Movement Of Things
Exploring Inertial Motion Sensing When Autonomous, Tiny and Wireless

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ABSTRACT
The Movement of Things project is an exploration into the qualities and properties of movement. Through a range of exercises these movements are captured and translated by custom-built software and the use of an autonomous, tiny and wireless motion sensor. A series of Motion Sensing Extensions suggest different approaches of how to use a motion sensor within various physical environments to capture movement to better understand the materialization of movement and new forms of interactions through movement.

Author Keywords
motion; movement data; motion sensing extensions; interactive object; embodied interaction; abstract visualization

ACM Classification Keywords
H.5.m. Information Interfaces and Presentation (e.g. HCI): Miscellaneous

INTRODUCTION
The Movement of Things project captures data that can be measured from the movement of everyday objects. Here an autonomous, tiny and wireless motion sensor is attached to a range of custom-built physical extensions to record acceleration and orientation of an object in various situations.

Figure 1. Motion Sensing Extensions.

The transmitted data is then expressed through an audio or visual medium in real time or as a recording for further evaluation. With the Internet of Things at our doorsteps, this project aims to comment on the increasing ubiquitousness of sensing technologies in our everyday lives and practices through performance, play and exploration. Furthermore we are investigating the potential of motion data sensors within the arts as a real-time interface for expressive interactions. How can we perceive and capture our surroundings through the lenses of sensing technologies, data and art?

CAPTURING MOVEMENT
This project makes use of a wireless motion sensor called the Twiz[1]. In order to capture various types of movement, a range of Motion Sensing Extensions were built including for example a clamp which can be attached to a branch of a tree to capture the movement of the wind swaying through the leaves, a block of foam to allow the Twiz to float on the surface of water or a cylindrical shaped piece of plastic to roll the Twiz along different types of surfaces.

Figure 2. The Twiz motion sensor mounted onto a Motion Sensing Extension (left), and attached to the branch of a tree to capture the movement of the wind swaying through the leaves (right).

AUTONOMOUS, TINY, WIRELESS TECHNOLOGY
Different 9 Degrees of Freedom Inertial Measurement Units (IMU) exist, S. Madgwick[2] developed an efficient sensor fusion but his hardware was not compact enough for most use cases and an extra module was needed to add wireless connectivity. On a more commercial side, the Hot Hand[1] has the compactness and autonomy but it only has a 3D accelerometer and the connectivity is limited. Then was made the Twiz,

[1] `http://sourceaudio.net/products/hothand`

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the Tiny Wireless IMU, as an open source project that gathers three 3D inertial sensors (accelerometer, gyroscope and magnetometer). A fusion of the sensors data is performed on board. It uses and adaptation of Madgwick algorithm to merge the stability of the magnetometer and the dynamism of the gyroscope. After being processed, this data is broadcasted wirelessly using a Bluetooth Low Energy (BLE) advertising hack that uses manufacturer data, which simplifies the reception as it avoids connection, and allows multiple listeners. This makes it easy to communicate with a mobile device to interpret and record data. Its small size, which is slightly larger than a coin cell battery, and no-wires-attached property, allow for much flexibility in use and application. The size and flexibility of the Twiz encouraged experimentation and play in between art and technology. There was for example the usage of the first Twiz prototypes to control musical effects. This gained interest amongst peers over time. This first tiny version started at noisebridge[2], as a collaborative side project and was improved in many hackerspaces all around the globe during the hacker trip to china[3]. This international hackerspaces development allowed a multi-crowdsourcing feedback, bringing a cultural cross-pollination and resulted in amazingly enriching collaborations such as this one.

INTERFACE

The Movement of Things interface consists of two parts where the Twiz serves as the data capturing client and a BLE capable mobile device to record and capture data within a range of up to 20 meters. The second part comprises of the so-called Motion Sensing Extensions, which allow the Twiz to be attached to different objects. Data is transmitted with an average frame rate of 25 frames per seconds. A custom-built android application captures and records the data received.

ARTISTIC EXPRESSIONS

The objective of the project is to collect the acceleration and orientation properties of moving objects and express them artistically. We have tested the Movement of Things in two different scenarios, a recorded and a real-time scenario.

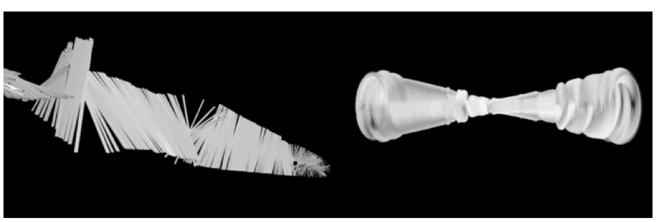

Figure 3. Abstract data renderings using data recordings captured with the Twiz motion sensor.

Recording Scenario

The recorded scenario took place in May 2015 in Paris where various subjects found in an urban environment were measured, including an air vent, washing machine, dryer, escalator, trees, water, doors or the metro. Later, the recorded data was interpreted through abstract data renderings and translated into a kinetic object animated by data recordings.

[2]Noisebridge is a hackerspace for technical-creative projects

[3]`http://noisebridge.net/wiki/NoisebridgeChinaTrip4`

Real-time Scenario

The real-time scenario comprised of a dance performance presented in August 2015 in Singapore where dancers would interact with two objects to respond to and inform an audio-visual system. The duration of the performance was kept at 10 minutes and was performed over 30 times, from which observations of a change in and adaptation of the dancers interaction with technology can be made. Here the initial discomfort continuously evolved into a better understanding of the medium and its improvisational qualities. For this performance we used a glowing sphere for dancers to carry and perform, and a suspended wooden bar for dancers to interact with, both equipped with a Twiz. Each object responded with an audio-visual feedback based on the motion measured to materialize movement [3] through custom-built software.

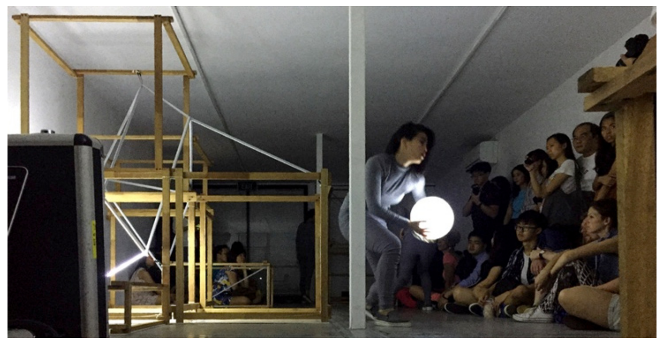

Figure 4. A dancer holding an object equipped with a Twiz to interact with the light and sound responsive stage design.

CONCLUSION

At this stage of the project, there is an initial understanding of how to use autonomous, tiny and wireless motion sensors to sense and measure the movement of objects under certain conditions. These had been done within different environments in order to create a range of artistic expressions. Based on the projects undertaken, there had been a development of two scenarios to better understand art-driven interactions with the use of technology. By conducting and observing the outcome of each scenario, there is an initial understanding of how interactions with this motion sensing technique evolved over time and how the limitations and the potential can inform a range of artistic practices through performance, play and exploration.

ACKNOWLEDGEMENTS

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