

MULTIPLE OBJECTIVE DECISION BASED MODERN DIGITAL HOME

Dr. GopiKrishna Pasam
Assistant Professor

Dept. of Electrical and Comp. Engg.
Addis Ababa Science and Technology
University, Addis Ababa, Ethiopia

Mr. Wondwosen Wubu Mersha
Head of Department

Dept. of Electrical and Comp.
Engg.
Addis Ababa Science and
Technology University, Addis
Ababa, Ethiopia

Mr. Sudarsi Rakesh
Lecturer

Dept. of Mech. Engineering
Addis Ababa Science and
Technology University, Addis
Ababa, Ethiopia

Abstract—Day to day the technology is advancing and it's becoming a part of our life. In this situation this project will provides an innovative and a complete solution for home automation based on multiple objectives. These objectives involve the switching ON/ OFF of home appliances automatically using different sensors, GSM modules, Smart phones with Bluetooth control, Smart phones with voice control, House security through GSM, Camera modules to send SMS, MMS when an unknown person entered into our locked house, Water tank level monitoring, Gas level, leakage monitoring systems, RFID (Radio Frequency Identification) locks and Number locks in the place of manual locks. These all objectives are innovatively incorporated into our proposed prototype home model using Arduino and Raspberry Pi microcontrollers, GSM, Blue tooth, camera modules, RFID, Number lock and different sensors. Among all these objectives gas level monitoring, water tank level monitoring are our own proposed methods implemented successfully. We proposed and developed a multiple objective based a complete solution for home automation which will make or initiate the people towards Modern home to lead their life more comfortably, securely and providing their contribution in saving the energy for the their nation and as well as to reduce Global warming.

Keywords—Home Automation; GSM; Bluetooth module; Switching by Voice; Water tank level ;, Gas level; RFID etc.,

I. INTRODUCTION

Home automation is similar to smart home, digital home, e-home and intelligent household shown in Fig. 1. They both mean a high living condition with many smart devices. It is the residential extension of building automation which is using automation technology, computer technology and telecommunication technology to give the user a developed living condition, entertainment and security [1]. It helps people in reducing the unwanted utilization of electrical energy without human intervention and household management by its automation and loop system. Home automation is the use of one or more microcontrollers to

accomplish basic home functions and features automatically and sometimes remotely.

A new smart home wireless sensor networks suitable for elders, blind, sight impaired and for disabled people these wireless systems offers a complete solution for the whole home environment for elders and disabilities by designing entering system, fall detection system, RFID system, lighting system, microphone/ speech recognition system, proximity sensor/ sound synthesizer system, gas leakage detection system, electrical devices monitoring and home structure health system. The system is extendable and easy in installation and maintenance it costs about \$8100 [2], with this system the home can be controlled locally using a remote control or an application on a PC or laptop, or remotely through the Internet. As compared to this system, we implemented similar objectives with the very much reduced cost using of different sensors, GSM module, relays, Arduino and Raspberry pi microcontrollers.

Actually, in addition to the convenient and comfort of these home automation technologies the most important enhancement to be taking into account is the expressing of the energy saving benefit of smart home technology by, first, using other resources for supplying power especially the solar power, second, continuous measuring of power consumption loads of different devices in such a way that gives the home owner guidance to control their use of electrical devices to reach a specific level of consumption or certain electricity bill, also the usage control can be done automatically through the desired programs [2].



Fig.1: A sample modern home [3]



One of the recent objective in the home automation is using of Bluetooth technology. The proposed objective [4] allows the user to monitor and control different appliances connected over a Bluetooth network in home environment. The system has been demonstrated to be functioning by developing a room temperature control system. The nature of this project is such that it provides a great scope for further developments. In this system, the error detection and correction facility is only handled at the Bluetooth level. Similar facility can be developed at the application level. Also, some security measures to avoid interference of neighboring home automation systems can also be incorporated into the application. Similar to this type of system, prototype models presented in this paper uses a Bluetooth module HM-10 for Arduino is used to control various devices through our own android app and through Google voice to text conversion app.

There are many ways how to use home automation with smart phones such as smart thermostats, which means to control the temperature of your home from anywhere, Motion activated security cameras, high-quality security cameras that allow you to be aware of anyone in your home, security system, the house person can be able to lock, un-lock, and send time sensitive smart keys to your family and friends discussed in [5] to [16]. These types of activities are achieved in this paper and are discussed in the forthcoming result section.

Monitoring and controlling automatic switching ON/OFF of any electrical devices without direct human intervenes. It will make the life in our home more convenient and controlled automatically. It can be used in houses, banks, stores, colleges, police stations, supermarkets and governmental buildings. The system intended to control electrical appliances and devices in houses with relatively low cost design, user-friendly interface and easy setting up works when a thief enter the building by switching the lamp, the bell and the camera takes a picture and record a video. Moreover, the system send an SMS to the owners to alarm them also can using Bluetooth to control of any device by mobile and voice. These types of technologies are successfully implemented in this paper with the multiple objectives mentioned in the section II, Methodology with implementation steps are discussed in the section III, followed by the corresponding results in section IV and conclusions in section V.

II. OBJECTIVES OF PROJECT

The main objective of this project is to develop a prototype home model which will involve the multiple objectives such as:

- 1) Switching ON/OFF of electrical devises automatically (using different sensors) and using GSM module by sending SMS.
- 2) Switching ON/OFF of electrical devises using Smart Phone through Bluetooth module.
- 3) Switching ON/OFF of electrical devises using Smart Phone through Voice control.

- 4) House security monitoring using GSM module and Camera module to send SMS & MMS.
- 5) Water Tank level monitoring and SMS alert systems to owner and water tank persons.
- 6) Gas level monitoring, Gas leakage alert and information sending systems.
- 7) Door lock through numbers keypad and RFID tags/cards
- 8) House lights ON/OFF based on room darkness and person's movement with temperature sensor display.

III. METHODOLOGY

The proposed systems block diagrams shown in Fig. 2 and Fig. 3 are used to develop a prototype model of modern home with multiple objectives as discussed in section II.

A. Operation of The Project

The project mainly consisting of Arduino boards, SMS (Short Message Service) Module, SD (Secure Digital) module, PIR sensor to sense the human so that the relay board to switch ON lamps through relay board and alarm ,Raspberry Pi camera used to take picture and SD card module is used for storing the pictures taken by camera , Bluetooth module switch (ON/OFF),Voice control sensor also switch (ON/OFF),Gas Sensor check leaking & measure the pressure and Water level Sensor is use if tank in our home is full or when come 25% we send message .

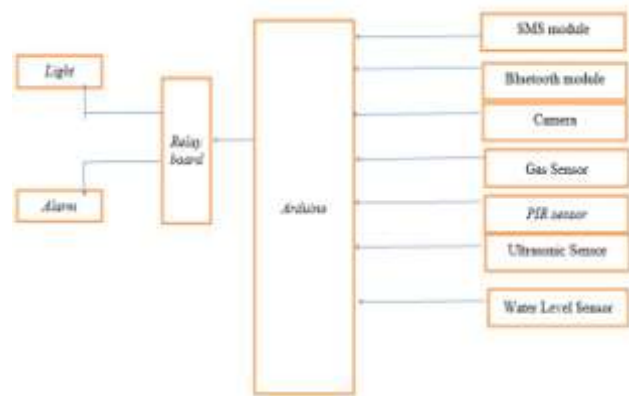


Fig.2 : Block diagram-1 for implementation of objectives 1-6

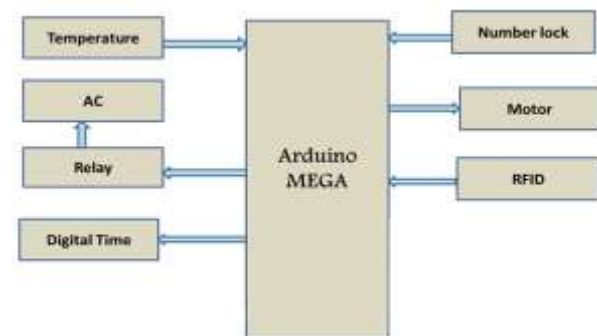


Fig. 3: Block diagram-2 for implementation of objectives 7-8

B. Implementation Steps

Step 1: Switching ON/OFF of electrical devices automatically (using different sensors) and using GSM module.

When any person entering in to the Home sensor it will sense PIR sensor will give signal to Arduino board, therefore that the Arduino board will give signal to relay board then the Lamp will ON automatically also will send message to the owner act like this message (Some unknown person entered in your home)

Step 2: Switching ON/OFF of electrical devices using Bluetooth module.

The Bluetooth is work like switching (ON/OFF) we can control by any device in our home using Bluetooth such as (fan, TV .AC, lamp and project) act like remote control in our home.

Step 3: Switching ON/OFF of electrical devices using Voice control.

Voice is will connected with Bluetooth to can control by any devices using our voice, example (light 1 ON, light 1OFF also fan 3 OFF) it is very easy, useful and effective to control by any devices in our home.

Step 4: House security monitoring using GSM module and Camera module.

Camera will teak picture and video then it will send by SMS this picture or link for this video to owner or will store in SD module.

Step 5: Water tank level monitoring using GSM module.

When the tank of water is full or soon it will finished Water level Sensor will give signal to Arduino board, therefore that the Arduino will give this signal at same time SMS will be send message to the owner using SMS module.

Step 6: Gas Quantity and Leakage monitoring and information sending system

When gas is leaking in the house because old pipes or rusted gas, our sensor will be detected and gives an alarm, in addition to that it will send a SMS to the owner of house to take preventive steps. This type of feature is not available in the present gas detection system. Importantly our system will also indicate quantity of Gas in the Gas Cylinder based on its weight, to achieve this we have not connected any electronic circuit to gas cylinder as it is dangerous, we just calibrating the weight of gas as quantity of gas.

Step 7: Door lock through numbers keypad and RFID tags/cards

In this step, we have successfully used a 4X3 keypad and RFID reader to create electrical door lock. When user enters a correct password, doors will be opened and when we press a closing button doors will be closed. Similar action is achieved when user shows protected RFID tag to the RFID reader.

Step 8: House lights ON/OFF based on room darkness and person's movement with temperature sensor display

In this step, we have used a Light Dependent Resistor (LDR) sensor to detect day light, and Passive Infra-Red (PIR) sensor to detect any person movement in the room/house. Using these LDR and PIR combinedly the lights in the room will be ON

only when there is a person in the room and that room having darkness. A LM35 sensor is calibrated and used to display the room temperature in the Liquid Crystal Display (LCD).

IV. RESULTS

The Circuit diagrams shown in Fig. 3 to Fig. 8 are used to obtain the results of multiple objectives discussed in the section III. The various results from these circuits are illustrated and presented in this section IV from A to L.

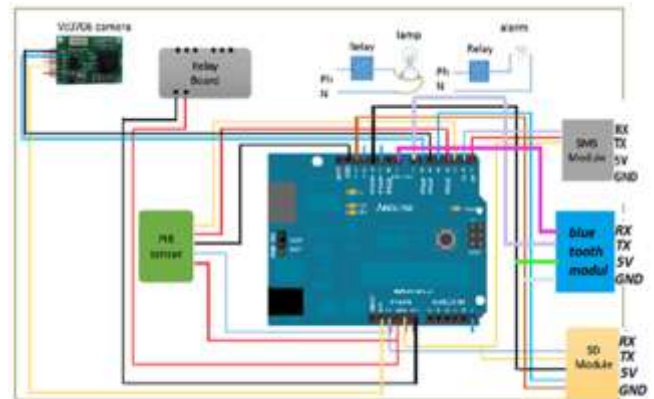


Fig. 4: Circuit Diagram-1 for Objectives 1 and 4

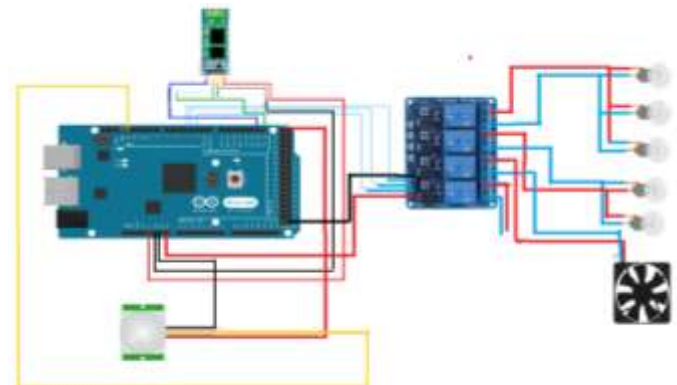


Fig. 5: Circuit Diagram-2 for Objectives 2 and 3

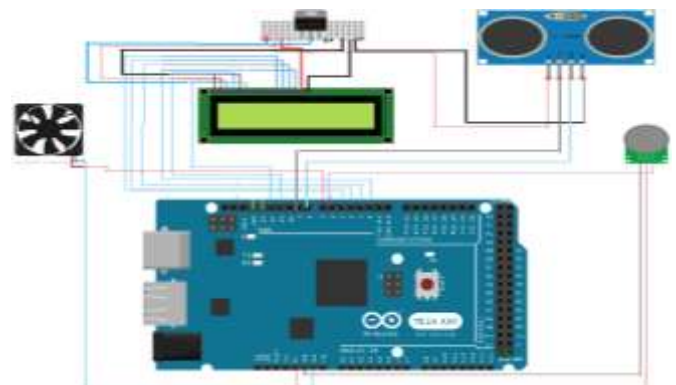


Fig. 6: Circuit Diagram-3 for Objectives 5 and 6

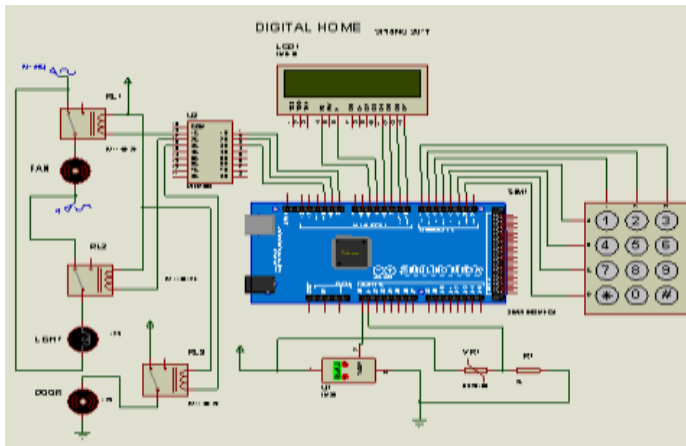


Fig. 7: Circuit Diagram-4 for Objectives 7 and 8

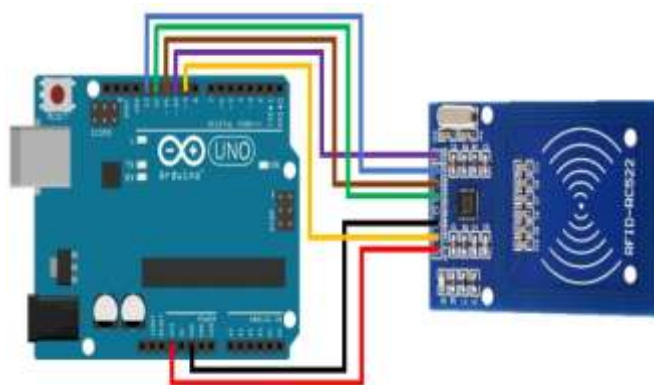


Fig. 8: Circuit Diagram-5 for RFID based Door lock

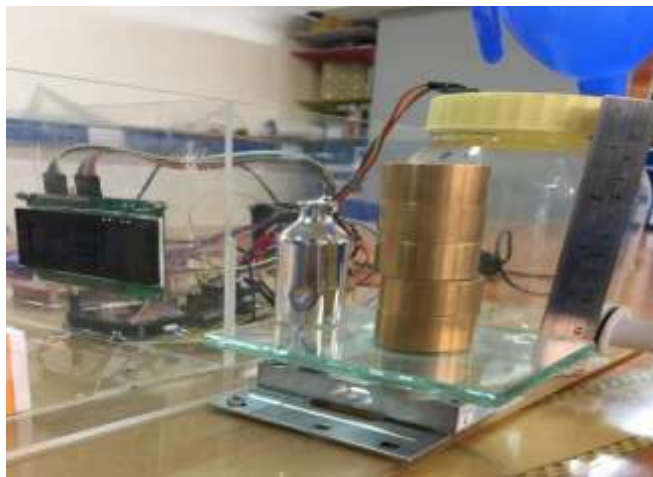
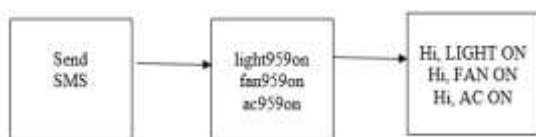
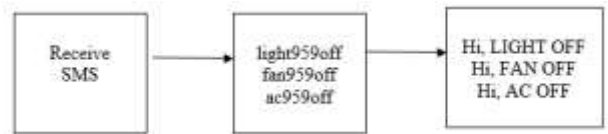


Fig. 9: Implementation picture of Water tank and Gas level

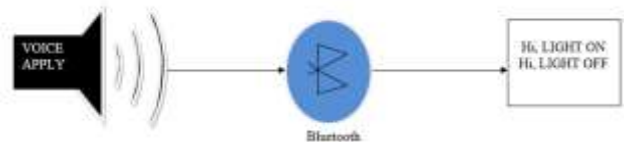
A. Result-1: To Send SMS



B. Result-2: To Receive SMS



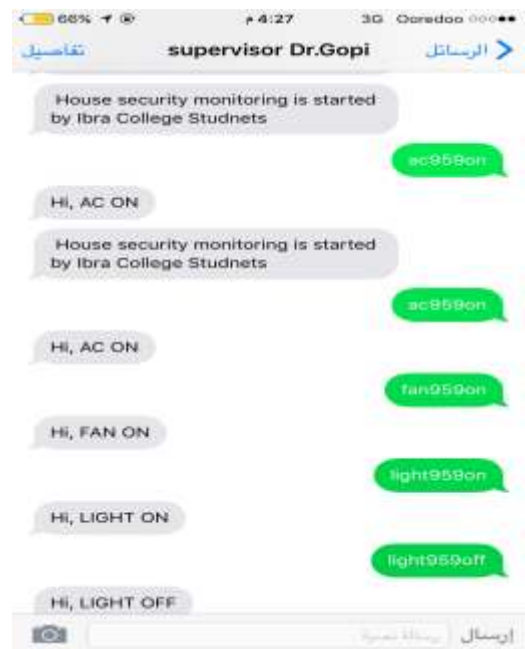
C. Result-3: Voice application and connection to Bluetooth device.



D. Result-4: Supervision and Regulation of Home Automation System

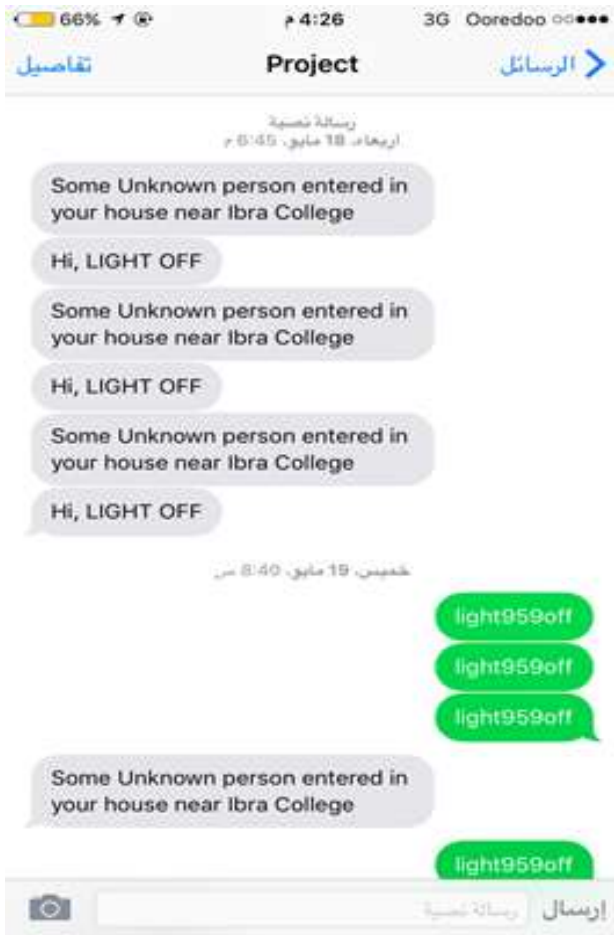


E. Result-5: SMS Switching ON/OFF various devices





F. Result-6: House Security Monitoring by GSM



G. Result-7: Gas Level Monitoring

The results shown in Table-1 are used for the calibration of GAS level with weight sensor to develop Arduino program for continuous monitoring of quantity of GAS usage. The implementation picture is shown in Fig. 9.

Table 1: Gas weight Vs. Arduino reading Display

Weight of Gas (Simulated) in gram	Arduino Serial output With Map	Arduino Serial output Without Map	Arduino Display of Gas Level
0	6.5	23-25	No gas
100	7	31	20%gas
200	9	37-38	40%gas
300	10-11	43-45	60%gas
400	12	50-51	80%gas
500	13-14	56-57	Full gas

H. Result-8: Water Tank Level Monitoring

The results shown in Table -2 are used for the calibration of water level with ultra-sonic sensor to develop Arduino program for continuous monitoring of usage of water. The implementation picture is shown in Fig. 9

Table 2: Calibration table for Sensing Water Tank Level

Water level from Sensor Position	Arduino Water Level Signal Reading	Arduino Display of Water level
1 inch	1.02	100%
2 inch	1.82	75%
3 inch	2.60	50%
4 inch	3.32	25%
5 inch	0	0%

I. Result-9: Door Lock implementation through RFID

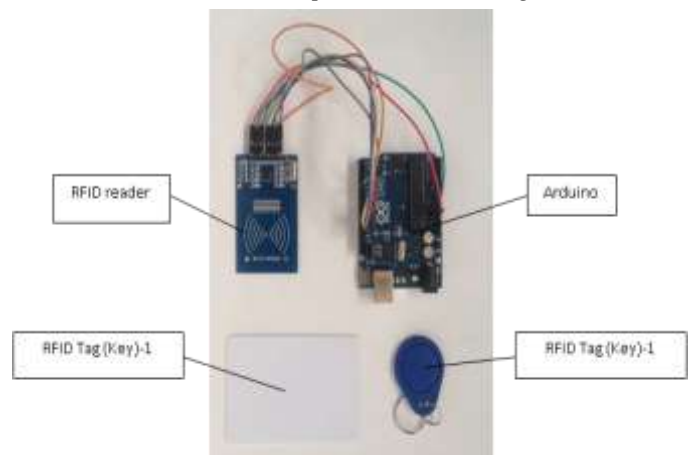


Fig. 10: Implementation picture of RFID with Arduino

By observing the Fig.10, there are two keys whenever these encrypted RFID Tags-1 & 2 to shows near to RFID reader, the security password will be identified and the door will be opened.

J. Result-10: Door Lock implementation through Keypad

The circuit diagram as shown in Fig.7 is used successfully to implement door lock through keypad. Using this circuit, when user press the predefined password key correctly then door will be opened and when press the close button, the door will be closed. We have programmed in such a way that, the user have a facility to set or change their passwords.

K. Result-11: Temperature, LDR & Motion detection Implementation Result

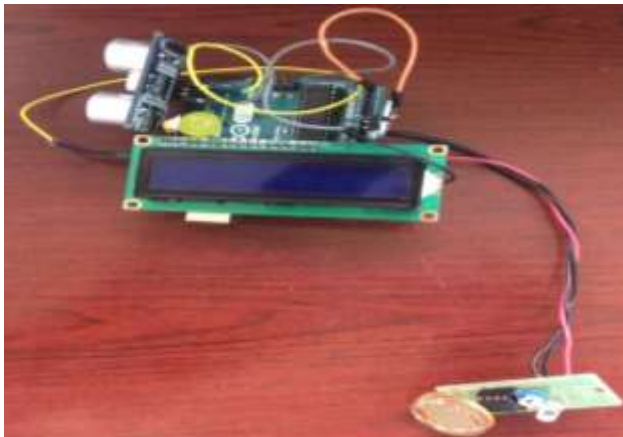


Fig. 11: Implementation picture of temperature and motion detection

The Fig. 11 shows the picture of implementation of sensing of Temperature, LDR & Motion detection. Temperature value can be shown through LCD. The LDR and Motion detection are related to each other whenever room gets dark and there is someone inside the room light will be switched ON automatically otherwise OFF.

L. Result-12: Total project Implementation result with all Objectives



Fig. 12: Total project implementation picture

The total project implementation picture of all objectives discussed in the section II is shown in Fig. 12.

V. CONCLUSION

The feasibility and implementation of multiple objectives related to home automation has been investigated and successfully implemented. The main objectives implemented and results are presented in this paper are related to the following objectives:

- ❖ Switching ON/OFF of electrical devices automatically (using different sensors) and using GSM module.

- ❖ Switching ON/OFF of electrical devices using Bluetooth module.
- ❖ Switching ON/OFF of electrical devices using Voice control.
- ❖ House security monitoring using GSM module and Camera module.
- ❖ Water tank level monitoring using GSM module.
- ❖ Gas leaking monitoring using GSM module & measuring level of Gas.
- ❖ Door lock through numbers keypad and RFID tags/cards
- ❖ House lights ON/OFF based on room darkness and person's movement with temperature sensor display.

Our project has many benefits in the present and in the future by utilizing the advanced developments in the technology to lead easy, comfort, and secure life and as well as saving of energy consumption from unnecessary usage of basic needs of power, water and gas, in that way the implementation of our project is more useful for the customer and for the society from global warming.

VI. REFERENCES

- [1] Chowdary, U.V., Rohith, K., Sandeep, P. and Ramu, M., "Home Automation System Using IR Sensors," *International Journal of Electrical and Electronics Engineering*, , issue 4, vol. 6, 2015, pp 11-1.
- [2] El-Basioni, Basma M. Mohammad, Sherine Mohamed Abd El-Kader, and Hussein S. Eissa. "Independent living for persons with disabilities and elderly people using smart home technology." *International Journal of Application or Innovation in Engineering and Management* 3.4 (2014): 11-28.
- [3] <https://www.efxkits.co.uk/android-home-automation-system/>
- [4] Bittins, Björn, Jürgen Sieck, and Michael Herzog. "Supervision and regulation of home automation systems with smartphones." *Computer Modeling and Simulation (CMS)*, 2010 Fourth UKSim European Symposium on.IEEE, 2010.
- [5] Corradini, Flavio, et al. "Private assisted house for smart living." *Journal of Ambient Intelligence and Smart Environments* 9.6 (2017): 725-741.
- [6] Hui, Terence KL, R. Simon Sherratt, and Daniel Díaz Sánchez. "Major requirements for building Smart Homes in Smart Cities based on Internet of Things technologies." *Future Generation Computer Systems* 76 (2017): 358-369.
- [7] Katz, James Everett. *Connections: Social and cultural studies of the telephone in American life.* Transaction publishers, 2003.
- [8] Javale, Deepali, et al. "Home automation and security system using android adk." *International journal of electronics communication and computer technology (IJECCCT)* 3.2 (2013): 382-385.



- [9] Kumar, P. Pavan, and G. TirumalaVasu."Home Automation & Security System Using Arduino Android ADK." *International Journal of Emerging Trends in Engineering Research (IJETER)*, Vol. 3 No.6, Pages : 190- 194 (2015)
- [10]Obaid, Thoraya, et al. "Zigbee technology and its application in wireless home automation systems: A survey." *International Journal of Computer Networks & Communications* 6.4 (2014): 115.
- [11]Hale, Kelly S., and Kay M. Stanney, eds. Handbook of virtual environments: Design, implementation, and applications. *CRC Press*, 2014.
- [12]Palaniappan, Satish, et al. "Home Automation Systems-A Study." *International Journal of Computer Applications* 116.11 (2015).
- [13]Javale, Deepali, et al. "Home automation and security system using android adk." *International journal of electronics communication and computer technology (IJECCT)* 3.2 (2013): 382-385.
- [14]Khiyal, Malik Sikandar Hayat, Aihab Khan, and ErumShehzadi. "SMS Based Wireless Home Appliance Control System (HACS) for Automating Appliances and Security." *Issues in Informing Science and Information Technology* 6 (2009): 887-894.
- [15]Bradai, Nourchene, Lamia Chaari, and LotfiKamoun. "A comprehensive overview of wireless body area networks (WBAn)." *Digital Advances in Medicine, E-Health, and Communication Technologies* (2013): 1-32.
- [16]Piyare, Rajeev, and M. Tazil. "Bluetooth based home automation system using cell phone." *Consumer Electronics (ISCE), 2011 IEEE 15th International Symposium on.IEEE*, 2011.