An example of forecasting by

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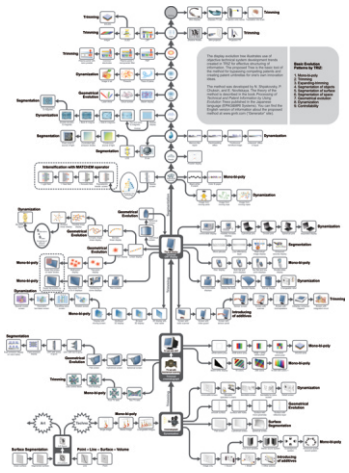
Solved with the Target Invention Forecasting technology

Prognostic solutions from the display Evolution Tree

1. Structure of the Display Evolution Tree



For an Evolution Tree constructing it is important to understand which evolution pattern will be basic and to determine the key points of this pattern which is the Tree "trunk".
The preliminary search resulted in several display modifications. After analyzing those modifications, the following key ones were selected:

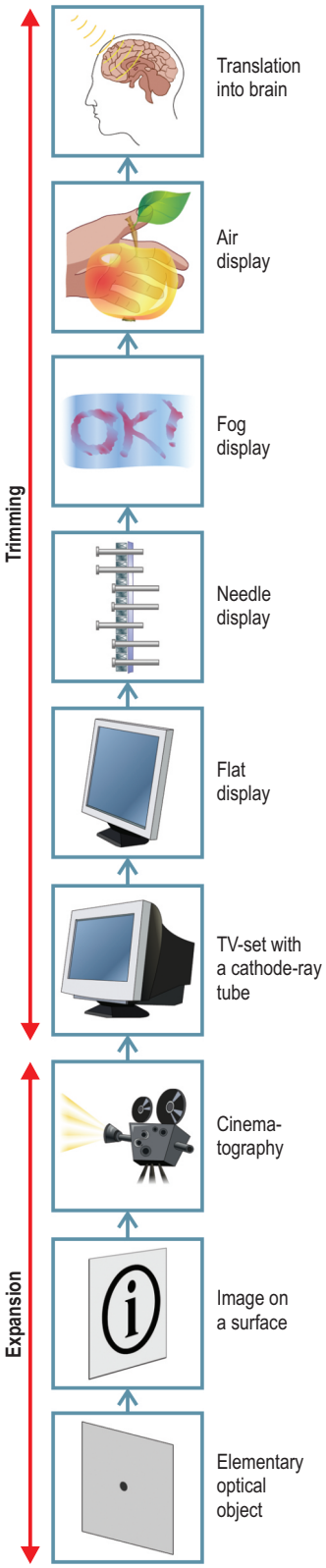
- elementary optical object;
- image on a surface;
- cinematography;
- TV-set with a cathode-ray tube;
- flat display;
- needle display;
- fog display;
- air display;
- display inducing image directly in the consciousness.

Transformations of any technical system performed over a long period of the system existence are usually described by the **"Expansion – Trimming"** pattern. Thus we may expect that this trend will be realized within the general structure of the Display Evolution Tree.

Indeed, the sequence of the first three modifications will show the **expansion** of the display composition, because an image on a surface is a set of elementary optical elements and cinematography is a set of alternating images. Because a cinematographic image may only be seen in the dark, there appeared a motion-picture theater which comprises a hall with seats for viewers, a projector and a screen.

Cinematography was expanded due to the introduction of new elements, for example, sound. Since the advent of sound color cinematograph, the satisfactory performance quality of the main useful function was achieved and the viewers' requirements were practically met. The image-producing system became fully expanded.

Further evolution of the system is mostly due to the **trimming** of the elements – system's parts. The hall with seats is removed from the system. The remaining elements – the projector and screen – are combined in a single cabinet – there arises a TV set with a cathode-ray tube. Further trimming of the system leads to the appearance of a flat display, where a projector and a screen are integrated into an elementary point – pixel. Different constructions of the flat display are well-optimized and its resources for further trimming are depleted to a considerable extent.



Expansion and trimming of the display during its evolution

To obtain resources for further improvement of the display, the display evolution should pass to the microlevel. Such a transition may be performed in accordance with the **"Segmentation of Objects and Substances"** pattern. Really, the last four transformations suit well this pattern covering such transformations as "Segmented monolith", "Fog and vapor", "Gas" and "Ideal Object". Thus, let us consider the **"Expansion – Trimming"** pattern passing then into the **"Segmentation of Objects and Substances"** pattern, as the Tree trunk.

After drafting the main axis of the Tree, a repeated information search was performed. It resulted in additional transformation versions. For example, in addition to the system modifications, display versions corresponding to the transformations of the "Segmentation of Objects and Substances" pattern were found.

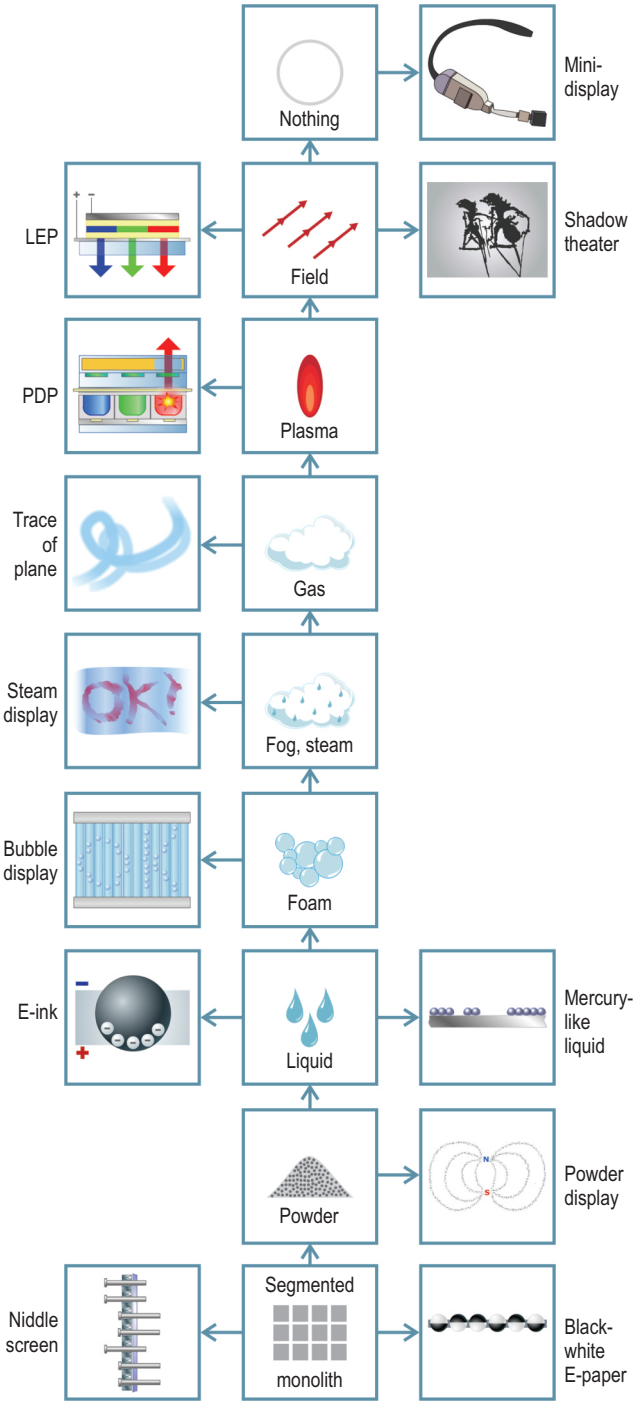
First goes the needle-type screen and electron paper which basic transformations are called "Segmented Monolith". The powder display corresponds to the "Segmentation to Powder" step, the liquid crystal display to the "Segmentation to liquid" step. The bubble and fog displays illustrate the "Segmentation to Foam" and "Segmentation to Fog" transformations. The display that projects an image directly in the air is an example of the "Segmentation to Gas" transformation.

Then follows the plasma display – "Segmentation to Plasma" step. It is followed by a series of displays which form image due to the minimum transformation of fields, for example a display based on the principle of light emission by special polymers, which corresponds to the "Segmentation to Field" transformation.

At the top, our Tree has displays which maximally comply with the basic transformation "Ideal Object". They are portable displays and displays which project image directly onto the retina. The most ideal version of the display is a hypothetic device that brings about visual information directly in the user's consciousness.

Horizontal side "branches" emerge from each transformation version situated on the Tree's "trunk". They are patterns according to which the "trunk" display transformation versions evolve. The number and composition of these patterns is determined by available resources. For example, an important resource of the display is its working surface (screen), light-emitting system as well as the control system of image-composing pixels.

In accordance with the Evolution Tree construction rules the evolution of elements of the display are described by such patterns as **"Geometrical Evolution of Screen Surface", "Complicating the Screen Surface Microrelief", "Mono-Bi-Poly of Pixel Color", "Display Dynamization"** and others.



Transition of the display evolution to the microlevel

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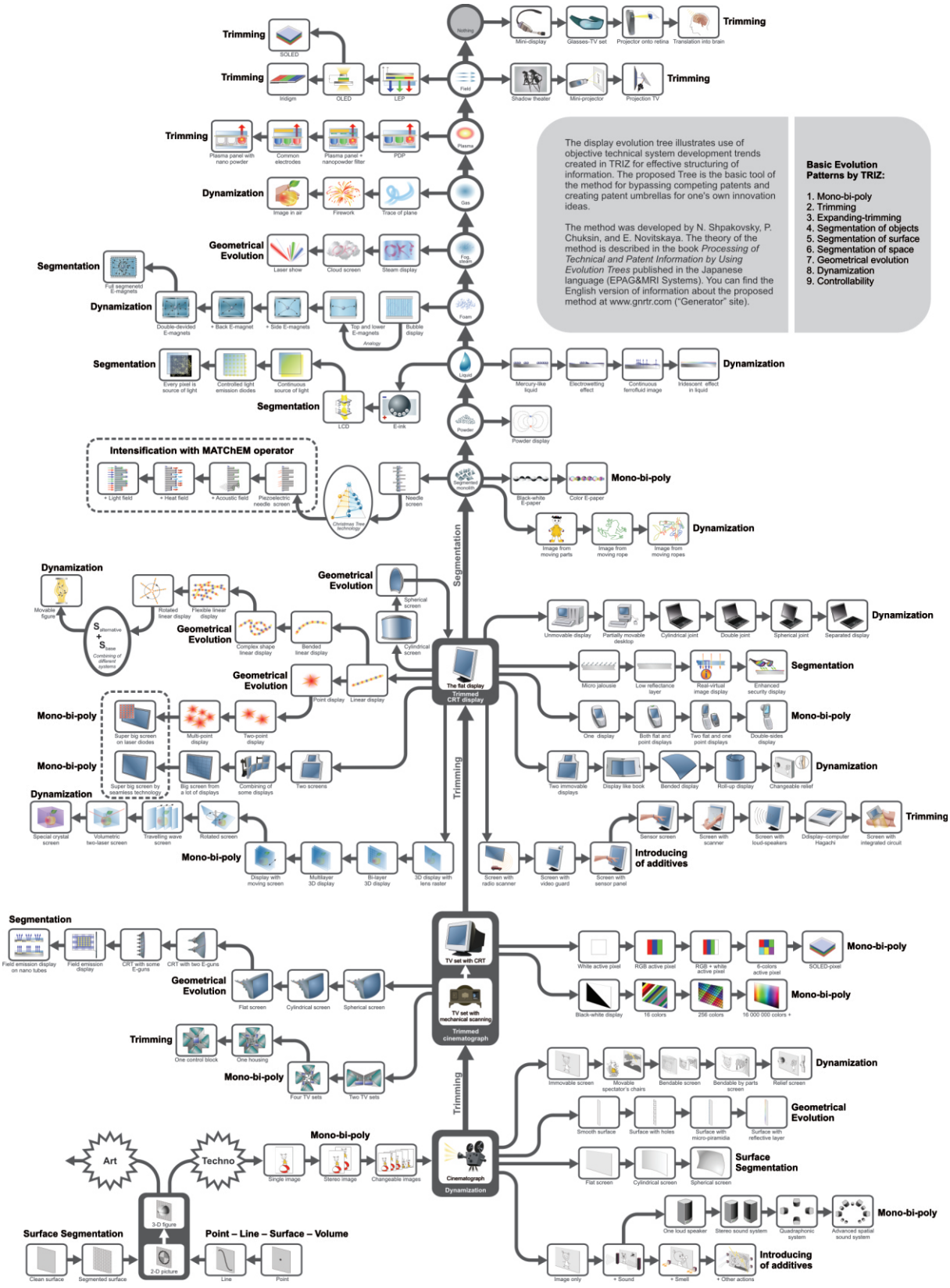
Evolution Tree
of display



2. Examples of prognostic solutions

A forecast is always an equation in many unknowns. Using Evolution Trees for visualizing probable system versions makes it possible to determine some of these unknowns. This eventually simplifies the forecasting procedure and makes a forecast fuller and more precise. In a "pre-marked" information field, a researcher sees a clear picture, representing all basic system versions. With this information, he can fully focus on solving a reverse problem and analyzing the system versions trying to find an answer to the following questions:

- What one or another version of the system may be needed for?
- Which parameters of a new system will change and how will they change?
- What advantages does any version have?
- What disadvantages does it have?
- How will the property of the product produced by the system change?
- Will the new version be more expensive or less expensive?
- How will the system's supersystem change?

Thus, a normal research work is meant here: study of the models of a new hypothetical system.

Building and analyzing the display Evolution Tree resulted in a number of prognostic solutions some of which are given below. Worth noting is the following fact: the display Evolution Tree was built as far back as 2001-2002. And what about prognostic solutions? Have any of them come true at least in a small measure? Have the display evolved in the directions indicated in the Tree?

Certainly. The display Evolution Tree is illustrative to some extent and based on open sources. To make a more accurate forecast, much research into closed information sources is needed as well as the analysis of special collections. Such work provides a strong result but no company will agree to publish the results of some real prognostic research work because it has a great advantage over a competitor

So let us have a look at our simple Evolution Tree of a display which in fact only differs from a big prognostic map by the study depth. Building and analyzing the display Evolution Trees resulted in a series of prognostic solutions, some of which are given below.

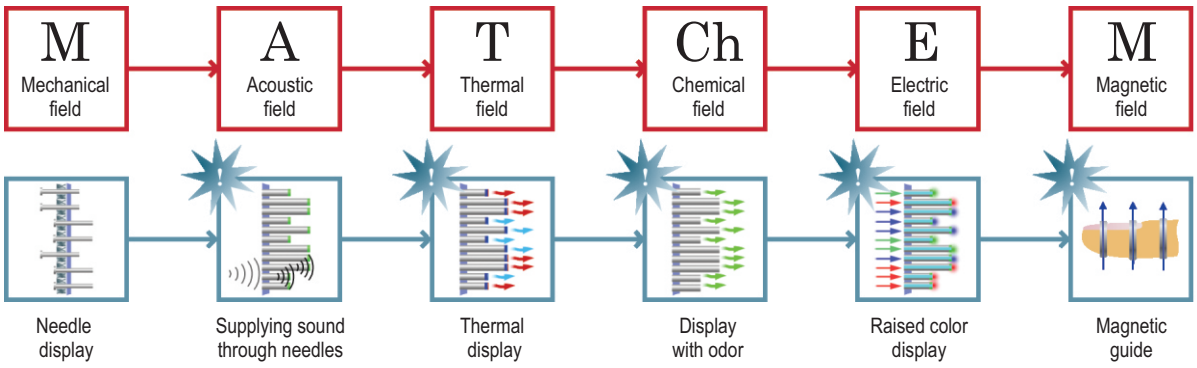
A) Forecast. Increasing the informativity of displays for the blind and weak-sighted people

Need – obtaining maximum information.
Work object – sense organs (excluding sense of sight).
Product – sense organs subjected to information action.
Tool – a needle display.

The version available on the Evolution Tree is a mechanical needle display. Transforming it by means of the **MATChEM operator** resulted in the following prognostic versions:

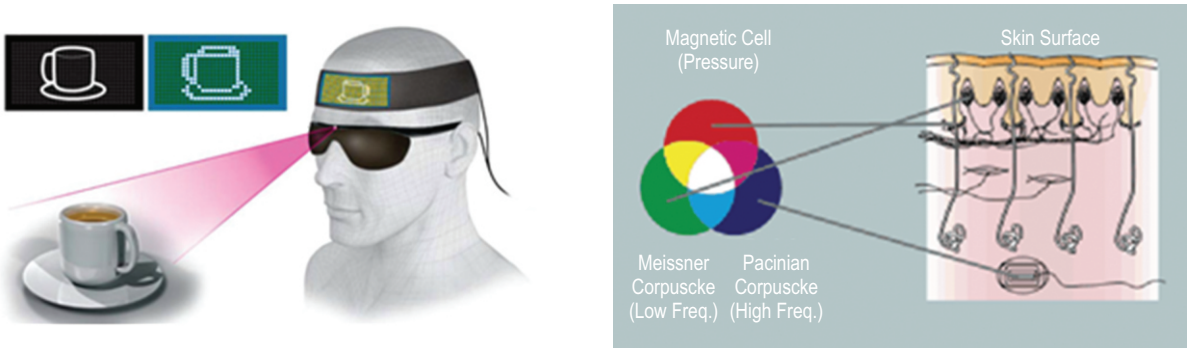
- **Acoustic field** – display with local supply of sound directly through the needles.
- **Thermal field** – "color" display for the blind where a color picture is formed by heating and cooling the needle ends.
- **Chemical field** – an odor-emitting display
- **Electric field** – a color raised display.
- **Magnetic field** – a device directing user's fingers to a necessary place on the screen.

Analyzing a needle display



A) Implementation

As far as the general trend is concerned, the evolution of displays for the blind is directed toward providing a complex action on the skin for information transmission. For example, in 2006, the Forehead Retina System was developed which employs electrical pulses of a certain frequency for image transmission. The research results proved that pulses of different frequencies are perceived as different colors.



Producing an image by the Forehead Retina system technology

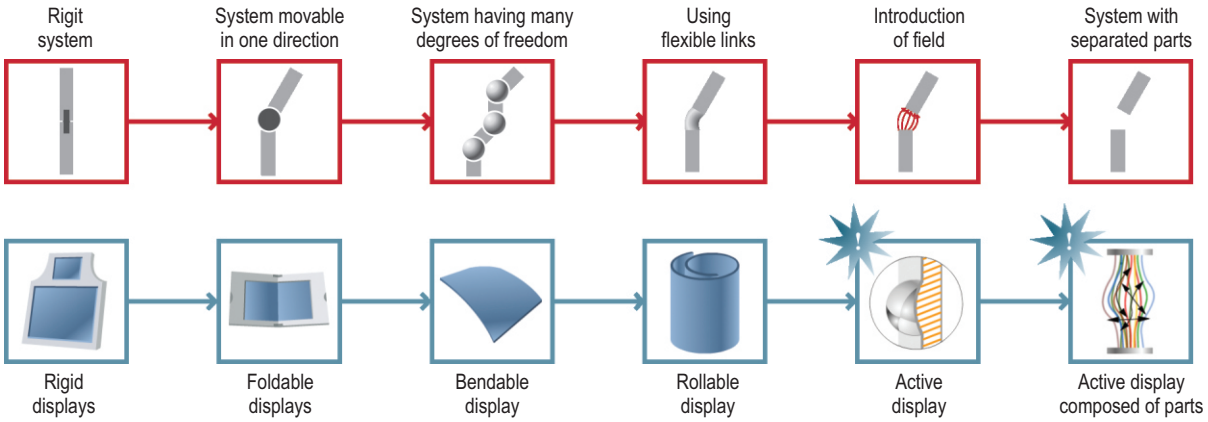
B) Forecast. Displays forming a real movable copy of a presented object

Need – producing a maximally real image.
Work object – sense organs (first of all vision).
Product – sense organs receiving a realistic image.
Tool – a display.

Analyzing the **"Dynamization of double screen display"** pattern and comparing it with the basic **"Dynamization"** pattern proves that the specific pattern is uncompleted, it lacks two transformation versions – "Use of field" and "System having segmented parts".

Using a force field, for example, of a field of active polymers jointly with a flexible screen allows producing a maximally realistic 3D image. Such a display is an executive mechanism, robot that may be similar to any object or man.

Such a device may also be obtained by analyzing the display segmentation evolution patterns, for example, by forming an image from "display fibers".



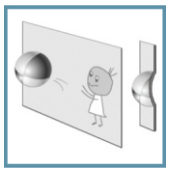
Analyzing a dynamic display

B) Implementation

Strange to say but we have not found any information about such devices in technical literature whereas the idea of such a machine, for instance, a robot having a face shaped into a flexible display, is obvious. This robot could have a considerable advantage over its faceless "fellows" by demonstrating an absolutely human (or non-human) complexion, play of colors, etc. I believe we will soon hear about another break-through in this direction.

C) Forecast. Dynamic screen display

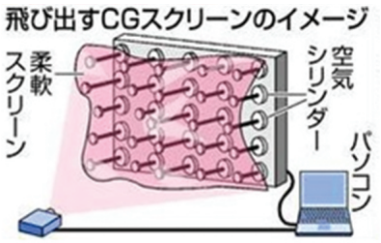
One of the ways of adding vividness and visuality to an image is transition to volume. Yet 3D displays are rather expensive and imperfect, while a 3D image can be imitated on a flat screen.
Need – obtaining a visual pseud-3D image
Processed object – sense organs (primarily, vision).
Product – sense organs which receive a realistic image.
Tool – display.
Analyzing the evolution pattern **"Double-screen display dynamization"** and comparing it with the basic **"Dynamization"** pattern shows that the display evolution pattern misses the "Using a field" version. Here a display version having an active bas-relief may be located, having the surface shape that can change with the image. Following the pattern logic, it can be represented by a flexible twistable screen the shape of which is changed by a magnetic field.



Display having a dynamic microrelief

C) Implementation

• In 2006 and 2007, there appeared information in the press about displays having active microrelief. One of them was invented in Japan by Prof. Yoichiro Kavaguchi. In the Gemotion display, image is projected onto a flexible screen. The screen shape is changed by as few as 72 pneumocylinders so it is too early to speak about transmitting some sensible information.
• The second display is a tray filled with ferrofluid. The action of magnetic field changes the ferrofluid surface shape.
• Further evolution of active microrelief displays: surface segmentation into increasingly small pixels, coordination of their position, shape, size, etc, additional dynamization of each screen portion and provision of good controllability. This may result in the creation of an operable screen, for example, for advertising applications.

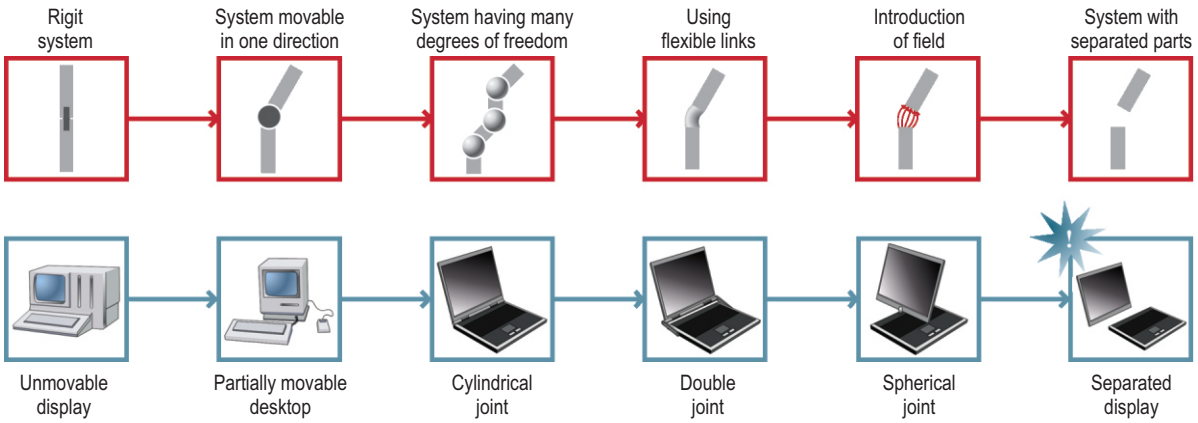


Displays with a dynamic microrelief of a screen

D) Forecast. Notebook with a detachable display

Need – obtaining a maximally movable notebook display.
Processed object – sense organs (primarily vision).
Product – sense organs which receive a realistic image.
Tool – display.
Analyzing the **"Display dynamization"** pattern and comparing it with the basic **"Dynamization"** patterns shows that the given pattern is not complete, it misses the last transformation – "System with segmented parts".

Dynamic display analysis



This step offers the following prompt: making the notebook display detachable from the keyboard. Such a display can be hung on a wall and used for mini-presentation or be placed in any other convenient place.

Separated display

D) Implementation

In 2006, Samsung declared about the creation of a new product: Samsung M70 notebook having a screen that could be detached from the keyboard and work by itself.

E) Forecast. Ideal display

An ideal display is a method of inducing visual sensations directly in the consciousness. The entire evolution history of displays and microelectronic devices is the tendency toward minimization, idealization. The top of the Evolution Tree is occupied by the most ideal displays. However, we would like to make them even more ideal.

Need – obtaining visual and other information without any devices.

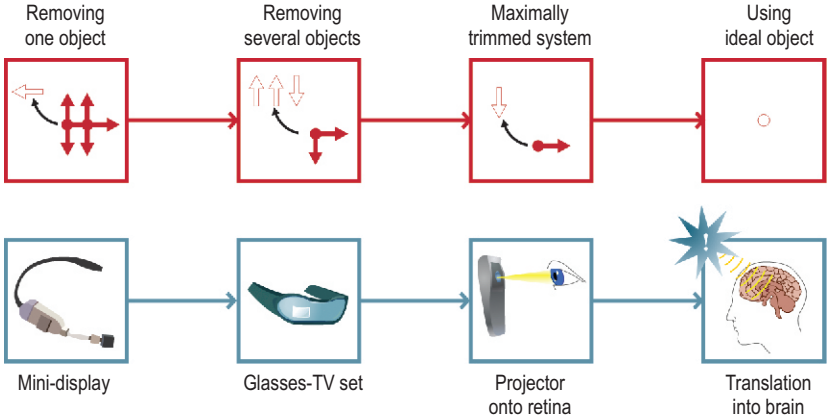
Work object – consciousness.

Product – brain that received visual information.

Tool – display.

Comparing the **"Trimming a display"** pattern with the basic **"Trimming"** pattern shows that uncovered is the final display transformation version. The essence of this transformation in the basic pattern is the use of the ideal object. What display will be the most ideal?

It is apparently a display that is absent while its function is performed, i.e. the most suitable will be a display version that induces image directly in the user's mind, bypassing eyes and other sense organs.



Analyzing the ideal display

E) Implementation

• Many companies felt interest in the creation of an ideal display, for example, Takara Co, which developed a "dream machine". However, all those efforts were not too serious until Sony reported that it worked on calling forth visual and other images directly in the neuronic chains of a man.

• In 2003 and 2004, the company received two patents on this method. Being familiar with the system of patenting novelties at Japanese companies, one may safely say that the works on the new technology are at full speed.

It should be noted that prognostic versions of a system often exist in some form but specialists may have no full understanding that it is just where the key evolution direction of the system is found. The analysis carried out by using the Evolution Tree allows better understanding of the system evolution logic and forecasting which versions exactly (existing or newly created) are the most promising form the technological evolution viewpoint.