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Cloud based management and control system for smart communities: A practical case study



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ABSTRACT

In this study, the implementation of cloud based smart community management and control system was undertaken. SmartCommunity.in is a flexible platform to manage and control the affairs of a condominium or society with thorough participation, visibility and transparency. Our research is the first attempt to study one such real life system of cloud based control and management in a smart housing community in India. There is a dearth of exploratory studies that explain the diffusion and adoption of cloud computing in different contexts and from a multiple stakeholder perspective. So, the main contribution of our research is to understand the framework of cloud computing based smart community services in India and the emerging cloud computing ecosystems. This research has wide ranging implications on the future of Internet of Things, and can be extended to elderly health and support, energy efficient systems and smart cities.

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1. Introduction

Cloud based services and Internet of Things are the current buzzword. Internet of Things is the use of RFID, sensors and actuators, metering devices for control and monitoring. The control and monitoring can be local or cloud based. “Smart” is a new generation of integrated hardware, software, and network technologies that provide information systems with real time awareness of the real world and advanced analytics to help people make more intelligent decisions about alternatives and actions that will optimize business processes and balance sheet results [35]. The Internet of Things (IoT) means a world-wide network of smart interconnected devices, uniquely addressable, and based on standard communication protocols. Connected things include smart LED lighting, healthcare monitoring, smart locks and various sensors for such things as motion detection and metering systems for electricity, water and gas. Homes will move from being interconnected to become information- and smart-enabled, with an integrated services environment that not only provides value to the home, but also creates individual-driven ambience.

Cloud based services save organizations from going through the cycle of buying a software license, installation of the underlying infrastructure, paying for the maintenance contract and then also

installing expensive upgrades [12]. Cloud based ERP in India is expected to grow at a compound annual growth rate (CAGR) of 28% and cloud based ERP in China is expected to grow at CAGR of 37% for the next five years. Gartner estimates that there are over 1000 user organizations that have adopted cloud-based ERP in India and China combined. Yet, cloud based ERP applications in India and China constitute less than 5% of the overall ERP market in India/China and their penetration is extremely modest, with only 8–10% of the global ERP market, in line with the global SaaS based ERP trend. So we see that, inspite of the low production costs, and SME's being ‘potentially’ big adopters, the cloud based services adoption rate is low [53].

In this paper we study the implementation of one such Internet of Things and cloud based SmartCommunity.in application through a case study. The implementation of such an application requires the creation of an ecosystem consisting of the application service provider, community administration, cloud services provider, utility services providers, mobile services providers and payment gateways in a multi layered system.

Smart homes, smart community and smart city, based on the Internet of Things and cloud based services technology are still at a conceptualization phase in India. Our research is the first attempt to study one such real life system of cloud based control and management in a smart housing community in India. There is a dearth of exploratory studies that explain the diffusion and adoption of cloud computing in different contexts and from a multiple stakeholder perspective. So, the main contribution of our

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research is to understand the framework of cloud computing based smart community services in India and the emerging cloud computing ecosystems. This research has wide ranging implications on the future of Internet of Things, and can be extended to elderly health and support, energy efficient systems and smart cities.

This paper is organized as follows: Section 2 contains the literature review and the introduction to the important concepts in the paper. Section 3 describes our research methods and data collection process. Section 4 discussing the results and Section 5 the implication and conclusions drawn from the research.

2. Literature review

2.1. Internet of Things and smart community

The concept of smart homes also falls in the IoT domain and the future home environment consists of embedded sensors and actuators which can be self-configured and controlled remotely through the Internet, enabling a variety of monitoring and control applications [27] as shown in Fig. 1.

According to Gartner, residential citizens will lead the way by increasingly investing in smart-home solutions, with the number of smart devices used in smart homes to surpass 1 billion units in 2017. The smart home concept when extended further leads to the concept of a smart community, which is further a building block to the concept of smart city. Smart homes, smart community, smart city etc., are equipped with a multitude of mobile terminals and embedded devices as well as connected sensors and actuators and use of smart computing technologies [35] (Table 1).

The technological components of the smart community framework are: a smart interface which is a dash board and a common operational platform of integrated web services, smart control systems, which consist of interconnected automatic control network in a smart home and smart database resources to store real time data [8,23,37,41]. A smart community is a multi-

Table 1

Smart devices installed base within smart cities (in millions).
Source: Gartner (March 2015).

| Smart city subcategory | 2015 | 2016 | 2017 |
|----------------------------|--------|--------|--------|
| Healthcare | 9.7 | 15.0 | 23.4 |
| Public services | 97.8 | 126.4 | 159.5 |
| Smart commercial buildings | 206.2 | 354.6 | 648.1 |
| Smart homes | 294.2 | 586.1 | 1067.0 |
| Transport | 237.2 | 298.9 | 371.0 |
| Utilities | 252.0 | 304.9 | 371.1 |
| Others | 10.2 | 18.4 | 33.9 |
| Total | 1107.3 | 1704.2 | 2674.0 |

hop network of smart homes that are interconnected through radio frequency following wireless communication standards such as Wi-Fi (IEEE 802.11) and the third generation (3G) of mobile telephony. It is a cyber physical system, where homes are multifunction sensors continuously monitoring the community environment from various aspects and automatic virtual feedback is input to improve community safety, home security, healthcare quality, and emergency response abilities [27].

Owing to the lack of exploratory studies that explain the adoption of cloud based services in India, our research is to understand the process of adoption of the technology and to identify the critical success factors for the successful implementation of the cloud based management and control system for smart communities through a case study.

2.2. Cloud computing

Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction [33]. According to an IDC report, cloud computing is being used by a

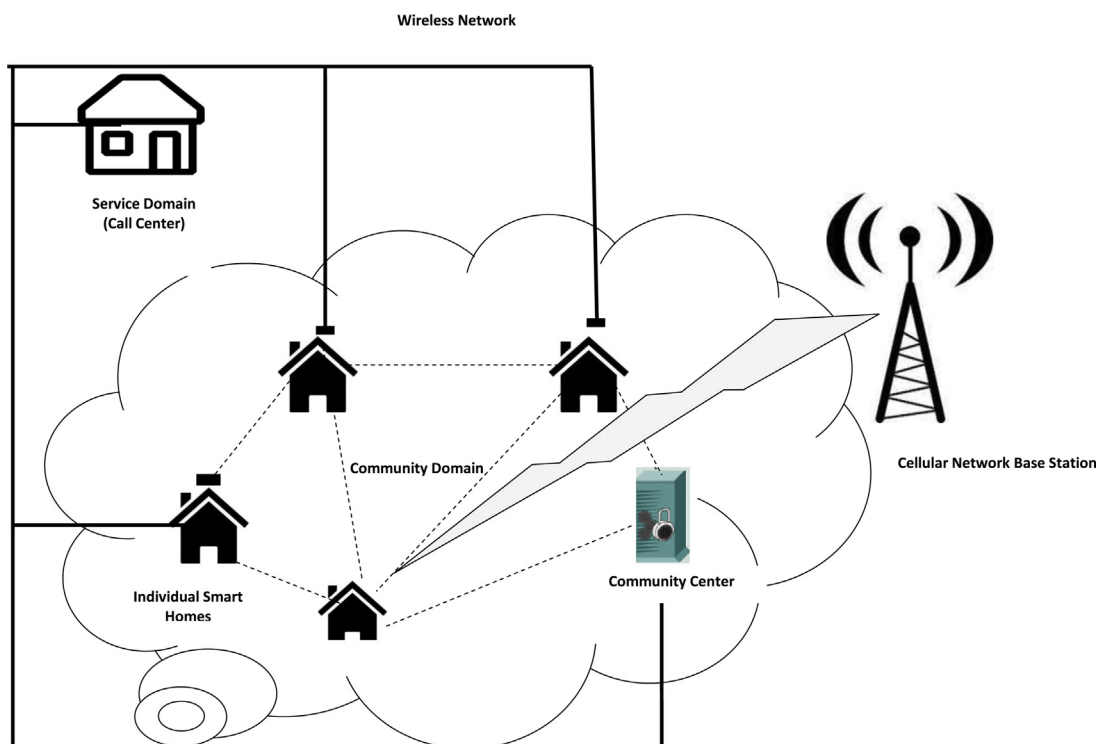


Fig. 1. Smart community [27].

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