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Transformation of the Role of Android Smartphones: From Communication Devices to Remote Control for IoT Based Home Automation Systems

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ABSTRACT: Smartphone technology, especially Android smartphones, has advanced quickly in terms of their function as smart and communication devices. Their capacity to function as remote control tools, enabling users to view and manage electronic gadgets via an Internet connection, is one notable advancement. Through the use of the Internet connection as a bridge between devices, smartphone-based remote control indirectly makes it easier to monitor and manage electrical gadgets. Uncontrolled electricity use and instances of high power consumption that occur when people forget to turn off equipment provide a challenge. The author suggests using the prototyping method, in which a prototype is created at the beginning stage for later development, to overcome this problem. Through

Keywords: Internet of Things (IoT)-Based Home Automation, Remote Access, Prototyping

INTRODUCTION

Many electrical items currently do not have computer systems incorporated into them, which makes it difficult for consumers to control these equipment remotely, especially when they are away from home. Due to the difficulty in monitoring some electronic equipment and the lack of a system that enables remote access to them, these gadgets are frequently left on after being used.

The prototyping method is the strategy adopted to address this problem, in which an early-stage system prototype is created with plans for further development. With this prototyping technique, a system prototype is created as a bridge between developers and users, allowing them to communicate while information systems are being developed. The early definition of rules is crucial for the prototype's success.

METHOD

To comprehend the pinch points and determine the necessary parameters for full-stack IoT development, an IoT prototype is used. A prototype is merely a trial version that is installed end-to-end with sensors connected through the device, network, cloud, end-user interface, and

enterprise integration. It is in no way a product that is ready for sale. Therefore, a prototype provides evidence of how your final product will look and function as well as a tool to picture your product in the manner you want it to.

One of the key processes in creating an IoT product is prototyping and designing software for IoT applications. PoC demonstrates the IoT solution's viability, whereas a prototype demonstrates its usability. The process of producing a full stack IoT product goes through a number of stages. IoT solutions are made up of diverse technologies that call for distinct skill sets.

- Devices and Sensors - The Internet of Things sensor nodes have equipment that has to be monitored. This information consists of different device parameters that will be tracked.
- Wireless connectivity protocols are used by Internet of Things devices to enable communication.
- Integration of an IoT platform with the cloud - The data collected from sensor nodes is stored and managed by a Cloud platform.
- IoT Dashboard or Mobile App - Supervisors can view the data from the monitoring devices on their computers or mobile devices. An IoT dashboard is a dashboard where the data is represented in the form of graphs and offers crucial details about the machinery being monitored.

An appearance model is a physical mock-up that first appears as a sequence of drawings exploring the product's various combinations. The final step is the printing of a 3D structure that aids in anticipating the final product's appearance. At this point, the dimensions are not fixed but are retained as a goal size. The size, color, control positions, actuator location, and other characteristics are illustrated using the appearance model.

To assess a technical component's performance in terms of viability Prototypes for proof of concept (PoC) are employed. It is the quickest method of determining whether the user interface is viable.

Prototyping is a technique for creating software devices that takes the shape of a physical functional model of the system and serves as its initial iteration. With the help of this prototyping technique, a system prototype will be created so that users and developers can communicate while working on the creation of an information system. (Windesi et al., 2022a)

The rules must be established early on for the prototyping process to be successful, and both the developer and the user must agree that the prototype is being constructed to specify basic requirements. Before testing is done concurrently with development, the prototype will have its components altered or added to such that it is in line with the planning and analysis done by the developer. There are four primary approaches for prototyping, namely:

1. Illustrative; generates model reports and screen presentations.
2. Simulated, with multiple different work system processes but no real data.
3. Uses real data and is functional; it can identify certain actual system flows.

4. Evolutionary, creating models that are integrated into the working system

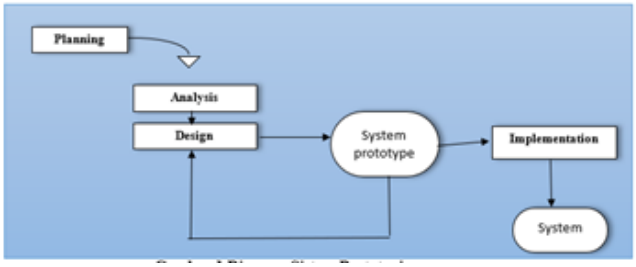

Figure 1. Prototyping System Diagram

Benefit Prototyping is used to: (1) Run the real system in a model of the future system. Take into account user feedback for system improvement; (2) Users will be more willing to accept any system modifications that arise as the prototype develops up until the ultimate development outcomes, which will occur later; (3) As the process moves along in development, prototypes might be increased or decreased. The user can immediately follow the process step by step; (4) saving time and money to create more high-quality, user-friendly goods.

Prototyping begins with requirements gathering, involves system developers and users to determine goals, functions and system operational requirements. The steps in prototyping are as follows following: (1) Requirements Collection; (2) Fast design process; (3) Build a prototype.

RESULT AND DISCUSSION

Design of Controller Structure

The connections in a circuit are displayed in a clear and consistent manner by a structure. This is a means of describing to other engineers precisely which parts are present in a circuit and how they are connected. A good scheme will label the part or parts, display the component name and value, and aid in communicating the intended use.

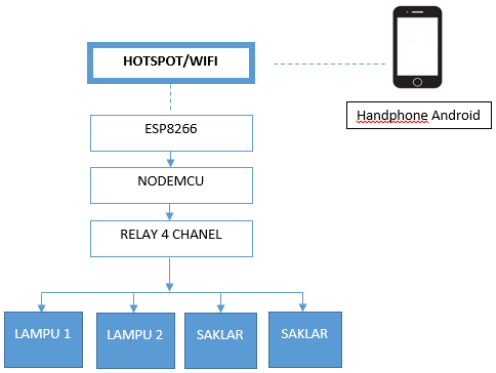

Figure 2. Device Controller Structure

Explanation of Figure 2: Using programs and the ESP 8266 wifi module to construct a light monitoring tool and connect the lights to a 4-channel relay The ESP8266 WiFi module is used by the Android phone in the image above to connect to the hotspot network. The WiFi module on the esp8266 can be given commands to determine the obtained IP address. Open the Android smartphone application that was created to control light relays using the newly acquired IP address.

Design of Block Diagrams

An explanation of the block diagram for the home system circuit automation using IoT-based applications is provided below:

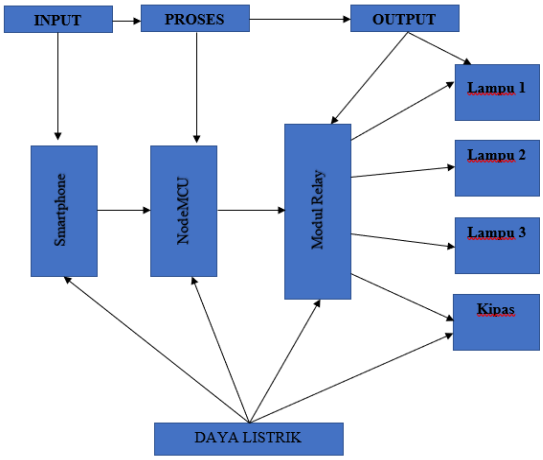

Figure 3. Block Diagram Design

Analysis of Figure 3. Here, electrical power serves as a voltage source that is directed at other components, including input parts, processing parts, and output parts. The components of each block cannot perform as they should if one component of the circuit is not powered. A 5 volt voltage supply is used by this electric power block to turn on each component. INPUT - Smartphone - PROCESS - NodeMCU - OUTPUT - Light - ELECTRIC POWER +5V will subsequently be the voltage source. A number of systems on the tool, including input blocks, process blocks, and output blocks, provide GROUND.

A. Blok Input Home Automation

- Building application projects is possible with Blynk Apps. For widget usage, each account is limited to 2000 energy usage.
- Blynk Server manages communication between mobile phones and other devices (hardware made). Blynk Cloud (Blynk Server) is open source and suitable for use on a local network; in fact, it can even be used with a Raspberry Pi.
- Blynk Libraries help to streamline communication between the server and hardware as well as the complete process, including input and output.

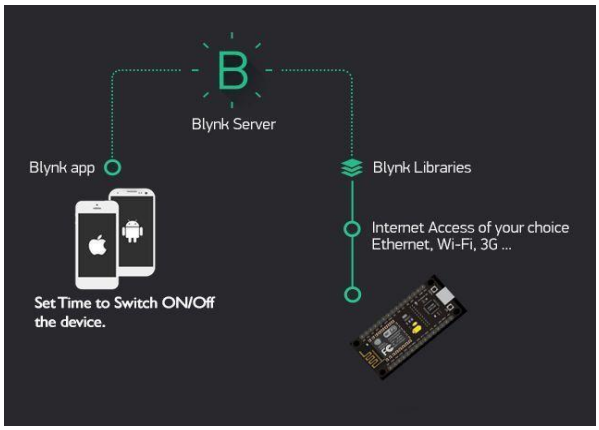

Figure 4. Blynk App, Blynk Server and Blynk Libraries

Figure 4's explanation is as follows: (1) All supported hardware and devices have a similar API and user interface; (2) Connections to the cloud can be made using Ethernet, Wi-Fi, Bluetooth, and USB (Serial); (3) Easy-to-use widget variations; (4) The ability to monitor historical data via the Widget History Graph; and (5) Device to device communication using the Bridge Widget.

B. Blok Proses

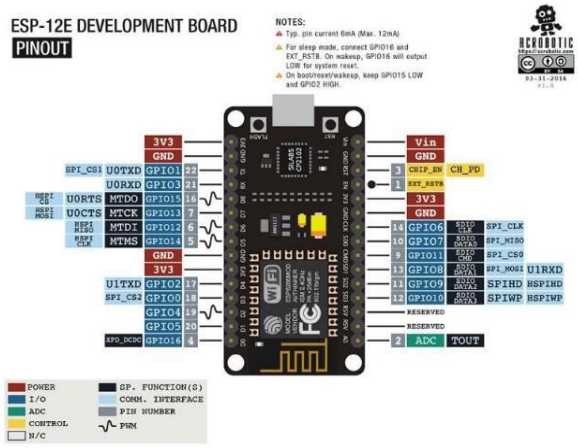

Figure 5. NodeMCU Poses Block

Analysis of Figure 5. NodeMCU, the tool's process block, serves as the focal hub for all operations carried out during the tool's process. The NodeMCU will process the logic input before determining the output depending on the software it has already been programmed with. Regarding the microcontroller In order for this NodeMCU to communicate with other devices and the devices database on the Blynk server, it must also be linked to the internet network.

C. Blok Output

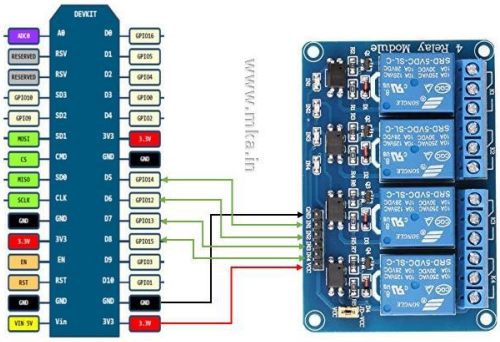

Figure 6. Output Circuit

Figure 6's output block circuit in the home automation system is explained. This Internet of Things (IOT) application uses a relay module with an indicator light to show when the system is functioning properly. Following that, it is sent to the tool in accordance with the instructions provided by the Blynk Application. Pins D0, D1, D2, D3, and Ground are utilized to link the NodeMCU to the relay module.

Implementation

A. Hardware Implementation

Multiple circuits with predetermined functions that are coupled to create a system make up hardware design. This study's instruments were managed using a NodeMCU ESP 8266 and a 4-channel relay. The following image will be described in more detail.

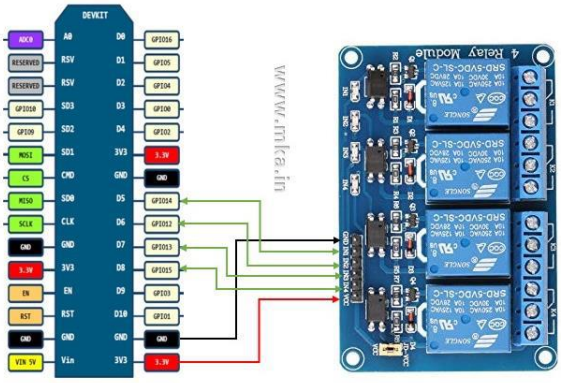

Figure 6. 4 Channel Nodemcu and Relay Circuit

The NodeMCU and ESP8266 chips are the key components of this lighting control system. The lights will be connected to the NodeMCU and ESP8266 in this system, which draws power from USB. Jumper cables are used to connect the NodeMCU and ESP8266 by connecting the pins on the NodeMCU board to the pins on the Relay 4 Channels.

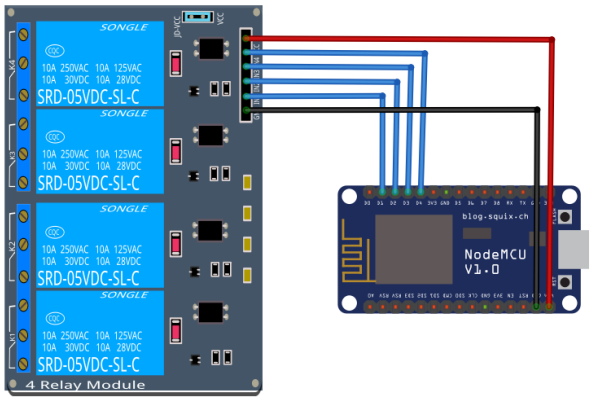

Figure 7. NodeMcu Circuit and 4 Channel Relay

As seen in the image above, a relay module with four channels needs six jumper cables in order to be connected to a Node MCU. Later, in response to commands performed on the board, the NodeMCU and the relay module will be connected from the jumper cable. The indicator light on the relay will turn on when a command is issued, indicating that the command was successfully executed. The lights come on or go out after the order is finished. As directed, the relay's indication will likewise switch off.

B. Arduino IDE programming

The most significant software is Arduino IDE, which enables Arduino to convert machine language, which is extremely sophisticated, into a simple logic language. It is vital to initialize the ESP8266 in the boards manager before developing a program in the Arduino IDE so that it will be uploaded in accordance with your requests and directions. The ESP8266 may be set up by choosing File, Preferences, then typing in the URL:

https://arduino.esp8266.com/stable/package esp8266com index.json, plus boards manager, and clicking OK.

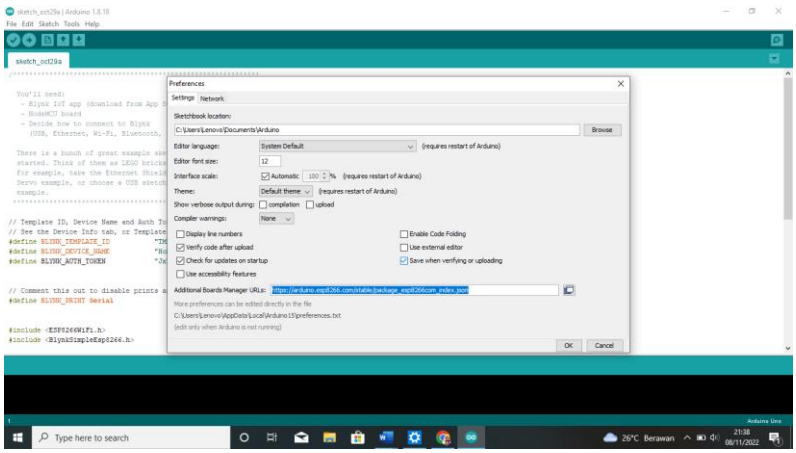

Figure 8. ESP8266 Configuration View

Install Blynk on its Library Manager once the ESP8266 has been successfully installed on the Arduino so that it can be attached later when developing the application that will be uploaded to NodeMCU.

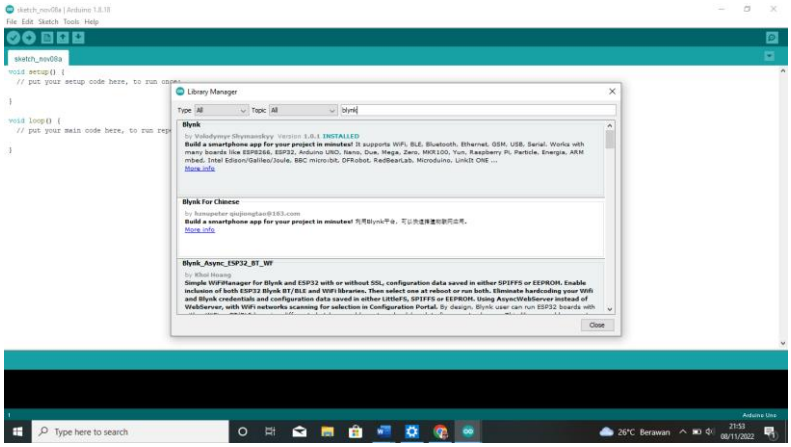

Figure 9. Blynk Installation View

After everything has been installed, all that remains is to program the Arduino IDE and link it to the Blynk terminal. after registering your email, by entering the token provided.

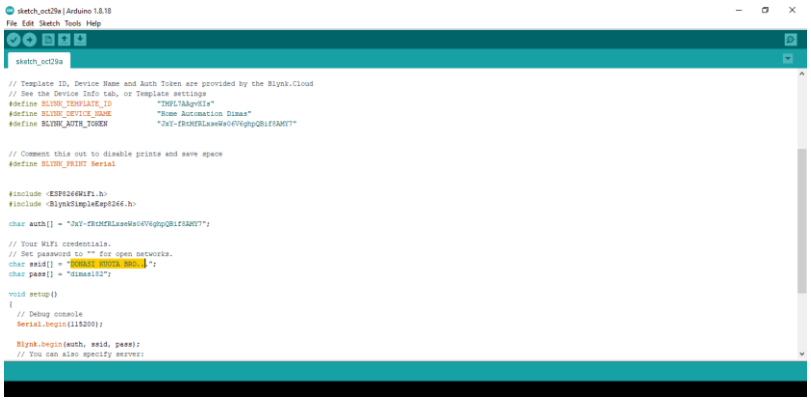

Figure 10. Arduino ID Program Display

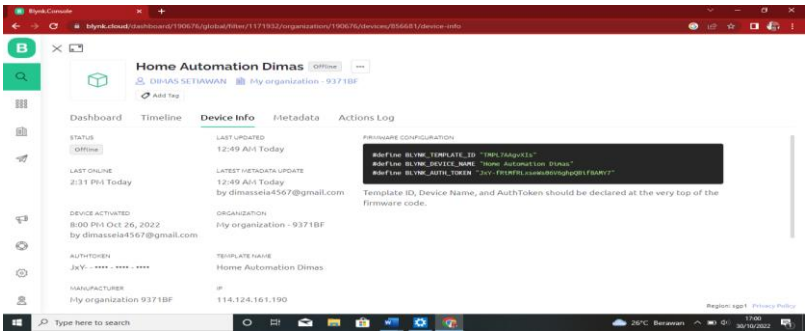

Figure 11. Blynk Console View

As a bridge or connection setup between NodeMCU hardware and the Blynk application, the Arduino IDE tools. These setups must be used using a login token from the Blynk dashboard and the Blynk-registered email. To link the NodeMCU hardware with the blynk application, use the

accessible internet SSID (Username) and Password after filling out the authentication token in the Arduino IDE Tools. When you receive the token, it is already included in the code.

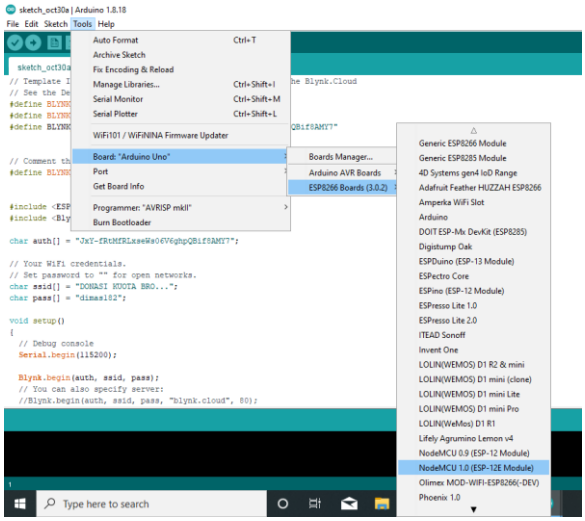

Figure 12. Arduino IDE Board Configuration Display to NODEMCU

Before uploading, when the token, SSID, and password have all been entered, setup the NodeMCU Board using Tools Arduino IDE by clicking tools in the Arduino IDE Menu Bar and navigating to the bottom of the page. "Arduino/Genuino Uno" should be clicked, and then the hardware module should be selected. We make use of NodeMCU1.0 (ESP-12E Module). See the image on the preceding page for further information.

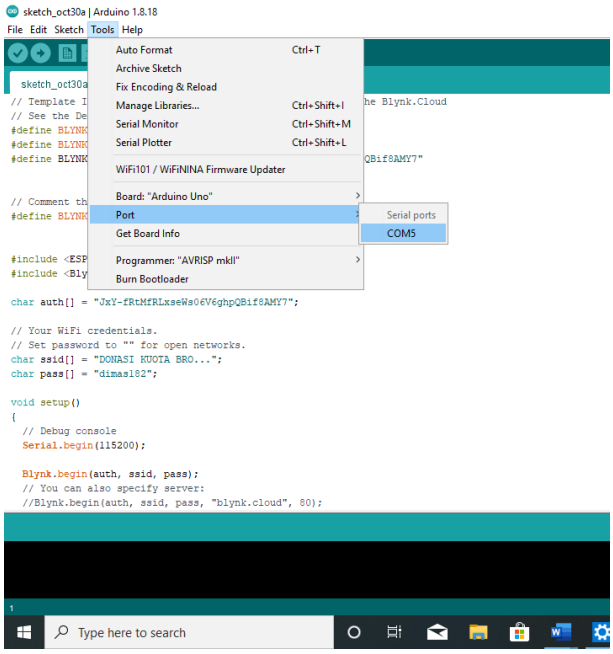

Figure 13. Arduino IDE to NodeMCU Port Configuration Display

Following the above-described configuration of the NodeMCU board, configure the port in the same manner. Click Tools in the menubar, scroll down, click on the port, and then choose the port with the port name "COM 5" that connects the computer to the NodeMCU. On each PC or laptop we use, every port has a unique name.

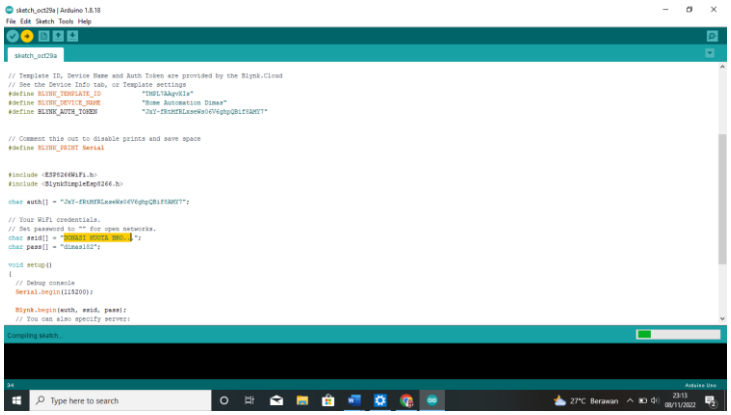

Figure 14. Uploading Display After Configuring

The last step is to upload the code that we previously created using the tools after everything has been configured, including the NodeMCU board configuration and configuration port. The sketch is a program produced using the Arduino IDE software, thus there is a compile option in the Arduino IDE that allows us to identify which writing has to be fixed or which is troublesome. Since the Arduino IDE utilizes the C/C++ language, compiling the sketch naturally takes some time.

Results of analysis

A. Software Analysis

It may be determined that software can function well based on the findings of testing on the Blynk Application that was done using the BlackBox tool. This software has the following disadvantages and benefits:

Too much

Because of its tiny application size, it can be used by a variety of Android devices and is simple to configure. It also has several button options and doesn't consume a lot of quota when in use.

The flaw

- Uses both the website and the application as venues for setting pins.
- A couple of unrestricted menus that can be developed during production.
- If you want to use all menus, you must upgrade at a price that is fairly high.
- Only compatible with Android-powered smartphones.

B. Hardware Evaluation

The hardware that will be utilized is predicted to work and function well overall based on hardware following tool assembly into a single part. From When the tool is functional, functions well, and there were no issues when receiving multiple orders, tests are conducted. If there is no power supply and no Internet connection acting as the connecting medium, not even tools can effectively receive commands. testing that has been done on a number of Home Automation tools. Excellent results were obtained during testing of tool performance, and no tool damage was found. the test outcomes.

CONCLUSION

The following conclusions can be taken from the design and execution of IoT (Internet of Things) Home Automation Systems using IoT-Based Applications:

- Users may easily access monitoring from the Blynk Application and access their current lights and fans at home from anywhere in a controlled manner by establishing a home automation system utilizing an application based on the Internet of Things (IoT).
- Users may simply control lights and fans with the help of this system by using the blynk application as the controlling medium and an Internet connection as the connecting medium.

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