Abstract - Current world wants everything around
them to be in a smart way for making their life smart. 
Internet of Things (IoT) is the technique which 
provides the smart environment for the needed people 
by combining the sensor nodes, cloud environment 
and wireless communications. Many smart devices 
are in use in the current contemporary world but still 
the issue is energy efficiency of these IoT devices. This 
paper provides a framework for energy efficient data 
communication between the IoT devices and by 
reducing the communication time. It also tries to 
enable the fast communication between the smart 
devices with less energy conservation.

Index Terms – Intelligent rules, energy efficient, IoT 
device, smart environment

I. INTRODUCTION
In current fast moving world, all the things which is 
surrounded by human being are smart devices. 
Smart devices needs the smart controller to control 
the activities within the range.

Zanella et al (2014) cited the different services 
offered with the help of IoT devices to make the 
smart environment. The services includes health 
monitoring, waste management, traffic congestion, 
smart parking, smart lighting and air quality 
monitoring. So, all the services needs the base as 
wireless connectivity between the devices. And 
another aspect they create the smart city by 
providing the data to the higher authorities for 
maintaining continuous monitoring. It also help for 
them to easily identify the fault occurrence place or 
device or where the immediate services are needed.

IoT is a concept where the real world entities are 
integrates with the computer systems to fulfil the 
user current requirements in a easier way. And it is 
the technology which combines the wireless 
devices with networking infrastructure to create 
smart environment. The problem in maintaining the 
IoT devices and smart environment is energy 
consumption by different devices. Each device 
required different energy level to execute their 
operation like data collection, information 
exchange, alert information, decision making, etc.

This paper focuses to provide the energy efficient 
framework for data collection between the IoT 
devices to implement any IoT based smart 
environment. The rest of the papers are explained 
as follows. Section discussed about the related 
literatures of the IoT based smart environment and 
energy efficient mechanism they are used. Section 
3 gives the proposed framework for energy 
efficient IoT based smart grid based environment. 
Section 4 analyse the advantages and limitations of 
the proposed framework. Finally concludes the 
paper with the conclusion and future enhancement 
to be done on the proposed framework.

II. LITERATURE SURVEY
Most of the existing literature works deals with IoT 
are concentrates on energy efficiency because 
energy loss in devices leads to data loss which 
makes the system fails.

Corno F and RazzaK F (2012) provides the smart 
grid environment based on the utility and their 
energy consumption. It creates the local energy 
management systems for segmented zone of grids 
and maintains the balance between user 
requirements and energy saving in the user devices.

Mainly, IoT devices are composed of sensor nodes 
and data centres to analyse the received 
information and make the decisions. Rault 
et al (2014) discusses about maintains the energy in 
wireless sensor nodes in an efficient way. This 
paper provides the systematic discussions that how
the energy consumptions of the nodes vary based on the user requirements.  

Akkaya et al (2015) provides the framework for energy efficient smart buildings. This work deals about the monitoring and data fusion techniques for increasing the monitoring accuracy in multi floor buildings.  

Machado et al (2013) gives the technique for energy efficient and enable the link quality between the IoT devices. The routing mechanism enables the lossless end to end link with respect to the hop count. It also maintains load balancing at each node to avoid the data loss because of packet over flow.  

Jahn M et al (2010) discusses about maintaining energy in the middleware devices which helps to inter connects the smart devices as a system. It says that the smart systems need the data in meaningful contexts to provide the meaningful decisions on the received information from sensor devices. It considers the energy consumed by the smart devices in standby mode also.  

Decision making based on the data received from the smart devices is the important thing in building the smart home environment.  

Han, D.M. and Lim, J.H (2010) discussed about smart home environment using Zigbee sensor networks in their work. Their system divides the home into several segments based on the physical area and allocates the component which is needed in each segment. This will avoid the energy consumption in all Zigbee nodes when it is not in use.  

Byun and Park (2011) proposes the self adaptable context aware systems which makes the device adaptable to provide services based on the user needs. This system consists of a gateway (self adapting intelligent gateway) and a sensor (self-adapting intelligent sensor).  

Gungor et al (2013) gives a survey on information and communication technologies with smart grid environment. This paper provides the overview of issues in communication with the smart devices when they send the information and to take the decision based on the analysis of the received information. It also discusses about the energy consumption of the storage devices and energy requires for real time data exchange.

Fig 1. Layered architecture for IoT based Smart Environment
III. PROPOSED FRAMEWORK

The IoT devices generally need the four layered framework for maintaining the smart environment. In this, top layer is cloud infrastructure, local server and IoT devices as shown in Figure 1. Cloud infrastructure maintains the database which contains the information about the IoT devices and their connectivity. It also integrated with the local servers to pass the decision making to the IoT devices.

Local servers are also called as intelligent servers which instruct the IoT devices based on the information received from them and maintains the communication between the IoT and cloud server for providing the smart environment. Some of the computational task are carried in the local servers for fast communication.

In the given framework the devices are sense the information and pass it to the local server for computational task. The local servers are not maintains the interconnectivity between them which reduce the collision between the servers and bottleneck problems. And also, the IoT devices are required less energy by not linking unnecessarily with all local servers. The Intelligent fuzzy rules are recommended here for decision making process. Because, each IoT device is used for any one purpose and they linked with local server to complete any computational task.

Consider the scenario, IoT device 1, 7 and 9 act as the camera then it can recognize the object by compare the object with data base maintains in the local server where they are connected. But device 2 may be the door sensor, it has to communicate with the cloud server to make the decision that the identity provided by the user is authenticated or not. Because, it should not be maintained at the local server 1 where it is connected to avoid the data loss. And also for all devices the backup data should be maintained at the cloud infrastructure with the provision of frequent updatations.

Algorithm: Intelligent Rules for Decision Making at Local Server

1. Get the data and task from IoT device.
2. Check task whether it is computational task, recognition task or analysis task.
3. If task = computational task then assign it to the local server.
4. If task = recognition task then check solution with cloud database
5. If task = analysis task then based on given information decision making process has to find the solution.

Based on algorithm 1, the task analysis and separation is performed by local servers when it receives the information from the connected IoT devices.

IV. PERFORMANCE EVALUATION

The performance of the proposed system is evaluated by the time taken for task completion in seconds and energy consumed by the devices in for their task for smart home environment. Experiments are carried out with fire base cloud setup, twelve sensor nodes or devices like finger print recognition, mobile phone act as a controller for control electronic items, camera and door sensor. Local servers are maintained to recognize the door sensor using finger print recognition, single remote to control all the electrical items, etc...

Table 1 shows the performance measures of IoT devices such as mobile phones, sensor nodes and cameras. Analysis are carried out for all devices with intelligent rules and without intelligent rules. The analysis shows that the energy consumption is reduced for most of the devices when they are operated with intelligent rules. Time Consumption is also reduced when we are executing the applications with the intelligent rules.
Table 1. Performance Measures with and without intelligent rules of IoT devices

<table>
<thead>
<tr>
<th>Devices</th>
<th>Energy Consumption (Joules)</th>
<th>Time Consumption (ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Without Rules</td>
<td>With Intelligent Rules</td>
</tr>
<tr>
<td>Node 1</td>
<td>0.5</td>
<td>0.3</td>
</tr>
<tr>
<td>Node 2</td>
<td>0.8</td>
<td>0.4</td>
</tr>
<tr>
<td>Node 3</td>
<td>0.7</td>
<td>0.45</td>
</tr>
<tr>
<td>Node 4</td>
<td>0.5</td>
<td>0.4</td>
</tr>
<tr>
<td>Node 5</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>Node 6</td>
<td>0.6</td>
<td>0.4</td>
</tr>
<tr>
<td>Node 7</td>
<td>0.5</td>
<td>0.3</td>
</tr>
<tr>
<td>Node 8</td>
<td>0.8</td>
<td>0.5</td>
</tr>
<tr>
<td>Node 9</td>
<td>0.5</td>
<td>0.3</td>
</tr>
<tr>
<td>Node 10</td>
<td>0.6</td>
<td>0.5</td>
</tr>
<tr>
<td>Node 11</td>
<td>0.6</td>
<td>0.55</td>
</tr>
<tr>
<td>Node 12</td>
<td>0.85</td>
<td>0.65</td>
</tr>
</tbody>
</table>

V. CONCLUSION

This paper comes with the framework to reduce the energy consumption of the IoT devices by applying intelligent rules. Most of the previous work are maintained either local server or cloud server for decision making. In this proposed system, both cloud and local server are used. But decision is taken by any one which will handled by intelligent rules. With the use of these rules, time consumption also reduced for all IoT devices.

REFERENCES


