Energy Harvesting and Home Automation

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Abstract

As now days the problem of energy got rise to a optimum level, supply of energy is less than its demand. As mostly in electric energy we can find its real deficiency of supply problem with respect to its consumption. Now in this modern word everything around us covered by electrical and electronic gadgets and appliances from bedroom to the outer world. Among all this if we talk about the Home and domestic consumption we can able to realize in what manner energy being consumed by heavy load appliances and machines such as refrigerator, air-condition, cooler, geyser, washing machine, bulb not of CFL, heater, and many more. And above all consumption wasting and misusing of energy also can be seen mostly in form of negligence and unawareness.

So, in this paper it has been discussed about the different process of energy harvesting, and for the human comfortness and laziness a new kind of system of making the smart home by using the theory of automations been used. As by this term most of us can be well familiar that the work would be done automatically by sensors and various other processes. Here it is mentioned that it can be manually also be operated by sitting ideally on the chair and can be operate able by using Bluetooth, smart phones, computer and remote too. Which can be make a somewhat control in wastage of energy and can be able to bring a limit in the electric-city bill.

Keywords: Conservation Voltage Reduction (CVR), Wireless Home Automation Systems (WHAS), etc.

I. INTRODUCTION

The worldwide energy demand is rising constantly. While many sectors (e.g., transport, production, industry, domestic) have been trying to reduce their consumption for several years. We can save energy while improving our home's comfort and helping the environment by making our home more energy-efficient. In fact, making our home energy efficient is the first step to green. And indeed, energy efficiency will save our money, allowing us to invest in other green technologies to make our home more suitable. The domestic sector accounts for 30% of total energy consumption in the country. There is a most tremendous scope to conserve energy by adopting certain measures. It would be careful to understand which appliance consumes how much of energy. Economic use of home appliance can help in reducing electricity bills.

The following table shows the energy consumption of various appliances normally used at home:

Appliances	Rating (Watts)	Operating Hrs/Day	Units/ Month
Incandescent Bulbs	40	6	7
	60	6	11
Fluorescent Tube light	40	10	12
Night Lamp	15	10	4.5
Mosquito Repellent	5	10	1.5
Fans	60	15	27
Air Coolers	175	8	42
Air Conditioners	1500	6	270
Refrigerator	225	15	101
Mixer/Blender/	450	1	13.5
Toaster	800	0.5	12
Hot Plate	1500	0.5	22.5
Oven	1000	1	30
Electric Kettle	1500	1	45
Electric Iron	1500	1	45
Water heater-Instant Type (1-2 Ltr capacity)	3000	1	90
Water heater-Storage type (10-20 Ltr capacity)	2000	1	60
Immersion rod	1000	1	30
Vacuum Cleaner	700	0.5	11
Washing Machine	300	1	9
Water pump	750	1	22.5
TV	100	10	30
Audio system	50	2	3

Table 1: xyz

Many well-developed energy efficiency measures and emerging technologies to reduce energy use in buildings have been available for years. However, adoption of many technologies is slow. The reasons include high installing prices, unawareness and operation difficulties. When a building owner starts an energy efficiency project, the implementation can be costly, including the hardware upgrade and labor costs. Most of the measures and technologies require higher quality hardware than today's standard practice uses. An energy efficiency project has three phases: energy audit and planning, implementation, and Measurement and Verification (M&V). Each phase involves heavy labor investment from both on-site staff and the service provider.

Particularly, a light accounts for a great part of the total energy consumption. Various light control systems are introduced in current markets, because the installed lighting systems are outdated and energy-inefficient. Among all outdated lights a new form of light got available in the market which has sufficient power and full satisfaction for the user and consumes very less energy i.e. LED lights, which is very much profitable. The proposed LED lighting system total power consumption up to 50% of the energy consumption compared to the fluorescent lighting device.

II. USEFUL TIPS TO SAVE ENERGY

1) Turn off the lights when not in use
2) Use task lighting, instead of brightly lighting an entire room, focus the light where it is needed

3) Compact fluorescent bulbs are four times more energy efficient than incandescent bulbs and provide the same lighting
4) Use electronic chokes in place of conventional copper chokes
5) Install exhaust fans at a higher elevation than ceiling fans
6) Microwave consumes 50% less energy than conventional electric/ gas stoves
7) Do not switch on the power when TV and Audio Systems are not in use, it causes energy loss of 10 watts/device
8) Setting computers, monitors, etc to use sleep-mode when not in use helps cut energy costs by approximately 40%
9) Battery chargers, such as those for laptops, cell phones and digital cameras, draw power whenever they are plugged in and are very inefficient. Pull the plug and save.
10) Leave enough space between refrigerator and the walls so that air can easily circulate around the refrigerator
11) Wash with washing machines only with full loads and use optimal quantity of water
12) Prefer air conditioners having automatic temperature cut off

Today's home require sophistication control in its different appliance and gadgets, which are basically electronic appliances. This has revolutionized the area of home automation with respect to an increased level of affordability. Green building is the term commonly used to define a building equipped with an ambient intelligence system, which can react to predefined condition in real time. The development of a smart house system is not a unique case; the concept has been existing since the term "smart house" was first coined by the American Association of house builders in 1984. The importance of smart house now days to fulfill comfortness and improving the lifestyle of families. Smart homes could be simple remote control of electrical appliances or more complex functionalities such as monitoring of the house using speech recognition, via an iOS or Android application or recognition of human gestures and moreover automatic sensors. As we know that after shutting down the devices like computer and its peripherals, TV, stereo, microwave and stove they completely does not get off, but, still draws electricity which is known as "phantom load" which can add up to 8% to our electricity bill. So, solution for this problem can be solved by using Smart Strip power strip which automatically detects when turned an appliance off and completely cuts power so that it can't able to draw electricity and provides surge protection.

Another effortless gadgets to control energy consumption by finding out how much energy are we using. By Kill-A-Watt and the Power cost Monitor, we can measure electricity an item uses, and also to find out how much total consumption of electricity consumed by household appliances.

A. *Conservation voltagr regulation(CVR):*
For many years, electric utilities have achieved load reductions by reducing the voltage delivered to air conditioners, home appliances and industrial machinery by CVR especially during critical peak load periods. CVR was implemented manually by reducing voltages at the substation to achieve a 1% energy savings over short periods.

III. HOME AUTOMATION
Home automation industry has drawn considerable attention of the researchers for more than a decade. It have been estimated that by 2017 90 million homes would have home automation systems. Different equipments of home been made and introduced, but among these only home security systems have become the main stream of development activities. Smart home system captured most wonderful gadgets and appliances available in the market. But manufacturing industries failed to make home automation as a popular subjects, because of some important reasons include cost, difficult to use, vendor dependency, less functionality, and security. Moreover, the installation and maintenance costs of the system were high and only wealthy people can afford to buy the products. For this purpose to overcome the situation wireless home automation system (WHAS) has been introduced.

IV. HARDWARE SYSTEM
A. *PIR sensor:*
Pyroelectric devices, such as PIR sensor made of crystalline material generate electric charge when it is exposed to a infrared radiation. Its vital part is infrared mechanism with which on-board amplifier captures the output and track the motion of the materials. On-board amplifier it main work is to observe the changes of voltage that is being generating from the object when the variable infrared radiation strikes the object. It also has a special filter known as Fresnel lens, which observes the path of infrared signals onto the elements.

B. *Optocoupler:*
Often now days we perform transferring of data and signal with some separate kind of electronic equipment, rather connecting directly with the electrical component the two devices are kept completely away from each other. Because, every electronic gadgets are mainly made of some microcontroller and other electronic materials, and has different capacity of holding current and voltage. As in microcontroller which operates from 5V DC and this is used with TRIAC which operates at 230V AC. So, from these unequal characteristics to save the microcontroller from over voltage damage they are

make to separate from each other. As with the help of electromechanical devices named relays are used for the operation for low voltage, but it have disadvantage that small relays tends to fairly bulky compared to IC's. So, for solving this problem ananother device is been discovered known as optocoupler which is smaller in size and has high speed too, and greater reliability is also important. It uses beam light to transmit the data and signal between the electrical barriers and isolates very likely.

C. Ethernet-

Another mode of connecting the electronic equipment to each other is with the mechanism of Ethernet which works on basically on the systems of networking. With the help of Ethernet in the modern world of IT which is very important systems now days make very easy and reliable for distribution and access the data which is critically important. As, it can link with more numbers of signals at a time and can be operate able to very easily. Ethernet now a days are used mostly in the offices, universities, and buildings in the form of local area networks (LANs).

Fig. 1: LAN Ethernet System

One standard organization names IEEE (Institute of Electrical and Electronics Engineers) has a standard IEEE 802.3 commonly called Ethernet used as a LAN. But it has a very short range of operation; it can work within a hundred meters range i.e. it works in limited areas inside the one building with close proximity.

D. Zigbee-

It is a special kind of system and gadgets which also work for a smart home appliance home automation works. The system works as a security purpose or to check the appliance whether the switch is on or off, it has the capabilities of monitoring window, smoke, gas leak, and water flooding in a home remotely. It has three systems of operation for tracking the user namely Indoor Positioning System (IPS-M), Indoor Positioning System Infrastructure (IPS-I), Indoor Positioning System Gateway (IPS-G). For its gateway system this system is very valuable to the users for controlling the home appliance. Another gateway system is used to connect low-rate home work with the internet through with by the help of internet system the appliance can be operate

able. By, its three system wireless communication can be done and also can be used as a Digital Signal Processing (DSP) along with the internet services. With the DSP real-time power parameters calculation is done which helps enormously in calculating the energy consumed by the load.. It has another quality of measuring the current and voltage consumption inside the house and stores in an embedded board. It first detects the overload in the lines and sends information to the circuit breaker to turn it off automatically. The system has capability of operating the house appliance from the remote location. With the help of real-time home security it can   sense the persons who enter a place illegally and sends the message to the mobile using GSM module. The wireless system comprises of three different components home server with GSM module, environmental detection module, and intelligent home appliance. With all this techniques it can be operate from a distance and also helps in the security work by ringing the alarm to remote location. But here comes some problems in sending the signals to a long distance for this a new technology was profound with the help of using multi-hop communication system. ZigBee works conjointly bringing hardware and software using Bluetooth, and GPRS types of wireless communication into the task and work together in home automation. It supports wireless communication on embedded board not in PC, which is more power efficient and more favorable in size. It has been seen that the mechanism of ZigBee is more efficient than any other devices such as Wi-Fi and Bluetooth, but it always keep in inspection to make better receiver to receive signal very strongly, and round trip delay work.

ZigBee works one such application that helps the handicap persons too for operating the home appliance by the voice recognition sensor. ZigBee receives voice as an input to an ARM 9 controller, which help in operating the microcontroller present in it. In this system client sends the voice to a server via Wi-Fi wireless network which coverts in the form of data and then it operates in switching on and off the appliance. Microsoft speech(SAPI) are used as a device for working on the principle of voice recognition with its mobile based voice command control and monitoring system with the help of artificial intelligence to sense the voice. In this system a multi-layer neural network are used and Microsoft voice engine for recognizing the voice. This system helped tremendously to the handicapped person for controlling the home appliance upto 20appliance and with 40 voice commands. The fault also can be noted by its monitoring system along with RFID system it can give the warning of fault in the connections. In this system LabVIEW name of software is parallely used for interfacing with the hardware to design and implement this software is very easy and reliable. The can be operate able from a distance by a mobile or a computer. It is easy to install and configurable too, no such kind of

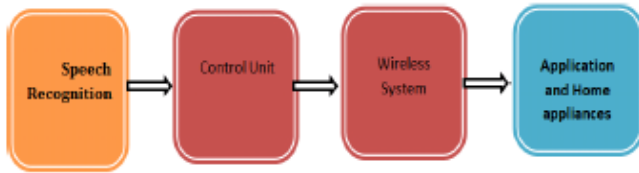expertness is being required, the system needs only one time to trained.

Fig. 2: The system block Diagram.

The working mechanism of this system is by its control unit (CU) which coordinates with the central processing unit (CPU) and other devices, and fetches the code or instruction that has been written by the help of program and software like Matlab, C++, and LabView. As previously it has been mentioned that in this system LabView is used for writing the program for following reasons: a) less code is required to write a big program in a piecewise, b) for interfacing with hardware is also easy with this system, c) easy to build user-interface, and d) easy to find compatible tools in the market.
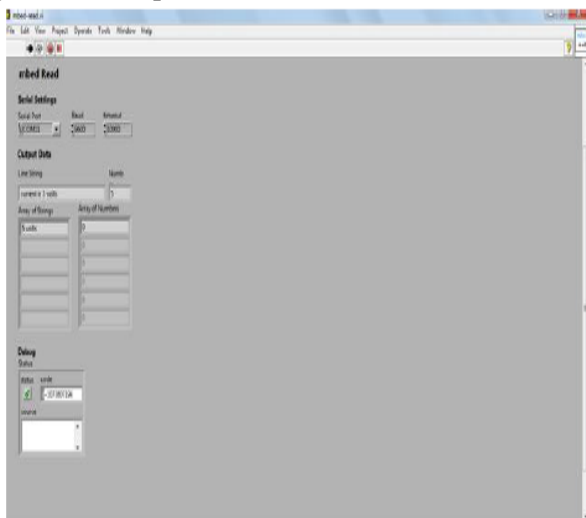
Fig. 3: LabView output window.

For whole system switching circuit is required to turn it On\Off, in addition switching devices a Data Acquisition Card (DAQ) are used in this work. DAQ consists of ADC and DAC to convert analog signal to a digital one for input/output mechanism and with the help of LabView this DAQ is interfaced
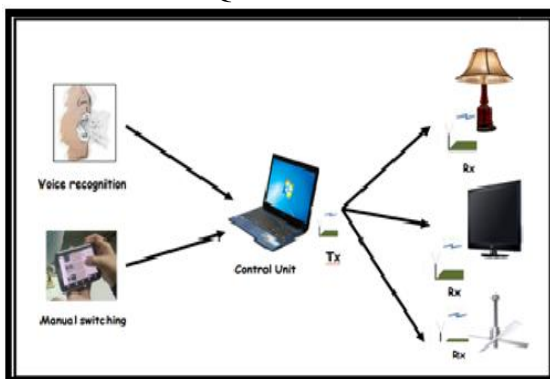
Fig. 4: System overview of automated system.
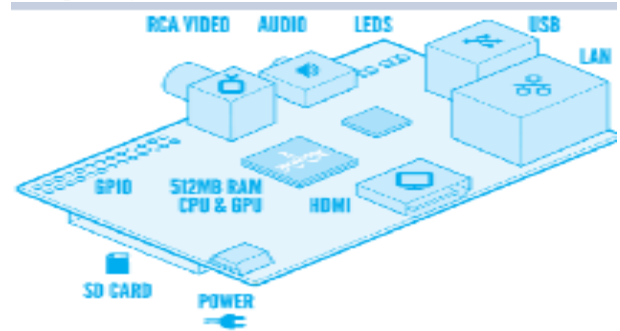
E. Raspberry PI:

Fig. 5: Rasbpberry PI model.

The Raspberry PI is also another device which is also related to a home automation work. It can able to manipulate and control the camera in a real time and records the video for looking it afterwards. It has a sensor, like PIR sensors which sense the motion of the material and starts recording and also sends alert to the user's mobile device. The user can observe from remote area and can respond to that controlling any device that is integrated with the Raspberry pi. It is very helpful for the security, if any thief or unknown persons enter to the room the device can record the video of how much long the user wants to make and then the user can turn on the light and stereo from remote place for detecting the intruder. All its external devices like cameras, lights, PIR sensor, are connected with the server or control unit for connecting to the web application from a mobile device.

F. INSTEON:

It is another important device used as a most-reliable home control and automation technology. It has a dual characteristic using both wires of home connection and radio frequency communication too. INSTEON is very much easy to setup and very much profitable, because it provides secure, highly available, affordable, smart home control and sensing to provide automation to the lighting and other home appliance. Other INSTEON device use power line with legacy X10 devices in a compatible way without the need for a bridging product. INSTEON works very intelligently it automatically finds the error and sends the message and the repairing work also done automatically by resending the message when the fault is detected. This system is independent of receiving the either from wireless or power line device. It works in an integrated form of device between RF and power line connecting peer to peer network connection.

G. XBee:

This device helps to connect point to point communication; it got many advantages on the remote control solution by becoming more efficient communication and reliability, elasticity, and no line-of-sight barrier. It transmits the signals at about 1000 meters long by no any signal interference problem. X-CTU software provided by Digi to initialize and test with

XBee communications. Microcontroller ATmega 328 is used for voice recognisation which records the command of voice and compares it the actual sound and then it sends out executable output of that commands. For avoiding error a basic detector device has been installed based on PWM (Pulse Width Modulation) which control the circuit. It shows the fault if any when the damages occurs in the LED bulb and fans or other appliance in the LCD screen. When the fault occurs automatically there will be no any voltage flowing across the resistor, and it reads the voltage value in analog and error detector can be recognized. It uses +9V battery for the power to CPUs and +12V battery for the whole connection of home appliances that are used.
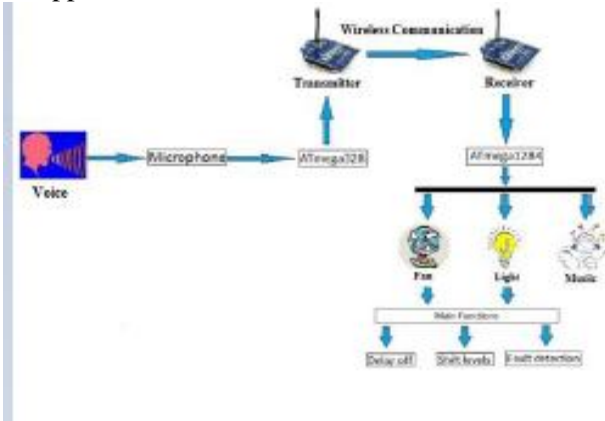
Fig. 6: Overview of system structure.

H. Arduino Microcontroller-
It is another type of device specially designs for real time home automation system with Matlab-GUI is used in this work. As simple microcontroller works same this microcontroller also works in two ways firstly, is based on cellular phone and secondly, self automated system. Mainly, the home automation are made of two systems: the PC home server and the Arduino uno microcontroller which is affordable, simple and works better by providing variety of digital and analog inputs, also works in a PWM output. This is very simple to connect with a PC through USB cable and data can be transferred very easily to the microcontroller where number of appliances and sensors are connected to ports of microcontroller board. In this system home appliance can be accessed and monitored from remote area by the help of internet.
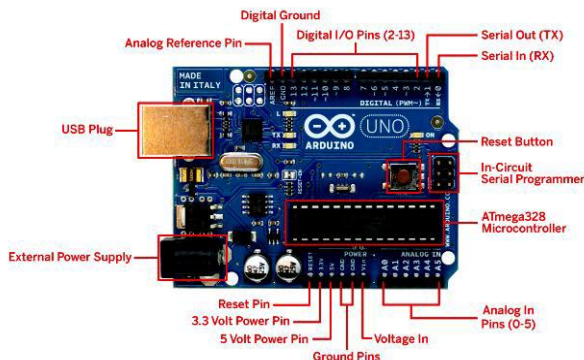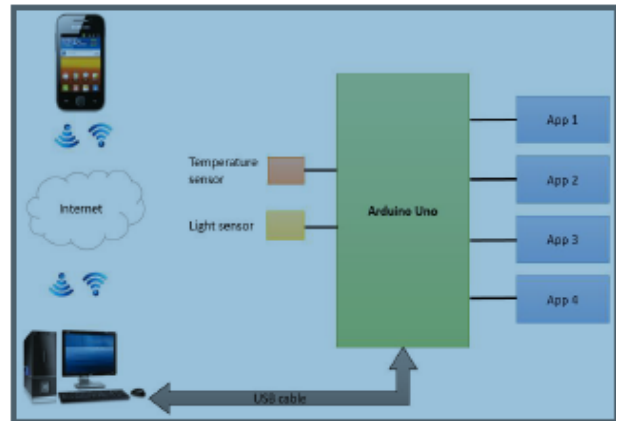

Fig. 7: Schematic Arduino Uno front.

Fig. 8: Proposed Home aumomation architecture.

Besides taking about this system, this system works on two principles one is manually-automated system. In which we connect the appliance and monitored by using Matlab-GUI and Arduino uno using the cellular phone. The appliance can be make off\on as the user wants manually. The flow chart is shown in the figure.
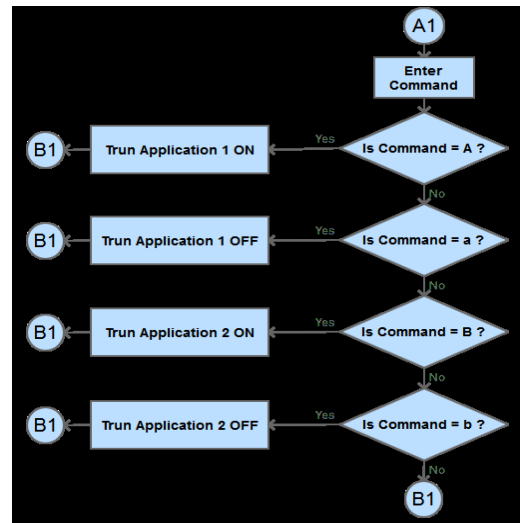

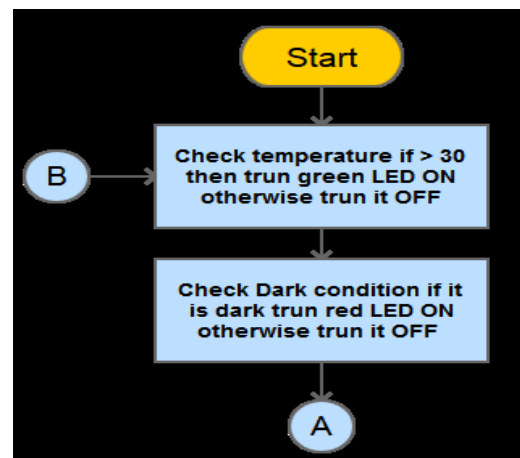Fig. 9: Flow chart of an manually automated system.

Fig. 10: Flow chart for self automaed system.

The other one is self-automated, in which microcontroller accesses the appliance automatically and

works upon that without confirming about the decision of user. The flow chart is shown in this figure.

A) Manually-automated system: As this system is discussed previously also that this system works in a manual form using cellular phone with Matlab-GUI remotely. This can switch on and off by handling the control of four appliances individually as shown in the figure below.
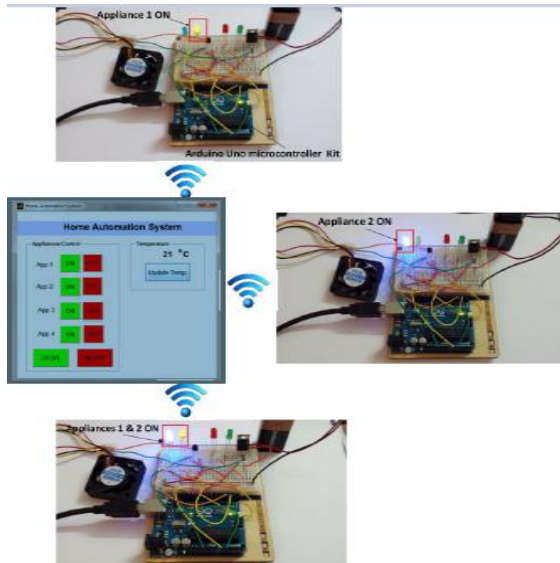

Fig. 11: Manual automated system.

B) Self-automated system: In this case the appliances are controlled automatically. Generally, it has two systems one is temperature sensor and other is light sensor.

In temperature sensor the temperature is set to some point suppose at less than 30^0 C, so the system automatically sense the temperature of the room. If the room is above the set temperature then the fan will start automatically according to the temperature of the room
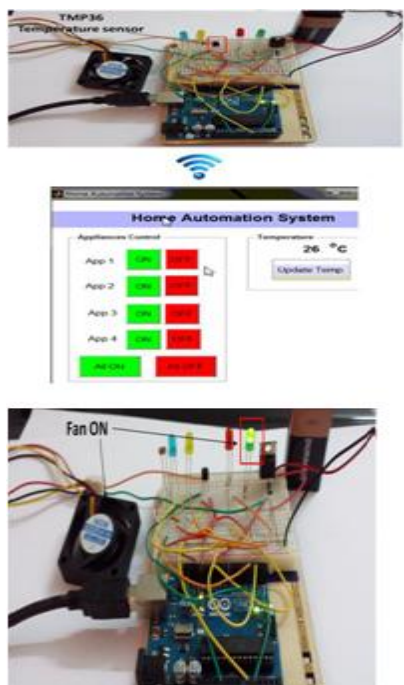

Fig. 12: Temperature self automated device.

LDR works in the mechanism of light/dark sensor circuit, it senses the presence of light by its sensor and gets automatically switch on and off. Generally, LDR has high resistance of 1,000,000 ohms, but when the light glows it sense quickly and dramatically its resistance gets decrease. This mechanism is quit very interesting without manually going to switch on or off it sense the intensity of light, when intensity of light is more (during day) the switch remains off and when the intensity is high then the switch gets on. The output of LDR gets directly linked with the ADC which converts analog signal to digital one and that data is supplied to a microcontroller.
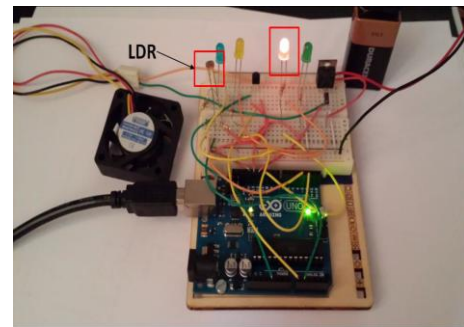

Fig. 13: Working model of LDR.

V. CONCLUSION

In, this paper it has mentioned how the energy are being wasted in spite of knowing that energy are very much short now a days. Some, process are mentioned how basically energy is misused in the house hold works. So, a very common solution now days are found out i.e. automation which has a vast field. But, very few persons are familiar with this term and equipments. Here, various kinds of electronic gadgets and equipments have discussed to solve the problem of wastage of energy in the house. And by this process and more upcoming technologies providing us great helpful to everyone even to the disable persons and handicap too who have the difficulties to walk and turn on\off the light. Some of the process are discussed here are affordable one for every persons now days and some may not be. Wireless features are now days very popular in the market and in demand by the every person for making the life more luxurious one and very relax able one.

REFERENCES

[1] Dhivyaa, M. Sundarambal, S.Elango "Design and Development Of Energy monitoring and automated control system using LabView for

International Journal of Scientific Research Engineering & Technology (IJSRET) ISSN: 2278–0882
EATHD-2015 Conference Proceeding, 14-15 March, 2015

67

energy conservation", IEEE paper on LabView, Vol. 2, Issue 6, June 2014..

[2] Ajaya Parimala, B.A. Sarath Manohar Babu "Smart home lighting system for high efficiency by using WSN and Ethernet", IEEE trans. on Ethernet ,Vol. 1, Issue 3 Nov 2014.

[3] Dr. S. Kanaga Suba Raja, C, Viswanathan, Dr. D. Sivakumar, M. Vivekanandan, "Secured smart home energy monitoring system (SSHEMS) using Raspberry PI", IEEE paper on Raspberry PI, Vol. 66, 10th aug 2014

[4] Eng. Inji Ibrahaim Attia, Prof. Dr. Hamdy Ashour, "Energy saving through smart home", IEEE paper on Smart system, Vol. 2- No. 3.

[5] Thorya Obaid, Haliemah Rashed, Ali Abu El Nour, Muhammad Rehan, Mussab Muhammad Saleh, and Mohanned Tarique, "Zigbee based voice controlled wireless smart home system", IEEE paper on voice controlled automation, Vol. 6, No. 1, Feburary 2014

[6] Thorya Obaid, Haliemah Rashed, Ali Abu El Nour, Muhammad Rehan, Mussab Muhammad Saleh, and Mohanned Tarique, "Zigbee based on wireless smart home system", IEEE paper on voice controlled automation, Vol. 6, No. 4, July 2014.

[7] Bama M. Mohammad El-Basioni, Sherine Mohammad Abd El-Kaer, and Hussein S.Eissa, "Independent living for persons with disabilities and elderly people using smart home technology", IEEE paper on smart home for disabilities, Vol. 3, Issue 4, April 2014.

[8] Suraj Bhatia, Jatin Bajaj, M. Mani Roja, "Technology, systems and implementation of a smart home automation system", Vol. 5(5), 1690-1695

[9] A, Kumar and G.P. Hancke, "An energy-efficient smart comfort sensing system based on the IEEE 1451 standard for green buildings".

[10] Mohammed Abd El-L atlf Mowad, Ahmed Fathy, Ahmed Hafez, "smart home automated and control system using android application and microcontroller, Vol. 5, Issue 5, May 2014.

[11] PDF file on "Tips on energy saving in home appliance and electricity system". http://www.mercindia.org.in/pdf/TIPS_ON_ENE RGY_SAVING.pdf

[12] Bader M.O. Al-Thobaiti, Iman I.M Abosolaiman, Mahdi H.M. Alzahrani, Sami H.A. Almalki, Mohamed S. Soliman, "Design and implementation of a reliable wireless real time home automation system based on arduino uno board microcontroller", Vol. 3, No. 3, July 2014.