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Project Goal

Introduction

Nowadays almost every human-computer interaction is based on graphical user interface (GUI). There are limits to this method of interaction. That's why alternative interaction methods are being explored. One of these alternatives is tangible interaction which focuses on the importance of the physicality of interaction. In this approach input and output are represented by physical, tangible objects.

The goal of this project is to design a working physical device that communicates with the GUI of instant messaging (IM) software which reacts interacts with the computer signals forthcoming from the IM program. In this way, the interaction between the screen and the physical objects result in a more 'tangible' interaction enhancing the messaging experience.

Tools

The following tools were available for achieving the project goal:

Jabber

Jabber is an instant messaging network that offers similar functionality to other IM services such as AIM, ICQ, MSN, and Yahoo. Jabber is developed by Jeremie Miller, 1998.

The main advantage of Jabber in this project, is that it is open source code software. This means the code behind the program is available so it can be adjusted and added to. The program can then be set up for communication with the Lego model driven by LeJOS.

More info: <http://www.jabber.org>

LeJOS

LeJOS, Lego Java Operating Systems replaces the original Lego Mindstorms firmware in the Lego Mindstorms RCX brick. It is a Java Virtual Machine so it enables you to program a Lego robot with the power of Java! It was developed during a project led by by Jose Solorzano. Using Infrared LeJOS makes it possible for the Lego Model to communicate with the Jabber program on your computer.

More info: <http://www.lejos.org>

Java

Java is an object-oriented programming language. Java has become one of the best programming languages around. Java is able to unite existing applications written on different platforms so they can run together. It was developed by a team led by James Gosling at Sun Microsystems in 1991. Java is needed for implementing the input and output programming into the Jabber program and into the Lego Mindstorms RCX driven by LeJOS.

More info: <http://java.sun.com>

Lego / Lego Mindstorms / Extra Lego sensors

Is it necessary to explain what Lego is? Lego gives you the possibility to make functional prototypes in a simple way. Besides using the standard (technical) lego blocks, in Mindstorms you are also able to use motors, sensors and other electronics. These are all connected to the main unit, which is called the RCX. This is the controller of all the electronics which can be operated with the original Lego Mindstorms software or by replacement software such as LeJOS so you are able to program everything with Java. It was a good medium to build the physical functional interface prototype in this project.

More info: <http://mindstorms.lego.com>

Research

Tangible interfaces

Applications domains of tangible interfaces are:

1. Information storage, retrieval and manipulation
2. Information visualization
3. Modeling and simulation
4. System management, configuration and control
5. Education, entertainment and programming systems

An example of a historical tangible interface is the **abacus**.

It exists of beads, rods and a frame. These are *physical representations* of numerical values and operations. Simultaneously these components also serve as *physical controls*. Further the abacus makes no distinction between input and output.

On the contrary a Graphical User Interface makes a distinction between input devices and output devices. (Input devices are for instance: keyboard and mouse and Output devices: monitors and head mounted displays)

Input devices are called **controls** and Output devices are called **representation**.

Conclusion: The abacus eliminates this distinction between *controls* and *representation*

Tangible interfaces give physical form to digital information, employing physical artifacts both as *representation* and *controls* for computational media. It also coupled representation with digital representation, yielding interactive systems that are computationally mediated.

You can divide *representation* into two classes:

- *Internal representation*;
These are programs and data structures. They serve the computer's information. Another word for internal representation is; **models**
- *External representation*
This information is directly perceivable by the human senses

Now we can also divide external representation into two sub classes:

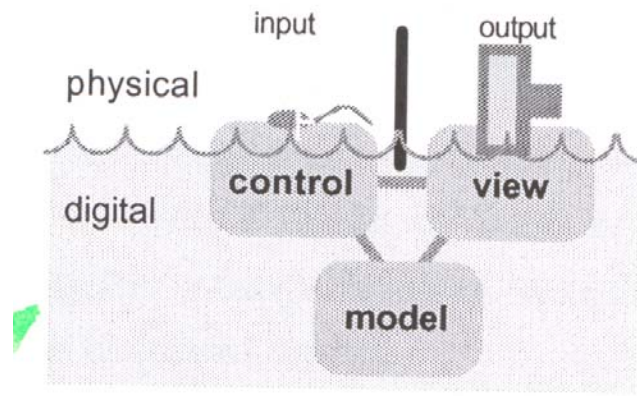
1. *physical representation*

It is embodied as tangible form e.g. chess pieces, chess boards

2. *digital representation* →

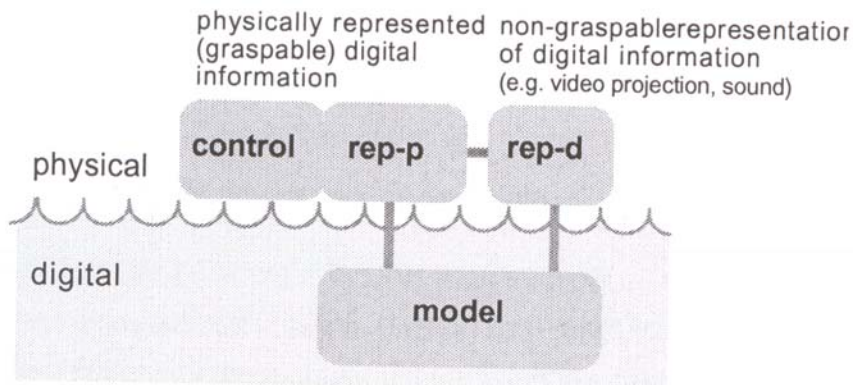
It is embodied as intangible form; e.g. pixels on screen, audio from speaker

Traditional computer = MVC (Model view Controller)



(a) interaction model of GUI:
MVC model (Smalltalk-80)

Interaction model for tangible interface = MCRpd (Model Control Representation, physical and digital) see **B**



(b) interaction model of TUI:
MCRpd model

1. Physical representations (rep-p) are computationally coupled to underlying digital information (**model**).
2. Physical representations embody mechanisms for interactive control (**control**)
3. Physical representations are perceptually coupled to actively mediated digital representations.
4. The physical state of interface artifacts partially embodies the digital state of the system.

Tangible interfaces are generally built from systems of physical artifacts, TUI artifacts are persistent. They cannot be banished from existence. Besides tangible interfaces are products of a careful balance between these two forms of representation (physical and digital representation) for instance, when the power of tangible interface is removed, it's the digital representation which disappears and the physical representations remain

An example of a tangible user interface is the URP (Ullmer & Ishii: Emerging frameworks for tangible user interfaces, 2000).
How does it work? Model on workbench (URP) → workbench give directly shadow of model by computing underlying system.
Such tangible interface is a *Spatial approach*. It means physical objects are directly interpreted and augmented by the underlying system.

Unlike the software centric of graphical interfaces, tangible interface design often hinges on the engineering of custom electronics and mechanics. Often the design of tangible interfaces has been driven first by the pragmatics of electronic and mechanical design, with conceptual and aesthetic issues of physical form taking a lower priority

TUI's are intrinsically well suited to collocated cooperative work by virtue of their loci of physical control.

Beauty in Usability (to pay attention of designing a product)

The followings points are the starting points for design.

The sake of analysis, man's skills, maybe considered on three levels;

- Cognitive skills (knowing)
- Perceptual motor skills (doing)
What people can perceive with their senses and what they can do
- Emotional skills (feeling)
Pure logic alone, without emotional value, leaves a person, or a machine for that matter, indecisive.

When a designer seeks advice to achieve the integration of the impossible such as accelerating, technological innovations, human perceptual- motor, cognitive and emotional skills and electronic aesthetics? This problem may be solved by turning to the user's experience fully respecting all his skills. The designer needs to create a context for experience, rather than just a product. He offers the user a context in which he may enjoy a film, dinner, cleaning, playing, working ... *with* all his senses

Usability is aimed for through logic using speech recognition, through grouping and color coding of buttons with related functions, through adding displays with abundance of text and icons and through writing logically structured manuals. *The rational is assumed to lead to ease of use.*

To build emotionally rich interactions the designer needs new methods to sound out the experiential world of the user. Interaction relabelling and designing for extreme characters are new methods.

1. *don't think affordance, think temptation*

Affordance refers to inextricability of both perception and action, and a person and his environment. It is what people can do. Besides it is essential a non cognitive and non-representational concept.

Affordance refers to the inextricability of both perception and action, and a person and his environment

People are not invited to act only because a design fits their physical measurement. They can also be tempted to act through the expectation of beauty interaction.

2. *don't think beauty in appearance, think beauty in interaction*

products which are good looking, but frustrate us as soon as we start interacting with them.

3. *don't think ease of use, think enjoyment of the experience*

a user may choose to work with a product despite it being difficult to use, because it is challenging, seductive, playful, surprising, memorable or rewarding, resulting in enjoyment of the experience.

Once the designer gets a feel for the experiential world of the user, he needs to focus on designing the interaction. He needs stayed tuned to the experiential.

A word that we have to account within developing of a product is; *Macro movement* = visible movement

This can be seen as indicators of behavior. For example; when people's behavior are changing then also the macro movements are changing.

If somebody develop a product the following point are often neglected of human?

1. the perceptual motor- skills
2. emotion skills
3. touch is often neglected in electronic products

Course KW4

An engaging context for experience

The designer should not think in terms of ease of use, but in terms of enjoyment. He should create a context of experience rather than a functional product.

The 5 aspects which are essential of design practice:

1. *Functional possibilities and performance of the product*

A properly function product forms the basics of aesthetics of interactions. A product that does not do what is supposed to do make it harder for the user to become intimate and experience the beauty. Clever solutions which work well can smooth the way for intimate interactions.

2. *The user's desires, needs, interest and skills (perceptual- motor, cognitive and emotional)*

The user's character, skills, needs (short term and long term) mood... determine the value of the interaction for an individual

3. *General context*

For instance; toaster placed on a "Raymond Loewe Kitchen", which contributes to the overall experience

4. *Richness with respect to all the senses*

Not only to richness in visual aspects of the product, but also wealth, subtlety of auditive, olfactory, scent, tactile and kin aesthetic aspects during interaction is at least as important to achieve a beautiful interaction and engaging experience. Users are very capable of distinguishing between the functionalities of every day objects on the basis of difference are eliminated and everything looks and behave the same, things become difficult → Not only think visual, but multi sensorial and multi-modal

5. *Possibilities to create one's own story and ritual*

A product tells a story about the user and the relationship

Existing design tools and techniques

A sketch can tell the story of a product, but the 2D paper doesn't allow for human-product interaction.

Focusing on context, the *experiential* is preferable above the *distant* way

experiential: models, prototypes

distant: sketches, drawing

1. *Drawings*

Drawings allow the designer to capture the overall atmosphere as well as the richness of appearance of the product as such.

2. *Collages*

Make 3 collages. Why? It can enhance poetic atmosphere of interaction itself. It explores and evaluates a desired expression

It enhances creativity in the sense that designers can react to images, materials, sound, etc and subsequently create their own instead of starting from scratch and inventing the entire expression themselves.

3. *Models*

Spatial models are necessary addition to visualization techniques which support the designer developing context for experience. They allow the designers to explore and test interactions to evaluate and develop aesthetic aspects of design and to determine manufacturing.

Models are represented as demonstrated hardware

To make software of a product you can use Hypercard, MacroMedia Director or

Authorware of paying attention to the virtual part.

Modeling is also a quick and adequate way to let the user participate in design process without having to acquire specialized skills.

Easy development of physical Interfaces through Physicals Widgets

Physicals Widgets are building blocks to help a developer to construct a physical (tangible) user interface.

Similar to *widgets*, *phidgets* abstract and package input and output devices: they hide implementation and construction details, they expose functionality through a well-defined API, and they have an (optional) on screen interactive interface for displaying and controlling device state.

Every day programmers still face considerable hurdles. Perhaps the biggest obstacle is the sheer (change course) difficulty of developing and combining physical devices and interfacing them to conventional programming languages. Several difficulty points are:

1. Simple devices made out of cheap and readily available electronic components (switches, sensors, solenoids, motors) are hard to build unless one has a background in hobby electronics, circuit design or electrical engineering.
2. Commercially available devices may have no published application-programming interface (API). As a result, an outsider cannot program them unless the devices is *hacked* or *reverse engineered*.
3. Alternatively, commercial devices designed for particular application settings typically have a configuration and/ or API at a level of abstraction that is not well suited for building the kinds physical devices we want.
4. Some construction kits are oriented to quite different markets e.g. the Behavior Construction Kit and Lego Mindstorm target children and educational uses, while most MIDI- based kits target performers
5. Developers may not have these devices readily available at early stages of their programming effort, perhaps due to expense, shipping delays, cost factors, etc. While a program can be written without a device, they are difficult.

Exploring the Design use of Peripheral Displays of Awareness Information

What is awareness? Awareness has been defined as "the state of knowing about the environment in which you exist; about your surroundings, and the presence and activities of others".

There are 2 kinds of awareness information;

1. Heavyweight information; with this information the user needs his full attention. It is for him difficult to concentrate on a separate task at the same time.
2. Lightweight; here you can separate your attention on separate tasks and obtaining awareness of different information.

Nowadays there are several IM applications that provide users with awareness information. Despite these IM applications are lightweight software there are still several constraints on its usability.

For example

- First the user must be in front of the computer or within close proximity to be able to receive awareness information from the software.
- Second, the sounds triggered by buddies going online/ offline and upon receiving a message can be distracting to user working on a separate task while at the computer.

Instant Messaging

Instant Messaging is a popular way of communicating on the internet. Programs like MSN Messenger are used worldwide to exchange text messages within a community of 'buddies'. The interaction with these programs is through a Graphical User Interface (GUI) with simple sounds added to indicate incoming messages. The two main things of interaction are the dialog window, in which the conversation (messages are displayed and can be typed in on the bottom) takes place and your buddy list. The status of a buddy in your list is indicated through various pictograms, e.g., online, available or busy, etc. The user can also set his own status in a pull-down menu. In this status menu the user can select different states like away, occupied, busy, 'be right back'.

Another option from your buddy list is that you can contact offline buddies by sending them emails through the program.

Instant messaging is a very quick and easy way to contact people all over the world. Just type in a message for a buddy and your buddy immediately receives a popup window with your message. It's up to your buddy now if he wants to chat with you.

Questionnaire about Instant Messaging

The Goal

Before starting to think of concepts it was necessary to have some facts about people's behaviour during chat sessions in their IM program so you have a certain base of requirements for your concepts. Around 130 persons filled in the questionnaire.

The following questions gave a clearer thought of concepts:

1. Which status or states do users use most often?
2. With how many buddies do users chat simultaneously on average?
3. How many buddies do users have in their list?
4. Do users sort their buddies into groups?
5. Which features of IM programs do users like?
6. Which features of IM programs do users dislike?

The Results and the Conclusions

1. Which status options are mostly used?

online	96	←
away	97	←
extended away	23	
busy	50	←
free for chat	05	
invisible/show offline	42	←
other, namely	25	
lunchbreak	14	
dnd	06	
meeting	01	
watching tv	01	
brb	04	
on the phone	03	

Conclusion 1: mostly used: *ONLINE, AWAY, BUSY* and *INVISIBLE/OFFLINE*

2. How many buddies do you chat to simultaneously on average?

1 buddy	27	←
2 buddies	50	←
3 buddies	20	←
4 buddies	07	
5 buddies	03	
More than 5 buddies	04	

Conclusion 2: mostly between 1 and 3 buddies. Keep this in consideration.

3. How many chat buddies does your list contain?

Less than 25 buddies	04	
Between 25 and 50 buddies	24	←
Between 50 and 75 buddies	26	←
Between 75 and 100 buddies	18	←
Between 100 and 125 buddies	07	
Between 125 and 150 buddies	27	←
Between 150 and 175 buddies	01	
Between 175 and 200 buddies	02	
More than 200 buddies	04	

Conclusion 3: varying from 25 till 150. Keep this in consideration.

4. Have you split up your buddy list into groups? If so, how many groups?

No	28	
Yes, 2 groups	13	←
3 groups	15	←
4 groups	14	←
5 groups	14	←
6 groups	10	←
7 groups	06	
8 groups	03	
9 groups	02	
10 groups	03	
11 groups	01	
12 groups	02	

Conclusion 4: varying from 2 till 6. Keep this in consideration for the concepts.

5. Which features of IM programs do you like?

We had a lot of different answers here. But there were some features that were mentioned often:

- easy way to communicate
- chat with more than one person at the same time
- only talk to people who you want to talk to
- status function: people know if you are free for chat

Conclusion 5: these are things we may not alter or adjust.

6. Which features of IM programs do you dislike?

For this question we also had a lot of different answers. The most mentioned:

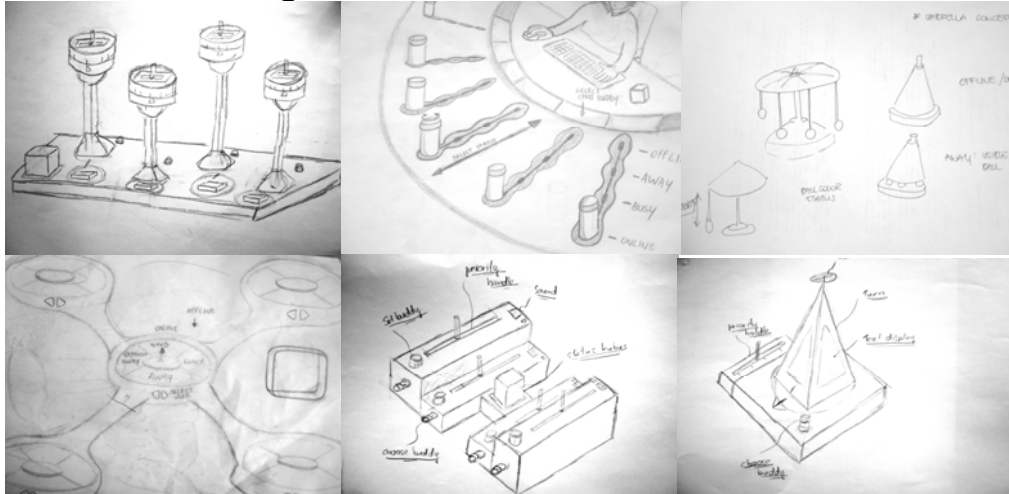
- managing all the upcoming windows
- emotion of persons is not really clear
- groupchat function is often abused.

Conclusion 6: these features need to be increased or removed.

NB: We made up more questions that even were in the questionnaire but they would not alter something on the concepts. The full questionnaire with all its results can be found on the Project cd-rom.

Concepts

Sketches and drawings



A lot of drawings were made after the questionnaire to keep our minds working. Some of them can be seen above. Also some tinkering led to some nice ideas of how to realise functionalities.



The above picture shows some of our Tinkering & Interaction Relabelling objects. This was a good procedure for inspiration, although they are simple objects varying from child toys to drinking straws.

After all this led to the following model realisations of which we would choose the final concept:

1. Concept Zane



This concept is a box that sits on your desk next to your monitor.

Own state

When the box is closed, you are 'closed' and thus offline.

Open up the box and you are online. Close it partially to set your state to busy or away.

Buddy state

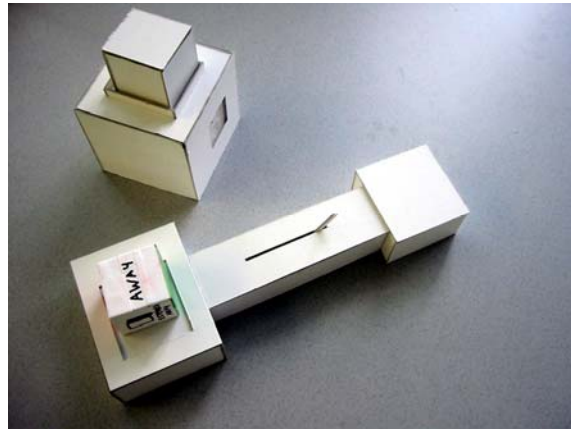
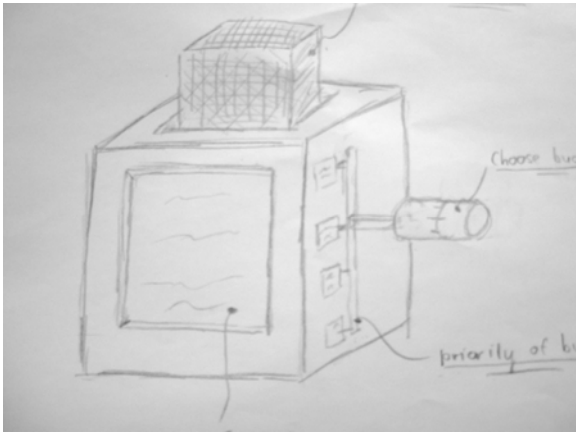
Inside the box are 5 handles. Each one represents a buddy on your list.

When your buddies are offline, the handles are concealed in the box and unreachable, when a buddy comes online the corresponding stick pops up and you are able to grab a hold of it.

Pulling a stick towards you initiates a chat with that buddy.

When a stick moves up and down, a buddy has sent you a message and is asking for attention. Pushing the stick back into the box closes the window.

2. Concept Ingmar

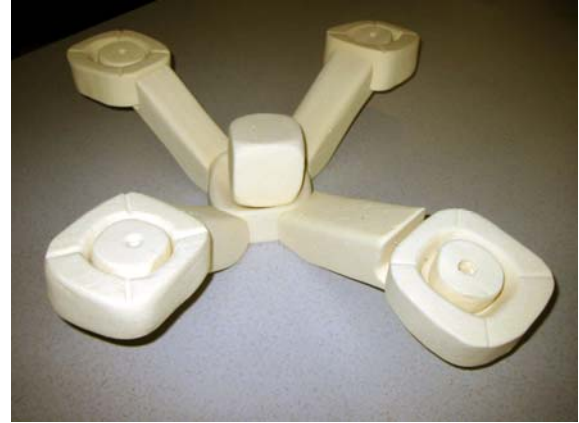


The shape of this TIM device is a cube. Why? The idea was that it had the same shape as the status block to make it one whole object. Each side of the cube is representing a different status, namely; away, busy, offline, online, lunch and invisible. With this cube the user controls its own status.

The TIM device is provided of a display and a priority slide. This display shows when your buddy is online. In other words, when your buddy comes online a picture of him will appear on the display. This makes it personal. A handle will appear to show which status the buddy has. This handle rises automatically to different heights, depending on the buddy's status.

To decide if you want to chat with your buddy you use a priority slider. With the slider you can maximize or minimize the window of your buddy.

3. Concept Stef



This concept has a lot of ways to handle: it has a lot of different movement possibilities. It is also logical that the user is in the centre, this is sort of a representation of the idea of IM programs: You can talk with all the people in the program. They are “around” you. Your buddies (arms) are connected to the user which is in the centre. Because of its cylindrical form it invites you as a user to turn an arm around the centre. The basins at the far ends of the arms have small cubes inside them which represent a message. If this cube comes up it means that person is sending you a message. You can then accept it by turning the arm to you or decline it by pushing the small cube back in the basin. Because of its wide movement possibilities and its user centred idea this concept is chosen as the final concept.

Functions explained:

1. Your own status: You can switch your own status with the cube in the middle by turning it to another side. (the topside of the cube is your current status)
2. Buddy status: The buddy status is being represented by the height level of an arm.
3. Come online: You come online by just turning the cube onto its online side.
4. Send a message: Pull the buddy (arm) who you want to message to you and a message window will popup. Start typing.
5. Receive a message: When you receive a message this window will be shown minimized in your taskbar. The small cube in the basin in the arm that represents the buddy who sends you a message will pop up and you can decide to accept or decline this message. Accept it: pull the arm to you and the window will maximize from the taskbar. Decline it: push the small cube down again.

Final

As final concept the base of Stef's concept has been used. But it was important to increase and alter its functionalities to make it interesting for realisation and make it a concept of which we believe in. A Lego model was built.



Choices and conclusions

Functionalities

Switch your own status:

You have a cube with cube holder to control your own status. Take the top cover of and you go online. Take the cube out ("away") and you are away. Put the cube back in the holder diagonally and you set your status to busy.

Representation of buddy status:

The arms represent your buddies. You can assign a buddy which you often chat with from your list to one arm. When this buddy is offline, the arm is down and to the back. When this buddy comes online, the arm will rise up high and turns 90 degrees to the user so it will be on the side. When this buddy changes his status to away, the arm goes down until it is in horizontal state. When the arm is at the back but totally raised up its status will be busy.

Notification of buddy send message:

Each arm has a basin at its end with a cube inside. This cube shows if a buddy sends you a message. The cube will then pop up. Once you tap this cube, you can see your

buddy's message for a time interval to have a glance at it (it will maximize from your taskbar. If you want to continue the conversation or want to answer because its message is interesting, you pull the arm to the front of the device. The window then stays maximized.

To decline the message/start of conversation just push the cube back down inside the basin.

Start a conversation with a buddy:

Pull the arm of the buddy which you want to talk to, to the front of the device and a chat window comes up. Type in your text and send it. The buddy will notice it the same way as you do when a buddy contacts you.

Scenario George and Tony:

Let us introduce George and Tony to you. They are both users of the TIM device. George wants to go online so he takes the top cover of from the cube holder from his TIM device. After a while Tony does the same. George notices that Tony comes online because the arm which is assigned to Tony raises high and moves towards George. Tony also notices that George is online because the arm assigned to George on Tony's device also rises up and moves towards him. Tony wants to chat with George so he opens a new chat window for George and himself by pulling "George's arm" to the front of the device. Than he types the message with his keyboard and presses enter to send it. The cube in the basin on the end of the arm that represents Tony on George's device pops up and also a chatwindow is minimized into his taskbar. George notices this and wants to know if Tony says something interesting to him. He taps the top of the popped up cube and the window maximizes so he can have a glance at the message. It looks interesting so he decides to accept the conversation. He pulls the arm in front of the device so the chatwindow of Tony stays maximizes. George types a message back to Tony. Tony notices this because the cube outside George's arm also pops up. They keep chatting. After some time Tony has to go to the supermarket for a while so he says George goodbye and sets his status to away by taking the status cube out of the cube holder. George notices this because the arm that represents Tony on his device automatically turns to the back of the device and goes down until it is totally horizontal. He also puts the message cube down. The chatwindow closes on his computer. George also closes the chatwindow by pushing the message cube down. He has to do a lot of homework so he doesn't want to be disturbed from now on. He takes his status cube out of its cube holder and puts it back in diagonally. On Tony's device the arm that represents George automatically turns to the back but stays up. After a while Tony comes back from the supermarket and goes back behind his computer. He sets his status back to online by putting the status cube back into its holder. George notices this because the arm that represents Tony rises again and turns to him, to the side of the device. Tony needs to say something to George although George is in Busy DND status. He turns George his arm to the front of his own device which will open a new chat window. He types his message and sends it. George notices this because the cube in the basin at the end of Tony's arm pops up again. He takes a quick view at the message by tapping it again. But he's not interested. He declines the conversation by pushing the cube back down.

Next?

Buddy representation.

Color, Material feeling, Patterns, Picture of the buddy on it. A turnable display which displays the name of the buddy.

Intelligent status.

What to do when you don't use the IM program for a couple of minutes. In the GUI it then automatically switches to away or busy. But how to do this with the cube? The cube cannot go out of the holder automatically. An idea is to make the cube a ball which can roll out of the holder. But then you can't see the difference between straight or diagonally.

Direct interaction

User moves arm, arm of the buddy will then automatically move.

Status per buddy

It would be nice if there is an option available for setting different states for different users. So you can better choose with which buddies you want to chat and which not.

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