Communicating through movement

How can an inanimate object express expectations through movement patterns, and trigger certain behaviors in the spectator?

Report

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Abstract

This paper documents the development of a tangible that users can interact and communicate with, solely through movement and subtle light responses. It introduces a prototype that represents an entity designed to be foreign and unfamiliar to the human eye, to put more emphasis on a reduction to intuitive responses and the human capacity to adapt to foreign non-verbal communication signals.

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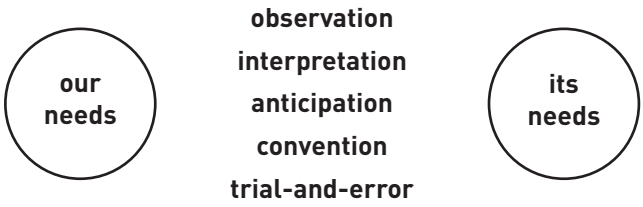
01 Motivation

Everyday we interact with everything and everyone surrounding us, other humans, as well as machines and gagdets to fulfil our own needs. Sometimes those needs might collide with somebody elses needs and then we can talk it out or even argue. However, there might be cultural issues or a language barrier, and then we are stripped down to one of our most essential abilities.

Human nature allows us to observe, interpret and adapt to another (potentially foreign) entity's behavior. We imagine that in an encounter with such an entity, that's completely foreign to us, several aspects will play a role for a successful interaction.



Resulting questions:

When we want something from somebody or something we don't understand, how do we behave?

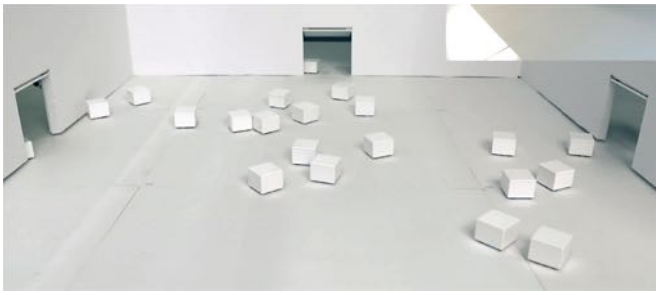
How minimal can communication be for us to still understand basic needs of another entity?

How sensitive are we to minimal nonverbal signals, like movement? And how do we read movement?

In order to research these questions, we wanted to build a counterpart for users to interact with, which seems inanimate, unfamiliar and hard to project human mannerisms onto.

02 Research/related works

When developing our idea, there were two projects that inspired us along the way:



(Dis)Appearables, a project by MIT Tangible Media Group that explored the concept of cubical tangibles that are completely mobile and can move on their own. They are controlled by a central unit and can visualize or express content by appearing and disappearing from a stage.

Pinokio, a project by Adam Ben-Dror which consisted of a desk lamp that has an endearingly innocent and quirky personality and interacts with spectators.

Given the time frame we decided to focus our work on expressivity through movement on a 2D plane rather than expressivity through body gestures.

03 Concept

Scenario

In order to have a framework that would help us to come up with a set of interaction ideas, we developed a brief scenario.

Being stranded on a foreign planet, the user encounters an entity that seems to be inanimate at first, but shows signs of conscience when they approach it.

How will it go?

Interaction

Based on this scenario we defined 3 ways for the user to approach the entity:

① approaching slowly, carefully and tenderly

② approaching fast, in a threatening, intimidating way

③ standing and waving, friendly and openly

We then designed a first draft of movement patterns, that the entity should follow upon being approached, in order to evoke certain impressions in the user. We implemented said first draft in our prototype and conducted some tests with participants. Based on the test results we were able to lose some of the less expressive movement patterns and reinforce the more promising ones. We ended up designing 5 ways for the entity to react in, when approached, and combining them with very subtle color changes on the prototype's light strip:

① attack / defensive / intimidation | red light
➡ the entity charges quickly at the user, and ends with repeatedly obnoxious sideway movement

② disinterest / disregard | red light
➡ the entity noticeably and consciously turns away from the user and moves a bit in the opposite direction

③ shyness / sadness | blue light
➡ the entity slowly turns away from the user and moves away a bit

④ fear / flight | no light
➡ the entity quickly moves away from the user, and ends with high frequenced sideways movement

⑤ excited / happy / outgoing | yellow light
➡ the entity moves quickly from side to side in rounded movements

04 Technical setup

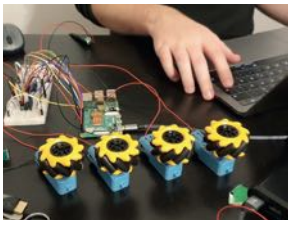
Design choices

The prototype's design is consciously minimalistic. In order to clearly establish a non-humanoid shape, we chose a cubical silhouette, with no indication of a front or a back, to make its movement seem less familiar and more inanimate. It is simply black from all sides except for a small light strip in the upper third of the body.

Components

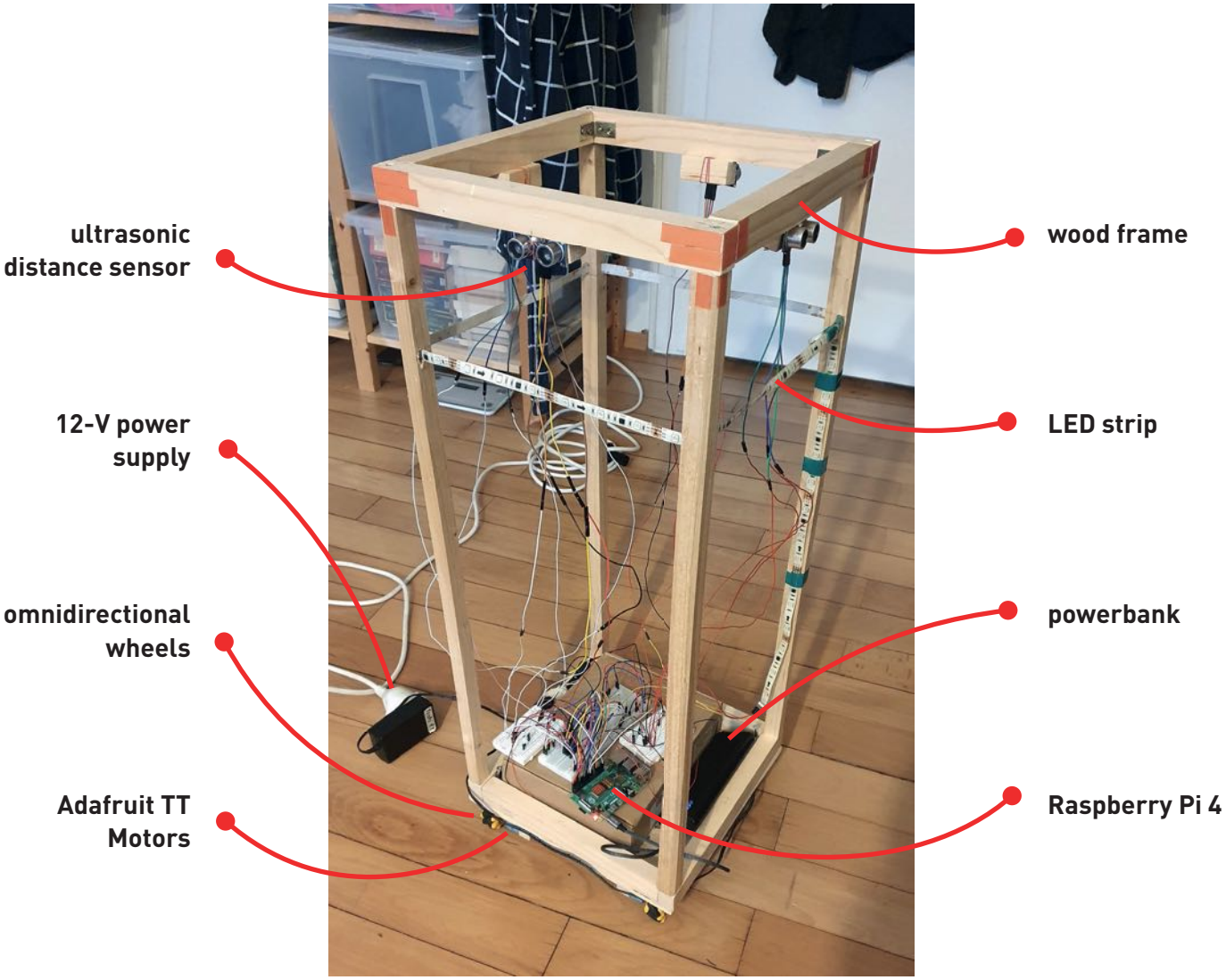
The prototype mostly consists of wood and electronical parts, as well as some construction paper for outer veneering.

The prototype has omni-directional wheels that can move in any direction without having to rotate.



Infrastructure

The prototype's central control unit is the Raspberry Pi 4. The code, the sensor input and the controlling of the wheels (via two motor drivers) is processed on it. This prevents any kind of data transfer loss. Therefore the whole prototype is able to drive independently, when the current is provided by a 12-V battery. Code changes could be implemented almost instantaneously, through access to the Raspberry via ssh when connected to the same network.



05 Conclusion

User study

Apart from the testing of the first draft of movement patterns for the reactions there hasn't been an opportunity for a systemized testing and empirical survey, due to the restricted time frame. We do think that the next steps would definitely include a user study to verify the theories and observations we have formed so far.

Insights and informal user response

Up to this point we were able to design movement patterns and interaction framework that are promisingly expressive, which seems to be confirmed by the informal responses from users and spectators we have received so far.

Our initial research questions have partially been answered but have also opened up lots of follow-up questions and new theories to verify. We think there is a great opportunity to research human perception to movement patterns while distinguishing more clearly between human and non-human movement as opposed to human and non-human interaction counterparts. Human to non-human communication through movement can be expressive and conclusive in some cases, but needs to be researched further. Here again, a proper user study will help to formulate more precise research questions.

Problems

We encountered some problems during the project which are mainly hardware-driven. The set of omnidirectional wheels we used, are quite sensitive to the surface quality of the ground. As a result they often get caught by minor unevennesses, which compromises the expressivity of the movement greatly. This issue would have to be addressed as well as the currently non-sufficient power supply. The original build of the prototype contained a battery pack which allowed for free and wireless movement, but the power supply wasn't strong enough to keep movements that are designed to be fast up to speed.