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COMPARITIVE ANALYSIS OF IOT SENSORS FOR CONSERVATION OF ENERGY

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ABSTRACT

Saving Energy is the most important and difficult task these days. In modern era where energy resources are used in large amount and 20-25 percent of the energy is wasted. The resources are decreasing day by day. Level of ground water is decreasing in much higher speed then the last few decades. World is reaching towards the day when there will be no drinking water. Cape Town is the first major city in the world which is in the situation of facing threat of running out of drinking water. Without water the survival of human being is impossible. In this era human is dependent on LPG, natural gas and electricity to cook food these energy resources are also important to conserve. This study will help in saving more and more energy like cooking gas, electricity and water

Keywords: - *NodeMCU, LDR, PIR Sensor, MySQL Database, Web Server, Gas Sensor.*

I. INTRODUCTION

The dependency on energy resources like water, wood by the humans is from the very beginning of human civilization. With the increasing amount of time, fresh technologies have been developed by the humans with their such ability and are completely dependent on these invented technologies. There has been a constant regularity in this dependency of man on the natural resources. The natural resources are categorized as follows:

Renewable natural resources: Renewable natural resources can be defined as the resources that have the tendency to get exhausted on their own. Rain, tides, geothermal heat, sunlight and wind can be categorized as the examples of renewable energy resources. The processes of electricity generation, heating of water, transportation are done with the help of the above mentioned resources.

According to the REN21's 2017 report, 19.3% of the total human's global energy consumption comes from renewable energy resources and 24.5% of the total electricity generation in 2015 and 2016 came from the renewable energy resources. The division of this energy is as following:

a) 8.9% from traditional biomass

b) 4.2% from geothermal and solar heat energy

c) 3.9% hydro-electricity

d) 2.2% from wind, solar, geothermal and biomass.

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More than USD 286 billion worldwide investment is done in renewable technologies in 2015. Countries like China and United States are investing in power plants that are generating energy from wind, hydro, solar and biofuels.

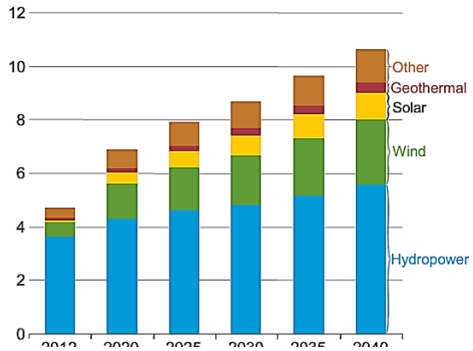

Figure 1 | Electricity generated from different renewable energy sources

| Source - http://geothermalresourcescouncil.blogspot.com

Non- renewable energy resources: Non-renewable energy resources are those resources that does not renew itself at a sufficient rate. These energy resources are also known as finite resources as these resources are in limited amount. The continuous use in large quantity can finish these energy resources. These resources are carbon-based, organically-derived fuels. These resources are made up of original organic material with the aid of heat and pressure, for a long time, with this process oil and gas is made. Some of the non-renewable resources are:

a) Earth minerals and metal ores

b) Fossil fuels

c) Ground water

These energy resources generates more than 70% of the energy generated in today's world.

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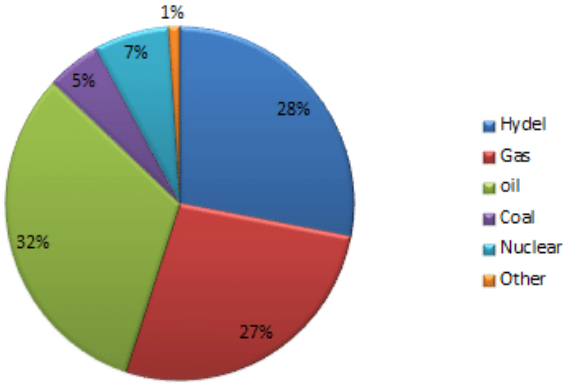

Figure 2 | Electricity generation from renewable and non renewable resources |
Source - https://www.researchgate.net

Day by day as these resources are decreasing, they have to be conserved. Conventional energy management systems are not much affective as the wastage of energy continues in large amount. To save the energy in modern world, management system has to be connected with internet. Internet is the most evolutionary invention done in recent times. Using the internet energy management system will be more effective as it provides remote access to all appliances connected with it. It also provides the monitoring of all devices connected to it. This management system comes under a concept known as internet of things or internet of everything.

Internet of things or internet of everything is newly evolved technology in which the electronic, electrical or mechanical devices are connected to internet for transmitting their data. In electrical and electronics, every device can be connected to internet by adding a wireless module. But in mechanical machines, an electronic controller is connected with the machine which will further connect with internet.
The network connection between the physical devices, vehicles, appliances along with the electronic sensors and software for exchanging data are termed under the internet of things. The creation of integration opportunities between computer based and physical world is always helpful in reducing human exertions.

The number of devices connected with internet is increasing at the rate of 31% per year and it has reached to 8.4 billion in 2017. It is estimated that there will be more than 30 million devices connected to internet by 2020. The statistical market value of IoT is estimated to be $7.1 trillion in the year 2020.

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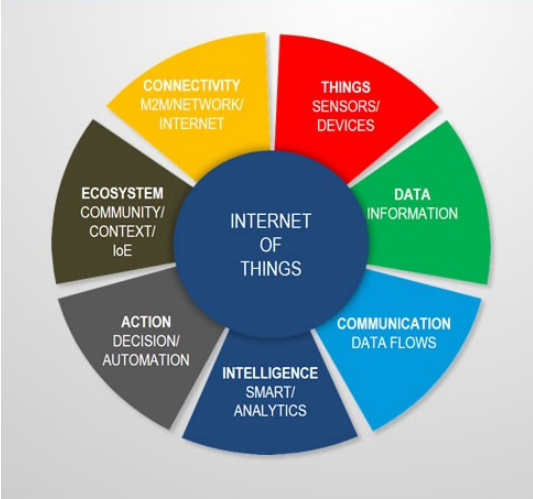

Figure 3 | Seven characteristics defining IOT |

Source - https://in.pinterest.com

II. LITERATURE SURVEY

S.no.	Author	Year	Contribution
1	Rajeev Piyare	2013	This system mentioned comprising low cost home monitoring device in his paper. The architecture has three parts, Home Gateways, Environment and Remote Environment. It includes hardware, software and web server. Light switches, temperature sensors etc can be controlled with this system.
2	Akbar Satria et al	2015	In this device, Arduino microcontroller is used. It is connected with Measuring Tool Power and Ethernet Shield. This device operates on 5v dc supply. Connectivity between the device and the phone is with internet which helps the user to control the device with the phone.
3	B. Muralikrishna	2015	In this system, Bluetooth module is used to control the devices. The platforms used to develop this system are Embedded systems, Xilinx and a Bluetooth Module (HC-05).

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4	K. Vidyasagar	2015	To detect the presence of Ammonia in surroundings Methane Liquid propane gas sensor is used. This element adsorbs it after ionizing to its constituents. The gas sensor gives output signal when gas is detected. Fire detection is done using a device in which hydrocarbons would burn than other regular combustibles with flammable to increase temperature. Smoke sensor is used to detect the smoke. It is followed by a voltage drop at the pins of the sensor.
5	K. Ghosh	2015	Using this research, human life will be more comfortable and easy as it will decrease the human interference by making home fully automated. In this, voice commands are used to control the devices. This research is very-much helpful for disable people.
6	PoojaN.Pawar	2016	This research helps in making home-automation system using microcontroller, LCD, Bluetooth module, power supply and a simple crystal circuit.

III. IMPLEMENTATION

This Internet of things based energy conservation system is used to monitor and control the devices connected with it. It can control the connected devices using the readings of the connected sensors. It also provides the remote access to the user from anywhere using the mobile and web application. The basic sensors connected are:

Light dependent resistor(LDR): LDR is the sensor which works with the intensity of the light. The resistance of the sensor varies as the intensity of the light varies. It is used to control the lights in the house. In the evening and night times, when the intensity of light is very low it sends the readings to controller which will control the lights

using relay card. In the day time when the intensity of light is high and there is no need of light, then the controller can switch off the lights automatically using the readings of LDR sensor.

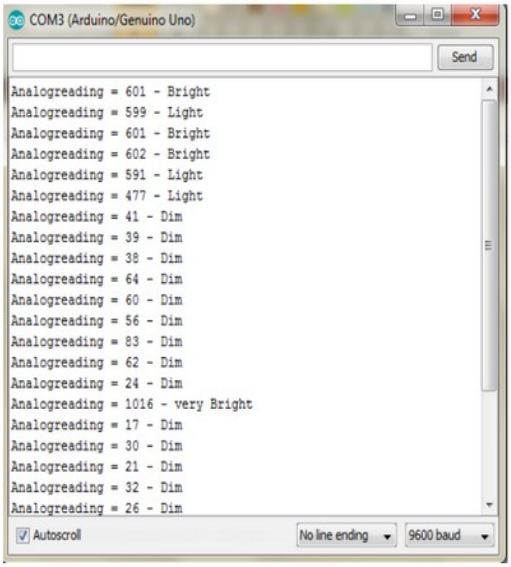

Figure 4 | Readings of LDR Sensor

Passive Infra Red (PIR) Sensor: PIR sensor is the sensor used to detect the human motion. When there is any human motion, it detects and transmits a signal to the controller. With this signal the controller can control the devices.

Example: When there is no human in the area, this sensor will not sense any thing and send 0 to the controller. At this time controller will switch off the lights and when the motion is detected in that area, it sends 1 to the controller. Using the programing the controller can switch on the lights.

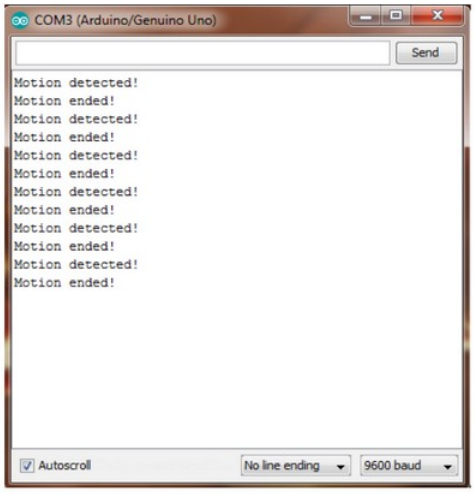

Figure 5 | Readings of PIR Sensor

Temperature Sensor: Temperature sensor is used to read the temperature of a particular area and transmit that temperature to the controller. This data is used by the controller to control the speed of the fan. If the temperature of

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the room is high, then the controller will increase the speed of the fan and if the temperature is low, then the controller will lower the speed of the fan.

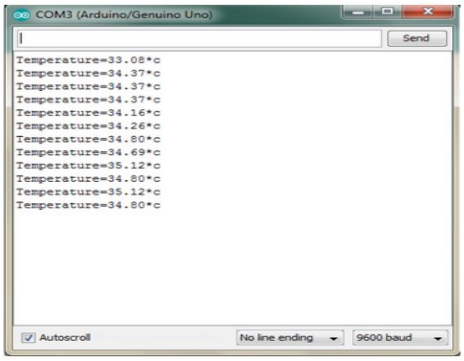

Figure 6 | Readings of Temperature Sensor

IV. BLOCK DIAGRAM

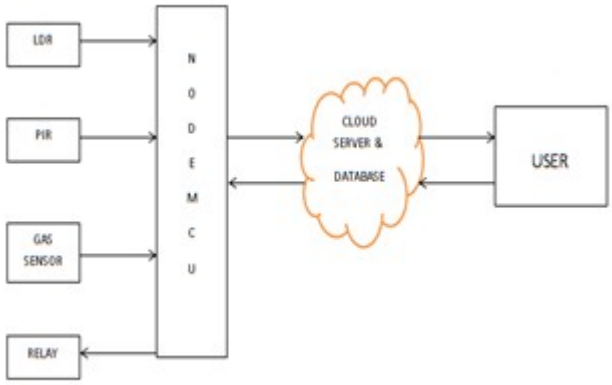

Figure 7 | Block diagram for implementation

NodeMCU is the controller which takes the readings from connected sensors (temperature, PIR, LDR) and transmits those readings to the cloud server and the database. Using this server, the user can access the data from anywhere. These readings can be used in analyses of consumption. User can control these connected devices from anywhere in the world at anytime using mobile application and web application. Gas sensor is used to detect the leakage of gas in the house. It will send an alert to the user on the mobile and web application of leakage. The user can control the inlet of gas pipeline from these mobile and web application. In the same way water sensor is used. It will check the continuous flow of water for a particular time after that time if water flows continuously, an alert is sent to the user on the mobile and web application.

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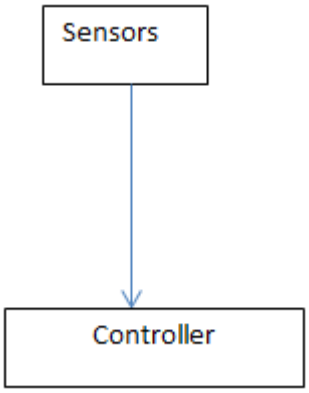
THE value of Temprature is:	THE value of Humidity is:	THE value of Intensity is:	Leakage Status	Gas Valve Status
28	49	513	NO Leakage	Valve On

Figure 7 | Web page view

V. STEPS OF EXPERIMENTATION

Step 1
Sensors take readings from soundings
Temperature, Intensity of light, Gas Leakage
Step 2
Transmission of readings towards controller



Step 3
Controller analyses the values and perform functions according to it. Transmits the values to cloud server and database

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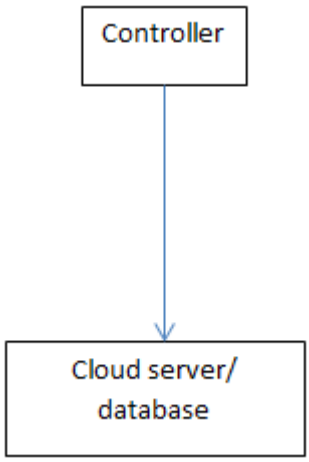
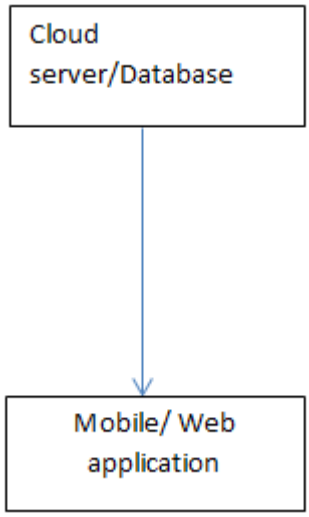


Like :
Light intensity is LOW, Switch ON the lights
Temperature is LOW, Slow down the fan
Gas leakage detected, CUT the main supply of GAS
Step 4
Server sends every single change as notification on mobile and web application



Step 5
User controls the devices connected to the controller using mobile/web application

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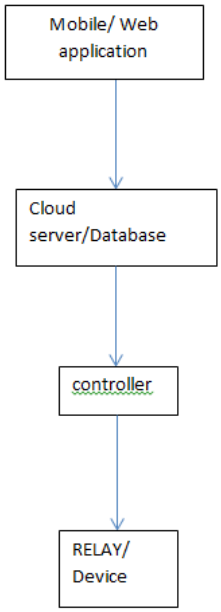

C1: Brightness (B)	L-Low M-Medium H-High	C4: Temperature (T)	C-Chill A-Ambient H-Hot	C7: GAS LEAKAGE (GL)	Y- YES N-NO
C2: Human (HU)	Y-Yes N-No	C5: Humidity (HD)	L-Low H-High	C8: WATER LEAKAGE (WL)	Y- YES N- NO
C3: Weather (W)	S-Sunny R-Rainy C-Cloudy	C6: Time (TM)	M-Morning A-Afternoon E-Evening	C9: HOUSE LOCKED (GL)	Y-YES N-NO

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ID	Rules (Condition and Decision Attributes
Rule1	(C2 is True)^(C1 is Low)=>Lights ON
Rule2	(C2 is True)^(C1is High)=>Lights OFF
Rule3	(C2 is True)^(C4 is Hot)=>Increase Fan Speed
Rule4	(C2 is True)^(C4 is Chill)=>Decrease the Fan Speed
Rule5	(C2 is True)^(C6 is Aftemoon)=>Increase Fan Speed
Rule6	(C2 is False)=>Lights OFF
Rule7	(C7 is True)=>GAS OFF
Rule8	(C8 is True)=>WATER OFF
Rule9	(C9 is True)=>GAS/WATER/ELECTRICITY OFF

VI. CONCLUSION

Internet of things based energy conservation system is the advance system to save the energy that was wasted in a house. It is providing lifesaving security in gas leakage case as it is sending alert to user's mobile and web application. The combination of hardware and software provide the access of connected devices to user. User can remotely access any of the connected devices. It is also providing a feature in which during the time when there is no-one in house it automatically shut down every single device as well as water and cooking gas inlets.

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