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A simulation study on the optical behavior of individual voxels for three dimensional displays: Synopsis

In this project, we perform two-dimensional and three-dimensional device simulations to analyze small-scale structures that can be designed to absorb energy efficiently and exude electrical energy in the form of light. Based on our findings, we propose that these small-scale structures can be programmed to generate a three-dimensional screen or a hologram. Each structure would be considered a voxel (volumetric pixel). By utilizing the third dimension to create displays, the limitations of a two-dimensional surface can be subverted. As most artificial objects can be devolved into a set of fundamental shapes or functions, our understanding is that the outcome of this project will provide a deep insight in controlling the arrangement and movement of the voxels efficiently to enrich device performance. This innovative form of interactivity will provide a better perception to improve the productivity of three dimensional displays which is sure to enhance usability, understanding and entertainment.

It should be noted that this idea is still very much in a preliminary phase, and a wealth of additional research is required to truly produce something of value. However, the groundwork and basic models have been established—this is what will be presented. This idea is proposed as an alternative method of generating three-dimensional imagery, without the complications arising from manipulating light itself into the desired shape; instead, the physical nanostructures can arrange themselves, and then emit the light at the desired wavelengths/colors. Thus, the above issues can be effectively subverted.

In an ideal situation, the final product will resemble a designated, confined space at which these structures can move freely and effectively in a medium of low viscosity and proper density. By navigating towards each other by commands from a remote source, the entities form programmable shapes and proceed to generate light of an effective luminosity. Possible power sources include bacteria that have been discovered to generate current, solar-to-electrical conversion, and the inclusion of minute semiconductors. Movement can be achieved in a liquid medium through a form of helical or rotating propellers, placed in ideal locations for varying directions of movement (depending on the shape used). For generating the optical features, a Light-Emitting Diode (LED) is the current proposition for embedding within each nanostructure. LEDs are efficient in modulating colors, as well as their widespread use in current technologies (smartphones, computers, etc.). Utilizing software developed for many physical and electrical simulations, a simple LED was modelled for basic analysis. The data first modelled the structure and anatomy of the diode in very small dimensions—only a few microns (millionths of a meter) in length and width. The luminous power generated by this simulated LED peaked at approximately 24 watts per centimeter—a rate that is ambiguous in desirability, given the varying nature of pixel strips in different screens. However, based on these results, a Light-Emitting Diode is potentially the most optimal light-generating mechanism thus far.