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Cloud Based Home Automation Using IoT

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Abstract: **Ever since the beginning of automation technology the need of automating homes has always been a focal point of much attention along with the introduction of IoT which connects a wide range of electronic devices over the internet and allows them to share data and communicate. Home automation with IoT is a rapidly growing field in a bid to provide solutions for smart homes, many big tech giants are now increasing their stakes in this field. Existing home automation models are plagued with problems such as high costs, limited wireless capacity, and poor user interface. This paper provides a review on a cost-effective Home automation system with a web page-based user interface and cloud data storage facility. To achieve this, we will assemble Internet of things and cloud networking along with Intel Galileo microcontroller board to provide user control of appliances in his house over the internet and store data on the cloud server which can be accessed anytime. This review paper would help understand IOT, and its use in home automation**

Keywords: **Home Automation system (HAS), Internet of things (IoT), Cloud networking, Intel Galileo microcontroller, Smart home (SH).**

1. INTRODUCTION

With the advancement in recent technology, the demand for automation in homes has risen steadily. Home automation means automating the operation of all devices/appliances/systems to suit the needs of the people living there. It provides cost-effective living with safety, comfort, convenience, and entertainment. Smart homes are an integral part of smart cities. IoT has a large number of applications including smart homes. It is a network of sensors, software, actuators, micro-controllers that communicate with each other over the internet. Our research focuses on developing a wireless home automation system, backed by IoT, which can be monitored online, while also storing the data on a cloud server, accessible on mobile/laptop. An Intel Galileo chipset with a built-in Wi-Fi card port, providing Wi-Fi connectivity are used, and all sensors are connected to the chip. This setup can be assembled for Rs.7500 and can be modified by adding an intercom hub, CCTV, Video doorbell, smart garage doors, etc., as per the customer needs.

2. CURRENT TREND IN HOME AUTOMATION

Home automation is a relatively new concept in India and faces issues such as high cost of installation and maintenance, inflexibility, poor management and knowledge, and lack of sufficient safety**. *The main objective is to design and test a HAS prototype model that is capable of automating, controlling, and monitoring most of the systems and devices used in homes, while also being cost efficient, and safe.*** The system will allow the user to control all appliances in the home, over internet. This will decrease the installation cost, and will increase the operability and maintainability of the system configuration.

In recent years, the use of Wireless systems, like Wi-Fi in home automation systems, has become increasingly common due to its obvious advantages over wired systems, all connected to a common board. Wireless systems are cheaper to install and provide system scalability, upgradability, and extension to the SH, while also eliminating complex wired connections and can be monitored remotely over a network, using the internet.

3. PROPOSED SYSTEM

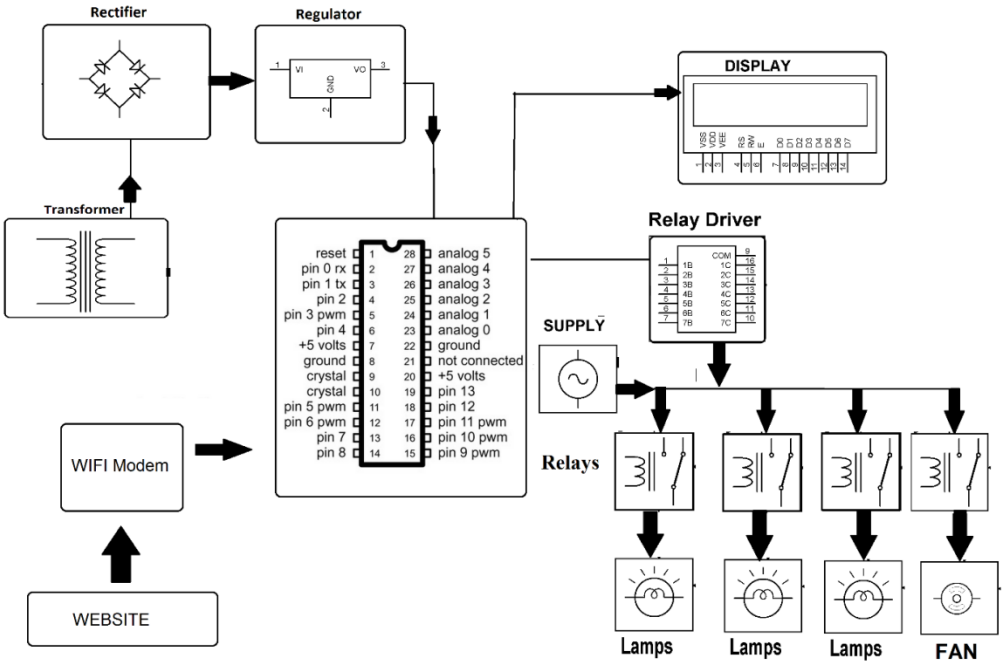


Fig 1: Circuit diagram [20]

The rough outline of the given system is as shown, in **Fig.1**, above. Here, a temperature sensor (thermostat), a motion sensor, a Gas sensor (MQ-6), and a Light Dependent sensor or (LDR) are used. The microprocessor that is used is cheap and easily available. Intel Galileo connects to the internet over wi-fi. When all components are set up, and connected over IoT, it will start reading sensor values V_1(Temperature Sensor), V_2(Light Level Sensor), V_3(Gas Sensor), and the designated threshold values as t_1(18°**C**), t_2(1000 lux), t_3(150 ppm), and display them over a GUI, and it can be stored on Cloud, as well as, can be accessed anytime with a mobile or laptop. Once the sensor values exceed the threshold values, a signal will be generated causing the system to take appropriate action. There are 3 alarms a_1, a_2, a_3 respectively. In this proposed model, temperature of the house is maintained by automatically starting AC, in case it exceeds the threshold and is turned off when it drops below the lower threshold. In an event of gas leakage or fire, the MQ6 gas sensor notifies the system and raises an alert. The LDR sensor measures the level of light, and turns ON/OFF lights according to the set limits. All the appliances can be monitored remotely and can be turned ON/OFF simply by logging into the appliance IP address, over internet..

4. APPLICATIONS OF PROPOSED SYSTEM

The system is expected to perform the following applications on successful installation

1. Heating, ventilation and air conditioning (HVAC).
2. Detecting movement using motion sensor.
3. Detection of fire and smoke.
4. Detection of Level of light.

5. HARDWARE DESIGN

Intel Galileo

An Intel Galileo micro-controller, shown in Fig. 2 below, is a 32-bit chipset with intel x86 architecture, compatible with Arduino UNO, with an inbuilt Wi-Fi card port for internet connectivity, and 256 MB of memory are used for the design purpose. It is preferred over raspberry-pi for projects including sensors, because of high processing power and a real-time clock that is active even without internet or power, making it ideal for IoT applications.

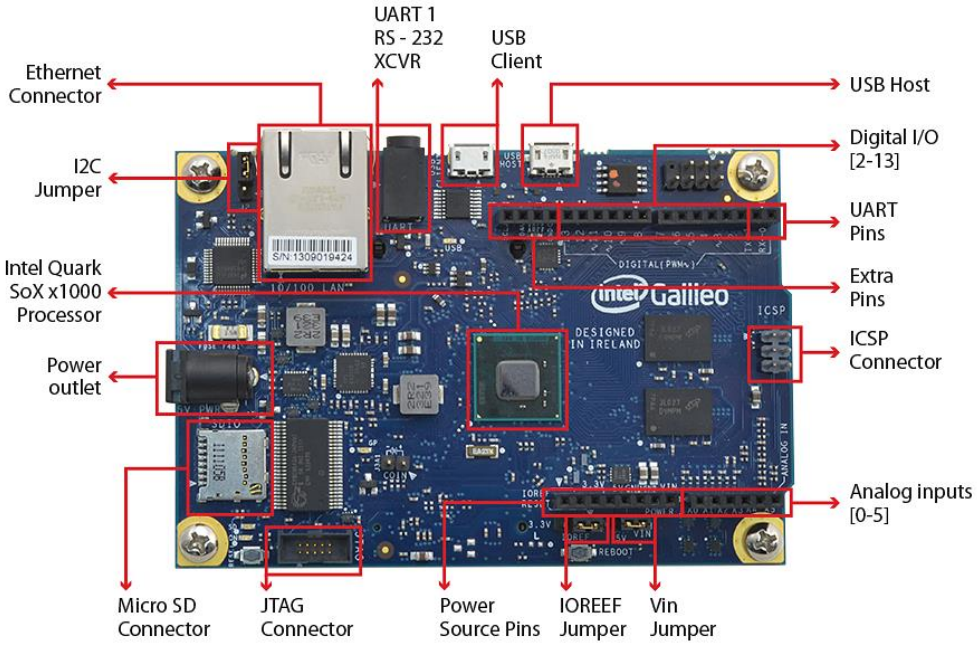


Fig 2: Board overview of intel Galileo

LDR Sensor

LDR or light-dependent resistor, shown in Fig. 3 below, is used to detect the level of light in a given environment. It is also known as a photo resistor. It works by changing resistance according to changing light levels, as per the principles of photoconductivity. It is cheap, readily available, and convenient to use.

Fig 3: LDR Sensor

PIR SENSOR

PIR or passive infrared sensor, shown in Fig. 4 below, is used to detect human motion within its range, by detecting the IR waves emitted by objects in its vicinity. Its range lies between 25cm to 20m. They are small, cheap, easy to use, and compatible with Arduino, 8051, & raspberry, etc.

Fig 4: PIR SENSOR

Gas Detection

The MQ-6 Gas sensor, shown in Fig. 5 below, can detect or measure gases like LPG and butane. It ionizes the gases around it producing a change in resistance. It can also measure ppm of air, and used in air quality, as well as, gas leak safety installations.

Fig 5: MQ-6 SENSOR

6. SOFTWARE DESIGN

WEBPAGE DESIGN

HTML is a format that is used to design as to how a webpage and the data to be displayed should look. HTML files are text files, encoded with codes that a web browser reads, and converts to data on a computer screen. A webpage is designed using proper tools, to represent values of temperature, light switches for all rooms & toggles, and motion detected logs, as well as, controls, to turn ON/OFF smart appliances of the system.

CLOUD STORAGE

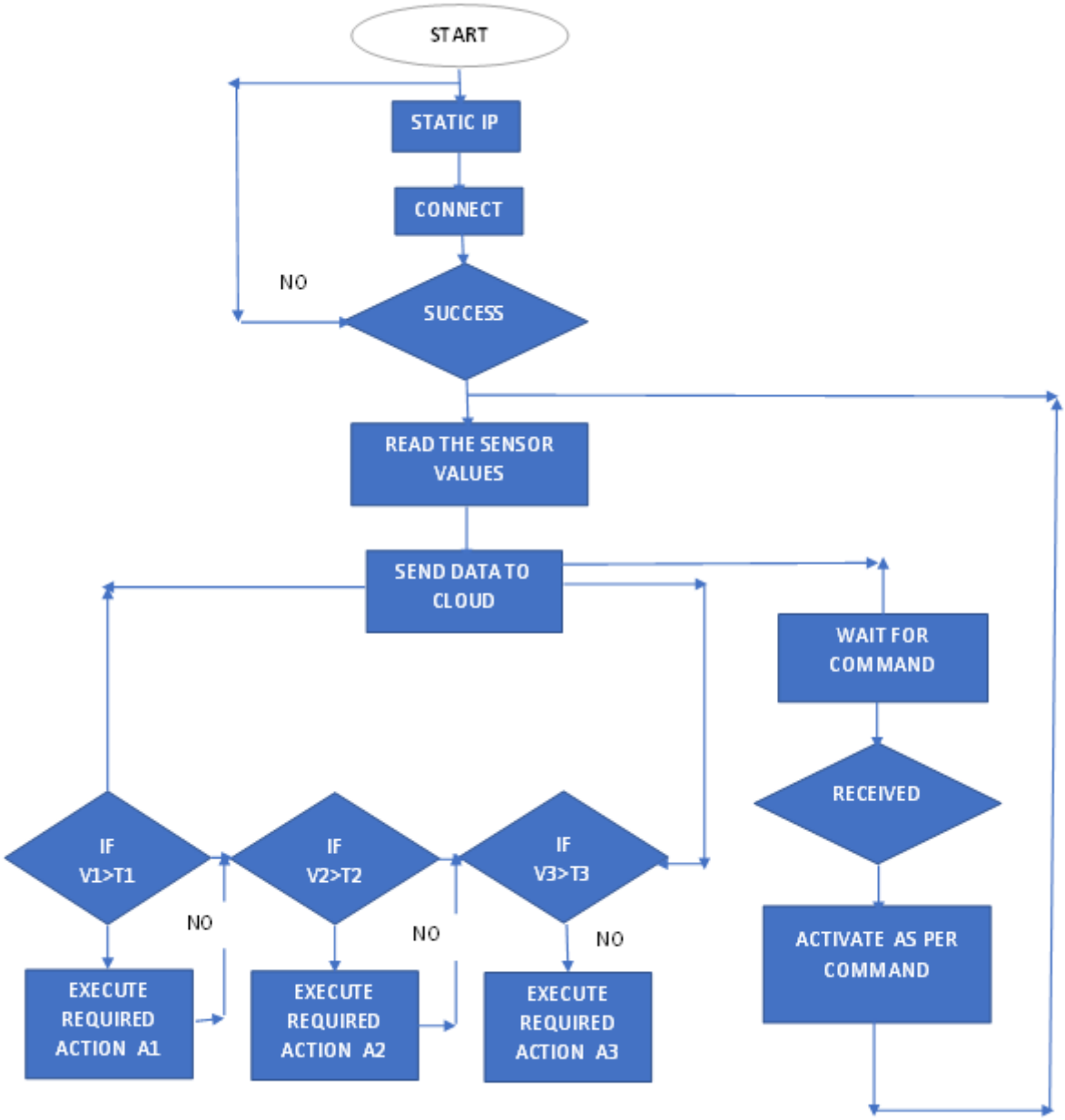
Cloud data storage in IoT is an integral part of a web-based system, and is used to store, the data over the internet. The Cloud is a streamlined server containing data and computer resources that can be accessed when required. Cloud Computing is an effective communication method for the large data packages generated by the IoT to be stored. It eliminates the need of separate applications, thereby allowing easy maintenance and support. Cloud Computing allows SH to log and store data, collected by the sensors, using facilities like Gmail, and can be accessed when required.

ARDUINO IDE

Arduino IDE is an open-source software that is used for writing and compiling the code into the Arduino based boards or microprocessors. It is an easy-to-use software, and a powerful tool for modifying, experimenting, and running systems on Arduino module. The code once compiled is stored as a hex file which is uploaded to the Arduino board.

7. SYSTEM IMPLEMENTATION

The flowchart given below illustrates sequential series of operations undergone in the HAS, once the connection is established, it will start reading and recording the values of the sensors i.e. V1, V2, V3 compare them to threshold values T1, T2, T3, and required action A1, A2, A3 will be performed. for example, if the temperature increases above a certain point (36 C) AC will be turned on and if it is below (18 C) heating system will be operational, In case of a fire or gas leak, the MQ-6 gas sensor will activate and generate an alarm and send an alert to the owner. If someone approaches the house from the front door or window the motion sensor activates and registers any activity along with the timestamp and stores it on an excel file it can also be connected to a CCTV to start recording in case the motion sensor registers a reading. The LDR sensor activates all lights insides the house when the sunlight level goes down and turns off all when the sunlight level rises. Intel Galileo microcontroller coordinates the operations of all sensors and appliances. The user can also keep track of appliances like TV, heater, fans, light connected to the system and turn them on/off over the internet using the webserver. User can turn on AC before entering the room to maintain the desired temperature. All the data collected by the sensors is recorded and stored in a Cloud server like IoT Things speak or Gmail. The Intel Galileo is connected with a WI-FI card which provides internet connectivity.



8. RESULTS

Once the connection is established, data from the sensors is collected, later sent to a web server, and is displayed on a webpage. This web page can be accessed by an IP address, assigned to the web server, which can be accessed anywhere on the web, using the IP address on both laptop and mobile. It displays temperature, in different places inside the house, which is read and stored in degree Celsius. Motion sensor logs for motion, detected by the sensor, along with timestamps, and the status of all appliances connected to the system, like fans, TV, lights, which can be switched ON/OFF remotely, via web server. All the data is stored in a cloud server and can be viewed and analysed, as per need.

9. CONCLUSION

Home automation is successfully implemented using IoT, and the system developed performs its required functions of connecting household appliances to each other, which could be monitored and controlled over internet. Designed system is implemented in a modular fashion which allows later modifications with an easy to use webpage interface. System observes sensor data for light, temperature, & motion, and also performs an action when required, like generating an alarm, in case of a gas leak. All the data collected is regularly stored over cloud server, which helps the user keep track of sensor parameters and the activities of the system.

10. FUTURE WORK

The system developed is a very basic model of an IoT based home automation system and it performs a limited set of operations including making the home more energy-efficient and safer. But, in time, it can be expanded to perform various functions, such as, automatic garage doors, CCTV, which starts recording when someone rings doorbell and other features, according to the needs of the home owner. The system can also be enhanced by using machine learning algorithm.

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