

Waldemar Karwowski
Tareq Ahram *Editors*

Intelligent Human Systems Integration

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Preface

This volume, entitled *Intelligent Human Systems Integration*, aims to provide a global forum for introducing and discussing novel approaches, design tools, methodologies, techniques, and solutions for integrating people with intelligent technologies, automation, and artificial cognitive systems in all areas of human endeavor in industry, economy, government, and education. Some of the notable areas of application include, but are not limited to, energy, transportation, urbanization and infrastructure development, digital manufacturing, social development, human health, sustainability, new generation of service systems, as well as developments in safety, risk assurance, and cybersecurity in both civilian and military contexts. Indeed, rapid progress in developments in the ambient intelligence, including cognitive computing, modeling, and simulation, as well as smart sensor technology, weaves together the human and artificial intelligence and will have a profound effect on the nature of their collaboration at both the individual and societal levels in the near future.

As applications of artificial intelligence and cognitive computing become more prevalent in our daily lives, they also bring new social and economic challenges and opportunities that must be addressed at all levels of the contemporary society. Many of the traditional human jobs that require high levels of physical or cognitive abilities, including human motor skills, reasoning, and decision-making abilities, as well as training capacity, are now being automated. While such trends might boost the economic efficiency, they can also negatively impact the user experience and bring about many unintended social consequences and ethical concerns.

The intelligent human systems integration is to a large extent affected by the forces shaping the nature of future computing and artificial system development. This book discusses the needs and requirements for the symbiotic collaboration between humans and artificially intelligent systems, with due consideration of the software and hardware characteristics allowing for such cooperation from the societal and human-centered design perspectives, with the focus on the design of intelligent products, systems, and services that will revolutionize human–technology interactions.

This book also presents many innovative studies of ambient artificial technology and its applications, including the consideration of human–machine interfaces with a particular emphasis on infusing intelligence into development of technology throughout the lifecycle development process, with due consideration of user experience and the design of interfaces for virtual, augmented, and mixed reality applications of artificial intelligence.

Reflecting on the above-outlined perspective, the papers contained in this volume are organized into five main sections, including:

- I. Intelligence, Technology, and Automation
- II. Humans and Artificial Cognitive Systems
- III. Computational Modeling, Simulation, and Design
- IV. Ambient Intelligence and User Experience
- V. Society, Governance and Smart Systems

We would like to extend our sincere thanks to Dr. Stefania Camplone, University of Chieti-Pescara, Italy, for leading a part of the technical program that focuses on Smart Materials and Inclusive Human Systems. Our appreciation also goes to the members of Scientific Program Advisory Board who have reviewed the accepted papers that are presented in this volume, including the following individuals:

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We hope that this book, which presents the current state of the art in *Intelligent Human Systems Integration*, will be a valuable source of both theoretical and applied knowledge enabling the design and applications of a variety of intelligent products, services, and systems for their safe, effective, and pleasurable collaboration with people.

January 2018

Waldemar Karwowski
Tareq Z. Ahram

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Smart Cities-Smart Societies

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Abstract. The concept of smart cities and smart societies should start from the base up, from the individuals and not the other way around. The 21st century should be about developing the new smart concepts about a smart transportation system combined with the smart energy one. In these concepts, smart technologies like phone apps that provide people with quick information about how to move, where to park, what areas to avoid due to congestions etc., should be affordable for everybody.

Apps that interconnect people and cities around states or the European Union with functions like booking a sharing bike or a sharing car should also be available for each individual. Smart transportation, from cars to trains, bikes or planes, all interconnected by a new technology should serve in the future the citizens around the globe.

Keywords: Smart Cities · Smart societies · Smart transportation

1 Introduction

In this Work we intend to present a comparative research that integrate the concepts of Smart Cities, by it's basically functionally parts of legislation, information circulation and security, mobility infrastructure and modern energy concerning. By developing this heterogenic parts and putting them together, we intend to construct a real modern platform based on a VRE which will ensure the cooperation between the described "playing actors" which are necessary to integrate their research and results and, the most important, to cooperate, in order to obtain the goal of a Smart City, beside just individual results in the described areas.

2 Urban Mobility

Sustainable Urban Mobility is a concept designed to meet the needs of mobility of individuals and businesses in cities and their surroundings for a better quality of life. This concept is based on practices and it takes into considerations the existing principles of integration, participation and evaluation.

Sustainable Urban Mobility aims to create a better transport system by addressing one of the following objectives:

- Ensuring that all citizens are given transport options that allows access to key destinations and services;
- Improving traffic safety and security;
- Reduce air and noise pollution, emissions greenhouse gas emissions and energy consumption;
- Improving the efficiency and cost-effective character transport of persons and goods;
- Contribute to the attractiveness and quality of urban environment and urban design for the benefit of citizens, the economy and society as a whole.

Starting from current European frameworks, the basic features of a the Sustainable Urban Mobility are:

- A long-term vision and a clear implementation plans;
- A participatory approach;
- A balanced and integrated development of all modes of shipping;
- A horizontal and vertical integration;
- Evaluation of current and future performance;
- Monitoring, review and periodic reporting;
- Taking into account all modes of transport.

2.1 Interdisciplinary Research Visibility of Transport and Traffic Domain

The visibility of transport is one of the most important parts of a city growth and of Sustainable Urban Mobility. It consists from three main parts:

1. Transport policies
2. Integrated transport
3. Priority traffic solutions

It is important to evaluate the current public transport visibility and to create an analysis of the possible sustainable solutions so that a framework document can be created. The document will help the authorities to address the current problem and to take actions in order to correct them with the best solutions in the field.

Baseline

The current context and the starting point of the proposed framework is based on three main classes of problems:

- Public awareness of the climate changes increased over the years.
- Population does not seem to be aware of the link between general environmental issues and personal life style or transport habits.
- *Measurement - Recording - Traffic Flow Analysis, applicable in different mobility scenarios on local or regional level.*
- By applying different methodologies that Faculty of Mechanical Engineering has developed over time, we can make measurements of traffic values in different

strategic points of the urban agglomeration, these measurements are then processed and analysed by specific means.

- It is possible to create different scenarios for fluidization and growth in urban mobility so that we can make application in different scenarios of urban mobility implemented at local or regional.
- Because traffic phenomena are random phenomena, the association and dissociation of traffic flows vary, so that there are endogenous and exogenous factors that require quantification, design, optimization and traffic implementation of complex solutions, which are evolving in time and space.
- Achievements by milestone M2
- A covering urban area database of traffic flow according to basic parameters, which will be used as a inputs information for futures dedicated models.

2.2 Development of Urban Mobility Compared Solutions

To establish traffic volume and pattern now we are using techniques and methods of “traffic engineering”, to research and determine how to act, now and in the perspective to the phenomena and laws of movement, in order to design and implement road, streets and highways. Congestion and the existence of discontinuous traffic movements in the road network requires the identification of the basic characteristics of traffic flows and existing models in the literature for urban flow analysis.

In current traffic conditions it is important to make evaluations before making any changes into traffic flow. The knowing how in this area achieved by us, allows us to realise traffic flow modelling and simulation, the results giving the possibility to obtain different optimisation solutions in the context of Urban Mobility.

Baseline

Economic growth and material conditions facilitating the progressive extension of the use of motor vehicles. It was is far known in many cities the situation where, due to the multitude of relations which necessarily results in the development of human life, the movement has become particularly intense. This creates special problems of traffic flow due to the fact that cities concentrate most of the fleets.

Because of this there is a need to ensure a major street network traffic volume and speed large city proper, located in the vicinity of large urban units and a network of ground located within these units to ensure local circulation and access characterized by size and low speeds.

The baseline of this task is in the incipient stage because specialized software’s for traffic modelling, simulation and optimization are not used or trusted enough to be used as a tool in traffic flow optimization.

Achievements by milestone M3

Establishing a pilot proposal of a solution scenarios about a coherent and sustainable urban mobility.

3 Smart Energy

This task is related to the dissemination of existing research results (use-case: Energy regeneration and active filtering in DC railway traction substations) and the other three require further research activities.

Synthesis of the existing research results related to active filtering and energy recovery systems for active DC traction substations: structures and configurations; algorithm for reference currents generation; management of the operation in active filtering and regeneration regimes.

This it will be concluded in:

- (a) Putting the results in an appropriate and interactive form, for implementation in VRE;
- (b) Analysis of the feedback from partners/virtual users and improving the presentation form;
- (c) Elaboration of responses to requests for details, participation in an eventual discussion forum and finding ways of developing the research.

Baseline

The conducted research led to the setting up of a complex system designed to materialize the new concept of “active station” which uses the new developments in power electronics and has three main functions:

- The recovery of the electrical energy of braking by its regeneration to the traction stations power line through a sinusoidal active grid current;
- The filtering of the power grid current in the coupling point of the traction station, so that it meets the actual standards for harmonic distortion;
- The reactive power compensation in the traction stations power line.

The configuration found out was analysed based on model and validated through the system performances. They are very good and at the top level of the proposed objectives (power factor is very close to unity and the total harmonic distortion factor of the current is often at a level of 1%).

The innovative structure for the separation circuit between the DC line and the power inverter, as well as the reference current calculation under non-sinusoidal conditions based on p-q theory, are the subject of two invention proposals.

Modelling and simulation based analysis of the structure that uses the adapting transformer were the basis for two journal papers.

Achievements by milestone M1

Document presenting the existing research results related to active filtering and energy recovery systems for active DC traction substations in an appropriate and interactive form, for implementation in VRE: structures and configurations; algorithms for reference currents generation; management of the operation in active filtering and regeneration regimes.

Experiment-based study of energy efficiency in tramway transportation systems: Craiova transportation case-study

Baseline

The expertise of the research team is proved by the experimental models and results achieved in all research projects and disseminated in many scientific papers. Thus, we achieved experimental models for an active filtering system ($S = 15$ kVA) and an induction heating system with resonant parallel voltage inverter ($S = 50$ kVA), respectively.

The experimental protocol involves the simultaneous measurement of the main quantities and power quality indicators at the substation input and on the transportation vehicle.

The main research equipment includes: acquisition system for electrical quantities under non-sinusoidal regime, power quality analysers (Fluke 435, Fluke 41 B), digital oscilloscope equipped with recorder and analyser for harmonics (FLUKE 196 B), data acquisition boards National Instruments, portable industrial computer with integrated DSP-based system, dedicated software (such as Matlab-Simulink, LABView), specific developed graphic user interface.

Achievements by milestone M1

Synthesis report with experiment-based energetic performances in Craiova tramway transportation system.

Technical solutions for increasing the energy efficiency in tramway transportation systems and model-based validation.

Baseline

The system that is the subject of the project proposal aims to have energetic performances similar to the systems offered in the European market for the tram traction substations transformation into “active stations”.

The main advantages of the system proposed by this project are:

- The use of performing components in terms of energy and cost, in order to have high reliability and a competitive price;
- High quality of the power transferred to the power grid (the harmonic distortion factor of the output current in regeneration regime to be below 3%);
- The efficient filtering of the power grid current, so that the harmonic distortion factor of the current to be less than 5%;
- The efficient compensation of the grid reactive power, so that the displacement power factor to be close to unity;
- The use of the active power filter intrinsic capacity to provide an increased, imposed voltage value on the DC bus, within an active filtering and energy recovery multi-functional system for active DC tram traction stations.

It must be specified that the product that is the subject of the project proposal is an absolute novelty at national level.

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