ENDORSE Concept

An Integrated Indoor Mobile Robotic System for Medical Diagnostic Support

Panagiotis Vartholomaios, SingularLogic S.A., Dionisos, Greece
Nacim Ramdani, Université d’Orléans, PRISME, Bourges, France
Christophoros Christophorou, CITARD, Nicosia, Cyprus
Dimosthenis Georgiadis, CITARD, Tseri, Cyprus
Thomas Guilcher, StreamVision, Paris, France
Myriam Blouin, StreamVision, Paris, France
Mohamed Rebiai, StreamVision, Paris, France
Andreas S Panayides, University of Cyprus, Nicosia, Cyprus
Constantinos Pattichis, University of Cyprus, Nicosia, Cyprus
Michail Sarafidis, Institute of Communication and Computer Systems (ICCS), Zografou, Greece
Dimitrios Koutsouris, Institute of Communication and Computer Systems (ICCS), Zografou, Greece
Eleftheria Vellidou, Institute of Communication and Computer Systems (ICCS), Zografou, Greece

ABSTRACT

Hospitals are considered a field of logistic robotics of high commercial potential and therefore a handful of mobile robot solutions exist. However, they have failed to trigger widespread acceptance by the market. The ENDORSE system will pursue 4 innovation pillars: an infrastructure-less multi-robot navigation, i.e. minimum installation of sensors and communications buses inside the building for the localization of robots, targets and docking stations; advanced HRI for resolving deadlocks and achieving efficient sharing of space resources in crowded environments; the deployment of ENDORSE software as a cloud-based service facilitating its integration with corporate software solutions such as ERP and CRM, complying with GDPR data security requirements; and allowing for reconfigurable and modular hardware architectures so that diverse modules can be easily swapped. ENDORSE functionality will be demonstrated via the integration of an e-diagnostic support module for vital signs monitoring, facilitating connectivity to cloud-based EHR, and validated in an operational hospital environment for realistic assessment.

KEYWORDS

Bioinformatics, Cloud Computing, Cybernetics, Data mining, E-Health, Embedded systems, Hardware platforms, Intelligent robotics, Machine learning, Medical informatics

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INTRODUCTION

Autonomous mobile robots for the transport of goods and materials are nowadays a well-established solution in large industrial infrastructures and transit warehouses, where they offer significant economic and administrative advantages. In contrast, in spaces such as hospitals, nursing centers, hotels, museums, malls, commercial spaces, offices and retail stores, which herein for economy of space we call commercial spaces, the use of autonomous robots is very limited. The use of existing robotic systems designed for large industrial and warehouse spaces is not applicable to indoor commercial spaces because of the different specifications and different constraints. A fundamental difference is that large industrial and warehouse spaces are characterized by a very structured and predictable environment where robots move in predefined paths and interaction with humans can easily be avoided. Contrary to the industrial warehouses, commercial spaces are less structured, the environment is much more dynamic, and the interaction with humans is frequent. Also, the load specifications are different and the interior architectural specifications are much more constrained.

Automation of the supply chain in commercial spaces could have a high economic impact because a large number of transfers take place per day in these spaces. For example, in a hospital or a health care center, several tenths of person months annually are spent on transfer of goods, linens, biological samples, medical equipment, pharmaceuticals, mail parcels, and of medical waste (more than 850 man-hours per week in a 500 beds hospital) (Ozgil et al., 2009). These transfers are currently carried out manually (by pushing carts for long distances) by nurses or carers. That is a no-added-value job which deprives the patients of valuable nursing services. The same arguments apply to the other commercial spaces listed in the first paragraph. In addition, automation of the supply chain will enable full traceability of the goods and the products from the time of the request till the moment of delivery to the recipient; a well-programmed logistics system will improve the services offered to the end-user (i.e. the hotel customer or the patient and the carer in a hospital) by reducing the response times for each request. Hence, the indoor supply chain is an application that calls for automation and at the same time has high commercialization potential because the involved corporations and organizations hold a huge part of the market, they have specific practical problems, and seek specific solutions for which they are willing to pay.

BACKGROUND

Interior spaces in hospitals and healthcare centers, offer advantages that would facilitate the deployment of mobile robots. They are required by law to meet stringent building codes and therefore, from a robotics perspective, the navigation space exhibits some structure which moderates the technical challenge (e.g. concerning home environments). Moreover, most commercial spaces have reliable and predictable communications infrastructure (e.g. Wi-Fi and cellular connectivity), since it is required for normal business operation (Deyle, 2017). Thus, spaces of hospitals and healthcare centers are rightfully considered the next great field of robotic deployment, after the industrial spaces. Despite these advantages, today, few solutions exist for hospital and healthcare spaces - unlike in the case of industrial spaces -, and these solutions do not trigger widespread acceptance by the market. This is because they require costly and time-consuming localization infrastructure (significant peripheral sensor installation, mapping, etc.); they do not easily integrate to corporate IT solutions; as a result, they do not address data protection and cybersecurity threats satisfactorily; they are not adaptable and reconfigurable and therefore are limited to a single type of service. Existing solutions for small and medium commercial spaces, such as hospitals and healthcare centers, by Aethon (‘Aethon - Autonomous Mobile Robots - Industrial, Healthcare and Hotels’, 2018), and SwissLog (Swisslog, 2018) are costly (>75,000 Euros plus installation costs) and exhibit operational limitations. They lack motion flexibility, and therefore the design and implementation of their route become challenging in small spaces; they are not customizable and modular and therefore perform no tasks other than
Assessing Physician and Nurse Satisfaction with an Ambulatory Care EMR: One Facility’s Approach
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