Developing a New Acoustic Levitation Platform Design for Non-Contact Handling in Electronics Assembly

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In this study, a new acoustic levitation prototype was developed in order to test novel PNP (pick-andplace) machine designs. This new method addresses the issues of conventional designs -their complexity, low speeds, and high cost. The prototype used an installation consisting of 64 emitters and 32 transistors to amplify signals. Both components were placed on a single PCB, utilizing an easier amplifier circuit and new board layout, which allows for lower complexity compared to similar designs. A computer program was used to calculate phases for each individual emitter and send them to the system. Transponders, emitting phase-modulated waves, created a pressure difference above and below a point, "trapping" the particle, and, by calculating phase-shifts using Gorkov's formula, particles could be moved over the platform in 3 directions. After conducting multiple experiments, it has been shown that stable levitation of small particles and electronic components, their precise manipulation (accuracy of 0.05 mm), is possible. This method provides a movement speed of around 50 mm/second and the ability to transport more than 2,000 components per hour. Multi-particle independent stable manipulation has been achieved, allowing for faster speeds. This research shows the possibility of using levitation for new PNP machines. This can reduce production defects, as no need is required for contact with components. A prototype of an acoustic levitation platform was created, which used new techniques to make it cheaper, such as using a single PCB for both amplifiers and transponders and utilizing a simpler amplifier circuit. The next steps should be achieving even faster speed and accuracy by adding more transponders to the system and creating a levitation-based PNP machine prototype.

human participants	potentially hazardous biological agents					
vertebrate animals	microorganisms	rDNA	tissue			
2. I/we worked or used equipment in a regulated research institution or industrial setting (Form 1C):				YES	X	NO
3. This project is a continuation of previous research (Form 7):				YES	X	NO
4. My display board includes non-published photographs/visual depictions of humans (other than myself):				YES	×	NO
 This abstract describes only procedures perform research, and represents one year's work only: 	ned by me/us, reflects my/c	ur own independent	×	YES		NO
6. I/we hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.			×	YES		NO
The stamp or embossed seal attests that this project is in con	npliance with all federal and stat	e laws and regulations and the	t all			
appropriate reviews and approvals have been obtained inclu	aing the final clearance by the S	cientific Review Committee.				

1. In this research project, the student directly handled, manipulated, or interacted with (check ALL that apply):

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