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Social IOT

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Abstract- An emerging paradigm of IoT is Social IoT (SIoT). In SIoT, different IoT devices interact and create relationship with each other to achieve a common goal. In essence, Social IoT adapts a service-oriented architecture where heterogeneous IoT devices can request or offer autonomous services and collaborate on behalf of their owners. Operating Systems (OS) are employed in IoT devices because they offer threading support, access to development libraries and portability; thus allowing simplicity in IoT application development. Several OS are available for IoT devices, but selecting a hardware and OS befitting for a particular IoT application is a crucial task. In case of SIoT, the selection of specific OS for hardware devices in various applications is even more challenging due to their collaborative nature. Existing surveys on OS are mostly lack the discussion on domain oriented and hardware architectural features. As a consequence, it results in under performance in many application scenarios as it is infeasible for developers to choose best-suited OS for various hardware platforms. This paper provides an OS-to-hardware architectures features-mapping while searching the unique requirements of SIoT applications and considers quality features of OS as well as hardware IoT platforms. In doing so, resource-constrained IoT devices are particularly highlighted due to their power limitations and memory constraints. Further, OS architecture model is associated open research challenges and proposed for devices in SIoT applications are identified. This research will benefit developers to utilize IoT platform resources and to envisage an efficient OS for futuristic SIoT applications.

Keywords: - SIoT, Operating Systems, Microcontroller Architecture, Embedded Systems.

I. Introduction

Social infrastructure is converging with the Internet of Things creating a new phenomenon known as Social IoT (SIoT), IoT meets social infrastructure. This is a NEC's special feature named 'IoT Meets Social Infrastructure'. Household garbage is picked up by garbage collectors following a particular route and on a specific timetable. But on days when the amount of garbage is less or more than usual, the collection route and timetable may need to be adjusted. Making these adjustments is not this easy, and it is an issue that providers of garbage collection services face every day. Now there is a solution, by attaching sensors to garbage containers, real-time data on garbage amounts can be transmitted to the control center via the network. All collection locations are managed on a map and displayed on a large screen at the control center. The data collected from the sensors is analyzed and sent to the garbage collectors, allowing them to prioritize collection of full containers and move more efficiently around their collection routes. This solution has already been adopted by the City of Santander in Spain. The solution is just one of the ways that social infrastructure is converging with the Internet of Things, creating a new phenomenon known as Social IoT. Social IoT uses distributed sensors and other connected devices to improve the efficiency of social solutions in fields such as energy, utility services, and transportation. There is no doubt that sensor for collecting huge amounts of data are set to become an integral part of our lives. This article examines the convergence of ubiquitous connectivity and the task of managing related data and analytics output. So, how can firms get the most out of IoT technologies in terms of data? Both sensors and devices have, indeed, allowed the collection of huge amounts of data. Yet the real importance lies in how, and how quickly, the collected data is processed and analyzed so that firms can use such data effectively. If processing is not optimal, for instance, there is a high risk the data will lose its effectiveness. NEC offers various technology solutions to enable quick and effective data analysis for the benefit of society. The strength of NEC's Big Data analytics is seen, for example, in innovative solutions for analyzing customer voice data. These solutions go further than simply looking at a list of problems—they are able to account for the surrounding situation as well.

II. Literature Survey-

The currently available research work in the literature on OSs can be broadly classified into two major areas including Wireless Sensor Networks (WSNs) and IoT

1. WSNs-

In last decade or so, many research studies are conducted on the suitability of OSs for constrained environments. The design of a lightweight Linux Security Module (LSM) is presented in which claims implementation with minimal changes in the kernel. The LSM module design ensures generality and its access control for other modules. In this, the performance analysis of tailored Linux OS on different microcontrollers is provided. The paper discusses the memory management and processes running in the tailored Linux design while also describing some key differences in the kernel with that of Desktop Linux. While the majority of other survey papers on constrained OSs are domain oriented as they describe features and layers of OSs which are appropriate for particular domains. Primarily these surveys are focused on WSNs. For instance, a research paper has discussed the support for different programming languages framework along with the networking protocols supported by various OSs for WSNs. The hardware platforms on which these OSs can be ported are also figured out. Authors discussed multiple OSs while considering various features required for WSNs. These features are discussed in the light of architecture, programming model, scheduling techniques, memory protection and management, communication stack, resource sharing algorithms and real-time capabilities. This research work also considered the requirements and key challenges for any OS to run in domain-specific hardware in constrained environments. The software stacks of the OS are taken into consideration and availability of some core libraries in software development kit (SDK) is investigated as well.

2. IoT

The majorities of research works on the OS selection specific to IoT domain is either focused only on a certain OS or has limited scope. For instance, the technical aspects of various OSs are individually considered in several papers. Some major concerns in the design of OSs for typical network domains are highlighted. In this context, the architecture of these OSs is elaborated, and corresponding advantages and disadvantages due to the underlying architecture for these domains are reviewed in these papers. The algorithms developed for resource sharing, memory protection, and management of these OSs are also discussed. Moreover, these papers describe design and implementation of typical modules/layers in specific OSs. Similarly, features of specific layers or modules of OS to serve in a certain domain are also emphasized in some research studies.

Specifically, a comparative survey on existing OSs for IoT is conducted. Therein, authors comprehensively discussed all the potential OSs for IoT and compared them according to a specific set of criteria. In this, a short survey on the selection of suitable OS for two different classes of IoT platforms is presented. The survey briefly discusses the requirement of choosing the right OSs for IoT hardware platform architectures including the Cortex-M and TI MSP430 microcontrollers. Another brief survey on the different available options of OSs for IoT devices is presented. The paper discusses the desired features of an OS for IoT while presenting a comparison of existing OSs based on these features and a generic framework for designing a potential OS for IoT. We have opted a similar approach, but in our case, the hardware architectural features of IoT devices are also highlighted while suggesting specific OS for IoT device(s). In addition, the application specific scenarios where device-level interaction and socialization become the key requirements of SIoT are also particularly emphasized.

III. Applications of Social IoT

Several SIoT application scenarios can emerge involving the continuous and evolving interaction among a variety of devices. Some of the prospective socialization opportunities in IoT applications are as follows

1. Smart Shopping Mart Retailing
2. Healthcare and Telemedicine
3. Intelligent Multimedia Streaming System
4. Smart societal interaction
5. Traffic surveillance and road safety

IV. OS Recommendations-

The constrained devices in SIoT applications have different requirements such as device-level interaction, socialization, trustworthiness evaluation, among others. These requirements can be enabled through specific features in embedded OSs and hence should be explored prior to an OS selection. Moreover, to efficiently manage the hardware resources, the selected OS, in turn, needs to be run on suitable hardware architectures. In this Section, an OS-to-hardware architectures feature-mapping is provided so that the corresponding features meet the requirement of SIoT applications. Firstly, several unique features of embedded OSs are identified which are significant for SIoT paradigm. These features are taken as performance metrics for choosing an OS and stated along with their corresponding support capabilities desired for hardware platforms.

The SIoT devices are heterogeneous and every device has to go through and perform different phases of friendship establishment with other devices to avail some service(s) or compose entirely new ones. So at each phase, the devices perform some type of ranking to evaluate and assess the available options according to different SIoT components. To make this ranking and evaluation easy and efficient, we provide a mapping of features of devices (software and hardware resources) on different SIoT components. Thus, the complete SIoT cycle of social relationship establish, starting from service discovery up to relationship management. For instance, considering the transitivity property in case of trustworthiness, a device can get more trust opinions from other devices if it is supported by rich communication interfaces ('σ') offered by its OS and the hardware.

1. 8051architecture
2. Peripheral Interface Controller (PIC)
3. Advanced Harvard architecture (AVR)
4. ARM Architecture

V. Open Research Challenges

In this Section, we highlight the most significant challenges in realizing the proposed features in model OS.
1. Optimized resource utilization
2. Security and trust management
3. Compatibility
4. Accuracy and reliability
5. I/O handling
6. Cost effectiveness

VI. Conclusion

This research work describes the key features of the latest available resource constrained hardware platforms for SIoT applications. Based on these features, specific OSs are recommended for each platform to utilize their hardware capabilities efficiently. Structure, architecture and operational features of recommended OSs are described that make efficient use of hardware architectural potentials of devices employed in SIoT applications. Therefore, a comparative study is presented on features of OSs and hardware architectures particularly focused on resource-constrained devices. While enabling these necessary features in OS architecture, associated challenges that may arise and should be taken into account are also articulated in this paper. Thus, the study opens doors for future work since following the proposed recommendations, more robust algorithms can be implemented to better utilize the specific hardware architectural features of devices in SIoT applications. Moreover, this research can be taken as initiating guidelines for developers to design an efficient OS to meet the demand of futuristic IoT and SIoT applications.

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