CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 History of Home Automation

Home automation is something we take for granted nowadays. We cannot imagine our day without having an Alexa device playing our music, our smart TV showing the latest Netflix shows or a day without our smartphone.

The technology progress has been through a lot of changes throughout the years, and that is shown best in our daily appliances and smart devices. We gathered some historical examples of early versus modern technology to demonstrate to you how thankful we should be for what we have.

Did you know that the first devices used in home automation were labor-saving devices? These are a few of the most significant innovations in this field since its inception in the 1800s.

Home automation has a long history that dates back to the early 20th century when electrical appliances first became widespread. The development of home automation can be traced through various technological advancements:

1. 1900s-1950s: The invention of household electrical appliances such as refrigerators, washing machines, and vacuum cleaners laid the foundation for automation.

2. 1960s-1980s: The introduction of remote-controlled devices, such as garage doors and televisions, marked the early forms of automation.

3. 1990s: The emergence of programmable logic controllers (PLCs) and wired automation systems allowed for greater integration of home automation features.

4. 2000s-Present: The development of wireless communication technologies such as Wi-Fi, Bluetooth, and Zigbee has led to the modern era of smart homes, where devices can be controlled remotely via mobile applications (Miller & Johnson, 2020).

Automation performs an increasingly vital role in daily experience and global economy. Engineers strive to combine automated devices with mathematical and organizational tools to create complex systems for a rapidly expanding range of applications and human activities. The concept of home automation has been around since the late 1970s. But with the enhancement of technology and smart services, people's expectations have changed a lot during the course of time to perfectly turn the traditional house into smart home, and also think that what a home should do or how the services should be provided and accessed at home to became a smart home and so has the idea of home automation systems.

2.2 Home Automation System

Giving end users the ability to control and operate electric appliances is possible with a home automation system. When examining various home automation systems over time, we can see that they have consistently worked to give residents of homes safe, practical, and effective ways to access their homes. The look of a home automation system hasn't changed over time, despite changes in user expectations, advancements in technology, or time itself.

Many existing, well-established home automation systems are based on wired communication such as Arduino based and raspberry pi based home automation systems. This does not pose a problem until the system is planned well in advance and installed during the physical construction of the building. But for already existing buildings the implementation cost goes very high. In contrast, Wireless systems can be of great help for automation systems like Bluetooth, Wi-Fi and

IOT based home automation systems. With the advancement of wireless technologies such as Wi-Fi, cloud networks in the recent past, wireless systems are used every day and everywhere.

2.2.1 Arduino-Based Home Automation

Arduino-based automation systems have gained popularity due to their low cost, open-source nature, and ease of programming. According to Brown et al. (2021), Arduino-based home automation systems provide a flexible and scalable solution that allows users to integrate multiple sensors and actuators. Researchers have successfully implemented Arduino systems for controlling lighting, temperature, and security features in smart homes (Jones & Lee, 2019).

2.2.3 Bluetooth Based Home Automation System Using Cell Phones

Relays are used to connect the Arduino BT board to the input/output ports of the home appliances in a Bluetooth-based home automation system. The Arduino BT board connects via Bluetooth and is programmed using the high-level interactive C language of microcontrollers. Only authorized users can access the appliances thanks to the password protection. For wireless communication, the Arduino BT board and phone establish a Bluetooth connection. This system uses a Python script that is portable and installable on any Symbian OS environment. A single circuit is created and put into use to receive phone feedback, which shows the device's status.

2.2.4 Zigbee Based Home Automation System Using Cell Phones

To monitor and control the home appliances the system is designed and implemented using Zigbee. The device performance is record and store by network coordinators. For this the Wi-Fi

network is used, which uses the four switch port standard wireless ADSL modem router. The network SSID and security Wi-Fi parameter are preconfigured. For security purposes, the message is first processed by the virtual home algorithm. Once it is deemed secure, it is re-encrypted and sent to the home's actual network device. The Zigbee controller sent messages to the end of the Zigbee network. the security and safety of every message that the virtual home algorithm receives. ZIGBEe communication is useful in lowering the system's cost and the intrusiveness of the installation process.

2.2.5 GSM Based Home Automation System Using Cell Phones

Because of the mobile phone and GSM technology, the GSM based home automation is lure to research. The SMS based home automation, GPRS based home automation and dual tone multi frequency (DTMF) based home automation, these options we considered mainly for communication in GSM. In figure shows the logical diagram the work of A. Alheraish, it shows how the home sensors and devices interact with the home network and communicates through GSM and SIM (subscriber identity module). The system use transducer which convert machine function into electrical signals which goes into microcontroller. The sensors of system convert the physical qualities like sound, temperature and humidity into some other quantity like voltage. The microcontroller analysis all signal and convert them into command to understand by GSM module. Select appropriate communication method among SMS, GPRS and DTFC based on the command which received GSM module.
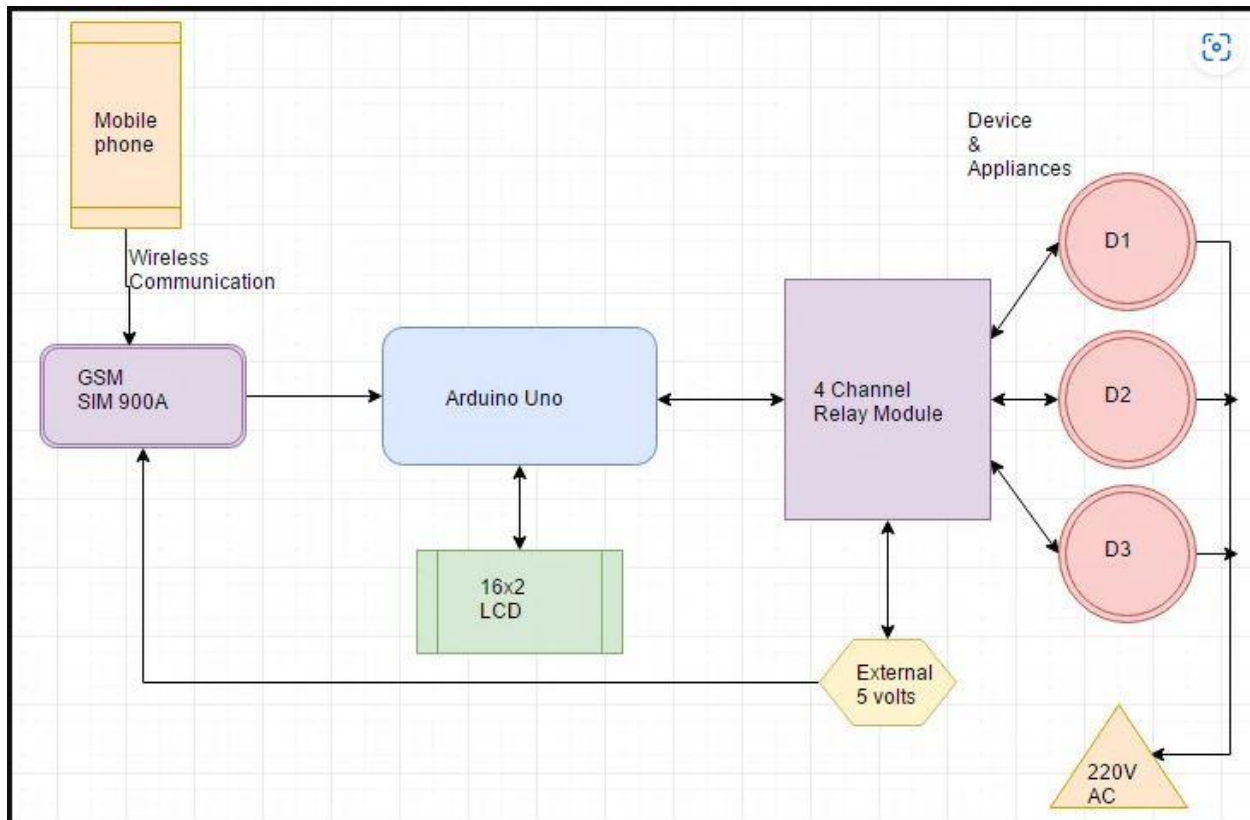
Figure 1 The block diagram of a GSM home automation system

2.2.6 Wi-Fi Based Home Automation System Using Cell Phones

Wi-Fi based home automation system mainly consist three modules, the server, the hardware interface module, and the software package. The figure shows the system model layout. Wi-Fi technology is used by server, and hardware Interface module to communicate with each other. The same technology uses to login to the server web based application. The server is connected to the internet, so remote users can access server web based application through the internet using compatible web browser. Software of the latest home automation system is split to server application software, and Microcontroller (Arduino) firmware. The Arduino software, built using C language, using IDE comes with the microcontroller itself. Arduino software is culpable for

gathering events from connected sensors, then applies action to actuators and pre-programed in the server. Another job is to report the and record the history in the server DB. The server application software package for the proposed home automation system, is a web based application built using asp.net. The server application software can be accessed from internal network or from internet if the server has real IP on the internet using any internet navigator supports asp.net technology. Server application software is culpable of, maintain the whole home automation system, setup, and configuration. Server use database to keep log of home automation system components, we choose to use XML files to save system log.
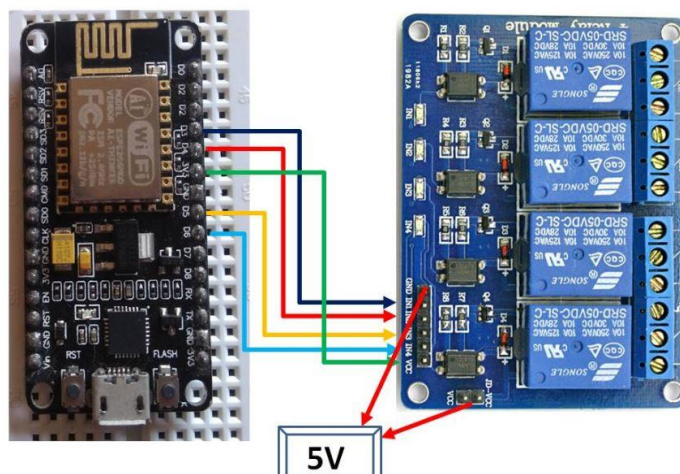

Figure 2 the diagram of a WIFI based home automation system

2.2.7 Home Automation Using RF Module

Building a home automation system with an RF-controlled remote is a key objective of home automation systems. As technology advances, homes are becoming increasingly intelligent. A centralized control system with RF-controlled switches is purposefully replacing the switches found in modern homes. These days, it is difficult for the end user to approach and operate the

traditional wall switches that are dispersed throughout the house. For older adults or those with physical disabilities, it becomes even more difficult to do so. Using RF technology, home automation via remote implements a simpler solution. Solution with RF technology. In order to accomplish this, a RF remote is combined to the microcontroller on transmitter side that sends ON/OFF signals to the receiver where devices are connected. By operating the stated remote switch on the transmitter, the loads can be turned ON/OFF globally using wireless technology.

2.2.8 Raspberry Pie Home Automation with Wireless Sensors Using Smart Phone

Using a smartphone and wireless sensors, a Raspberry Pi home automation system Using a Raspberry Pi to read the email's subject line and algorithm, a home automation system was created. The Raspberry Pi promises to be a productive platform for putting strong, affordable smart home automation into practice. Raspberry Pi home automation is superior to all other home automation techniques in a number of ways. For instance, the call tariff is a significant drawback of DTMF (dual tone multi-frequency) using home automation, even though this is not an issue with their suggested approach. Because it only makes use of the well-known web server service provided by Gmail, the design of the web server and the memory space needed are disregarded in home automation using web servers.

2.4 Bluetooth Technology in Home Automation

Bluetooth technology plays a crucial role in wireless communication for home automation. Unlike Wi-Fi, Bluetooth does not require internet connectivity, making it ideal for offline applications. According to Patel & Sharma (2022), Bluetooth-based home automation systems

offer a reliable, low-power alternative for controlling appliances within a limited range. Various studies have explored the advantages of Bluetooth-based automation, highlighting its affordability and ease of implementation (Kumar et al., 2021).

2.3 Challenges of Home Automation Systems

Home automation systems suffers four main challenges; these are poor manageability, inflexibility, difficulty in achieving security and high cost of ownership, The main objectives of this research is to design and implement a home automation system using IoT that is capable of controlling and automating most of the house appliances through an easy manageable web interface. The proposed system has a great flexibility by using Wi-Fi technology to interconnect its distributed sensors to home automation server. This will decrease the deployment cost and will increase the ability of upgrading, and system reconfiguration.

2.4 The Necessity of Home Automation system

2.4.1 Convenience and Comfort

1. Remote Control: One of the most significant advantages of home automation is the ability to control home devices remotely. With smartphones, tablets, or smartwatches, homeowners can turn lights on or off, adjust the thermostat, or unlock doors from virtually anywhere. This level of control makes managing a home more convenient, especially for people with busy schedules or those who travel frequently. Additionally, voice assistants like Alexa or Google Assistant enable hands-free control, making it even easier to manage home tasks. (Wang et al., 2015).

2. Automation of Routine Tasks: Home automation systems can handle repetitive tasks without any user intervention. For example, lights can be set to automatically turn on when someone enters a room or a coffee machine can brew a cup at a specific time in the morning. Such automation removes the need for manual input, saving time and effort. (Liu et al., 2018)

3. Customized Comfort: Climate control is another example where automation makes a difference. Smart thermostats learn user preferences and adjust the temperature based on time of day, weather, or occupancy. This ensures comfort while also preventing energy wastage, as the system won't waste energy heating or cooling an empty home. (Deng et al., 2017)

2.4.2 Energy Efficiency and Cost Savings

1. Energy Consumption Monitoring: With the growing awareness of climate change and the need for sustainability, home automation helps homeowners track and reduce energy consumption. Smart meters and energy management systems provide insights into how energy is being used, enabling users to identify high-consumption appliances and take steps to optimize usage. For instance, smart lighting systems use motion sensors to ensure that lights are only on when rooms are occupied, cutting down on unnecessary electricity usage. (Zhao & Zhang, 2019)

2. Smart Thermostats: A well-known feature of home automation systems, smart thermostats like Nest, Eco bee, or Honeywell, can significantly lower energy costs. These devices can detect when the home is empty and adjust the temperature accordingly to save energy. They

can also learn the homeowner's habits and set heating/cooling schedules based on personal routines. Over time, this smart behavior results in better energy efficiency and lower monthly utility bills (Bohannon, 2016).

3. Automated Shading and Lighting**:** Automated shading systems can adjust the blinds to block out heat from the sun during peak hours in the summer, reducing the need for air conditioning. (Kumar et al., 2017)Similarly, lights can automatically adjust to the ambient light levels, ensuring that rooms are neither too bright nor too dark while using the minimum amount of energy required.

2.4.3 Enhanced Security and Safety

1. Surveillance Systems: Security is a major concern for homeowners, and home automation helps address this by providing an advanced security system that monitors the home 24/7. Cameras, motion sensors, and door/window sensors are often part of a smart security system. Alerts are sent to the homeowner's smartphone if there is unusual activity detected, allowing for immediate action. Furthermore, some systems can be programmed to send alerts to emergency services or to notify trusted neighbors in case of a break-in.

2. Smart Locks: Smart locks are a critical part of home automation security. These locks allow users to lock or unlock doors remotely via a smartphone app. They also provide the ability to give temporary access to others, such as housekeepers, friends, or service technicians, with digital keys that can be revoked at any time.

3. Emergency Alerts and Monitoring: In addition to security, smart home systems can detect safety hazards such as smoke, fire, carbon monoxide, or water leaks. If such an event occurs, the system will alert the homeowner, and in some cases, can automatically shut off

systems like water valves or turn on emergency lights. This proactive approach ensures the safety of both people and property.

2.4.4 Accessibility for Elderly and Disabled Individuals

1. Assistive Technologies: For elderly or disabled individuals, home automation provides essential support in maintaining independence. Devices like voice-activated assistants can help those with limited mobility control lights, door locks, fans, and even appliances. Automated reminders for medication or appointments can also be programmed, helping individuals stay on top of their healthcare needs without relying on others.

2. Remote Control for Comfort and Safety**:** Features like automated lighting and adjustable thermostats can be particularly beneficial for elderly individuals, helping them to stay comfortable without needing to adjust settings manually. Smart home technology also enables remote control of doors, windows, and blinds, reducing physical strain.

3. Health Monitoring and Emergency Response: Some home automation systems integrate with health monitoring devices, such as wearable health trackers or emergency alert systems. These can be used to monitor vital signs or detect falls. In case of an emergency, the system can notify caregivers, family members, or emergency services for quick response.

2.4.5 Integration with IoT and Smart Technologies

1. Seamless Integration: Home automation is a key component of the broader Internet of Things (IoT) ecosystem. It enables communication between a wide range of smart devices, including lights, appliances, thermostats, security systems, and even entertainment

systems. This interconnected network allows for centralized control through a smartphone app or voice assistant, making it easier to manage multiple devices at once.

2. Data and Feedback: IoT-enabled smart homes collect vast amounts of data about how devices are being used. This data can be used to further optimize systems, provide insights into energy use, and even predict future behavior, such as when a device is likely to need maintenance or replacement.

2.4.6   Increased Property Value

1. Appeal to Homebuyers: As smart homes become more popular, they are seen as more modern and desirable. Installing smart devices such as lighting, security, and climate control systems can increase the overall value of a property, making it more attractive to prospective buyers. Real estate agents often highlight smart home features when marketing a property, and many buyers now view these features as a key selling point.

2. Competitive Advantage: In competitive real estate markets, smart home features can set a property apart. Automated homes are perceived as more convenient, secure, and energy-efficient, which can lead to a higher resale value or quicker sale.