



REMOTE ENERGY CONSUMPTION CONTROL USING INTERNET OF THINGS

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ABSTRACT

Nowadays, the urban areas and cities of the country are developed rapidly. The domestic houses and commercial building are constructed and are equipped with many devices, either electrical or electronics appliances. Those devices are mostly controlled manually using switches or any other manual mechanism. They consume electrical energy. Sometimes the owner's of the houses forget to switch off them and energy is lost. The ICT technologies are mainly used to link the physical objects to accumulate and exchange data with the interconnectivity of wireless protocols. The techniques and technological methods can be used to know the abnormal state of operation of apparatus located inside the building and household services with the purpose of decreasing power utilization and provide to owner's home the best way of managing of the assets set.

The easy control and monitoring of all appliances used inside the house and management of energy they consume can be achieved by the use of IOT technologies. The IOT technologies work properly with different sensors for controlling the switching of ON/OFF of LEDs and socket outlets, regulating of temperature, humidity, heating and illumination, monitoring of security around and inside the homes, temperature metering.

This project describes the easy method for controlling and monitoring the electromechanical appliances installed at home and create the comfortable life of owner's home to get best efficiency of energy management. The control and monitoring are obtained by using of smart mobile hand set through GSM module and Bluetooth module interconnected wirelessly by cloud internet. The project is made by

microcontroller Arduino Uno used to run the point lights and other appliances and equipment connected to the Arduino via relays. That microcontroller board is interfaced to GSM module and an HC-05 Bluetooth to match up with the smart mobile hand set.

It was clearly that GSM had high range from the electromechanical and electronics appliances to be remotely controlled, but with low data rate comparatively to Bluetooth which has high data rate and small range distance from the home equipping the devices.

This system has an advantage of using both GSM and Bluetooth technology which thereby eliminates the cost of network usage to a great extent by using Bluetooth when in the range of few meters with the devices. The system has its application in situations where the amount of data to be transferred is not tremendous.

The results and outputs of the project of the proposed system of remote control of smart home using GSM and Bluetooth connected together, have shown that, the old manual control of many buildings has to be changed into smart home automation to get the comfort life of owner's home during the control of different assets. The automation of industry and power plants is recommended where personal technicians are not allowed to enter in due to harmful electromagnetic waves. The growing of sensors, automation of apparatus of factories, notifications to operators of machinery in industry, and implementation and testing of real situation of our simulated project must be applied.

Key words: ICTs, IOT (Internet of Things), sensors, Smart Home, Interconnection of smart home, smart phones, home automation, Smart home energy management, Smart thermostat, Thermal comfort control, Smart energy control, Smart home energy management system opportunity, Wireless Sensor Networks

Purpose: Nowadays, the urban areas and cities of the country are developed rapidly. The domestic houses and commercial building are constructed and are equipped with many devices, either electrical

or electronics appliances. Those devices are mostly controlled manually using switches or any other manual mechanism. They consume electrical energy. Sometimes the owner's of the houses forget to switch off them and energy is lost. The ICT technologies are mainly used to link the physical objects to accumulate and exchange data with the interconnectivity of wireless protocols. The techniques and technological methods can be used to know the abnormal state of operation of apparatus located inside the building and household services with the purpose of decreasing power utilization and provide to owner's home the best way of managing of the assets set.

Methodology: This project describes the easy method for controlling and monitoring the electromechanical appliances installed at home and create the comfortable life of owner's home to get best efficiency of energy management. The control and monitoring are obtained by using of smart mobile hand set through GSM module and Bluetooth module interconnected wirelessly by cloud internet. The project is made by microcontroller Arduino Uno used to run the point lights and other appliances and equipment connected to the Arduino via relays. That microcontroller board is interfaced to GSM module and an HC-05 Bluetooth to match up with the smart mobile hand set.

Findings: The results and outputs of the project of the proposed system of remote control of smart home using GSM and Bluetooth connected together, have shown that, the old manual control of many buildings has to be changed into smart home automation to get the comfort life of owner's home during the control of different assets.

Unique Contribution to Practice: The automation of industry and power plants is recommended where personal technicians are not allowed to enter in due to harmful electromagnetic waves. The growing of sensors, automation of apparatus of factories, notifications to operators of machinery in industry, and implementation and testing of real situation of our simulated project must be applied.

INTRODUCTION

Today's homes require sophistication control in its different devices which are basically electronic appliances. This has revolutionized the area of home automation with respect to an increased level of affordability and simplicity through the integration of home appliances with smart phone and tablet connectivity. Smart phones are already feature-perfect and can be made to communicate to any other devices in network with a connectivity options like Bluetooth and GSM module. With the arrival of mobile phones, Mobile applications development has seen a major outbreak. Utilizing the opportunity of automating tasks for a smart home, mobile phone commonly found in normal household can be joined in a momentary network inside a home with the electronic equipment.

According to Clement Regis Tuyishime (2021), RWANDA is implementing the vision of 2050 in the paragraph of 'smart and green cities for sustainable growth' with a focus on SDGs goals with aim of development of cities and communities that "integrate shared ICT infrastructures and services into management and provision of critical public utilities and services in rural and urban setting to achieve; smart energy, smart transport, smart water and sanitation, smart social services, smart environment, and smart agglomeration. IOT technologies are planned to be used in the smart homes, with considering ICT technologies.

In this project, the settled system will indicate how the operation, monitoring and control of smart home applications and help the generation of smart decisions through notification to the user.

Currently, the interest in Smart City (SC) and Smart Home (SH) are growing due to smart phone and internet use, alongside the rapid development of the Internet of things (IoT). Data-driven decision-making is helping to improve the efficiency of homes and cities, enabling a more sustainable mode of living that discourages wastefulness.

It is possible today to see an SH as an automation process for different devices within a building, including monitoring control and automation for heating, ventilation, air conditioning (HVAC), lighting, electronics, household appliances, and security systems. This automation consists of the ability to schedule events for these devices either locally or remotely. An SH system makes life at home more comfortable, but it also aims to reduce energy consumption. This is key for engaging actors interested in transforming homes into an SH, since electric energy consumption in the residential sector represents a quarter of the world's total final energy consumption. It is essential in daily activities; therefore, practices and solutions that promote the saving and efficient use of energy must be included to correctly manage the energy supply in homes, preserving the natural environment

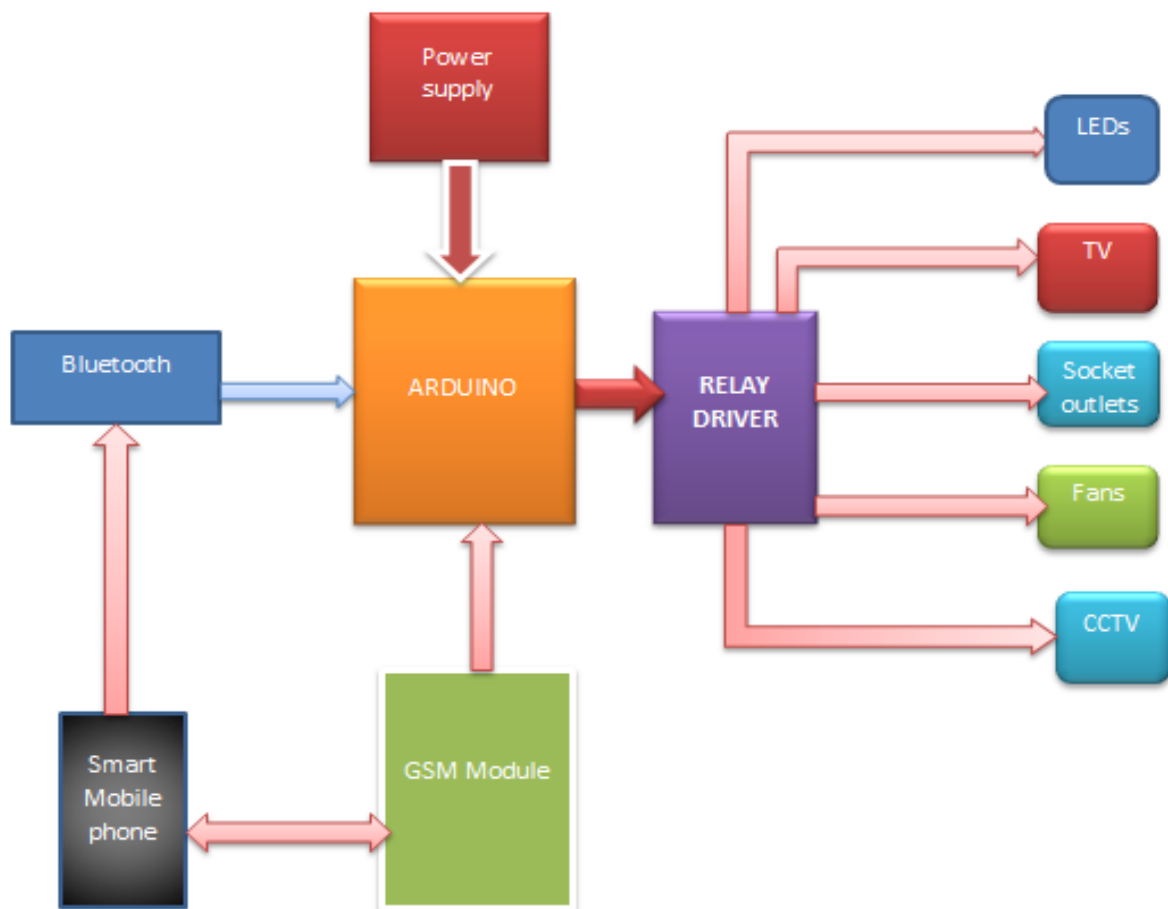
According to F García Vázquez (2021), SH systems could be integrated by a wide range of devices, such as smart switches and plugs, temperature, humidity and presence sensors, security cameras among others. Smart switches are devices that can be installed in an electrical appliance or house lights.

They can be controlled and monitored with a mobile application from anywhere as long as the user has an active internet connection. In case of network failures, the switch can be manually controlled without using the internet, not affecting the user's comfort. These devices are an alternative to reduce the electrical consumption of home lighting instead of changing the lights, or the user can even use both options to increase efficiency. Any attempt to reduce energy consumption consists of making an initial financial investment, recovered over time. However, it is essential to offer the user more alternatives to choose the best option.

Therefore, introducing a new SH platform that increases user comfort by controlling and monitoring household appliances at home from anywhere and anytime as long as an active internet connection becomes the cornerstone when transforming a home into a smart home. Offering users adequate management of the lighting system in a home represents the first step towards an SH.

System Block Diagram

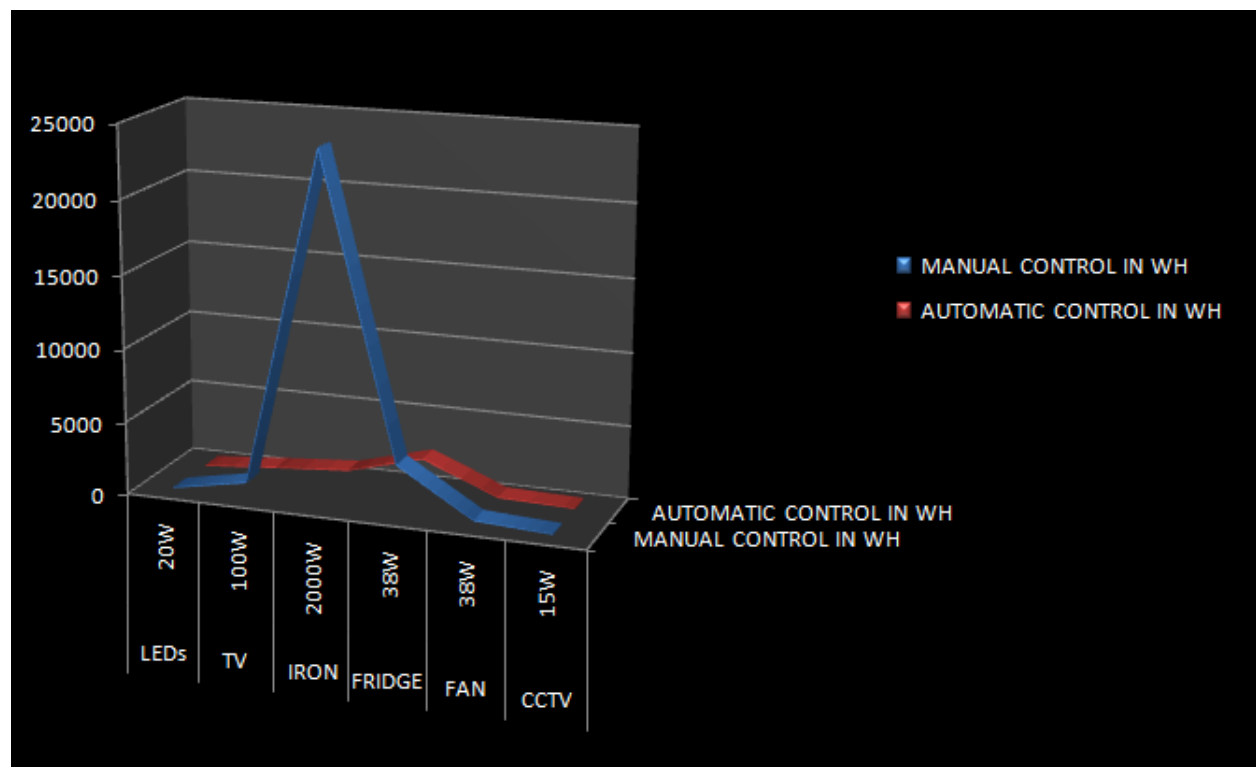
In the following paragraph, is showing how different elements will be connected together and how the study research is look like. The devices located in smart home, have to be controlled remotely or locally will be driven by relays. The GSM Module and Bluetooth will be connected together to Arduino to monitor the sensors data. If you are inside the house you can control your appliances using Bluetooth when outside use your GSM phone touching manually on your handset. In the figures bellow, there block diagrams and proposed general circuit of the project research.



COMPARISON BETWEEN MANUAL CONTROL AND AUTOMATIC CONTROL

DOMESTIC ELECTRIC LOADS	LEDs	TV	IRON	FRIDGE	FAN	CCTV
ENERGY/POWER	20W	100W	2000W	38W	38W	15W
ENERGY CONSUMMED WITH MANUAL CONTROL IN WH	240	1200	24000	3600	456	180
ENERGY CONSUMMED WITH AUTOMATIC CONTROL IN WH	160	600	1000	2400	304	180

RESULTS, ANALYSIS AND DISCUSSIONS



CONCLUSION, RECOMMENDATIONS, AND FUTURE WORKS

The smart home is actually consisting of different electrical and electronics appliances and devices. Sometimes is not easier to control those devices for comfortable life of owner's home. The most control of home is done manually. The owner of home needs to control all devices installed in his/her

house remotely in order to manage the energy consumption. Our study was to establish the remote control system of electromechanical equipment and electronics devices using smart phone. The control was to be done near closer to the home or far away from the building. The proposed system of using GSM and Bluetooth together to increase the occupant's comfort in monitoring and control the major electromechanical apparatus in the building. This represents passable management of all in operation such as electrical energy, water for drinking, bathroom and garden, fuels for petrol engine. This research project brings the manageable secured and smooth life. We achieve this by using mobile hands sets and internet connection, but we have limited by finding the real and physical devices to test the project, that is why our project is limited to simulation and what is simulated can be transformed into physical hardware.

The proposed system is affordable and has low running cost through the implementation of both Bluetooth and GSM control. Consumers neither require internet connection nor a computer to make use of the proposed system. The system has a friendly interface through the use of a simplified Android application and provides accurate and real time feedback during Control. In addition, it also provides a security feature to help detect intrusion or unauthorized entry while the home user is away

5.3. Recommendations

According the results and outputs of the project, the proposed system of remote control of smart home using GSM and Bluetooth connected together, it is recommended that the old manual control of many buildings has to be changed into smart home automation. In future works on smart home automation, we suggest the notifications by SMS, email and other kind of alert of what happen inside the building during the remote control. This will help the owner's home to be sure that the control is surely done and

possible communication to others who don't have that assigned tasks. The algorithm can be improved to be used in industry and factories to increase the precision of technician's adjustments.

5.4.Areas for further research

Additionally, the project is predictable to carry on working in further domains like automation of industry and power plants where personal technicians are not allowed to enter in due to harmful electromagnetic waves, the growing of sensors, automation of apparatus of factories, notifications to operators of machinery in industry, and implementation and testing of real situation of our simulated project.

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