[in]formal Seat

decentralized modular robots,
shaping a dual mode
seating experince

Design Booklet
Edition 01

March 2018

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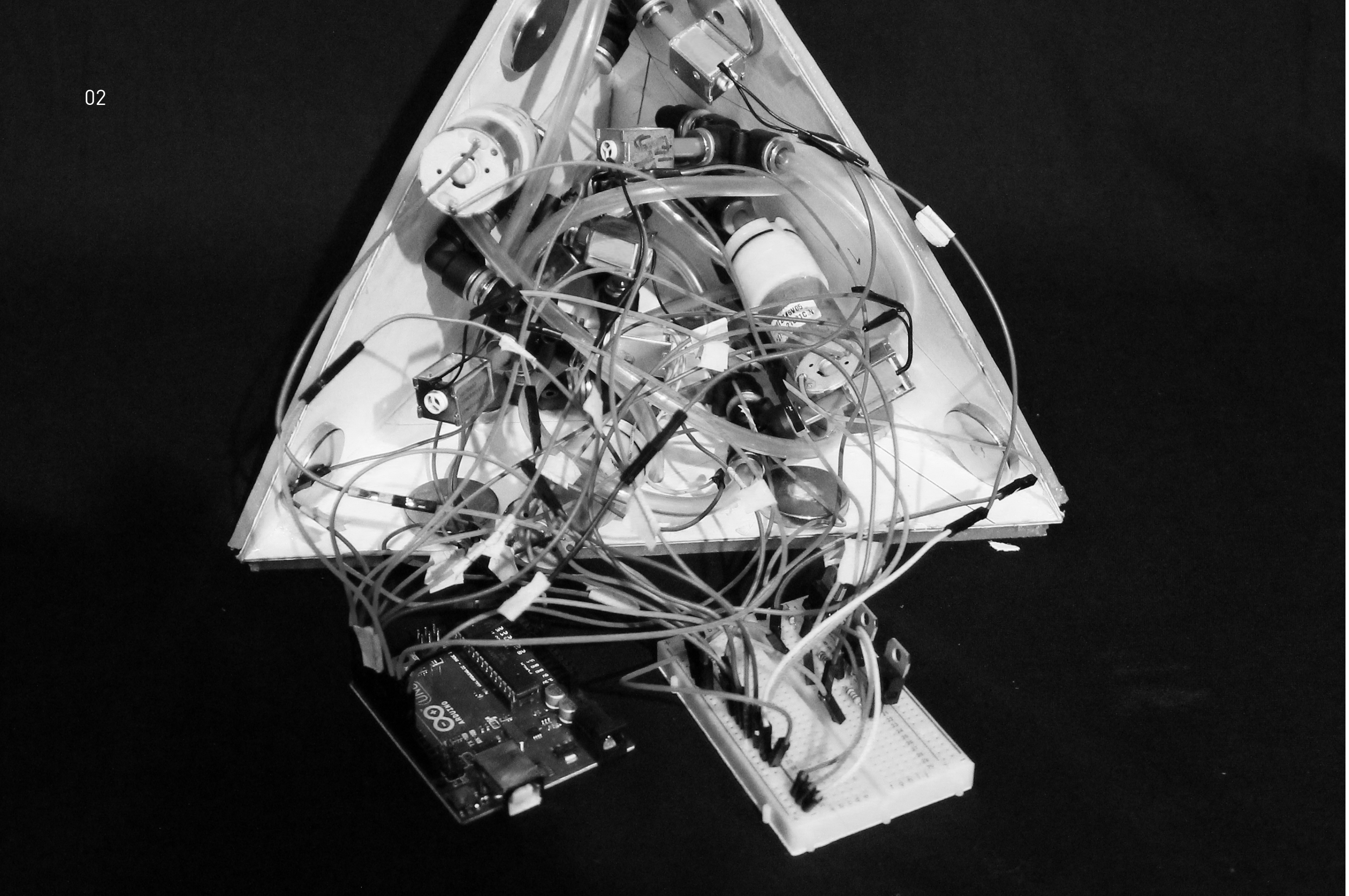
Smart Seat

The project has been defined and developed during the SmartSeat studio
at Tehran Urban Innovation Center (TUIC) in collaboration with University College London (UCL)



Content

Project Brief

As one of the simplest, most common and higly repetitive experiences, seating has been always considered as a core activity of human daily life. But the question here is, how can we rethink of the interaction between a seat and its user? Is it the user that should adapt himself/herself to the form of a seat, or there is another possibility which can examine an adaptable seat as opposed to an adaptable user?

As an example, there are variations of seats which can be categorized based on the fact that to what extend they are formal, or informal. Clearly, based on the defined function of the context, the formal or informal seats can be the choice of the user. However, there are situations in which this choice is to get benefits out of being at formal and informal seating position at the same time, on the same seat.

“[in]formal Seat” project aims to create a dual-mode seating experience (formal and informal), through shapeshifting a single seat.

Design Process

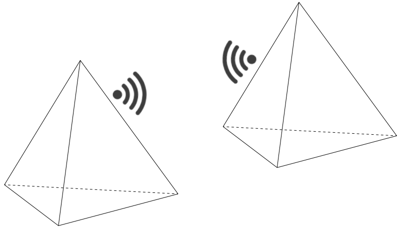
Shapeshifting behavior is a general solution for approaching a multimodal product. Narrowing down this approach led us to think of a modular system, consisting of a number of units, which can shape different forms as a whole by displacing around themselves. This modular system, as any others, can perform as voxels in a 3d space which gives an uncountable number of forms that can be shaped out there based on the position of each module.

Interaction Scenario :

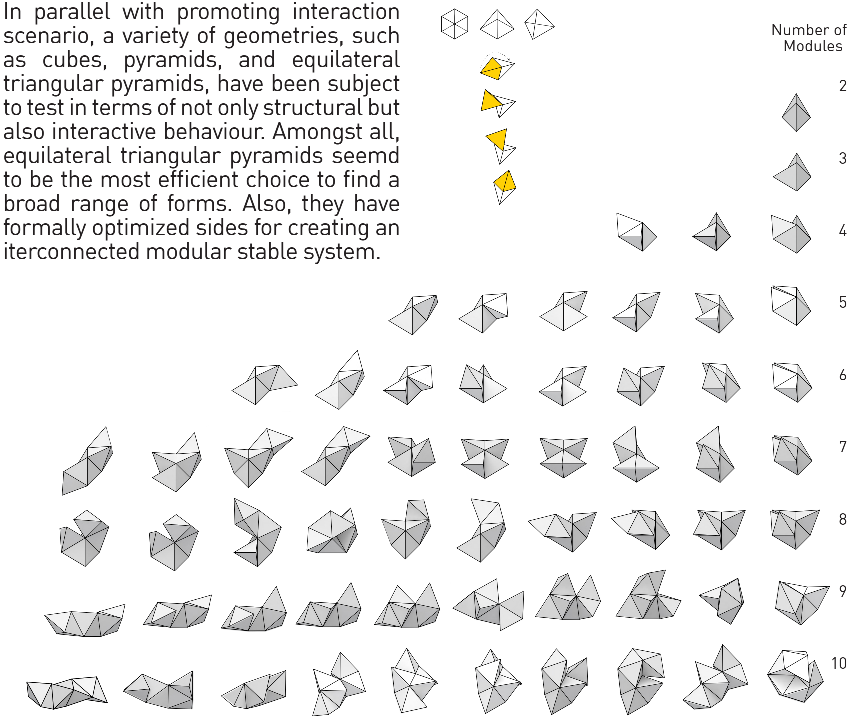
The interaction scenario of the system is not about human-robot interaction, but it’s about an inter-module interaction, or in other words, a kind of communication between each of the modular soft robots. This communication enables the robots to find their right position according to the other’s.

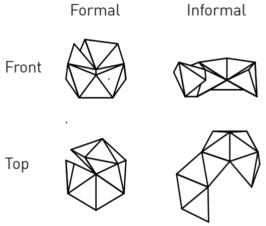
The mission of the inter-module interaction is to displace module and lead it to the right place.

The interaction starts when the user of the seat decides to shift the seat from formal mode to informal mode, or the other way around. By pressing a button, the pre-programmed modules start their displacement, by the help of lifting on the proper sides through the inflation of silicon bags enabled by internal air compressor. As the module lifts, it gets locked to the destination side of another module by the help of a series of coin magnets embedded in the system. A number of displacements of modules shape the new form of the seat as a whole.



In parallel with promoting interaction scenario, a variety of geometries, such as cubes, pyramids, and equilateral triangular pyramids, have been subject to test in terms of not only structural but also interactive behaviour. Amongst all, equilateral triangular pyramids seemd to be the most efficient choice to find a broad range of forms. Also, they have formally optimized sides for creating an iterconnected modular stable system.



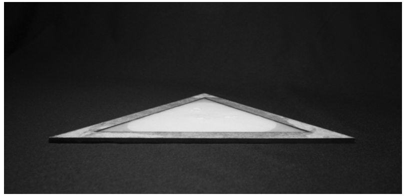


After all, the entire system has been defined with eleven equilateral triangular pyramid modules, forming a seat which could support two basic human positions, formal and informal. To shift from a formal position to an informal one, four modules of the system (out of eleven) can move on the other modules.

Material Studies and Fabrication

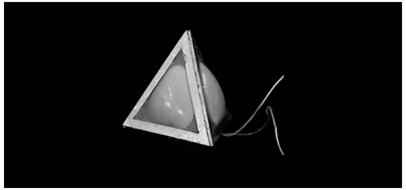
The entire system contains two sets of materials. One is the structure which provides stability and the other is inflatable parts which gives a movable feature for each module, or say, each soft robot. For the structural part, strength and lightweightness were crucial indicators which were found in thin Medium-density Fiberboard. For the inflatable parts, it seemed essential to approach a material system that not only functions efficiently with a reasonable air input, but also can provide a minimum comfort for the user, since it is in direct touch with the user's body. In order words, to reach features mentioned above, different ranges of Latex and Silicon were investigated.

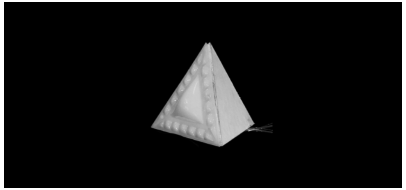
In the first step, a surface made out of Latex was casted to assess its flexibility and plasticity, but we found that in the scale of our module, Latex may not be suitable for supporting all features.So different ratios of Silicon (50*70 ;50*50) were casted to be examined, and at the end the ratio of 50*50 was selected as a proper case which can support the requested range of flexibility and plasticity.
Besides the hard part (structure) and the soft part (inflatables), placing the pieces of magnets and controlling them in size and attraction power were another challenging part. Dealing with the challenge, Electro Magnate (EL) and Coin Magnate (CM) were tested; EL was not the best option since not only it could not work in a long-term period of time, but also it needed a large-scale battery to power. Hence, CMs were tested with three geometries out of Silicon surfaces.

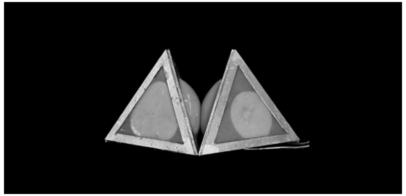


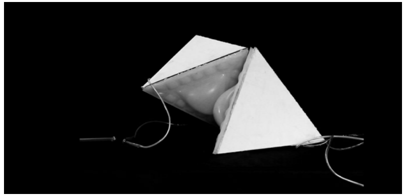
During the 1st test, although Silicon surface could actuate the modules immediately, it could not guide the module towards the requested direction. Accordingly, during the next test, the inflatable surfaces were divided into four parts. The central part which was assumed to disconnect modules, and the others were placed right in the edges of every side of modules should be able to help the system to control the direction of the displacement.

In this sense, the inflation happens on every edge that is needed to perform as an anchor. However, the problem there was that the size of silicon bags on the edge was not big enough, therefore it could not reach the minimum height.



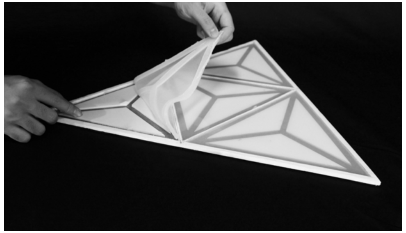


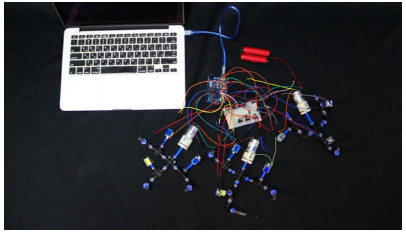


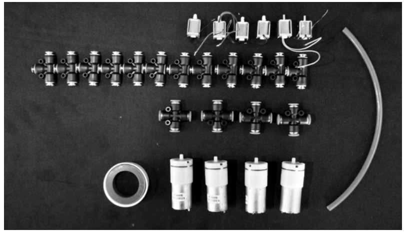


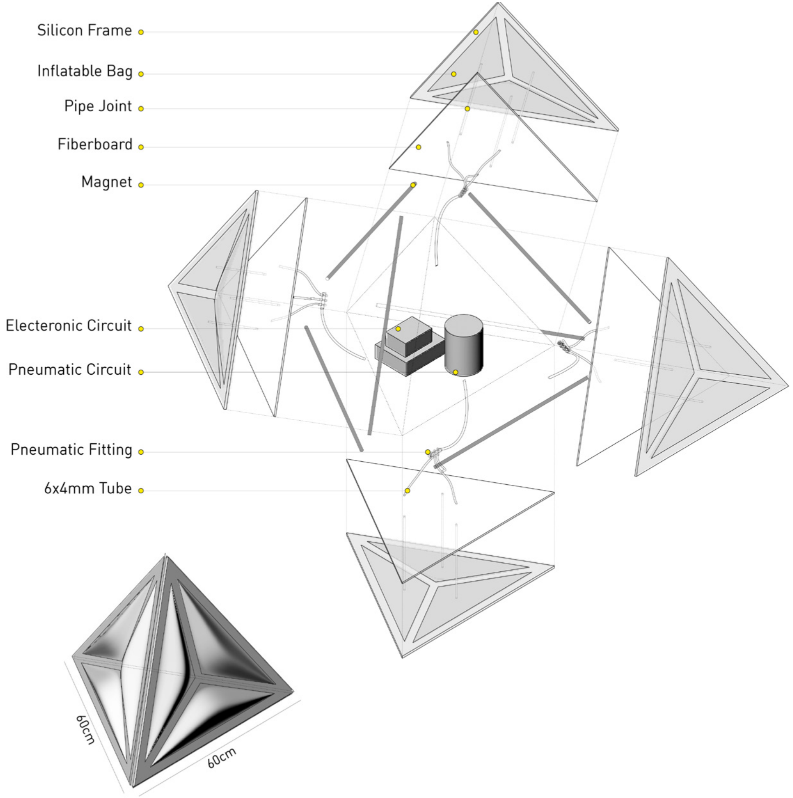
Final Prototype

Accordingly, during the 3rd test, an integrated method gained out of the previous tests led us to reach the balance between the size of inflation, the power of batteries, the power of air compressor, the attraction of the magents and the stability of the modules during the displacement. We divided every silicon surface into three main parts, equal in size, each part was capable to perform as an actuator for rotating the module.









Project Vision

The main aim of this research was suggesting an intelligent modular system capable to form various kinds of furnitures based on human and environmental conditions and situations.
The further study aims to optimize the system in any aspect (geometry, electronics, weight, material usability, structurla performance, pneumatic circuit efficiency, etc), so that it can be proposed not only as a seating set, but also as an integrated system, able to be defined in much more contexts.

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