Smart-homes: A New Challenge for Artificial Intelligence

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Abstract: Recent advances in information and communication technology opened the perspective of embedding "intelligence" in a number of components of our home, transforming it into a kind of multi-functional robot, usually referred to as "smart-home". Leaving apart an excess of technology that probably we don't want in our everyday life, a number of potential facilities exist that could effectively increase the quality of life by solving important social problems, such as security, elderly people leaving alone, child care, handicapped support. Here, we will investigate how AI techniques can be effectively integrated into smart-home technology solving important problems, which are beyond the reach of non-AI techniques.

The first application area is "security and protection" intended either as "protection" against intruders or as protection/rescue of a person with respect to possible accidents in the domestic environment. A number of techniques have been proposed to detect risk conditions or to detect the occurrence of an accident. Some of them are based on image analysis and others make use of specific sensors that the person to be protected is required to wear. However, no single technique is fully reliable for deploying critical applications. We will discuss how AI methods are essential in order to trespass these limitations.

The second application area is user interface. Even though simple traditional interfaces, such as switches, buttons, or infrared remote-controls, are the ones most users still prefer, there are a number of cases where advanced interfaces such as vocal or gestural are required. This is the case for handicapped people with severe mobility reduction due to aging or disease. This is a challenging area where machine learning and adaptive algorithms can be exploited to quickly develop specific solutions tailored to the user physiological conditions.

The third application area is energy management, with the goal of reducing both the cost for the end user and the consumption of natural resources. Addressing this problem requires addressing two separate tasks. The first one consists of developing the monitoring systems that are able to identify and explain energy wastes. The second one deals with the planning of energy usage. In fact, available energy may have different costs during the day depending on the sources (public network, solar panels, wind mills), which in turn may depend on the weather conditions and on the geological location. Both tasks are classical AI topics, involving fault diagnosis, planning and machine learning. We will discuss the peculiar aspects, which are more challenging with this respect.