Power Distribution System Using IOT-FOG

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ABSTRACT: ***Rising demand for energy calls for effective management of the supply. All devices in smart homes are connected to the Internet via the Internet of Things. There is a possible means to research the trend of consumer usage and to forecast their energy demand accordingly. Multi Agents have long been used in computer science, and have applied for many applications to replicate human work. Such multi-agent systems have been implemented in smart transportation, smart cities and smart grid and so on to track and manage the cyber physical structures. This paper proposes a Multi-Agent System (MAS) in an IoT based framework for smart energy management. Inspired by the rivalry in human societies to accept the best proposals: this work proposes a demand reduction Agent Negotiation method. The IoT network agents are negotiating with the meter agent to approve a suggestion that will reduce the use of the peak hour. The negotiator also negotiates energy usage with the meter agent when the supply of renewables is excess. This agreement is carried out with hundreds and thousands of households, thereby allowing utilities to efficiently meet the supply-demand. Consumers get the best offers depending on the programs they support.***

KEYWORDS: ***Internet of Things, Multi-agent system, Negotiation, Distribution automation, Smart grid.***

INTRODUCTION

Multi Agent System (MAS) has been applied for monitoring and control in cyber-physical systems; where smart grid is the major application. They aim to simplify the monitoring and control process. Government plans for smart grids and smart cities involve complex infrastructures and technological technologies as well. The growth in population has called for an increase in demand for oil. The rising worldwide demand for energy can be met through the incorporation of renewable energy sources with existing sources of fossil fuels. For rising global warming, the world needs to move from non-renewable energy usage to greener energy. Electricity generation from fossil-fuel plants is rising the carbon emissions. Through integrating the use of renewable energy sources into the grid, carbon emissions will be lowered and renewable energy will be harvested more.

Electricity Grid control involves advanced technology such as IoT, cloud computing and Edge / Fog computing in real time. A description of how multi-agent Power Distribution (PD) help is shown in Fig. 1. Such systems are experiencing a lot of improvements and are also hitting greater frontiers. The processing latency at the Edge computing, where analytics occur closer to the device, is that. Distributed computing methodologies improvise monitoring and control of the system's output which is geographically distributed. Sensors and sensors can be mounted in smart homes to track and operate the appliances. The research proposes a PD system architecture for the MAS. Agents are software bots that are able to sense an environment and function on the environment autonomously. The agents can gain knowledge through predefined decision-making rules or through the use of complex algorithms for machine learning.

There are a few characteristics that differentiate agent programming from conventional software and hardware systems; these are reactivity, pro-activity, and social functionality. The Intelligent Physical Agents Foundation (FIPA) sets out open principles for applying MAS.

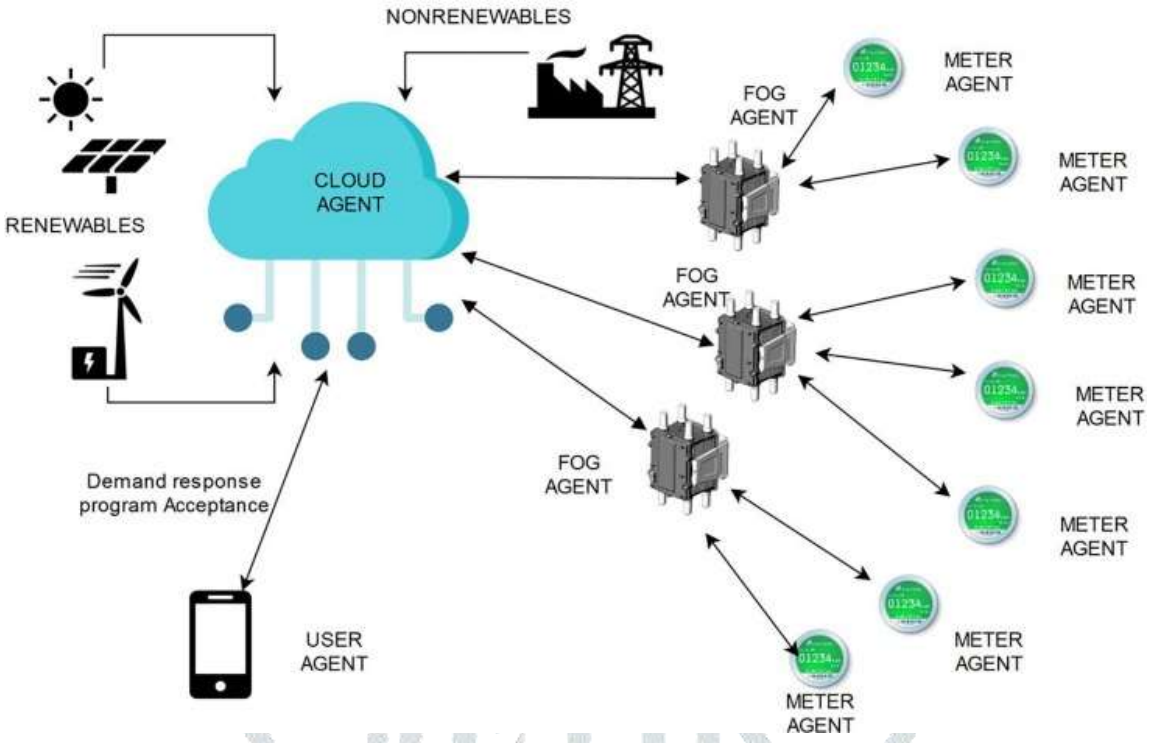

FIGURE 1: IOT based power distribution system.

Multi-agent systems were used in Power System Applications and proved reliable. The applicability of MAS in all power systems fields is stated in this research work. That is because the collection was performed by MAS and Agents work together to achieve common objectives. Power systems are geographically dispersed systems, and a special software program is required to control this. Industries and researchers have reportedly used MAS for power flow solutions, feeder reconfiguration, automatic metering, and other applications in power systems. Agent-based negotiation for the smart energy management is suggested in this work. Based on the knowledge of timely pricing, the availability of resources, the negotiating agents negotiate with the home agent of the customer to minimize demand during peak hours. If the available electricity is cheaper due to the availability of alternatives, the bargaining agent negotiates with the customers on the use of energy by showing competitive costs. The negotiating agent serves as a mediator between utilities and customers, thereby showing a better management of resources.

The paper's contributions are as follows:

- Modeling of an IoT-Fog based PD device MAS.
- Defining targets for different agents, such as Cloud Manager, Fog Manager, meter agent, user agent, and demand manager.
- Power control agent negotiation: Manager negotiates with households to curb demand during peak hours.
- The agent negotiates with the household for energy usage when the renewable energy is surplus and the price is weak.

LITERATURE REVIEW

Fog is an evolving computing, storage, power, and networking architecture that distributes these resources closer to end users along the Cloud-To-Things continuum. This incorporates both mobile and wireline cases, runs through hardware and software, operates on the edge of the network, but also across access networks and end-users, and contains both data plane and control plane. It supports an growing range of applications as an architecture, including those in the Internet of Things (IoT), fifth-

generation (5G) wireless networks and embedded artificial intelligence (AI) [1]. This paper provides a comprehensive overview of IoT with respect to device architecture, enabling technology, security and privacy problems, and fog/edge computing and IoT integration, and applications. This paper discusses, in particular, the relationship between cyber-physical systems and IoT, both of which play important roles in the realization of an intelligent cyber-physical environment. Thereafter, current architectures, enabling technologies, and IoT security and privacy issues are addressed to enhance understanding of state-of-the-art IoT growth [2].

Fog Computing expands the cloud computing concept to the edge of the network, allowing for a broad variety of software and services. Defining Fog's characteristics are: (a) low latency and position awareness; (b) widespread geographical distribution; (c) mobility; (d) large number of nodes; (e) predominant function of wireless access; (f) fast streaming and real-time applications; g) heterogeneity. This paper argues that the above features make the Fog the correct platform for a range of critical services and applications on the Internet of Things (IoT), namely Connected Car, Smart Grid, Smart Cities and, in general, Wireless Sensors and Actuators Networks [3].

Next, this paper presents a tutorial on fog computing, including its similarities and differences, and its associated computing paradigms. Next, it include a taxonomy of research topics in fog computing, and then summarize and categorize the efforts on fog computing and its associated computing paradigms through a detailed survey. Finally, posing of problems and future directions for fog computing work was done. This paper addresses security and privacy risks to IoT applications, and examines the criteria for protection and privacy in fog computing. In addition, paper illustrate possible problems in securing fog computing and evaluating the state-of-the-art approaches for IoT applications used to resolve security and privacy concerns in fog computing. Eventually, it is expected to attract more focus and effort into this new architecture by identifying some open research issues. This paper addresses security and privacy risks to IoT applications, and examines the criteria for protection and privacy in fog computing. In addition, paper illustrate possible problems in securing fog computing and evaluating the state-of-the-art approaches for IoT applications used to resolve security and privacy concerns in fog computing.

Eventually, it is expected to attract more focus and effort into this new architecture by identifying some open research issues. The authors address security and privacy concerns in IoT environments in this article, and suggest a system that uses fog to improve the distribution of information about certificate revocation among IoT devices for security enhancement and also provide possible directions for research that seek to use fog computing to enhance security and privacy problems in IoT environments [4]. Internet of Things (IoT) offers a seamless forum for connecting people and objects to each other to enrich our lives and make them easier. This vision brings us from compute-based centralized systems to a more distributed world that provides a wide variety of applications such as smart wearables, smart home, smart mobility and smart cities. This paper explores the applicability of IoT in healthcare and medicine by introducing a comprehensive ecosystem model for IoT eHealth.

Due to inadequate and less accessible healthcare facilities, healthcare is becoming increasingly difficult to manage to meet the growing demands of an aging population with chronic diseases. Emerging technologies such as the Internet of Things (IoT) involve computation that is latency-aware to process applications in real time. Connected objects produce vast quantities of data in IoT environments which are commonly referred to as big data. Given the on-demand services and scalability features of the cloud computing model, data generated from IoT devices are typically processed in a cloud infrastructure. However, processing IoT application requests exclusively on the cloud is not an efficient solution for some IoT applications, especially time sensitive ones. Fog computing, which exists in between cloud and IoT devices, has been proposed to address this problem. In general IoT devices are connected to Fog devices in the Fog computing system.

This paper offers an overview of the Internet of Things (IoT) with a emphasis on technology enabling, protocols, and application issues. The IoT is allowed via the latest advancements in RFID, smart sensors, communication technologies and protocols on the Internet. The basic concept is to have smart sensors work directly to produce a new class of applications, without human intervention. The new Internet, Smartphone, and Machine-to-Machine (M2 M) technology revolution can be seen as the first step of IoT. The IoT is expected to bridge diverse technologies in the coming years to allow new applications by linking physical objects together to support intelligent decision-making [5].

METHOD

The electric grid system's vision is to make it smarter and more dependable. Integrating Information and Communication Technology would offer the grid network a new form of control and automation. In the geographically distributed device IoT and Fog computing will play a significant role. The smart meters would be able to relay the readings to street aggregators in real time. These aggregators communicate with the Fog routers located nearer to the network. The Fog routers use the WLAN or 3G/4G backhaul or future 5G to transfer the data to the cloud of the Utility.

The framework for intelligent metering is 6LoWPAN focused. The Fog router will be the border gateway for data frame conversion and carrying out the analytics necessary. The utilities will now research the consumption pattern for an region and individual customers as well. Now for utilities to curtail load during excess demand, control the billing system and perform automatic disconnection and reconnection, there is a need for multi-agent system that performs the job without the need for human being, thus bringing automation into the system.

Meter agent

This agent is present in every home on the Smart Meters. They are responsible for gathering current, voltage and power consumption values. They also communicate with Fog Agent when negotiating to submit info. The meter agent is connected to the home computer system to monitor the appliances during the response to the demand. The meter agent is responsible for disconnecting / reconnecting the supply, depending on the cloud agent's billing status.

Fog agent

It is responsible for gathering data of consumers' power use. At the fog node, the real-time analytics regarding smart energy management for demand reduction occur. The fog agent forwarded the details to the cloud. The fog-agent is searching for cloud policy changes. It looks for bill payment status and sends disconnect/ reconnect information to the meter agent.

User agent

User agent is normally present on the cell phone where a Utility program is running. They are used for the option of demand response services, the regular consumption update, the saved money.

Cloud agent

This is the cloud agent who is responsible for the overall delivery network. They are looking for blackouts, outages and brownouts. The Utilities agent is the Cloud agent. They collect information about renewable energy supply, climate prediction, and special day information. The agent provides the real-time pricing. This agent initiates the Demand Response System.

Billing agent

Such agents residing in Fog are timely agents that operate on a given period to collect the meter reading from meter agent for billing. In this way, it is possible to introduce dynamic billing on the basis of agreements between utilities and customers.

Demand managing agent

The agent is a cloud-based negotiating agent. By negotiating with customers to reduce the load during peak hours, they perform a specialized role. They serve as a broker between user and utility. They act on the information gained from analyzing customer data. The meter agent either curtails the load during peak hours, or schedules the use of equipment during off-peak hours, depending on agreement. During the agreement the billing agent determines the bill for the customer according to the agreed pricing.

Agent proposal for demand reduction

Negotiating Multi-Agent systems were developed, inspired by the competition in human societies for accepting such proposals. Agent Negotiation for Demand Reduction makes use of this job. The cloud agent gathers information from utility policies concerning the real-time pricing. From the day ahead predictions, they gather the availability of renewable energy resources. The cloud agent fixes pricing for peak hours and non-peak hours on the basis of this information, and also for the time of day pricing.

Fog Agent analyses the consumption habits of homes and has individual customers predicted for the next few days. Appliances that play a major role during peak and non-peak hours are rated by the Fog Agent using Discriminant Analysis model. This detail is forwarded to the User Agent. In Cloud, the Demand Management agent and the user agent check the user's check for a response to the Demand. When the customer approves the agreement, the Negotiation Agent in the Fog will then discuss demand reduction with the meter agent. This work uses a dataset to research home use trends and to calculate the rating of the appliances. This is focused on three universities and ten industry stakeholders in the UK undertaking REFIT project. The data is a high frequency for 2 years, with combined load values and nine home appliances at an interval of eight seconds. There were 20 metered houses. A detailed account of this collection of data is given in. The consumption trend of individual homes was analyzed, as well as the short-term demand forecast.

Agent Negotiation in power distribution network to reduce customer demand during peak hours, to use the power during the availability of excess electricity. That's also focused on the electricity price during daytime. The Negotiation Agent is now negotiating with the Meter Manager; discussions are taking place for the policies below. Based on the user's permission to negotiate with the negotiating agent. Negotiation Agent is only seen for one home in this job. The cloud agent has hundreds and thousands of User Agents linked. Therefore there is bargaining with a variety of households and also for various hours of the day. The negotiating agent will negotiate during the peak hours to turn off certain devices that are now in use and move them to a time when the energy supply is cheaper. If the agreement has been concluded, the Meter Agent can now give control signals to the loads switched off and shift to a different time of day. Both devices are in Direct Load Control under the demand response system.

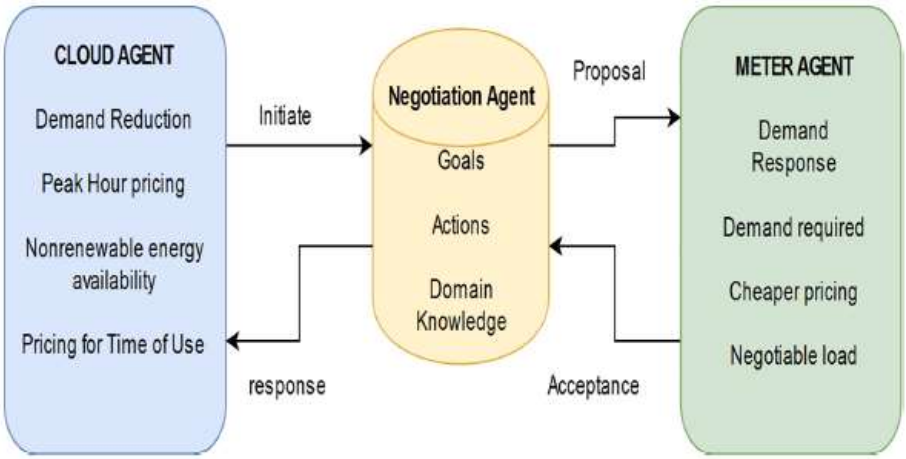

FIGURE 2: Agent Negotiation with meter agent.

CONCLUSION

In conclusion, this study introduced MAS for smart energy management and cutting peak demand in smart homes. Within this work the policy-based negotiation of the agent was proposed. An agent-based system was developed for a power delivery system based on IoT-Fog. Different agents were modelled to perform various tasks. When the information about the individual houses is collected and the day-ahead pricing is fed from the utilities, the negotiating agent begins negotiating to limit the power usage during peak hours and transfers the use to the off-peak hours. It helps utilities increased the use of burning fossil fuel and make good use of renewable energies. The agreement aims to reduce the total monthly billing to customers. The negotiating agent can also negotiate in real time with customers to voluntarily curb the load during enormous demands and also ask consumers to use electricity when the energy is excess by offering cheaper prices or bonuses.

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