

# Multimodal Attention Arousal in Head-Mounted Displays

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## Motivation

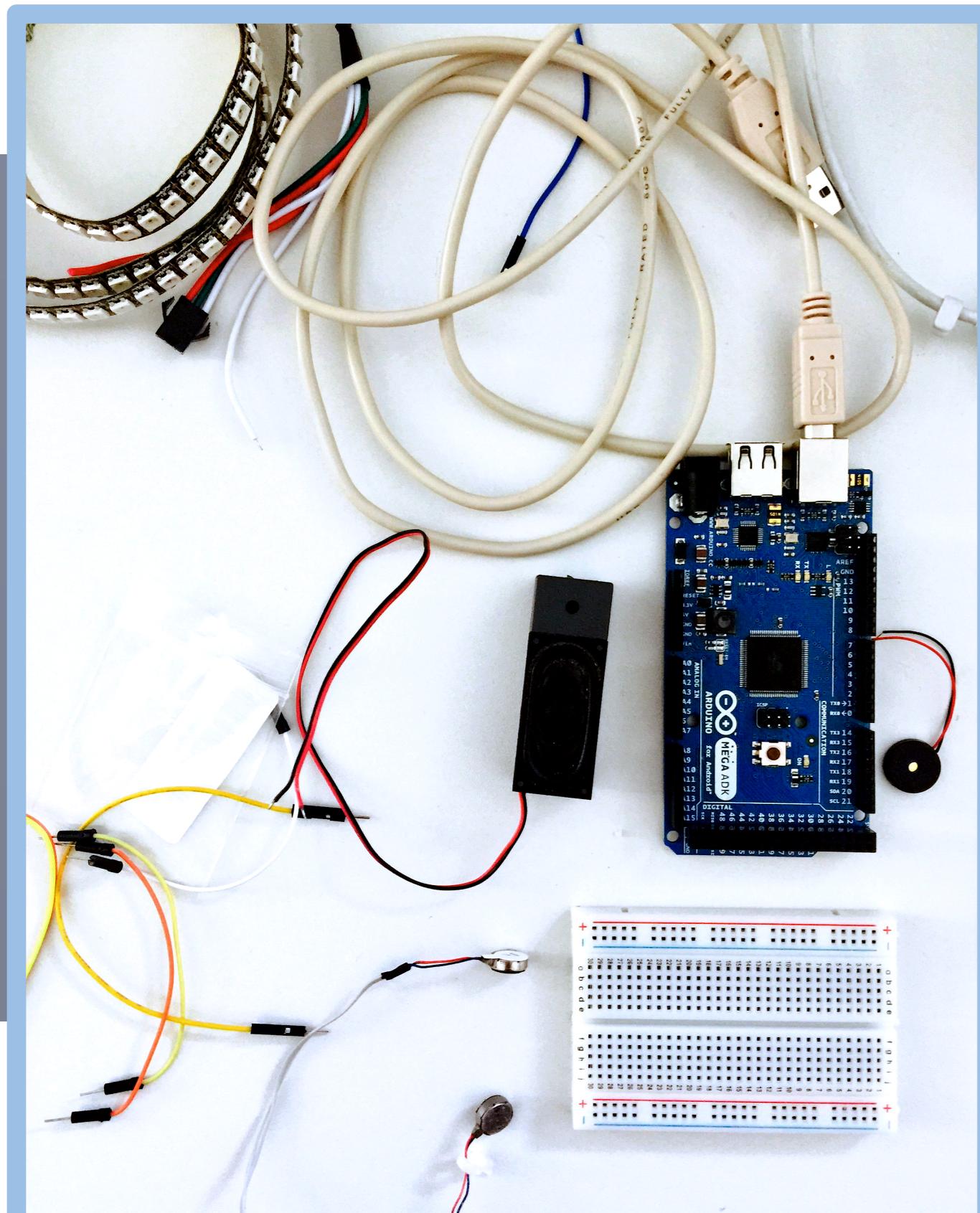
Noise desensitization & alarm fatigue of staff working in loud, safety-critical environments

(ex. vital patient data in hospitals, collision time of ships)

## Planning

Use vibro-tactile and auditory modalities to rouse user attention and gauge urgency level perception of select parameters:

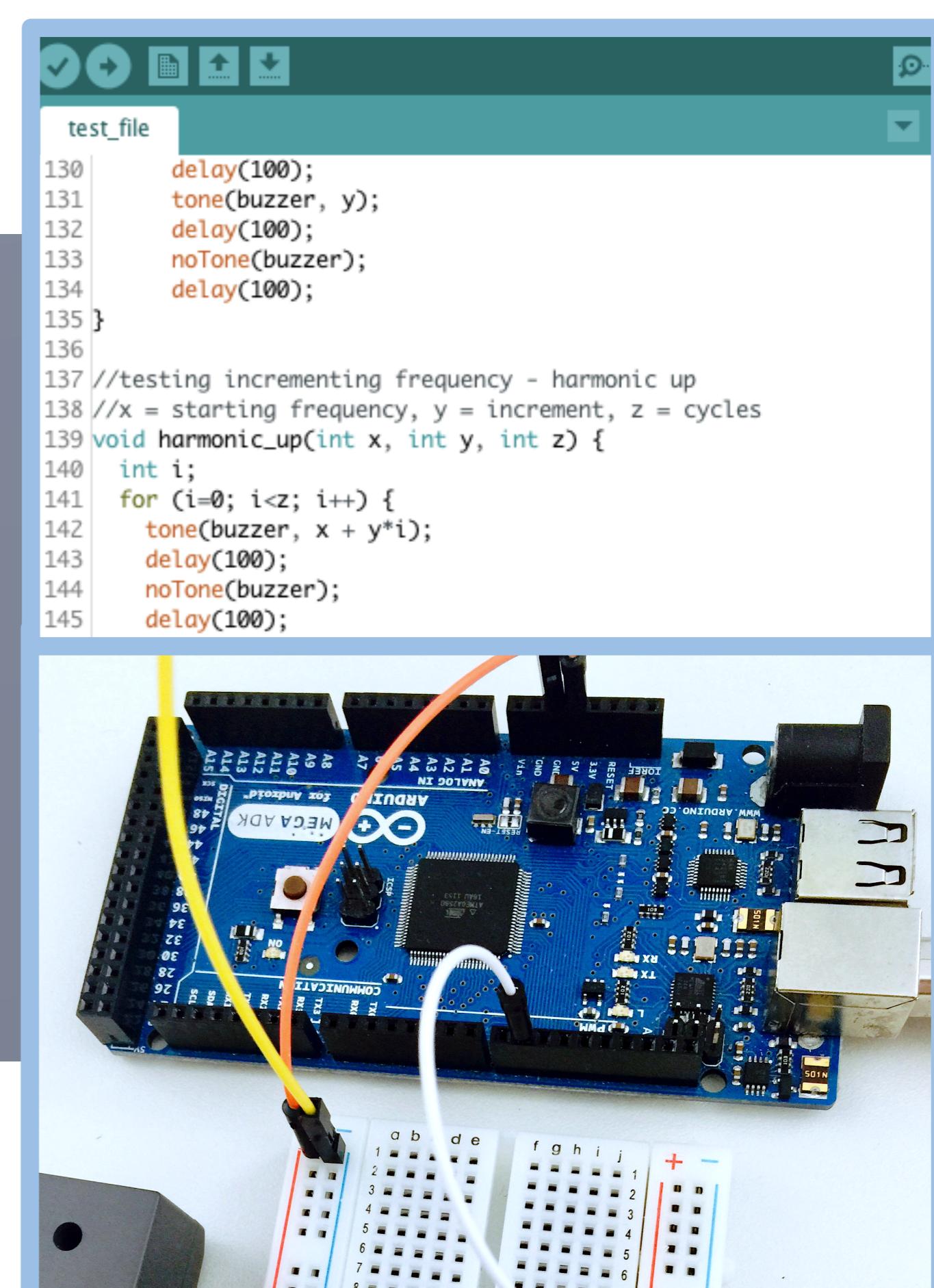
location, duration, frequency, etc.



## Process

Auditory Parameters	Notes	Implications/Thoughts	For Testing
Overall	Auditory is beneficial if message is simple/short, not referenced later, deals with events in time, calls for immediate action, visual cues unrealistic, and/or user has a lot of movement	In Head-Mounted maze experiment, speech feedback was preferred over vibro-tactile. Speech dictation may be more effective than vibro-tactile had lower workload and faster completion/travel distance, may have potential with visually impaired people and modality (Kendegari, "Head-Mounted Conclusion")	It is possible to better use existing "ear-concs" or design your own. "ear-concs" aka metaphoric sounds are more successful and efficient than speech dictation; music is also more effective - independent on user's musical background if using for complex cues
Type	Defined as what type of sound - "beeping" alarm, speech dictation, etc., speech is slow, "earcon" = symbolic sound, divided into three classes: representational, abstract, and semi-abstract (Gardiner, "Auditory Interfaces")	If speech is used, consider the environment, voice/vocalize polyglotic words, better to use tones but beware false alarms (Ghiradelli, "Auditory-Visual Interactions")	Importance of correspondence between acoustic characteristics of alarm and properties of the message, for example mimicking a heartbeat to elicit help function (Guilaine, "Judging Underlying Perceptual Processes")
Frequency	Pitch of stimulus, tested with no silence between pulses (Balwin, "Multimodal"), the higher the pitch the greater the perceived urgency (Guilaine, "Judging"). It is difficult to distinguish the fundamental frequency of extremely high and low pitches (Ghiradelli, "Auditory-Visual Interactions" 5.2)	Pitch is not always applicable because only sounds with regular periodicity for at least a certain duration will be heard as a pitch, and mapping information with pitches only works with users who have a musical background (Ghiradelli, "Auditory-Visual Interactions" 5.1)	In Baldwin's experiment, frequency was tested with no silence between pulses and instead a 20 ms on/offset (Balwin, "Multimodal" General Methods)
Rate (Tempo)	Rate or tempo is expressed as duration between onset of successive tones (interonset interval, ms) and inversely related to musical concept of tempo as beats/min (Guilaine, "Judging")	The faster the rate, the greater the perceived urgency (Guilaine, "Judging"). unpredictable temporal events are more attention-getting and enhance degree of urgency (Guilaine, "Judging" Underlying Perceptual Processes)	Temporal structure of alarms should have silent periods that allow users to react to the alarm and communicate (Guilaine, "Judging")

## Research



## Hardware

## Testing

## Next Steps

1. Integrate vibration motors and buzzers/speakers with the eye tracker, reducing user burden to one prototype device vs. multiple
2. Experiment with adjusting chosen parameters
3. Potentially move into spatial experiments with directional cues

