Photo Booklet

PRINTING FUTURE DAYS 2013 | Design

Printed Electronics meets Design

a collection of ideas

Photo Booklet of the Printing Future Days Design 2013
September 10-12, 2013
Chemnitz, Germany, 2013

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Institute for Print and Media Technology
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VWB - Verlag für Wissenschaft und Bildung
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Postfach 11 03 69
10833 Berlin, Germany
info@vwb-verlag.com · www.vwb-verlag.com

ISBN 978-3-86135-625-7

Bauhaus-
Universität
Weimar

Form and Function in Interface Design - an updated „Bauhaus“- approach.

The Bauhaus seeks - by the means of systematic theoretical and practical research into the formal, technical and economic fields - to derive the form of an object from its natural functions and limitations. (...) Research into the nature of objects leads one to conclude that forms emerge from a resolute consideration of all the modern methods of production and construction and of modern materials.
Frank Whitford (1984) in: „Bauhaus“

The central points of Whitfords summary of the historic Bauhaus design approach can still be applied to describe the methods of the Interface Design Group. From todays perspective digital media nevertheless require a more contemporary interpretation of the original meaning of terms like „emergence of form“, production and materials.

The Interface Design Group at the Bauhaus-Universität Weimar mainly investigates interactive and networked systems for communication and information. Our focus is on the conception and realization of tangible interfaces as well as screen-based interfaces and services for the WWW and mobile devices (Touch phones, Pads)

Kniewel R. (2009), Thesis: Digital Bubble /
An Android App for the Hannover fair.

Lihs, M. (2009), Thesis: WiiSpray /
A digital spray can for back projection systems.

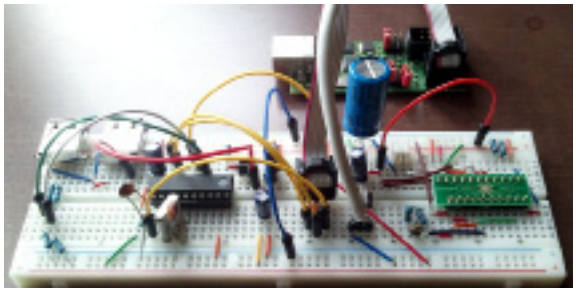
For our research we use methods derived from creative art and design workflows combined with scientific principles. This is very much related to what Whitford describes as „systematic theoretical and practical research into the formal, technical and economic fields".

Because the above-mentioned design approach does not really take the "User" of the product into account as a major factor in the design of the "form" we combine this approach with current results from Human Computer Interaction research. In Whitfords description this could be linked to "modern methods of production and construction".

The first step in a project is to develop an initial idea and a conceptual description on the basis of the technological state-of-the-art. Depending on the accessibility and availability of technology we then build prototypes - in the most advanced form as a proof-of-concept prototype.

Naturally we also take target groups into account by describing specific personas in detail, we define contexts of use in use case scenarios and we evaluate user experiences and acceptance with low-fidelity prototypes. Specific individual needs and requirements as well as the contextual and spatial settings strongly influence the final form and function of a product.

Most traditional interaction paradigms investigated in the field of Human Computer Interaction are based on traditional interfaces, mainly keyboard, mouse and monitor. Materials do not play an essential role in this research but they are crucial for tangible interfaces. A very high competence in how we can use different materials for interfaces is existent in the design domain - especially in product and industrial design.



Tretter S. (2013), Thesis: Guerilla Meshnet/
A solar powered WLAN-Router for Mesh Networks

Printed electronics offer highly interesting features for the development of new digital interfaces and services. With the possibility to mass-produce smart two dimensional products that have embedded functionalities and "intelligence" completely new application fields can be investigated and identified.

It is therefore not only consequent but necessary to conduct research in printed electronics from a design perspective in close co-operation with engineers. We are very much looking forward to continue this extremely exciting research. We believe that printed electronics will play an important role in future digital applications and embedded services.

Interaction and Experimental Interfaces - Master course in Interface Design

Bauhaus-Universität Weimar

The Master course „Interaction and Experimental Interfaces“ is part of the international Master programs „Media Art and Design“ (M.F.A) and „Media Architecture“ (M.Sc.)
It is open for students from different backgrounds such as media art, product design, architecture, computer science, etc.
The course is an extensive, integrated, one-semester project that covers theoretical and practical aspects. Accompanying hands-on courses offer necessary skills to realize individual, technically advanced projects.

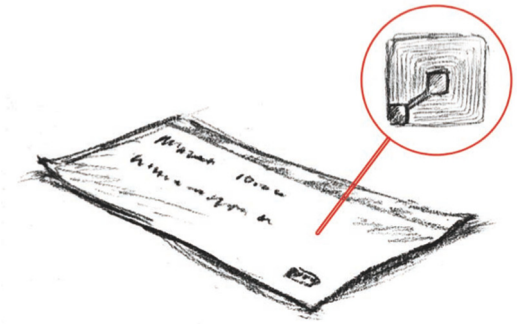
The main topic in this course is printed and organic electronics and their potential for future digital interfaces and services.
Current HCI themes are introduced and the projects main focus is on the development of ideas, concepts and the construction of prototypes based on the students ideas.
Because students have differet backgrounds and expertises from their initial studies they are encouraged to work in teams and to exchange their experience.

In this semester printed and organic electronics are introduced and design research is conducted regarding the potential impact of these emerging technologies on interactive applications in print products, embedded computing, etc.

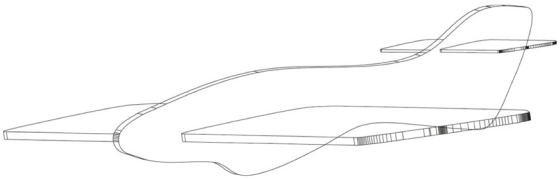
Conceptual and practical methods of art & design were applied to investigate contemporrary questions in the area of human-computer interaction in architectural and urban settings.

During one semester several concepts for interactive and tangible devices, spaces and applications were developed.

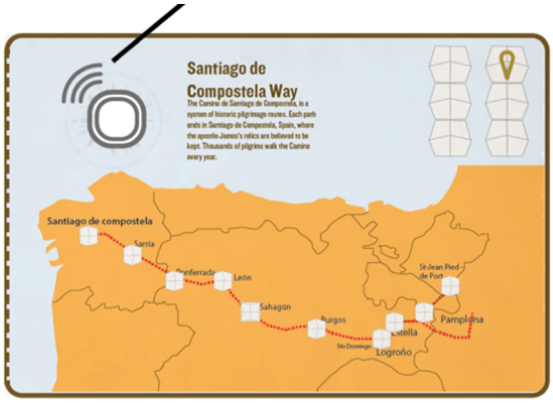
Florian Wittig developed a concept for an inteligent public transport information and ticketing system. His concept makes use of printed electronics to help passengers find their way in public transit systems.



Daniel Winterberg proposes a concept for a toy airplane with printed solar cells. His intention is to build a model airplane, which is able tofly independent of external energy supply with a small electronic motor.



In her Master thesis Adriana Cabrera is working on an electronic postcard system. She developed a concept for a remote interaction using tangible interactive cards, allowing the sender and the receiver to communicate via tangible messages with the card and Internet.



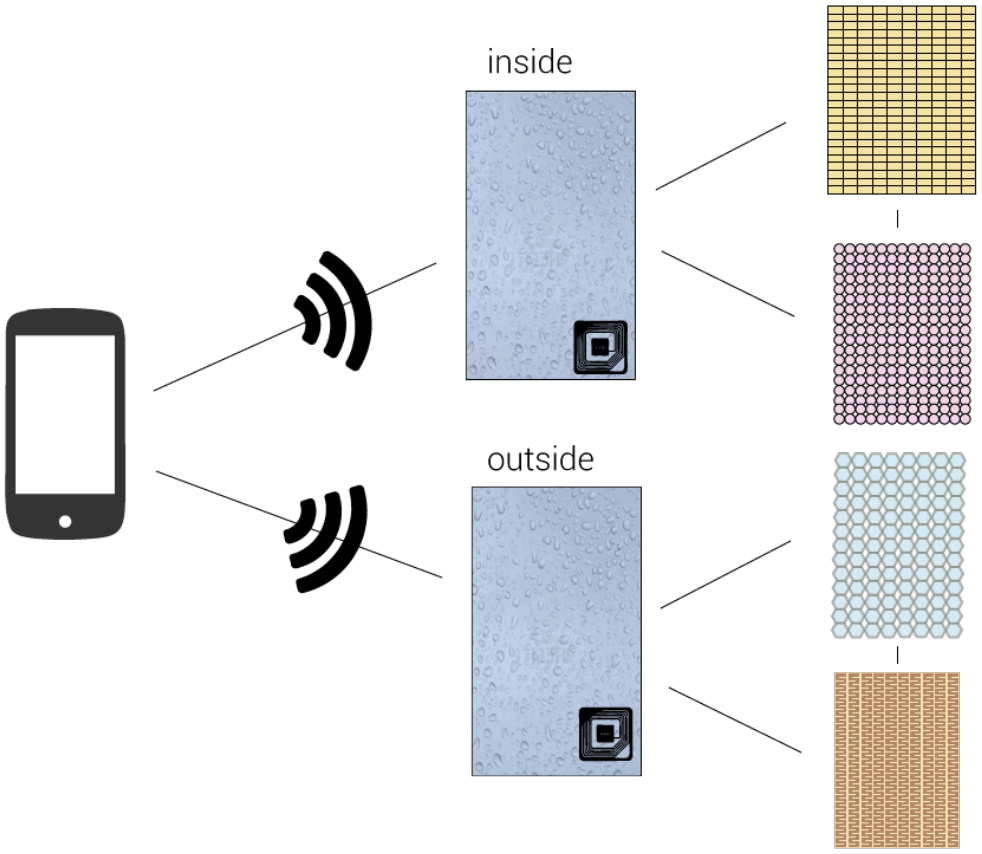
Jorgelina Garcia suggests an e-friendly book for children with printed RFIDS. Her design proposal is a book combining classical printing technologies with functionalities of the e-book (Kindle, etc.) in a new interactive approach.

Light-Foil

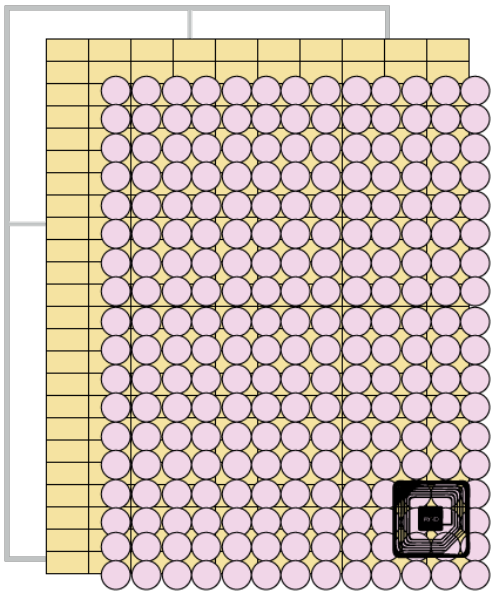
- a design proposal for the use of printed electronics in architecture

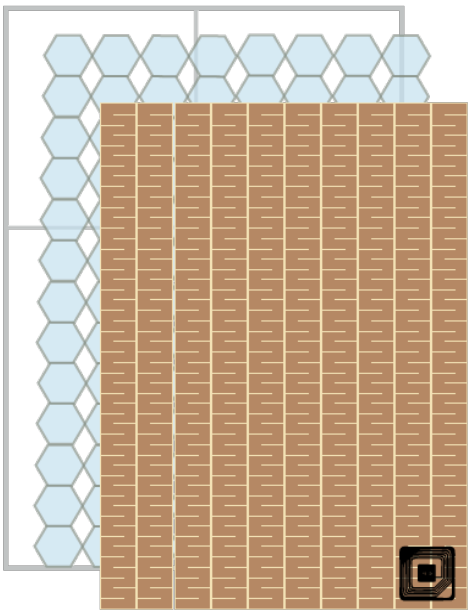
The Light-Foil is a flexible display using the characteristics of OLED and electrophoretic displays. The latter can be used to create images on the inside of the window, the other is used to as a light-emitting surface.
Through daylight harvesting with solar cells the foil gathers energy to power both displays. The concept also deals with the issue of thermal transmittance. The ability to stop increasing indoor temperatures in hot climates not only significantly curtails the cost of electricity and produced greenhouse emissions, it also adds to the comfort of residents.

Attaching a transparent and conductive foil to the inside and outside of window glass is the basic idea of the Light-Foil concept. Two foils are used to control the light, temperature and window-image inside and outside of a building. They are capable of not only brightening and darkening a room naturally; they



Laura Jozefini, Jens Geelhaar





can also show a different image of the outside world and hide the inside through a reflected image. Both foils are controlled by a smart phone app, which can change their structure or behavior with a simple tap.
Transparent solar cells are embedded into the outside foil and provide the power to maintain the brightening effect. The inside foil is used to control the light and view characteristics of a window. The outside foil is used to protect from heat and an unwanted visual audience. The latter could be achieved by using a Venetian mirror effect, which isn't possible at the moment with printed electronics.

To provide the foil with the tools necessary for its functions, it is going to consist of at least four "layers". The inside foil will need OLEDS, an electrophoretic display with RGB filters and an RFID tag to connect it to a smart phone.
The outside foil requires transparent solar cells for daylight harvesting, a coating for thermal protection, another RFID tag and a layer for the mirror effect.
Both foils possess patterned conductive traces that are used to route signals from the smart phone to the relevant component in the integrated multi-layered printed circuit to display the needed function.
The inside foil features a display layer of integrated OLEDs. Their efficiency nearly succeeds the one of conventional lighting and inorganic LEDs, and they are suitable for large-area usage. In combination with a red, green, and blue organic emission a white emission with a high Color Rendering Index (CRI) of 90 can be created. The electrophoretic layer can temporarily or permanently display an image uploaded from the smartphone without having a constant power supply. The backplane of this display could either be an organic thin-film transistor (OTFT) or a flexible printed circuit (FPC). These two connected layers are used for the window- image and darkening function.

An important part of the concept are transparent solar cells. For a low-cost concept like the Light-Foil an alternative to the usual ITO containing organic solar cells is used: cells which consist of a stack of aluminum doped zinc oxide and thin silver layers. They have a transparency of over 75% and can achieve a power conversion efficiency of 6.1%.
The solar cells can be printed in a roll-to-roll process onto the foil. The final electrode at the top is applied by screen printing a grid structure that allows for light transmission. The integrated solar cells are used to power other functions of the Light-Foil.

To enable the foil to protect the resident from thermal transmittance, the outside is coated with an electrochromic layer. Using a single roll coater to spray or slot-die coat an electrochromic layer onto the flexible foil it is possible to switch between a transparent and colorful (white) state.

An alternative to the usual ITO containing organic solar cells are printable, transparent solar cells consisting of a stack of aluminium doped zinc oxide and thin silver layers.

To activate the foil-modes a smart phone is supposed to communicate wirelessly connected via RFID / NFC tags printed onto the foils. A final protective layer on the foils protects the RFID tags and circuits from environmental stress.

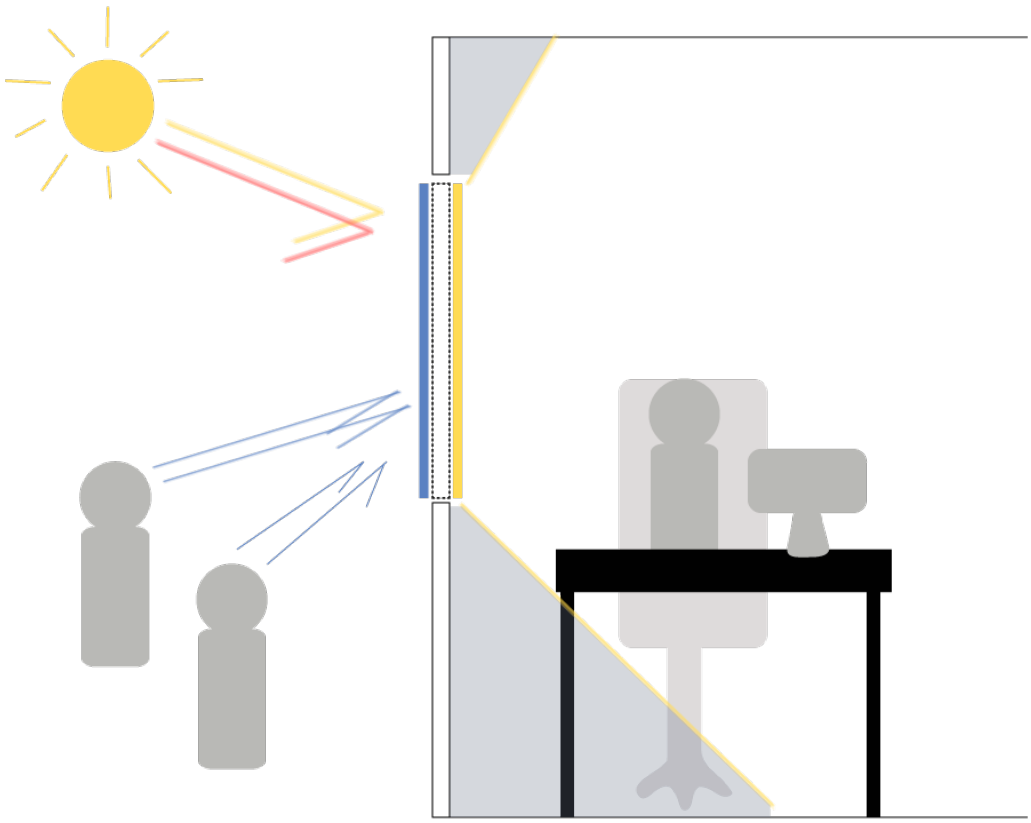
The Light-Foil uses window glass as a subsurface as windows are natural sources of light in architecture. They are capable of establishing a feeling of protection and safety while also allowing a connection with the outside world. The foils build on these characteristics and extend their functionality.
The light effect is a crucial aspect of the design. Artificial illumination through lamps is to be replaced by natural light, saving cost and energy. Using the foil, urban households and indoor spaces can be illuminated and a natural feeling generated. They can be brightened beyond the point of the lighting conditions outside to emulate bright sunshine.

Another important feature of the Light-Foil is the possibility of darkening the windows. It is useful for people working night shifts, as it makes undisturbed sleeping in the darkness possible.
There are two further characteristics of the light-foil: thermal protection and control of the window-image.
The outer foil is able to reduce solar heat gains significantly. This can be essential for office buildings, which are predominantly designed with glass fronts. The image control is an inside foil effect. Activating it, the view from inside to outside can be changed to display the desired view. It is a useful application for people living in group homes or hospitals, as the presence of windows can reduce stress levels, anxiety and depression.

The Light-Foil can be seen as a low-cost concept for the use of printed electronics in architecture. The printing cost for large-area

Laura Jozefini, Jens Geelhaar

foils would be less expensive than the production of electrochromic glass. Looking at the foils production and application, energy costs and greenhouse gas emissions could eventually be significantly lowered.
The application of an intelligent foil as natural and comfortable light source inside a building can replace the usage of lamps. It is a way of saving space and money, and also gives the user the sense of daylight instead of artificial light.
The electronic compounds required in this project (transparent solar cells, OLEDS, electrophoretic displays, electrochromic coating, RFID tags) can already be manufactured, therfore the two most important aspects of the Light-Foil concept -brightening a room naturally and the use of transparent solar cells- can already be achieved through printed electronics. A cost effective production of the Light-Foil in the future appears to be feasible. The implementation of a one-way mirror into the foils seems to be possible in the future, allthough some research has to be conducted in the printing and application of a highly reflective surface that transmits light in only one direction.

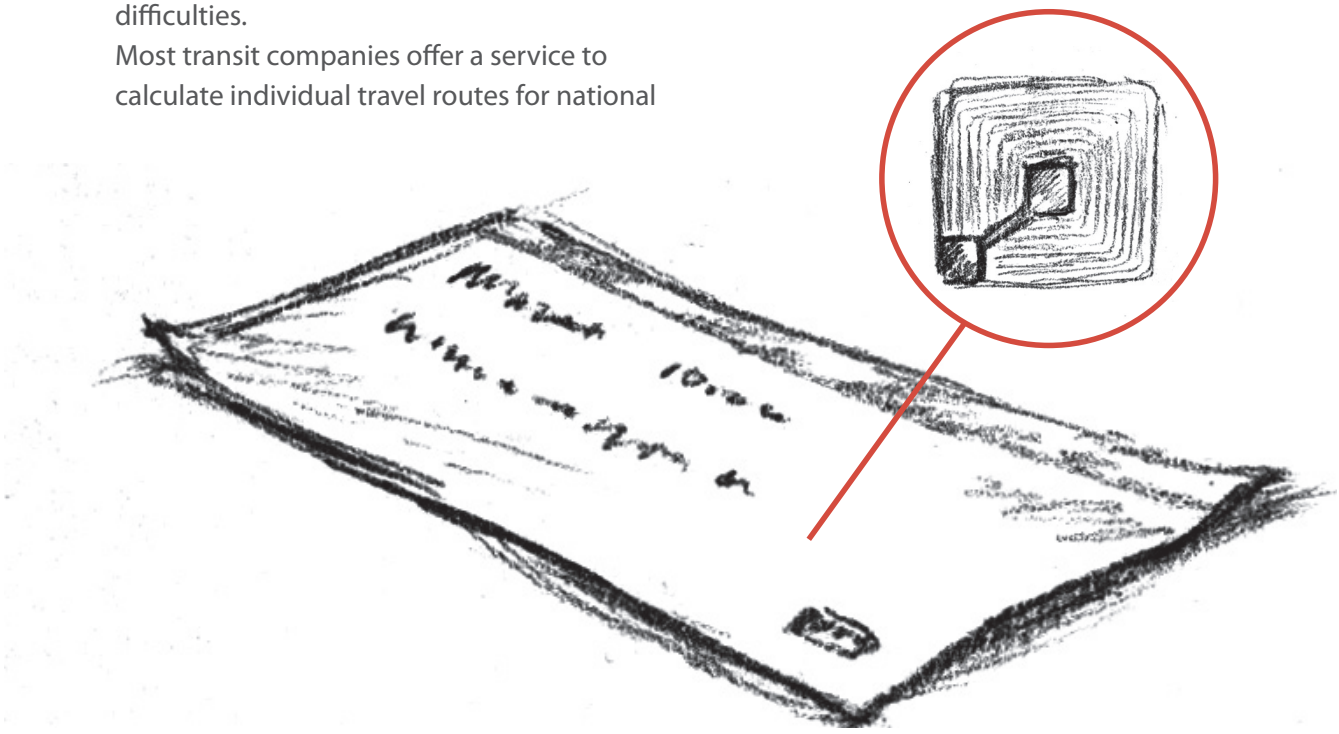


Navigation Concept using printed RFID in Public Transport

Printed RFID tags in train tickets can be connected to reading devices at train stations and on trains to help passengers navigate in public transportation in case of delays or platform changes.

Train stations in larger cities may have more than 20 platforms, located on different floors or in different buildings. According to the German railway company more than 160 million passengers change trains at Munich station each year. It can be assumed that this includes a large number of people who do not use the national transit system on a regular basis. Passengers may derive from countries all over the world and are used to differently organized transit systems and different signage. In spite of well-designed wayfinding systems at train stations passengers often face difficulties when their travel routes change spontaneously due to delays, platform changes or technical difficulties.

Most transit companies offer a service to calculate individual travel routes for national train lines. These services can be accessed by customers online via the company's web page, in applications for mobile devices, or at vending machines. At the vending machines these travel routes can be printed to take on the journey. If the route changes during the journey however the paper becomes obsolete. The same calculation can be done in mobile apps. This requires that the passenger possesses a certain mobile device and the corresponding app has to be installed beforehand as well. The user is also required to speak a certain language and to be in reach of a stable Internet connection which is usually not the



Florian Wittig, Jens Geelhaar

Suggestion for a reading device at train stations.

Using existing screens for information display.

case during train travel. Neither conventional printed schedules nor mobile apps are sufficient for easy wayfinding in case the travel route changes, the passenger is short in time, new to the country or does not own a smart phone.

The concept suggests that each train ticket purchased at a vending machine or a ticket counter contains an embedded printed Radio Frequency Identification (RFID) tag. The RFID tags should be printed on the same paper that is used in ticket vending machines at train stations. In many cases this is a certain security paper including features like holographic bands that take multiple steps to manufacture. During the manufacturing process the RFID tags should be printed in certain intervals on the paper. Later the paper is stored on a reel in the vending machine. At the purchase the paper has to be cut in a way that each ticket contains one RFID tag. At the same moment, the identification number on the tag is linked to the travel details of the passenger, mainly the travel destination. This information is stored in a database until the passenger has reached his or her destination.

Small RFID reading devices should be installed at train stations and on trains. The device is connected to a small computer with access to the transit company's database and is attached to a small screen. Passengers can push their tickets to the reading device – which will then read the tag and immediately know the corresponding destination. The device will call existing routines to calculate the fastest route for the passenger. The computed information is displayed on the screen attached to the reading device. The screen will only display

the most relevant information such as departure time, platform, and train number. Passengers should be able to grasp the information as quickly as possible so they can immediately look for their train. Once on the train the traveler can check the route again at another device. At that point the information is already updated and the next connecting train's information is displayed. This can be repeated as many times as necessary. If a connecting train is late, canceled or departing from a different platform than initially planned, the information is updated so that the passenger does not have to worry about how to find the way at the next station.

As this idea requires a large number of devices being installed at stations and trains, using Near Field Communication (NFC) technology can be considered as an alternative. NFC tags printed or installed at different spots within a transit system (e.g. timetables on stations, railroad maps on trains, vending machines) can communicate the exact location of the passenger. An NFC-equipped smart phone is meant to serve as the reading device. The relevant information is then collected from the database and can be displayed on the phone screen. Some transit systems already use NFC for ticket purchase so this functionality could be added. This alternative is much more limited in terms of the target group as it requires owning an NFC-equipped phone.

Passengers should be able to grasp the displayed information as quickly as possible so they are able to immediately look for their train.

The goal of the RFID-based concept is to help all passengers when signage systems are limited in their possibilities to guide the people on their individual route. While the service at vending machines allows customers to choose between different routes, the concept introduced here will only display the fastest route. If passengers select certain stations as breakpoints when purchasing the ticket, this can be included in the calculation. For the sake of simplicity and speed no selection is possible at the introduced device, it is only for displaying information. A glance no longer than three seconds must be sufficient to grasp the content. Even if a passenger has merely a few minutes to catch a train, he or she is able to take a look at the device and assure him/herself of the right direction. Passengers using the service for the first time do not have to read a manual. A simple symbol on the device will indicate where to put the ticket to get an effect. There is no menu to browse, just one screen of information, unambiguous and clearly legible. It is usable for passengers of all ages including those who are not used to browsing through digital menus. Apart from holding the ticket to the device the only other interaction that could be added is a language selection. Although the only language-specific word is "platform", a language selection might be useful for people who are used to different scripts such as Arabic, Chinese, Japanese, or Korean.

A key aspect of the concept is to only show the absolutely relevant information to the passenger. The pictures show different ways of how the information could be distributed. From top to bottom the information is displayed in the following order: Departure

Two suggestions for information display.

platform, departure time, train number as well as a list of all stations that require changing trains plus the final destination. This list should show the passengers the way of their journey if they have time for a second glance. The train number and destinations are presented in a different hierarchy, distinguished by background color and type size. It must be obvious for the viewer which information is most relevant. Updated information can be indicated through the use different colors. The information is desired to be easily accessible in the user's perception. Thus the information has to be displayed legible and clearly structured. The proposed screen designs also work for the NFC alternative. Here the layout is displayed on the phone screen.

Using printed RFID technology is a useful way to make wayfinding in public transportation easier. Especially passengers who do not frequently use public transit might benefit from additional navigation as long as it is self explanatory and easy accessible. Printed RFID tags on tickets may offer a simple solution to put up with train delays and route changes during the journey. It is yet to be determined if the cost of printed RFID tags on every ticket makes sense from an ecological and economical perspective. The next step would be to set up a user survey to determine how the target group perceives the concept. A survey will help to define how the travel information should ideally be distributed. The NFC-based concept has the advantage of being less costly but using RFID-tickets might be more convenient for a broader target group as the passenger does not have to fulfill any special requirements.

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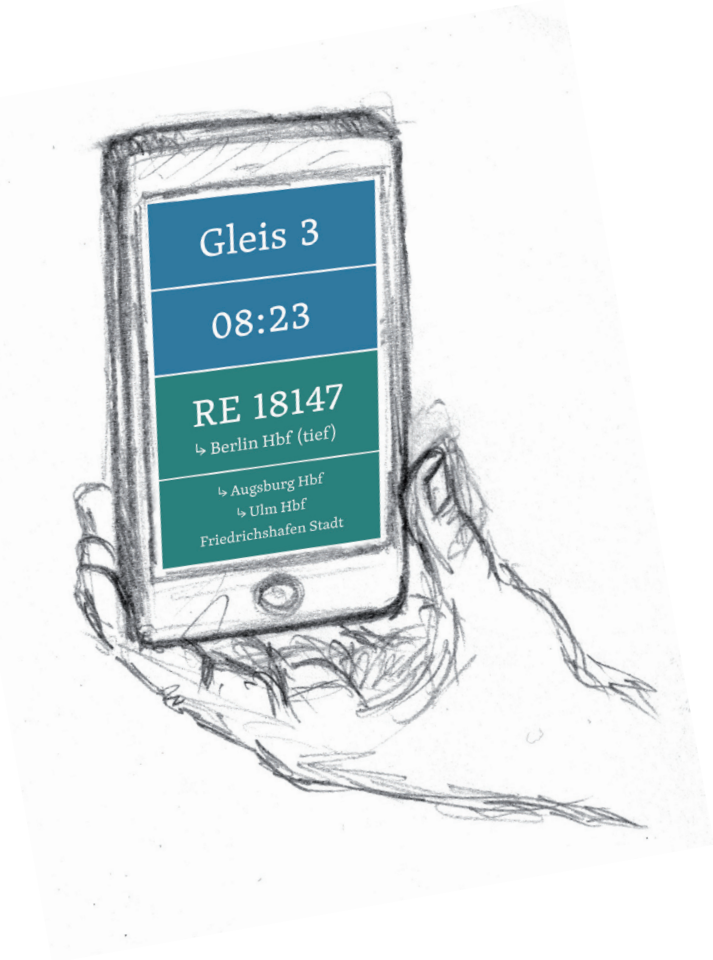
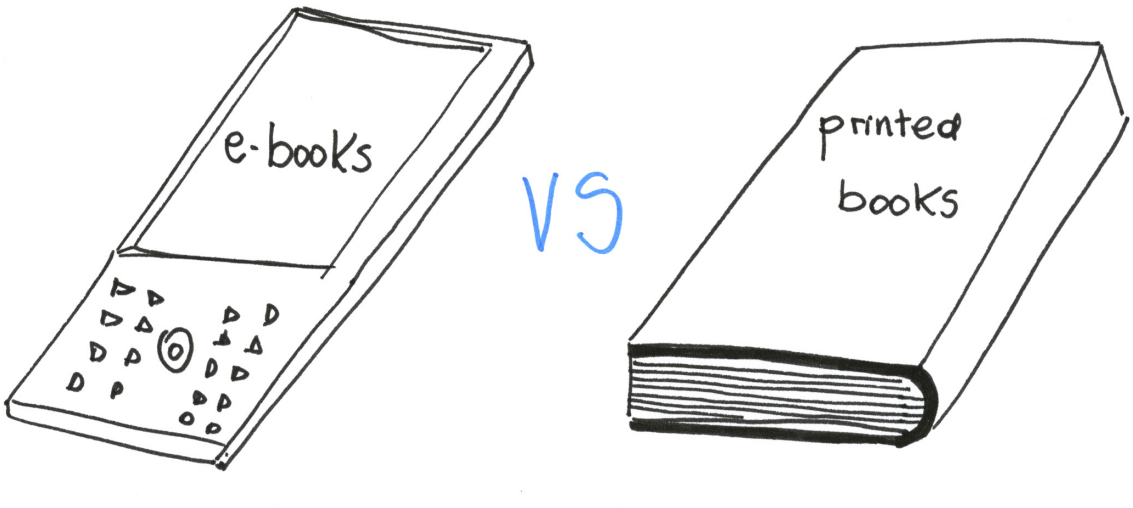


1. Concept for an interactive printed e-Book

The design proposal of a "printed e-Book" is a book that combines classical printing technologies with functionalities of the e-book (Kindle, etc.) in a new interactive approach. The proposal focuses on children books. In existing research it is discussed whether new technologies such as e-books or others, are appropriate for this target group [1].

Typically the reading habit is established in childhood [2]. The experience of reading and playing with books as a child, normally remains present in peoples memories for their whole life. The fact of only looking at a picture has the potential to take readers to wonderful imaginary worlds.
Today, with the new generations the concept of a still image as a way of entertaining is starting to disappear. Nowadays, with the advance of new technologies, it is difficult to see a kid without being surrounded by "intelligent" devices full of different kinds of interaction. Reading from an electronic screen is completely different than reading a conventional printed book. The idea of a printed e-Book is situated exactly in the middle of both of them. It should preserve the value of the material qualities of the paper as well as the illustrations and texts on it. At the same time it stays updated to the newest technologies in order to satisfy the requirements of the new generation.



Jorgelina García, Jens Geelhaar

This proposal consists of the revival of old children's books. Keep the classic paper book, but adapt it to new technologies such as the printed electronics. Allow kids to play and interact with the printed e-Book even when their parents are not around.

Through the printed electronic sensors, OLEDs, batteries and other components, as well as the possibility of being able to communicate and interact with other electronic devices, the user will be able to experience a totally new way of reading from the beginning of the book until the end of it.
The advantage of being flexible, rugged and "tangible" provides the "printed e-Book" with the same meaning as a conventional paper book, which stores and communicate knowledge through reading and, at the same time, it makes it almost as interactive as an e-book or other electronic devices.

Touch-, light-, and sound-sensors will be included in this application, as well as printed loudspeakers, OLEDs , transistors, capacitors, batteries and other electronic components. They will be printed on different reactive functional layers inside the book. All functional layers and components could be printed by means of gravure, flexo-, screen- and ink-jet printing [3]. Currently it is investigated if it is possible to include voice recognition on a low-tech level.

Functions

To better describe the application, the functions were adapted to one specific children's book: Where Is Wally?/ Where Is Waldo? (a well-known "interactive" book where the reader has to find different characters and items).

Time

. If staying too long on the same page:
The searched character talks from the area where it is hidden.
. If the reader can't find the solution the character/item runs or moves to the next page.

Sensors

Touch-, light- and sound-, sensors will be included in this application.
. If the reader finds a character/item he/she can touch it. The reader can also find hints in the different chapters/stories by touching special characters/items.
. This device recognizes if there is few or no light in the area/room. The e-book will be put
into night mode and be illuminated via OLEDs.

Sound

. On the first page the reader is allowed to record his/her name in order to make it more personal. All characters will call the reader by his/her name in the following story.
. Before the story begins, the reader has the possibility to enable the characters via sensors to tell their own stories.
. Music could also be added to different stories in different chapters/pages with an on/off button.

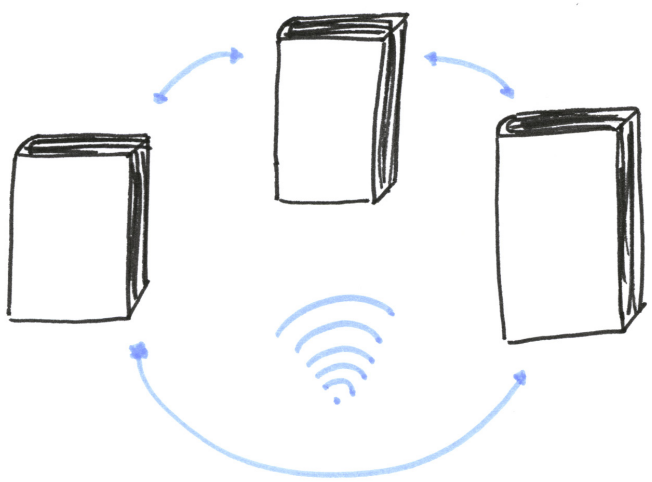
Light

. In every page in the book there is the option of "night mode" set-up.
. When the user reaches higher "levels" in the book, there will be pages that could only be played if the lights are off. If the light is on the page will be white.

Jorgelina García, Jens Geelhaar

Connection

. It can be connected and synced to other devices (computer, pads, smart phones, etc.)
. It is possible to create a link between the book story and an online app where the user can mix playing online and reading the book.
. The book can be enabled as multi-players/multi-readers and connect with other people that are also reading/playing at the same time.



The fact that the printed electronic technology promises to be an available and inexpensive technology, lead to the assumption that a printed e-Book could be very useful to improve the education of the young generation. These functions could be added to school books and inspire young people to learn in a more interactive way.
From our perspective a very important point is to keep the value of the material qualities since we live in a world that becomes less and less tangible. The idea of making an analog object with almost the same potential of interaction as an e-book, is something that is considered to be highly attractive. This new application could lead to the possibility of linking the analog to the digital world as well as the invention of other applications that could be customized and adapted to different types of already existing books.

[1] Jeremy Greenfield, Digital Book World: "For Reading and Learning, Kids Prefer E-Books to Print Books", URL http://www.digitalbookworld.com/2012/for-reading-and-learning-kids-prefer-e- books-to-print-books/ (published: 9-01-2012, last request: 05-07-2013).
[2] Y.-Y. Kang, M.-J. J.Wang, R. Lin.: "Usability evaluation of E-books" Displays 30 (2) 49–52 (2009).
[3] Dr. Andreas Willert: "Printing Technologies for Functional Layers and Components"
URL http://www.enas.fraunhofer.de/en/core_competences/printing_technologiesforfunctionallayersandcomponents.html (last request: 02-07-2013).

Chameleon – Interactive Smart Phone Cover

This project addresses the aesthetic conformity of existing mobile handy covers and proposes a design for a new interactive smart phone cover. The inspiration for this design comes from the chameleon.

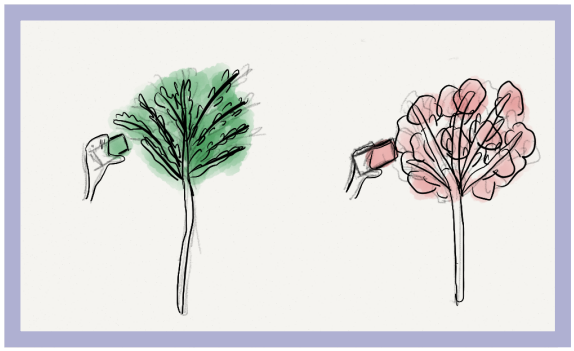
A color sensor embedded in the smart phone cover allows users to interact with colors in the real world. The sensor can detect the colors of objects in the real world and changes the appearance of the smart phone cover to a similar color. The smart phone cover mainly consists of a color sensor, solar cell and transparent layers and an OLED. For the output of colors we will use flexible electronic OLED. By using printed electronics technology it allows us to make the handy cover as thin as possible.

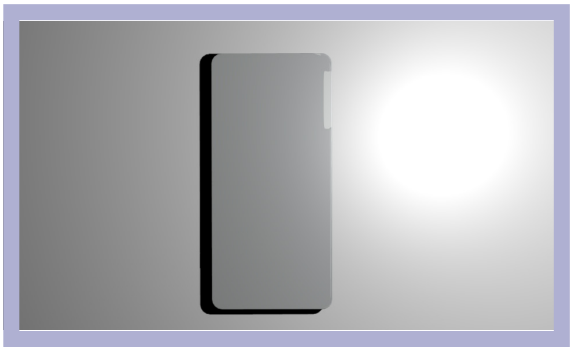
The disadvantage of existing smart phone covers is their aesthetic similarity and conformity. When using a new smart phone cover this can be chosen according to the mood and specific style of their owner. The target group for the Chameleon smart phone cover is:

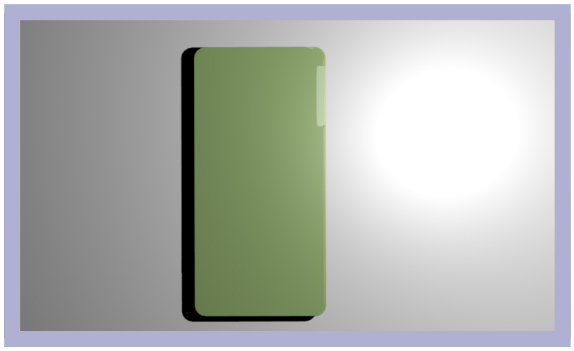
- Young people owning a smart or mobile phone
- People who are interested in fashion and fresh design
- People who like to use changing accessoires

The main goals of the design are to make a smart phone cover with flexible design appearances, to make the smart phone cover as thin as possible and to add interactive functions, so people can have more fun when they use it.

Lingling Li, Jens Geelhaar







To realize this project the main task is the recognition of color and the output of color. Therefore, this smart phone cover will work like a color I / O device. With the development of technology and the use of different sensors the products become more and more diverse. In this case the color sensor will play a central role as a recognition unit of the real color in the world. Another aim of this project is to make the handy cover as thin as possible. This goal will be achieved through the use of printed electronic technology. Printed electronic technology allows us to print electronic components in thin layers. The sensor and solar cell should both be printed.

The main parts of the handy cover are the color sensor, a transparent layer, a solar cell and an OLED display. The transparent layer will be used as a substrate to print electrical devices on it. The printed solar cell will work as the power supply in this case. The color sensor will be used for the recognition of color. The OLED display works without a backlight. Thus it can display deep black levels and can be thin and light.

Workflow

The workflow can be divided into four steps. First the user points the smart phone cover close to a colored object. Then the inside color sensor will recognize the color and convert it into a digital signal. The next step is the digital transmission. Finally the color will be displayed through a flexible OLED.

Technical Setup

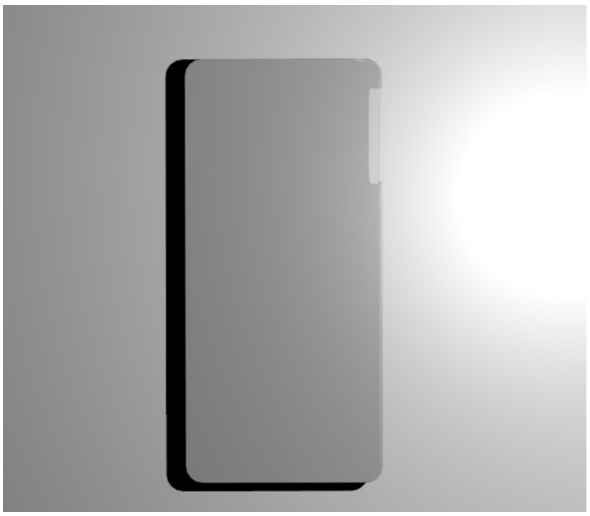
Printed electronic is a set of Printing methods used to create electrical devices on various substrates. Printed electronics promise varous kinds of sensor circuit labels, for applications in distributed sensing and monito- ring, which can be manufactured by using traditional printing tools at very low cost. An OLED (organic light-emitting diode) is a light-emitting diode (LED) in which the emissive electroluminescent layer is a film of orga- nic compound, which emits light in response to an electric current. Flexible OLED Displays have started to appear in a variety of applications. This new display technology consists of two parts: a front plane that contains the imaging component, and a back plane that controls which pixels are on. For a display to be fully flexible, both parts need to be flexible.

Lingling Li, Jens Geelhaar

Future Application

In this project the most important part is the interaction process between the handy cover and the real world. From a marketing perspective the smart phone cover can achieve product diversification through this process. The intention of this design concept is to give the users a joyful experience.

About the product application we can also combine it with the handy functionality. For example, when the phone receives a call or a text message, the handy cover will change its color in order to achieve the reminder function.



Conclusions and Outlook

Currently the project is in an initial creative phase. The work done so far is related to the explanation of the product's functionality and an introduction to a potential technical implementation. The realization of the product will be the main focus of future work. In addition the products functionality will also be a major issue.

Model Airplane with Solar Energy

The main focus is on producing a »ready to fly« flat cut-out plane model for a children toy with independent energy supply on the wing.

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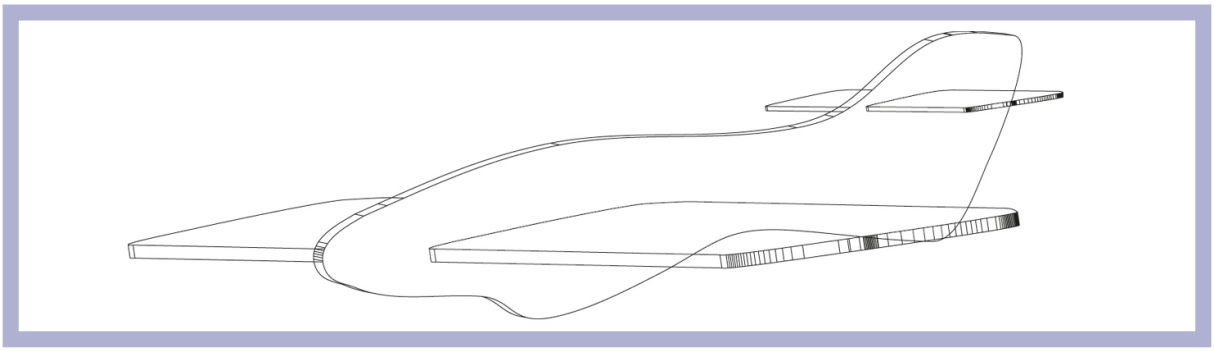
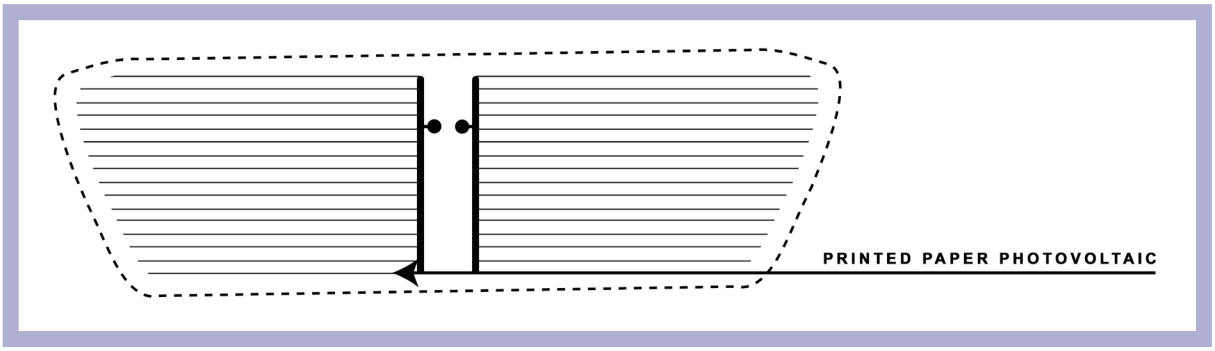
Keywords: photovoltaic, toy plane, printed organic electronics

Abstract

The intention of the following concept is a model airplane, which is able to fly independent of external energy supply with a small electronic motor. Most of its functional electronic energy supply parts should be delivered through printed photo-





voltaics on the wing. Low prices ensured by the mass production process make the plane affordable and allow the production as a children toy.

1. Introduction

The focus is on producing a flat cut-out plane model for a children toy with independent energy supply. It is important to use parts and materials of low weight. On the other side it is very important to produce a low cost toy because the target group is looking for a cheap and uncomplicated alternative to the bigger models that are available on the market. Manufacturers of toys and model makers developed some interesting airplane-model kits controlled by radio. One of the interesting customers is the Plantraco company. The Plantraco Micro Flight "Classroom Fighter" [1] proves that it is possible to build a flat cutout model of an airplane from Styrofoam which is controlled by radio and able to fly.
In the market of micro model building one can easily access small motors, geardrives, receivers, actuators, servos, batteries and propellers. An important part for radio controlling is an RC receiver. Plantraco developed a very small Receiver to control theairplane named micro9 [2]. This state-of-the-art technology is available on the model builders market.

2. Materials and Methods

2.1 Concept

The intention is to develop a flat model of an airplane, which parts are 80% printable and that is able to fly without external energy supply or batteries. We suggest to use the printed paper photovoltaics 3PV technology [3] to print a photovoltaic supply on the main

wing of the airplane. For the flight control we want to use a smart phone, a tablet pc or a radio remote control.

2.2 Technical Setup

The model consists of three printable parts, the body, the main wing and the rear wing. The different parts of the model should be blanked out of Styrofoam, which is coated with printed paper. All wiring will be mounted during the printing process as printed lines. Electromechanical parts, like the motor and the control unit, could be mounted by plug. Connections should be established without additional mounting parts or adhesives.
The independent energy supply will be ensured by photovoltaics printed (3PV) on the main wing. The major advantage is that time consuming recharge of batteries or capacitors will be obsolete. These normally consume a lot of time and reduce playful experiences.
The avoiding of energy storage should save enough weight for the assembly of photovoltaic. Weight and space saving RC-Technology enables the integration of antennas, receiver and controls in the body of the model.

The whole control technology is available on market as DIY- variation or pre-build parts like the micro9 RC module. Its weight of 0,95g makes it perfect for micro engineering. This state-of-the-art technology is fully integrated in the market of model makers. For remote control it is possible to use a smart phone or tablet PC. To translate the movements to data you can use the gyroscope sensors by the mobile device. So it is possible to look at the flying model while handling the controls. For directing the model you can use a magnetic actor at the tail of the plane. The HingeAct Magnetic Actuator 0.23 g [4] with its weight of 0,23g has enough power to steer the model into the left and into the right.
For the electronic drive I use a motor with a gearbox.

2.3 Planned application

Many people are looking for a cheap airplane model that is easy to use. The printed model airplane is an easy way to play with a high performance toy.

I think about two ways for distribution:

I. Buy the model kit at a shop

It is easy for everybody to buy the model airplane in a special shop or an online shop. The advantage is to buy all parts at the same time. You don‘t need special tools or much knowledge for electrics and handcrafting. After downloading the mobile application for your smart phone or tablet you can begin to play.

II. Distribution by Magazine

You buy a magazine with all parts included. This could be published once a month with different designs. Parts like the motor could be re-used.

3. Result and Discussion

3.1 Prototype

There are many different airplane models on the market. They are expensive and hard to use. You need a lot of know-how and experience to build these models. The printed Airplane does not need a special workspace or expensive tools. You can build the model

easily. Its very interesting for model makers because you don't have to charge batteries or other external energy supplies.

3.2 Application

The focus is on the photovoltaic wing for independent energy supply. That is new on the model builders and toy market. It is a chance to distribute printed photovoltaics to a new target group.

3.3 Conclusions and Outlook

It is possible to build a flat cut-out model of an airplane with a photovoltaic integrated on the main wing. With the state-of-the-art technology it is possible to let them fly and to control his flight by radio remote control. For the future questions like the weight and the size of the wings and the body of the toy have to be addressed indetail

4. Acknowledgment

I would like to acknowledge Plantraco Microflight for the great development of flat models of airplanes and their whole technology. Thank you to Prof. Dr. rer. nat. Reinhard Baumann and his team from the Technical University Chemnitz.
Thanks to Prof. Jens Geelhaar and the Bauhaus-University Weimar.

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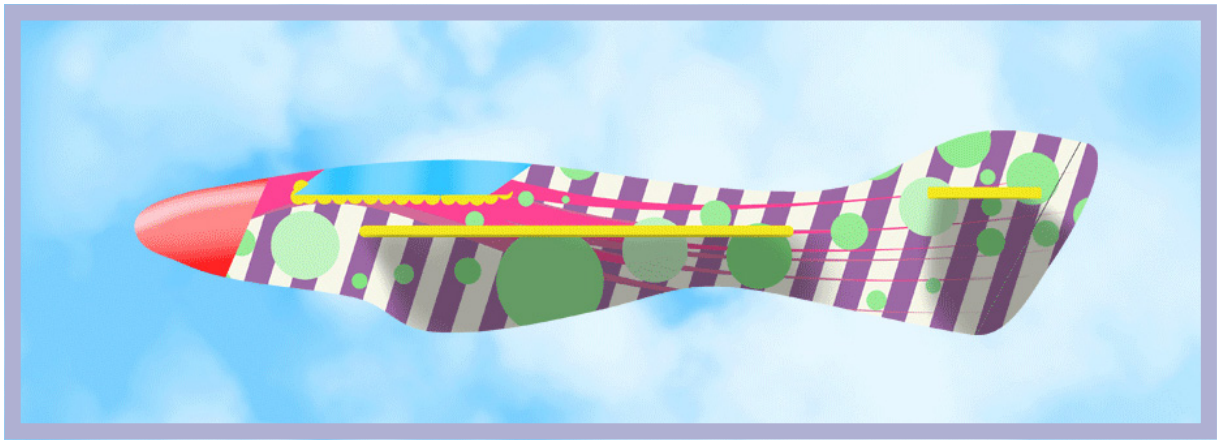

“In-touch” Interactive Tangible Cards System Design Concept

Remote Communication through an Interactive Responsive Postcard System

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The project develops a concept for a remote interaction using tangible interactive cards, allowing the sender and the receiver to communicate via tangible messages with the card and Internet. Printed electronics on the card allow for different input and output signals to be embedded in the card. The sender and the receiver connect via the interactive cards system and a computer or smartphone. The In-touch interactive cards system allows a playful and haptic interaction through light and interactive folding patterns. This interface is meant to make long distance communication more sensual allowing partners to stay in touch through tangible messages.

Description of the concept

The postcard used to be a universal medium of correspondence [1], however nowadays it is considered an almost old-fashioned way to connect between people. This tangible medium can not only express pictographic and verbal meanings but also transmit aesthetic, cultural, and other non-verbal qualities.
In this way the interactive cards establish an interaction by sending and receiving short messages / signals through a responsive tangible system.

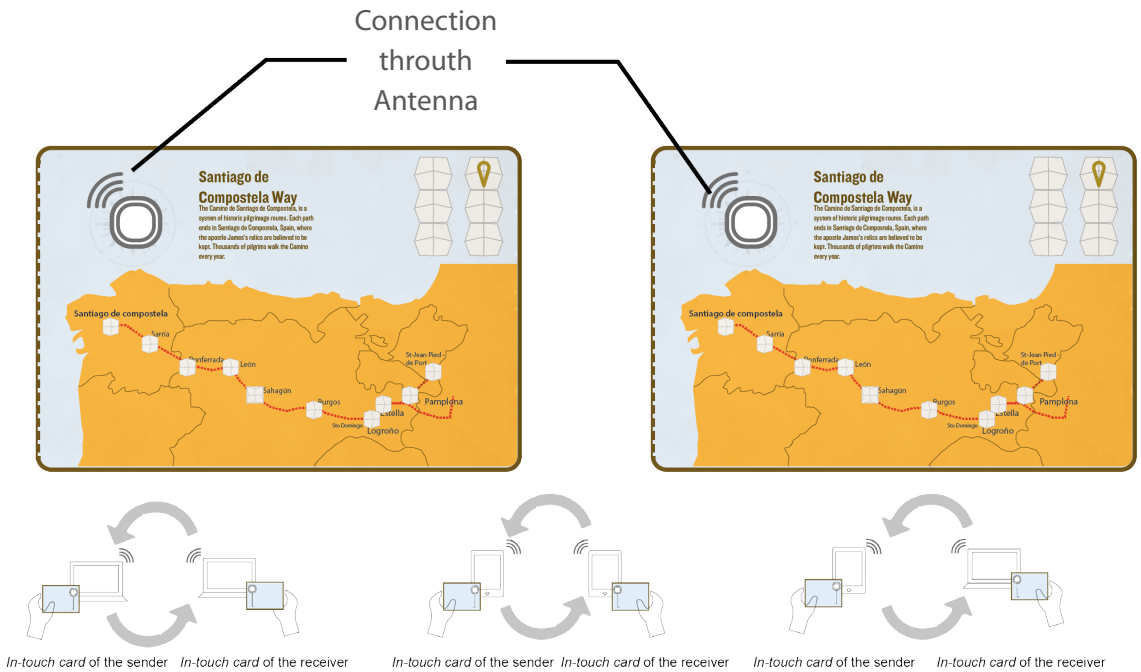

Fig. 1: Connection of the pair of cards via antenna, Computer or Smart Phone.

Design of the System

In the first use case scenario the design consists of a pair of cards. The sender keeps one of the cards and the other one is sent per post (as a postcard) to the receiver. The In-touch interactive cards can transmit their unique ID via the RFID or NFC antenna embedded in the card. This establishes the connection to the smart phone or computer. A short digital message can then be sent via Internet between sender and receiver (e.g. Facebook, SMS, ...).

In the second model, the card can be inserted to a stationary device called the "in- touch box" which is linked to the receiver's computer. In fact the box has an opening where you can insert the "Interactive Postcard". Once the postcard is inserted it can communicate via Internet with the receiver and vice versa. In the future different cards could be connected and coordinated through a network where the sender can communicate with multiples receivers.

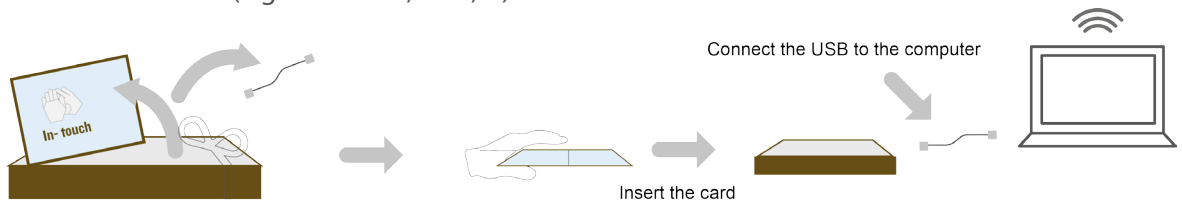

Fig. 2.1: Inserting of the card in the "in- touch box".

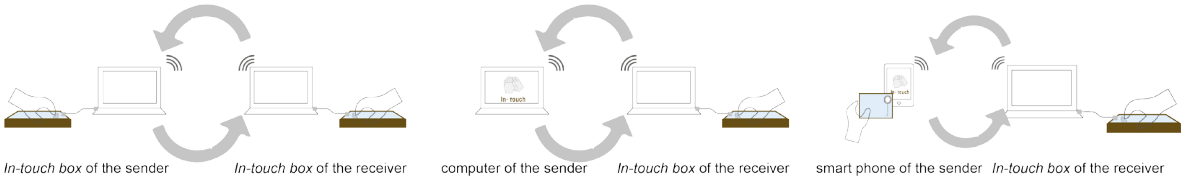

Fig. 2.2: Connection of the pair of cards through the "in- touch box".

Design of the Interactive Postcards

The postcard as a responsive surface has an important role because it is designed to generate a haptic experience for the user. The electronics of each of the patterns of the postcard can be printed or combined with different techniques depending on the level of interaction and complexity of the output. The design of the interactive cards is based on three levels of interaction:
In the *first level*, from a low level of intervention the user can interact with simple and basic information, using light signals as actuators and a switch as an input, answering to predetermined questions like "Where are you?" or "Are you at home?" This first level applies in situations like travelling, or finding out somebodies location. In the *second level* of interaction, the user can explore a tangible interaction with different kind of small activities. The user activates a function in a responsive touch panel. In this case the exploration produces a higher level of intimacy and can express more variable messages. This pattern is inspired by a situation where one wants to express feelings of love, friendship and so on.
The *third level* corresponds to the card as an object, which the sender and receiver can modify an elaborate in a small scale and transform from a plain surface to a 3D form.

Fig. 3: Patterns one, two and three.

Target group and scenarios

The post- and greeting cards are typically sent between friends and family, covering a considerable age range making the cards a universal product. In-touch interactive cards are a medium that is both conventional and alternative. The target group is focused in the users of regular postcards and greetings cards but also in communities such as pen pals and people using post-crossing [2].
This system contributes also to the use of traditional postcards and sending of non- digital cards. The experience of the interactive cards system generates different values for the user, which are described below.

Connecting

- To learn different verbal (including written) and nonverbal codes from people from different parts of the world.

Tangibility

- To send a traditional card nowadays has more personal value in comparison with electronic mails.
- Physical object that can be kept collected and displayed.
- It can be worn-out and torn from
- travelling.

Emotional Background

- Choosing a specially designed card having the receiver in mind.
- The possibility to personalize and transmit a feeling through the interactive cards system.
- The experience to share a signal simultaneously with the other person.
- A surprise for the person who receives the postcard. The excitement of waiting for the sender.

Prototype

The design of the interactive cards has embedded the circuits, the inputs and outputs and the electronic component integrated in each layer, which is explained in the figure 5.

Circuit board: The circuit layout connecting the inputs and outputs can be printed with conductive inks on paper. This layer contains the printed electronics inside the circuit such as the OLEDs resistors and capacitors, pressure sensors and the RFID antenna [3].

Integration of electronic components: As actuators SMD LEDs as an alternative to the OLEDs can be integrated. The shape memory wire (SMA) is integrated in the folding papers. In fact the paper functions as a spring to increase the mechanical properties, in which they actuate to generate the movement to up and down.

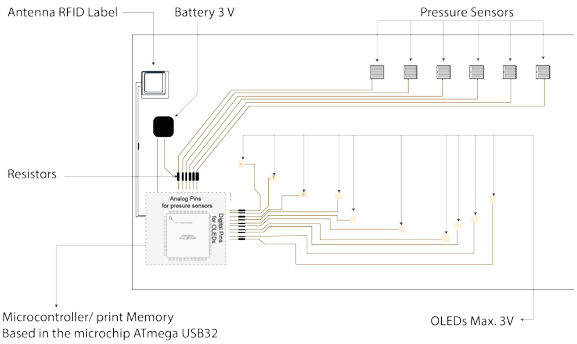

Fig. 1: Conductive circuits layer.

In the first phase of the interactive cards system prototype the microcontroller ATMega 44/128 will be used to facilitate the understanding of programming

The layers of the cards will be developed according to the Design of interactive cards patterns mentioned above. In the following figure illustrates the aspects of each pattern.

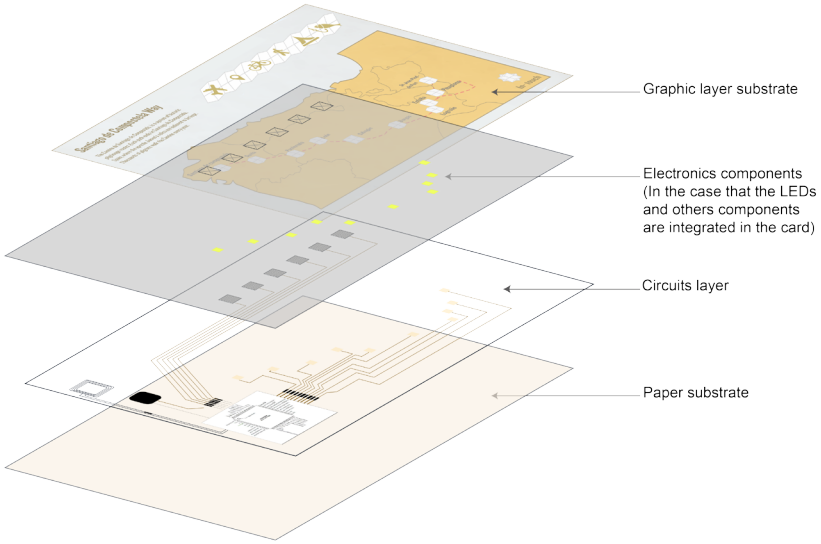

Fig. 5: Layers of the interactive cards.

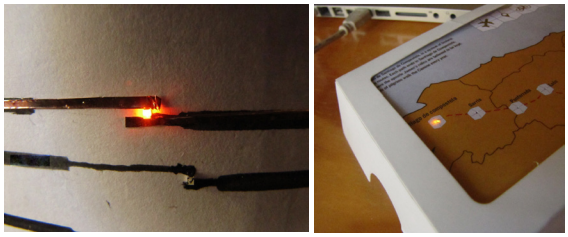

Fig. 6: visualization pattern one

Conclusions and Outlook

The work with a conventional medium and the reinterpretation of these techniques is an important contribution to the conservation of the printed media. In addition the design of the understandable technology integrated in media, permits that people can have access to another quality of interaction through the experience of sending a postcard [2].
The interactive cards should in the future be improved to arrange a communication without devices. This way one can explore a more direct and tangible interaction. This will be possible if the RFID chip is embedded in the card and the antenna can transmit the signals directly to other TCP/IP enhanced devices or objects.

This is meant in the sense that the postcard has the potential to develop more concepts in mobility and intimacy in long-distance relationships [1]. As a result the design of the interactive card motivates different kind of users and communities that are interested in a simple and tangible form of communication.

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PRINTING FUTURE DAYS 2013 | Design

VWB - Verlag für Wissenschaft und Bildung, Berlin

ISBN 978-3-86135-625-7

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