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COMPUTER NETWORK

PROJECT: IOT AND HOME APPLIANCES

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IOT and Home Appliances

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Abstract:

In this age of technological technology, customers' first priority is to create a secure, happy, and comfortable atmosphere in their homes. As a result, one issue raised is how to safely and simply handle these numerous equipment. In this search paper a smart control system have been elaborated to tackle with this problem. This system have its own characteristics of home security, control and management, monitoring and analysis. In the automation of smart houses, the top most demand of customer is to have a secure space at their home along with controlling and monitoring home appliances. Therefore, an efficient system is required to control appliances and door permission system to secure the interaction between the visitor and the owner. A low-cost, low-power consuming system is proposed in this paper using internet, GUI interface and GSM module. The technology will reduce the wastage of electrical energy along with security. Remote control mode of smart appliances is also one of the interesting part of emerging technology In this research paper ZigBee wireless sensor network based remote control system is discussed. This remote control system is flexible, reliable, and unique and has its own interesting features and compatibility over traditional control systems.

Keywords: WSAN (Wireless Network or Actuator Network), Wireless Network communication, ZigBee, Wi-Fi, 433 MHz Radio Frequency (RF), SHIS (Smart Home Information System), IoT (Internet of Things), GSM (Global System for Mobile Communication), Smart appliances, Wireless sensor network, Raspberry Pi2 model B, Arduino mega2560, Door permission, GUI (Graphical User Interface), Home appliances , Dialogflow, NodeMCU,Node-RED

I. INTRODUCTION

One of the focus of today's advanced technology is the automation of homes to support luxurious life style. Recently sensors and wired networks are widely used in automation of home appliances. Improving connectivity is the major goal of Internet of Things (IoT). More facilities and home appliances are being introduced as per people ever-growing high demand of quality life. Facilities or appliances and their control are two different things having big differences. As the people are expecting comfort, security and convenience so the control system should be a big efficient system because simple conventional system may not meet customer requirement. The core of automating a smart house is home networking.

In smart home appliances mostly the networking system used is wireless instead of traditional networks. This is because wireless networking system provides mobility, accessibility and expandability. Along with this, number of cables are also reduced by installing wireless network. Wireless networking methods include Wi-Fi, ZigBee and 433 MHz Radio Frequency (RF). ZigBee is a standard-based wireless networking system of low-cost used to create small personal area network and internet of things (IoT) networks.

Yuksekkaya et al implemented a remote home automation control system based on internet, voice recognition and Global System for Mobile Communications (GSM). The two main parts of this system are smart permission system and control/monitoring of appliances. Methodologies like World Wide Web (WWW) and Graphical User Interface (GUI) can be used for monitoring and controlling purpose. The user can control the appliances by monitoring status ON\OFF by being online or offline. By using smartphone or laptops the user can watch his house members anywhere. Along with this the Smart permission system give user an ease to secure his interaction with the outsider/visitor.

II. A SMART CONTROL SYSTEM BASED ON IoT

Following model is presented to control facilities and appliances in a home. In this efficient control system, 433 MHz Radio Frequency (RF) wireless networking approach is used.
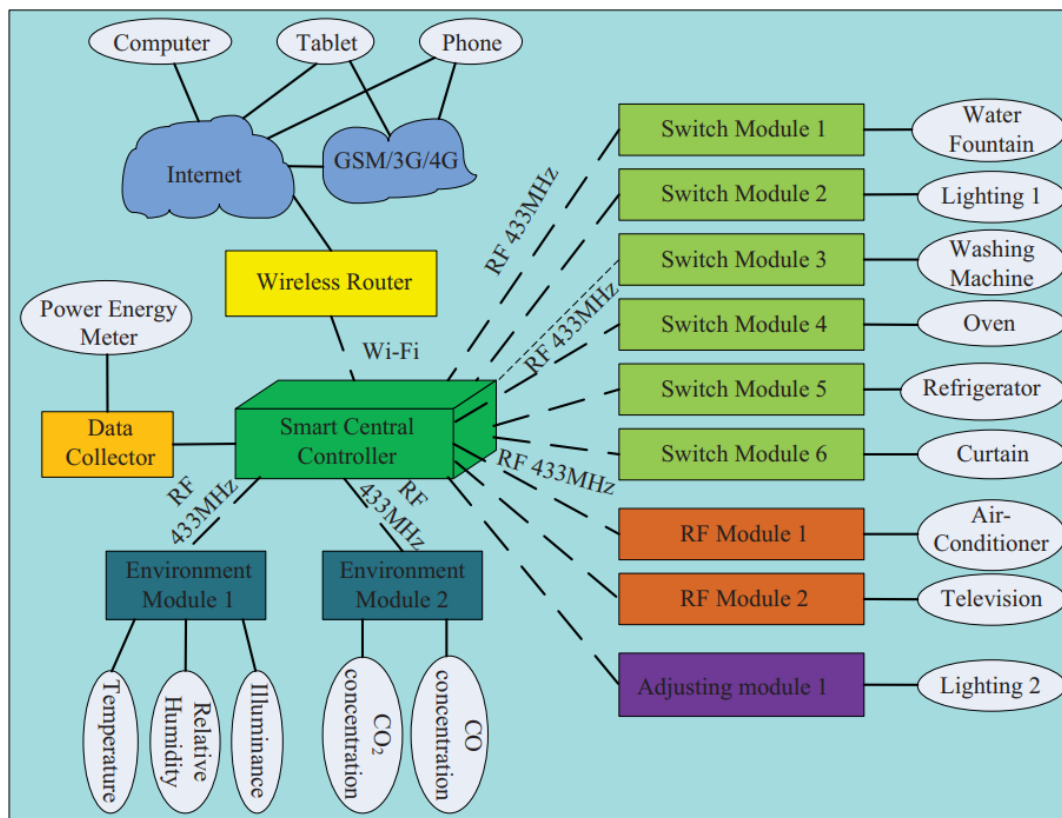

Fig. 1: Smart IoT-based home control system

The core component of this network (WSAN) is the efficient central controller. It is responsible for setting up control modules with wireless network and organizing them. RF module, switch module and adjusting module are there for various appliances. It means corresponding control module is controlling each appliance. This home control system is divided into lower and upper part. Data collectors, adjusting modules, switch modules, RF modules, and central controller (smart) are included in the lower part while smart phones, tablets, computers and wireless routers are categorized in the upper part. This is a very efficient control system because WSAN network has been used, which means less cables (wiring) are used. Secondly because of self-organization and self-configuration a balance is maintained throughout. Thirdly, the control modules can be installed easily because of their standard sizes. Hence this smart control system is very easy to be installed and maintained. Among wireless networks of Wi-Fi, Bluetooth and ZigBee, 433 MHz wireless medium is used because it has its own characters. It is license-free and globally available. It relatively use low frequency bandwidth. It uses power very efficiently while transmitting and receiving.

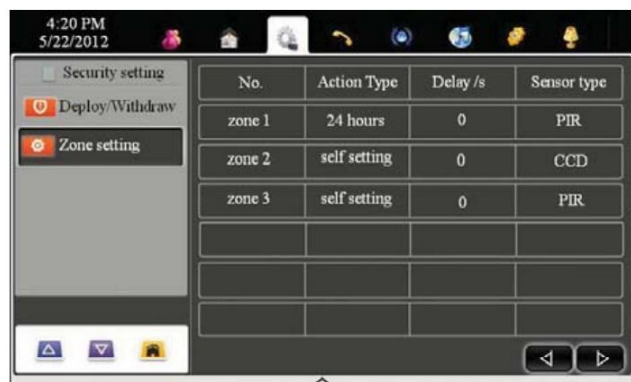Fig. 2: Interface of air-conditioner control in the SHIS

Fig. 3: Security system in SHIS

A Smart Home Information System SHIS (Figure. 2) is running either on the owner's system or on the management server. SHIS compromises of security system, graphical display, energy management, data processing, user's login authority and controlling appliances through internet. Along with this SHIS provides user's definition mode which has facilitated user a lot.

The top most demand of the customer is to have a reliable and secure system. An efficient system that provides safety and security. In

Figure. 3 security system of SHIS is shown. The user can set these security zones by configuring security sensors for a scheduled time.

III IoT BASED MONITORING AND CONTROL SYSTEM

Arduino mega3260 and the Raspberry Pi2 model B are the main components of the system implemented by Yuksekkaya et al.
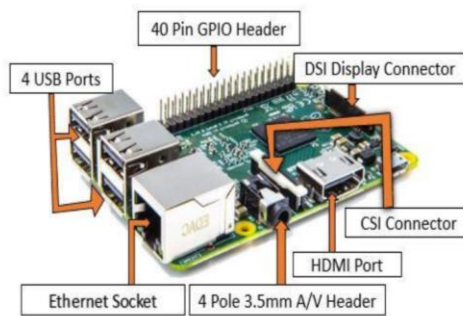

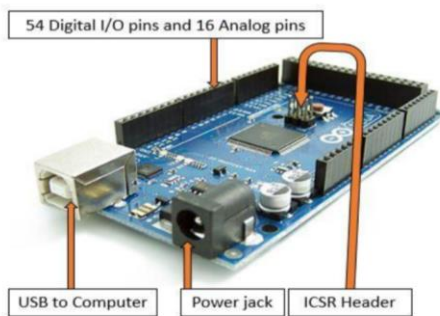
Fig. 4: Raspberry Pi2 model B

Fig. 5: Arduino Mega2560 board

IoT (Internet of things) technology allows user to control and monitor appliances on their smart phone through internet. This is one of the most emerging and surprising technology.
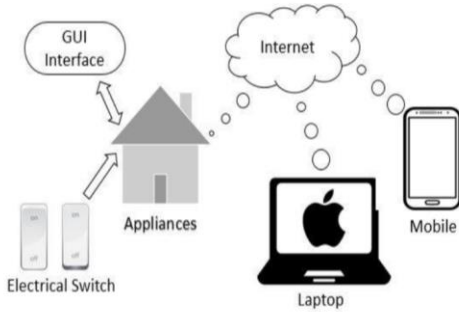
Fig. 6: IoT based smart home system

To make or break the connections between devices, staircase switch is used. The GUI interface provides the ease to select a device. For the processing of input-output signal, Arduino is used as a processor.
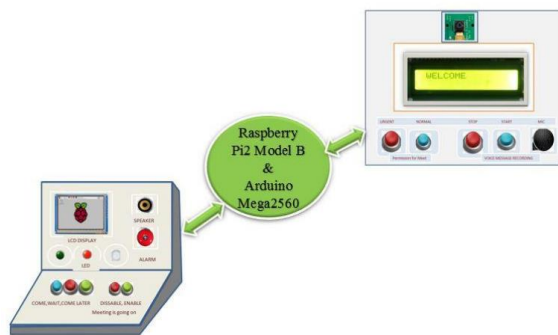

Fig. 7: Layout of door permission system

Door permission system is elaborated in figure 7. This layout consists of two main things i.e. special designed hardware permission system and two controllers. This layout provides various options for the visitor and the owner like the house owner can select message of "Come", "Wait" or "Come Later" for the outsider/visitor. Similarly the visitor can leave a voice message or can ask for permission by pushing button from the owner. This system saves the image of the visitor along with time and date with a buzzer sound.
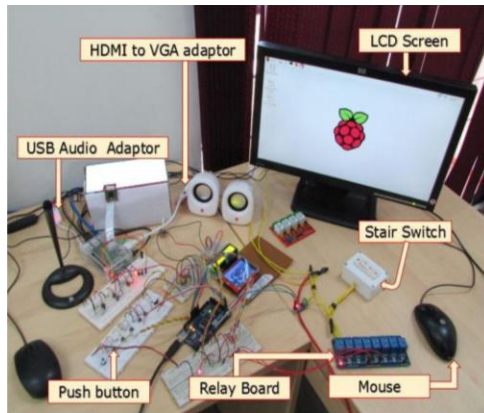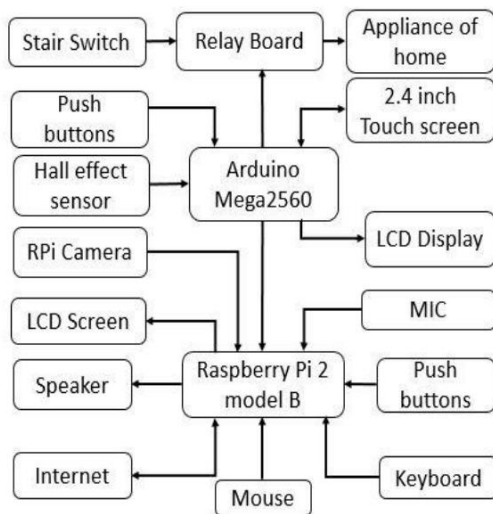
Fig. 8: View of hardware implementation

Fig. 9: Block diagram of control system and door permission system

The block diagram shows the integrated components of IoT based monitoring and control system for smart homes. This diagram shows the information flow of components behavior and data sharing between components i.e. input device(mic), output devices(speaker) and input output device(touch screen).

IV. RESULTS AND DISCUSSION

The smart control system allows the user to control appliances through internet. It is a very smart system with low-cost. While the system installed by Yuksekkaya et al, provides security along with monitoring and controlling appliances. The owner can control and monitor appliances, reducing wastage of electricity. It improves the security factor due to door permission system installed in this system. The GUI interface in this system interacts with the user through visual and graphical icons. Hence it a low-cost, secure and flexible system for the automation of smart house.

No.	Parameters	Smart Control System	IoT based monitoring and control system
01	Cost of system	Medium	low
02	Way of control method	Internet, Electrical switch	GUI, Internet, Electrical Switch
03	Circuit complexity	Medium	Comparatively less
04	Integration of appliances	Medium	High
05	Live video streaming	No	Yes
06	Audio and Video processing speed and quality	No	Better

V. IoT based Voice/Text Controlled Home Appliances

Internet of Things (IoT) open the door to access, monitor, control and connect the entities of this world through Internet. When IoT is implemented on home, it converts a simple house into a smart automated home. This smart system of controlling home electronic appliances provides the benefit of remotely access through voice/text. The user will either provide a voice or text command to On/OFF the application according to their necessity. It is a low-cost, cheaper and flexible system with high performance.

A smart home security system is built by the set of sensors. TI-CC3200 Launchpad board is used as a microcontroller, Arduino uno3 and ESP8266 Node-MCU which monitors the status of the connected devices. By the use of these, electrical appliances of home can be accessed and controlled. This is a consistent, low-cost and flexible system providing security through remotely monitoring and controlling. This system will support voice based commands while other existing systems do not. The users can control and monitor home appliances through their smart phone. The use of Firebase Cloud Service make the system secure. User provides the input by using Google Assistant through smart phone. Provided input is then fed into Firebase. ESP8266 control the device by turning ON/OFF according to the information provided by user. Following are the basic steps in the flow of interaction: 1. Input is provided by the user 2. Dialogflow agent analyze the provided input 3. Response is returned to the user.

Experimental Setup:

- **The Node-MCU**
  It is an open source development environment used in the automation of Home. ESP8266 is an excellent choice because it has all the necessary elements.
- **Relays**

Relays act like switch. They respond to current and voltage and in response to this open or close the circuit.

- **The Arduino IDE**
  The Arduino Integrated Development Environment is used to write and upload programs to compatible board i.e. smooth way for software library
- **Dialoglow**
  The user queries are responded through it. It is an interaction based technology
- **Firebase**
  It provides backend and database services to the owners.
- **Node.js**
  It runs JavaScript code. It is an open source for supporting language.
- **Node-RED**
  It is a web browser editor used to implement JavaScript functions.

This application is highly flexible for the old age people and different disable people who cannot reach ON/OFF button. They can easily control and monitor their home electrical appliances through their smart phones. Further modules can be added to this system to make it more efficient like smart filling of water tanks or to find a leakage of gas with an alarm sound in the home.

VI. ZigBee Wireless Sensor Network

Security of network, total implementation cost and power consumption are the main concerns of a wireless control and monitoring network in smart houses. As far as ZigBee wireless sensor is concern, it is a low-power consuming network. ZigBee can support up to 65,000 nodes. Its bandwidth (20-250KBPs) is enough for support families of a general society. This wireless network has its own unique feature. This bandwidth is more than enough to support security of the house, humidity and temperature related information to the owner.

In ZigBee network, the devices are categorized into two classes i.e. FFD and RFD. RFD is Reduces Full Devices and FFD is Full Function Device. The devices are categorized according to the tasks assigned to them. The devices are either categorized as general device or coordinator or PAN coordinator. ZigBee wireless network have ZigBee node (first or second type), a ZigBee coordinator and function driver module (first or second type). This network can provide communication of bidirectional. ZigBee protocol is the core part in establishing a ZigBee wireless network. Way of control method used in this network is internet, GSM module and SMS. This monitoring and control system is flexible, sustainable and compatible as compared to the traditional systems installed before. Mesh, star and cluster are used in this network topology. With the integration of TCP/IP protocol, GSM communication module and ZigBee protocol a remote control system layout is prepared whose performance is high rated. This remote control system is meant for the internal house controlling and monitoring appliances.

Conclusion:

In this research paper low-cost, low-power, flexible, secure, reliable and compatible IoT based control and monitoring system and remote control system is discussed. Automation of smart house is now on top trend. With the number of increasing smart home appliances the question arises how to control them, integrate them together. For the solution of problem, control and monitor systems are being installed for the ease of owner. The owner can control the appliances through internet on their smart phones/laptops through GUI interface. The owner can secure his interaction with the visitor. Hence along with comfort, security is also provided to the user. This will also result in the less consumption of electricity. Moreover, these systems are compatible with the traditional ones' used in the past.

<u>References:</u>

(Uma et al., 2019)Ab Rahman, R., Kassim, M., Isa, N. M., & bin Daud, J. R. (2011). Home electrical appliance control application using Zigbex Ubiquitous Sensor Network. *2011 IEEE International Conference on System Engineering and Technology*, 143–147.

Khan, A., Al-Zahrani, A., Al-Harbi, S., Al-Nashri, S., & Khan, I. A. (2018). Design of an IoT smart home system. *2018 15th Learning and Technology Conference (L&T)*, 1–5.

Kodali, R. K., Jain, V., Bose, S., & Boppana, L. (2016). IoT based smart security and home automation system. *2016 International Conference on Computing, Communication and Automation (ICCCA)*, 1286–1289.

Kumar, P., & Pati, U. C. (2016). Arduino and Raspberry Pi based smart communication and control of home appliance system. *2016 Online International Conference on Green Engineering and Technologies (IC-GET)*, 1–6.

Malche, T., & Maheshwary, P. (2017). Internet of Things (IoT) for building smart home system. *2017 International Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud)(I-SMAC)*, 65–70.

Satapathy, L. M., Bastia, S. K., & Mohanty, N. (2018). Arduino based home automation using Internet of things (IoT). *International Journal of Pure and Applied Mathematics*, *118*(17), 769–778.

Singh, S., & Ray, K. K. (2017). Home automation system using internet of things. *International Journal of Computer Engineering and Applications*, 1–9.

Uma, S., Eswari, R., Bhuvanya, R., & Kumar, G. S. (2019). IoT based voice/text controlled home appliances. *Procedia Computer Science*, *165*, 232–238.

Wang, D., Lo, D., Bhimani, J., & Sugiura, K. (2015). Anycontrol--iot based home appliances monitoring and controlling. *2015 IEEE 39th Annual Computer Software and Applications Conference*, *3*, 487–492.

Wang, M., Zhang, G., Zhang, C., Zhang, J., & Li, C. (2013). An IoT-based appliance control system for smart homes. *2013 Fourth International Conference on Intelligent Control and Information Processing (ICICIP)*, 744–747.

Zhang, T., Li, Q., & Ma, F. (2013). Remote control system of smart appliances based on wireless sensor network. *2013 25th Chinese Control and Decision Conference (CCDC)*, 3704–3709.

(Ab Rahman et al., 2011; Khan et al., 2018; Kodali et al., 2016; Kumar & Pati, 2016; Malche & Maheshwary, 2017; Satapathy et al., 2018; Singh & Ray, 2017; D. Wang et al., 2015; M. Wang et al., 2013; Zhang et al., 2013)