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Lisbon
Computation
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Aesthetics
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SCOREKEEPERS

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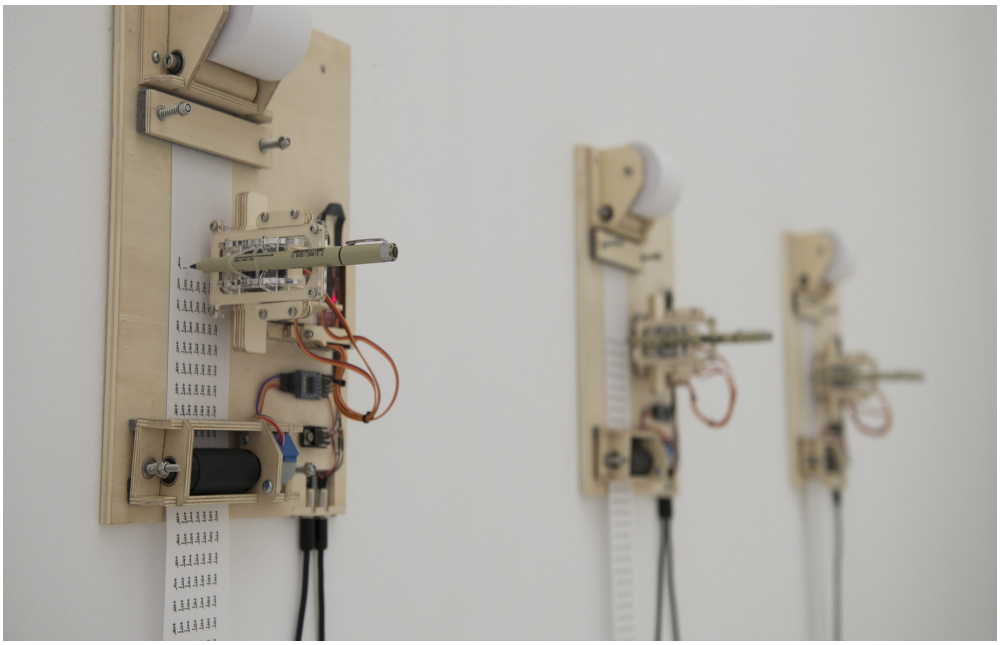

Abstract
A modular, time based installation and performance consisting of three small drawing machines and a counting device with digital display. Triggered by a pulse sent each second from the device, the machines are engaged in the act of counting via three different common tally mark systems; one predominant in western cultures, one used in cultures influenced by Chinese characters, and one common in many romance-speaking countries. The total count is also rendered to a display as a number in three different bases: binary, decimal, and hexadecimal.

Keywords
Digital Fabrication
Drawing Machine
Machine Aesthetic
Time
Clock
Counting
Arduino
Piccolo CNC

1. OVERVIEW

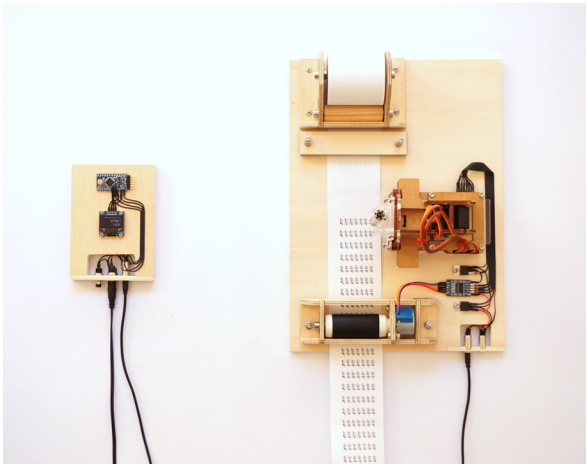

Fig. 1
Scorekeepers prototype with single drawing machine module.

This installation seeks to invite the viewer to contemplate calculation and computation through the ritual of counting, and the relationships these activities have with mark making, drawing, and writing. In an action familiar to many, three drawing machines are engaged in a seemingly endless task of counting, using pen on paper and three different commonly used tally mark systems.

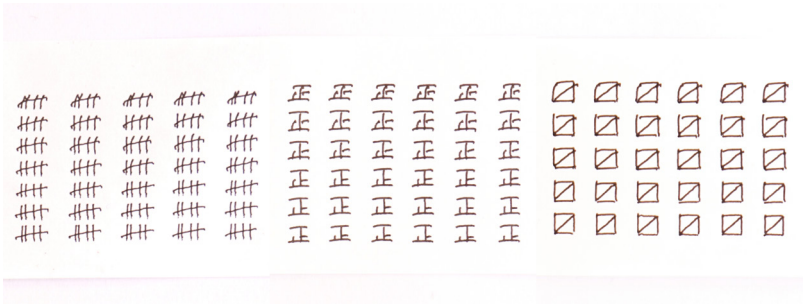

Fig. 2
The three tally mark systems employed by the drawing machines. (from left: barred-gate style, ideographic style, box style).

Scorekeepers makes use of digital fabrication to explore our relationship with mark making, by contrasting the old with the new. Unary counting systems can be traced back to the origins of mathematics, where the earliest records of counting have been found in the form of notches on paleolithic artifacts, whilst it is also speculated that counting may have emerged from the evolution of non-representational geometric patterns evident in cave paintings, or even as a visual analogue of sound (Allen, 7-12).

The viewer is asked to consider the visual differences between these three tally mark systems as cultural artifacts. The "barred-gate" style common in western cultures is also highly visible in popular culture (Fig. 1) whilst the box style most commonly visible in South America but also in other French and Spanish speaking countries is often associated with keeping score during games such as the popular card game Truco (Lunde and Miura, 2015). The technique of using the segments of the ideograph 正 is common in Asian cultures influenced by Chinese characters, where horizontal tally marks are also visible as the characters for one, two and three, indicating a literary connection.

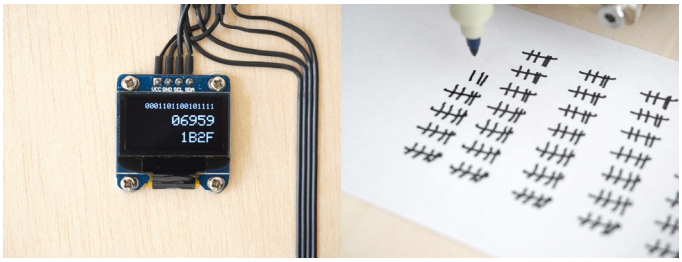

Fig. 3
Synchronised counting between the alphanumeric display and tally marks on paper.

According to its internal clock, once every second the counting device sends a pulse to the drawing machines. Using this 1Hz clock signal, the machines record each pulse according to a particular tally mark system.

Writing in columns, each of these unary numeral systems cluster marks in groups of five, and so by counting these clusters the viewer can begin to count how many seconds, and thus minutes, or even hours, have passed. Alternatively, the viewer can refer to the total count on the display, easily legible in decimal, but also represented in binary and hexadecimal. By observing the seconds pass, the differences between these bases is made more apparent, including the speeds with which the different place digits change.

Partially due to the shape and style of the different tally mark systems, each drawing machine allocates a different number of clusters per column. Despite all counting in unison, this causes the machines to advance the paper roll, and emit the accompanying sounds, with different frequencies. Much like the different rates of change of the digits of the different base numbers, these different frequencies overlap to create interference patterns (Fig. 2).

These effects serve to help make the viewer more aware of the duration of their attention to the installation, as well as the relative time scale of the performance. While the activity of the machines may appear endless, it is obviously limited with regards to the amount of paper and ink available. An electronic limit is also implied however, through the use of leading zeros on the display; space is allotted for 16 bits or two bytes, indicating a maximum count of 65,535. This translates to a little over 18 hours, at which point the counter will stop and the performance comes to an end.

Unlike the positional notation used on the display, by using the unary tally mark systems the number represented on paper is proportional to the length of paper used to write it down. This creates a relationship of quantity that gives a sense of physical scale to the number counted, and thus also to the number of bits (in the case of the binary number), and bytes (in the case of hexadecimal) used.

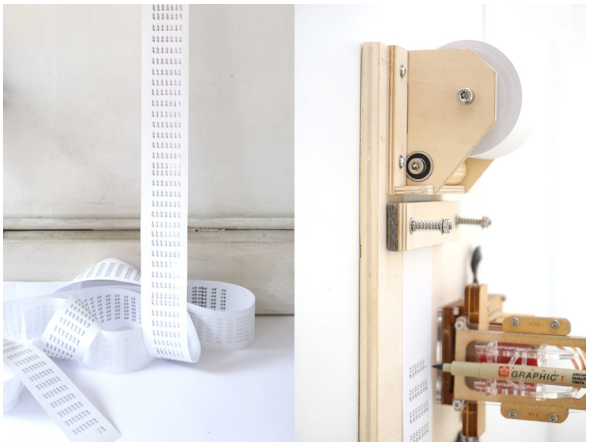

Fig. 4
Accumulation of tally marks beneath the drawing machine, and detail of the paper feeding mechanism.

Although mechanical, the drawing machines are imperfect, and so the tally marks are drawn with many small variations, creating a pseudo hand-drawn appearance. Any attempt to anthropomorphise the machines however, also requires the viewer to confront the mechanical nature of the task. With this contrast the work hopes to suggest that the codification involved in establishing these counting systems can be seen as both an essentially human as well as machine process, and that both aspects play a role in a resulting machine aesthetic.

2. TECHNICAL DESCRIPTION

These drawing machines are of the Piccolo design, a simple open-source 3-axis cnc machine using Arduino. The Piccolos are attached to a custom paper feeding mechanism which uses rollers to feed a roll of electronic calculator paper. The counting device also makes use of Arduino together with an OLED display, and the installation is powered by a single 12V power supply.

The counting device sends short pulses every 1000ms from one of its digital pins, which are monitored using interrupts by the Piccolos. A button and potentiometer on each Piccolo is used to adjust the Z-position of the pen, and a button on the counting device is used to start, pause or reset the counter. The current count is stored in EEPROM on the device when it is paused, allowing the installation to resume the count after being paused and switched off.