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FINAL YEAR PROJECT

A Bluetooth based home appliance control system.

CHAPTER ONE: GENERAL INTRODUCTION

1.1 INTRODUCTION

Information and communication technology in houses with components communicating through a local area network is referred to as "smart home technology" as a whole. According to the predetermined criteria, the technology can be utilized for monitoring, alarming, and carrying out actions. By transmitting messages or alarms to one or more recipients, the local network uses Bluetooth wireless technology to communicate with the outside world.

Smart homes can incorporate energy-control systems, such as adjusting the heating at all times, communication linked to the phone or the internet, environmental control systems like remote or programmed control of door, windows, and lights, safety features like alarms, and entertainment options like television, movies, and music. These tools have all been around for a while; none of them are brand-new innovations. The ability to create automatic activities and the devices' integrated communication are what make something smart.

Smart living is rapidly altering people's lives with the advancement of modern technology and the android smart phone. This project will implement Bluetooth technology in home automation and networking environment. The project will demonstrate the development of a cell phone-based smart home system that is adaptable, affordable, and secure. The system will allow a user with a Bluetooth enabled android mobile device to run a piece of downloadable software application which will allow the user to control a device that is connected to any home appliance that is Bluetooth enabled. The control of the lighting and temperature systems is the main goal of this project.

If someone goes to bed and wakes up in the middle of the night because they are uncomfortable with the house's temperature. By turning on and off the air conditioning, the client will be able to regulate the temperature thanks to the built system. Without getting out of bed, the user can also check the status of the interior lights and control the lighting. The device would also help the users with limited mobility that may have difficult time getting to or even reaching their light switch.

The solution that is being designed will be quick enough to fulfill the full potential of wireless technology and economical enough to support its inclusion in home automation systems.

1.2 BACKGROUND

The “Home Automation” concept has existed for many years. The terms “Smart Home”, “Intelligent Home” followed and have been used to introduce the concept of networking appliances and devices in the house. Home automation Systems (HASs) represent a great research opportunity in creating new fields in engineering, architecture, and computing (Humidor and Millan, 2004). HASs are becoming popular nowadays and are entering quickly in this emerging market. However, end users, especially the disabled and elderly due to their complexity and cost, do not always accept these systems.

For several reasons, the emergence of home automation in the 1970s did not result in a better quality of life for users. First off, it might be challenging to quantify the economic advantages of home automation systems. The benefits of installing smart home technology must outweigh the costs of doing so. Home automation solutions must be affordable, simple to set up, and adaptable to a variety of network infrastructures and appliances.

1.3 PROBLEM STATEMENT

Most internet monitoring systems have greater operational costs due to bandwidth or data speed requirements, making them only appropriate for use in industrial or biomedical applications in developed nations. The most obvious warning sign of the internet is its security weakness; no malevolent component should ever take over the system. Resources like stable internet connections and hosting servers are needed for web usage. Due to usage fees for each message transaction, the long-term operational cost of internet and cell phone monitoring systems is relatively significant.

1.4 AIM

The aim of this project is to create a Bluetooth based smart home appliance control system.

1.5 OBJECTIVES

- To create a Bluetooth appliance controller. To carry out the automation, a microcontroller will communicate with the Bluetooth module.
- To Integrate the appliance controller with the device, the appliance controller will be integrated with the lighting system and the temperature control section.
- To create an Android application for a smartphone.

1.6 SCOPE OF PROJECT

The lighting and fan systems will be the focus of the project since they will allow Bluetooth remote control of these two appliances using either speech or button instructions. Within a 10-meter radius of this, there will be a noticeable Bluetooth signal intensity. The technology is unable to control several appliances.

1.7 SIGNIFICANCE OF STUDY

The goal of this project is to create a home automation system that is affordable, straightforward to install, and straightforward to produce. The manufacturer will profit from

the application's simplification and cost reduction, while customers will gain from lower prices. The client's home will become considerably more convenient as a result, especially for the elderly and people with disabilities. Recognizing how difficult it is to mix hardware and software is a crucial first step in attaining the Masset (Zimbabwe Agenda for Sustainable Socio-economic Transformation) objectives. It makes you aware of the virtually limitless opportunities for obtaining economic liberation.

1.8 EXPECTATIONS AND ASSUMPTIONS

Android smartphones are used by 76.24 percent of people worldwide, which represents a bigger percentage of the population (Amirah, 2014). Since Bluetooth technology is present in every smartphone, the system can be implemented with the readily available hardware components.

When the project is finished, the user will be able to use an android phone to manage household appliances. The user will be able to turn on or off the appliances on the mobile phone, which serves as the subsystem, and this will actually be the switch on/off function. Any device with Android software, such as smartphones and tablets, can use the program. The software will allow for up to 10-meter-distance remote control of appliances. The maximum range of Bluetooth wireless technology is 100 meters.

1.9 SUMMARY

The development of the smart home system and the technologies that will be used have been introduced in this chapter. Also, it provides a quick overview of the present system's flaws and how the proposed system plans to fix them.

CHAPTER TWO: LITERATURE REVIEW

2.1 INTRODUCTION

This chapter looks at and explains the current technologies and theoretical foundations employed in this area of research, the evolution of home automation systems, their effects, and other accessible smart home systems. Since Bluetooth wireless technology will serve as the project's standard, the research will also cover it. It also highlights the similarities and differences between several systems that have been researched by others in the field.

2.2 HISTORY OF SMART HOME SYSTEMS

A "smart home" is a concept that has been around for a while. The terms "smart house" and "intelligent home" were then used to describe the networking of home furnishings and technology. Home automation offers a significant opportunity for the development of new disciplines in engineering, architecture, and computer (Azlina, et al., 2019).

Smart homes can tell you the status of connected devices at home through a user-friendly interface. For a variety of reasons, the rise of home automation in the 1970s did not significantly raise the quality of life for its consumers. The first difficulty is determining the financial benefits of home automation systems. Installing smart home technology must be more cost-effective than it is beneficial. Affordable, easy to install, and adaptable to a range of network infrastructures and appliances are all requirements for home automation solutions.

The development of wireless technology has led to the introduction of numerous new types of connections, including GSM, GPRS, ZigBee, Wireless LAN, and Bluetooth. Each technology has a unique set of applications. The study effort provides information on how to wirelessly manage household appliances with a cell phone and an Arduino (Bluetooth) device. Depending on the Bluetooth device class, the 2400Hz Bluetooth frequencies enable communication across distances of up to 100 meters at rates of up to 3Mbps. In addition, a Bluetooth master device can connect 7 other devices to form a Piconet. The features of Bluetooth are more than adequate to be used in the design. A lot of contemporary laptops, notebooks, and cellphones also come with built-in Bluetooth adapters. As a result, the price of this system will decrease.

Smart Home is the term commonly used to define a residence that uses a Home Controller to integrate the residence's various home automation systems (Robles, Rosslin & Kim, Tai-hoon, et al., 2010). The following section includes a summary of previous research into smart homes within the past decade.

2.3 PREVIOUS SMART HOME SYSTEMS DEVELOPED

The computerization of household tasks is known as home automation. Hardware for lighting control may be included in home automation systems. Home automation can enhance personal enjoyment for persons who typically require parental guidance or institutional care, especially the elderly and the crippled.

Figure1: Smart home system (Sulaiman, 2018)

Numerous automated home systems can be applied in both business and academic settings. This automation technique has been applied in the fields of security systems, medical, and environmental protection. This automation technique has been applied in the fields of security systems, medical, and environmental protection. Much of the research in table 1, shows the comparison of different wireless home automation technologies (Danbatta, 2019). Automation's primary goal is to reduce human involvement by linking devices and sensors.

Table1: Wireless automated technologies (Danbatta, et al., 2019)

PROTOCOL	Bluetooth	Wi-Fi	Zigbee
FREQUENCY	2.4 GHz	2.4GHz, 5GHz	800MHz, 915MHz, 2.4GHZ
MODULATION	FHSS	QPSK, COFDM, QAM	BPSK, O-QPSK
ERROR CONTROL	CRC (16-bit)	CRC (32-bit)	CRC (16-bit)

RANGE	10m	100m	10m-100m
NETWORK SIZE	8	2007	64000
POWER CONSUMPTION	Medium	High	Very low.

On the basis of the Internet of Things, a real-time algorithm for smart home systems is suggested by (Khan, 2016) in Figure 2. The algorithm is built on Iota and utilizes sensor nodes that are directly coupled to an Arduino Nano. Based on a motion sensor, a light is turned on or off, and a gas sensor triggers an alarm. The system uses a Wi-Fi capability feature that enables remote monitoring and control of a variety of household appliances through the internet. By integrating it with actuators and sensors, the Arduino Mega is utilized to operate the system's entire automation component. A current sensor is used to track how much energy is used by home appliances, and the data is sent through Wi-Fi to the internet where it may be seen on a web page. The Wireless network's security protocol flaws must be corrected to guarantee that only authorized users can access the services. The author omitted to explain the procedures followed to guarantee that data cannot be intercepted, read, or manipulated.

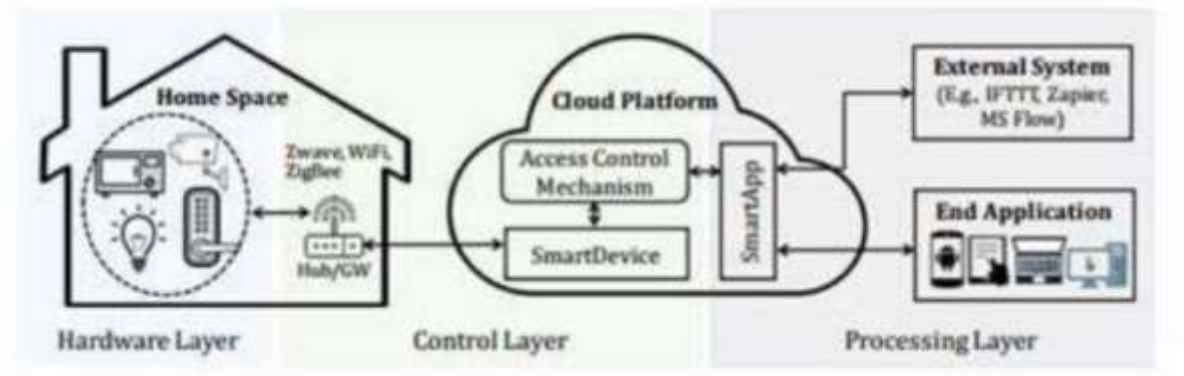

Figure2: Real time algorithm for smart home system based on the internet of things (Khan et al, 2016).

(Mostakim, et al., 2020) Built an SMS-based monitoring system that could control equipment with a range of functions, such as light, humidity, movement, and temperature sensors (Figure 3). An SMS alarm is sent to the phone of the responsible authority by the RM Controller processor when the sensors' specified limits are exceeded. The responsible authority reacts by controlling the system using a mobile phone that is connected to and set up on a computer, along with a SIM CARD. The computer will combine the SMS messages into useful hardware device functions after that. However, users of this system must know a number of AT commands in order to operate devices because it lacks a graphical user interface. Because our

proposed system relies on mobile applications for user engagement, there will not be a lot of technical commands to learn.

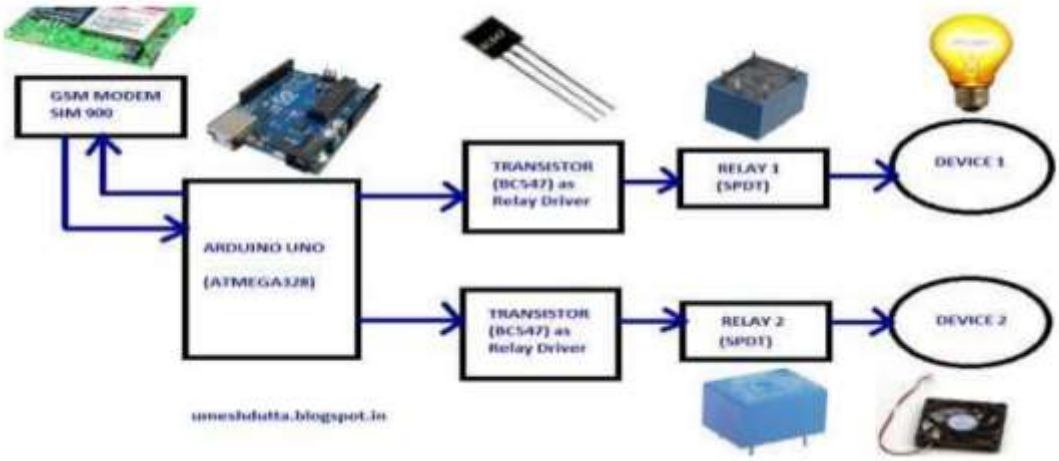

Figure 3: SMS based monitoring system (umeshdutta.blogspot.in)

A Gesture Based Smart Home Automation System Using Real Time Inputs is suggested by (Pradeep, et al., 2021). The technology employs hand motions to control the electrical appliances in the home for people with disabilities. The hands are being sent live via a camera to the video processing system at that same moment. A signal is received by the relay from the processing system that receives instructions from the motions to control other equipment. The writers advanced energy conservation by only turning on lights when there are people present. When a person enters or exits a room, sensors detect it and transmit a signal to microcontrollers, which then send a control signal to a relay, which turns on or off the lights in the corresponding rooms. According to light levels, exterior lights were also turned ON and OFF (Figure 4). This innovation introduced smart energy for energy conservation in smart homes.

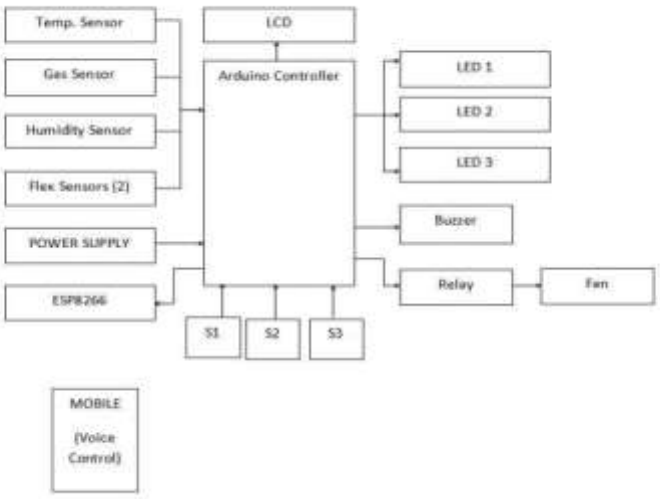

Figure 4: Gesture based smart home system using real time inputs (Pradeep, et al., 2021)

The Intelligent and Flexible Home Automation System was developed by (Majeed, et al., 2020). The system's main goal was to control home appliances, give operating schedules based on user needs, and provide an energy consumption report each day. The authors developed a rule-based system that incorporates support vector machines and fuzzy controllers to produce intelligent results. (SVM). SVM is adaptive in that it evolves as the number of sensors rises and learns from the rule set. As a result, before using that data to train an SVM, the system operates on data gathered by the fuzzy controller. It is possible to imitate complex human thought processes using fuzzy logic. The support vector machine operates effectively in situations where there are numerous features (variables) and training data. The author supposedly witnessed the system's capacity to change to accommodate users' daily requirements, preferences, and schedules.

(Omran & Mustafa, 2021) Describes a system that uses energy from the environment or manufactured lightning to automatically regulate the temperature in a room and track appliance consumption (AC, heater). By obtaining energy from the environment, energy harvesting technologies enable wireless sensor networks (WSNs) to increase their lifespan. The process by which energy is obtained from external sources, such as solar power, is known as power harvesting or scavenging. A photovoltaic cell that powers a sensor charge in response to both natural and artificial light. The home automation is managed by a control algorithm. The Maximum Power Point tracking (MPPT) method is used to draw the most power possible from the solar panel.

The “smart house model using android application” that (Nisar & Ibrahim, 2018) presented makes use of a ZigBee module to interface with an Android phone. Since the android phone needs to be connected to an external ZigBee transceiver, this is a poor communication method. In comparison to Bluetooth, which is already a part of an Android phone, this results in power waste and the employment of numerous components. Like this, (Shah, et al., 2020) suggested an android application and wireless sensor network for smart home automation for the elderly. The system was made up of three modules: sensor, control, and actuator. The control module managed the smart house, the sensor module functioned as a transmission channel, and remote monitoring of other sub-modules and actuator modules displayed the responses of all linked appliances in the actual system. This system's flaw is that if a module cannot be controlled, the entire system will fail.

Using the Arduino Uno Single-Board Microcontroller, a Reliable Wireless Real-Time Home Automation System is designed and implemented by (Alahmadi & Ahmad, 2019). Two operational modes were used by the proposed system. The first is a manually automated mode that allows the user to monitor and manage the home appliances from any location using WI-FI. The second mode, known as self-automated mode, uses sensor technology to react to stimuli automatically (figure 5). In this instance, the microcontroller automatically accesses the appliances without consulting the user. Only the user may observe the action. The system, according to the author, can be scaled up and expanded because it is straightforward, affordable, and versatile. In comparison to a system using Bluetooth technology, there is

greater system mobility and scalability with the suggested Wi-Fi technology. One drawback of using a personal computer is that it uses more electricity.

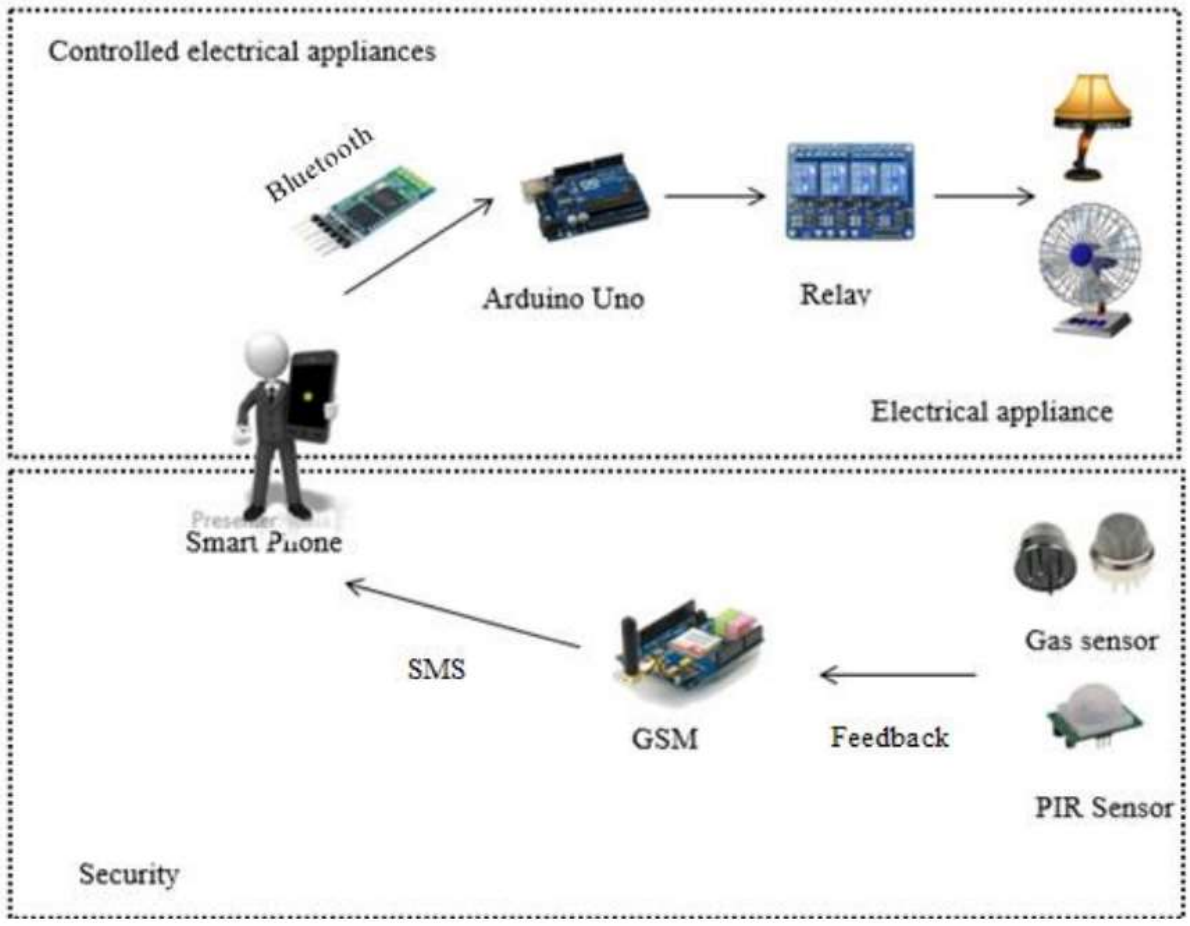

Figure5: Wireless Real-Time Home Automation System Based on the Arduino Uno Single-Board Microcontroller (Alahmadi & Ahmad, 2019)

Utilizing a predictive strategy and adjusting to modifications in user usage patterns, (Afzalan, et al., 2019) proposed a web-based system. By keeping a log in the cloud server and using a smart interface, the system can predict the user's behaviour after a period of continuous device use. All the logs of when the user turned on a device or turned it off using an Android phone will be stored on this cloud server. And after a predetermined amount of time, the HAS will simultaneously switch the devices on or off if the user selects that state, or it can be manually overridden later. It finds a variance in the pattern and includes new features to account for the change. The system can function independently as a result, providing the user with the necessary comfort. In addition, the author advised installing security cameras around the house to keep an eye on activity and setting up cross-platform solutions that could be installed on Windows and iOS.

A Bluetooth-enabled Android mobile-based home automation system was developed by (Ngerem, 2021). The system was installed right next to the wall-mounted normal electrical

switches. Thanks to a Bluetooth wireless connection, the device may communicate without a cable with a graphical user interface (GUI) on a PC/laptop or smartphone. The Main Control Board of the system oversaw managing the targeted household appliances. To operate household appliances, the user only needs to touch the phone's screen. The disabled folks who struggle with locomotion were helped by this portable approach. My prototype system is not directly mounted to wall switches.

2.4 THE WIRELESS TECHNOLOGY OF BLUETOOTH