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IoT based Intelligent Algorithm for Automation of Devices

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ABSTRACT

Internet of Things (IoT) is the emerging technology which is supported by vast growth in various types of Interfacing and hand held devices, Network Topologies, bandwidths and industrial & cutting edge sensors, etc… The growth in IoT changes this world a lot. IoT implementation is a five phase process. In the first phase, sensors act as data providers for network gateways. Network gateways forward the useful data to cloud service. Cloud service will analyse and process the data. In the final phase the useful data from cloud service will interact with the user by using interfacing devices like mobile phones, laptops and etc.. The main purpose of using IoT is to take intelligent decisions a part of the user. In this paper, we proposed a methodology in the form of algorithm to implement different IoT architectures and through this approach we implemented a home automation system using pure IoT, which in turn has fruitful results.

Keywords: Internet of Things, Sensors, Gateways, Cloud Computing, Mobile Phones.

INTRODUCTION

The technology "Internet of Things (IoT)" was developed since twenty years ago by researchers from IT industry but came into existence recently. The recent development of project is a combination of several things, where the "things" included are nothing but the applications, each application has some specific characteristics to make this technology work in an efficient manner to carry out the specific work to reorder many aspects of the way we live [1].

For customer, IoT appliances those are Network connected, natural observing, Architectural management, Energy consumption management, Manufacturing, Building & home automation and Medical & human services are moving us toward a goal of the "smart world'', offering more adaptability, flexibility, protection and optimal energy consumption viewpoints [2].

The realization of "intelligent cities" has less obstruction and effective power utilization through intelligent vehicles, intelligent traffic system, and intelligent roads. Intelligent vehicles are well network enabled vehicles that move around by using geo-graphical networks. Traffic signal directs the traffic by using intelligent algorithms. Roads that are embedded with rich featured sensors [3].

Sensors play a major role in IoT [4]. The sensor collected information can be used to benefit the fields like automobile, Medical, agriculture, industry, and energy production and distribution increasing the availability along the value chain of production. However, IoT raise many troubles and demanding situations that need to be taken into consideration and technique approach in order for potential benefits to be realized [5].

HUMAN SENSORS

Human sensor cells of a brain system respond to a particular physical phenomenon and maps particular areas in the brain. Human sensing organisms are classified into two sorts' extro-ceptive and intro-

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ceptive [6]. Extro-ceptive deals with the position, motion and state of the body, intro-ceptive with perceive sensations in internal organs. The eyes for sight, nose for smell, skin to touch, tongue for taste and ears for hearing are the five sense organs, first classified by Aristotle. Yet we have numerous other sensing organisms like receptors within the muscles, tendons, joints, vestibular organs, circulatory systems, digestive system, and etc. The information from this organs send to brain in order to provide the information of outside environment depends on our ways of recognition[7]. In a few cases one or more organs might not work well, in such instances, other well operating organs want to exceed their regular capability to deliver make up records. Perception psychology, Cognitive psychology, and Neurosciences are the particular areas that explain the operation, classification and overlapping concept of senses. To get a fine and comfortable life these human senses are provided within the shape of sensors in IoT [8].

INTERNET OF THINGS

In this section we will have the definition for IoT, basic architecture of IoT, and etc.

A. About IoT

IoT is a trending concept in which the machines or things are made to interact with the environment by exchanging data and information sensed by the sensors. IoT is a rich collection of smart things; the things are from our daily life in order to make our life more comfortable [9]. Smart things are from the substantial collections of intelligent algorithms & programs, powerful sensors, flexible mechanical parts, communication devices, well organized internet, and etc.

As shown in the following Fig. 1, the basic architecture of the IoT contains four levels i.e. sensing devices at the first level, in the second level we have gateways, third level consists of cloud services and the in the final level userinteractive devices are there. The following is the block diagram of the basic architecture of IoT.

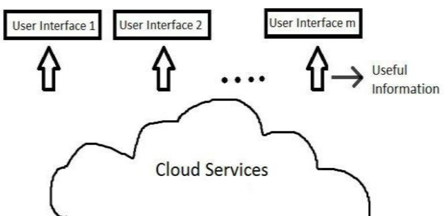

Fig: 1. Basic IoT Architecture

e.g.: Calorimeter, Thermocouple,Thermistor, Gardon gauge, Proximity and Presences sensors (. e.g.: Doppler radar, Motion detector.) are few categories of sensors. The sensory nature of smart mobiles makes it to play a key role in IoT communication [12].

The following Fig. 2 shows the Block diagram of a SENSOR which contains four major components [13]. The Transducer receiver senses the physical stimuli and passes the information to Logic Circuit which performs necessary action according to the nature of the sensor, the output of Logic circuit is carried out by Detector circuit to convert them as digital signals and the formatted digital signal supplied to the communication devices through the Output module.

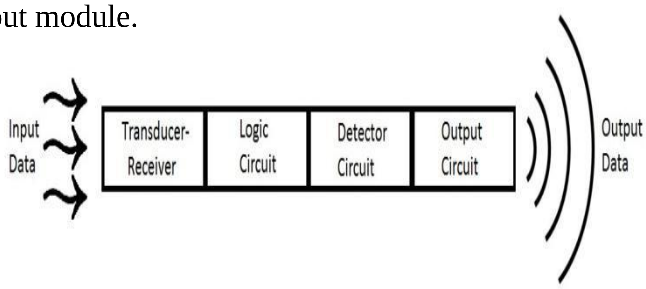

Fig: 2. Sensor internal architecture

B. Sensing Devices

A Sensor is a minute tool that is used to repeatedly perceive and respond to any signal which can be read from physical stimuli, displayed or stored in the form of digital signal. It is used to quantify function of any object. As described in the section 2 about human sensing organisms, in order to make any intelligent decisions, sensors in IoT plays a major role [10].

In this drastic changing technological international wide variety of sensors came into life. Sensors play a

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vital role in Telecommunications, Health care, Business, Industry, Aircraft, Automobiles, Consumer electronics and etc., [11].

Several sensors are Classified according to their nature of work. Automotive sensors (e.g.: Speedometer, Radar gun, Speedometer, fuel ratio meter.), Chemical Sensors (e.g.: Ph sensor, Sensors to detect presences of different gases or liquids.), Electric and Magnetic Sensors

(e.g.: Galvanometer, Hall sensor which measures flux density, Metal detector.), Environmental Sensors (e.g.: Rain gauge, snow gauge, moisture sensor.), Optical Sensors (e.g.: Photo diode, Photo transistor, Wave front sensor.), Mechanical Sensors (e.g.: Strain Gauge, Potential meter (measures displacement)), Thermal and Temperature sensors.

In IoT system, software has its unique role and sensors act as a base thing for the software, which collects vast information from the environment to get interpret by IoT software. The main challenges faced by sensor technology in IoT are sensors need to collect dynamic information which is rapidly changing with reasonable security and reliability, it needs to be cost effective, it needs to show variations as per the real world changes, it has to provide a wide variety of information according to the processing purpose, it should be weather and temperature effective, it has to cover wide range of area, it should elaborated rather than specific in nature, and etc [14].

C. Gateways

An application called Gateway neither the server nor the client can access directly, through which client, sever communicates with each other to exchange the data/information in a network [15]. The information from outside of the internet can be securely accessed by the server irrelevant to data/resource, the Gateways make it possible. The main purpose of Gateways is to connect non-IP devices to the internet or network. Gateways can handle traffic from multiple sources [16].

In IoT, Gateway establishes a communication path between the field and a cloud for processing and storing of data in both online and offline mode. Generally two kinds of Gateways are in use, simple Gateways and Embedded Control Gateways

Where, former organizes and transports the data from/to end points and later extends it functionality by applying intelligent algorithms to run local applications, which intern reduces the cost and complexity at end points and as well as it deals effectively with heterogeneous devices when compared to manual operations. Suitable Gateway will be considered depending on the nature of application. The following Fig. 3 shows the block diagram of basic Gateway. Without Gateway noting happens in IoT. It connects the basic building blocks i.e. sensors which carries useful information to the IoT software. There are a lot of challenges in the implementation of Gateways for IoT [18]. Firstly it should be capable of maintaining huge amount of data producing from sensor networks, it should be able to handle data from variety of sensor networks, it is difficult to maintain permanent Gateways for IoT, privacy & security issues, the Gateway should have the capability to recognize the active sensors, Gateways should have coordination, and etc [19].

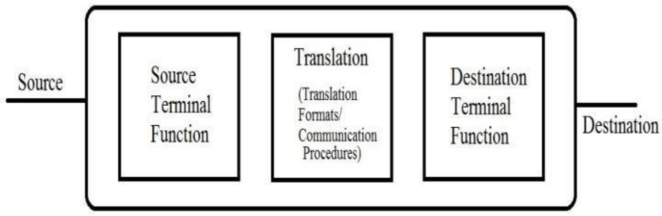

Fig: 3. Gateway internal architecture.

D. Cloud Services

The main purpose of the Cloud is to provide Internet based services. This service nature of Cloud makes it tightly coupled with IoT [20]. The Cloud has the capability to store, process and access the sensory data streams in IoT. Ultimately, the main objective of Cloud is to transfigure sensory data stream into productive information by applying intelligent decisions for the end user in cost-effective and optimal [21].

Thebasic architecture of the Cloud for IoT shown in the following Fig.4. It has four basic phases Data Collection, Data Store, Data Analytics, and Application Processing, connectivity & Visualization.

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Fig: 4. Cloud basic architecture

1) Data Collection: When Gateways forwards the data to Cloud, it collects the data in a systematic way. The collected data will be formatted according to the usage. In order to collect the data multiple times from the same source, it maintains data volume technique. When there are multiple sources, data from each source is separately collected [22]. The challenges in data collection of Cloud are In IoT, the Cloud should be able to maintain enough buffer space to collect the data as the data is having rapid growth and real world dynamic nature, it should be capable to maintain different types of data collected through different sources, it should be able to collect both structured and unstructured, it should be able to support numerous types of Gateways.

2) Data Store: The collected structured or unstructured data is stored dynamically and is categorized. The location of data that is stored in Cloud Storage area is forbidden but can be effectively accessed. It supports both SQL and NoSQL forms of data [23]. Data Storage of IoT leads to several challenges like identifying suitable database like SQL or NOSQL for the collected data according to application usage, maintaining of virtual directories for large volumes of data, space allocation issues for the massive volumes of data, and etc.,

3) Data Analytics: The revolution in modern Technologies leads to increase the availability of huge volumes of data, without applying proper analytics on the data makes in vain. So Data Analytics plays a crucial role in processing, examine, polish and model the data to successfully transform with the support of decision making by using intelligent algorithms in IoT. We have availability of wide range of data analytical tools such as Weka, Excel, R, Hadoop, and etc [24]. Without Data Analysis, the services of IoT will not be fulfilling the needs of end user.

E. User Interactive Devices

At the final phase of IoT architecture, end user – interacting devices play a crucial role. The Interactive Devices are the edge points of IoT, which carries services to the user according to the requirements [25]. Based on the requests of the users, Smart devices interact with the cloud services and get well formatted information. Users provide requests through interfaces like touch screens, Gesture recognition tools, speech recognition tools, and etc. Inside the Cloud locale the requests are processed to generate appropriate services/data sent back to the client(s).

BASIC ALGORITHM FOR IOT ARCHITECTURE

The following is the algorithm proposed for Basic IoT Architecture.

Input: Data from different sensors: α,
Filtered data at Gateways: β, and
Cloud services: γ.
Output: n number of refined selected services in γ, m number of things.
Procedure:

```
Start
Select α data items from the sensors
Sel_ βi_data_items
Sel_Gateway(βi_data_items)
for i =1, 2, ... γ do
        get βi_data_items set;
        train M = filter
seli = selected features in Mi
through βi_data_items
        n ← n+ {q, q ε γ}
m_get(n)
```

end

The proposed algorithm takes different type of data sets from a wide range of sensors. The Gateways select suitable data sets. These filtered data sets are forwarded to cloud services. Where after investigation, the model dynamically filters the data sets and prepares to provide the requested services among m things.

WORKING NATURE OF PROPOSED ALGORITHM ON REAL WORLD DATA

The proposed algorithm successfully implemented for a unit consists of sensors (Brainstorm Temperature Sensor), smart devices (Android Mobile) and a system (Intel Atom Processor S1200 Product Family for Micro server, Fedora Operating System). We supplied a wide range of temperatures through the sensor, at humid temperatures the system automatically adjusts room temperature by using Air Conditioning system and it indicates the message though smart device. The experiment results and the actions are mentioned in the below TABLE 1.

Experiment trail No.	Temperature(°C)	Automatic adjustment of temperature(°C)
1	28	-1
2	28.5	-1
3	29	-1.5
4	32	-3.5
5	34	-6
6	36	-10
7	37.5	-10
8	18	+8
9	19	+5
10	30	-3

Table 1: TEMPERATURE AND CORRESPONDING ACTIONS

The above TABLE 1 shows the adjustments of the current temperature as per the current comfortable body temperature by keeping humidity as a factor. For a given temperature, the system automatically adjusted the temperature to human comfortable zone. The below figure 5 shows the graphical representation of relative temperature changes. The red colored region in the bar is the automatically adjusted relative value.

CONCLUSION

The Internet of Things provides the best services that an average person would ever think. To implement these kinds of services, the IoT system needs to be well defined in its architecture. The above proposed algorithm is best suitable to the basic architecture of IoT. The algorithm worked well for a simple kind of system and generated better results. This algorithm can be useful to implement future systems with numerous services.

REFERENCES

[1] Xia, Feng, et al., "Internet of things," International Journal of Communication Systems 25.9 (2019): 1101.

[2] Doukas, Charalampos, and Ilias Maglogiannis, "Bringing IoT and cloud computing towards pervasive healthcare," Innovative Mobile and Internet Services in Ubiquitous Computing (IMIS), 2012 Sixth International Conference on. IEEE, 2020.

[3] Caragliu, Andrea, Chiara Del Bo, and Peter Nijkamp, "Smart cities in Europe," Journal of urban technology 18.2 (2011): 65-82.

[4] Silviu C. Folea and George Mois, "A Low-Power Wireless Sensor for Online Ambient Monitoring," Sensors Journal IEEE, vol. 15, pp. 742- 749, 2015, ISSN 1530-437X.

[5] Miorandi, Daniele, et al., "Internet of things: Vision, applications and research challenges," Ad Hoc Networks 10.7 (2020): 1497-1516.

[6] Wyburn, George M., Ralph W. Pickford, and Rodney Julian Hirst, "Human senses and perception," (2019).

[7] Sugawara, Yoshiaki, et al., "Use of human senses as sensors," Sensors 9.5 (2019): 3184-3204.

[8] Su, Xiang, et al., "Connecting IoT Sensors to Knowledge-Based Systems by Transforming SenML to RDF," Procedia Computer Science 32 (2014): 215-222.

[9] Gubbi, Jayavardhana, et al., "Internet of Things (IoT): A vision, architectural elements, and future directions," Future Generation Computer Systems 29.7 (2013): 1645-1660.

[10] Kelly, Sean Dieter Tebje, Nagender Kumar Suryadevara, and Subhas Chandra Mukhopadhyay, "Towards the implementation of IoT for environmental condition monitoring in homes," IEEE Sensors Journal 13.10 (2013): 3846-3853.

[11] Qian, Zhihong, and Yijun Wang, "IoT technology and application," Acta Electronica Sinica 40.5 (2012): 1023-1028.

[12] Chi, Qingping, et al., "A reconfigurable smart sensor interface for industrial WSN in IoT environment," IEEE Transactions on Industrial Informatics 10.2 (2014): 1417-1425.

[13] Benbasat, Ari Y., Stacy J. Morris, and Joseph A. Paradiso, "A wireless modular sensor architecture and its application in on-shoe gait analysis," Sensors, 2003. Proceedings of IEEE. Vol. 2. IEEE, 2013.

[14] Estrin, Deborah, et al, "Next century challenges: Scalable coordination in sensor networks," Proceedings of the 5th annual ACM/IEEE international conference on Mobile computing and networking. ACM, 2020.

[15] Zhu, Qian, et al., "Iot gateway: Bridgingwireless sensor networks into internet of things," Embedded and Ubiquitous Computing (EUC), 2019 IEEE/IFIP 8th International Conference on. IEEE, 2010.

[16] Datta, Soumya Kanti, Christian Bonnet, and Navid Nikaein, "An IoT gateway centric architecture to provide novel M2M services," Internet of Things (WF-IoT), 2014 IEEE World Forum on. IEEE, 2014.

[17] Rahmani, Amir-Mohammad, et al., "Smart e-health gateway: Bringing intelligence to internet-of-things based ubiquitous healthcare systems," 2015 12th Annual IEEE Consumer Communications and Networking Conference (CCNC). IEEE, 2015.

[18] Mainetti, Luca, Luigi Patrono, and Antonio Vilei, "Evolution of wireless sensor networks towards the internet of things: A survey," Software, Telecommunications and Computer Networks (SoftCOM), 2011 19th International Conference on. IEEE, 2011.

[19] Sheng, Zhengguo, et al., "A survey on the ietf protocol suite for the internet of things: Standards, challenges, and opportunities," IEEE Wireless Communications 20.6 (2013): 91-98.

[20] He, Wu, Gongjun Yan, and Li Da Xu, "Developing vehicular datacloud services in the IoT environment," IEEE Transactions on Industrial Informatics 10.2 (2014): 1587-1595.

[21] Calheiros, Rodrigo N., and Rajkumar Buyya, "Cost-effectiveprovisioning and scheduling of deadline-constrained applications in hybrid clouds,"International Conference on Web Information Systems Engineering. Springer Berlin Heidelberg, 2012.

[22] Rolim, Carlos Oberdan, et al., "A cloud computing solution for patient's data collection in health care institutions," eHealth, Telemedicine, and Social Medicine, 2010. ETELEMED'10. Second International Conference on. IEEE, 2010.

[23] Wang, Cong, et al., "Privacy-preserving public auditing for datastorage security in cloud computing," INFOCOM, 2010 Proceedings IEEE. Ieee, 2010.

[24] Talia, Domenico, "Toward cloud-based big-data analytics," IEEEComputer Science (2013): 98-101.

[25] Carroll, David W., et al., "Interactive devices and methods," U.S.Patent No. 6,285,757. 4 Sep. 2020