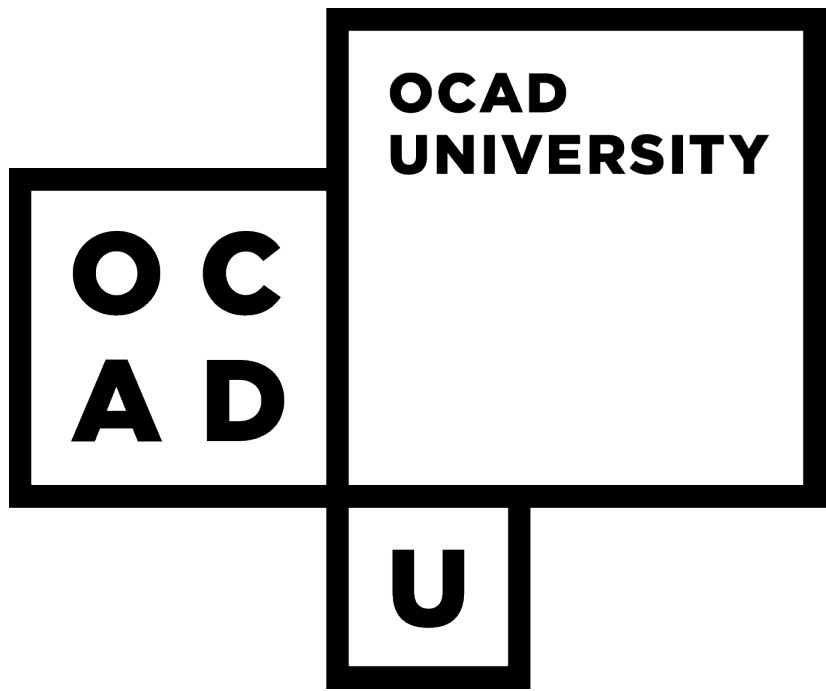


Haptic pattern representation using music technologies

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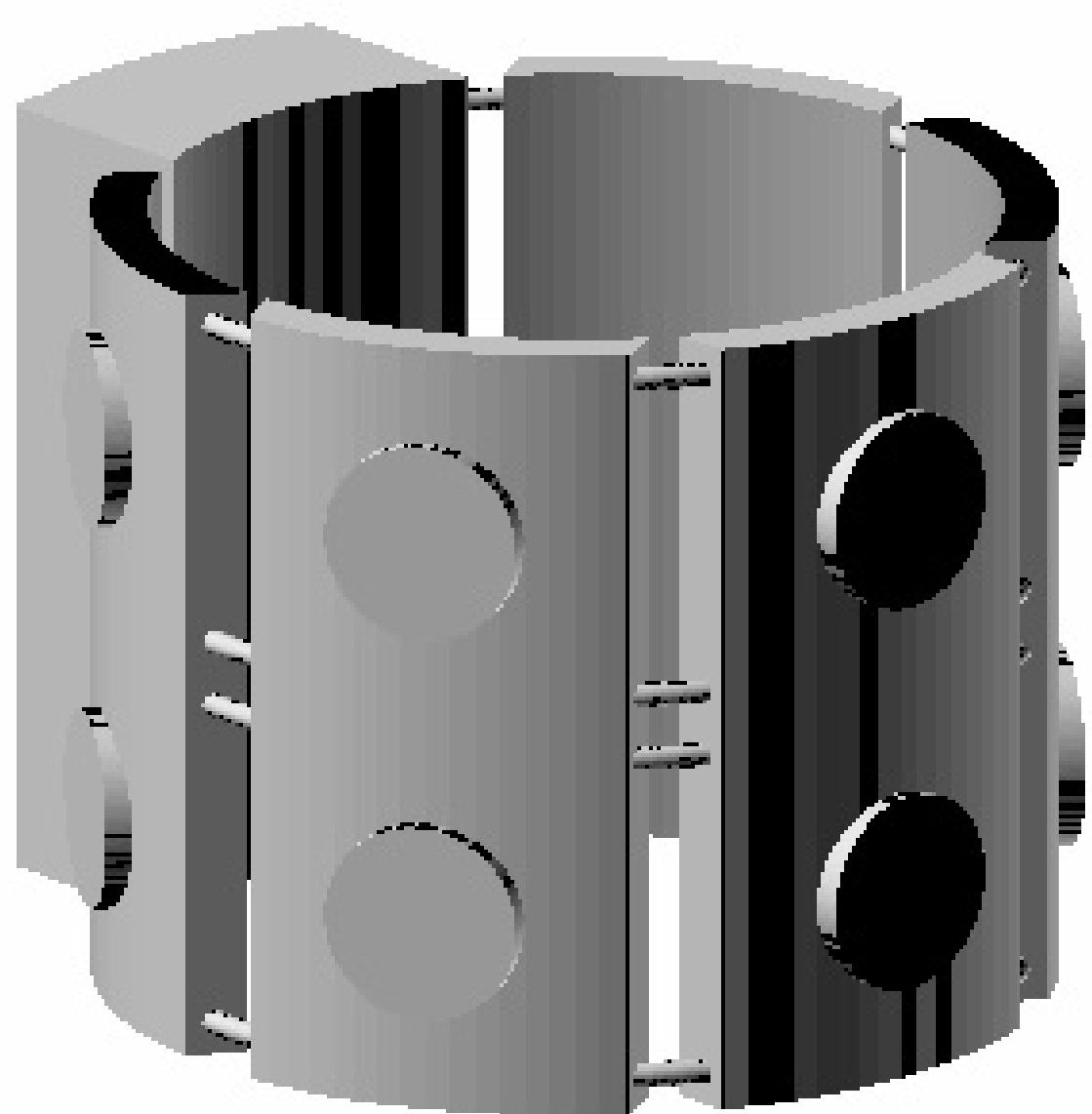


Introduction

Wrist-wearable vibrotactile arrays can serve many functions: typically they are used for non-disruptive notification from social media. They can also be used for direction finding, gaming and entertainment. Authoring and programming of wrist-wearable vibrotactile arrays can be difficult because of the lack of standardized notational systems and file formats. We propose that standard musical notation is an appropriate method for standardization and compositional expressiveness.

What?

We are developing a MIDI-driven, wrist-wearable device that integrates with a gaming app on an accompanying smartphone. The wrist device includes LED lights, vibe motors and buttons that activate when vibe motors are touched. A wrist-wearable vibrotactile device, or what we call a *vibe bracelet*, needs activation patterns to operate. It is unclear how to design such patterns in a standardized way using the technology closest at hand, which in our case is low-level code written in the C or Wiring languages.



Vibrotactile band with 2x5 tactor array.

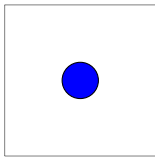
Conclusion

Acknowledgements

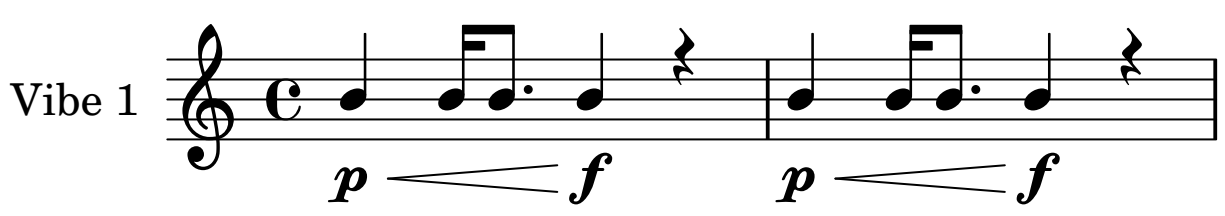
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Device with no spatial dimension (0D = point)



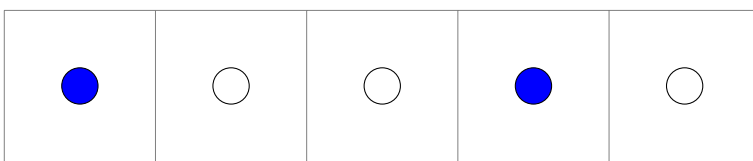
Schematic of a device with a single vibe motor



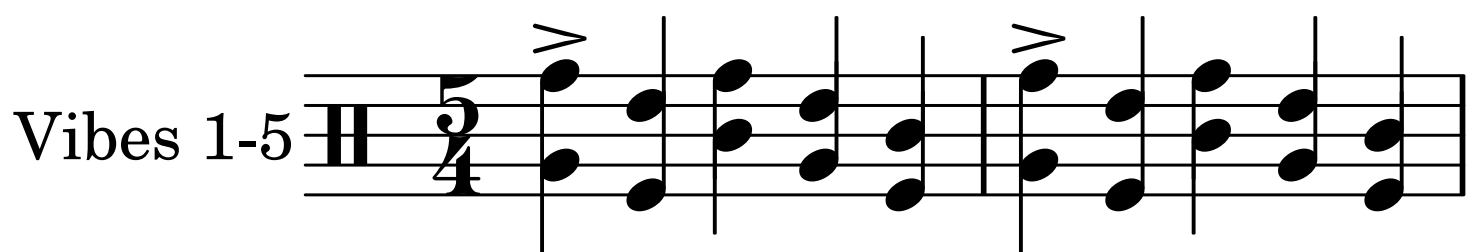
Score for single vibe motor playing a simple solo rhythm

- Specifies activation for a single component
- Time = horizontal axis
- Horizontal, or rhythmic information as per standard musical notation
- Vertical position does not vary (therefore, unpitched notation would also be suitable)
- For most vibe motors pitch remains constant, but intensity can vary; Intensity specified by dynamics markings
- Information is not very dense (single line score would suffice)
- **NEXT STEP** notate for multiple vibe motors

Device with one spatial dimension (1D = linear) Vertical note position maps to five components



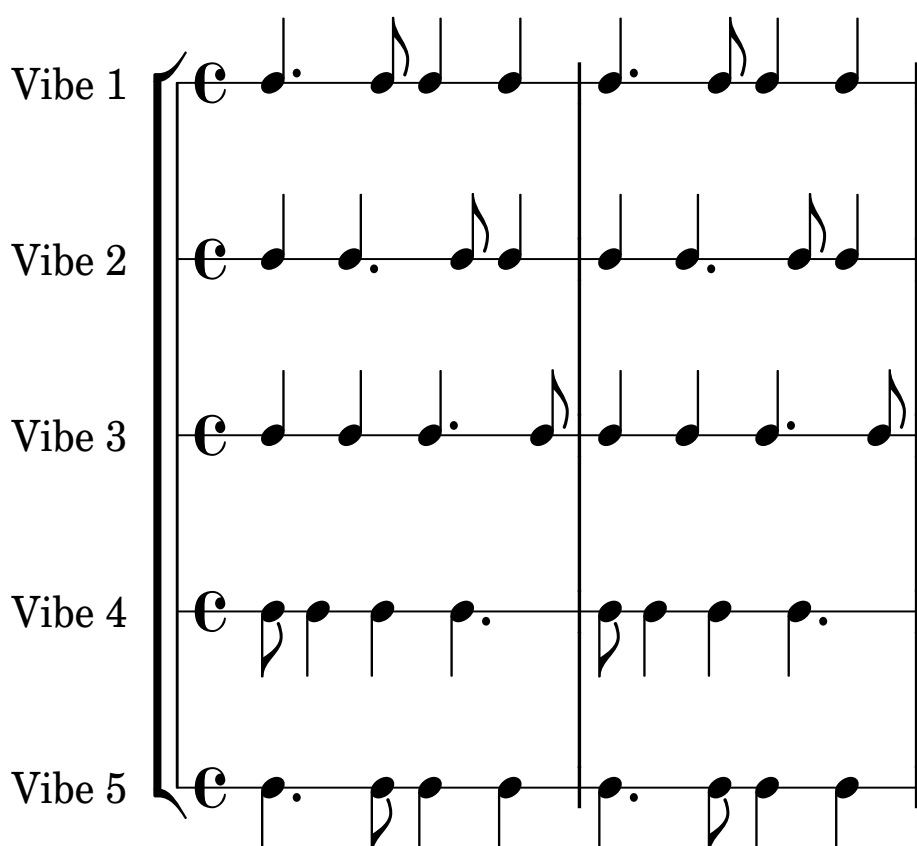
Schematic of a device with a line of vibe motors.



Score for a linear array of five vibe motors

- Specifies activations for five, independent vibe motor components
- Time = horizontal axis
- Notation is for unpitched components and uses five staff lines
- Each part occupies one staff line (rests are hidden)
- Vertical staff position specifies vibe motor to activate; top line=1, second line=2, etc.
- MIDI number for note \Rightarrow vibe motor address
- **PROBLEM** Putting five parts on one staff is hard to read
- **NEXT STEP** Make notation less dense and more readable

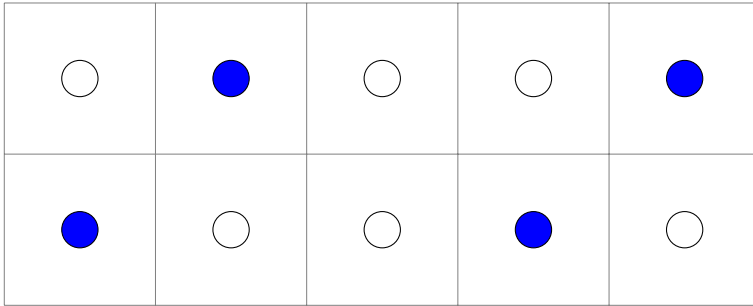
Part numbering maps to five components



Score for a linear array of five vibe motors

- Specifies activations for five, independent components
- Time = horizontal axis
- Five part rhythmic notation
- MIDI number derived from part number \Rightarrow vibe motor address
- **NEXT STEP** Make notation suitable for two dimensional arrays of vibe motors

Device with two spatial dimension (2D = planar)



Schematic of a device with an array of vibe motors



Score where each staff represents one column of vibe motors



Score where each staff represents one row of vibe motors

- Time = horizontal, x-axis
- Ten dimensions need independent addressability
- Needed: either five systems (for columns) or two systems (for rows)