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SMART HOME AUTOMATION**Srujana Eleena¹, K. Apoorva², Meghana Mangipudi³, Mr. C Kishor Kumar Reddy⁴ and Dr. B V Ramana Murthy⁵**^{*1,2,3,4&5}Stanley College of Engineering and Technology for Women, Hyderabad**ABSTRACT**

Internet of Things also widely known by its abbreviation IoT is a viable and trending technology in the present age of automation. IoT integrates different modules like smartphones and laptops using cloud computing platforms. IoT has numerous applications in various fields. The most known application is Home Automation. Homes equipped with IoT are often termed Smart Homes and are becoming increasingly common. IoT in home automation involves connecting sensors and other devices to a common cloud platform where data is stored. Tasks on home devices can be executed via web or mobile platforms which are connected through a cloud. Therefore it allows remote control of appliances. Doors and lights can be controlled by the press of a button on a mobile application. Temperature and humidity can be measured using sensors. The data collected is displayed on the application. Based on these readings, the user can choose to open or close the windows. IoT enabled homes enhance the quality of life and have great future potential.

Keywords: *Internet of Things, Home, Smart, Arduino, Cloud, Sensors, Mobile.*

I. INTRODUCTION

The internet is a dynamic global network of networks connecting millions of users worldwide. It carries an infinite amount of data which is widely accessible. A thing can be interpreted as an object. In today's world we can connect these objects to the internet giving rise to the technology commonly called as Smart Things or Internet of Things (IoT). IoT is defined as the extensive network obtained when these intelligent objects connect to the internet. It can be described as a wireless network of distributed sensors. This network allows the objects to perform certain actions and tasks on their own like automatic sharing and organization of information, data and resources between two or more parties.

This project with the domain as Internet of Things(IoT) is built keeping in mind the minimal wastage of resources and manual work. The main focus is about how we can sit at a place and control devices around us. In this project of Smart Home Automation, the lights in the house are controlled not only by switches but also by web and mobile applications. All the lights are connected to the applications. A push of a button is required to switch on and off the light. Another added feature is the switching on of a light near the main entrance door as soon as the door is opened. This feature is only for basic needs but can also act as a security measure. Whenever someone enters the house through the door the light immediately switches on and an intruder can be recognized. The other area focused on in this project is the smart controlled door. The door can be opened or closed based on the user. It works similarly to the lights as it can also be controlled via a web or mobile application. These two parameters can be determined inside the house using a DHT11 sensor. After collecting the data, it is displayed on the application for the user to see. Based on this, the user can choose to open or close the windows to regulate air flow throughout the house. Commands to perform these functions can be given by the user from any location as long as internet connectivity is available. There is no problem regarding the range of operation. This allows the user to give commands even if they are not at home. The only disadvantage of this project is the overdependence on a strong internet connection. A very slow internet connection will hinder the transfer of commands to the system. The project also doesn't always guarantee security as there may be malfunctions with the commands given. It may also take more time for the instructions to be executed.

II. LITERATURE SURVEY

SomayyaMadakam presented a paper “Internet of Things: Smart Things”; This paper focusses on the idea of smart things and their active role in our everyday life. It has a methodic outline exploring the scope and applications of Internet of Things in various fields like education, business, management and recreational sectors. It also stresses upon the need to concentrate on network protocols to ensure security of devices in the virtual world [1].

Suchitra.C et al presented a paper “Internet of Things and Security Issues”; This paper presents the architecture of IoT and the security issues that may arise .It describes the framework of IoT in the form of layers and the security issues can be inscribed using certain communication protocol It also mentions the necessary security requirements for the wide use of IoT in the future [2] .

JayavardhanaGubbi et al presented a paper “Internet of Things (IoT): A Vision, Architectural Elements, and Future Directions”; This paper talks about the need for Radio Frequency IDentification (RFIDs) and sensor network technologies to facilitate the process of transferring data in IoT. Cloud implementing, expanding on the need for convergence of WSN, the Internet is discussed [3].

Jaehak Byun et al presented a paper “Smart City Implementation Models Based OnIoT Technology”; This paper discusses the possible business models that can be implemented in a city to make it a smart city. These methods can be applied by the governments to improve the lifestyle [4].Sushma P et al presented a paper “Wi-Fi Based Home Automation Using Android & Arduino Platform”; This paper talks about smart home automation. Home automation is the fastest growing IoT application. It comprises of several domains like mobile applications, cloud, embedded technology and IoT [5].

Ajay et al presented a paper “IOT Based Smart Environmental Monitoring Using Arduino”; Thispaper discusses the possibility and feasibility of constructing an environmental monitoring device using Arduino board. This device can monitor the surrounding environmental conditions using a set of sensors and uploads the findings to an internet database from which the data is accessed. It also explains the advantages of installing such devices in remote areas .It would help in detecting natural disasters and it also has a long life cycle [6].

SiddharthWadhvani et al presented a paper “Smart Home Automation and Security System using Arduino and IOT”; IoT can be used to control domestic and industrial applications. Various sensors can be used with a Arduino board to which helps implement home automation and security. The status of the appliances are stored in a cloud platform .The user should be able to enable or disable the sensors easily. This can be achieved by using flex sensor, accelerometer sensor, magnetic sensor etc. This increases the standard of living [7].

Andrea Zanella et al presented a paper “Internet of Things for Smart Cities”; This paper discusses the possibility of a general architecture connecting a large variety of devices. Advanced communication technologies can be used to improve the services provided to the people of a city [8]. Lalit Mohan Satapathy et al presented a paper” Arduino based home automation using Internet of things (IoT)”; This paper presents a low cost, extensible and steady home automation system with additional security provided by an Arduino microcontroller. IP connectivity is established through local Wi-Fi. This allows the user to access and control the devices remotely. Certain mobile applications, web applications can be created for this purpose. This IoT framework can be applied everywhere from consumer applications at home to industrial applications. This system has many advantages as it reduces power consumption less wiring. Wi-Fi is also available everywhere which makes this easy to apply on a wide scale [9].

Tanish Sehgal et al presented a paper “Home Automation using IOT and Mobile App”; This paper presents a system for home automation which works based on voice recognition. This paper targets cost effective and wireless home automations which can be controlled through a simple user interface like an app[10].

Yuichi Kawamoto et al presented a paper “Internet of Things (IoT): Present State and Future Prospects”; This paper discusses the concept of IoT being associated with various communication networks. Numerous applications can be

created using IoT. It can be integrated into our daily lives with ease. IoT has many practical applications. Some examples are tsunami detector, earthquake detector ,home automation etc [11].

AelitaSkaržauskienė et al presented a paper “The Future Potential Of Internet Of Things”; This paper also mentions that relying on IoT will open up a brand new market for new technologies. It will invent a new service experience. IoT can completely transform the future [12].

Muhammad RaiselAlam et al presented a paper “A Review of Smart Homes-Past, Present and Future”. This paper discusses the outline of preceding smart home technologies along with the correlated units needed to design an innovative and pioneering Smart Home .Smart Homes can be designed as per the required service. These services include categories like comfort, health care and security. All these services can be integrated using a smart grid .Certain algorithms are explored and analyzed based on the required scope [13].

Taranjot Kaur et al presented a paper “Smart Homes Sensible Living Using Internet of Things”. This paper discusses the possibility of controlling home appliances and devices from a remote location at any time. It can be used in lighting systems, security, outdoor monitoring, alarming system etc. The paper also discusses about the devices and soft wares needed to implement the above applications .The user can analyze the conditions at home. This design can be implemented in future models [14].

H.B.Shinde et al presented a paper “Smart Home Automation System using Android Application”. This paper presents different technologies which can be used to design a Home Automation System (HAS).Different technologies like Wi-Fi, Bluetooth and ZigBee can be used to enable communication between devices. Any user connected can control all the home appliances though a controller which can be a web or mobile application. This implementation is very convenient as this Home Automation System also helps save electricity and cost [15].

Abhishek Bhat et al presented a paper “Home Automation Using Internet of Things”. This paper discusses the way we can utilize cloud based platforms to connect distinct devices allowing us to access them anytime and anywhere. In this paper, a Home Automation System using Arduino Uno is discussed. The proposed system consists of controlling the lights, fans and other appliances in an house .A Arduino Ethernet Shield is used as a medium to connect the board to the internet. Now buttons can be pressed on a web browser to control the connected devices [16].

M.Abivandhana et al presented a paper “Smart Home Automation Based on IOT and Android Technology”. This paper discusses about the concept of IoT and how it can be employed to construct an effective mechanization using Arduino. Two models are discussed, one is a model utilizing Bluetooth and the other is using an IoT module. It is observed that using an IoT design is much more advantageous when compared to using Bluetooth [17].

Mohamed S. Soliman et al presented a paper “Towards the Design and Implementation a Smart Home Automation System Based on Internet of Things Approach”. This paper presents two implementations of a Smart Home. The first one is a wireless based design and the second one is a wire-line based design. For the wireless design, Arduino microcontroller is used along with the Wi-Fi. A mobile having Matlab-GUI platform is used to control the devices through the Internet. In the wired design a field programmable gate array (FPGA) is used. Both the designs consist of a manual and automated mode [18].

T.Rajesh et al presented a paper “Home Automation Using Smartphone Application”. This paper presents a House Automation (HA) system in which mobile technology is used to control numerous home appliances. In a completely automated system, the home appliances are controlled by the outputs given by the sensors connected to the devices. This implementation uses GSM (Global System for Mobile) and GPRS (General Packet Radio Services). A relay circuit is used to indicate ON/OFF for the devices. The android application developed to control the appliances has two modes. In the first mode, commands are sent to the microcontroller through GSM via SMS. In the second mode, Wi-Fi module is used to send commands [19].

Md. Abdullah Al Ahasan presented a paper “Modern Home Automation System Using Android Mobile App and Web Based Server”. This paper proposes a home control system in which lights, power plugs, gas and temperature sensors are integrated together. An Android Bluetooth mobile application or web application is used to control the electric devices. This control can be done in a remote manner. To construct this system Arduino board, Bluetooth module and various sensors are required. Both these systems can help in the security and energy saving sectors [20]. A. Vinodha Krishnan et al presented a paper “Smart Home Automation System Using Arduino”. This paper presents an IoT enabled model to save energy and electricity. This cost-effective prototype can switch off lights and fans when they are not in use by anyone from a distance. It uses a Arduino and a Bluetooth module. The devices are controlled by the Arduino board based on the information or command sent by the mobile through Bluetooth. This system can be extended to more home devices or appliances [21].

VimalNakrani et al presented a paper “A Review: Internet of Things (IoT) Based Smart Home Automation”. This paper presents a cost effective and secure Internet of Things (IoT) Smart Home Automation using Arduino connected with different sensors. Instead of using GSM or GRPS, a Wi-Fi module is used to decrease the cost .A web server developed using PHP MySQL and an Android smartphone are used to give commands and control the appliances. Password protection is also available to provide home security [22].

Vinay Sagar K N et al presented a paper “Home Automation Using Internet of Things”. This paper presents a Home Automation System (HAS) using Intel Galileo that integrates cloud computing and wireless networking to develop a remote control over home electric gadgets. The devices are automatically controlled depending on the data collected by the sensors. A database stores all this data on a web server. A response is actuated based on this data [23].

Waiz Khan et al presented a paper “Smart Home (Home Automation)”.This paper presents a mobile and Arduino home automation system and smart locking of a door which triggers an alarm in case of a security breach. A dual tone multi frequency (DTMF) decoder is used to control the devices from a mobile application. A buzzer and sensor are connected to the Arduino board for the smart locking system. This can help reduce energy consumption in domestic households [24].

Ravi Kishore Kodali et al presented a paper “IoT Based Weather Station” .This paper discusses the use of multiple sensors like temperature and humidity sensor, pressure sensor, raindrop module and a light dependent resistor in a home appliance to collect the required data. This information can be used to calculate various parameters needed to determine the weather. These readings and values can be sent [25].

III. PROPOSED ARCHITECTURE

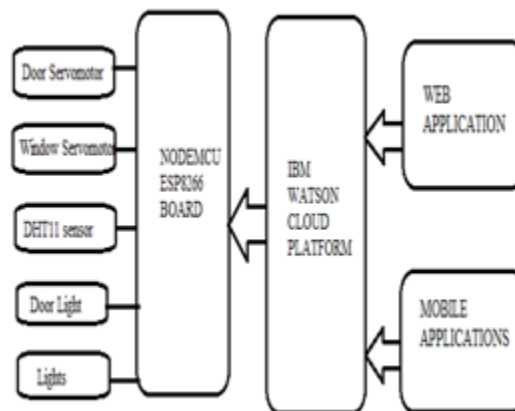


Figure 1: Block Diagram of the System

The above figure represents the entire design of the Smart Home Automation system as a block diagram. The commands can be given via a web or mobile application. The command is transmitted to the ESP8266 board through the IBM Watson Cloud Platform. Based on the given command the operation is executed by the board.

The IBM Watson Cloud Platform is an integrated platform consisting of various services, tools and data. This Cloud is used to connect our devices with the web and mobile applications. Node Red is a flow based software tool developed by IBM to connect hardware devices together by programming.

Arduino IDE is a cross-platform integrated development environment programmed in Java. It is used to write the code and upload it to the ESP8266 board. The code is written in a mixture of C and C++.

MIT app inventor is an open-source application developed by Google which can be used to develop a mobile application for the Android operating system.

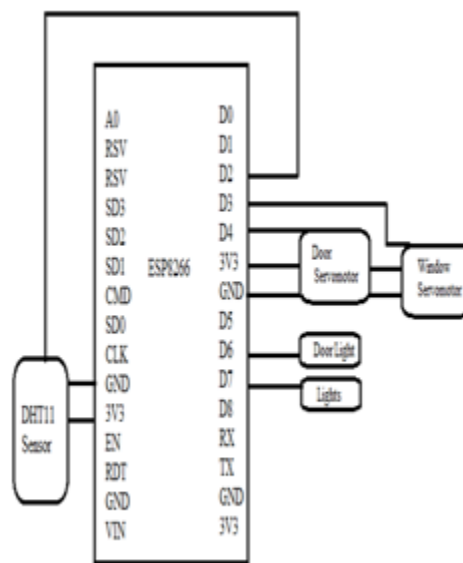


Figure 2: Block Diagram explaining the circuit

The above figure is used to summarize the connections made in this home automation system. A NodeMCU (ESP8266) board has 30 pins in total. There are 9 digital pins available. The servomotor used to control the door is connected to digital pin D4. Similarly the servomotor controlling the window is connected to the digital pin D3. The LED connected to the door is connected to digital pin D6 and the LED representing all the lights in the house is connected to digital pin D7. The DHT11 temperature and humidity sensor is connected to digital pin D2. Power supply to the servomotors and DHT11 sensor is given by using the 3V3 and GND pins as shown in the figure.

The servomotor is a rotary or linear actuator that allows us to precisely control various parameters like linear position, angular position, velocity or acceleration. It is a closed loop control system. A servomotor consists of three wires. Two wires are connected to a power supply and ground respectively. The third wire is connected to a control unit i.e. digital pin of the ESP8266 board in this project.

The DHT11 sensor measures humidity and temperature by generating a digital output. It consists of three components: A resistive type humidity sensor, a NTC thermistor to measure temperature and a 8 bit microcontroller which converts the analog inputs given by the resistive type and thermistor to a digital output which can be received by a board.

IV. IMPLEMENTATION

The implementation of the Smart Home Automation as per the proposed architecture is done in many stages.

First we need to create an IBM cloud to access the resources the IBM Watson Cloud Platform offers. This is shown in the figure below

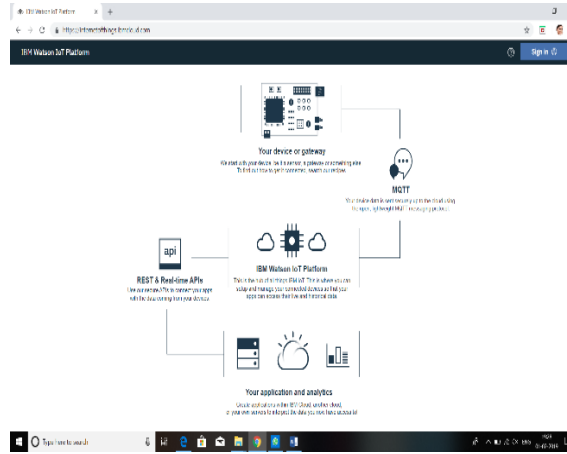


Figure 3:IBM Watson Cloud Platform

Now we need to create a device and fill certain details. API keys can be generated. The resource is basically for creating app details. Visiting the app url will open the Node-Red page.

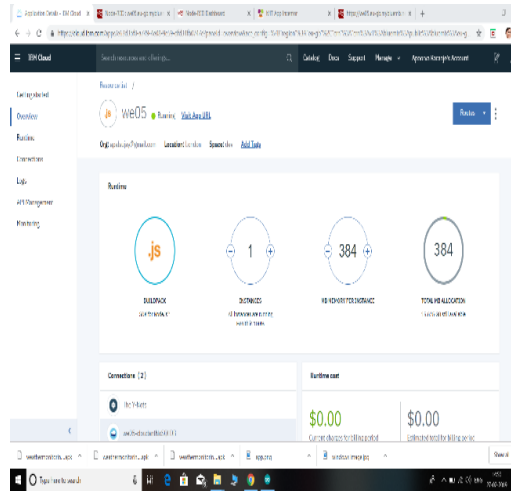


Figure 4:Cloud Foundry App page

The Node-Red page opens directing you to a platform where numerous flows can be constructed. The working of application can be done here by creating a connection between different nodes. Each node has been accordingly defined depending on the function we want.

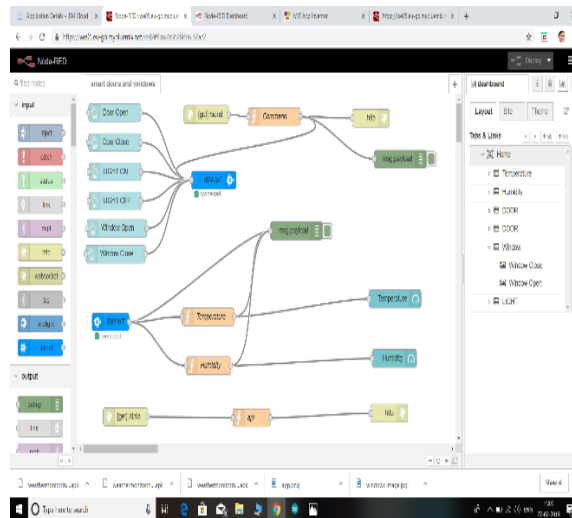


Figure 5: Node Red flow

Now, that a flow is created, the web application is also created. It can be opened from clicking a button in the flow environment. The web application consists of buttons which the user can click to give a command. The humidity and temperature readings are displayed in a gauge with a range of 0-100 as shown in the figure below.

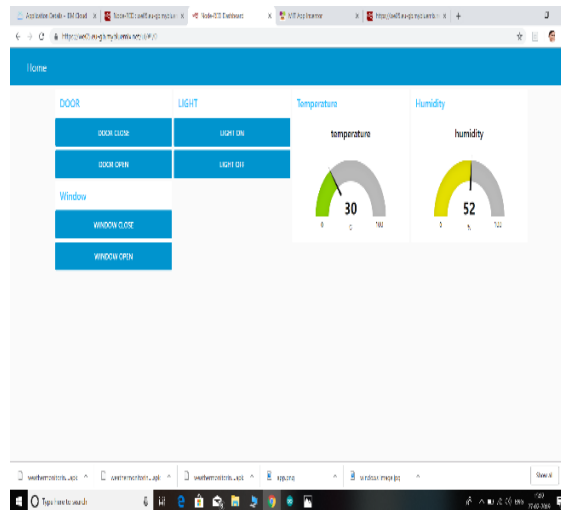


Figure 6: Web Application

The possible commands are shown as above. The MIT app inventor is used to design the app. There are two parts involved. The Design part involves designing the layout of the app whereas the Blocks part is used to develop the backend of the application. Home page of the created mobile application is shown below.

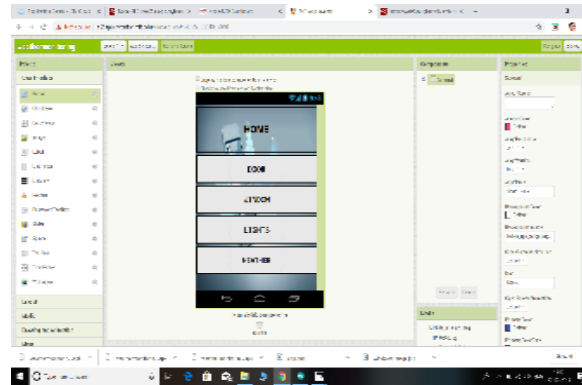


Figure 7:Homepage of Mobile Application

The below figure shows the way the screen functions by combining numerous blocks

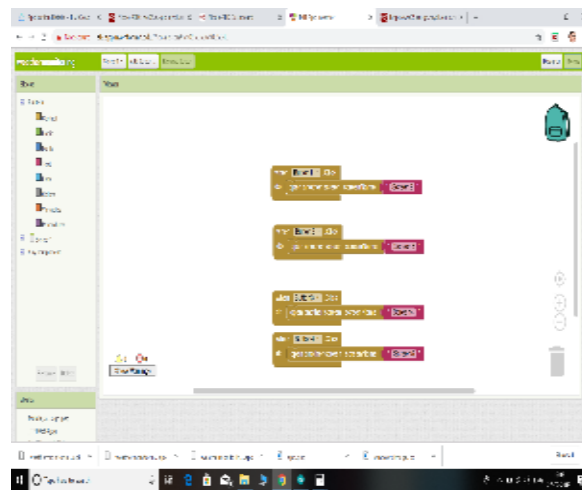


Figure 8: Blocks of the Homepage

Every screen of the app has to be developed on both the front and back ends for the commands to be executed. After all these steps are completed our mobile and web applications are complete and can be used to give commands. The development of the app can be seen in the figures below.

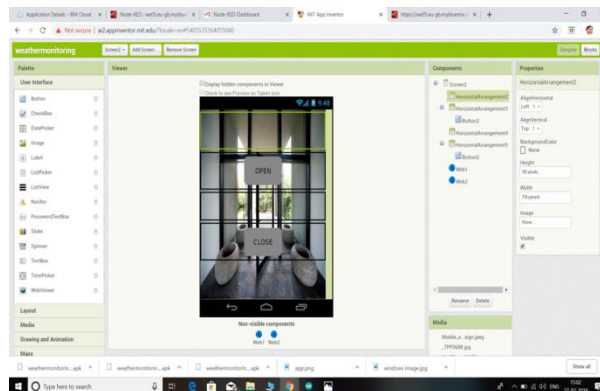


Figure 9: Door (Screen 2)-Designer view

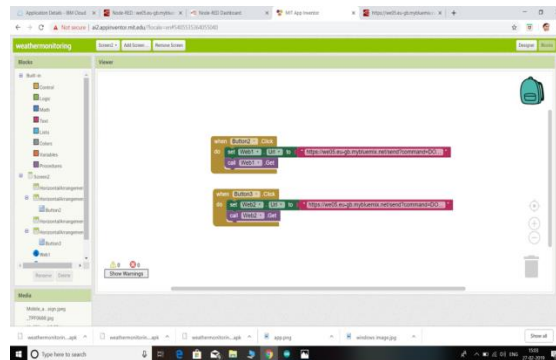


Figure 10: Door (Screen 2)-Blocks view

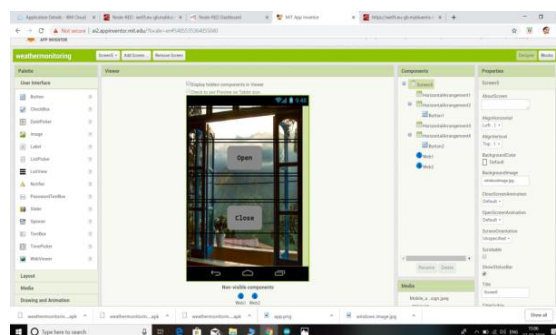


Figure 11: Window (Screen 3)-Designer view

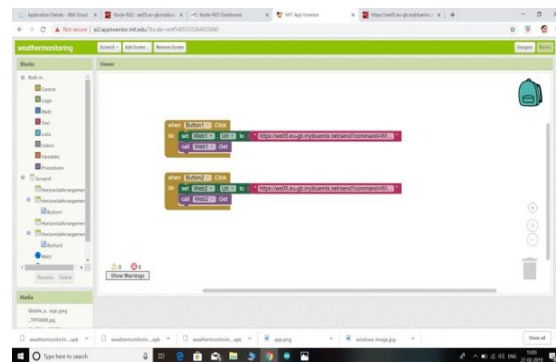


Figure 12: Window (Screen 3)-Blocks view

The development for controlling the doors and windows is pretty similar. The command is sent to the cloud once the button is pressed. The same logic is applied to the lights switching on and off. But the temperature and humidity part is very different as the data has to be collected by the sensors, published on the cloud and then received by the mobile application to be displayed on a screen.

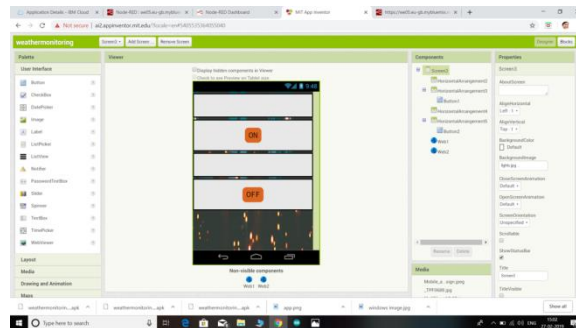


Figure 13: Lights (Screen 4)-Designer view



Figure 14: Lights (Screen 4)-Blocks View

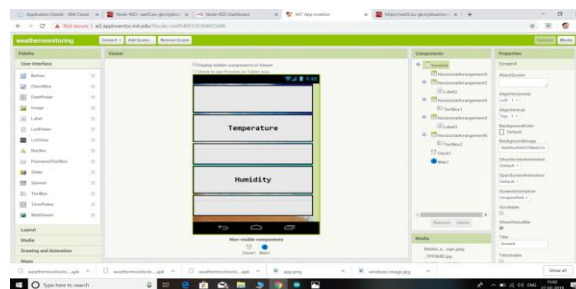


Figure 15: Temperature, Humidity (Screen 5)-Designer view



Figure 16: Temperature, Humidity(Screen 5)-Blockview

Following all these steps creates our cloud along with a web and mobile application which can be used to carry out automations. The doors and windows can be open/closed, lights can be switched on/off and temperature and humidity readings can be viewed.

V. RESULT/DISCUSSION

The project is completed. The doors and windows can be open/closed, lights can be switched on/off and temperature and humidity readings can be viewed. This is the final look of the mobile application constructed.



Figure 17: Homepage on Mobile

Based on what we wish to control we can click on the option. They will redirect the user to a different page as seen in Figure 17. The buttons can be pressed to give the instruction.

Instruction or command can be given at any location provided internet connection is available. If access to mobile application is not possible, this system also allows control from a web application.



Figure 18: Mobile Application

VI. CONCLUSION

Therefore in conclusion the project's main focus is the reduction of manual-mechanical work by implementing the principles of the IoT domain. The project's core idea being home automation involves controlling the entire house via a single cross-platform application. A cloud platform is the basis for communication between the sensors and the application (software) and the synthesis of the application. This project helps us achieve ease in day to day life and makes the house ecofriendly by auto controlling the lights, fans and overall electricity of the house. However the dependency of the entire idea on the internet connection and speed makes it a liability in the absence of a good internet connection.

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