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Barwon Health

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Human-Device Interaction Behaviours in IoT Collectives

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INTRODUCTION

Introduction

An emerging aspect to consider during human-device interaction is addressing ethical concerns about smart, internet-connected devices (Internet of Things) and making them behave in a more human-centred manner, i.e., ethically and in a socially acceptable manner.. How users interact with multiple IoT devices and how such devices behave appropriately in such an environment, and how to develop the software applications needed to support such interaction behaviours, is our main concern.

Literature Review

In the literature, various approaches to making smart devices responsible have been explored, and only a few have discussed the integration of ethics in IoT and do so without providing an effective computational solution/approach. Our research is focusing on operationalizing ethical behaviour on the Internet of Things by enacting policies that govern smart device interaction.

Research Questions

RQ1. How to best model and develop (complex) systems (multi-human and multi-device) with multiple interactions?

RQ2. How can an interaction model be built that can incorporate human-centric interaction behaviours, including socially appropriate actions, decision-making transparency and handling of uncertainty in smart devices

RQ3. What are the appropriate policy rules for smart devices in different environments

RQ4. What tools can be applied to model and implement such complex interactions with human-centric behaviours guaranteed.

METHODOLOGY

Design Science Research Methodology

This research focuses on proposing a policy-based approach to apply three different types of socio-ethical policies (authorisation, prohibition and obligation) on smart devices to control their behaviours during Multi-User and multi-Device Interactions. To obtain reliable results, we plan to follow the Design Science Research Methodology as well as perform experiments to validate research requirements. Figure 1 presents the reference architecture of whole system.

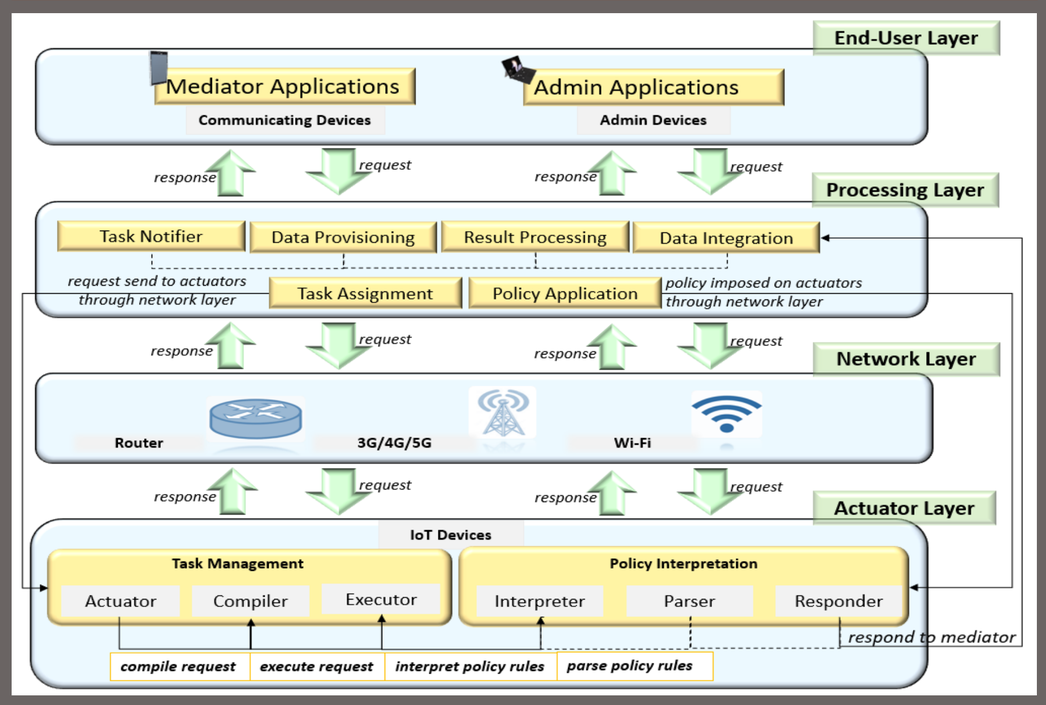

Figure 1: Reference Architecture

CURRENT WORK

Experiments

In order to validate the research requirements, three case studies are scheduled to be prototyped: aged care center, supermarket, and education centers.

Case Study One: Aged Care Center

In this scenario, we have multiple Internet-connected robots tracking multiple seniors admitted in an aged care home. The manager of aged care home can impose the socio-ethical policies (authorisation, prohibition and obligation) on all the robots through a system installed in his/her office. A collection of robots can be instructed by the families to track their seniors throughout the day, partially as a form of communication mediator between family members and the aged person and partially to ensure that the elderly person is properly taken care of – in a way, attempting to prevent the problem of elder abuse by carers (staff members of the aged care home). Robots can also be helpful to carers in the aged care home as they can also command the robots to move to different locations and track seniors. The robots must perform duties adhering to policies (authorisation, prohibition and obligation).

- Authorisation Rules: The smart devices are authorised to perform the tasks mentioned above.
- Prohibition Rules: The smart devices are prohibited to do some tasks to enforce certain limits on them.
- Obligation Rules: The smart devices are obliged to follow obligations to behave ethically with the seniors and staff members.

Figure two presents the policy management framework and figure three presents the aged care scenario with a link to prototype implementation:

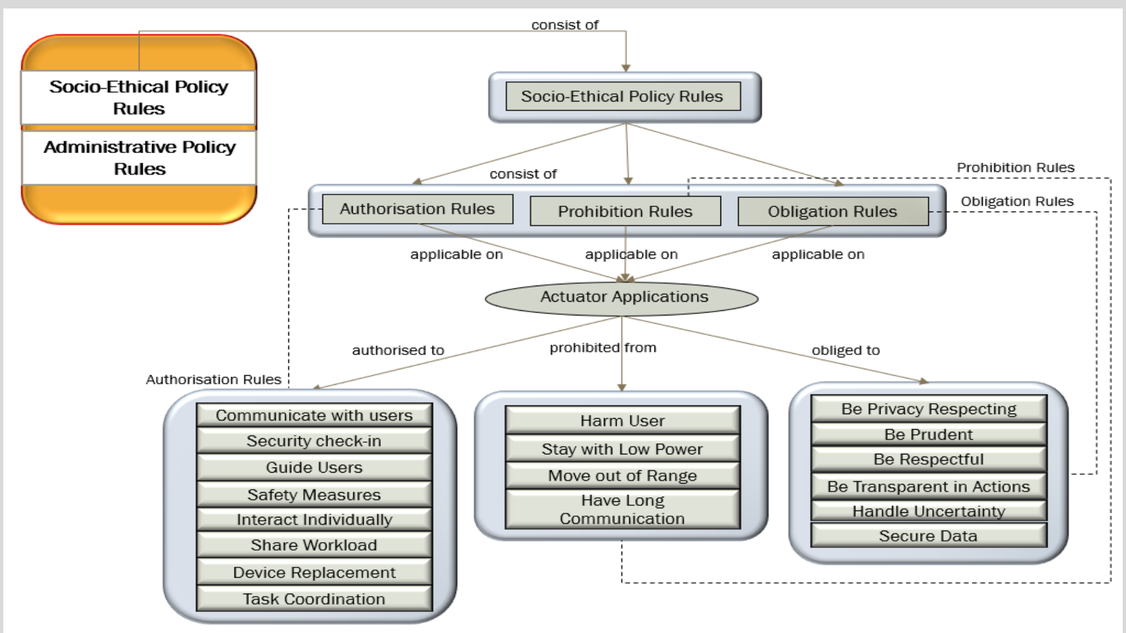

Figure 2: Policy Management Framework

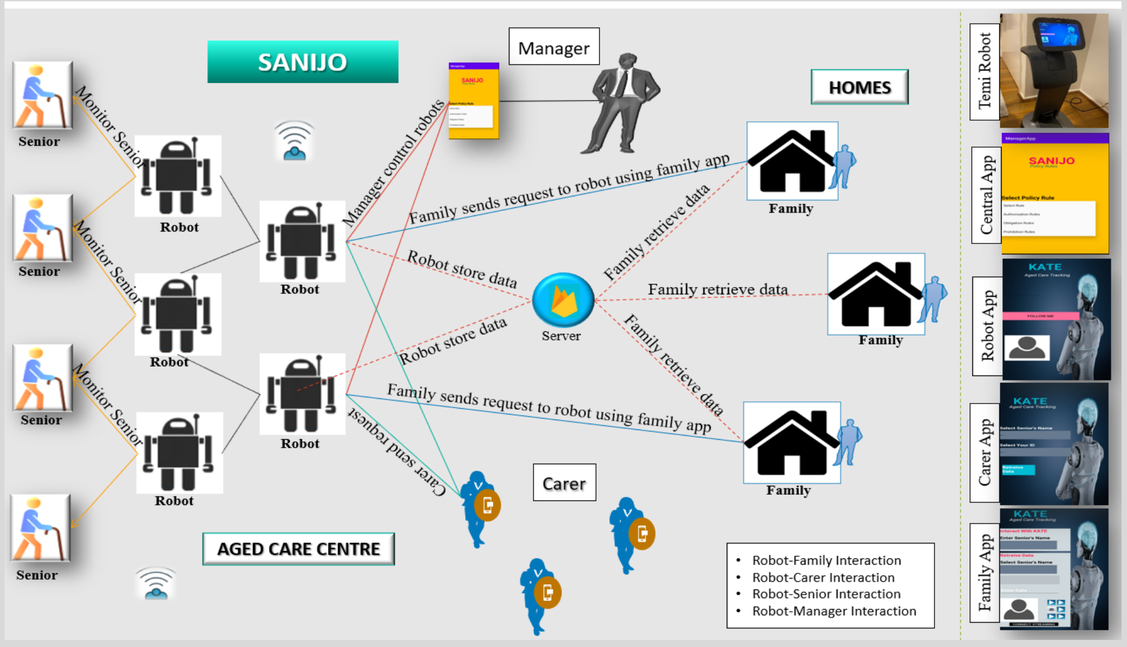

Figure 3: Aged Care Scenario: https://www.youtube.com/watch?v=K1j0fkvIaxY&t

CONCLUSION

On going work

The evaluation of our prototype implementation needs an involvement of different users and during COVID-19, it is not safe to do so. Therefore, we decided to design a questionnaire and get responses to perform statistical analyse of the results. Post COVID-19, we will deploy our system and will also evaluate it using complexity metric measurements and focus groups.

Conclusion

1. We envision environments containing multiple IoT devices and multiple users involved. For instance, a living room with Amazon Alexa, Google Home, smart TV, smart radio, smart phones, digital photo frames, smart lighting, smart appliances, and a home-robot, and multiple users of such devices (different family members).
2. How users interact with such devices and how such devices behave appropriately in such an environment adhering to policies are important.
3. How to develop the software applications needed to support such interaction behaviors, is a concern of this research