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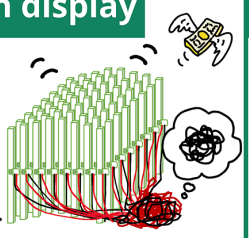
Non-electrical control of magnetic pins shows various shapes

MagneShape: A pin-based display using magnetism

Abstract

Pin-based shape-changing displays provide dynamic shape changes by actuating numerous pins. However, as long as an electric motor is used as an actuator for each pin, the mechanical structure and wiring path become more complex as the pin array size increases. The development of such devices requires in-depth knowledge of engineering and considerable resources. We therefore propose a simple pin-based shape-changing display that outputs shapes and motions without any electronic components. Our magnetically actuated pin-based shape-changing display consists of magnetic pins, a pin housing, and a magnetic sheet. It is easy to build, easy to control, and can display characters, waves, and rapid motions without any linear actuators. We believe this new technology will expand the possibilities for 3D presentation and tactile interaction in homes, schools, and small offices, leading to a richer and greener information technology in the future.

Non-electric approach to pin display

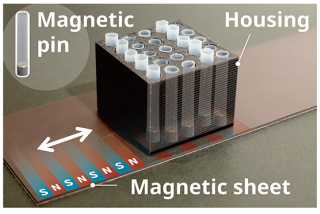


- Pin-based shape-changing displays provide dynamic shape changes by actuating dozens of pins.
- However, it takes considerable knowledge and resources to build a device with many electrical actuators.

→ To create new experiences, pin displays that are inexpensive and easy to build are needed.

➢ **We have developed a simple approach to the creation of magnetically actuated pin displays.** [1]

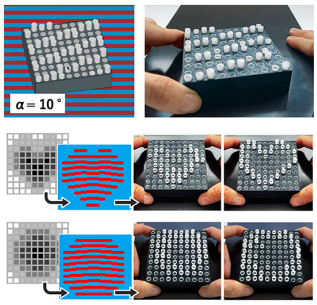
Simple design, versatile expression



Simple construction

MagneShape consists of magnetic pins, a pin array housing, and a magnetic sheet.

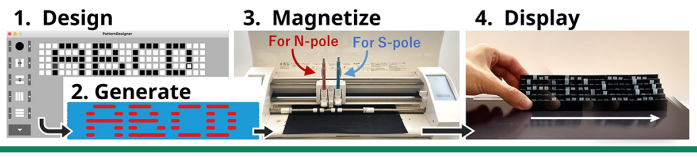
➢ **Easy to build, and no additional complexity with more pins.**



Various expressions

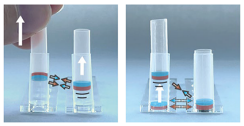
Different pin motions can be created by moving the magnetic sheet in different directions and at different speeds.

➢ **Using our design tools, it can display waves, characters, and simple animations.**



Magnetic pin control

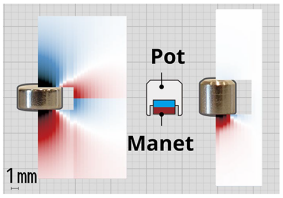
Pin levitation height control with higher pin density



The stronger the magnetic field, the higher the magnetic pin levitates. However, too strong a magnetic force attracts/repels adjacent magnetic pins.

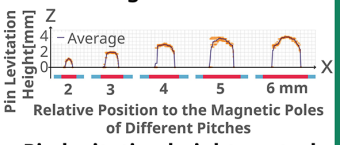
➢ **Using pot magnets allows for a denser array of pins.**

- Pot magnets are magnets made by fixing a permanent magnet in a high permeability pot.
- The distance required to avoid magnetic interference is reduced from 23.4 mm to about 6 mm.



Pot concentrates the magnetic field

➢ **We demonstrated that the maximum levitation height varied as the magnetic stripe width was changed.**



Pin levitation height control

Alternative fabrication methods for pins

Cost and Availability

Commercial pot magnets are very limited in size, shape, and

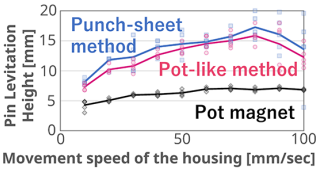
➢ **We have devised two alternative approaches for the magnetic pins.**

- Pins of various sizes and shapes can now be created
- Material costs are significantly reduced

➢ **Pins fabricated with the alternative methods levitate higher.**

Punch-sheet method
Using a hole puncher and magnetic sheet.

Pot-like method
Create a pot-like structure using common metal parts.



Improved levitation height

[1] K. Yasu, "MagneShape: a non-electrical pin-based shape-changing display," in *Proc . UIST '22*, 2022.

References

[1] K. Yasu, "MagneShape: a non-electrical pin-based shape-changing display," in *Proc. The 35th Annual ACM Symposium on User Interface Software and Technology (UIST '22)*, 2022.

Contact

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