# TOUCHSTORMING and BODYSTORMING, A generative approach for the elaboration of a gesture database in interaction design

Abstract: In this paper we describe a new approach for idea generation in interaction design. This approach is based on creative sessions namely *touchstorming* and *bodystorming*. It enables to generate gesture ideas which can be applied in two different configurations, 2D and 3D. A set of about 200 ideas of gesture was proposed for 2D interfaces (80) and for 3D interfaces (114). These gestures are then analysed and categorised. Finally some specifications for interaction design are defined. The originality of the research lies both in the approach established and in the taxonomy according to which the gestures resulting from this approach have been categorized. Indeed, as most existing taxonomies are technology driven, the classification proposed in this paper is more oriented towards creativity and final user.

***Key words: Interaction design, Gesture, Creativity***

## 1. Introduction

Nowadays, in order to be innovative, the companies must adopt new ways of designing concepts through highly creative design approaches. In the last decade, some creativity methods have been spread out in the companies [Benson & al, 2003; Carter, 2000; Von Oek, 1993; Higgins, 1994]. Most of them are based on animation methods involving a group of participants who use the appropriate creativity tools. Brainstorming enables to produce a huge quantity of ideas in a very short time and is so considered as one of the most used and efficient tools for product design. It allows a wide production of ideas in positioning the participants in a flow situation with a quick demultiplication of the quantity of ideas. This phenomena is due to the very fluid exchange of information which takes place between the participants.

As product design is evolving more and more towards interaction and experience design, the traditional creative brainstorming approach is somewhat not well adapted to concepts generation in this new area. The main difficulty is that interaction design needs ideas that can be projected into time sequences. As soon as designers enter into a sequential mode, the time sequence is blocking the fluidity of idea production. In order to overcome this problem, we defined a new generative approach based on *touchstorming* and *bodystorming* in a creativity session with 8 participants. *Touchstorming* and *bodystorming* have been used by the participants in order to express respectively 2D tactile interaction and 3D immersive interaction. The resulting ideas have been synthesized into a database of gesture stereotypes rendered under the form of visual icons. These icons show the gesture sequence used in relation with the interactive systems. They were drawn after working out a set of pictures captured while the creativity session. This paper is describing both the method defined and the related output. A

gesture database of 200 stereotypes for 2D tactile interaction and 3D immersive interaction is presented and described.

## 2. Theoretical background

### 2.1 Creativity in design

Traditional creativity methods are mainly based on brainstorming which is one of the most powerful tools in creativity [Isaksen, 2012; Jaoui, 1994; Van Gundy, 1983]. The brainstorming approach is based on the production of a huge amount of ideas from an initial question which is explicitly exposed to the participants. Most of the time, they express verbally some ideas which are further written on a paperboard and shared in real time with the other group participants. As gesture is a sequential feature to be drawn in interaction design which involves a relatively high involvement of the producer, the philosophy of brainstorming can be applied to hands, arms and whole body expression scenarios. A first goal in this study is to explore a new way of gesture expression, sequential enough to show and share the gesture with every participants, and quick enough in order to keep the fluidity needed in a creative session.

### 2.2 Gesture based interaction and gesture taxonomy

Gesture is becoming an increasing part of interaction design and of user experience. As most interface are progressively moving from traditional supports such as computers equipped with keyboard and mouse towards tactile surfaces and even more gesture recognition, the nature of interaction is changing with new interaction styles. The more the interaction is based on gesture, the more there is freedom in the interaction style and the more the users seem to go towards a communication which is similar to natural more or less codified human-human communication. At the same time, the more the user is using gestural modality, the more he is actively engaged in interaction. Several authors started to establish taxonomies or classifications for gesture. The three most complete ones are detailed in the following table.

<table>
<tr><th>Gesture types</th><th>Karam & Schrafel</th><th>Rime & Schiaratura (in Buxton)</th><th>McNeills (in Buxton)</th></tr>
<tr><td>Gesticulation</td><td>Natural, often with speech</td><td></td><td></td></tr>
<tr><td>Manipulation</td><td>Real time control of an entity</td><td></td><td></td></tr>
<tr><td>Deictic</td><td colspan="2">Pointing spatial location</td><td rowspan="3">Cohesive: variations of iconic, pantomimic or deictic gestures related to speech</td></tr>
<tr><td>Iconic</td><td></td><td>Shape related gesture</td></tr>
<tr><td>Pantomimic</td><td></td><td>Mimic the movement of invisible objects</td></tr>
<tr><td>Semaphoric</td><td>Communicative symbols</td><td rowspan="2">Symbolic / cultural meaning</td><td rowspan="2">Beat: hands up or down in speech rythm</td></tr>
<tr><td>Sign language</td><td>Grammatical and lexically complete</td></tr>
<tr><td>Multiple styles</td><td>Combination of at least two previous types</td><td></td><td></td></tr>
</table>

Table.1 Taxonomy of gesture in interaction design

Karam & Schrafel (2005) established a taxonomy of gestures in human computer interaction which includes the following types:

• *gesticulation*: natural forms of gesturing commonly used in combination with conversational speech interfaces.

• *manipulation*: those whose intended purpose is to control some entities by applying a tight relationship between the actual movements of hand, arm and the entity being manipulated

• *deictic*: those which involve pointing to establish the identity or spatial location of an object within the context of the application domain.

• *semaphoric*: communicative symbols to be communicated to the machine, those signaling using flags, lights, arms, or any gesturing system that employs a stylized dictionary of static or dynamic hand or arm gestures

• *sign language*: gestures used for sign languages and considered as independent of other gesture styles because they are grammatical and lexically complete, often compared to speech.

• *multiple styles*: combination of several styles such as deictic and manipulative, or semaphores and manipulative.

Rime and Schiaratura (1991) cited in Buxton (2013) propose complementary taxonomy with components such as *deictic* gestures, *symbolic gestures* which cover *semaphoric* and *sign language* gesture, but also more specific ones:

• *Iconic gestures*: these gestures convey information about shape while moving hands through the air (size, shape or orientation of the object, ⋯).

• *Pantomimic gestures*: those mimic the movement of some invisible tool or object.

In addition to both of these classifications, there are also broader ones cited by Buxton (2013) such as the one of Cadoz (1994) which groups gestures into three types: *semiotic* to communicate meaningful information, *ergotic* to manipulate the physical world and create artifacts, and *epistemic* to learn from the environment through tactile or haptic exploration, and the classification of Mulder (1996) which provides a summary of several different classifications, especially with respect to semiotic gestures. McNeills taxonomy (1992) gives a finer view about communicative gestures with *beat* and *cohesive* gestures. Gestures can also be ordered according to their speech/gesture dependency (Kendon 1988 in Buxton 2013). Kendon's proposed the following Continuum:

Gesticulation -> Language-Like -> Pantomimes -> Emblems -> Sign Language

(Beat, Cohesive) (Iconic) (Pantomimic) (Deictic) (Symbolic)

Finally, Ruiz & al (2011) give a definition of surface gesture research which is applied in the domain of surface computing, and motion gesture. They emphasize that the fact not so much research has been published describing the classification of motion gestures. So far most of publications focus on interaction techniques through technologies and tools but not necessarily on gesture. It is the case for the ones cited in Ruiz & al (2011): Rekimoto (2002), Harrison &al (1996), Small & Ishii (2000), and Barlett (1941).

As future interaction systems are progressively moving towards gesture only interfaces, then gesture and speech and conversational interfaces, it is now becoming crucial to define new creative approaches to generate gestures dedicated to gesture only interfaces instead of more direct interaction.

## 3. Research question

The goal of this study is to explore the concept of gesture in interaction design from a creative point of view and to propose a taxonomy which is oriented towards creativity and user purpose and not necessarily towards technology. The objective behind for designers is to find triggers as potential input data for creative sessions in interaction design.

## 4. Methods

### 4.1 Creativity session objective

The objective of the creativity session was the definition of ideas for gestural interaction according to two modes: 2D interaction for tactile screens and 3D interaction for gesture commanded interfaces. A first prototype of the software was also shown to the participants to better explain the related functionalities in action. The procedure included the application of several specific creativity tools applied with a mixed group of 8 designers and engineers. Some well known tools such as the purge (in order to get an insight about the existing interaction modes and human-machine systems) followed by a brainstorming were initially used. In a second time new approaches for gesture generation were applied, *touchstorming* and *bodystorming*, through a scenario based approach.

### 4.2 Procedure for *touchstorming*

The 60 minutes lasting *touch-storming* enabled to generate gestures with realised hands and arms on a magic screen in order to command the software functionalities. The gestures were played by the participants according to the functionalities listed by the animator, and pictures were taken at the same time with the cascade function. Participants had to mimic the interaction and to note their ideas of gesture through keywords on post-its.

### 4.3 Procedure for *bodystorming*

The 60 minutes lasting body-storming enabled to generate body gestures while imagining a magic room in order to command the software functionalities. As for the 2D context, gestures were played by the participants according to the functionalities listed by the animator, and pictures were taken at the same time with the cascade function. Participants had to mimic the interaction and to note their ideas of gesture through keywords on post-its.

Every gestures ideas generated were then refined and put in perspective by using a scenario based approach closer to the real expected use of the software. As output data of this phase and of the whole session, two HMI systems were schematised and scenarised by showing the evolution of the interaction sequence when playing the scenario. For this phase, the initial group of 8 participants was splitted into two groups of 4 people. They were asked to draw the use of the system in terms of sequence of use formalised through screenshots with arrows and keywords bubbles, legends, … The results were formalised on A3 paper sheets. Finally the scenarios were played in front of every participants who had to express advantages and drawbacks of the two systems.

## 5. Results

### 5.1 General results

As functionalities have been the input data of the creativity session for 2D and 3D gestures, the first classification has been established according to these functionalities.

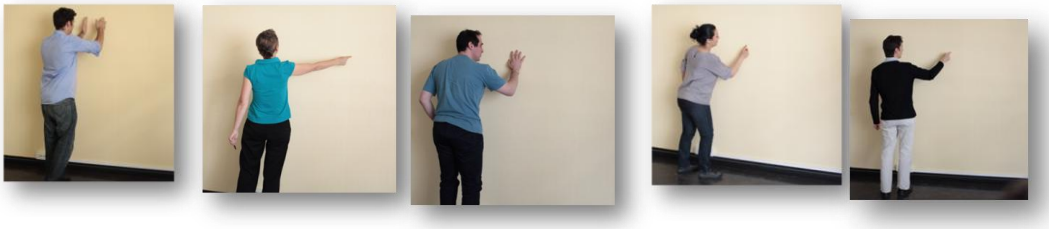
| | |
|---|---|
| ***Touchstorming*** |  |
| ***Bodystorming*** |  |

Table.2 Illustration of *touchstorming* and *bodystorming*

## 5.2 Results of *Touchstorming*: Two dimensional interaction gestures

A set of 80 gestures has been generated and formalized by the group of designers (see figure 1).

Figure.1 *Touchstorming* results: 2D gestures

For the 2D configuration, a set of 80 gesture stereotypes has been established. We can observe some variability in terms of engagement, depending on the parts of hand or number of fingers involved in the related gestures. These gestures involve mainly only one hand for 70 of them, and sometimes two hands for 10 of them. In addition, 33 of these stereotypes are involving only one finger and the other ones the

whole hand. It is also to say that even if almost every categories found in the literature review are also present in this set of gestures, the main part is based on a true contact with the screen and this way is not a gesture only interaction. This means that this context is more oriented towards *manipulation* than towards *gesticulation*.

### 5.3 Results of *Bodystorming*: Three dimensional interaction gestures

A set of 80 gestures has been generated and formalized by the group of designers (see figure 2).

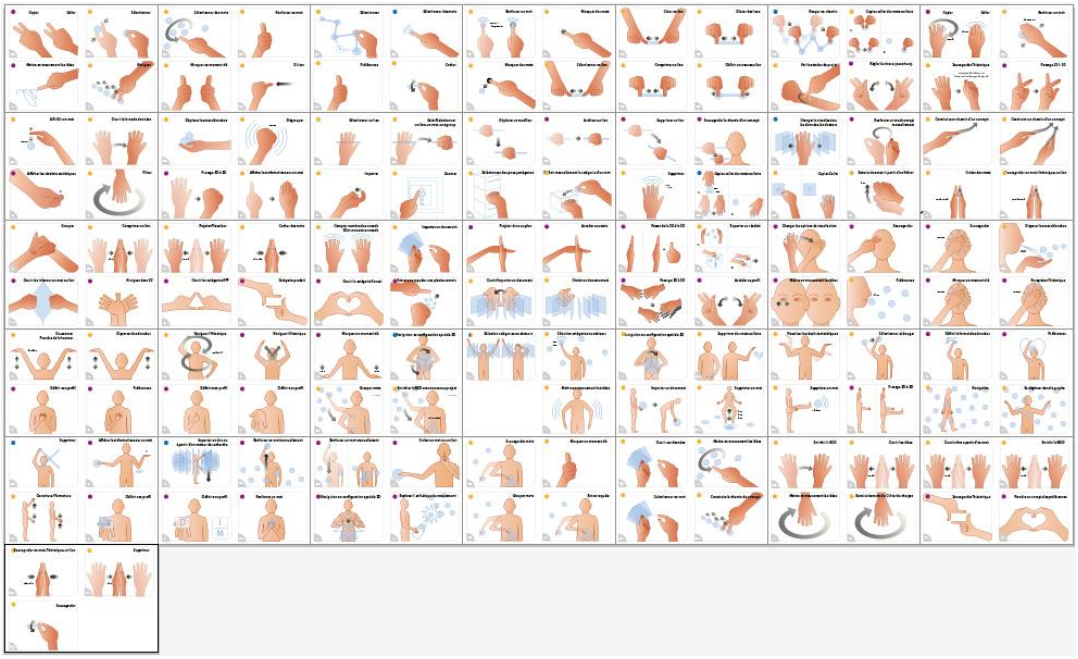


Figure.2 *Touchstorming* results: 3D gestures

For the 3D configuration, a set of 114 gesture stereotypes has been established. As in the 2D configuration, we can observe some variability in terms of engagement, depending on the parts of the body which are involved, going from one finger only to the whole body. However, most of these gestures are related to arms and hands. In addition, 33 of these stereotypes are involving only one finger and the other ones the whole hand. In this case we can find every category found in the literature review with a particularly good ratio of *gesticulation* and *sign language*.

### 5.4 Towards a new taxonomy for gesture in interaction design

In this study two creativity techniques were experimented for the generation of interaction gestures. The *touchstorming* produced 80 2D gestures (tactile) (figure 1). Those were between 1 to 6 ideas per function. The *bodystorming* generated 114 gestures (figure 2) with 1 to 8 ideas per function. In comparison, the two configurations enabled to express different sets of gestures. The 2D gesture are mainly based on a contact based interaction, while the 3D gestures are realised in a free space which gives more freedom for hands, arms and even body. For instance, in the 3D configuration, the reference to sign language is important, which is not the case in the 3D configuration.

Among the gestures we found different criteria for classification. First of all, as interesting for the interaction developers, a tri per *function* was the first natural classification done because the functionalities were used as input data for the creative sessions. According to this first classification, some functions have been combined in one gesture. Furthermore we saw differences in the *originality* of the gestures. Many ideas came from *analogies*, especially in the *bodystorming*. The participants imaged a functionally similar situation in the physical world and interpreted the gesture for the virtual context. For example in the *bodystorming* the gesture for the function *randomize the visualization* was interpreted through a spiral finger movement that resembles the principle of a blender or symbolizes a hurricane (see table 3). Other gestures were directly adapted from already known tactile interfaces, like double tap with a finger to activate an element. More gestures from known interfaces appeared during the *touchstorming* than during the *bodystorming*. Still there were gestures that were new without any reference to other interfaces or physical actions. The number of such new ideas was significantly higher for gestures from the *touchstorming* than for the *bodystorming*.

Another criterion to class the ideas is the intensity of corporal engagement that each gesture demands. As this criterion is crucial into the user experience, we considered it in our classification. Some gestures are pure symbols, without any movement, others only need little motions of the finger tips. Others require a medium effort, whether because of a wider range of movement or slightly uncomfortable positions. And finally there were ideas with a high corporal engagement among the 3D gestures that involve moving the whole body vigorously.

A final distinguishing point between the ideas from the *touch-* and *bodystorming* are the body parts required for the gesture. For the tactile 2D interfaces they range from one finger, multiple fingers, to one or both hands. In the 3D virtual interfaces those are complemented by gestures of the hands in connection to the head, movements of the head, movements and positions of the limbs, and gestures that involve the whole configuration of the body parts to each other.

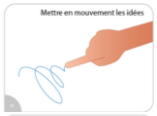
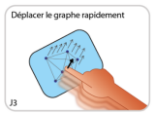
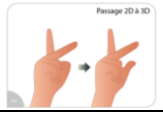
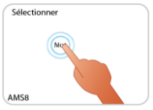
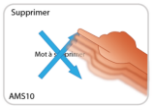
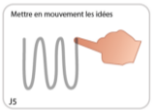
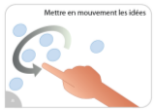
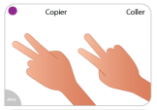
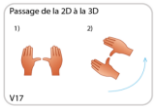
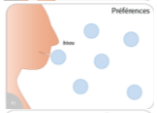
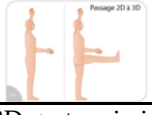
| | TOUCHSTORMING - 2D<br>80 gestures (1 to 6 ideas per function) | | BODYSTORMING - 3D<br>114 gestures (1 to 8 ideas per function) | |
|---|---|---|---|---|
| | *example* | *nb of gestures per class* | *example* | *nb of gestures per class* |
| *originality* | | | | |
| analogies from world |  | 27 |  | 90 |
| familiar from interfaces |  | 23 |  | 10 |
| new |  | 30 |  | 14 |
| *corporal engagement* | | | | |
| none |  | 11 |  | 14 |
| little |  | 39 |  | 40 |
| medium |  | 30 |  | 39 |
| high | | - |  | 21 |
| *body parts involved* | | | | |
| one finger |  | 33 |  | 6 |
| fingers |  | 12 |  | 5 |
| one hand |  | 15 |  | 31 |
| two hands |  | 20 |  | 25 |
| hand and head | | - |  | 5 |
| head | | - |  | 2 |
| limbs | | - |  | 20 |
| body | | - |  | 20 |

Table.3 Creativity oriented taxonomy for 2D/3D gesture in interaction design

## 6. Discussion

### 6.1 Feedback on results

More ideas from interfaces appeared during the *touchstorming* than during the *bodystorming* because the participants were already familiar with touch interfaces from mobile phones, ATMs, etc. They have already adopted gesture codes from these devices. In comparison, 3D gesture interfaces are still a new terrain to which users are not yet accustomed.

The higher number of new gestures, without analogies in the *touchstorming* than in the *bodystorming* is probably related to the limited range of possible movements with two hands only. Compared to those, the whole body in gestural 3D interfaces allows adopting much more ideas from analogies.

Looking at the results we assume that the body gestures are easier to learn because of their reference to physical world movements. On the other hand they often demand a much higher corporal engagement because they involve more body parts and are therefore more tiring for the user.

### 6.2 Consequences for interaction design

Firstly, the criterion of originality is very one of the most important when elaborating new databases for interaction design. Indeed it is often by a distinction through a user centered design approach than some leading companies become the most influential. As *originality* is sometimes increasing oppositely to ease of use and *affordance*, it is also crucial to consider *familiarity* with well known use stereotypes which can be transferred from one application field to another. This way, by doing a wide awareness and considering gestures in many fields of application, it is possible to imagine stereotypes that will make interaction original and provide ease of use at the same time.

Secondly, it is also useful to have an eye on a wide spectra of analogies fields as analogies provide a high level of creativity and correspond to well known references at the same time.

Finally, as interfaces and everyday life tools made the users more and more physically passive in their interaction to objects, nowadays the tendency is to have a more and more engaged and fluid interaction style as in the human-human communication. So the criteria of engagement can also be used as a trigger for guiding creative sessions.

## 7. Conclusions

Many design approaches are based on the use of creativity tools such as brainstorming which is one of the most powerful approach in creativity for design. However, specific creative approaches for interaction and experience design are not yet much formalized. In this study, we defined a creative approach which can be applied in any interaction design contexts. It is based on *touchstorming* and *bodystorming* applied in a scenario process where the participants imagine they play with magic tools and devices.

Morevover, as most of the existing taxonomies focus on the technologies to be implemented behind, we propose a new taxonomy which can be used in order to structure creativity sessions. This taxonomy mainly includes the criteria of originality (versus familiarity) and engagement. These criteria can help in structuring creative sessions in interaction design and are highly impacting the user experience. This way they are more user-driven instead of technology driven.

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