International Journal of Emerging Technology in Computer Science & Electronics (IJETCSE)
ISSN: 0976-1353 Volume 26 Issue 7 – DECEMBER 2019.

MODULAR THINGS SYSTEM FOR HOME AUTOMATION

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***Abstract*— Smart devices being sold in the market can be used solely for its own specified purpose and doesn't adapt to the change in users requirements, which makes it a substandard investment in long run. Moreover Machine Learning is perceived to be a technology of the future and it is currently constrained to only certain applications. Project MT (Modular Things) breaks the confinement of conventional smart devices which are tied up to a single use case, this is done by making components truly modular and abstracting complex programs into a simple interface for use by an average person unacquainted with programming. By the use of modular components the users can build their own smart devices and deploy machine learning on them for simplified control and automation for day-to-day use. The user can easily swap modules depending on his use case.**

***Index Terms*— Arduino, Sensors (Temperature, Humidity, Light, etc), Internet of Things (IoT), Modules.**

I. INTRODUCTION

Internet of things (IOT) has promised the ability to provide the efficient data storage and exchange by connecting the physical devices via electronic sensor and internet. The IOT has created the revolution all over the world and fascinatingly it has become integral part of life. Hence, this paper utilizes Arduino fundamentals and some sensor to ease the way we can make our own devices to suite our needs rather than buying commercial products that are intented for one type of use.

This is achieved by interfacing sensors like temprature sensor, light sensor, humidity sensor, flame sensor with microcontroller based system like Arduino UNO. The values from the sensor change the status of the appliances connect to the switch and the status of appliances and sensors can be seen on the cloud platform.

II. EXISTING SYSTEM:

"Nest" is a commercial product line that offers solutions for various realtime problems. One such instance is Nest Protect. The nest protect is a smoke

alarm system which can be paired with a smartphone to alert user in case of fire accidents in house. Another insatance is the Nest Thermostat, which automates room temperature using a sensor. Apart from saving energy, the user doesn't need to constantly adjust temperature for comfort. Other products in Nest line include Video Doorbell, Alarm System, Door Lock, and Google Home Hub.

III. OUR PROPOSAL:

One important problem with Nest is that it offers separate products for various use cases. In addition to that, each of the products costs a lot for one to buy the complete line.

Our proposal gives a simpler solution to this. The sensors are broke down into separate modules that the user will assemble for the particular use case. If at any point of time, the user will feel that there no more requirement for that particular system, He/she can still deassemle the product and use it for some other purpose.

The product that includes all the compenents and sensor could still be given at a cost much lower than that of a single product from Nest.

IV. COMPONENTS AND SOFTWARES USED:

Arduino Micro, Relays, Temprature Sensor, ESP 32, Humidity Sensor, Motion Sensor, Arduino IDE, LDR (Light Dependent Resistor), Android Studio, ATTiny 85

V. SPECIFICATION OF COMPONENTS:

A. Arduino Micro Board:

The Arduino expansion was emerged in ITALY to build up low cost hardware for communicating design. This Arduino Micro is an excellent choice for any IOT applications design and, one can expect and carve programs according to the needs. The Arduino Micro board acts as a control unit in this experiment.

B. 5V Relays:

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal.

C. WI-FI Module:

The ESP32 WiFi Module is a self-containedSOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. The ESP32 is capable of either hostingan application or offloading all Wi-Fi networking functions from another application processor.

D. Arduino IDE:

The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. It runs on Windows, Mac OS X, and Linux. The environment is written in Java and based on Processing and other open-source software.It runs on your computer, used to write and upload computer code to the physical board

E. LDR (Light Dependent Resistor):

Light dependent resistors, LDRs or photo resistors are often used in circuits where it is necessary to detect the presence or the level of light. In this experiment we have used LDR to have automatic light control such that when there is brightness light is automatically OFF else it is ON.

VI. SYSTEM DESIGN:

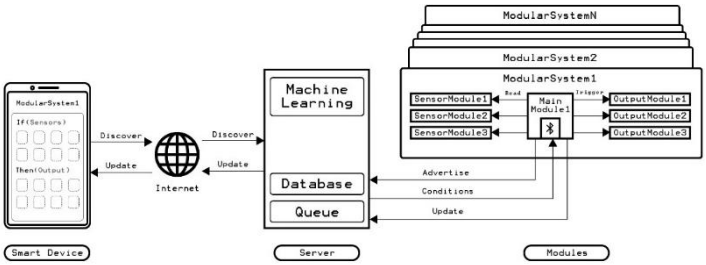


Figure. 1.0 Overall architectural view

A. Android App

The Android Application consists of a list of Range Seekbars representing each sensor available for setting conditions and a list of switches representing the output.

The user makes use of the slider control to set threshold values which when satisfied, turns on the intended appliance.

The app seamlessly updates the server just after pressing update so that even in case of network failure the app makes sure that it syncs immediately after the network comback.

In addition to these, the application also shows the current sensor values of each sensor connected with the Range Bar.

B. Server Setup

Google's Firebase offers a good solution to all database needs to store user inputted sensor Range Values. The Firebase Api is used on both software and hardware side to seamlessly update the data between the hardware and the android application through the cloud.

C. Hardware

The ESP 32 is a wifi enabled chip that acts as a Interconnection between the Main Module and the server.The function of the chip is to collect the sensor availability through the Main Module and upload it to the server and also retrieve the user set ranges and send them to Main Module. The Main Module is Injected with a program for checking the User Inputs acquired from ESP 32 via Bluetooth and it turns on or off the on Intended output switch when the conditions are met. These are a group of sensors connected to an Attiny86 to get them identified uniquely. A 16-bit sensor flag, where each sensor is identified by a bit, is synced to server to get thelist of sensors available. The modular system scans for allavailable I2C addresses and marks them available on the sensor and actuators flag

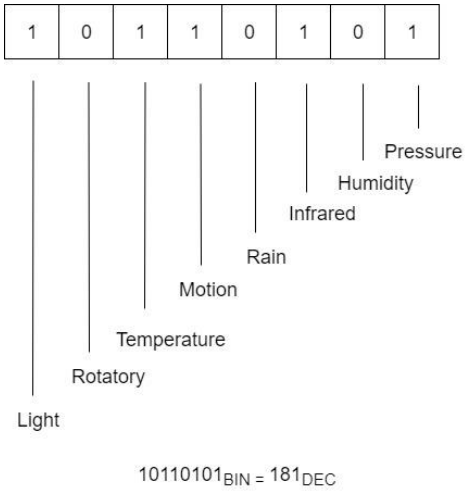


Figure. 1.1 Sensor flag structure

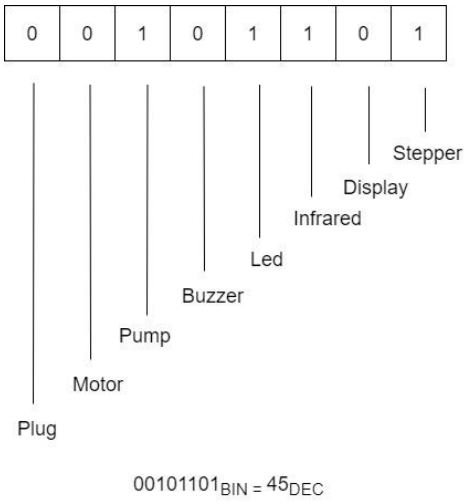


Figure. 1.2 Actuator flag structure

enhanced more to have a more simpler and clutter – free user experience.

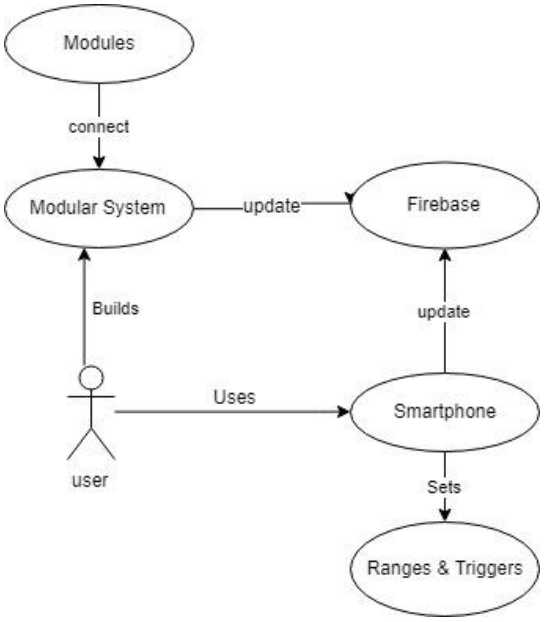
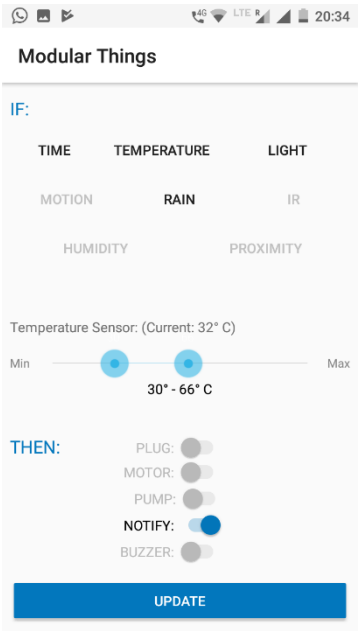


Figure. 1.3 Use case diagram



VII. OUTCOMES AND DISCUSSION

The app provides the user an Interactive UI to view the available modular systems, sensors, actuators and current sensor values. The initial interface consists of the list of modular systems which can be renamed according to the user made Modular System.The sensor section consists of a grid of buttons representing each sensor that can be connected to the systemThe sensors that are not connected to the system are greyed out and controls for them cannot be accessed. For available sensors, the buttons are clickable and the respective controls for that sensor pops up as a layout. Usually this is a RangeBar for setting minimum and maximum operational range for that particular sensor. This section also shows the current sensor value. The actuators section consists of a list of switches for the actuators that are compatible with the system. Controls for actuators that are not connected to the system are greyed out. With all these controls results in a highly customizable self made modular system that can literally be created for any use case. The possiblity of creation depends only on the user's creativity.

SPP Specification. Lower the cost of production by using IC's on custom PCB rather than development board and also improve port design to make them a standard. More modular sensors and actuators can be added to even more extend the possiblity of the modular systems that can be made. Inter module communications can be implemented. Most important of all, Machine Learning can be implemented on the system to automate the system creation itself by analysing historic data and predicting the enviromental conditions for the future days. Application UI

VIII. CONCLUSION AND FUTURE WORK

This project enables the user to attach the required sensors and actuators for their automation requirement and detach any unecessary sensors and actuators. This satisfies the true meaning of modularity. Making this a commercial product is not only much cheaper than home automation products available in the market, but also lets users to reuse the same system to different use cases.

The user can monitor the sensor values and create automation tasks from anywhere through internet connectivity and the interactive UI. The user doesn't need to be aquainted with programming skills to make their own systems unlikc other products available in the market.

Future work to reduce power consumption by the use of BLE GATT service over the bluetooth 3.0

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