually. The modular design of the board allowed for the connection of multiple platforms together. By changing (shifting) phases of the emitters separately, the levitating object could be moved precisely in the air. An FPGA-based main controller, that would generate the phases for all the emitters, was mounted on top of the main PCB, which allowed its easy removal and reprogramming. To receive the necessary information, the main board was connected to a custom-written computer simulation of the acoustic field via an SPI protocol. By combining two platforms, situated opposite to each other, a stable static levitation, as well as precise (with deviation of 0.5mm) and fast (more than 50mm/s) movement of the suspended object were achieved. Levitation of diverse solids (foam, silicon, and ceramics) was shown to be stable as well. Overall, this research presents a new design of an acoustic levitation platform, which ensures fast and precise electronics placement, as well as ease of scaling the system, due its modular design, making electronics manufacturing cheaper and minimizing production defects.

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