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# A detailed study of Automation Techniques at Home that contribute to Energy Efficiency

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## Abstract.

Witnessed with the increase in energy consumption and population, there is great concern to conserve energy in every possible way. Lack of access to and management of electrical equipment from remote areas is one of the main causes of power loss. Therefore, the concept of smart house is gaining attention a few years ago. The current 'system' is also ready to solve one or two of those problems. However, a smart home automation 'system' is not only secure, but, nevertheless, even the most intelligent understanding process and analytical talents have. This method will create the use of 'Wi-Fi', 'GSM', 'Bluetooth', 'ZigBee' completely different governing devices are available in existing 'system's. The Internet or associate degree application automaton is used by users to provide directions to those 'system'. These applications are already available in a few places for a large variety of applications. Also, an automatic home reduces excess energy loss and helps save energy. This paper presents a survey of all these 'system's associated with energy efficiency.

**Keywords.** Energy saving, Electrical and Electronics, Devices, Home Automation and System

## 1. INTRODUCTION

The electrical along with its applied entities in relation to the given concept in any area that includes electrical equipment such as air conditioner, fan, T.V, motor, heater, lighting 'system's, etc. and is controlled using software as a virtual connector, which integrates the Android 'system' and the web 'system'. Such remote access 'system's already exist in the market, but they also have many drawbacks. This paper aims to research all such existing programs and compare the available features.

## 2. STRATEGIES

### 2.1. Home automation through GSM

This type of 'system' provides three home management methods: Internet, GSM network and voice [1]. Real-time monitoring is a smart utility application 'system' that can be used in changing home 'system's. In the event of a change in device status, the user may be notified in real time. User instructions are transmitted to a server usually generated by the PC [2]. The server runs operations on user commands and pushes them to the appropriate units. It helps control and operate electrical items.

This method establishes a connection in areas where lack of proper internet connection is there. The server processes 'AT commands' to connect to the 'GSM modem' [3]. The server has four active engines - a web server, a website, a central control 'system' and a speech recognition 'system'. SMS technology is equipped to control the commands in this 'system', like verification messages. Speech processing works on a flexible folding algorithm [4]. Testing this 'system' with voice processing, it was found to be less effective. Alternatively, voice input can be activated with the wireless unit present. Every node of the application has four components - transmitter, receiver, Input / Output device and 'microcontroller' [5]. The main server controls 'system' that captures data like status information on the device in real time.

The next advancement was the introduction of GPRS or General Packet Radio Service [6]. This application prefers to run on SMS and 'Attention commands'. There is a PC which acts as a command center. GSM dialing and communication 'system' are embedded in PC. The PC receives the messages and executes the required commands. For any application, this 'system' can be tailored. Any mechanical devices can be operated via the sensors that transform electrical signals into 'mechanical signals' from this 'system' [7]. But it can't be used as a 'real-time control 'system'' as it does not give feedback.

The head (main) server is built on an "SMS / GPRS mobile module" with a small controller, like "Java-enabled" phone. This paper also introduces the design and implementation of an "AT modem" driver [8]. It is a text-based command processing software which operates through a 'microcontroller'. Mobile phones provide an easy-to-use interface which work by sending commands and receiving feedback from the 'system'. Password-based verification 'system' must be used to ensure security. But this 'system' is not so reliable as SMS charges are high, slow and prone to attackers.

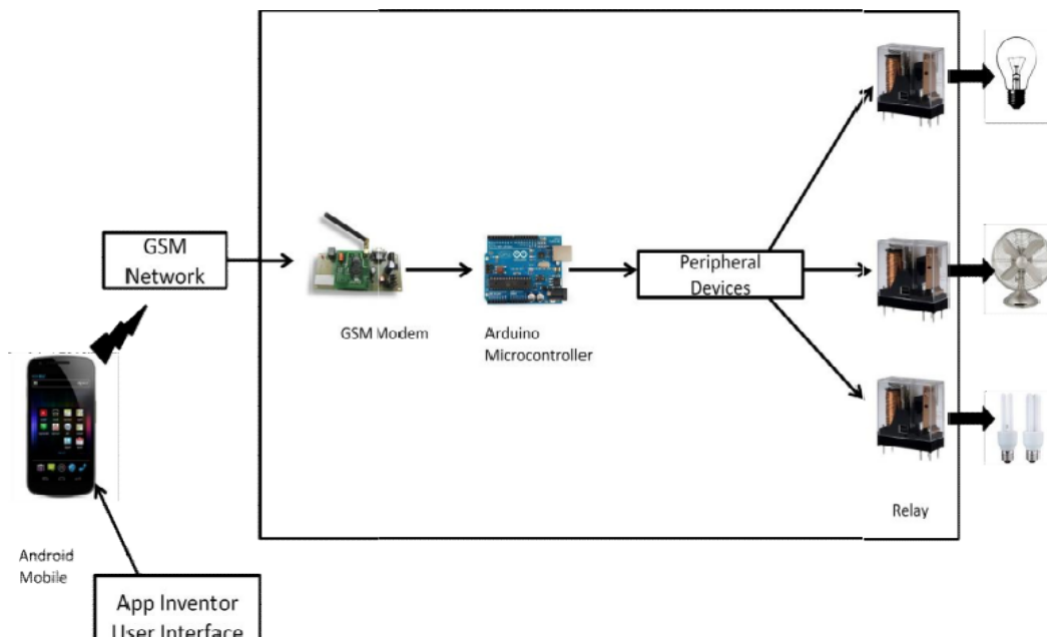


Figure 1 - GSM based HAS

## 2.2. Home automation with 'Bluetooth technology'

The 'Bluetooth technology' is secure along with low cost feature [9]. It uses Arduino and Bluetooth module. An active python application is used on mobile phones to provide a user interface. Bluetooth board Input / Output ports and slides used to communicate with devices with user instructions. Password protection feature of 'bluetooth' makes it a safe technology. Hence, it ensures that "the 'system' is secure and not misused by any attacker". Bluetooth has a short-range operation of 10 to 100 meters It has 2.4 GHz bandwidth and 3 Mbps data transmission speed [10]. It is fast and efficient. It can detect problems in the 'system' and send feedback accordingly. The con about 'Bluetooth' is that it is time-taking to find active devices near it.

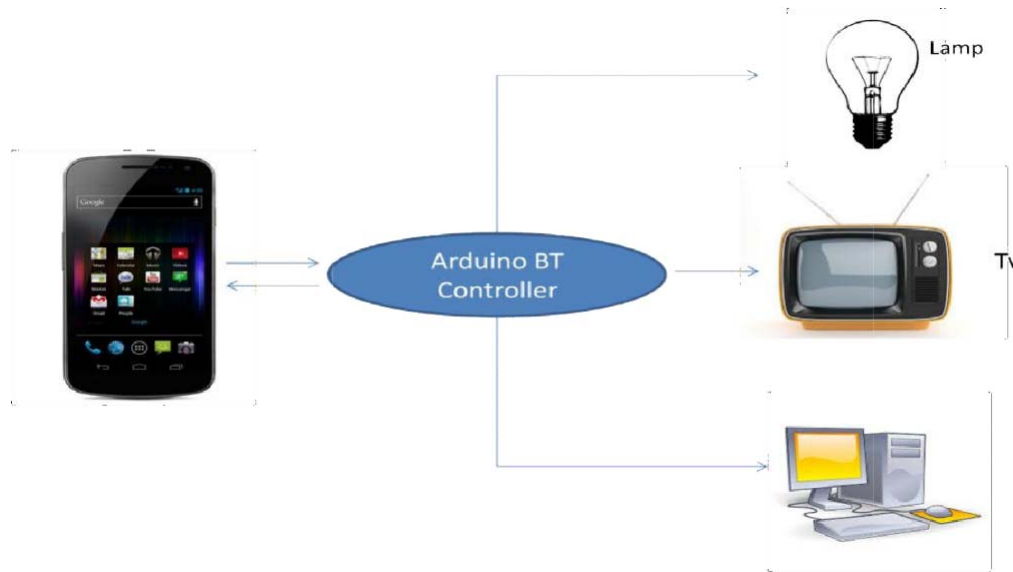


Figure 2 - Bluetooth based home automation

## 2.3. Phone based short range home automation

Permissive 'system' is a 'system' that exercises special abilities to provide a standard technical brochure for 'home automation' [11]. It offers an automated home 'system' which facilitates utilities such as a "controller", 'wide house wires' and "a common interface". This will allow you to use the existing 'system' for home automation. Remote control based on hardware control panel is defined [12]. The remote control functions the power provided to remote devices. The 'system' uses the phone line to transfer instructions. The controller eliminates the costs used as of microcontrollers. It uses a 'DTMF' transceiver connected to a "solid state relay". This controls power supply. It can also be used for testing of infra red signals and the company's AC power network technology. The home automation 'system' uses 'dual tone multi frequency' or 'DTMF' which exists in telephone lines [13]. This 'system' has three divisions. First, the 'DTMF receiver' and 'the ring detector'; after that is the IO interface unit; and the final component is a PC that performs online functions. The PC in this 'system' searches for the line ring and confirms the user.

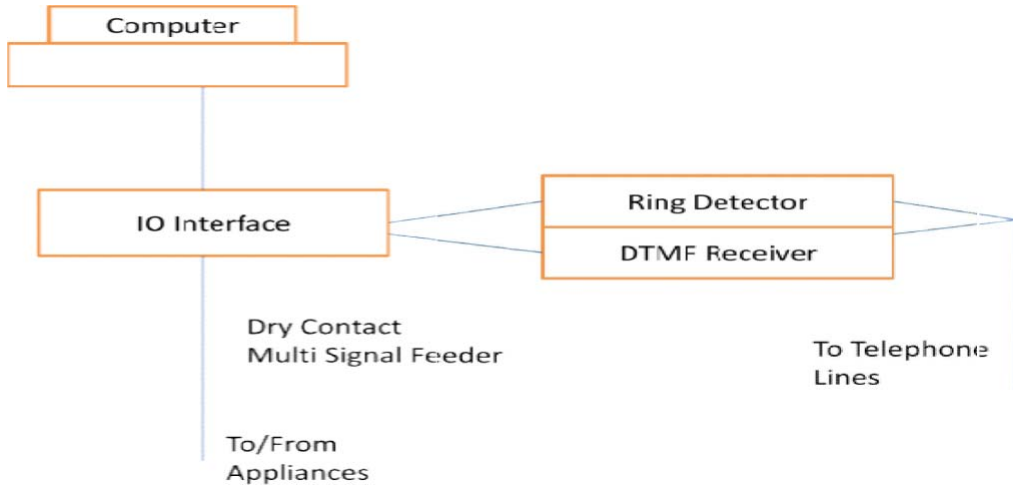


Figure 3 - Smart Control 'system' for remote control of telephones

**2.4. Home automation with the help of 'Zig-Bee'**

'ZigBee' can be implemented to enable automation at home [14]. It is a wireless communication technology. It uses a small PIC controller and voice-recognition for its functioning. Voice-recognition technology compares the voice command in a block and processes further. Then the command is transmitted to the receiver element by the PIC controller via 'ZigBee'. The receiver also has a PIC controller that can process the incoming commands. Relays are used to operate the appropriate equipment. "ZigBee" is a "low-level communication system", so "remote access" is limited to remote locations. Also, "the voice module" may be uncontrollable. This 'system' is very useful and has various applications like, if any smoke is detected in home, it alerts the user via the 'built-in cell' phone number of the user.

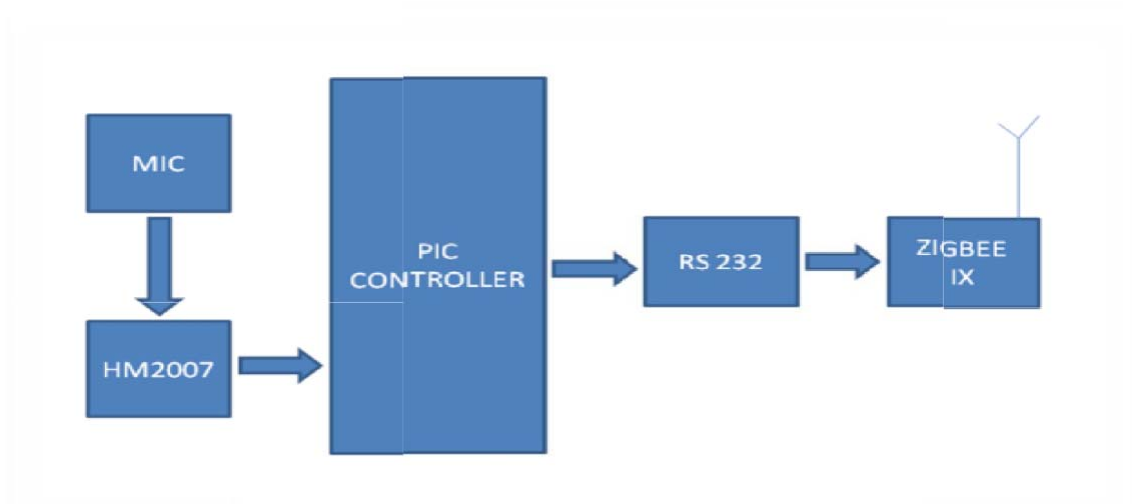


Figure 4 - Transmission Unit flowchart and elements

## 2.5. Home automation via Wi-fi

'System's that use wireless connections can be made by connecting independent electrical appliances located in the home or office and integrated into a co-operative network. 'Wi-Fi' and 'Bluetooth' can be used together for integrating a 'system'. A transparency is entitled in the network with the global power of "Plug and play" technology. The 'system' uses "Open Service Gateway Interface (OSGi)" [15]. The machines are connected by many inter-connected network technologies. User application layer uses web browsers, pocket PC can also be used to control electronic items. Linux environment provides the processing medium for the functioning of this integrated 'system'. A device can be identified in the network by this 'system'. It is best to work with "pattern-recognition", sensors and "intelligent control modules". The program features "the ability to add intelligent control modules". The "control module" poses the capacity to extract information and perform 'pattern recognition'. The universal "plug and play system" uses various unique protocols to work together. The makeable utilization of the "system" is its "interoperability" [16].

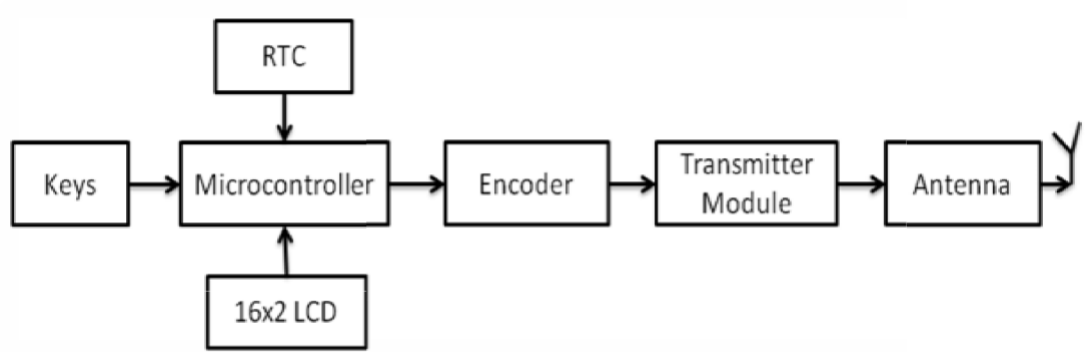


Figure 5 – Transmitter Section flowchart and elements

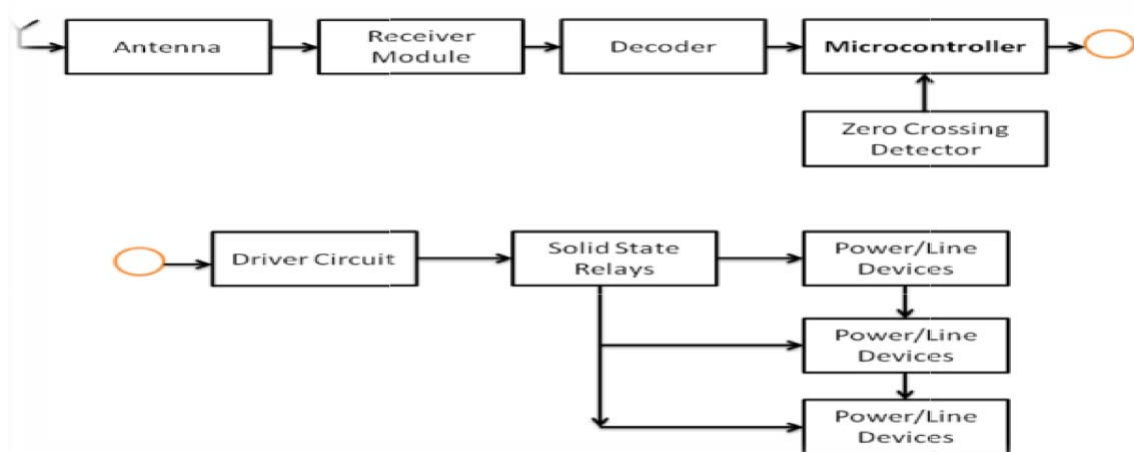


Figure 6 – Receiver Section flowchart and elements

## 2.6. Home automation using Mixed Type

Home automation can be done via any of 'GSM', 'Bluetooth', 'ZigBee', 'Wi-fi' or a combination of these. Communication can be done through an app on Android platform. The app takes a user input, may be in voice or any form of data and transmits text instructions. These instructions are sent via SMS to a phone at home. This 'system' is known as a "remote control unit" [17]. This remote control unit sends commands to the 'ZigBee Transceiver' which in return processes these commands via 'ZigBee' and transfers to the chief controller. "The main controller translates the commands and performs the required function which also sends status feedback via ZigBee". This 'system' is very practical and readily usable. But, the whole 'system' installation and implementation incurs little more cost than usual. This is because it uses technologies.

Many unusual home automation 'system's are available in combination with the GSM and "FPGA (Field Programmable Gate Array) system" [18]. The "FPGA" provides flexibility to be customized by the required application by the user. In comparison to a microcontroller, it stands cost efficient. Hence, overall 'system' is deployed at a lower cost. "FPGA" is connected to the "GSM modem". The "GSM modem" interacts among the devices. "FPGA" decides functioning about the equipments. "UART" implementation enables connection in-between "GSM modem" and "FPGA". Real-time programs use this automation widely.

## 3. CONCLUSION

On the whole, the paper tries to collate the programs available in the script so far. The 'system's tested have some similar features. All of these programs use basic communication techniques. Now, there exists some advantages and disadvantages of the "system" are found in this basic technology. Each one of the above 'system' includes a control circuit which function the electrical equipment. A standard command 'system' is used to execute instructions in the control circuits. "The user interface determines how the user will interact with the system" and therefore, design the level of control needed in the 'system' [19]. This is necessary as it affects the performance of the 'system'. "Many 'system's also have security features to ensure authorized access only."

GSM 'system' heavily depend on use of SMS messages to transmit user-issued commands to the central home 'system'. This 'system' provides the facility to function electrical items from anywhere in the world. However, the costs incurred may be significant depending upon the location. On the other side, there are certain drawbacks too. Delivery of a message is unreliable and uncertain. Real-time 'system', thus, do not use GSM technology.

The 'Bluetooth' 'system' relies on a smart-phone or a PC acting as the receiver element. At home, the Bluetooth function can provide complete control of household entities as long as the user is in the specified range. It can serve as a 'real-time' program. There is security feature in Bluetooth technology as well as transmission speed. But, it cannot provide control outside its range. Bluetooth distance range is 10 meters which marks a drawback of this 'system'.

"ZigBee" is another technology parallel to "Bluetooth", which has identical pros and cons as of 'Bluetooth based system', but slightly better because it does not have a range factor.

'Wi-Fi systems' can use a number of communication technologies and devices. It can be implemented in 'real-time systems'. Spectrum availability is the only factor pulling it back; otherwise, the signals are very wide and offer great options for remote access.

Many existing 'system' uses a combination of methods to compensate for their individual obstacles. Such integrated implementation may give rise to sound 'system'. The lone factor is that, it can affect such programs is the cost of programs and the possibility of duplication.

The “User-Interface (UI)” is another feature where ‘system’ is very different. Previous ‘system’s used with little or absolutely no user interface feature allowed the user to enter commands in the controls. But now-a-days, in smart automated ‘system’s, they have an intuitive UI and much attention is paid to its design and fabrication. The most abundant choice for this ‘system’ is a smart phone. Smart phones are often a useful tool for controlling changing ‘system’s at home. Another option for using web applications is that it may work in browsers.

A quick walk-through of the various technologies for home automation is given below [18].

<b>System</b>	<b>Primary Communication</b>	<b>Remote Access</b>	<b>Count of Devices</b>	<b>Cost</b>	<b>Speed</b>	<b>Real Time</b>
GSM	SMS messages	Anywhere	Unlimited	High	Slow	No
Bluetooth	Bluetooth and AT commands	Within 10 metres	Unlimited	Low	Fast	Yes
Phone Based	Phone lines	Anywhere with a phone line	12, due to 12 frequencies of DTMF	Average	Fast	No
Zigbee	Zigbee and AT commands	Around 10 metres	Unlimited	High	Fast	Yes
Wireless	Radio/infrared Or other waves	Depends on Range and Spectrum of Wave used	Unlimited	High	Slow	Yes

Table 1: Microscopic Comparison Report of all ‘systems’

Summarizing all the tested programs and their advantages and disadvantages, this paper introduces features that should have a good 'home automation' 'system' with 'remote access'. Availability of the most feasible and efficient program worldwide will be showcased in the upcoming time to the user and in real time. One guarantee that access can always be made available through the internet. This will create a general access point for household entities exercising the "Internet Protocol (IP)". The displayed information must be a "web application" with an inter-linked "mobile application" that the user will interact. Only then we can automate homes, ready to be able to trade. Homes can be connected to various sensors like, 'light sensors', 'smoke sensors' and 'temperature sensors' and provide automatic device-based switching. Additional power can be saved by marking the seal that the home stays afloat before turning on the devices and regular inspection of the lights and turning off the lights when not necessary. The further span would be to stretch the program to a larger scale, such as warehouses, corporate offices, factories and other workplaces.

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## Biographies



**Sougata Banerjee** received the Bachelor's degree in civil engineering from University of Engineering & Management, Jaipur in 2021 and perusing the master's degree in structural engineering from the same institute His research areas include building materials, building information modeling and smart construction methods.



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