

Of Machines and Man: Exploring Growth and Decay of Movement for Interaction Design

In this paper we explore Ingold's notion of growth and decay of movement, an approach of understanding the relationship between human and the environment. We presented two instances regarding human and machine movement from our exploration during a brief ethnographic study at a local pot warehouse. This is followed by further analysis of two video clips, where we explore the richness of human movement as a relationship between the actor and the environment; we then analyze how the task is done differently in the machine's case. In the last part of this paper, we raise issues regarding the appropriation and implication of this notion of growth and decay of movement in the field of interaction design. We concluded with opening up a discussion arena for further works in this field to look at the appropriation of technology in relation to the importance of human's freedom to move, express and experience.

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INTRODUCTION

When it comes to interaction design, there are many approaches in understanding the relationships between human and the product contextually. In the field of designing tangible user interfaces, especially, significant amounts of study have looked closely at ways to observe and analyze human movements while interacting with products (Djajadiningrat, Gaver and Frens, 2000; Buur, Jensen and Djajadiningrat, 2004). However, it seems to be an importance to look further into the movements in the larger context, where sometimes they seem to be more intricate than just moving parts of a body. Do movements have meanings? How do we move? What are the relationships between movements, the actor, the artifacts and the environment?

TOWARDS AN UNDERSTANDING OF HUMAN MOVEMENT

What does it take to understand human movements? We realized that in the case of human, the notion of movement is far more complex than the straightforward definition found in a dictionary. There are significant relationships between movement and time, actor, meanings, and the environment. From an observation exercise with a video ethnography of a Dutch funeral, we found out that body movement is very much connected to the societal context in which it took place. By this we mean that movements could be seen as more than just a set of actions. From this brief video observation exercise, some movements can be performed and/or interpreted as complex as cultural or as subtle as emotional expressions. In these cases, movements have meanings and they are defined not only by the mind of the actor, but also influenced by the unfolding relationships of various experiences both from the past and present, the place, the evolving culture and tradition where these movements are expressed (Otto, 1997).

We also learned from exploring briefly upon the complexity of culture, the notion that it is both organized and natural, supports the idea that body movement, as a cultural expression doesn't merely serve as a collection of actions in completing a task, but also as a reaction, or perhaps a conversation with the environment, objects and other body movements that exist in the context (Farnell, 1999). In a way movements are structured with some level of organization, where one action is followed by another, either moulded by human biological conditions or by rules and restrictions in societal agreements such as laws and rituals. However, even to the level that they are ritualized such as prayers and dances, movements constitute the dynamic and reflexive flow of actions both internally and externally, involving the human mind and body being aware of the material, space, and time.

GROWTH AND DECAY OF MOVEMENT

According to Ingold, human movements as part of skilled practices are too often regarded as only an extension of one's ability to physically manipulate objects (Ingold, 2001). The trail of these movements then can be seen as a line of "transport" (Ingold 2005). It is destination oriented; the

movement is focused on transporting from one point to the next (See Figure 1). Here, human movements are presented as completion of a task after another. Here the notion of perception and action is isolated and solely oriented on the actor and object.



Figure 1: Transport: movement from point to point

Ingold argues that human movements are far more intricate than such simple transport. Movements should be seen as a string of actions that are thought out through one's awareness and knowledge in interacting with the objects, space and other actors. In other words, one way to look at movement should not be in a way that we end up fragmenting the body-object-space-others interactions from one set of actions to the others. Instead, movements should be observed as a lively process where the actor is present both physically and mentally through a path. Ingold proposes to look at the path of the wayfarer. A wayfarer's travel trail is different from the travel of a vehicle from one point to another. A wayfarer establishes his path in a rich process, where he relates to the environment and other humans: here the actors are actively part of the process or "alongly integrated" (Ingold 2005) (See Figure 2). The movements can be seen not as dots along these paths. Rather movements are scattered through out the path, where they can be seen as growth, as they are about to be enacted, and decay, as the actor proceeds gradually to the next movement (ibid).



Figure 2: Wayfaring: alongly integrated path of movement

FIELD STUDY

In order to explore different types of skilled movements we performed an ethnographic study. We visited both industrial and crafts sites, ranging from a one-person therapeutic massage therapist to a large multi-national industrial component producer.

One site that took our attention the most was a local pot warehouse. The warehouse has over 16.000 m² of stock under roof and around 8.000 m² of outdoor stock. In their warehouse, we found pots from all the key major pottery regions of the world. The warehouse use two different operations in wrapping a stack of pots; manual operation and automate operation. Manual handling or automatic handling is decided based upon visual input, e.g. the operator has to check the type of wood has been used for the pallet.

During the field studies we employ a large range of techniques, for example, interviews, observation and video analysis.

VIDEO ANALYSIS

Manual operation

Fragmenting movement

Looking at it briefly, there are two main steps that are clearly carried out by the operator in order to completely wrap one stack of pots: 1) Put the plastic bag on (Fig. 3a), and 2) seal the stack up by heating the bag with gas torch (Fig. 3d). However, when looking at it more closely, each step is a result of movements each building on top of each other, leading towards the completion on a task. For example, if we describe what happens during the first main step, "putting on the bag" can be broken down into several sub-steps such as: 1) open the bag, 2) throw the bag in the air, 3) tip the bag over, 4) lower the bag down, 5) envelope the stack with the bag, and 6) pull the bag down.

But such description of movements leaves out other details such as the actual movement of the operator's body. For one simple sub-step of opening of the bag, for example, what actually happened to the operator's feet, head, shoulders, arms, biceps, wrist, and fingers? And what actually was the operator thinking then?

Looking at what's in between

Instead of isolating the operator's movements into the two main steps, we try to look at what happen during the transition from "putting on the plastic bag" to "sealing up the stack". When focusing on one of the influencing factors, space, we realized that upon the transition from Step 1 to Step 2, the operator leaves and re-enters the space where the stack is located. When the operator finishes putting on the bag, he goes to grab the torch, located not too far from the stack (Fig 3b-c). He then goes back to the stack and starts to seal it up. We realize that the main task of bagging and sealing up the stack cannot be completed without movements that are in between.

Obviation approach, as Ingold proposes, is perhaps a better and more appropriate way to understand movements in relation to the nature of human beings (Ingold, 1999). Instead of looking at events or points when a task is completed, we should try to look at the progression of movements as *alongly* integration (Ingold, 2005) process, where the operator is not simply transporting from one point of task to another, but instead he is actively present in his movements and interacts continuously with the environment.

Each movement that he makes is not a predefined action and isolated from the others. For example, when the operator is pulling the plastic bag down (Fig. 3a), his movement is influenced by the previous one, when he throws the bag up in the air, as his feet balancing the act and thus locating him in the corner of the stack. Perhaps unconsciously he does this as what might feel right or logical to do. But in a way, he is also aware of the spatial conditions of the artifacts he is dealing with: the size of the stack, the stiffness and creases of the plastic bag, etc.



Figure 3a-d: Manual Operation. The four sub-steps of packaging a stack of pots

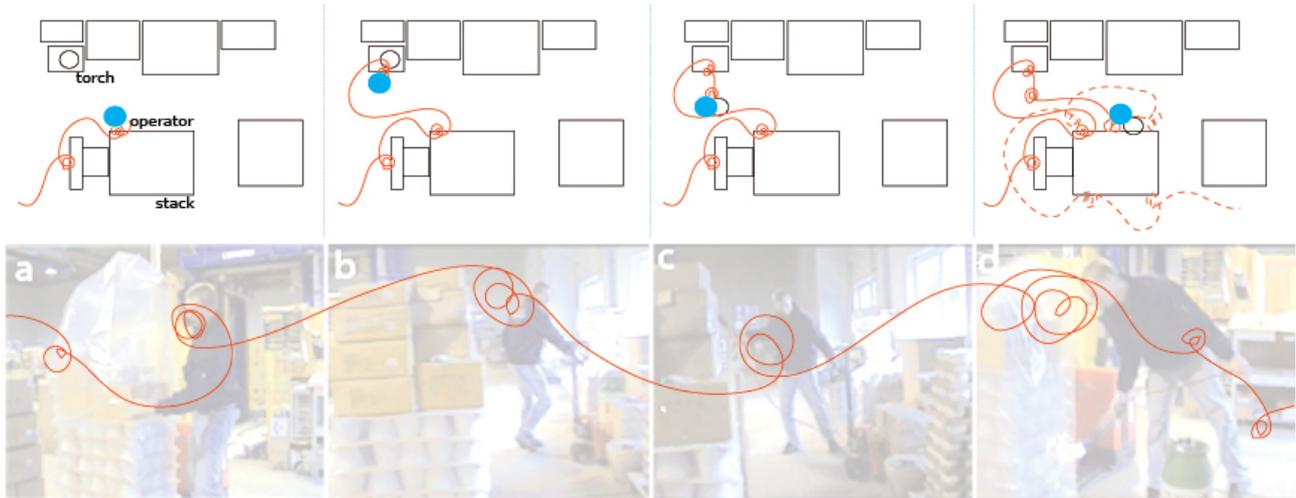


Figure 4: When we trace the operator's movement, we can see his trail in a swirl-like path, rather than a straight line, flowing within the environment, around the artifacts.

But it seems that this awareness is not automatically executed either. The operator seems to continually adjusting his positions and actions, thus resulting in an intricate web of movements. All these seem to be part of the operator's dexterity in completing the task. Each movement builds not necessarily on top of each other, but together simultaneously along a path.

Socially influenced path

What kind of path that the operator deals with? From our study, we found several artifacts which might partly constitute as a path such as manuals, signs, labels and lines painted on the floor and wall all around the warehouse. The warehouse is also set up in an order where three main rooms house three activities: stacking, packaging, and shipping. It seems that these artifacts constitute the orders and rules to be followed. Are these the only paths influencing the operator's movement?

As mentioned before, the operator is present and aware of his movements. He is actively engaged in the deciding process, where to go and what to do. But from our observation, though he is working individually during the manual packaging section of the warehouse, he is still a part of a greater social context, where he works together, alongly with the rest of the workers. His path of movements is comprised of both physical and social artifacts. The rooms, signs, manuals, labels, the stacks, the torch are the physical artifacts that shape the interactions in the warehouse, thus play an important role in shaping the movements of the operator (See Figure 4). At the same time, the social artifacts might seem less visible, since it is influencing the operator's movements implicitly through verbal communications and common understanding of each other's work among workers in the warehouse.

Automatic Operation

In the case of automate operation in order to completely wrap one stack of pots the machine performs the following steps:

1. Frame opens up (Figure 5a)
2. Frame moves down (Figure 5b)
3. Stop. Torch turns on (Figure 5c)
4. Frame moves up (Figure 5d)

In the current growing field of automate service, machine plays a key role where in many cases machine and human share the same workspace and to some extent even have to work together. In the case of the local pot warehouse, we could not see if machine is a single entity in the packaging system or not. The fact that the operator moves around the machine for supervision, and that the high stack of pots could have been wrapped out by two operators lead us into some thoughts that the machine, serves as a supplemental tool.

Furthermore, while machine executes the pre-defined command, machine follows a rigid pattern to complete a task. The completion of task is a *transport* of one step to the next. This type of movement did not allow any other movement to take place; lacking the flow where movements *integrated alongly* a path of growth and decay.

With the current pace of technology, it becomes obvious that in many dynamic situations or complex control tasks, human rely on machine to extend their perceptual-motor capabilities. A more expressive interface would be needed to allow human interact with machine without being overpowered.

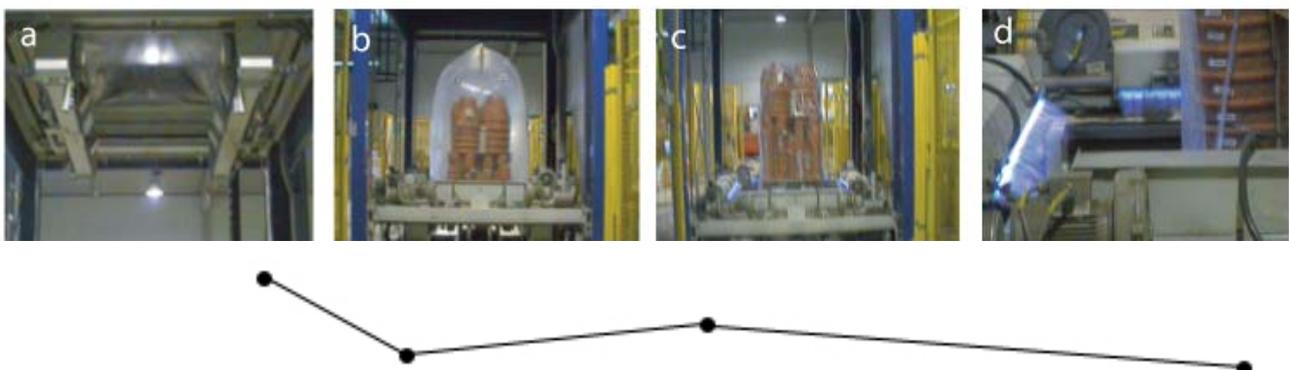


Figure 5: Automatic Operation: the machine wraps a stack of spot in four steps

CONCLUDING DISCUSSION

In designing interactions (products, interface, system, etc), it seems to be the case that the focus of study leaves out the complexity of human movements. Approaches in product design for example have been able to thoroughly look at an array of dismantled movements: twisting, turning, pushing, tapping, etc. However, it is important to consider further the importance of the context (meaning, values, space, artifacts, environment) in which the movement is expressed and experienced.

Growth and decay of movement

From our field study, we found out that once we try to describe the movement of an operator during interacting with a product at a local pot warehouse, it is very easy to fragment his movements into steps. Perhaps it is easier to do so since, we are able to recognize (at least visually) the result of a task, or the artifacts that are used during the specific movement. Bagging the stack and sealing up the bag are two movements that can be identified directly by acknowledging the presence of the bag and the use of the torch. However, such description, truncates the flow of human movements that actually takes place in a very intricate way.

By looking at the strings of movements and how they influence each other, we were able to see that movements are very much influenced by both physical and social artifacts, such as (in our case) instructions, labels, signs, torch, stacks of pots, bags, discussions, etc. The operator moves in a path where we could find traces of his movements through the aforementioned physical and social artifacts.

From the path we were able to recognize the growth and decay of movement, as influenced by these artifacts. For an example, around a stack of pots that is ready to be manually packaged, we found that the growth of movement is present as the operator picks up a plastic bag and continues through until the bag is enveloping the stack. The movement starts to lessen as he leaves the space and entering another space to pick up the torch. The short walk to the other space is the decay of the previous movement. It seems to be an importance to regard this process as a *rest* (Ingold, 2005), a moment when the operator progresses from one movement to the other.

At the same time, the movements are not only influenced by the dynamics of these artifacts, but also influenced by the operator's qualities of care, judgment and dexterity (ibid), where he as an active body and mind, continually interacting with other actors in the environment. This process evolves into the development of skills where the operator is able to continually adjust his movements and acquire knowledge of the tasks. This doesn't predetermine a perfect, satisfying outcome, however. The completion of the task is still flexible to various changes that might take place, perhaps influenced by the culture or freedom of expressions.

Technology in the picture

It seems to be an importance to recognize that the design of machines appears to be inspired perhaps mostly by the knowledge of human movements in completing if not the same, similar task. In the case of bagging and sealing a stack of pot, we realized that the main steps the machine executes mimic the steps that are done manually by the operator. However, the movements are very different. Perhaps this is not a coincident, since machines are built to help or support our work. But how can we design machines that in a way that it doesn't end up overpowering, but empowering the human ability to move, express, and experience?

In the case of the automatic packaging machine, we notice that the machine still needs the operator's supervision and it doesn't have the ability to adjust its movements. The machine is a closed mechanical system that is not able to be continuously influenced by the environment. However, the design of the machine leaves room for an interaction with some physical inputs from the outside, such as when an operator pushes the activation button or when a stack of pots activates the sensor to move the conveyor belt.

But, what does this interaction mean for the operator? One may see this as an opportunity for the operator to acquire new skills: operating and supervising the machine. Does this skill replace his previous skill of manually packaging the stack? This is a crucial question that needs to be considered in design, whether or not such design allows or disallows the operator to carry out the task appropriately? The next question would then be, what is appropriate and how do we find out?

Anthropology of movements: a step ahead towards an understanding the complexity of interaction between humans, the artefact, and the environment

It is challenging to develop a design that supports and improves appropriate interactions for human and its environment. Human movements are influenced by both the environment but are also adjusted by the body and mind in a very intricate and complex way. From our experience in observing the operator and the packaging machine at a local warehouse, we learned that one single movement is very much connected to other movements. These movements are enacted not only as actions to complete a task, but also as a result of interacting with the physical and social environment. From this observation, it seems to be an importance to take this notion of growth and decay of movement as springboard to uncover the complexity of human movements in designing interactions.

The relationship between the user and the environment indeed will be different from case to case. This notion of growth and decay needs to be appropriated to the users, the environment and the meanings and values of interaction. This understanding then, would perhaps allow members of the design team to move forward and further in the next stages, developing not only the appropriate style, tangibility, or interactivity of a product, but also allowing user in their environment to move naturally and meaningfully.

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