International Journal of Interdisciplinary Innovative Research &Development (IJIIRD)
ISSN: 2456-236X
Vol. **06** Special Issue **01** | **2021**

Smart Home with Edge Computing

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ABSTRACT

IoT i.e Internet of Things is everywhere. We can see various example of iot in our day to day life. With the help of iot we can implement the concept of smart cities or smart home by using various protocol, sensor and other electronic decices etc. With the help of iot we can monitor, manage and control city remotely, but there are few limitations in the perspective of security, when we talks about iot and smart home or smart city implementation. For this the solution is edge computing. We can use edge computing to implement smart home projects.

Keyword: - IoT, Cloud, Edge computing, smart home, fog node.

1. INTRODUCTION

IoT is an expanding field. We can see various wide range of electronic devices used with IoT example smart refrigerator, smart TV, smart light etc. Alexa is the very popular application of IoT which we can see in every second home nowadays. Even for most of the security system IoT is paired with such kind of devices to provide more advanced and effective service. We should know one thing IOT is an interconnected system of objects, animals, human, Computing devices, various software, electronic devices, mechanical devices any many more, they are interacting with each other without human interference and having ability to transfer the data on the internet. Here the question arises where this data is going.

In current scenario whatever the data is collected by IoT devices is to be sent to remote server with the help of the internet. This data is stored on a remote server for the purpose of analysis and action or control purpose [1]. This centralized system can collect data from multiple devices or objects and has power to compute this data. If we are using this architecture then there are a number of limitations. Before implementing any architecture we should be aware about its limitations very firstly and solution also.

In this paper very firstly we will see limitations of using IoT, solution for this limitation, edge intelligence, edge Computing architecture, edge computing capabilities for smart home conclusion.

Implementing concept of IoT with smart home is now trending but as we know if we are sending this huge data from devices to remote server creates latency and delay issue on sending data. This is a critical issue and can create major problem in real time analytics. Whatever data is sending and stored on remote server will raise security issue also. Along with that privacy concern also raise where data of smart home stored on remote server. To deal with this we need technology which can be able to deal with all issues with major positive outcomes [2].

Future of smart home and smart cities are depended on 5G but still 5G is not that much economical, till the time we can say edge Computing is the solution for this to make it fast and convenient.

2. EDGE COMPUTING

Daily number of smart devices, sensor, and wearable, autonomous machines generating increasing variety of volume that is processed and analyze by computing devices, it must be done reliably and cost effectively. In traditional centralized system architecture data is stored and processed centrally or cloud. This centralized system is slow for today's quick world; so many industries are moving towards decentralization of data. In this data is processed on the edge of network only, it will increase the speed of performance and also helpful to maintain cost [3]. Edge

Computing actually allows data of various IoT devices to be processed on edge of network and remaining data is to be sent on cloud.

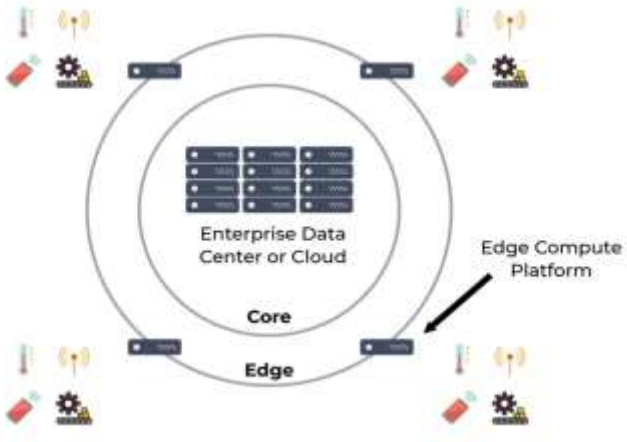

Fig.1.Edge computing decentralizing data

2.1 NEED OF EDGE COMPUTING

a) Push from cloud services

When a device collects data, always trying to send it to the cloud is not tricky. The amount of data produced is too huge, and it can affect the overall performance of cloud architecture. For example, let's talk about the autonomous car where per second 1gb data is generated, this system needs real time processing. Every time we try to send it on the cloud, obviously the response time will get affected here, along with that bandwidth and response time also get affected[4]. Instead of sending all the data to the cloud, if all these things compute on edge, then it will be good for real time processing where response time will be less.

b) Pull from iot

Almost all electronic devices are connected with IoT, from smart street light to smart kitchen. Whatever data they are producing is enormous to handle by a conventional cloud computing system. This means this data will not send on cloud instead of it will get processed at the edge, i.e., all data handling things by cloud will be difficult and not energy efficient, so few things should be processed by the edge side.

C) Change from data consumer to data producer

In cloud computing paradigm, end devices play a role of data consumer. For example, when someone wants to upload data or video on cloud like social media platforms like Facebook, Instagram etc., then time when a user wants to upload video that time before uploading obviously takes more bandwidth because the video size is maximum. In this case, the video should be demise at the edge before uploading [5][6].

3. Smart Home with Edge

Already lots of smart iot devices are available in market, and if home is smart home it will be more convenient for people. We can see various electronic application like smart bulb, smart speaker, smart oven in market. But only adding a wifi module with any electrical device doesn't make it smart in real sense. If we wants to implement smart home then it needs to deploy sensor, controller etc on wall, ceiling, door, floor etc. This can lead problems with data transmission, privacy and security issue. Here cloud paradigm will get fail. So the best option is here edge.

Collecting information from device and sending to cloud then waiting for computing it's lengthy process so instead of this Computing will take take place at the edge then it will more effective to make decisions[7]

3.1 Architecture of Edge for Smart Home

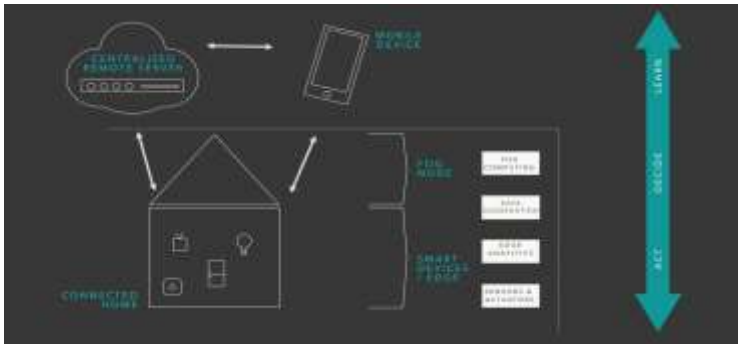

Fig 3.1 Edge Computing Architecture

This architecture explains the edge with smart home as follows.

The main goal of the edge is to pull the work of cloud computing of we can say instead of centralized work Computation should be done on edge only specially for smart home.
Data are collected from the device and it is computed by that device only otherwise data is collected and Computed by any local node of the home network only i.e. fog Computing.
Whatever the analysis and decision are taken by the device or fog node, this data are fed to the device to take further action [8].
The only subset of data is to send on a server which we can see on the diagram. As we know privacy and security matters a lot when we talks about home so here private data is computed by an edge and other data is to be send on remote server
This is helpful to reduce latency, privacy security issues and also utilizes all network resources very well.

3.2 Edge For 2021 with Smart Homes and It's Major Advantages

A) Security

For security purpose of if, we are using the camera, smart door, etc. then they will send data to fog node instead of the centralized server, decision and analysis is performed by fog node only and notification will be sending to mobile phones without the interference of third parties sever.

B) Privacy

In smart home security camera process the image to detect any unwanted activities at the edge. This is the need because it may contain sensitive and private data so that the edge Computing will work here to maintain privacy.

c) Internet Connectivity

If the internet connectivity is low still smart video and audio detecting gadget of smart Home can work and automatic door opening is possible.

D) Edge Analytics and Fog

The smart band can check vital parameters of a person and can call to the ambulance even in the situation of any emergency where fog computing will be helpful to collect all this information from the smart band and can set the smart Home as per the mood of a person[9][10]. It will play major role to analyze the mood of a person.

4. CONCLUSION

Nowadays more and more data are pushed from cloud to edge network because of its various advantages over cloud. bandwidth can be save if most of part of data is computed on edge only instead of cloud. As we know day by day people are liking to switch on smart home concept, to implement this edge Computing would be great choice to maintain more security and privacy with great performance.

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