

ÍCHNI: 欢乐建筑中的装置

ÍCHNI: DEVICES FOR A JOYFUL ARCHITECTURE

1 引言

活跃的身体往往处于愉悦状态，因此令人愉悦的建筑也必定能够激发更多的肢体动作。游乐场便是此类建筑的有力证明——在这里，孩子们释放天性，尽情攀爬奔跑，欢声笑语不断。即使偶有小摩擦，所有挥洒汗水的瞬间也都是幸福的。

斯宾诺莎式哲学思想认为愉悦之感源自人的主动（或本能）探索，基于这一思想，“欢乐建筑”主张通过空间邂逅来激发身体的行动意愿^[1]。例如，在荒川修作与马德琳·金斯的建筑作品及威廉·福赛斯的装置作品（图1）中，空间均能够让身体保持活跃的张力。古罗马建筑师马库斯·维特鲁威·波利奥认为，好的建筑应该具备稳定性、实用性和趣味性三大特征^[2]。如果说愉悦感与趣味性是建筑的核心，而行动又是快乐的源泉，那么于建筑而言，激发行动的能力至关重要。

2 建筑的动词属性

“我身边的物体映现了我的身体对其的反作用。”

——亨利·柏格森^[3]

我们早已习惯通过常规方式来欣赏建筑，与建筑相关的论述也多局限于其静态实体、形状和线条等设计语言。除非是运用了拟人化的形态，否则人们往往不会将建筑与身体联系起来。因此，我们应该构思新的建筑语汇，关注建筑中的行为与互动，而非仅仅将欣赏停留在静态层面。正如芬兰建筑师尤哈尼·帕拉斯马所认为的，建筑意象的动词属性远比名词属性丰富^[4]。例如，我们可以由一扇门联想到出入行为，而非只是一块带有把手的木板；由一把椅子联想到坐下这一隐含行为，而非只是由四条腿支撑的面板。由此，建筑所代表的就不仅是其物理属性，更是其喻义行为。而空间要素则应被解读为人类

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摘要

建筑是否能够激发身体产生更为复杂的行为？活跃的身体往往处于愉悦状态，久坐会大幅减少我们与美好空间邂逅的机会。故而建筑应当激发人们积极参与其中的意识。

Íchni是一项有趣的探索，旨在研究空间装置如何通过互动技术激发身体的行动意愿，以及如何通过物理-数字系统促使身体与周边物体形成情感反馈回路。项目设计了一个嵌入了物理传感器的互动“舞蹈装置”，通过投射在幕布上的虚拟影像来追踪舞蹈动作的物理作用力，并将捕获的数据信息进行转译，再投射至原有环境中，以此来提高人们的行为意识，影响人们在这一生成的环境中的行为方式。

关键词

空间；运动；情感反馈；物理传感器；虚拟投影；互动；技术

ABSTRACT

Can architecture prompt the body into more complex actions? An active body is a joyful body, and our sedentary behaviors are inhibiting the delightful encounters of spaces. Architecture should, in fact, inspire active and engaging experiences.

Íchni is a playful exploration into how spatial devices can increase the body's potential to act through the use of interactive technology; an investigation in generating affective feedback loops between surrounding objects and the body through a physical-digital system. Through developing "choreographic devices" — playable structures embedded with physical sensors — and a virtual projection overlay, the physical forces of movements are captured as data points, then translated and projected back into the environment, heightening the awareness of our actions to affect the manner in which we move through a generative environment.

KEYWORDS

Space; Movement; Affective Feedback; Physical Sensors; Virtual Projection; Interaction; Technology

翻译 肖杰 王颖

TRANSLATED BY XIAO Jie WANG Ying

生活的背景条件或促发因子，或者如帕拉斯马所说，是对行为的“允诺和邀请”^[5]。

心理学家詹姆斯·J·吉布森指出，功能可供性是指由动物所在的环境赋予其的“行动的可能性”^[6]。吉布森对物体的物理属性及其隐含行为——即其名词属性与动词属性——进行了辨析。例如，物体表面的隐含行为包括人类（或动物）“爬上、跌落、进入或撞到（它）的可能”^[6]。基于建筑的功能可供性定义，我们不再只通过其表面的物理轮廓来感知空间元素，而是将其理解为种种实现身体、行为与环境之间连接的暗示与诱因。

3 Íchni装置

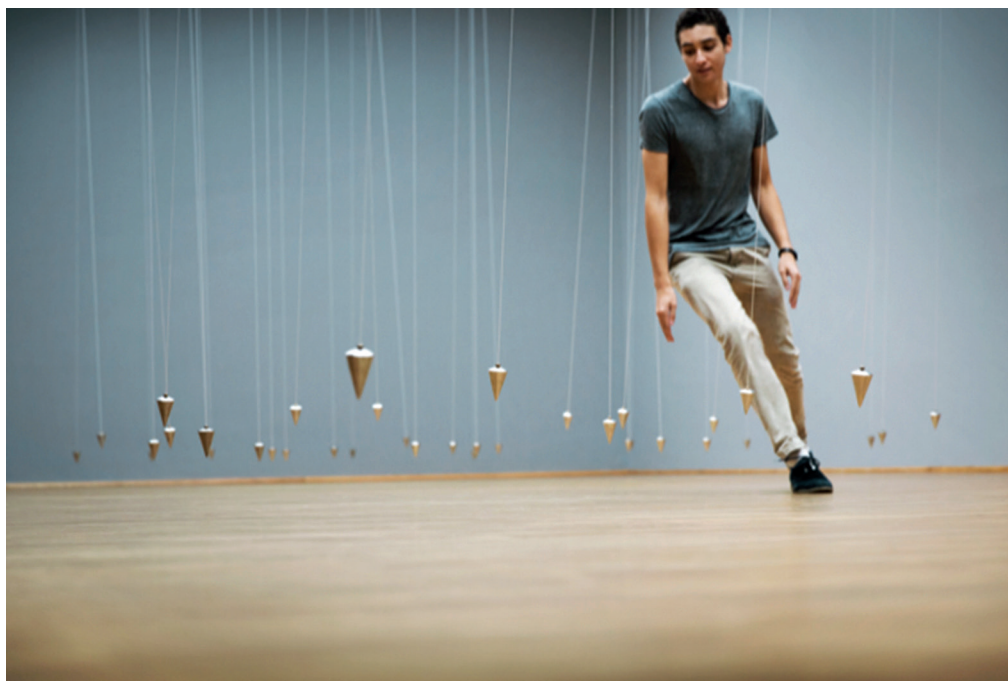
Íchni一词在希腊语中意为“痕迹”，涵盖了瞬间动作和符号标记双重含义。通过追踪转瞬即逝的物理运动，将捕获的数据信息进行转译与可视化处理，构建身体、装置和环境之间的情感反馈回路，以此改变人们的行为模式，激发非常规行为（隐含行为）。

Íchni装置旨在研究交互式物理—虚拟系统如何触发不可预测的复杂行为，重点关注人们的动作意识对自身行为及与物质环境互动方式的不同影响。研究中所采用的混合现实“舞蹈装置”由可用于舞蹈表演的金属装置和虚拟投影设备组成。从某种意义上说，这些能够激发使用者行为、鼓励使用者对其施加影响的装置其实就是舞台。每个装置中都嵌有物理传感器，用于捕捉使用者的物理运动，进而将其转译为可视化数据信息，再重新投射至原有环境中。这一过程使得运动效果与行动传播过程变得可见，也强化了使用者对于动觉的感知。

帕拉斯马指出，对建筑意象的传达不应仅停留在其名词属性上，而应更多地关注其动词属性^[4]。但这种观点仍旧因语言表达的局限而限制了行为的广度。然而，在转译并可视化捕捉到的物理运动后，物体的动态行为便超出了语言表达的范畴，物质环境中承载的行为也更加丰富。由此，对物体的阐述由规定性定义转变为了描述性定义，透过虚拟投影这一视角，使用者可感知到帕拉斯马名—动词二元论之外的物理属性。

装置的设计保留了材料的原始性能，并依据其功能可供性来建造，旨在激发使用者产生开放而有趣的解读。例如，数条横向的金属棒连接起了两根平行的弧形金属条，构成了形似跷跷板的装置，能够让人联想到类似于摇摆的动作（图2）。可以发现，人们对于与装置积极互动有着特有的直觉倾向。1971年，罗伯特·莫里斯在伦敦泰特现代美术馆举办的展览（该展览于2009年再次举办），通过设计一系列“行为装置”，有意吸引参观者与装置互动，从而挑战并扩展了“装置”原本的概念。展览取得了惊人的成功：参观者与装置亲密接触的热情一路高涨，很多人甚至在互动过程中受伤。

尽管Íchni装置是作为一项调查研究提出的，团队将其作为布景工具进行了测试，邀请具备一定动作掌控力的舞蹈演员在舞台布景中表演。舞蹈演员在装置内部舞动身体，仿佛在“演奏”一项乐器，同时控制着数字投影的效果（图3、4）。在这一过程中，Íchni装置成为了表演的一部分。并且，除专业舞蹈演员外，业余舞蹈爱好者以及动作略显笨拙的老年人和儿童的参与，还将为进一步探究装置中的行为增添不少趣味。此时的Íchni既是交互式游乐场，又是戏剧表演道具，还是沉浸式艺术装置。



1. 威廉·福赛斯的编舞
作品《无处又处处》
(2013)
1. *Nowhere and
Everywhere* by William
Forsythe (2013)

4 技术是答案……

舞台装置中嵌入的传感器包括开源电子原型平台Arduino和各类经济型传感器——如压电式传感器及由加速度计和陀螺仪构成的惯性测量单元（IMU），它们可通过一系列数值读取基于使用者行为的模拟输入信号（图5~7）。以安装于“跷跷板”上的六轴IMU传感器为例，其可测量摆动的加速度、方向和角度（图8，9），再通过Wi-Fi将这些数据传输到计算机中Processing语言的sketch操作界面中，以传感器读数作为数据点，由程序生成几何可视化图像和粒子行为，并投射至屏幕上（图10~12）。

在过去数十年中，许多艺术家和设计师已经开始将创意计算应用到设计实践中。尽管直至当前，鉴于复杂性与计算能力的限制，软件和硬件编码始终只能依靠科学家和工程师在实验室中的超级计算机上完成，但更为先进的个人计算机和日渐发展的编程语法推动了新技术的普及，也降低了非专业人士掌握技术的门槛。

当前已有艺术家专门针对视觉艺术开发了类似Processing语言的编程集成开发环境，用以服务更多的艺术家。艺术与技术的交融也催生了多种多样的全新艺术形式，如互动装置、数字艺术、程序或衍生艺术、互联网艺术、虚拟现实、增强现实、参与式艺术等。由Arduino等公司生产的即插即用微控制器也使得不具备电子学或编程背景的人员能够轻松理解物理计算。与此同时，交互设计也开始摆脱屏幕，渗透到日常的空间实体中，继而走进建筑领域。

5 ……那么问题是什么？

1966年，英国建筑师塞德里克·普莱斯曾发出诘问：“如果技术是答案，那么需要用技术解决的问题是什么？”^[7]随着技术门槛的降低，人们往往过度强调工具的作用，而忽略了问题本身。伊丽莎白·格罗斯曾写道：

“在某种意义上，技术虽然是由人开发、为人所用的，但也在改变着人类的行为：技术的价值不在于引发更好的行为，而在于带来更多的行为可能性。”^[8]

当代空间常常不能满足身体的需求——既难以让身体与之互动，又无法让人产生愉悦之感。究其根源，在于行为的缺失。对于人机交互的参与天性激发了使用者在物质环境中积极参与的欲望，促进了身体和空间之间更为密切的互动。回顾基于Íchni装置的舞蹈表演，当表演者逐渐摸索到人体力学、装置与环境之间的关联后，这一物理—数字系统便催生了一段舞蹈设计。

回到最初有关表演与愉悦的问题上来，我们应该利用新技术来挑战对行走、就座、行动和移动等行为的固有认知，而对于技术的具体化呈现则应鼓励人们积极地与日常建筑碰撞出更多愉快的火花。这就是需要解决的那个问题。LAF



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3 © Isabella Ong, Alexandra Niaka, Marianna Chrapana

2. 鼓励人们进行行为交互的跷跷板、绳带和可移动金属框架等舞蹈装置及屏幕。
2. Choreographic devices (seesaw, ropes, and movable frame) that invites playful actions, and the screen.
3. 舞者与布景结构的互动——通过动作的变换来控制数字投影。
3. A performer “playing” the scenographic architecture by using their movements to manipulate the digital projections.

1 Introduction

An active body is a joyful one. Accordingly, a joyful architecture is one that encourages the body into more actions. One need not look far to find proof for this: the playground. The untamed scene of kids climbing and running about is often accompanied by the discordant din of their shouts and laughter. Amongst the sweat and despite the scraps, it is hard to find an unhappy child in a playground.

By adopting a Spinozist attitude which associates joy with active effort (or conatus), an Architecture of Joy describes spatial encounters that increase the body's potential to act^[1]. The architecture of Shusaku Arakawa and Madeline Gins and William Forsythe's works (Fig. 1) are examples of such Spinozist architecture, with spaces that maintain the body in a state of active tension. Marcus Vitruvius Pollio declared that the three principles of good architecture are stability, utility, and delight^[2]. If joy and delight are fundamental to architecture, and action is fundamental to joy, we can thus conclude that it is essential for architecture to facilitate actions.

2 Architecture's Verb Form

"The objects which surround my body reflect its possible action upon them."

— Henri Bergson^[3]

We have grown accustomed to the formal appreciation of architecture. Architecture discourse is primarily confined to the



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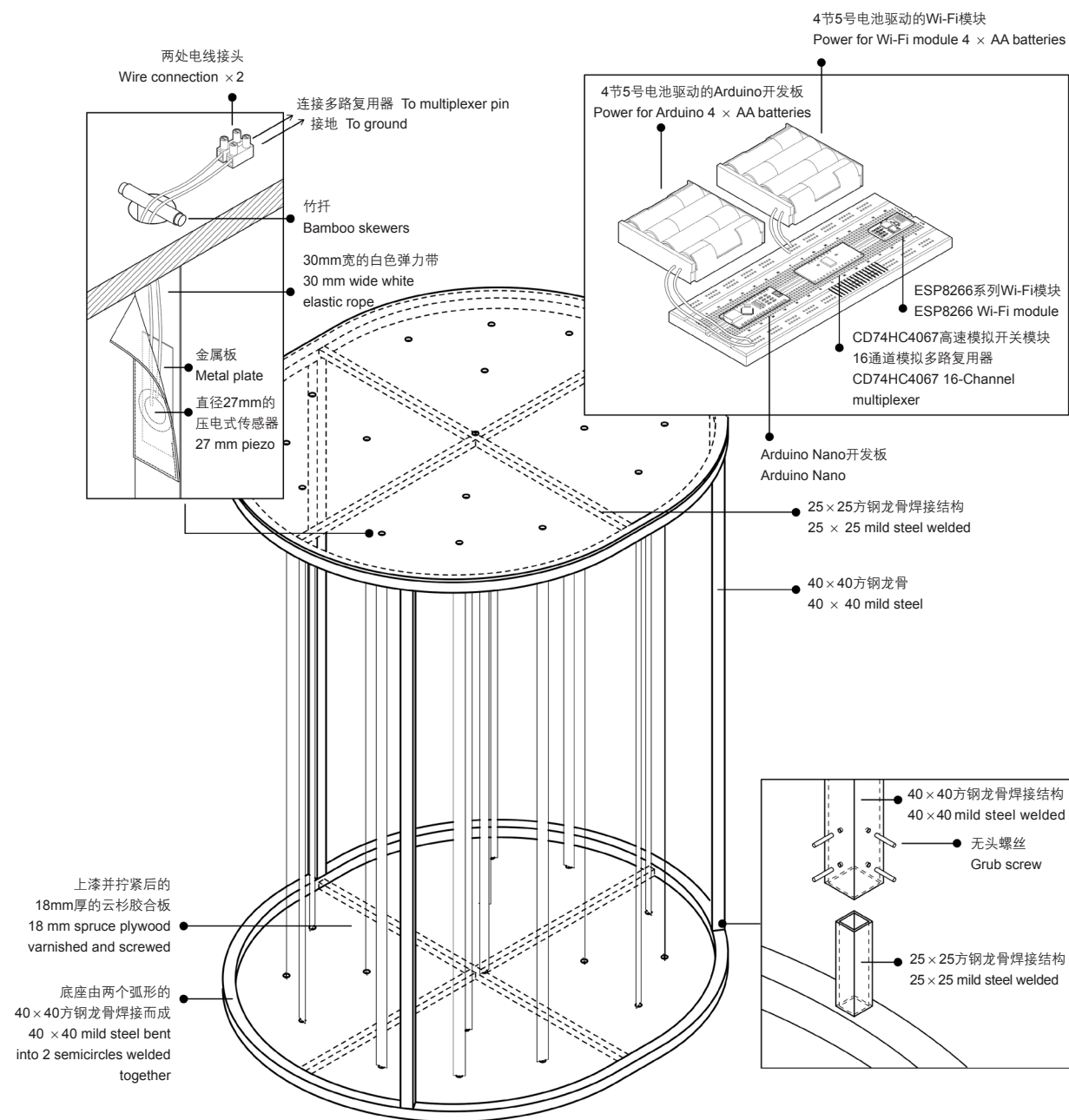


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4. 舞者与íchni装置进行互动
4. Dancers performing with íchni

language of static solids, shapes, and lines, often with no relation to the body other than its anthropomorphic fit. It is high time we conceive of an alternate architecture vocabulary that consists not of nominative terms that limit spatial appreciation to the formal; one in which action — and interaction — is the form. Juhani Pallasmaa observes that architectural images have less of a noun form than a verb form^[4]. Rather than thinking of a door as a panel with a knob, we can think of it in its suggested act of entering and exiting; instead of thinking of a chair as a surface supported by four legs, we can think of it in its implicit action of sitting. Architecture then can be conceptualized in terms of its solicited actions instead of its physical attributes. Spatial elements thus function as a condition and facilitator for human life, or as Pallasmaa describes, “promises and invitations” for actions^[5].

According to psychologist James J. Gibson, affordances define as the “action possibilities” offered to an animal by its



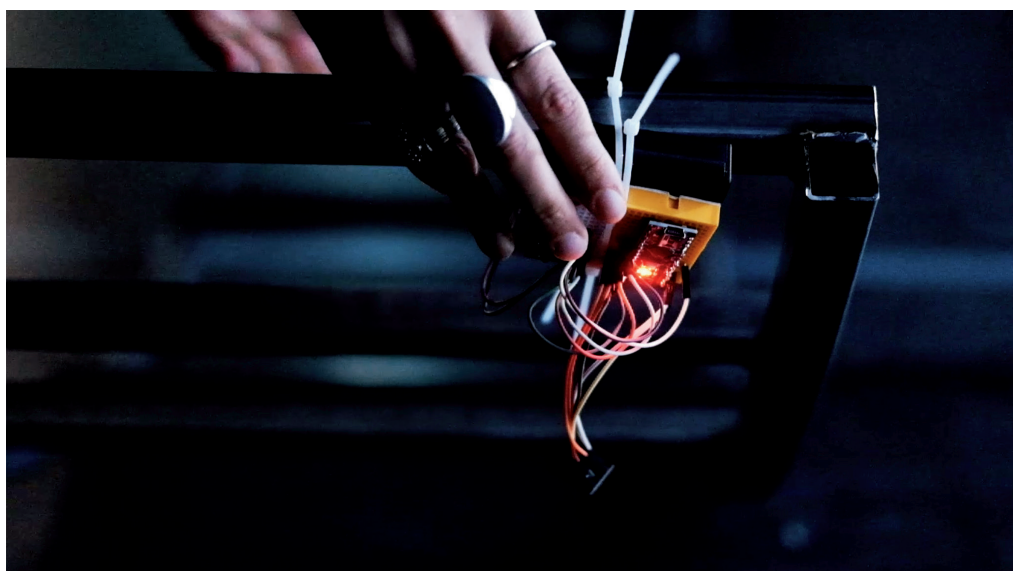
5. 绳带装置的技术图与施工图
 6. 通过安装了Arduino开发板和IMU传感器的设备来测量跷跷板的摆动。
 7. 每条绳带上都安装有压电式传感器，可探测绳带的晃动。
5. Technical and construction drawing of the rope set up
 6. A device built using Arduino and an IMU to measure the oscillation of the seesaw.
 7. A piezoelectric sensor is attached to each rope, detecting when it is activated.

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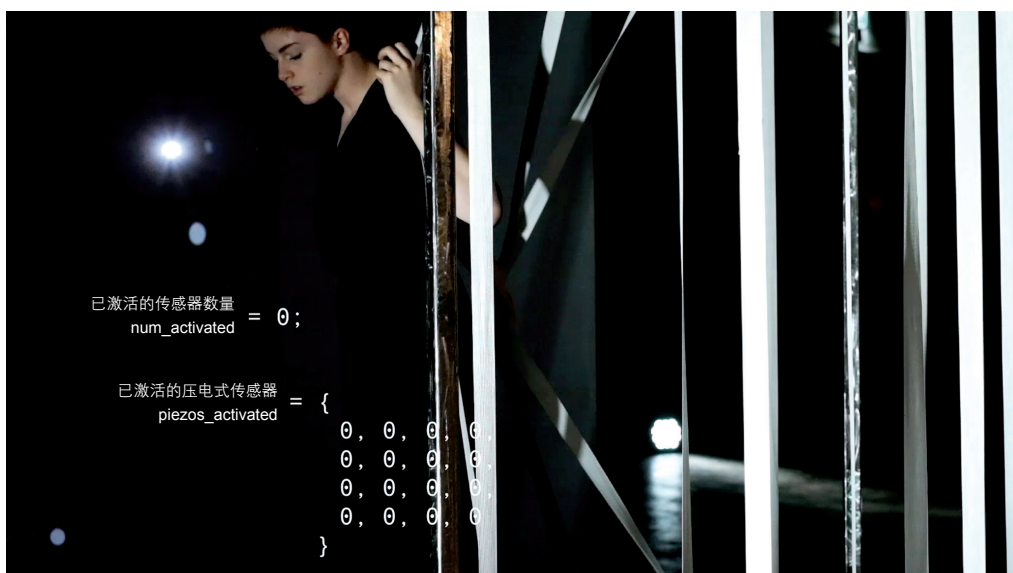
environment^[6]. He distinguishes between the physical properties of an object from its implicit actions — noun versus verb form. The suggested actions of material surfaces can be what we, the animal, perceive as “climb-on-able or fall-off-able or get-underneath-able or bump-into-able”^[6]. By adopting an affordance-based definition of architecture, we perceive spatial elements not by the physical delineation of their surfaces but as cues and triggers, ensuring the non-disassociation between body, behavior, and environment.

3 Íchni

Íchni is the Greek word for “traces,” and it encapsulates both the concepts of passing movements and notational markings. Physical movements, which are usually so fleeting, are captured into data points, translated and visualized to create an affective feedback loop between the body, devices, and the environment, altering the way we behave and cueing the body into unconventional movements.



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Íchni investigates how complex, unpredictable movements can emerge from an interactive physical-virtual system, with an emphasis on how conscious awareness of our movements affects our actions and causes us to negotiate with the material environment differently. The research took the form of a mixed-reality play installation, composed of playable, metal sculptures — “choreographic devices” — and virtual projections. These sculptures are choreographic in the sense that they invite actions from the users and elicit forces to be acted upon them. Each of these devices is embedded with physical sensors that measure and capture the physical movements, which are procedurally

translated into digital visualizations that are then projected back into the environment. This makes visible the effects and propagations of the movements and amplifies users’ kinesthetic awareness.

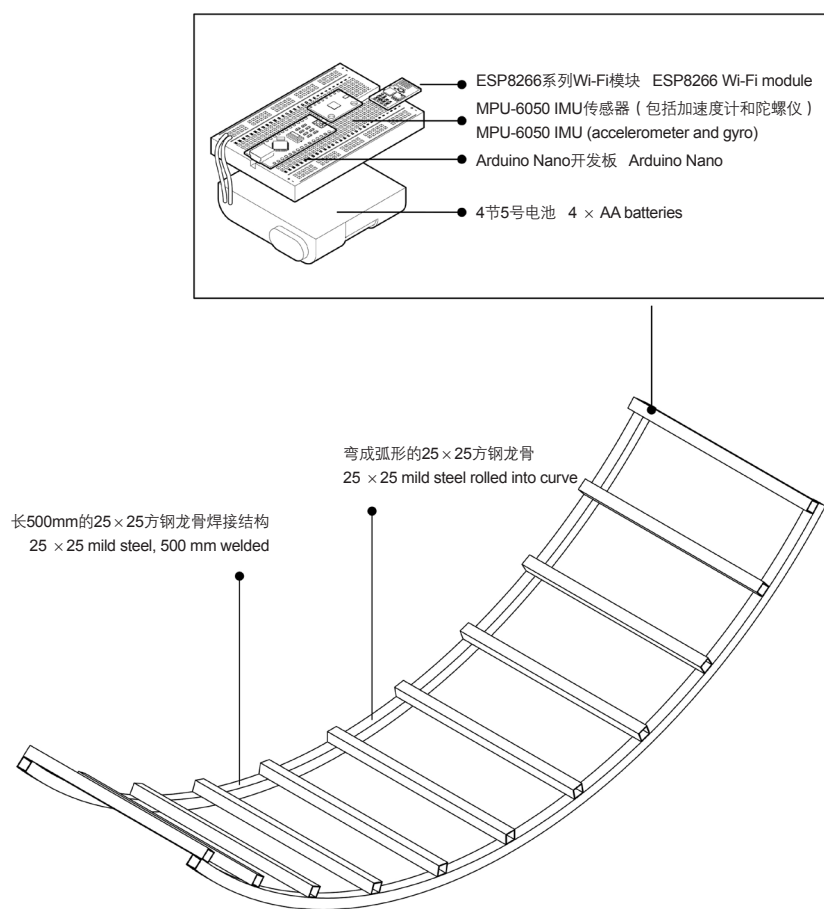
Pallasmaa proposed to communicate architectural images in their verb instead of their noun form^[4]. This, however, still reduces the range of actions to the limits of language. By translating the captured physical forces into visualizations, it opens up the active form of the object beyond linguistic limits and accommodates the richness of movements afforded by the material environment. Objects then become descriptive rather than prescriptive, with the virtual projection operating as a viewing scope through which users can perceive the physical beyond Pallasmaa’s noun-verb dichotomy.

The designs of the sculptures were kept rudimentary to evoke open, playful interpretations of their use and were constructed with their affordances as references. For example, two curved rods held parallel by horizontal bars hint at the actions of rocking, swaying, or oscillating, similar to that of a seesaw (Fig. 2). There is a particular intuitiveness for active participation in playing objects. In Robert Morris’ 1971 exhibition (recreated three decades later in 2009) at the Tate Modern, he challenged and expanded the notion of what a sculpture is by designing a series of “action sculptures” to intentionally include visitors’ participation in the works. This proved unexpectedly effective as visitors took the invitation to play a little too enthusiastically and went berserk, with many hurting themselves in the process.

Although developed as a research investigation, Íchni was tested as a scenographic tool where dancers — people exercising certain mastery over their movements — were invited to perform within the system. The architecture became an instrument that the performers could “play” by using their body movements to manipulate the digital projections (Fig. 3, 4). The research apparatus thus became part of the performance. It will be interesting to gather further insights by expanding the application of this installation to include a range of body types, from professional performers to the amateur, clumsy bodies, from older folks to young children. Íchni can take the form of an interactive playground, a theater prop, or an immersive art installation.

4 Technology Is the Answer...

The embedded sensors of the choreographic devices were built using Arduino and various inexpensive sensors such as piezoelectric sensors and IMUs (an accelerometer and gyrometer combined), which read the analogue inputs of users’ movements



8. 跷跷板的技术图和施工图
9. 传感器感知到跷跷板角度的变化。

8. Technical and construction drawing of the seesaw
9. The sensor reading of angle change of the seesaw.

through a range of values (Fig. 5 ~ 7). In the example of the seesaw, a 6-axis IMU sensor was attached to measure the acceleration, direction, and angle of the oscillation (Fig. 8, 9). These values are transmitted via Wi-Fi to a Processing sketch on a computer, which uses the readings as data points to procedurally generate geometrical visualizations and particle behaviors that are projected on a screen (Fig. 10 ~ 12).

In the last few decades, many artists and designers have started to incorporate creative computing as part of their design praxis. Hitherto software and hardware coding have always been confined in the labs of scientists and engineers with their supercomputers due to the complexity and computational power required. But personal computers becoming more powerful and programming syntaxes less esoteric engender the democratization of new technologies, lowering the barrier of entry for non-experts to adopt them.

Programming IDEs (Integrated Development Environments) like Processing are created by artists, for artists, and are specifically produced within the context of visual arts. The intersections between art and technology have spawned a diverse range of art categories: interactive installations, digital art, procedural / generative art, Internet art, virtual and augmented realities, participatory art, etc. Physical computing is also rendered more accessible for people with no background in Electronics or programming with companies like Arduino making plug-and-play microcontrollers. As such, interaction design starts to break out of the screen and seep into the hardware of our everyday spaces, into the domain of architecture.

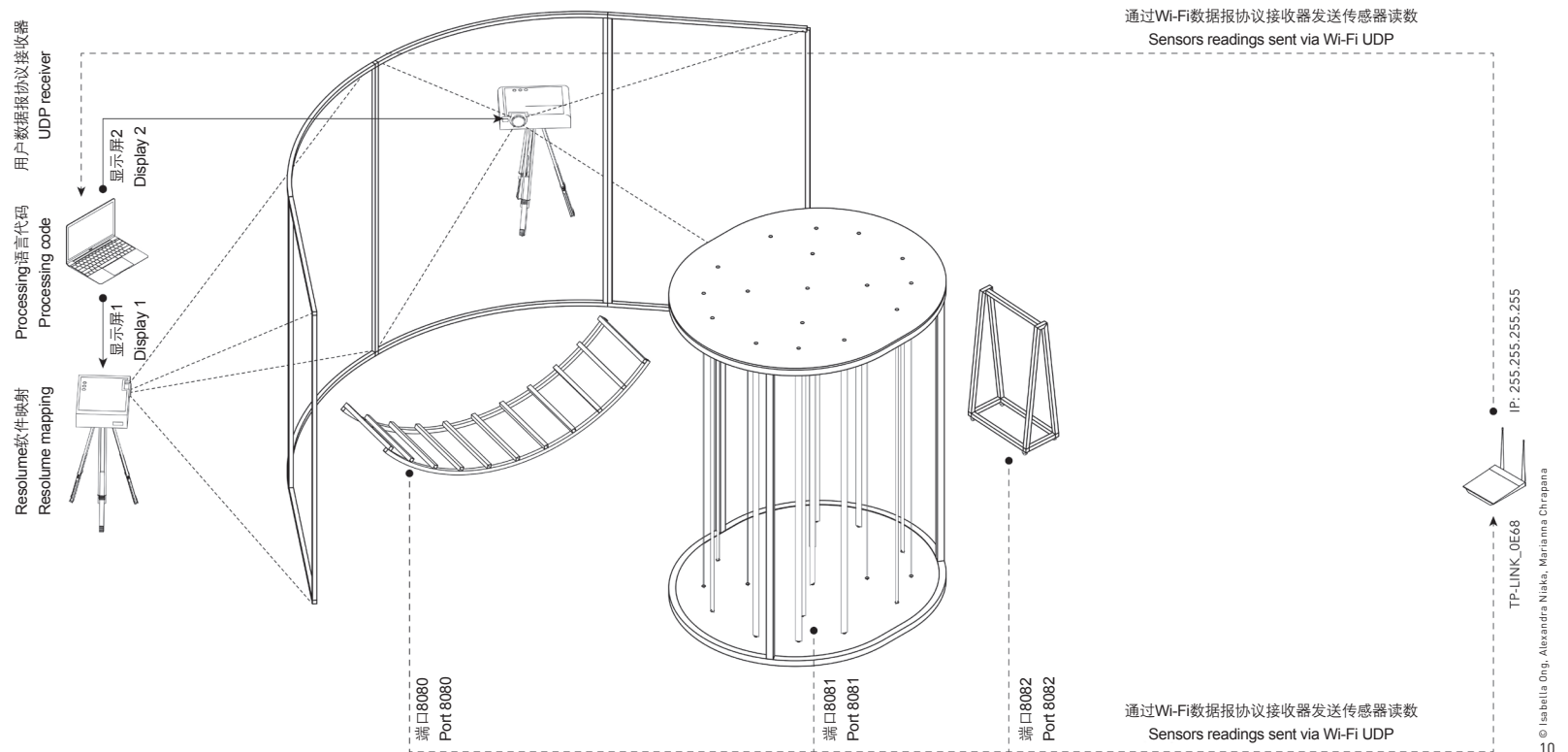
5 ... But What Was the Question?

In 1966, Cedric Price posed the rhetorical question, “technology is the answer, but what was the question?”^[7] With technology becoming more accessible, there is the temptation of overemphasizing the tool while ignoring the problem. Elizabeth Grosz writes,

“Although technology is in a sense made by us and for our purposes, it also performs a transformation on us: it increasingly facilitates not so much better action but wider possibilities of acting, more action.”^[8]

Contemporary spaces often fall short in serving the body: they require little from the body and do not aspire towards delight and joy. Underlying all, these is the absence of action. The participatory nature of human-computer interaction, when embedded into our material environment, presents the opportunity to demand a greater involvement of the users,

10. 在将影像投射至弧形屏幕之前，通过Wi-Fi由Arduino开发板向Processing语言的sketch操作界面中传输模拟数据。
 11. 通过利用Processing语言的编程集成开发环境将动作的模拟信号转化为程序化的视觉影像。
 12. 将运动行为映射为可视几何元素的初步研究。
10. Analogue inputs are sent via Wi-Fi from the Arduinos to the Processing sketch, before being projected on the curved screen.
 11. Procedural visuals are generated from the analogue signals of the movements, using the Processing IDE.
 12. Initial studies on the behavioral mapping of the movement to the geometrical visual elements.



facilitating a more intimate interplay between body and space. During the dance performances of Íchni, a generative choreography emerged from the physical-digital system as the performers progressively find complicities between the mechanics of their own bodies, the sculptural devices, and the environment.

Going back to fundamentals, such as play and joy, we should utilize new technology to challenge the basics: how we walk, sit, act, and move. Our embodiment of technology should inspire active and delightful encounters in our everyday architecture. The question is simply that. **LAF**

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