Collective design in 3D printing: A large scale empirical study of designs, designers and evolution

This paper provides an empirical study of a collective design platform (Thingiverse); with the aim of understanding the phenomenon and investigating how designs concurrently evolve through the large and complex network of designers. The case study is based on the meta-data collected from 158,489 designs and 247,768 users; and it reveals that (i) Designs can be shared and quickly evolved into other designs through a distributed network of designers, (ii) only a small portion of the users are designers and (iv) collective design has deep and strong evolutionary roots. Better understanding of collective design platforms can help design practitioners to identify lead users in their respective domains and to discover latent needs that stem from different sub-communities or geographic regions.

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Makerspaces in Engineering Education: A Case Study

The recent years have witnessed a new generation of Makers working with new ways of knowledge generation for creation and sharing of digital and physical products. While this development has started within collaborative and grass roots organised networks; educational institutions have also embraced it by opening makerspaces and adopting elements of the Maker Movement in their offerings. This paper investigates how university driven makerspaces can affect engineering design and product development education through a case study. We provide our findings based on interviews and data collected from educators, students the administrative and workshop staff of the makerspace. The findings are used to outline the challenges in incorporating the offerings of makerspaces. By discussing these challenges we identify opportunities for turning university makerspaces into innovation hubs and platforms that can support engineering design education.

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Authors: Jensen, L. S. (Intern), Özkil, A. G. (Intern), Mougaard, K. (Intern)
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Pervasive assistive technology for people with dementia: a UCD case

Smart mobile and wearable technology offers exciting opportunities to support people with dementia (PwD). Its ubiquity and popularity could even benefit user adoption – a great challenge for assistive technology (AT) for PwD that calls for user-centred design (UCD) methods. This study describes a user-centred approach to developing and testing AT based on off-the-shelf pervasive technologies. A prototype is created by combining a smartphone, smartwatch and various applications to offer six support features. This is tested among five end-users (PwD) and their caregivers. Controlled usability testing was followed by field testing in a real-world context. Data is gathered from video recordings, interaction logs, system usability scale questionnaires, logbooks, application usage logs and interviews structured on the unified theory of acceptance and use of technology model. The data is analysed to evaluate usability, usefulness and user acceptance. Results show some promise for user adoption, but highlight challenges to be overcome, emphasising personalisation and familiarity as key considerations. The complete findings regarding usability issues, usefulness of support features and four identified adoption profiles are used to provide a set of recommendations for practitioners and further research. These contribute toward UCD practices for improved smart, pervasive AT for dementia.

Prototypes in engineering design: Definitions and strategies

By reviewing literature, we investigate types, purposes and definitions of prototypes. There is no overarching definition of a prototype, but we identify five categories of prototypes in literature. We further synthesise and reference previous work to create an overview of aspects in prototyping strategies. Due to rapid changes and progressions in the use of prototypes, we conclude that there is a need for more holistic and overview generating research about prototyping. This for product developers to properly manage, select and apply the optimal prototyping process.
Remember to remember: A feasibility study adapting wearable technology to the needs of people aged 65 and older with Mild Cognitive Impairment (MCI) and Alzheimer's Dementia

A Deported View Concept for Touch Interaction
Following the paradigm shift where physical controls are replaced by touch-enabled surfaces, we report on an experimental evaluation of a user interface concept that allows touchscreen-based panels to be manipulated partially blindly (aircrafts, cars). The proposed multi-touch interaction strategy – involving visual front-view feedback to the user from a copy of the peripheral panel being manipulated – compares favourably against trackballs or head-down interactions.
Automatically Annotated Mapping for Indoor Mobile Robot Applications

This paper presents a new and practical method for mapping and annotating indoor environments for mobile robot use. The method makes use of 2D occupancy grid maps for metric representation, and topology maps to indicate the connectivity of the ‘places-of-interests’ in the environment. Novel use of 2D visual tags allows encoding information physically at places-of-interest. Moreover, using physical characteristics of the visual tags (i.e. paper size) is exploited to recover relative poses of the tags in the environment using a simple camera. This method extends tag encoding to simultaneous localization and mapping in topology space, and fuses camera and robot pose estimations to build an automatically annotated global topo-metric map. It is developed as a framework for a hospital service robot and tested in a real hospital. Experiments show that the method is capable of producing globally consistent, automatically annotated hybrid metric-topological maps that is needed by mobile service robots.

Kansei Engineering and Website Design

Capturing users’ needs is critical in web site design. However, a lot of attention has been paid to enhance the functionality and usability, whereas much less consideration has been given to satisfy the emotional needs of users, which is also important to a successful design. This paper explores a methodology based on Kansei Engineering, which has done significant work in product and industrial design but not quite been adopted in the IT field, in order to discover implicit emotional needs of users toward web site and transform them into design details. Survey and interview techniques and statistical methods were performed in this paper. A prototype web site was produced based on the Kansei results integrated with technical expertise and practical considerations. The results showed that the Kansei Engineering methodology in this paper played a significant role in web site design in terms of satisfying the emotional needs of users.
Mobile Robots for Hospital Logistics

Hospitals are complex and dynamic organisms that are vital to the well-being of societies. Providing good quality healthcare is the ultimate goal of a hospital, and it is what most of us are only concerned with. A hospital, on the other hand, has to orchestrate a great deal of supplementary services to maintain the quality of healthcare provided.

Logistics is the most resource demanding service in a hospital. The scale of the transportation tasks is huge and the material flow in a hospital is comparable to that of a factory. We believe that these transportation tasks, to a great extent, can be and will be automated using mobile robots. This talk consequently addresses the key technical issues of implementing service robots in hospitals.

In simple terms, a robotic system for automating hospital logistics has to be reliable, adaptable and scalable. Robots have to be semi-autonomous, and should reliably navigate in large and dynamic environments in the hospital. The complexity of the problem has to be manageable, and the solutions have to be flexible, so that the system can be applicable in real world settings.

This talk summarizes the efforts to address these issues. Upon the analysis of the transportation tasks and how they are currently handled in hospitals, a navigation system is envisaged. The concept of hybrid mapping is at the core of the solution, making it possible to efficiently represent the environment.

Topological nodes greatly improve planning capabilities, and create a redundant layer for localization. The system features automatic annotation, which significantly reduces manual work and offer many advantages beyond robotics.

A case study on logistics solutions is finally presented. A robotic solution is tested in a hospital to handle the transportation of blood samples between the clinic and the lab. Without any environmental modification; it is shown that lab turnover time can be reduced from hours to minutes; by simply replacing the human porter with a mobile robot.
Service Robots for Hospitals: Key Technical issues

Hospitals are complex and dynamic organisms that are vital to the well-being of societies. Providing good quality healthcare is the ultimate goal of a hospital, and it is what most of us are only concerned with. A hospital, on the other hand, has to orchestrate a great deal of supplementary services to maintain the quality of healthcare provided. This thesis and the Industrial PhD project aim to address logistics, which is the most resource demanding service in a hospital. The scale of the transportation tasks is huge and the material flow in a hospital is comparable to that of a factory. We believe that these transportation tasks, to a great extent, can be and will be automated using mobile robots. This thesis consequently addresses the key technical issues of implementing service robots in hospitals. In simple terms, a robotic system for automating hospital logistics has to be reliable, adaptable and scalable. Robots have to be semi-autonomous, and should reliably navigate in large and dynamic environments in the hospital. The complexity of the problem has to be manageable, and the solutions have to be flexible, so that the system can be applicable in real world settings. This thesis summarizes the efforts to address these issues. Upon the analysis of the transportation tasks and how they are currently handled in hospitals, a navigation system is envisaged. Visual tags are a part of this system, and a survey was conducted to find out the most prominent ones to be used in mobile robot navigation. The concept of hybrid mapping is at the core of the solution, making it possible to efficiently represent the environment. Topological nodes greatly improve planning capabilities, and create a redundant layer for localization. The system features automatic annotation, which significantly reduces manual work and offer many advantages beyond robotics. Finally, this thesis outlines our contributions in representation of multi-floor buildings, which is a vital requirement to achieve robust and practical, real-world service robot applications.

Mapping of multi-floor buildings: A barometric approach

This paper presents a new method for mapping multi-floor buildings. The method combines laser range sensor for metric mapping and barometric pressure sensor for detecting floor transitions and map segmentation. We exploit the fact that the barometric pressure is a function of the elevation, and it varies between different floors. The method is tested with a real robot in a typical indoor environment, and the results show that physically consistent multi-floor
This paper presents a practical navigation scheme for indoor mobile robots using hybrid maps. The method makes use of metric maps for local navigation and a topological map for global path planning. Metric maps are generated as 2D occupancy grids by a range sensor to represent local information about partial areas. The global topological map is used to indicate the connectivity of the 'places-of-interests' in the environment and the interconnectivity of the local maps. Visual tags on the ceiling to be detected by the robot provide valuable information and contribute to reliable localization. The navigation scheme based on the hybrid metric-topological maps is scalable and adaptable since new local maps can be easily added to the global topology, and the method can be deployed with minimum amount of modification if new areas are to be explored. The method is implemented successfully on a physical robot and evaluated in a hospital environment.

Empirical evaluation of a practical indoor mobile robot navigation method using hybrid maps
This video presents a practical navigation scheme for indoor mobile robots using hybrid maps. The method makes use of metric maps for local navigation and a topological map for global path planning. Metric maps are generated as occupancy grids by a laser range finder to represent local information about partial areas. The global topological map is used to indicate the connectivity of the 'places-of-interests' in the environment and the interconnectivity of the local maps. Visual tags on the ceiling to be detected by the robot provide valuable information and contribute to reliable localization. The navigation scheme based on the hybrid metric-topological maps saves memory space and is also scalable and adaptable since new local maps can be easily added to the global topology, and the method can be deployed with minimum amount of modification if new areas are to be explored. The video demonstrated that the method is implemented successfully on a physical robot in a hospital environment, which provides a practical solution for indoor navigation.
**GPU-Boosted Camera-Only Indoor Localization**

Localization can be defined as the process of estimating the pose of an agent, given a representation of the environment and sensor input. In this work, we use Topo-metric Appearance Maps to represent the environment, and introduce a new method for localization using only a camera. The method relies on local image features detection, description and matching; by parallelizing these computationally intensive tasks on the graphical processing unit (GPU), it is possible to do online localization using a Topometric Appearance Map. The method is developed as an integral part of a mobile service robot system [1], and empirically evaluated using a real robot in a typical indoor environment.

**General information**
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**Mobile Robot Navigation Using Visual Tags: A Review**

In this paper, the need for automated transportation systems for hospitals is investigated. Among other alternatives, mobile robots stand out as the most prominent means of automation of transportation tasks in hospitals. Existing transportation routines of a hospital are analyzed in order to verify the need for automation and identify possible areas of

**Service Robots for Hospitals: A Case Study of Transportation Tasks in a Hospital**

In this paper, the need for automated transportation systems for hospitals is investigated. Among other alternatives, mobile robots stand out as the most prominent means of automation of transportation tasks in hospitals. Existing transportation routines of a hospital are analyzed in order to verify the need for automation and identify possible areas of
improvement. The analysis shows that most of the existing transportation is carried out manually, and hospitals can greatly benefit from automated transportation. Based on the results of the analysis, three alternatives are derived for implementing mobile service robots for transportation tasks in hospitals.
Design of a robotic automation system for transportation of goods in hospitals

Hospitals face with heavy traffic of goods everyday, where transportation tasks are mainly carried by human. Analysis of the current situation of transportation in a typical hospital showed several transportation tasks are suitable for automation. This paper presents a system, consisting of a fleet of robot vehicles, automatic stations and smart containers for automation of transportation of goods in hospitals. Design of semi-autonomous robot vehicles, containers and stations are presented and the overall system architecture is described. Implementing such a system in an existing hospital showed the need of necessary modifications to the hospital infrastructure.

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Authors: Özkil, A. G. (Intern), Sørensen, T. (Intern), Fan, Z. (Intern), Sørensen, T. (Intern)
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Genetically Generated Double-Level Fuzzy Controller with a Fuzzy Adjustment Strategy

This paper describes the use of a genetic algorithm (GA) in tuning a double-level modular fuzzy logic controller (DLMFLC), which can expand its control working zone to a larger spectrum than a single-level FLC. The first-level FLCs are tuned by a GA so that the input parameters of their membership functions and fuzzy rules are optimized according to their individual working zones. The second-level FLC is then used to adjust contributions of the first-level FLCs to the final output signal of the whole controller, i.e., DLMFLC, so that it can function in a wider spectrum covering all individual working zones of the first-level FLCs. The second-level FLC is again optimized by a GA. An inverted pendulum system (IPS) is used to demonstrate the feasibility of the approach.

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Department of Electrical Engineering
Automation and Control
Centre for Playware
National Institute of Aquatic Resources
Section for Oceans and Arctic
Department of Mechanical Engineering
Engineering Design and Product Development
Fluid Mechanics, Coastal and Maritime Engineering
Period: 01/02/2016 → 31/01/2018
Number of participants: 6
Acronym: REMORA
Project participant:
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Mariani, Patrizio (Intern)
Visser, Andre (Intern)
Özkil, Ali Gürcan (Intern)
Nielsen, Ulrik Dam (Intern)
Project Manager, academic:
Galeazzi, Roberto (Intern)

**Investigating New Design Paradigms in Agile Product Development and Rapid Prototyping**
Department of Mechanical Engineering
Period: 15/07/2015 → 14/07/2018
Number of participants: 3
Phd Student:
Jensen, Lasse Skovgaard (Intern)
Supervisor:
Mortensen, Niels Henrik (Intern)
Main Supervisor:
Özkil, Ali Gürcan (Intern)

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Source: Internal funding (public)
Name of research programme: Samfinansieret - Andet
Project: PhD

**New AI and its Application in Hospital Service Robotics**
Department of Management Engineering
Period: 15/02/2008 → 31/08/2011
Number of participants: 6
Phd Student:
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Supervisor:
Aanæs, Henrik (Intern)
Kjaerstrup Kristensen, Jens (Intern)
Main Supervisor:
Fan, Zhun (Intern)
Examiner:
Ravn, Ole (Intern)
Hallqvist, Claes Brylle (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: ErhvervPhD-ordningen VTU
Project: PhD

Activities:

**European Robotics Forum 2012**
Period: 5 Mar 2012
Ali Gürcan Özkil (Organizer)
Department of Mechanical Engineering

Description
Organizer, Robots in Healthcare and Welfare Workshop, EU Robotics Forum 2012, Odense

Related event

**European Robotics Forum 2012**
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Odense, Denmark
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