Intelligent manifestation of ingenious devices: Improving Human Computer Interaction using Early Automatons
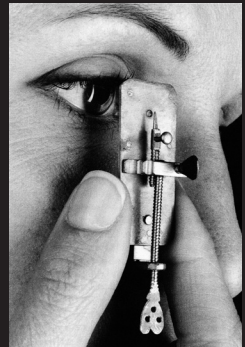
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Intelligent manifestation of ingenious devices: Improving Human Computer Interaction using Early Automatons

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Abstract

The following paper is presented in two parts. The first uses Standage's (2002) book, *The Turk: The Life and Times of the Famous Eighteenth-Century Chess-Playing Machine*, which explains the secrets of the fascinating machine know as the 'Turk', made by Wolfgang von Kempelen in 1770. For many years, before it was finally revealed to be a fraud, the Turk chess-playing machine simulated an automaton that could play authentic games of chess. In the second part, the paper aims to develop connections between the characteristics of this artefact as an analogy of cognition and our interaction with objects and machines. Although the Turk chess player was an illusion, made for the amusement of its audience, it is used here to explore ideas and concepts about the relationship between materiality, physicality and cognition through objects, connecting mind, body and environment within a model of distributed and embodied mind. The intention of this paper is to propose a critical way of thinking about human-computer interaction, using the early automaton as a model to elucidate how intelligence is manifest in interaction.

Introduction

Partially dedicated to the mythologies of artificial, automata and mechanical machines, the ongoing doctoral research which informs this paper is concerned with human-computer interaction (HCI), development and design, and is intended to amplify our comprehension of various aspects of the relationship between humans and machines. In order to do this, one specific early machine known as the 'Turk' is analysed to explain some of the research concepts. The Turk was a chess-playing automaton made by Wolfgang von Kempelen in 1770, and although it was designed as an elaborate hoax, the mechanical chess player speaks eloquently of the harmonious cooperation between the elements (human and mechanical) responsible for presenting it in such a way that it appeared to the audience as a seamless unity, rendering

the trick itself invisible. The Turk played chess and intimidated its opponents for more than seven decades. Even in von Kempelen's time, the invisible power of this ingenious and elaborate device stimulated discussions and ideas concerning with artificial intelligence, raising questions about whether a machine could be more intelligent than a human and whether logical thinking could be mechanically formalised, as well as suggesting a range of other philosophical queries (Standage, 2002).

In this paper, the Turk is used to propose that, in HCI, it is possible to explain how users actively think 'distributively' through devices (or objects) as part of an interactive solution, rather than simply developing interaction based on representations. Drawing on this model, the paper presents images of the Turk to illustrate useful concepts for the contemporary develop-

Fig. 1 - Racknitz's book

ment of HCI, presenting a different model of the mind as 'embodied' (Hutchins, 2010, pg. 426) and the possibility of interactions using the intelligence of the 'artificial' world, focusing on the physicality of the 'medium'. It advocates thinking through devices as a contemporary alternative in interactive human-computer development. This is not just a simulation of the world as in, for instance, the dominant 'graphical user interface' (GUI) paradigm, but it uses the 'world' itself, regarding it as the best 'representation' and, therefore, as central to the cognitive process.[1]

The secrets of the Turk

The Turk (or the Mechanical Turk) was capable of convincing an audience that it was able to play chess and therefore to formalise logical thought mechanically in a very restricted do-

main. In fact, its secret consisted of a human chessmaster operating the machine from inside its cabinet to produce a mechanical illusion of autonomy that persisted for decades. Its secret was never publicly revealed by a reliable explanation, so there remained a great deal of conjecture around how it actually worked until it was destroyed in a fire in 1854.

Standage (2002) dedicates an entire chapter to explaining and describing the Turk's secret, after decades of speculation. According to him, it was only in 1857 that an authoritative account appeared, written by Silas Wier Mitchell, whose father had been the Turk's last owner. This appeared in the form of a series of articles entitled 'Last of the Veteran Chess Players', published in a New York magazine, *Chess Monthly*:
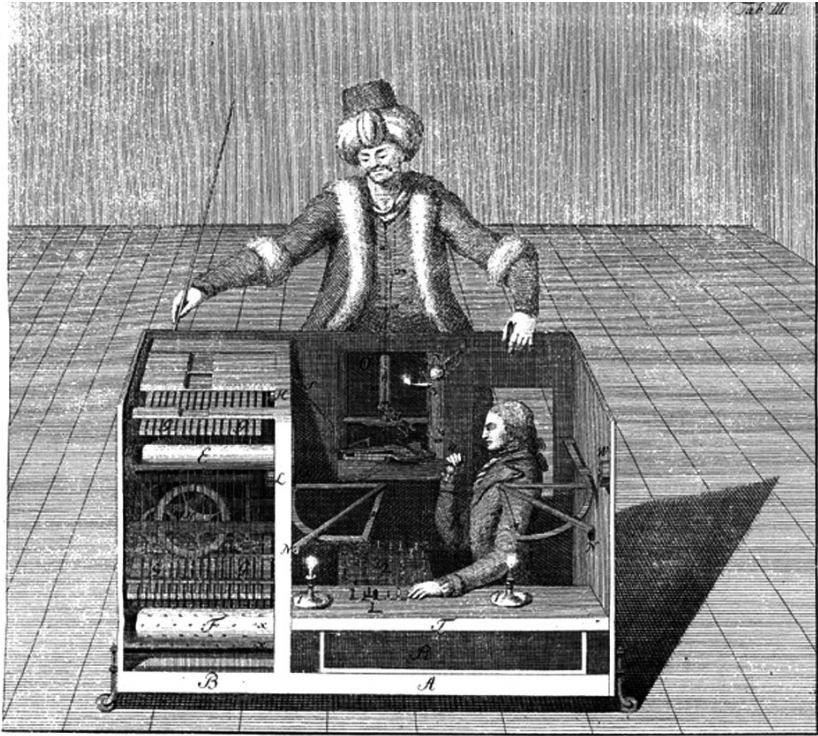
Fig. 2 - Racknitz's wrong assumptions

Silas Mitchell's description of the account was based on his own recollections and some notes made by his father. It repeats a number of myths about the Turk (such as it having played against George III and Louis XV) and contains several errors relating to the manner of the Turk's presentation. But Mitchell's articles, together with other documents dating from the Turk's last days in Philadelphia, make possible a full explanation of the automaton's secret. […] As had been widely suspected, the Turk was indeed controlled by an operator concealed inside the cabinet, who remained there throughout the performance. There was no need for wires or pieces of catgut, nor for trapdoors beneath or behind the automaton. Nor was the automaton's strategy guided in any way by the artful use of exterior magnets. (Standage, 2002, pp. 194-180)

Standage concludes that the fact that the exhibitor outside the cabinet had no direct control over the automaton's actions or strategies made the trick appear more plausible.

Based on his own observations, Joseph Friedrich Freiherr von Racknitz (1744-1818) published a book, *Ueber den Schachspieler des Herrn von Kempelen, nebst einer Abbildung und Beschreibung seiner Sprachmachine*, with illustrations explaining how he believed the Turk operated (fig. 1). His assumptions, however, were later proved wrong (Standage, 2002, pp. 198-199).

According to Standage:

> Racknitz wrongly concluded that the operator had to fit solely into the space behind the machinery, there was even enough room for the operator to sit up. So there was no need for the operator to be a child, a dwarf, or an amputee; the cabinet was capable of concealing a full-size adult. [...] The clockwork machinery visible on the Turk's left-hand side (as seen by the audience) did not extend all the way to the back of the cabinet, behind the drawer was pulled out, it appeared to have the same depth as the cabinet. (Standage, 2002, p. 87)

Standage (2002, pp. 198-199) describes the plates in his book (fig. 3) thus: "The base of its secret was a sliding seat that can be moved back and forth by the operator, opening and closing various folding partitions." The secrets of the Turk are explained in detail in Standage's book [2] using four specific plates and although a detailed description is not essential for understanding the argument developed in this paper, they are useful to clarify some questions and ideas that are stimulated by the machine, including how cognition can be distributed among agents, the materiality of the machine, among other characteristics and concepts in HCI and design development.
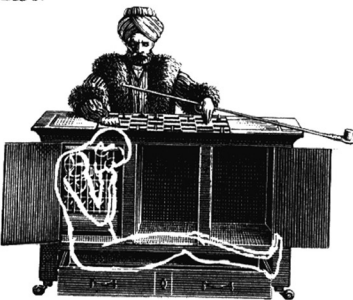

Fig. 3 - The plates illustrating the way the Turk worked

'Cognitive and distributed power' as manifested in the Turk

According to Standage (2002), computers are unquestionably the modern descendants of automata: they are "self-moving machines", (p. 224) in the sense that they blindly follow a preordained series of instructions – although, rather than moving physical parts, computers move information. Just like automata, computers operate at the intersection of science, commerce and entertainment. They also have given rise to an industrial revolution of their own by extending human mental (as opposed to physical) capacity. The interaction of human agents with the Turk stimulates an insight that helps make more explicit the connection with the materiality of objects and their importance for cognition, and therefore for human-computer interaction.

During its short history, the field of HCI has been responsible for making our interactions with technology – more specifically with computers – more friendly and natural. An analysis of the Turk reveals that it shared some of these aspects, illustrating an alternative model of the mind. Used as a model for HCI, it suggests a range of possibilities that need to be considered, including a more 'embodied mind' and 'external' interpretation of cognition, rejecting the predominant computational approach. Some of the observations, therefore, question the limits of the representational and computational (GUI) paradigm. One element manifested by the Turk was the materialisation of cooperation between all the elements involved. The way its was designed suggests that von Kempelen had a full and detailed understanding of all the constituent parts of the automaton, not only its natural elements, but also the artificial and mechanical harmony that was manifested so eloquently in the machinery in order to perform the trick and to respond the 'user's needs'.

What is curious to note is that, although he could not have been aware of the contemporary discussions of HCI, von Kenpelem's concerns with the machinery in terms of its design and applicability and the harmonic interaction between all its elements, in order to perform the trick in a convincing, synchronised manner, generated a device where human cognition was distributed between the people involved (inside and outside the cabinet) and the artefact (the Turk itself). The fraud perpetrated by von Kenpelem, therefore, created a structure that promoted interaction between the elements inside and outside of the cabinet. This interaction resulted in the chess game, where not only the challenger, but also the chessmaster inside the cabinet, manipulated the chess pieces and exercised their cognitive capacities in a common pursuit. As Hutchins (1995) reminds us, "the heavy interaction of internal and external structure suggests that the boundary between inside and outside, or between individual and context, should be softened" (p. 288).

What von Kenpelem conceptualised, in one sense, was the creation of an artificial environment where intelligence[3] could be manifest and cognition could be distributed across the material and cognitive properties produced by the interactions among the parts. Hutchins (1995) calls this aspect "cognitive power" (p. xvi), and continues, "the environments of human thinking are not 'natural' environments. They are artificial through and through. Humans create their cognitive powers by creating the environments in which they exercise those powers". In harmony with Hutchins' idea, the chess-playing machine gave informed feedback and possessed an eloquent transparency based on its own structural form, generating a restricted terrain for human inference:

> A good deal of what needs to be done can be inferred from the structure of the artefact, which constrains the organization of action of the task performer by completely eliminating the possibility of certain syntactically

> incorrect relationships among the terms of the computation. […] Rather than amplify the cognitive abilities of the task performers, or act as intelligent agents in interaction with them, these tools transform the task that the person has to do by representing it in a domain where the answer or the path to the solution is apparent. (p. 155)

In fact, the Turk suggests a solution based on task specialisation, restricting the interaction to the machine's physical structure and materiality. When it comes to desktop computers, what comes to mind is how the complexity and openness of the human project called 'personal computers' became a very ambitious project with higher expectations and computers have become a viable project based even more on the flexibility, ability and cognitive competence of the user than on the characteristics and qualities of the system to be more user-friendly and accessible by programmer and designers, described as 'usability'.

It seems impossible to deny that computers based on representational GUI, is a model that will persist for several more years. However, it can be observed that this paradigm is changing, adding a second level of interaction to GUI that is opening up new possibilities, simulating materiality and operating according to a logic of cause and effect, stimulated by an external force or agent (for example, gestures like pinching or tapping or the use of such technology as accelerometers). These provide a different model of interaction, taking the best of the both worlds. This link between the two worlds – the material and the digital – provides an alternative model to the abstract manipulation of representations. Putting together graphic representation and mechanical or physical aspects seems to be part of a model where most of us can share the experience of 'being in the world', as Heidegger claimed. [4]

This condition, also present in von Kempelen's Turk chess-playing machine, highlights a fun-

damental difference between the digital world and the 'real' world. The digital world is intangible, and its language uses a rhetoric that tries to simulate some of the aspects of the real world, making it intuitively congruent with what people assume is 'real'. Buttons seem to be pressed, pages simulate movement, and behaviours and resistances are predicted because they obey fundamental and invariable laws of nature, or at least what is understood as such. As a result, they are more consistent with the mental model of the human users, which is different from what made HCI a discipline mostly concerned with anticipation and prediction, creating a model of reverse engineering based on behavior in order to understand the human mind. The Turk, as a model, exactly elucidates this point; the automaton highlights this 'enactive' approach. This is the central argument against the way that traditional information-processor psychology understands perception as something that is entirely internal, arising from within the individual. The enactive approach illustrates how perception not only depends on, but is also constituted by, our possession of the sort of embodied and embedded sensorimotor knowledge that is crucial to the understanding of cognition.

> Having failed to notice that the central metaphor of the physical-symbol-system hypothesis captured the properties of a sociocultural system rather than those of an individual mind, AI and information-processing psychology proposed some radical conceptual surgery for the modeled human. The brain was removed and replaced with a computer. This surgery was a success. However, there was an apparently unintended side effect: the hands, the eyes, the ears, the nose, the mouth, and the emotions all fell away when the brain was replaced by a computer. (Hutchins, 1995, p. 363)

The Turk, determined by the materiality of its components and the restricted domain of the chessboard and direct manipulation, offered the 'user' simple interactivity based on 'real

world interaction', creating space not only for the manifestation of the human mind through the machine, but also for the manifestation of sensorimotor knowledge and agency, promoting perceptual experience. Hutchins himself argues that perceptual experience depends on sensorimotor contingency – that is, there is a causal dependence of experience on action: "Perceptual experience, according to the enactive approach, is an activity of exploring the environment drawing on knowledge of sensorimotor dependencies and thought" (1995, p. 228).

The Turk, as a tool, possessed the quality of promoting this reconciliation where "[t]he computational constraints of the problem have been built into its physical structure",– not just a simulation of the world (as, for instance, in the dominant GUI paradigm) but, paraphrasing Edwin Holts, using "the world itself as its best representation" and therefore as central to the cognitive process.

Concluding remarks

The research from which this paper is drawn is mainly an attempt to relate two aspects – early automatons and human-computer interaction – and to discover what it is that speaks to us so eloquently in the Turk machine that can help us rethink HCI.

This idea is not new: the notion of distributed, embodied and enacted cognition has been current for some time in the scientific community. The philosophical idea implying that a new concept of mind is needed to understand cognition and consciousness has been used to reframe several disciplines; in this research it is used to reframe human-computer interaction. Although, HCI has achieved considerable commercial success, empowering users to undertake their own work and activities by using this sophisticated piece of engineering, and thus promoting technological inclusion,

much of what is known about HCI is based on the archaic notion of computation within cognitive science which maintains that people behave like information processors and that the process of thinking is very similar to the process of computing.[5] All the substantial changes in HCI are contaminated by this idea, which has transformed it into a discipline of incrementalism, offering substantial resistance to users.

The way automata were regarded in the 18th century, however, suggests that they fulfilled a human desire to use machines for entertainment, for joy, but also for enlightenment, as well as to potentially replace human labour. Nowadays, the computer is the machine that carries the hope that it can relieve humanity of labour. However, it is interesting to note that this relationship has, ironically, turned the users into 'authentic automatons'. If computers are able to do this, to relieve human labor, the conclusion must be that there is something wrong with HCI. It seems clear that computers can replace some human activities – sometimes, even more efficiently – or even support humans in some tasks. But more sophisticated tasks require more dynamic processes and more complexity than the current computational models can accommodate. The Turk automaton brings to the surface some of the points where embodied cognition emerges through the materiality of its components, highlighting the crucial points in human-computer interaction where users are still struggling to wind up the clock.

Notes

[1] Winograd and Flores (1986) have developed this idea further, expanding on Heidegger's challenge to the dominant view of mind, by arguing that cognition is not based on the systematic manipulation of representations, which denies the physical basis of human action.

[2] Standage (2002, pp. 198-199) describes the plates in his book (fig. 3) thus: "The base of its secret was a sliding seat that can be moved back and forth by the operator, opening and closing various folding partitions.":

> Plate 1: "At the start of the performance, the operator moved forward on the sliding seat. The movement of the seat caused a small amount of dummy machinery visible through the cabinet's leftmost door (as seen by the audience). It was then possible for the exhibitor to open the small door at the back of the cabinet and hold a lighted candle up to it, whose flickering could just be seen through dense machinery that now seemed to extend all the way to the back of the cabinet." (pg. 198).

> Plate 2: "Once the exhibitor had removed the candle and shut the rear door, the operator straightened his legs and slid backward on the moving seat. This caused the dummy machinery to fold up and also closed a small window behind the front-most machinery through which the light of the candle had shone. This ensured that there was no danger that the operator, now sitting up behind the clockwork machinery that was still visible to the audience, would be seen." (pg. 198).

> Plate 3: "The operator now had to prepare the cabinet's main compartment for inspection by the audience. As Willis had suspected, the main compartment, which was lined with green baize, was not as simple as it seemed. After sitting back, the operator covered his legs by folding over a lid that formed part of the main compartment's floor; then he concealed his body by closing a door that formed part of the main compartment's floor … [and] a door that formed part of the main compartment's side. This ensured that the main compartment resembled an almost empty box. By pulling on a string, and hooking its end over a button, the operator then raised into place the small amount of machinery, including wheels, cylinders, and brass quadrants, that was situated in the main compartment. Again, this machinery was a decoy and had no useful function." (pg. 199).

> Plate 4: "All of this took a few seconds, however, so the exhibitor did not immediately open the cabinet's front doors. Instead, he opened the drawer and slowly and deliberately removed the chessmen. Have done so, the exhibitor could then open the doors of the main compartment and reveal its almost empty interior. Next, he would open the door at the back of the main compartment and reveal its almost empty interior. Next, he would open the door at the back of the main compartment and introduce a candle, so that the spectators could inspect the main compartment. The exhibitor then spun the whole contraption around and opened the doors in the back of the Turkish figure to reveal more decoy machinery." (pg. 199).

[3] Michael Punt's (2002) paper describes a taxicab as not only a "…transporter of bodies between destinations, but […] a complex data storage and retrieval system. Not quite an artificial intelligence machine, since it needs a sentient human processor, but nearly." (p.366) His idea suggests that we might also consider systems

like the Turk as manifestations of intelligence distributed within a number of elements.

[4] Clark, A. (1997), Dreyfus (1972, 1992), Winograd and Flores (1986), are some of the authors that have used Heidegger ideas ostensively in their work, to understand computers, mind, cognition and also, Artificial Intelligence.

[5] Lakoff and Johnson (1999) will differentiate these both models of the human mind, classifying the information-process model as first-generation of cognitive sciences (desimbodied) and second-generation of cognitive science (embodied mind).

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