ORIGINAL RESEARCH

A neuro fuzzy system for incorporating ethics in the internet of things

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Abstract

The Internet of Things (IoT) is a promising technology for addressing the challenges of urbanisation, however ethical ramifications of introducing such pervasive technology have not been duly considered. It is assumed that smart devices are exempt from moral, religious or legal responsibilities with regard to their surroundings. Such a perspective on device functioning may lead to situations where essential human values are put at risk. We suggest that social parameters be also included within the realm of machine functioning. In this work, we propose a neuro fuzzy system (NFS) that is able to implement ethics relevant to the context of a device and also fine tune them. Initially ethical requirements are specified in terms of fuzzy ethics rules and appropriate ethical response is learned subsequently. The method enables us to address the vital question of ethical compliance of smart things so that ethical rights of people are not infringed upon. By such incorporation, we ensure that machines respect core human values paving way for human friendly technology ecosystems like ethical smart city.

Keywords Artificial intelligence · Ethics · Internet of things · Neuro fuzzy system

1 Introduction

IoT signifies a novel networking paradigm that is poised to revolutionise the way we perceive and interact with the physical world. The idea is to extend the realm of connectivity from computers, smart phones and sophisticated gadgets to virtually all things on the planet and hence the term Internet of Things. The vision is enabled by advances in sensing and communication technologies that can be embedded in ordinary things to transform them into smart things of the IoT world. Such advancement promises to offer an unprecedented class of services by processing data collected by these smart devices.

Among the numerous application areas that IoT promises to revolutionise, intelligent transportation systems (ITS), healthcare, industry, smart grid, smart home and smart city represent the most prominent ones. By the end of 2025, total market share of IoT is estimated to reach a staggering $6.2 trillion (Manyika et al. 2013). In view of the strategic importance that IoT holds, there is a global trend of collaboration among academia, industry and governments to realise the IoT dream.

While it may be necessary to sense certain information from the surroundings in order to provide advanced class of services, uberveillance (massive surveillance) over personal, private and public lives of individuals via sensors embedded in smart phones, smart TVs, smart cars, smart beds, and other household items raises serious ethical concerns (Michael et al. 2014). In order to evade answering the question, some quarters have even suggested tax rebates or some other monetary gain for those willing to share private data (Ridley-siegert 2015). Corporates venturing in the IoT landscape view economic gain as primary objective whilst its impact on the privacy, security and ethics of society is not their necessary concern. However, over thirty years of research into technology and governance strongly supports the view that connections between technology and society are deeply intertwined and as such cannot be ignored (Meijer and Bolivar 2015). If ubiquitous technologies like IoT are to thrive, ethical complicity is indispensable else their fate would be similar to smart energy projects in US and Europe that failed because the citizens were anxious about privacy and trust (Brown et al. 2013).

While the security concerns of IoT are well acknowledged in literature (Granjal et al. 2015), ethical implications have not been considered. It is assumed that artificially intelligent machines would lead to greater fairness and eliminate bias, however the reality is, absence of a sound framework of ethics

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