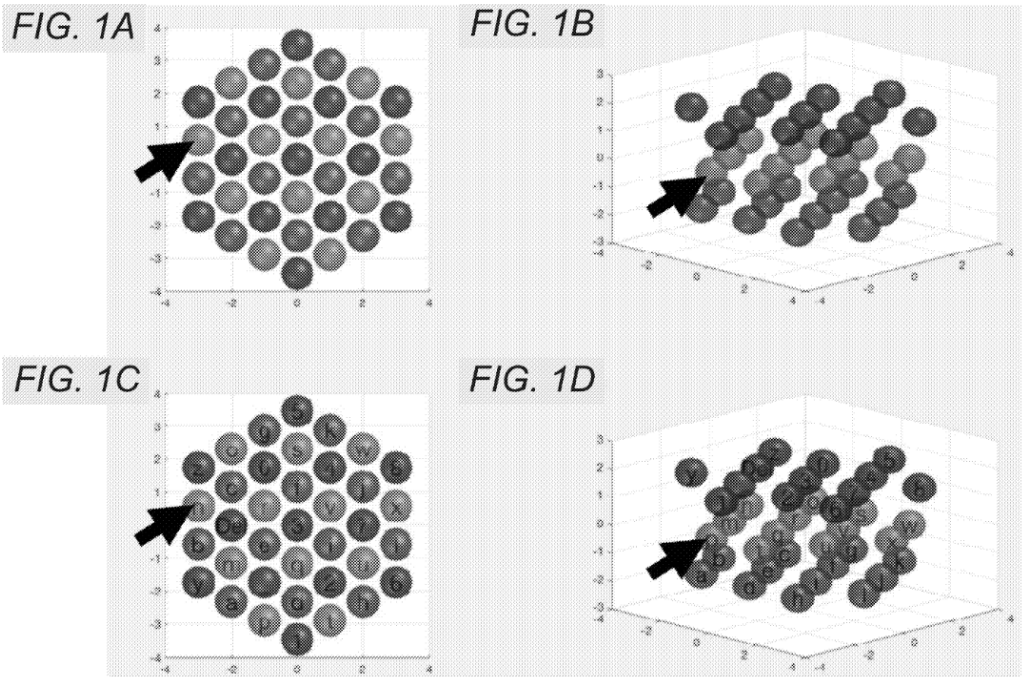
**Docket #:** S18-371

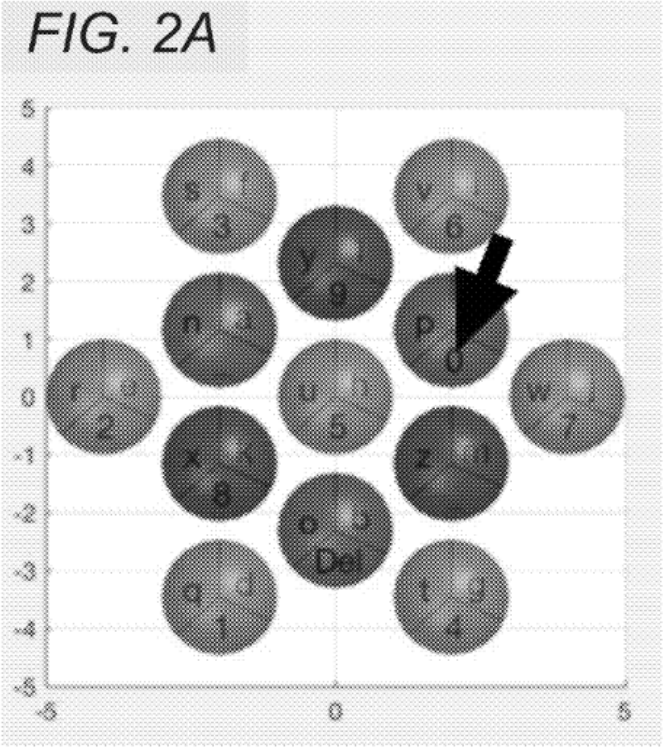
# High dimensional virtual keyboard

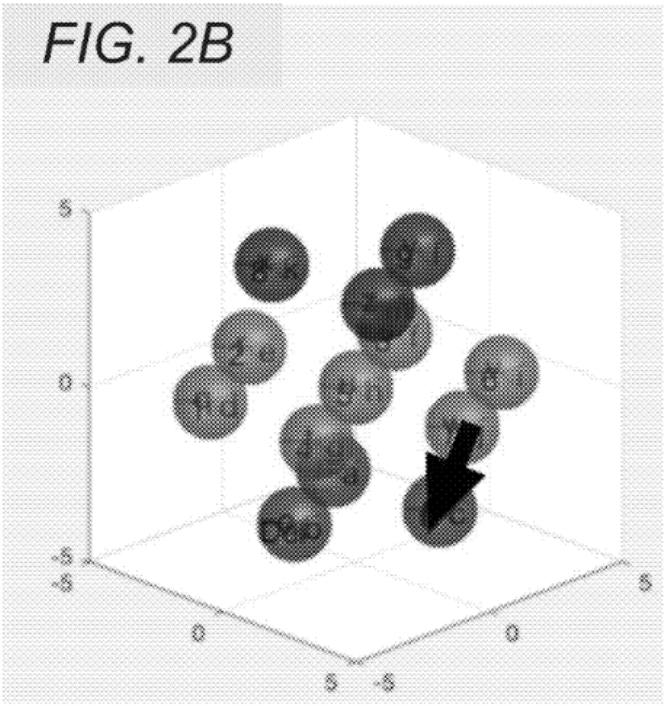
Stanford researchers have developed an efficient, virtual keyboard to facilitate independence and faster communication for those who use assistive technology. Communicating through typing can be essential to daily life, work, and entertainment when the ability to speak is limited. Existing keyboards are designed for 10-digit typing and are suboptimal and slow for 1-digit typing, which is typical for assistive technology. The Shenoy Group takes advantage of 3 and 4 dimensions available to cursor movement controlled by brain computer interface (or eye-tracking) to improve typing efficiency. The high dimensional virtual keyboard has multiple, semi-transparent layers of keys that are located behind each other (see Fig. 1). The selection of a key can be done with a 3D-cursor in a 3D visualization (figures 1 B & D) or with discrete action to browse between the keyboard layers in a 2D visualization (figures 1 A & C).




3D Virtual Keyboard (B&D) and 2D Visualization of the Keyboard (A&C)

The 4D-keyboard is a 3D-keyboard where each key is divided into smaller keys (see Fig. 2). Selection of a key is via 4D-cursor, which is a 3D cursor with rotation where the direction of the arrow is also controllable.




4D Virtual Keyboard

These keyboard designs can cut the average distance between keys by half, double the typing rate, and improve the clinical viability of typing technologies for people with paralysis. Typing performance can be life-changing for these users, and make the difference between using the system to communicate or not.

**Stage of Development – Proof of Concept**
The Shenoy Group parametric keyboard optimizes keyboard design depending on the number of keys – a 26 key layout will be different than a 36 key layout. The integration of the keyboard with eye tracking and BCI is ongoing.

## Applications

- **Computer peripheral / input device, in particular for:**
  - Eye tracking and brain computer interface (BCI) assisted devices
  - Assistive technology for people with paralysis

## Advantages

- Doubles typing speed and performance
- Ease of use improves communication and tool adoption

## Publications


- Even-Chen, Nir, and Krishna Vaughn Shenoy. "Systems and Methods for Virtual Keyboards for High Dimensional Controllers." U.S. Patent Application 16/664,738, filed April 30, 2020.


## Patents

- Published Application: 20200133486
- Issued: 10,949,086 (USA)

## Innovators

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