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TECNOLOGIA DE INTELIGÊNCIA ARTIFICIAL PARA CUIDADOS DE SAÚDE E RESGATE: CONSIDERAÇÕES SOBRE O IMPACTO DOS DESENVOLVIMENTOS TÉCNICOS E SUA UTILIZAÇÃO

ARTIFICIAL INTELLIGENCE FOR HEALTHCARE AND RESCUING TECHNOLOGY: TECHNICAL DEVELOPMENTS AND THOUGHTS ABOUT EMPLOYMENT IMPACTS

TECNOLOGÍA DE INTELIGENCIA ARTIFICIAL PARA LA SALUD Y EL CUIDADO DE RESCATE: CONSIDERACIONES SOBRE EL IMPACTO DE LOS DESARROLLOS TÉCNICOS Y SU USO

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RESUMO

Introdução: Tem-se tornado complicado avaliar o impacto geral da Inteligência Artificial (IA) e da Robótica no emprego e na organização do trabalho pelo facto de essas tecnologias estarem a revolucionar muitos campos de aplicação/intervenção, muito díspares uns dos outros. Neste artigo, consideramos duas aplicações específicas emergentes de projetos de pesquisa recentes: um aplica tecnologias de IA e robótica ao setor de saúde e outro à Pesquisa e Resgate em áreas selvagens. Baseamo-nos nesses estudos de caso para especular sobre como esse tipo de aplicação inovadora, que provavelmente se tornará cada vez mais comum e difundida, pode afetar o emprego e a organização do trabalho em geral.
Objetivos: Entender como as aplicações inovadoras podem impactar o emprego e a organização do trabalho em geral e especificamente nos serviços de saúde e sociais.
Métodos: Neste artigo são discutidos dois desenvolvimentos recentes de pesquisas baseadas no uso da Inteligência Artificial (IA) nos campos da saúde e resgate.
Resultados: As tecnologias de IA e Robótica têm aplicação específica em serviços de saúde e sociais e exigem novas habilidades profissionais para gerenciar esses novos métodos. O nosso trabalho de pesquisa e principais resultados foram alcançados no âmbito de um projeto da Fundação Nacional de Ciências da Suíça e procuramos apresentar uma visão simplificada do componente de classificação inovadora da arquitetura.
Conclusões: Concluímos que, dependendo do campo de aplicação, uma redução na força de trabalho necessária para realizar tarefas que serão assumidas pela automação pode ser contrabalançada por um aumento drástico na demanda (serviços de saúde), ou uma mudança nas competências requeridas / habilidades (busca e resgate); Em ambos os casos, podemos esperar um impacto social positivo, também motivado por um aumento do padrão de serviço.

Palavras-chave: Inteligência artificial; Robótica; Cuidados de saúde; Serviço de resgate; Organização do trabalho.

ABSTRACT

Introduction: To evaluate the overall impact of Artificial Intelligence (AI) and Robotics on employment and work organization is complicated by the fact that these technologies are expected to revolutionize many application fields, which are very different from each other. In this paper, we consider two specific applications emerging from recent research projects: one applies AI and Robotics technologies to the healthcare sector, and one to Search and Rescue in wilderness areas. We generalize from these case studies to speculate on how this kind of innovative applications, that are likely to become increasingly common and widespread, might impact employment and work organization in general.
Objectives: To understand how innovative applications might impact employment and work organization in general and specifically on healthcare and social services.
Methods: Two recent research developments based on the use of Artificial Intelligence (AI) in the fields of healthcare and rescuing, respectively, are discussed. Therefore, our research work and main results have been achieved within a Swiss National Science Foundation project and a simplified view of the innovative classification component of the architecture is presented.
Results: AI and Robotics technologies have specific application on healthcare and social services and demand new professional skills to manage those new methods.
Conclusions: We conclude that, depending on the application field, a reduction in the workforce required to carry out tasks that will be taken over by automation might be counterbalanced by either a drastic increase in demand (healthcare services), or a shift in the required competences/skills (search and rescue); in both cases, we can expect a positive societal impact, also motivated by an increased standard of service.

Keywords: Artificial intelligence; Robotics; Healthcare; Rescuing; Work Organization.

RESUMEN

Introducción: Evaluar el impacto general de la Inteligencia Artificial (IA) y la Robótica en el empleo y la organización del trabajo se complica por el hecho de que se espera que estas tecnologías revolucionen muchos campos de aplicación, que son muy diferentes entre sí. En este documento, consideramos dos aplicaciones específicas que surgen de proyectos de investigación recientes: una aplica tecnologías de inteligencia artificial y robótica al sector de la salud, y otra a la búsqueda y rescate en áreas silvestres. Generalizamos de estos estudios de caso para especular sobre cómo este tipo de aplicaciones innovadoras, que probablemente se volverán cada vez más comunes y generalizadas, podrían afectar el empleo y la organización del trabajo en general.
Objetivos: Comprender cómo las aplicaciones innovadoras pueden afectar el empleo y la organización del trabajo en general y específicamente en el cuidado de la salud y los servicios sociales.
Métodos: Se discuten dos desarrollos de investigación recientes basados en el uso de la Inteligencia Artificial (IA) en los campos de la atención médica y el rescate, respectivamente. Por lo tanto, nuestro trabajo de investigación y los principales resultados se

han logrado dentro de un proyecto de la Fundación Nacional de Ciencia de Suiza y se presenta una vista simplificada del componente de clasificación innovador de la arquitectura.
Resultados: Las tecnologías de inteligencia artificial y robótica tienen una aplicación específica en los servicios sociales y de salud y exigen nuevas habilidades profesionales para administrar esos nuevos métodos.
Conclusiones: Dependiendo del campo de aplicación, una reducción en la fuerza de trabajo requerida para llevar a cabo tareas que serán asumidas por la automatización podría verse contrarrestada por un aumento drástico en la demanda (servicios de salud) o un cambio en las competencias requeridas (búsqueda y rescate); en ambos casos, podemos esperar un impacto social positivo, también motivado por un mayor nivel de servicio.

Palabras Clave: Inteligencia artificial; Robótica; Cuidado de la salud; Servicios de rescate; Organización del trabajo.

INTRODUCTION

In this article we elaborate on the impact that recent advances in Artificial Intelligence (AI) and Robotics might have on employment and work organization in general. The study is motivated by some concerns people have about automation taking over their jobs, and aims at showing that technological progress should not be perceived – at least in the cases treated here – as a threat for human employment.
In details, two recent research developments based on the use of Artificial Intelligence (AI) in the fields of healthcare and rescuing, respectively, are discussed. For each of them, after an overview of the research progresses and their application, some views about the impact of the new systems on work organization are drawn. General conclusions are finally provided.

1. AI FOR HEALTHCARE

The ability to effectively move and orient autonomously is often compromised by ageing, both considering indoors and outdoors environments. This phenomenon can have strong negative impacts on the quality of life and the psychological well-being of a person, leading to a spiral progressively leading to a situation where elders are in need of more and more help. There is a concrete interest by Public Authorities to understand how much technology can contribute to help the elder to overcome these naturally arising limitations, giving them more independence as a side effect.
The scenario descriptions that will follow represent a concrete example of how technology can be employed for the assistance of elder people. It is developed targeting a large facility of interest for the elder, such as a nursing home or a hospital. It is assumed that the facility can be easily mapped, and sensors can be deployed to monitor and track the location of users in- side of the facility itself. An elder woman, with orientation difficulties, feels she required directions, and therefore asks for and receives them through a navigation interface specifically tailored to her needs and (dis)abilities. An old man obtains assistance for traveling to a medical appointment using a motorized wheelchair that guarantees a safe navigation. In the meantime, the personnel is timely warned that a potentially dangerous situation is happening: a resident affected by dementia issues is trying to escape from the facility.
The ALMA project Ageing without Losing Mobility and Autonomy (ALMA, 2013) works in the direction of realizing the scenario vision presented above, supporting the autonomous mobility, navigation, and orientation of the person with reduced mobility. The architecture of the project is depicted in Figure 1, which is self-explaining and shows the different components and briefly explains their roles and adopted methods. In particular, the system relies on wireless systems for indoor localization of people and objects, and indoor ambient monitoring techniques based on time-of-flight cameras. The system interacts with users through multi-modal interfaces designed ad-hoc to adapt to their specific needs and requirements.
Note that the example described above addresses a healthcare facility, but project outcomes could be intuitively generalized to other scenarios, such as shopping malls or airports, where problems are slightly different, but the approach and technology employed can be seen as extremely similar. The project includes three academic partners and three small/medium enterprises for technological development. In addition, a rehabilitation clinic and a nursing home are available to provide real test-beds for on-field evaluation.

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1.1 Impacts on employment

A superficial analysis might lead to the conclusion that a massive deployment of the Robotics and AI technologies described previously might lead to a consistent decrement of jobs in the healthcare sector. However, once the whole picture is considered, it is easy to see that the situation is substantially different. In developed countries the population is ageing fast, and as a consequence the resources allocated to take care of elder people are increasing more and more. For example, a 2010 study about Norway (Nordlander, Lamorgese, Nguyen, & Montemanni, 2016) was showing that projecting the current healthcare system without correction into the future, would lead already in 2035 to a situation where every third Norwegian pupil should end up working in the healthcare sector. The present and future situation in the healthcare sector has to be analyzed therefore with such a picture in mind. The conclusion is that healthcare is a critical sector that will absorb more and more resources in the near future; therefore the adoption of novel technologies is crucial, and the required workforce is expected to increase despite the increased efficiency. A side effect of this situation might be a shift of the workforce towards more specialized figures, capable of dealing with advanced technologies. We however observe that this is the trend in all sectors.

2. AI FOR RESCUING IN WILD ENVIRONMENT

Autonomously following a man-made trail (such as those normally traversed by hikers or mountain-bikers) is an extremely challenging task for robotics. Solving such problem is important for many applications, among which search and rescue tasks.
Following a marked trail could be classified as the most efficient and safest way for a ground robot to travel distances in a forested environment, since by their own nature, trails avoid excessive slopes and impassable ground (e.g. due to excessive vegetation or wetlands). Many existing robot types, including wheeled, tracked and legged vehicles, are capable of locomotion along real-world trails. However, Micro Aerial Vehicle (MAVs) flying under the tree canopy represents the most compelling and realistic option to travel forest trail, since they minimize the interaction with the elements of a forest. Moreover, recent technological advances, such as collision-resilience, make possible to effectively employ MAVs for these tasks (Giusti, Guzzi, Ciresan, He, Rodriguez, Fontana, Faessler, Forster, Schmidhuber, Di Caro, Scaramuzza, & Gambardella, 2016). For these reasons, the attention is focused on flying robots. The results presented in this section have been achieved within a Swiss National Science Foundation project (Giusti, Guzzi, Ciresan, He, Rodriguez, Di Caro, Schmidhuber, Fontana, Faessler, Forster, Scaramuzza, & Gambardella, 2016). A simplified view of the innovative classification component of the architecture is presented in Figure 2. The raw-pixel values of the current snapshot of the camera view are processed by a Deep Neural Network, which in turns outputs the probability for the MAV to turn left, go straight or turn right.

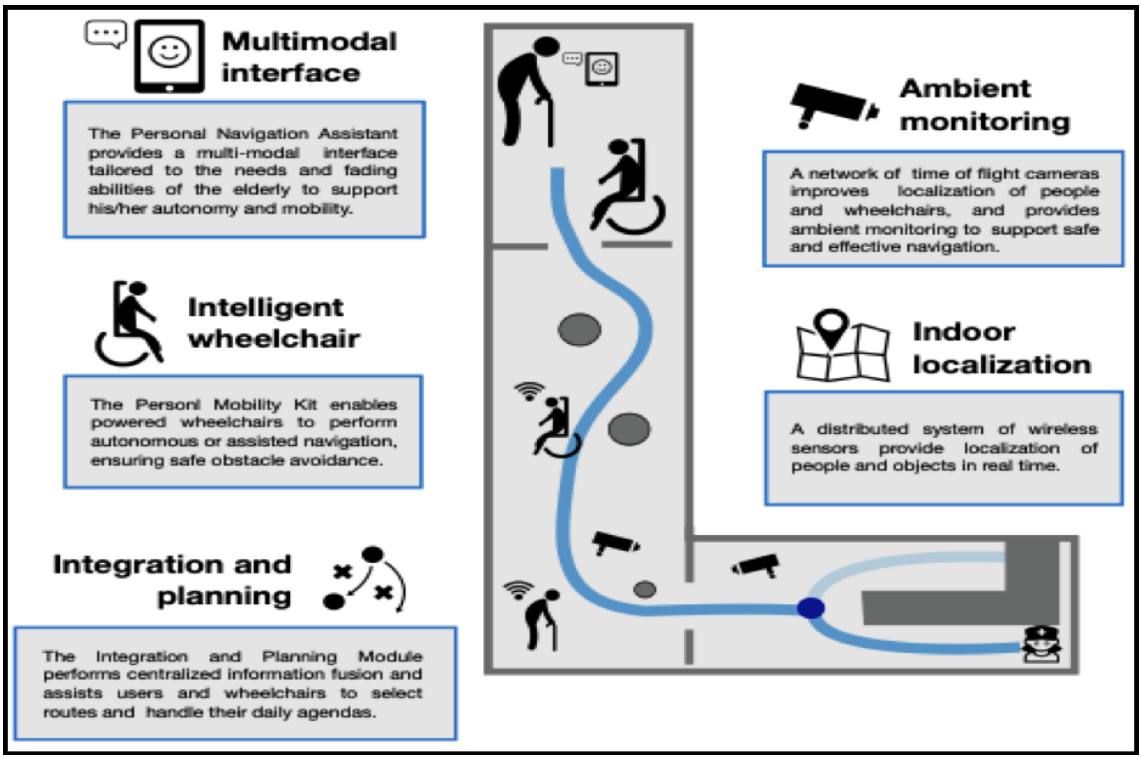

Figure 1 – Architecture of the ALMA project.

In order to successfully follow a forest trail, a (flying) robot has to perceive where the trail is, then react in order to stay on the trail. A visual perception of forest trails is developed and used by an autonomous quadrotor for experimental results. The input is a monocular image from a forward-looking camera. The system developed for the task proves very efficient in classifying where the trail continues, given a current position (Giusti, et al, 2016). This is an example of a common approach which is frequently adopted in recent state-of-the-art robotic systems operating in the real world: environment perception and sensor data interpretation, which is one of the most challenging components of the system, is powered by deeplearning approaches which directly operate on sensor data without handcrafted feature computation. One important advantage is that system designers do not have to design specific features or algorithms to directly interpret sensor data; on the other hand, approaches based on supervised machine learning rely on the availability of large amounts of labeled data.
The applications of such a technology to the rescuing domain are important, since it is possible to deploy several autonomous agents in impervious areas to locate persons either lost or injured.

2.1 Impacts on employment

The use of AI technology, coupled with MAVs and control systems, is not to be perceived, in our opinion, as a direct threat for human occupation and employment. It represents instead a precious tool to take a crucial activity like rescuing to new levels of efficiency, leading to benefits for the whole community. In particular, rescuing missions under tree canopies – where a higher altitude aerial view is limited – will substantially benefit from such a system.

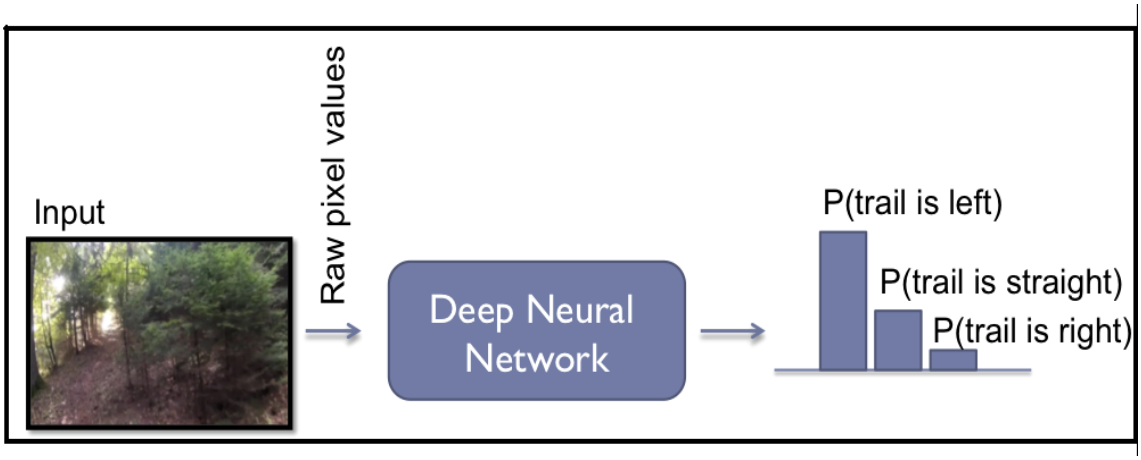

Figure 2 – Simplified view of the forest trail classification system.

Another consideration is about the people normally employed in large search missions. They are often enrolled for the mission only from military or police corps, or even on a voluntary basis, in order to increase the power of the search team. As a consequence, it is difficult to speculate on the effects of technology on the occupational level of the sector, while it is easy to detect a substantial increase in the efficiency.
Coming to the tasks of persons permanently employed in the sector, a massive adoption of technology might again shift the knowledge required to operate from a physical knowledge of the local area of the mission, to the ability of exploiting the technology available, and to coordinate the mission. An interesting application where humans, different types of flying robots and dogs are coordinated as a team for rescuing purposes, is the project SWARMIX of the Swiss National Science Foundation.
In conclusion, although a moderate reduction of the workforce permanently employed in search and rescue missions might be forecasted due to the adoption of innovative technologies, this should be completely paid off by the increase quality of service for such crucial tasks.

CONCLUSIONS

More and more pressing concerns arise in advances Societies about the overall impact of Artificial Intelligence and Robotics on employment level and work organization in general. A general analysis is complicated by the fact that these technologies are expected to revolutionize application fields that are substantially different from each other.
In this study we have considerer two specific applications emerging from recent research projects: one applies AI and Robotics technologies to the healthcare sector, and one to Search and Rescue in wilderness areas. We have finally drawn some conclusions about the impact of these innovative applications on the employment market and on work organization.

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The conclusions for the two case studies considered can be extended to similar cases, and allow to speculate on how this kind of innovative applications – that are likely to become increasingly common and widespread – might impact employment and work organization in general.
We conclude that that, depending on the application field, a reduction in the workforce required to carry out tasks that will be taken over by automation might be counterbalanced by either a drastic increase in demand (healthcare services), or a shift in the required competences (search and rescue); in both cases, we can expect a positive societal impact, also motivated by an increased standard of service.

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