Design of an IoT Smart Home System

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Abstract: In improvement of technologies and industry, Our living turns out to be increasingly agreeable. Nonetheless, an issue of the present world is populace maturing. Over decades ago the quantity of more established individuals has been expanding. The objective of numerous inquiries about is to empower elderly individuals to live freely. The surrounding helped living envelops specialized frameworks, foundations, and administrations to help elderly individuals in their every day schedule and to permit an autonomous and safe way of life to the extent that this would be possible. One of those undertakings is eWALL venture. IOT is an idea that is utilized in these ventures and it speaks to the associations among people and keen protests that are a piece of this situations. In these sorts of keen conditions, diverse technologies are utilized for correspondence. These technologies are: Wi-Fi, Bluetooth, Bluetooth Low Energy. The objective of this work is to indicate conceivable issues in concurrence of previously mentioned technologies. Additionally, psychological radio is considered as an answer for obstruction issue caused by concurrence of various technologies in home condition.

Keywords: WI-Fi, Bluetooth, IOT, Bluetooth Low Energy, Ambient Assisted Living.

I. INTRODUCTION

Throughout the most recent decades number of elderly individuals has been expanding. Therefore, populace maturing has turned into the critical issue of the present society. Innovation assumes an imperative job in empowering more seasoned individuals live autonomously. Because of many research ventures, brilliant home conditions are created. Those situations are conveyed utilizing IOT. IOT speaks to the associations among people and keen protest that are a piece of shrewd home conditions. One of these tasks is eWALL venture. With various gadgets, technologies and brilliant articles it is intended to enable elderly individuals to live more autonomously. As the quantity of gadgets gets greater, a probability of obstruction in home condition gets higher. Obstruction in home condition is an aftereffect of gadgets utilizing diverse technologies for correspondence. In this paper, conjunction of remote technologies in IOT (Wi-Fi, ZigBee, - Bluetooth and Bluetooth Low Energy) in indoor condition is analyzed. Moreover.a probability and advantages of utilizing intellectual radio is inspected. So as to decide likelihood of obstruction SEAMCAT [2] reenactment apparatus has been utilized. A similar device was utilized for looking at conceivable outcomes of applying subjective radio in the brilliant home situations so as to enhance conjunction of various remote technologies.

II. SMART HOME SYSTEM

Keen home situations in encompassing helped living are produced to assist elderly individuals with living all the more serenely and freely. It comprises of extraordinary number of gadgets all of which have the job of empowering elderly individuals to carry on with a superior life. Web of things (IOT), as one of the real correspondence progresses lately, joins the Internet with ordinary sensors and gadgets and it is utilized for connecting physical and virtual items. In [1] engineering of IOT based home framework is introduced. The framework, in previously mentioned paper, can be partitioned in three layers: detecting and activating layer, arrange layer and application layer. In Fig1 design of IOT based brilliant home condition is displayed.
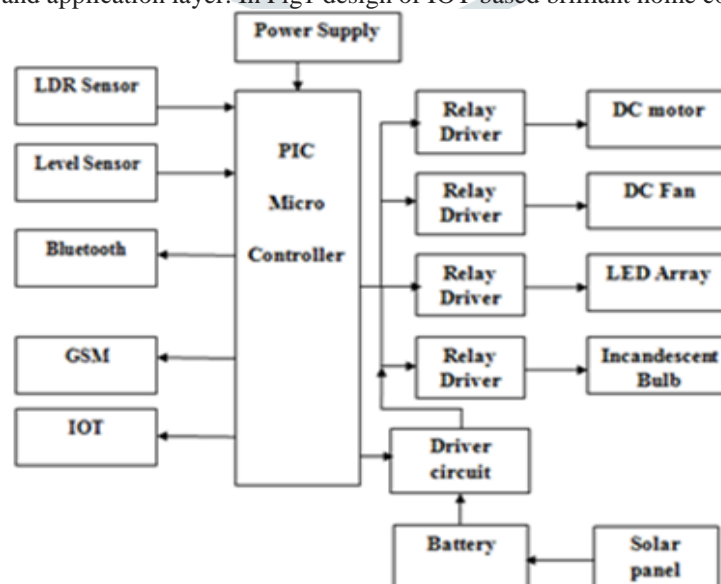

Fig.1. IOT based smart home environment [1].

The eWALL framework design is utilized for instance of conceivable IOT based keen home condition. It comprises of various gadgets, sensors and actuators that can be viewed as a piece of detecting layer as indicated by Fig.1. These gadgets are associated with home PC which is in control for information handling and exchanging information to eWALL cloud. It very well may be viewed as a system layer. At last, the eWALL framework comprises of various applications like My Health, My Sleep, My Daily Life and My Activity which make the application layer. In Figure 2.eWALL home establishment is appeared. In this work, the accentuation is put on detecting layer. It comprises of incredible number of sensors and gadgets. As it tends to be seen from the Fig.2. These gadgets and sensors utilize diverse remote technologies for correspondence. Because of various technologies utilization, home condition obstruction probability ought to be inspected.
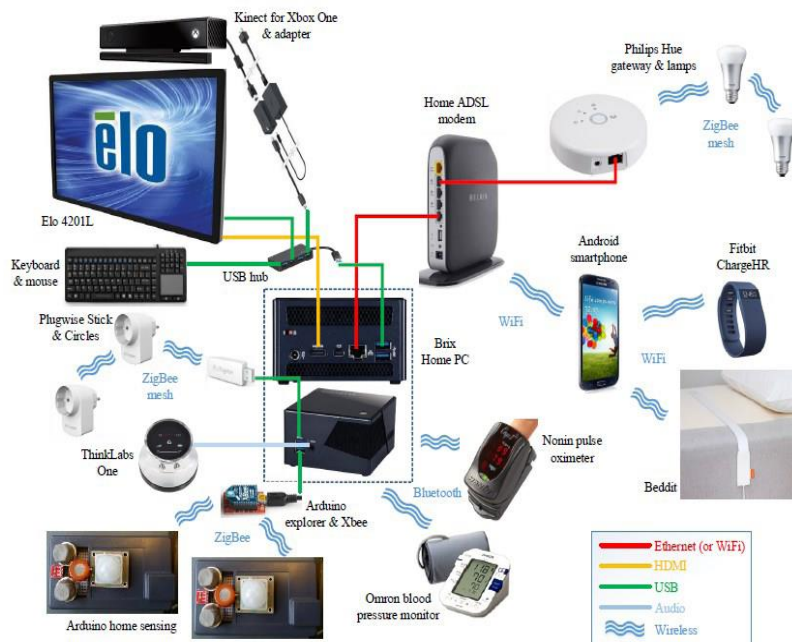

Fig.2. eWALL home installation [3].

A. Smart and Assistive Environments: Ambient Assisted Living (AAL)

Everything gets smart is an often heard slogan in the research field of Pervasive Computing. Nowadays this slogan becomes more and more reality. A lot of products and devices which we use in daily life are already smart. Furthermore our living spaces become smarter, too. Smart houses, homes and environments are nowadays no longer science fiction. One aim of Smart Environments and Product is to enhance the comfort of the occupant and the user respectively. All these (new) comfort can be an essential benefit for people with disabilities or elderly persons. Such equipped environments have the ability to compensate some disabilities of the occupant. It can simplify their daily lives and reduce the dependency on other persons. They can use all the provided functionality of the environment by themselves, reinforce their independence and personal freedom and can therefore remain longer in their usual surroundings. Ambient and Assisted Living (AAL) is the name for a European technology and innovation funding programme. It aims at extending the time older people can remain in their home environment by the use of smart technologies and remote and care services. Therefore Ambient and Assisted Living is one important field of application for Smart Homes. The STS is organized to provide a forum for the discussion of major issues related to 'Smart and Assistive Environments' and 'Ambient and Assisted Living', to identify technologies, strategies and approaches to realise smart living spaces and to identify the barriers and problems of existing approaches. Also the benefits and chances of such living spaces for elderly people and people with disabilities should be examined. Papers should address, but are not limited to the following areas:

- Ambient and Assisted Living
- Smart Devices and Intelligent Products
- Smart Environments, Assistive Environments, Smart Houses
- e-Care, e-Health
- Environmental Control Systems
- Accessible control systems for Smart and Assistive Environments
- Technology to realize Smart and Assistive Environments
- Experiences with existing Smart and Assistive Environments
- Social aspects of Smart and Assistive Environments

III. HOME AREA NETWORK

A. Home Communication General Architecture

A smart home can function to a certain extent in an interactive and independent way. These additional capabilities can then be used to improve the quality of life within the household in various respects, such as automation of routine tasks, provision of health services, rationalization of energy consumption, improved individual efficiency, and enhanced home security, as well as to revolutionize what we define as entertainment. Since smart home interconnection specifications and communication technologies are relatively new and under development, most available communication protocols were developed prior to the advent of the

smart home vision. Consequently, evaluation studies are critical to determine whether these protocols are suitable for smart home communication requirements. Thus, intense research has been devoted to this field [40]. In this context, local networks for small home areas are gaining more presence and relevance as advanced automation and energy management functionalities are added to household devices. Essentially, the HAN-enabled smart home is a fundamental step to enable the exchange of information and interoperability among several smart domestic appliances connected to other devices or networks through many protocols, such as Bluetooth, ZigBee, WiFi, Z-Wave, etc. inside or within the close neighborhood of a house. The modern home local wireless networking approach is based on standards such as Local Area Network (LAN) and Body Area Network (BAN) or Personal Area Network (PAN), which are used to describe a network of a smaller scale ranging from 12 to 100 meters. Commonly, they target local network applications based on low cost wireless technologies [41]. PAN and BAN communication infrastructures are largely employed in domestic applications allowing the user to be on the move, and do not require high expertise to manage the network operation, such as adding or removing components. Although some services like the monitoring of a certain feature related to health issues and performed by smart homes can be included in the BAN range of communication, a wider area of action is required for the whole infrastructure to function. On the other hand, such a network configuration can be sufficient since it is capable of staying fully operational for a long time and its energy is cost effective. PAN can fulfill more requirements since it consists of wearable and portable equipment capable of interacting with the immediate neighborhood and is able to communicate with the wider environment via larger area wireless backbones.

Wireless sensor networks (WSN) are alternative cost effective solutions for connecting sensor nodes in highly meshed networks with very low energy requirements [42]. Integrating sensing, communication, and computation capabilities for monitoring and data processing of variables, such as temperature, pressure, humidity, and light, allows complex data processing based on sensed physical phenomena for smart living purposes [43]. Even though such categories of networks cover a broad range of functionalities, this is insufficient. In addition, there is no interoperability feature that could allow communicating with each other. Fig.3 shows the general framework of the smart home integrating main application areas as identified below, meaning that security, health care, entertainment, energy efficiency, and all related services are connected to a domestic communication infrastructure.
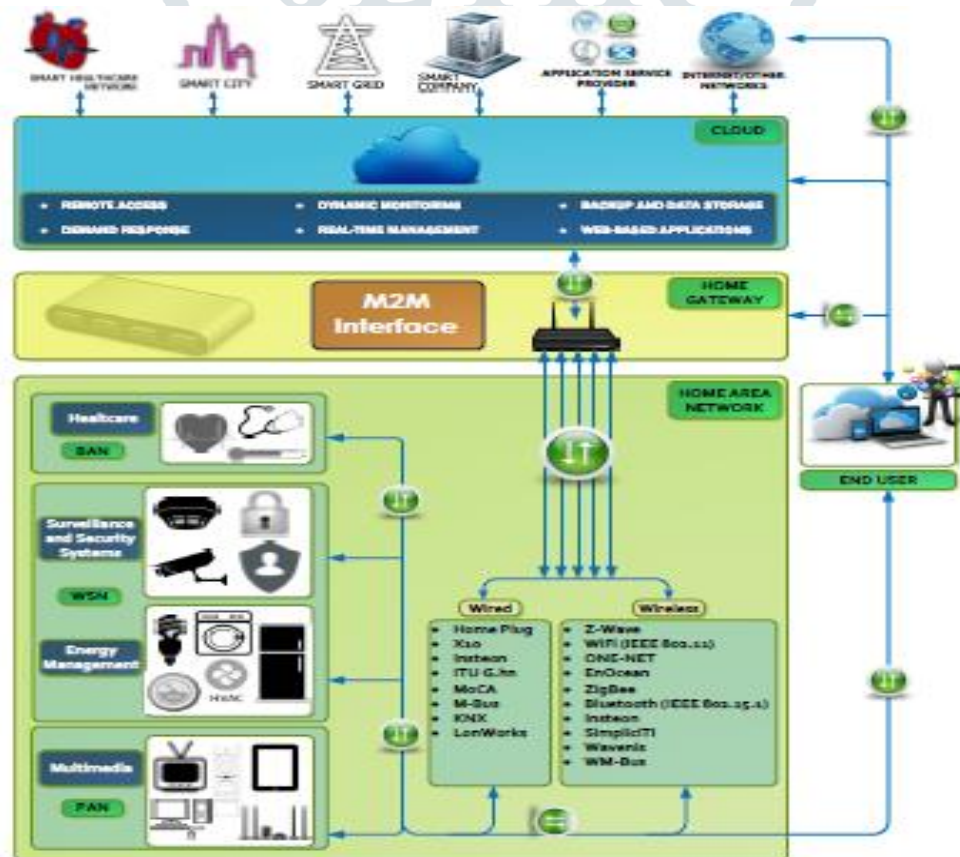

Fig.3. Smart home devices accessed through global network framework.

B. Smart Home HAN Requirements

The communication requirements related to HAN are defined by the services and applications which run in the household; for example, diverse processes have to be executed among all devices in a smart home network. According to this condition, HAN have to provide reliable communication between application area devices and from the functional area devices to HAN devices for different indoor scenarios. If such is the case, then all HAN devices have to be dependably accessible as well. Communication can be seen from the general and individual point of view. Therefore, it is important to identify what is needed to ensure an efficient exchange of information in a functional area. However, since we have more than one functional area in the same physical space of a smart home, we are required to find a way for them to coexist in a superior infrastructure of communication inside the same house. It may not be advantageous and economical to have identical communication requirements for all smart home appliances; for example, a temperature monitoring device needs only low speed communication infrastructure,

whereas facial recognition communication infrastructure is greater. Next, the organization and classification in four sections of main characteristics and requirements for HAN [4,41,50] is made, as shown in Fig.4.

Secure Communication: Home data networks are increasingly exposed to external attacks from the internet. At the same time, near local networks inside or outside of the house may be used to get access to sensitive information such as data metering or to change the dose of diabetic medicine endangering the lives of their residents. This means that the HAN has to authenticate all devices, protect data integrity and privacy (e.g., by encryption) and provide protection against replay attacks; such attacks are a particular concern where the HAN is used to support a security related application (people and/or property). HAN connected devices may have very limited resources to achieve low cost and long battery lifetime. This is the case of wireless HAN tailored for portable devices used, for example, to monitor patient health state or for tracking packages with restrictions such as antibiotics. As for networks based on physical cables, Ethernet enabled devices have enough hardware resources for accomplishing the security issue. Despite the physical and energy constraints advanced security services are expected to be provided by the wireless HAN technology and the platform operators. This is to say, higher level software does not need to implement security measures if the same are provided by the communication protocol.

Fig.4. The classification of the main characteristics and requirements for HAN.

C. Wireless Networks Suitability to Functional Area Requirements

Smart home distributed applications have their own requisites in terms of bandwidth, auxiliary services such as secure data transmission, data authentication, and so on. A first criterion to consider is to trace data rate requirements as a function of the application as depicted in Fig.5.
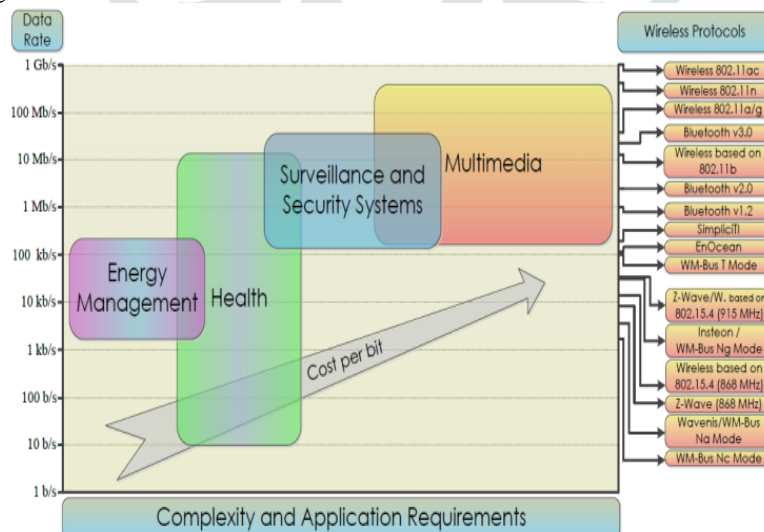

Fig.5. Wireless communication technologies for smart home applications vs. data rate.

Home metering data transmission along with energy management services shows the lowest communication bandwidth. Due to its low data requirement, simple low power RF protocol can meet this specification from M-Bus to 802.15.4 based protocols. On the contrary, the number of applications that may be deployed for home health care solutions is, in terms of bandwidth, very wide. In demanding implementations, the data throughput rate can reach 15 Mb/s. Surveillance and Security Systems may require

high bandwidth depending on the task to be performed. Intrusion detection and access control are medium intensive data transmission tasks even though events signalization such as alarms activation should be processed by the communication medium with low latency. If the security system includes video capture based surveillance, the number of frames as well the video resolution will have a strong impact on gross bandwidth needs. Among the four Smart Home application areas, the multimedia services demand the highest data rate. In the first hand, the bandwidth necessities are clearly different being this is the first criterion of differentiation between functional areas. On the other hand, it has to be seen if HAN requirements comply with the home application necessities. From the set of analysed functional areas, the healthcare field seems to be the most demanding one, since the integration onto or into the human body of electronic devices for diagnostic, therapeutic, or surgical function have to comply with very restricted technical and biological requirements [84,85]. It is the only functional area that requires high portability medical devices that must be designed with a high-energy optimization concern in a way to maximize the lifetime of power supply (e.g., the battery). Given that the patients need to have a high autonomy, it must be assured that the QoS of transmission cannot be corrupted by electromagnetic interference or by transmission anomalies generated in the patient's radio. In this case, the network must be prepared in such a way that if the condition of the network deteriorates, it would still be able to safeguard the minimum services of transmission.
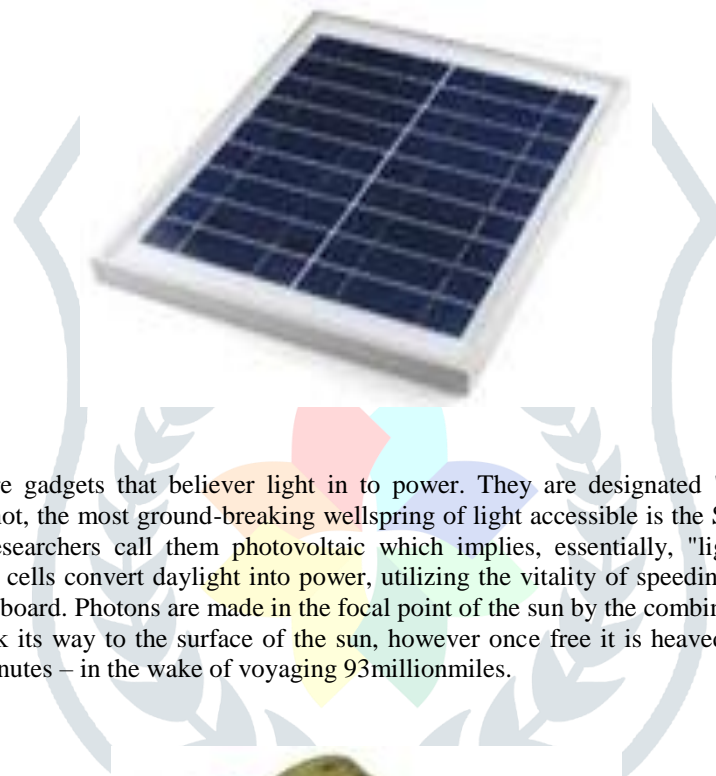
D. Solar Panel

Fig.6. Solar Panel.

Sunlight based boards are gadgets that believer light in to power. They are designated "sunlight based" boards on the grounds that more often than not, the most ground-breaking wellspring of light accessible is the Sun, called Sol by space experts as shown in Fig.6. A few researchers call them photovoltaic which implies, essentially, "light-power."Sun powered board comprises of sun based power cells convert daylight into power, utilizing the vitality of speeding photons to make an electrical current inside a sunlight based board. Photons are made in the focal point of the sun by the combination of iot as. It takes a photon around a million years to work its way to the surface of the sun, however once free it is heaved through space so quick that it achieves earth in only eight minutes – in the wake of voyaging 93millionmiles.

E. DC Motor

Fig.7. DC Motor.

ADC engine in basic words is a gadget that believers coordinate current (electrical vitality) into mechanical vitality. It's of essential significance for the business today as shown in Fig.7. ADC engine is intended to keep running on DC electric power. Two precedents of unadulterated DC plans are Michael Faraday's homo-polar engine (which is remarkable), and the metal roller engine, which is (up until this point) a curiosity. It will run when the operator send the commands from mobile phone

F. DC Fan
DC fan uses low voltage. It will run by the batteries which will be charged by the solar panel and can be easily operate by the given signal from user mobile phone as shown in Fig.8.

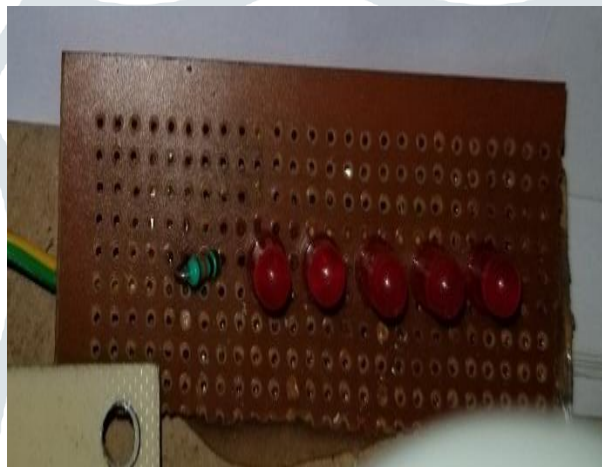**Fig.8. DC Fan.**

G. LCD Array

Fig.9. LCD Array.

LCD which is connected in this project can be controlled by the operator such as turning ON and OFF directly by the operator with the help of mobile phone as shown in Fig.9.

H. BULB

Fig.10. BULB.

Bulb is run through AC current and can be automatically ON and OFF with the help of LDR. Bulb will turn ON when LDR detect darkness and Bulb will turn OFF when LDR detect light as shown in Fig.10.

I. Light Dependent Resistor (LDR)

Light penniless resistor (LDR) is are sits or whose hindrance decreases with extending event light power or the different way. As the name proposes, LDR is a kind of resistor whose working depends on just on the light falling on it. The resistor demonstrations as indicated by proportion of light and its yield direct changes with it. With everything taken into account, LDR block is minimum (ideally zero) when it gets most prominent proportion of light and goes to most outrageous (ideally interminable) when there is no light falling on it.LDR, an acronym for light ward resistor is a resistor whose restriction is dependent on light. In this when the light falls on LDR, the hindrance of LDR ends up being low and the entire voltage drop occurs over the variable resistance(VR) (10K).LIGHT DEPENDENTRESISTOR SYMBOL The circuit image utilized for the light ward resistor or photograph resistor consolidates its resistor activity while showing that it's delicate to light.
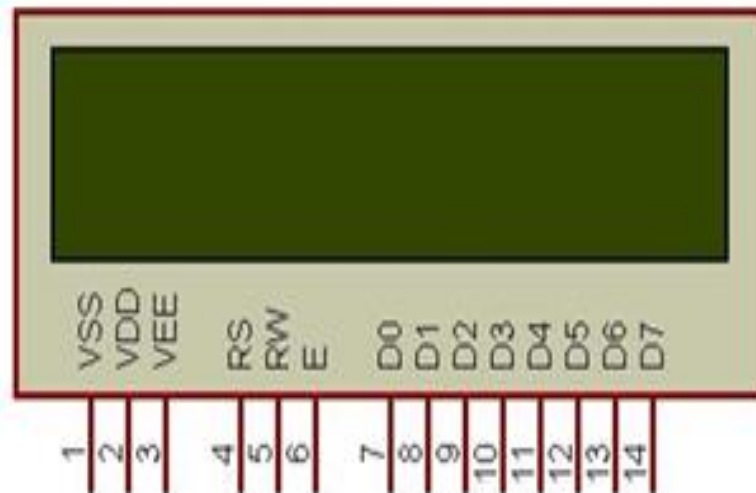
J. Liquid Crystal Display

Fig.11. Liquid Crystal Display.

LCD stands for Liquid Crystal Display. LCD is finding wide spread use replacing LEDs (seven segment LEDs or other multi segment LEDs) because of the following reasons: The declining prices of LCDs as shown in Fig.11. The ability to display numbers, characters and graphics. This is in contrast to LEDs, which are limited to numbers and a few characters. Incorporation of a refreshing controller into the LCD, thereby relieving the CPU of the task of refreshing the LCD. In contrast, the LED must be refreshed by the CPU to keep displaying the data. Ease of programming for characters and graphics. These components are "specialized" for being used with the microcontrollers, which means that they cannot be activated by standard IC circuits. They are used for writing different messages on a miniature LCD.

K. Bluetooth

Bluetooth is a wireless technology standard for exchanging data over short distances (using short-wavelength UHF radio waves in the ISM band from 2.4 to 2.485 GHz) from fixed and mobile devices and building personal area networks (PANs).In this project Bluetooth connected with mobile phone and passes the signal commands between the operator and system. With the help of it, operator can give commands and control the other devices like Bulb, LED, Motor, and Fan with the help of s2 terminal app which will connect both the Bluetooth devices as shown in Fig.12.
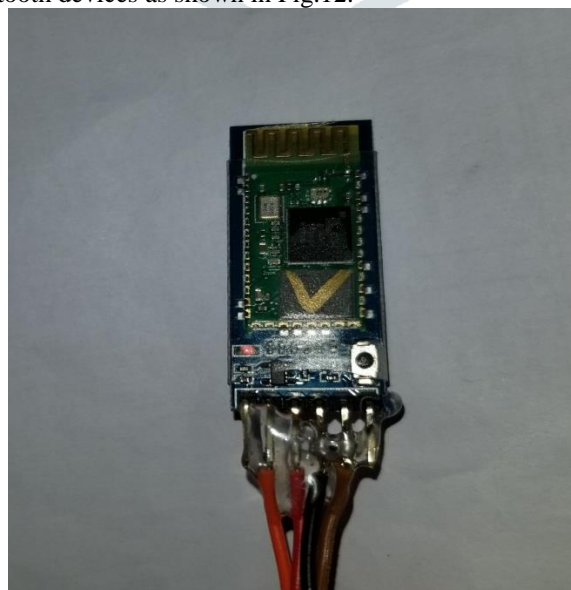

Fig.12. Bluetooth.

Here we can send commands through mobile device, By sending the Keywords like B.F.M.L for turning ON and b, f, m, l for turning OFF.. As, shown in below Fig.13.

Fig.13. commands.

L. Battery

A battery is a device consisting of one or more electrochemical cells that convert stored chemical energy into electrical energy. Batteries are another way to produce electricity. They are smaller and more safe. Batteries have one end that is positive and one end that is negative. For batteries to work, you need to make sure you put them in the right way. Batteries have become a common power source for many household and industrial applications. There are three batteries are connected to each other combining 12 V and get charged by solar panel. Mostly this project runs through batteries.

M. GAS Level Sensor

Fig.14. GAS Level Sensor.

Gas Level sensors detect the level of substances that flow, including liquids, slurries, granular materials, and powders. All such substances flow to become essentially level in their containers (or other physical boundaries) because of gravity as shown in Fig.14. The substance to be measured can be inside a container or can be in its natural form (e.g. a river or a lake). The level measurement can be either continuous or point values. Continuous level sensors measure level within a specified range and determine the exact amount of substance in a certain place, while point-level sensors only indicate whether the substance is above or below the sensing point. Generally the latter detect levels that are excessively high or low and send alert message through GSM and Iot.

N. Global System For Mobile

Fig.15. Global System For Mobile.

Global System for Mobile Communications (GSM) modems are specialized types of modems that operate over subscription based wireless networks, similar to a mobile phone as shown in Fig.15. A GSM modem accepts a Subscriber Identity Module (SIM) card, and basically acts like a mobile phone for a computer. Such a modem can even be a dedicated mobile phone that the computer uses for GSM network capabilities. Traditional modems are attached to computers to allow dial-up connections to other computer systems. A GSM modem operates in a similar fashion, except that it sends and receives data through radio waves rather than a telephone line. This type of modem may be an external device connected via a Universal Serial Bus (USB) cable or a serial cable. More commonly, however, it is a small device that plugs directly into the USB port or card slot on a computer or laptop. It is widely used mobile communication system in the world. GSM is an open and digital cellular technology used for transmitting mobile voice and data services operates at the 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands. GSM uses here to send the messages directly to an operator mobile phone and give the updates as shown in the below Fig.16.
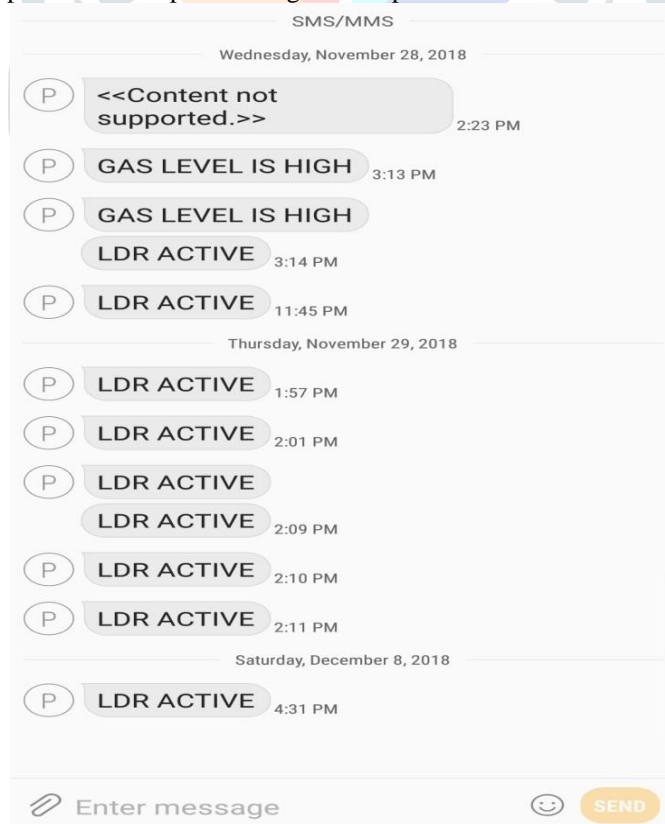

Fig.16. operator mobile phone.

O. Power Supply

The power supply section is the section which provide +5V for the components to work. IC LM7805 is used for providing a constant power of +5V.The ac voltage, typically 220V, is connected to a transformer, which steps down that ac voltage down to

the level of the desired dc output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation. A regulator circuit removes the ripples and also retains the same dc value even if the input dc voltage varies, or the load connected to the output dc voltage changes. This voltage regulation is usually obtained using one of the popular voltage regulator IC units.

P. PIC Microcontroller

Pic Microcontroller (or MCU) is a PC on-a-chip used to control electronic gadgets. It is a sort of chip stressing independence and cost-viability, as opposed to a broadly useful microchip (the kind utilized in a PC) as shown in Fig.17.

Fig.17. PIC Microcontroller.

The PIC16FXX arrangement has further developed and created highlights when contrasted with its past arrangement. The essential highlights of PIC16F877A arrangement is given beneath.

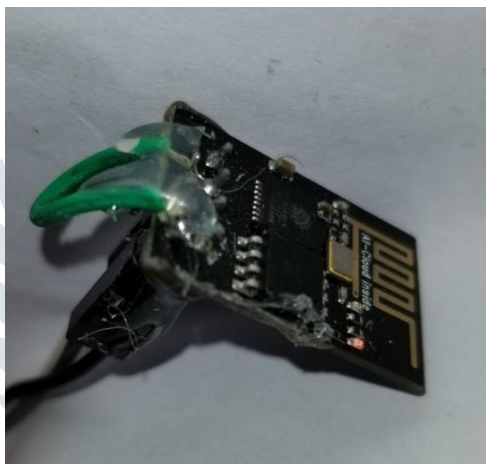### Q. Internet Of Thing (IOT)

Fig.18. Internet Of Thing (IOT).

The Internet of things (IOT) is the network of devices, vehicles, and home appliances that contain electronics, software, actuators, and connectivity which allows these things to connect, interact and exchange data as shown in Fig.18. When an operator store I.P address it will send the signals through internet to system as shown in below Fig19.
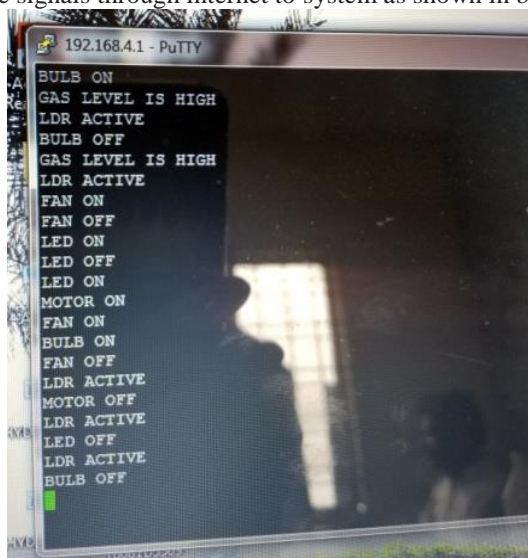

Fig.19. signals through internet.
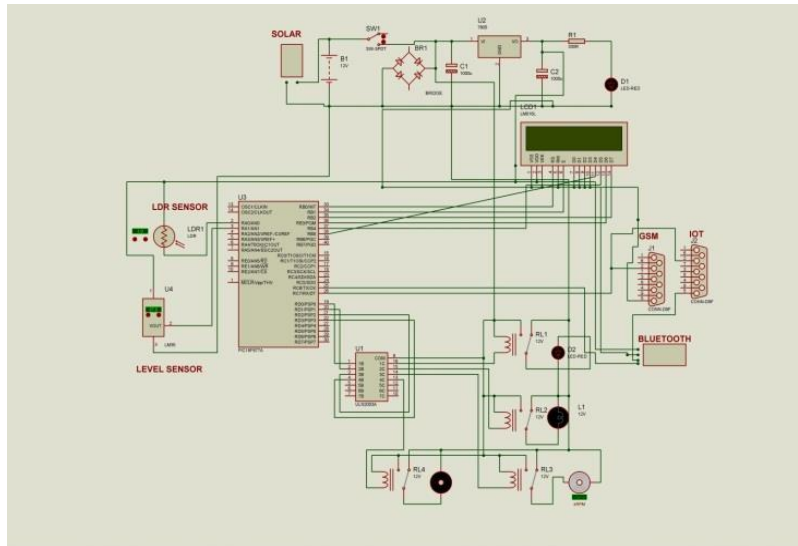
Schematic Diagram:

Fig.20. Schematic Diagram.
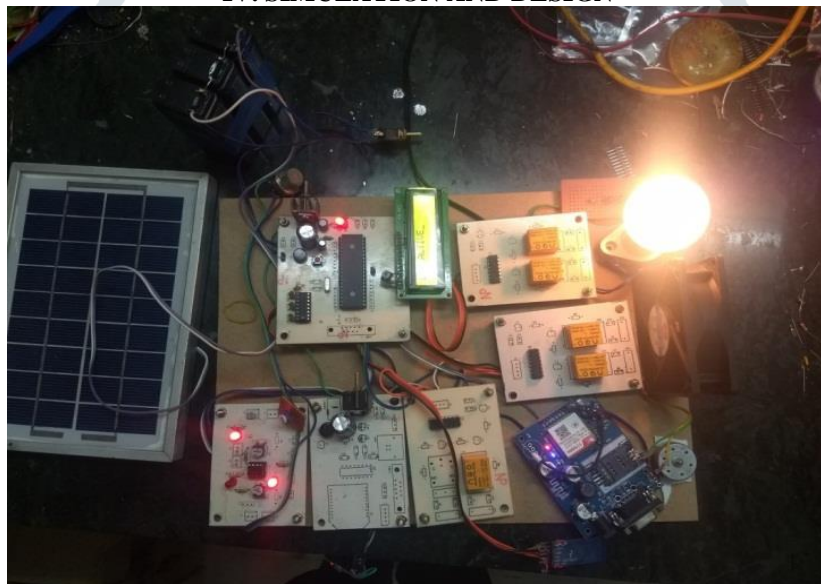
IV. SIMULATION AND DESIGN

Fig.21. Design.

Functional module of a Smart Home System, Functional module are Bluetooth, LDR, Fan, Bulb, LED, Motor, IOT, Gas Sensor, Display, Solar Panel, Microcontroller, GSM, Power Supply, Batteries as shown in Fig.21.

A. Port I. P Address

Fig.22. I. P Address.

I.P Address is 192.168.4.1

Port: 23

It is connected with IOT which help operator to get updates on devices like laptop, computer, and e.t.c as shown in Fig.22.

B. Gas Sensor

Fig.23. Gas Sensor.

Gas Level Sensor will detect the gas level of specific area. If the gas is leaking, it detects and Alert the operator by sending massage directly to a user mobile as "GAS IS HIGH" as shown in Fig.23.

C. LDR Active

Fig.24. LDR Active.

When the LDR is active it will turn ON and OFF the bulb automatically by detecting the day and night mode and the GSM will sends the update massages to a user mobile phone such as LDR is active and LDR is off as shown in Fig.24.

V. CONCLUSION

Smart home conditions are turning into a part of our regular day to day existence. These conditions are conveyed utilizing diverse gadgets and innovations. Diverse gadgets and sensors are speaking to physical items and IOT empowers connecting of those physical articles with virtual articles. Advances utilized for empowering correspondence among gadgets and sensors are: Bluetooth, Bluetooth Low Energy, Wi-Fi and ZigBee. In this paper, probability of interference between above mentioned technologies was examined. The results show that Bluetooth Low Energy has the lowest probability of interference while Bluetooth reaches the highest probability of interference. In order to lower the interference, the probability of cognitive radio or white space devices is considered. Utilizing the SEAMCAT device, we broke down enhancements that can be made in the impedance if void area gadgets are utilized. Two cases were considered. In first case, the edge estimation of 30 dBm was picked and in the second case, the limit estimation of - 100 dBm was picked. It tends to be seen that there is enhancement in likelihood of impedance when intellectual radio gadgets are utilized. In the second case, when edge estimation of - 100 dB is picked, better outcomes are accomplished. In this paper, it is demonstrated that utilizing intellectual radio gadgets, the upgrades in the likelihood

of obstruction can be made. At long last, the future research on utilizing subjective radio in savvy home situations will be directed.

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