IoT connected smart home automation using Web Application

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Abstract: Internet of things (IoT) gives an idea of how to remotely control and monitor real world devices. The article describes how to minimize the utilization of energy and make things smart by using Internet of things. For this purpose, all the home appliances are automated to avoid waste of power due to human behaviour. The proposed system in this article is monitored by web application. To keep user aware, logs are created in database and user is notified through a web application. The leverage obtained by this paradigm is that a user can have all previous records from the log of database.

Keywords: *Internet of Things (IoT), NodeMcu (Microcontroller), Raspberry pi (Microcontroller) and Infrared sensor (IR).*

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1. Introduction

Now a days, energy saving is one of the essential issues because energy is being expensive. Often people forget to turn off home appliances when these appliances are not in use. It has become a need of every individual to minimize energy utilization. To save energy, home appliances are automated by using IoT. IoT is a platform that connects people and devices through Internet. Recently, IoT is being popular rapidly with the technological evolution. The whole system comprises of sensors, microcontrollers, networking hardware/chipsets, microprocessors, embedded systems and the Internet. This system connects to local area network, where all possible communication between IoT devices. One of the most capable platforms used in IoT is Raspberry pi, which is a minicomputer that makes complex and heavy networks easier by using minimal extras. Raspberry pi provides a Linux server in a tiny package with a very low cost. If a person is not present in a room all appliances (Fan, AC and Heater) should be off to save energy. If a person enters a room, lights, AC or heater of room turn on automatically by use of IoT and when person leaves, lights, AC or heater are immediately off to save power. Similar conditions are set for the lights and exhaust of washroom. Exhaust of washroom remains on for two minutes after the person exits and then it turns off automatically. To keep record of all the power consumption, a current sensor is used that measures current being consumed and a log is created on the database and user is notified through web application. Model provides details how to improve human lifestyle with cost effective living including safety, security and compatibility.

2. Literature review

The integrated network and interconnected mechanism of sensors transfer the data via internet, an environment that can respond to humans has many benefits [1]. The description and usage of IoT platform in smart home automation is based on mobile application. Mobile application is used for connecting, controlling and monitoring the objects which are connected to the IoT platform [2]. The challenging task is to make context-aware system that gathers data from physical devices and creates data management systems to save and manage data retrieval [3]. The IoT smart home system runs on insecure network implemented on Alljoyn framework. The strong security approach is deployed for IoT smart home system. The Wi-Fi gateway is used as a centre node that is responsible for communication between IoT devices. Access and control of IoT smart home system through Android and web application running the IoT application program [4]. The growth of IoT in living environment of people changes a home to smart home. These IoT devices can be digital or analogue to communicate over the internet. All IoT devices made by different companies with different material and different technology, the Connectivity problems exists in these devices, the challenges in connectivity with different communication protocols in the smart home system [5]. Architecture for IoT device management framework is targeted for smart

home scenarios. The internal components of the architecture are highlighted along with Deployment scenario and prototype implementation and evaluation are presented. The overall prototype is found to be lightweight and allows real time interaction. Such prototypes could also pave way for developing user centric IoT services for smart home using other M2M functions like discovery, semantic data processing [6]. In particular, the machine interface between automobiles and humans must allow for the seamless integration of several types of personal devices that support various software and hardware standards to allow drivers to use their smartphones while driving. Therefore, the future vehicle will have the capability of surround sensing, and can form connections between vehicles, as well as between vehicles and surrounding infrastructure. This will lead to increased requirements for information and communication technology, and ultimately, cars will become a part of the Internet in near future [7]. The device detects the vibration of the washer and dryer and can distinguish the end of the operation. In addition, a refrigerator, an air conditioner, a robot cleaner, and two multi-room speakers are used as Wi-Fi communication devices [8]. PIR motion sensors are installed at the entrances of a building. These sensors as explained earlier detect the motion of human beings. This signal which detects their presence becomes the input trigger for the micro-controller. The owner, who may or may not be present in that building, will be receiving a voice call on his mobile phone (whose number is predefined in the program) stating that 'There is an Intruder in the House'. To turn ON the lights and alarm at house so that the intruder will be warned, the owner can press '1' from his mobile keypad. Moreover, if the owner finds that his building is not safe, he can send an SMS [9].

3. Methodology

The system consists of sensors, microcontrollers, networking hardware/chipsets, microprocessors, embedded systems and the Internet. The goal is to provide connectivity and data mining capabilities that use Internet and online server to process data and make intelligent decisions for end users. The principal of the system is based on artificial intelligence algorithm, which performs all the computation and communicates with distributed processing units installed at various locations in the buildings. The choice of sensor plays a crucial role in the performance of system. In addition to quality of the sensors, the calibration is carefully managed by the software in order to reduce errors. The Wi-Fi technologies are used for easy integration with the existing handheld devices and computers. In order to make the system well grounded, it is ensured that the connectivity between the sensors and the computing devices is maintained with very low-down time.

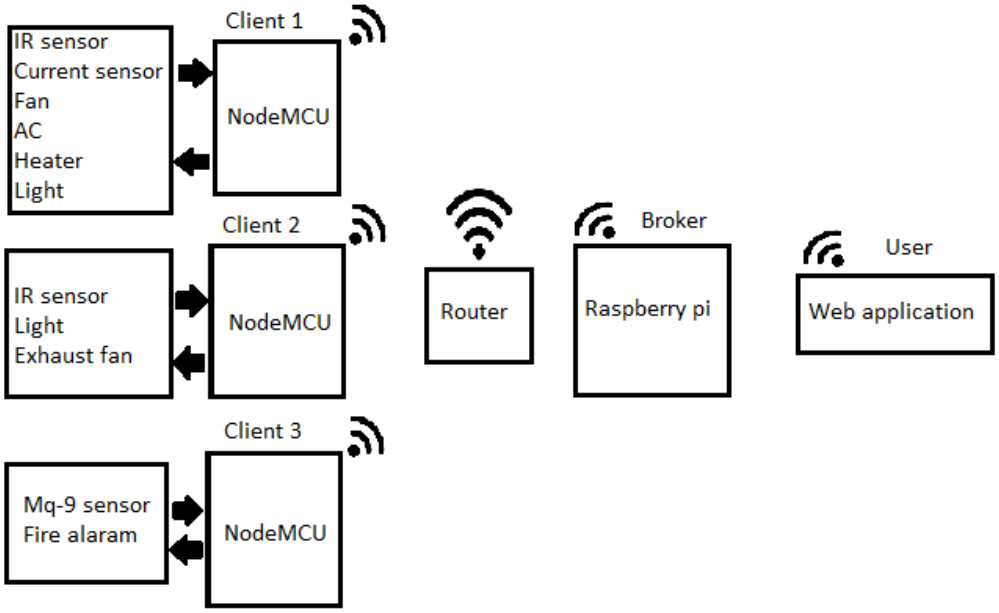

Figure: 1 Block Diagram

The complete lay out of the project is shown in Figure 1. Clients mentioned in the figure 1 are the microcontrollers (NodeMCU esp8266). Each of the microcontrollers is fixed in different place. Client 1 is placed in room. Three sensors, infrared, current and temperature sensor are connected to client 1 to control the appliances of room. Infrared sensor is fixed at door and it is detecting the motion whenever a person enters the room. Its purpose is to count the number of persons present in the room. If person is present in the room then the light, connected to a relay through NodeMCU is on. If a user wants the light to remain off even when a human is in the room, then a button of light in the web application must be set to off by the user otherwise light will get on or off automatically according to the human presence. A temperature sensor is also connected to the client 1 and it is sensing the temperature of the room according to which a fan, AC or a heater is on or off by the microcontroller. AC or heater are on if a human is present in the room and the temperature of the room is greater than a threshold set by the user on web application. A current sensor is connected to client 1 and measures the power consumed by all appliances of home and updates consumption of current to web application. Client 2 is placed in washroom whereas, IR sensor is connected to client 2 which is placed at washroom door to detect the presence of a person the washroom. If presence of a person is detected by sensor then light and exhaust of the washroom are on. When the person exits the washroom, light is off immediately, sand exhaust is off after two minutes.

Client 3 is placed in lounge. Toxic gas sensor (Mq9) and an alarm is connected to client 3. Sensor is sensing the toxic fumes in home. Alarm is on when the toxic fumes are detected in home and notification

is generated on web application. All the three clients and a raspberry pi (broker) are connected to router. Router is assigning dynamic IP addresses to clients and raspberry pi. Router is used for creating communication network between all devices. Broker is used for exchanging the data between all clients and database. Web application is a user interface which is connected to database. Web application has all the information about the sensors data and all the thresholds are set by user using web applications.

3.1 Web application

A web app is a program that is stored on a server and can be accessed through internet using a browser. By using a web app, a user can acquire and manipulate data. It is also accessible through a mobile, laptop or desktop computer using a variety of browsers.

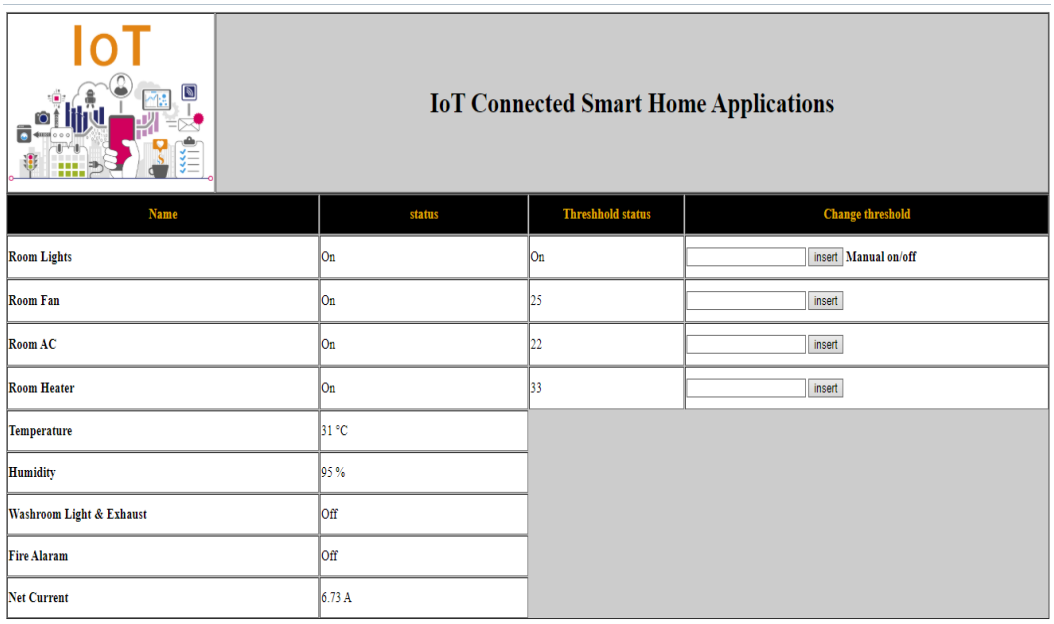

Figure: 2 web application

3.3 Web application interface

The title of web application is IoT Connected Smart Home Applications. First column is for name of different appliances, second for the current status of each appliance, third for the status of threshold set by the user and fourth one is for changing the threshold. A user can use the insert button to change the threshold temperature, to controls fan, AC or heater. There is also a button to turn light on or off if a user

does not want to allow it to be automated. Second row is for room lights, next is for fan, AC heater, temperature, humidity, washroom lights, fire alarm and net current respectively. Where Status tells current state of appliances. The threshold status tells what value is set by the users. Current temperature and humidity of the room is given in the second column (status).

4. Outcomes of Undertaking Coursework

Figure 3 shows 17 tables created in the database. For the data of each sensor there is a separate table. Some tables are used for setting thresholds. Each table has three columns. 1st column is for ID, 2nd for data of sensor and 3rd for time and date to keep record when database is updated. Figure 4 shows the results obtained by the temperature sensor and different time and date. The rows of the table show different entries of data which are updated to the database and rows are increased by default auto increment and a log is created. This log has all the previous record of the data obtained by the sensors. Figure 5 displays the results from the automation of light. It has three columns. 1st column is for ID, 2ND for the data which is in the form of zeros and ones to show if the light is OFF or ON, 3rd shows the time and date at which light is ON or OFF .When light is ON, 2nd column of the table is updated with a '1'. When light is OFF, 2nd column is updated with a zero.

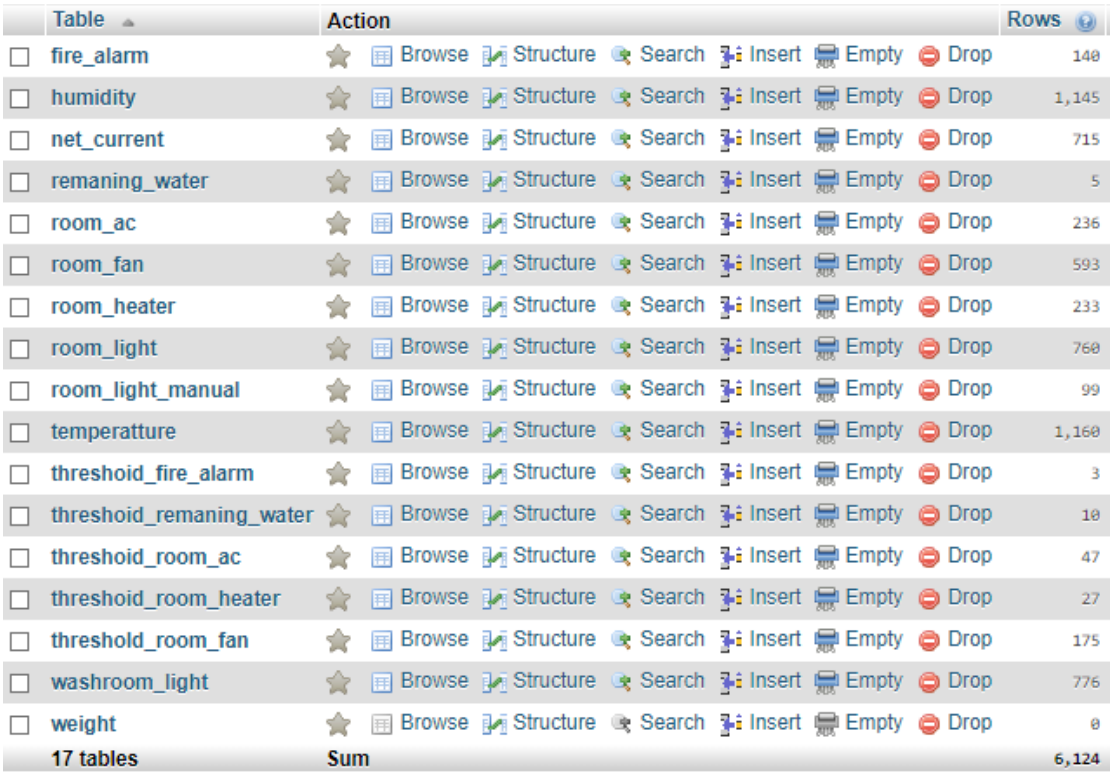

	Table	Action	Rows
☐	fire_alarm	Browse Structure Search Insert Empty Drop	140
☐	humidity	Browse Structure Search Insert Empty Drop	1,145
☐	net_current	Browse Structure Search Insert Empty Drop	715
☐	remaning_water	Browse Structure Search Insert Empty Drop	5
☐	room_ac	Browse Structure Search Insert Empty Drop	236
☐	room_fan	Browse Structure Search Insert Empty Drop	593
☐	room_heater	Browse Structure Search Insert Empty Drop	233
☐	room_light	Browse Structure Search Insert Empty Drop	760
☐	room_light_manual	Browse Structure Search Insert Empty Drop	99
☐	temperatture	Browse Structure Search Insert Empty Drop	1,160
☐	threshoid_fire_alarm	Browse Structure Search Insert Empty Drop	3
☐	threshoid_remaning_water	Browse Structure Search Insert Empty Drop	10
☐	threshoid_room_ac	Browse Structure Search Insert Empty Drop	47
☐	threshoid_room_heater	Browse Structure Search Insert Empty Drop	27
☐	threshold_room_fan	Browse Structure Search Insert Empty Drop	175
☐	washroom_light	Browse Structure Search Insert Empty Drop	776
☐	weight	Browse Structure Search Insert Empty Drop	0
	17 tables	Sum	6,124

Figure: 3 Tables of database

←T→	id	temperature	time and date
☐ Edit Copy Delete	8	32	2019-08-28 02:56:01.058447
☐ Edit Copy Delete	9	34.1	2019-08-28 02:56:39.370889
☐ Edit Copy Delete	10	29.4	2019-08-28 02:57:17.667351
☐ Edit Copy Delete	11	28.5	2019-08-28 02:57:55.969729
☐ Edit Copy Delete	12	28.1	2019-08-28 02:58:34.289416
☐ Edit Copy Delete	13	27.9	2019-08-28 02:59:12.608643
☐ Edit Copy Delete	14	27.8	2019-08-28 02:59:50.901012
☐ Edit Copy Delete	15	27.7	2019-08-28 03:00:29.264150
☐ Edit Copy Delete	16	27.7	2019-08-28 03:01:07.508218
☐ Edit Copy Delete	17	27.6	2019-08-28 03:01:45.812637
☐ Edit Copy Delete	18	27.6	2019-08-28 03:02:24.113644
☐ Edit Copy Delete	19	27.6	2019-08-28 03:03:02.462516
☐ Edit Copy Delete	20	27.6	2019-08-28 03:03:40.722721
☐ Edit Copy Delete	21	27.6	2019-08-28 03:04:19.004458
☐ Edit Copy Delete	22	27.6	2019-08-28 03:04:57.301667
☐ Edit Copy Delete	23	27.6	2019-08-28 03:05:35.629255
☐ Edit Copy Delete	24	27.6	2019-08-28 03:06:13.925654
☐ Edit Copy Delete	25	27.6	2019-08-28 03:06:52.239242

Figure: 4 Results of temperature

	id	room_light	time and date
Edit Copy Delete	1	1	0000-00-00 00:00:00.000000
Edit Copy Delete	2	0	0000-00-00 00:00:00.000000
Edit Copy Delete	3	1	0000-00-00 00:00:00.000000
Edit Copy Delete	4	0	0000-00-00 00:00:00.000000
Edit Copy Delete	5	1	0000-00-00 00:00:00.000000
Edit Copy Delete	6	1	2019-09-12 16:42:41.616653
Edit Copy Delete	7	0	2019-09-12 16:43:27.778259
Edit Copy Delete	8	1	2019-09-12 16:43:41.952074
Edit Copy Delete	9	1	2019-09-12 16:44:24.852880
Edit Copy Delete	10	1	2019-09-12 16:44:58.894987
Edit Copy Delete	11	0	2019-09-12 16:45:03.677299
Edit Copy Delete	12	0	2019-09-12 16:45:10.702947
Edit Copy Delete	13	0	2019-09-12 16:45:16.284047
Edit Copy Delete	14	0	2019-09-12 16:45:25.278408
Edit Copy Delete	15	0	2019-09-12 16:45:29.218511

Figure: 5 Results of room light

5. Conclusion

IoT connected smart home is beneficial for energy saving. Due to the automated home appliances, waste of energy is minimized at a big scale. Model is cost effective so everybody can afford this and save money by avoiding waste of energy. Web application is accessible through Internet anywhere in the world, which makes easy to keep an eye on the whole system and monitor appliances anytime from anywhere. The web application is user friendly and easy to use. The whole integrated system is perfectly functional and efficient enough to work for reducing unnecessary energy usage.

6. References

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