

Design, Construction, and Testing of a Novel Robotic Workstation

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Abstract

This paper describes the development of a novel robotic workstation which users configure to a variety of spatial forms. These configurations allow users to define their physical workspace as well as to situate computer and analogue tools precisely to support a broad range of work-and-leisure computing activities. The workstation is part of our *Animated Work Environment (AWE)* project aimed at programmable smart environments which fundamentally alter user experience. This paper describes, in detail, the design, realization, and initial testing of the multi-panel robot workstation which itself represents a novel type of robot surface.

Keywords: robotics, animation, human-robotic interaction, intelligent environments

1 Introduction

In an increasingly "digital" society, many of our everyday activities are becoming more efficient, stream-lined, and complex due to the wide-spread adoption of mobile Information Technologies [1]. People can answer e-mails, search the internet, record media such as audio files, photographs and videos, and edit documents on-the-move, using relatively inexpensive cell phones, PDAs and laptop computers – portable devices easily synchronized. But while Information Technologies have greatly expanded the mobility of computing, it has not offered as much to the relatively static, fixed work environments residing within our workplaces and homes. Here, printed materials and computer peripherals still clutter desks, while traditional furniture and lighting crowd rooms. A different kind of workplace incorporating intelligent, reconfigurable elements promises to better adapt to an increasingly digital world, allowing computer users to become more efficient, more organized, and potentially more creative.

Upon first approach, the robot workstation introduced in this paper appears to be nothing more than a flat wall (Figure 1). When the user takes control it transforms into a personalized, intimate space for the focused composing of documents (Figure 2); or, alternatively, a configuration designed for presenting to an audience (Figure 13a). The workstation efficiently utilizes space by dramatically transforming itself to match the needs and wants of different users. Computing, digital projection, and lighting will emanate from within the workstation itself.

The design concept is not limited to the office. The workstation can function inside distinct rooms of different sizes and purposes because it can adapt its physical form. At home, for instance, the workstation

supports home-office tasks; when these tasks are accomplished, the system provides configurations suited to online gaming (Figure 13b), shopping, viewing, tutoring, and creative/investigative activities.

The concept of a dynamically reconfigurable, intelligent environment is the focus of the larger *Animated Work Environment (AWE)* research project [1], [2]. The multidisciplinary research team is comprised of investigators in Architecture, Robotics, Sociology, and Psychology. In the first year of research, the Sociologists conducted detailed phone surveys of technology users while the Psychologists performed task analyses of a range of subjects chosen to represent a large spectrum of workers performing everyday tasks within their physical work environments [3]. These efforts helped the team identify the needs and wants of workers with respect to the physical environments in which they routinely perform their work. The results strongly support the need for embedded IT within a physical environment that is both intelligent and readily reconfigurable.



Figure 1: Workstation design as a flat wall

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Tucker Balch, Lynne E. Parker



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Advances in Robot Design and Intelligent Control Aleksandar Rodić, Theodor Borangiu, 2016-11-26 This book presents the proceedings of the 25th International Conference on Robotics in Alpe Adria Danube Region RAAD 2016 held in Belgrade Serbia on June 30th July 2nd 2016 In keeping with the tradition of the event RAAD 2016 covered all the important areas of research and innovation in new robot designs and intelligent robot control with papers including Intelligent robot motion control Robot vision and sensory processing Novel design of robot manipulators and grippers Robot applications in manufacturing and services Autonomous systems humanoid and walking robots Human robot interaction and collaboration Cognitive robots and emotional intelligence Medical human assistive robots and prosthetic design Robots in construction and arts and Evolution education legal and social issues of robotics For the first time in RAAD history the themes cloud robots legal and ethical issues in robotics as well as robots in arts were included in the technical program The book is a valuable resource for researchers in fields of robotics engineers who implement robotic solutions in manufacturing services and healthcare and master s and Ph D students working on robotics projects Robotics and Automation Handbook Thomas R. Kurfess, 2018-10-03 As the capability and utility of robots has increased dramatically with new technology robotic systems can perform tasks that are physically dangerous for humans repetitive in nature or require increased accuracy precision and sterile conditions to radically minimize human error The Robotics and Automation Handbook addresses the major aspects of designing fabricating and enabling robotic systems and their various applications It presents kinetic and dynamic methods for analyzing robotic systems considering factors such as force and torque From these analyses the book develops several controls approaches including servo actuation hybrid control and trajectory planning Design aspects include determining specifications for a robot determining its configuration and utilizing sensors and actuators The featured applications focus on how the specific difficulties are overcome in the development of the robotic system With the ability to increase human safety and precision in applications ranging from handling hazardous materials and exploring extreme environments to manufacturing and medicine the uses for robots are growing steadily The Robotics and Automation Handbook provides a solid foundation for engineers and scientists interested in designing fabricating or utilizing robotic systems **Robotic Fabrication in Architecture, Art and Design 2014** Wes McGee, Monica Ponce de Leon, 2014-03-20 Robotic automation has become ubiquitous in the modern manufacturing landscape spanning an overwhelming range of processes and applications from small scale force controlled grinding operations for orthopedic joints to large scale composite manufacturing of aircraft fuselages Smart factories seamlessly linked via industrial networks and sensing have revolutionized mass production allowing for intelligent adaptive manufacturing processes across a broad spectrum of industries Against this background an emerging group of researchers designers and fabricators have begun to apply robotic technology in the pursuit of architecture art and design implementing them in a range of processes and scales Coupled with computational design tools

the technology is no longer relegated to the repetitive production of the assembly line and is instead being employed for the mass customization of non standard components This radical shift in protocol has been enabled by the development of new design to production workflows and the recognition of robotic manipulators as multi functional fabrication platforms capable of being reconfigured to suit the specific needs of a process The emerging discourse surrounding robotic fabrication seeks to question the existing norms of manufacturing and has far reaching implications for the future of how architects artists and designers engage with materialization processes This book presents the proceedings of Rob Arch2014 the second international conference on robotic fabrication in architecture art and design It includes a Foreword by Sigrid Brell Cokcan and Johannes Braumann Association for Robots in Architecture The work contained traverses a wide range of contemporary topics from methodologies for incorporating dynamic material feedback into existing fabrication processes to novel interfaces for robotic programming to new processes for large scale automated construction The latent argument behind this research is that the term file to factory must not be a reductive celebration of expediency but instead a perpetual challenge to increase the quality of feedback between design matter and making

Towards Autonomous Robotic Systems Manuel Giuliani,Tareq Assaf,Maria Elena Giannaccini,2018-07-21 This book constitutes the refereed proceedings of the 19th Annual Conference on Towards Autonomous Robotics TAROS 2018 held in Bristol UK in July 2018 The 38 full papers presented together with 14 short papers were carefully reviewed and selected from 68 submissions The papers focus on presentation and discussion of the latest results and methods in autonomous robotics research and applications The conference offers a friendly environment for robotics researchers and industry to take stock and plan future progress

Robotics Text Book Manish Soni,2024-11-13 Welcome to Robotics From Fundamentals to Advanced Applications your comprehensive guide to understanding and mastering the field of robotics In an era where automation and intelligent systems are revolutionizing industries robotics stands at the forefront driving innovations across manufacturing healthcare exploration and more As we delve deeper into this transformative technology it is essential for both beginners and seasoned professionals to grasp its fundamental concepts and applications thoroughly This book is meticulously crafted to serve as a complete learning resource catering to the diverse needs of learners at all levels Whether you are a student embarking on your first exploration into robotics or a professional seeking to enhance your expertise this guide provides the essential tools and resources necessary to achieve your learning goals

Scientific and Technical Aerospace Reports ,1995 Lists citations with abstracts for aerospace related reports obtained from world wide sources and announces documents that have recently been entered into the NASA Scientific and Technical Information Database

Design Transactions Bob Sheil ,Mette Ramsgaard Thomsen ,Martin Tamke,Sean Hanna,2020 Design Transactions presents the outcome of new research to emerge from Innochain a consortium of six leading European architectural and engineering focused institutions and their industry partners The book presents new advances in digital design tooling that challenge established building cultures and systems It offers new

sustainable and materially smart design solutions with a strong focus on changing the way the industry thinks designs and builds our physical environment Divided into sections exploring communication simulation and materialisation Design Transactions explores digital and physical prototyping and testing that challenges the traditional linear construction methods of incremental refinement This novel research investigates the digital chain between phases as an opportunity for extended interdisciplinary design collaboration The highly illustrated book features work from 15 early stage researchers alongside chapters from world leading industry collaborators and academics Green Design, Materials and Manufacturing Processes Helena Bartolo, Paulo Jorge Da Silva Bartolo, Nuno Manuel Fernandes Alves, Artur Jorge Mateus, Henrique Amorim Almeida, Ana Cristina Soares Lemos, Flávio Craveiro, Carina Ramos, Igor Reis, Lina Durão, Telma Ferreira, José Pinto Duarte, Filipa Roseta, Eduardo Castro e Costa, Filipe Quaresma, João Paulouro Neves, 2013-06-06 The rise of manufacturing intelligence is fuelling innovation in processes and products concerning a low environmental impact over the product s lifecycle Sustainable intelligent manufacturing is regarded as a manufacturing paradigm for the 21st century in the move towards the next generation of manufacturing and processing technologies The manufacturing industry has reached a turning point in its evolution and new business opportunities are emerging With sustainable development arises the immense challenge of combining innovative ideas regarding design materials and products with non polluting processes and technologies conserving energy and other natural resources On the other hand sustainability has become a key concern for government policies businesses and the general public Model cities are embracing novel ecosystems combining environmental social and economic issues in more inclusive and integrated frameworks Green Design Materials and Manufacturing Processes includes essential research in the field of sustainable intelligent manufacturing and related topics making a significant contribution to further development of these fields The volume contains reviewed papers presented at the 2nd International Conference on Sustainable Intelligent Manufacturing conjointly organized by the Centre for Rapid and Sustainable Product Development Polytechnic Institute of Leiria and the Faculty of Architecture Technical University of Lisbon both in Portugal This event was held at the facilities of the Faculty of Architecture Lisbon from June 26 to June 29 2013 A wide range of topics is covered such as Eco Design and Innovation Energy Efficiency Green and Smart Manufacturing Green Transportation Life Cycle Engineering Renewable Energy Technologies Reuse and Recycling Techniques Smart Design Smart Materials Sustainable Business Models and Sustainable Construction Green Design Materials and Manufacturing Processes is intended for engineers architects designers economists and manufacturers who are actively engaged in the advancement of science and technology regarding key sustainability issues leading to more suitable efficient and sustainable products materials and processes NSF Program Solicitation National Science Foundation (U.S.), 1987 **Engineering Creative Design in Robotics and Mechatronics** Habib, Maki K., Davim, J. Paulo, 2013-06-30 While technologies continue to advance in different directions there still holds a constant evolution of interdisciplinary development Robotics and

mechatronics is a successful fusion of disciplines into a unified framework that enhances the design of products and manufacturing processes Engineering Creative Design in Robotics and Mechatronics captures the latest research developments in the subject field of robotics and mechatronics and provides relevant theoretical knowledge in this field Providing interdisciplinary development approaches this reference source prepares students scientists and professional engineers with the latest research development to enhance their skills of innovative design capabilities

Generation GrowBots: Materials, Mechanisms, and Biomimetic Design for Growing Robots Barbara Mazzolai,Ian Walker,Thomas Speck,2021-08-18 Robot Teams Tucker Balch,Lynne E. Parker,2002-04-17 This is a comprehensive volume on robot teams that will be the standard reference on multi robot systems The volume provides not only the essentials of multi agent robotics theory but also descriptions of exemplary implemented systems demonstrating the key concepts of multi robot research Information is presented in a descriptive manner and augmented with detailed mathematical formulations photos diagrams and source code examples

Fabricate 2020 Jane Burry,Jenny E. Sabin,Bob Sheil,Marilena Skavara,2020-04-06 Fabricate 2020 is the fourth title in the FABRICATE series on the theme of digital fabrication and published in conjunction with a triennial conference London April 2020 The book features cutting edge built projects and work in progress from both academia and practice It brings together pioneers in design and making from across the fields of architecture construction engineering manufacturing materials technology and computation Fabricate 2020 includes 32 illustrated articles punctuated by four conversations between world leading experts from design to engineering discussing themes such as drawing to production behavioural composites robotic assembly and digital craft

Fabricate 2024 Bob Sheil,Marilena Skavara,Mette Ramsgaard Thomsen,Phil Ayres,2024-04-04 Fabricate 2024 Creating Resourceful Futures is the fifth volume in the series of Fabricate publications The first conference Making Digital Architecture explored the ways in which technology design and industry are shaping the world around us Since then we have become finely attuned to the negative impacts of this shaping The 2024 conference hosted in Copenhagen sets focus on the pressing need to develop new models for architectural production that rethink how resource is deployed its intensity its socio ecological origins and sensitivity to environment This book features the work of designers engineers and makers operating within the built environment It documents disruptive approaches that reconsider how fabrication can be leveraged to address our collective and entangled challenges of resource scarcity climate emergency and burgeoning demand Exploring case studies of completed buildings and works in progress together with interviews with leading thinkers this edition of Fabricate offers a plurality of tangible models for design and production that set a creative and responsible course towards resourceful futures

Fabricate Achim Menges,Bob Sheil,Ruairi Glynn,Marilena Skavara,2017-04-03 Bringing together pioneers in design and making within architecture construction engineering manufacturing materials technology and computation Fabricate is a triennial international conference now in its third year ICD University of Stuttgart April 2017 The 2017 edition features 32 illustrated articles on

built projects and works in progress from academia and practice including contributions from leading practices such as Foster Partners Zaha Hadid Architects Arup and Ron Arad and from world renowned institutions including ICD Stuttgart Harvard Yale MIT Princeton University The Bartlett School of Architecture UCL and the Architectural Association Each year it produces a supporting publication to date the only one of its kind specialising in Digital Fabrication *The De Gruyter Handbook of Robots in Society and Culture* Leopoldina Fortunati, Autumn Edwards, 2024-09-23 The De Gruyter Handbook of Robots in Society and Culture provides a comprehensive discussion of how social robots take form function and meaning for individuals relationships cultures and societies Through a path breaking integration of perspectives coming from sociology communication and media psychology cognitive neuroscience anthropology political science and science and technology studies it focuses on the critical and social meaning of present developments in social robotic technologies This book looks at artificial agents from voice based assistants to humanoid robots as their use transforms private and public contexts and gives rise to both new possibilities and new perils for human being and becoming organizations as well as social structures and institutions The handbook traces the consequences and key problems of social robotics across broad social contexts in both public and political as well as domestic and intimate spaces Further it attends carefully to the implications of social robotics for various human identity groups including those based on gender ethnicity culture class ability and age Deep attention to interdisciplinarity inclusivity ethics and socio cultural futures serves as the guiding inspiration behind each contribution within this handbook

Automation and Robotics in Construction XI Alan Chamberlain, 2012-12-02 Sourced from international experts this book presents papers dealing with a wide range of soft and hard research issues at various stages of development in the field Some cover entirely new ground whilst others reflect progress on the sometimes frustrating path to truly robust technology Of particular interest are contributions discussing issues of exploitation and commercialisation the integration of end products within the design and construction processes incorporating information technology IT and the impact of the emerging technology on the culture and organisation of the construction industry A mark of growing maturity is apparent in the coverage of health and safety and related social issues This is complemented by a clear commitment to the consideration of human factors and the environment It is hoped that by promoting a wider debate on the matters of future technology and its horizons on the identification of what industry needs from the research and development community and on building effective partnerships between academia industry and government the publication not only addresses the practical commercial obligation to seek robust solutions for today's problems but will stimulate research for the years to come

K-12 Education: Concepts, Methodologies, Tools, and Applications Management Association, Information Resources, 2013-09-30 Primary and Secondary education is a formative time for young students Lessons learned before the rigors of higher education help to inform learners future successes and the increasing prevalence of learning tools and technologies can both help and hinder students in their endeavors K 12 Education Concepts Methodologies Tools and

Applications investigates the latest advances in online and mobile learning as well as pedagogies and ontologies influenced by current developments in information and communication technologies enabling teachers students and administrators to make the most of their educational experience This multivolume work presents all stakeholders in K 12 education with the tools necessary to facilitate the next generation of student teacher interaction

Designing with Multi-Agent Systems Evangelos Pantazis, 2024-02-19 The book presents a theoretical and technical background for applying MAS Multi Agent Systems in Architecture Engineering and Construction It focuses in the early design stage and makes use of domain specific data which relate to different design domains structural environmental architectural design to inform the agent behaviors The proposed framework is applicable especially to design problems which traditionally require the close collaboration of engineers and architects

Handbook of Research on Advancements in Robotics and Mechatronics Habib, Maki K., 2014-12-31 The field of mechatronics integrates modern engineering science and technologies with new ways of thinking enhancing the design of products and manufacturing processes This synergy enables the creation and evolution of new intelligent human oriented machines The Handbook of Research on Advancements in Robotics and Mechatronics presents new findings practices technological innovations and theoretical perspectives on the the latest advancements in the field of mechanical engineering This book is of great use to engineers and scientists students researchers and practitioners looking to develop autonomous and smart products and systems for meeting today s challenges

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