

Development of Smart Home Prototype Using IoT Technology

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ABSTRACT

This research is about the development of a prototype of Smart home features using Arduino microprocessor and sensors. The main objective of this research is to develop an automated system that performs all the basic functions of a virtual assistant, like telling the time, date, and temperature that controls the electrical appliances that are connected to the Smart Home system. The entire system is designed to be voice-operated, so no typing is required. Apart from the voice-operated commands the system will also use certain sensors to provide automation to specific appliances it also provides efficient electricity utilization. This can be attained through the use of IoT technology applied in some appliances such as lights turning off without the users' explicit command. The project prototype was tested in terms of its functionalities such as automatically turning on and off the lights, watering the plant if there is less moisture in the soil, opening and closing the doors and windows automatically, and detecting gas leakage if any. The result of the functional testing denoted that all the set functionalities of the Smart Home Prototype were met.

Introduction

The Internet of Things (IoT) means a system of computer devices that can collect data and transfer it through wireless networks without human intervention. It is the most confusing technology in our lives and it is known as the Internet of Things (IoT) (Bowers, 2019). This technology exists in this time of advancement in the world and it helps people to live comfortably. It is the best methods to use and live with this technological advancement that happens in this time (Oracle, 2023). In this modern era using this technology is very important because it works to improve the quality of life and provide means of comfort. IoT works through SMART devices that support the web, such as sensor devices, connected devices and treatments to collect the data that are getting and act upon it. These sensors share the sensor data that is collected via connection with the IoT gate. It can be used to benefit from Artificial Intelligence (AI) machine learning for making the operations of collecting the data easily (Alexander, 2022).

Problem Statement

The reason why it's important to use IoT at this time is because it helps people to work with more shape of intelligence and a more flexible life. IoT is considered vital in everyday life and one important uses of IoT is the application in home automation system (Matt, 2018). In particular, the home automation system is the perfect technique for a Smart future. It is use in houses that use connected devices to provide control remotely to manage the devices and systems like lighting and heating, etc. Besides, it is known as the Smart home that is capable of providing home-

owners with security, comfort, and energy efficiency by allowing them to control through smart devices. Most importantly, there are three basic factors to run the system: sensor device, controlling device, and triggers. These sensor devices can see what can be changed like the amount of water level, height of heat, or electricity level, etc.

Review of Literature

Internet of Things (IoT)

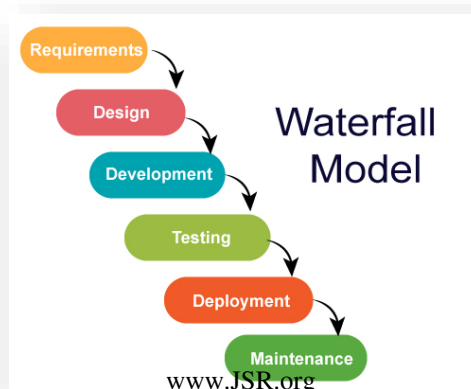
IoT became a popular topic in IT because it created a big impact on how people live nowadays. IoT became possible and useful because of the development of broadband Internet and its availability connects more places many devices can integrate with their connection because of the Wi-Fi features and sensors built on the devices. Nowadays, different brands and types of SMART phones are available in the market and because of the SMART phones availability, the utilization of IoT technology is become easier for the improvement of the lives of the people (Morgan,2020).

The home automation system can be set to control these sensors. Plus, controlling devices indicate Smart phone or personal computer devices and those which can be controlled to send and receive messages about what happens in your home. Maybe, the triggers are about keys lighting or another thing in the electronic system to the houses. However, why is this technology so important? That is because it is best for homeowners to start getting these benefits of the system. Also, can be getting of what can be happening in your home, and it can be via the existence of some sensors which can be helped to control easily. It can give your home more security, ease arrival comforts, and provide energy (Doe, 2020).

In addition, there are many benefits of home automation system technology such as the effectiveness of the entire system changes like when you want to turn on for heat in the winter season and strengthen of cooling in the summer season. So, this way will help you to facilitate your life. Plus, safety for your home through closing doors, and smart windows. It's one of the best advantages in controlling security in a great way, like controlled through fingerprint, face recognition, password, card, etc. It's very important if it will be there in your home, like activating home alarms and that can be via a sensor if someone comes into your house, and it will be working to emit sound to tell you someone is there in your house and these devices provide the security in your home. Most importantly, raising awareness through cameras security gives more safety and that can control over what happens in your home. It's like when you want to watch your home to see your children if it's fine or if they have some problems. Moreover, easy to operate is an important benefit of home automation systems because it helps to do anything in your home, and you can make your home beautiful through control of these devices to do so easily and comfortably (Hardik, 2018).

Methodology

Software Development Methodology for Smart Home Prototype using IOT Technology.



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ogy.

Figure1.The Waterfall Model

Waterfall model is the software development model that composed of different steps or levels that need to complete before moving to the next phase of the development (Javapoint,2022). This is the methodology followed by the researcher in developing the prototype of the SMART HOME. First, the researcher collected the requirements like the software and hardware needed for the development of the prototype. The research also conducted research about the functional and non-functional requirements needed. After the requirements gathering, the proponent developed the designs for the prototype like the design for the circuit diagram, etc. After designing the prototype the proponent did the coding and the assembly of the SMART HOME prototype. Next to the development is the testing of the prototype of the SMART HOME. This project is for the study purposes only so the cycle will stop on the deployment and maintenance as the research limitation.

Design of the Prototype of the Physical Smart Home

This project will aim to prove the quality of our life and make life easier and more comfortable to continue within easy life. So, this smart home will help to make life more developed and avoid something will happen. This project will be based on many techniques and will be used in many types to control in many ways. Also, this project can focus more on house devices and how it will be helpful in the future. Also, this smart home will be designed through 3D techniques.

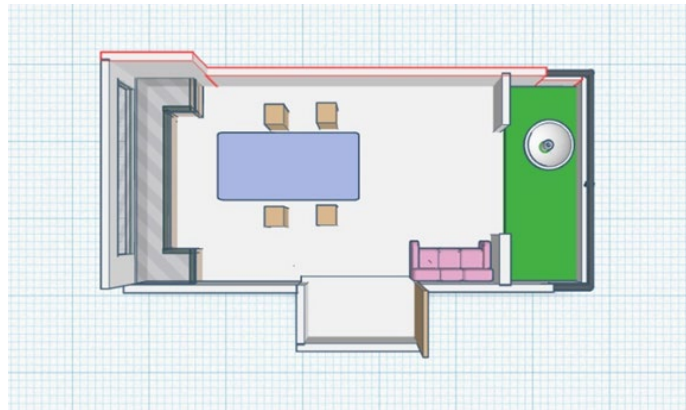


Figure 2. The physical prototype of the Smart Home (3D, within size 4X SHEET)

The proponents created a physical prototype using a sun board attaching a gas sensor, LED, moisture sensor, IR sensor, servo motor, etc. to produce a Smart Home.

Results

1. What are the hardware and software needed to develop the SMART Home Prototype?

The research proponents use ARDUINO as the Microcontroller, Servo Motor, Grove Light Sensor, Soil Moisture Sensor, Gas Sensor and LED Lights.

The proponents use SKETCH for the development of the coding of the SMART Home Prototype.

2. What are the functional and non-functional requirements in developing the SMART Home Prototype?

Table 1. Functional and Non-Functional Requirements

Functional Requirements	Non Functional Requirements
<ul style="list-style-type: none"> • The prototype must turn on and off the lights automatically with human intervention. • The windows and doors will automatically close and open. • Automatic water irrigation must water the plant if the soil is lacking of water or lacks moisture. • The gas sensor can detect the gas in a certain level that will give the alarm to the owner of the house 	<ul style="list-style-type: none"> • Accuracy - in terms of turning the lights on/off, closing, and opening the door and watering the plants if needed. • Usefulness – of the different SMART Home functionalities are useful to the end user. • User-Friendly – if the different functionalities of SMART Home can be used easily by the end-user. • Security – if the SMART Home automation is secure and cannot be used by the hackers to cause harm to the homeowner.

Table 2. Hardware Functionality Testing

Hardware	Expected Output	Actual Output	Remarks/Comments:
Arduino Microcontroller	The system will work as Arduino controls the SMART Home Prototype.	All the expected functionalities work well.	The objectives of the research were met.
Light Sensor	The system will give light if there is some movement detected by the sensor.	The system gives light automatically once the sensor detected any movement.	The objectives of the research were met.
Servo Motor	The system will water the soil or the plant once the sensor detects less moisture in the soil.	The system water the plants when the moisture of the soil became less.	The objectives of the research were met.
Gas Sensor	The system will give a notification once the sensor detects hazardous gas in the air.	The system notifies the house owner when there is hazardous gas in the air.	The objectives of the research met.

3. What are the challenges and limitations encountered in the development of SMART HOME?

Several major challenges and limitations can come up in a smart home system, such as how to manage and control these many diverse systems efficiently and easily, while providing a secure system that an attacker cannot break and gain access to the data of homeowners. Connectivity is also one of the challenges of smart home systems, and the challenge comes in figuring out how to achieve connectivity anywhere and at any time. It is important to

make the system more reliable and to give the server access to authentic users only. The system must be able to take appropriate action on security threats as well as reconfigure itself after attacks. Coordination between the various systems and the many connected devices at home. It is also important to construct the network structure in such a way that every device connected to it can self-organize and that the network itself is capable of self-organization.

Conclusion

In conclusion, this research is prototyping research that utilized IoT Technologies. The proponents used different types of sensors such as gas sensors, light sensors, servo motors, and Arduino Uno to develop the prototype of the SMART home. The proponents define the functional and non-functional requirements of the project and tested using the functionality test at the end to check if all the objectives of the study were met.

The smart home system contributes improve the well-being of a person in his home because it makes life easier for him, especially the things that need time to be accomplished, in addition to providing more security at home. Smart home systems contribute to reducing accidents, such as deaths due to gas leakage because they automatically detect and alert the user to the presence of danger. Automated home systems contribute to preserving natural resources as they reduce electricity and water consumption and can be operated using renewable energy to promote the goal of preserving the earth's resources. Several major factors influence people's choice of home automation systems, the most important of which are price, quality, and the benefits that they will provide. The advantages of home automation systems are that they provide a more comfortable life and more luxurious home, greater safety and security, and timesaving, environmentally friendly technology. The disadvantages of smart home systems are the high cost of construction, maintenance, and operation costs, in addition to security breaches, which is one of the reasons that companies producing smart home systems seek to develop strict solutions to hacker attempts to penetrate.

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