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# IOT based Interactive Controlling and Monitoring System for Home Automation

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***Abstract*—The "IOT based Interactive Controlling and Monitoring System for home automation" is a new technological advancement which can control and monitor devices nor only for home automation but any real life appliances remotely. Any automation project using embedded system like PIC Microcontroller provides an intelligent , low cost, energy preserving system for homes ,schools ,hospitals .The main objective of this paper is to design and provide implementation details of IOT based ICMS for home as well as for any real life applications to automatically switch on/off lights, fans, gas, curtains ,gates using sensors, which is capable of controlling and automating most of the real life appliances through an easy manageable android based interface. The same project can be scaled up in distributed systems for any real life application.**

***Index Terms*—IOT: - Internet Of Things, HACS: - Home Appliance Control System, ICMS- Interactive Controlling and Monitoring System, PIC:-Programmable Interface Controllers.**

## I. INTRODUCTION

The main objective of this home automation project using embedded system that uses PIC Microcontroller which provides intelligent energy preserving system, "IOT based INTERACTIVE CONTROLLING AND MONITORING SYSTEM (ICMS) for home automation" which is capable of controlling and automating most of the home appliances through an easy manageable Smart phone based android interface. The proposed system has a great flexibility which uses Wi-Fi technology to interconnect its distributed sensors to home automation server. This will reduce the deployment cost and will increase the ability of upgrading, and system reconfiguration. Our proposed IOT based automation system not only reduces overall cost because of PIC Controller which when used in distributed environment drastically reduces project cost because of cheaper components used, also it upgrades and does auto-system reconfiguration. The use of embedded system using PIC Microcontroller reduces project cost because it is cheaper in cost compared to other embedded systems controlling IOT. Already developed IOT based projects systems, faces four main challenges; these are high cost of ownership, inflexibility, poor manageability, and difficulty in achieving authorization security. In earlier IOT based projects, energy consumption reduction is also not considered as criteria [2]. This proposed system presents a low cost and flexible ICMS using an embedded PIC microcontroller web server, with IP connectivity for accessing and controlling devices and appliances remotely using Android based Smart phone application. This proposed and implemented system require a dedicated server PC and offers a novel communication protocol to monitor and control the home environment with more than just the switching functionality. To demonstrate the feasibility and effectiveness of this system, devices such as light switches, power plug, temperature sensor and current sensor, gas sensors have been integrated with the proposed ICMS automation system.

## II. SYSTEM ANALYSIS

In earlier, IOT based projects devices are connected to "Bluetooth" for controlling devices and appliances remotely using Android based Smart phone application, which controls various appliances such as lights, TVs etc. These IOT based HOME AUTOMATION SYSTEM (HACS) receives commands from remote devices using Bluetooth that are manipulated by user. The system in turn dispatch commands to respective appliances that will perform the actions. In present IOT based system range of controlling devices is limited because of Blue tooth technology as blue tooth will not cover range beyond 100 m, as in many cases some people are not able move much from one place it is essential for them to develop a system which requires less human interaction [1]. Also to improve standards of living, for less energy consumption it is needed to change home conditions [2],so we need flexible energy efficient system which detects the fault in the devices automatically and generate a recovery process to resolve the detected problem. If this system has to be scaled up to meet requirements of distributed systems then even though cost of one component of PIC controller based IOT device is less we can scale it up for multiple connectivity options, which overall reduces cost of distributed IOT based system.

## III. PROPOSED SYSTEM

An "IOT based ICMS for Home Automation" is a low cost and flexible system which provides various services for remotely accessing and operating on home appliances such as lights and fan on/off automatically as well as manually through android application on smart phones, monitoring room temperature , LPG gas leakage, gate and door open/close . The similar kind of project can be deployed for other real life applications hospitals and schools also.

The components are connected to embedded micro-web server, with IP connectivity either through LAN or Wi-Fi module for accessing, controlling and monitoring devices and appliances remotely using Android based Smart phone application. This system receives commands from remote devices that are manipulated by user. The system in turn dispatch commands to respective appliances that will perform the actions. This system also keeps track of the status of the devices.

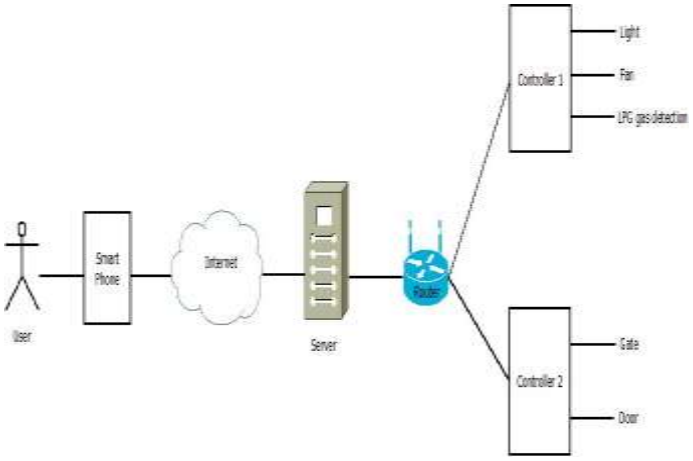


Figure 1: Block diagram 1- IOT controlled by smart phone

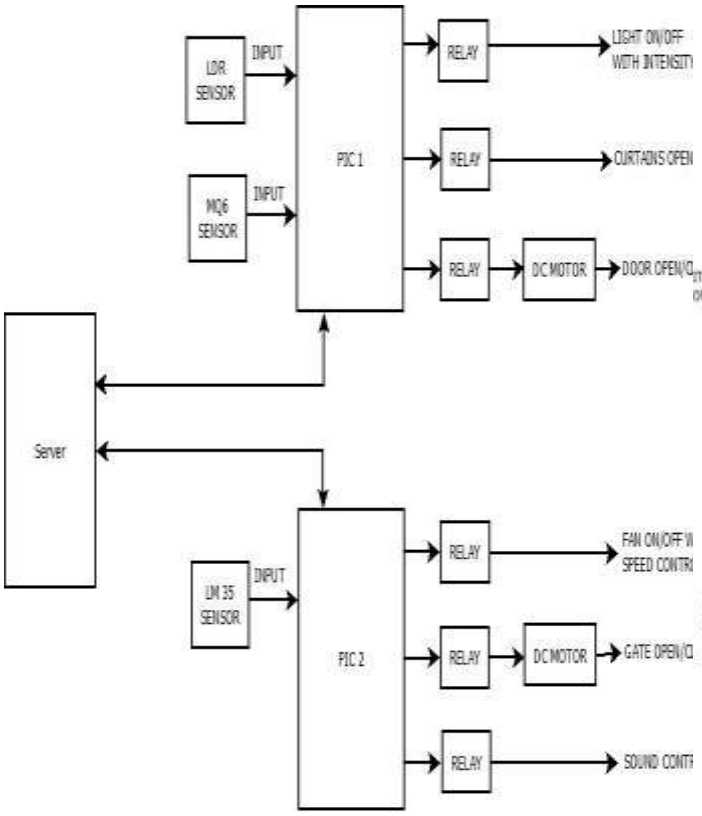


Figure 2: Detailed Block Diagram 2-IOT connected to external sensors & Devices

Through android application authorized user can access the system using Internet, by using router and hardware interface module. The primary function of the router for the proposed architecture is to provide data translation services between the Internet through sending and receiving requests and responses respectively. The main component is a web server based on Ethernet embedded with microcontroller. The main task of the server is to get the request, process it and then provide response back to the user. Hardware interface modules are directly connected with sensors and actuators through cables. It has the capabilities to control power management systems like lightings and security systems such as home door locks, and gate. PIC microcontrollers (Programmable Interface Controllers) are electronic circuits that can be programmed to carry out a vast range of tasks. They can be programmed to be timers or to control a production line and many more. They are found in most electronic devices such as alarm systems, computer control systems, phones, in fact almost any electronic device.

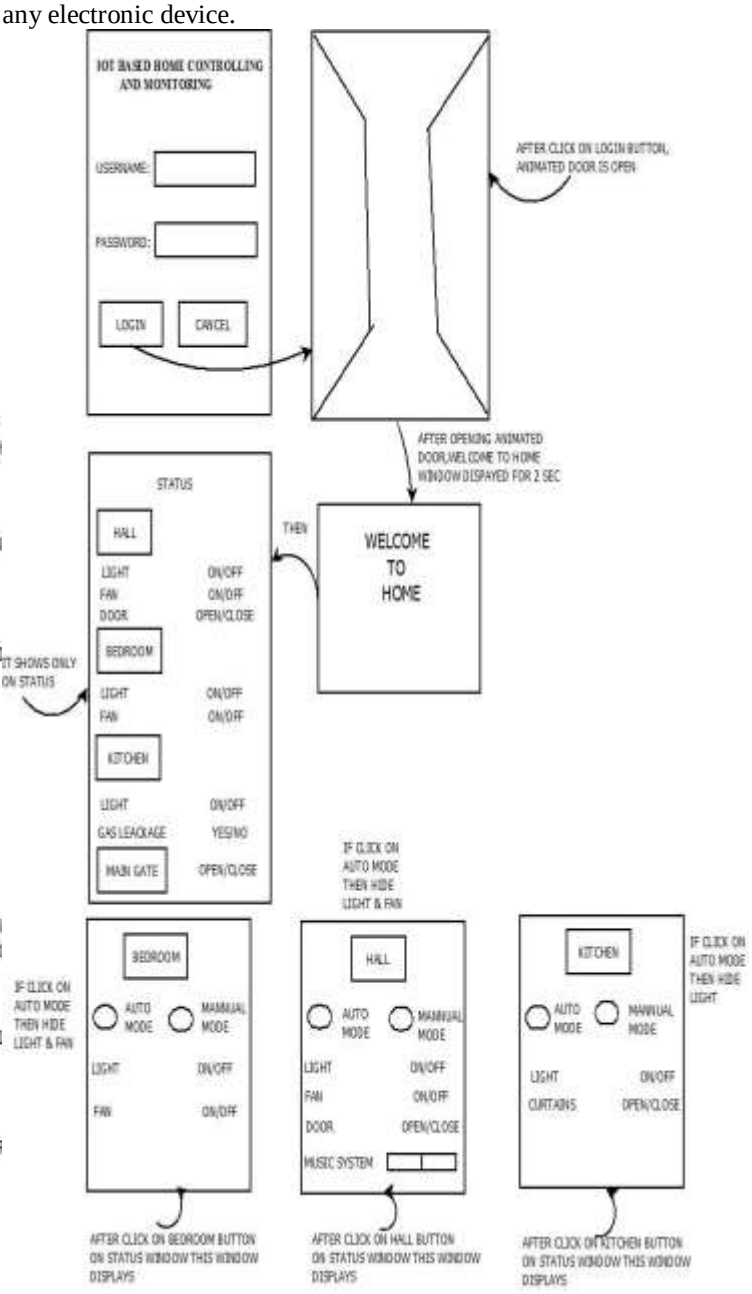


Figure 3: Detailed Block Diagram 2-Home Automation using IOT

PIC Microcontrollers are relatively cheap and can be bought as prebuilt circuits or as kits that can be assembled by the user. PIC devices are popular with both industrial developers due to their low cost, wide availability, large user base, extensive collection of application notes, and free development tools, serial programming, and re-programmable Flash-memory capability.

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IV. EXTERNAL COMMUNICATION INTERFACES

## A. *Communication Interfaces*

The "IOT based ICMS for Home Automation" uses the external devices which are accessible through android devices.

a) MQ6 (Gas Sensor):

High sensitivity to LPG, low sensitivity to alcohol. Fast response, Stable and long life

b) LDR (Light Dependent Register):

Quick Response, Reliable performance, measured dark resistance at $10^{th}$ second.

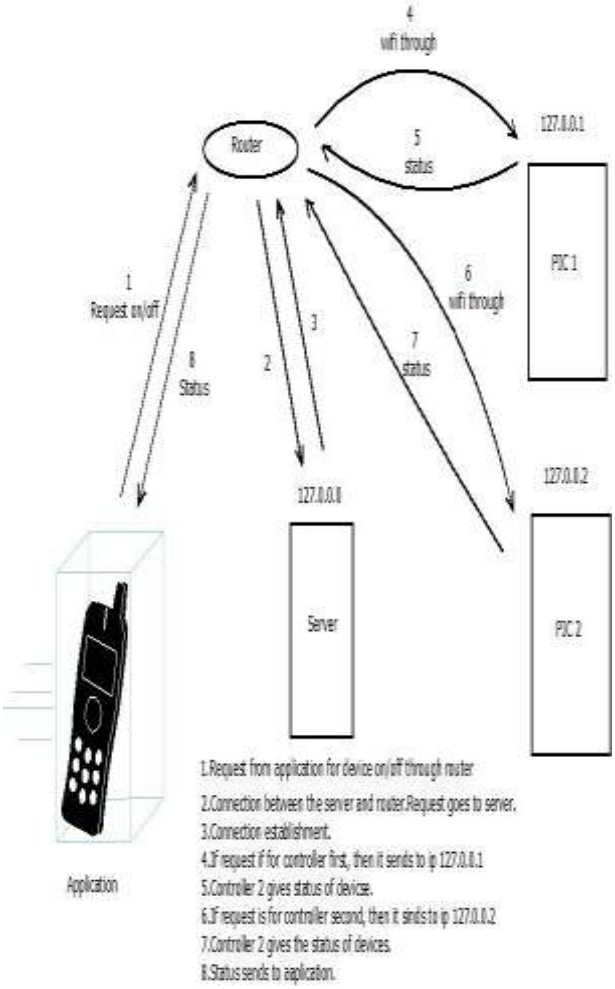


Figure 4: How communication between various devices taking place

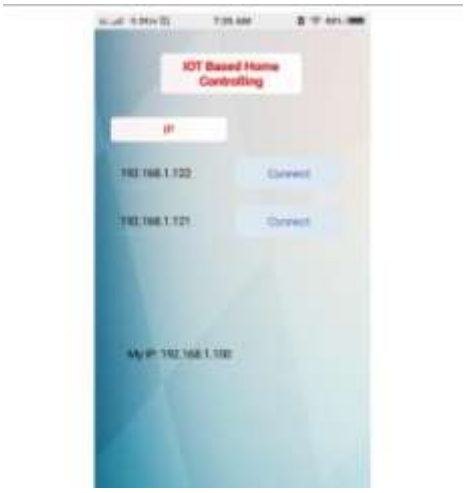


Figure 5: Explaining connection establishments through IP connectivity, The server connection is established, from the example above (note that the module has the IP 192.168.4.1 as an AP )

## B. *ESP8266 Wi-Fi Module*

ESP8266 is a Wi-Fi Module that cost is lesser than Ardiuno hence it is a feasible solution [1]. It is a great value for money and hence a practical way of putting all sensors on the internet.

- Wi-Fi route with 5 port(IEEE 802.11)
- There is 1 input and 4 output
- LM35(Temperature Sensor):
- Operating temperature range is from -55 degree C to 150 degree

ESP8266 is an impressive, low cost Wi-Fi module suitable for adding Wi-Fi functionality to an existing microcontroller project via a UART serial connection. The module can even be reprogrammed to act as a standalone Wi-Fi connected device to just add power.[3][5][8] The feature list is impressive and includes:

- 802.11 b/g/n protocol
- Wi-Fi Direct (P2P), soft Access Point (AP)
- Integrated TCP/IP protocol stack
- Acting as a Wi-Fi AP

In addition to connecting to Wi-Fi AP the module can also act as an AP. This means that we can Connect devices to the module without any other network infrastructure in place. It is Ideal for a local

Table 1 Process & communication with sensors

| **Process** | **Command (I/P from user to server then to controller)** | **Output of controller** |
|---|---|---|
| Light on/off | Input from light sensor (LDR) reading passed on to controller(Automatic) | Light on/off (according to reading of LDR intensity of light increases or decreases.) |
| Curtains open: | Input from GAS sensor(MQ6) to controller: (Automatic) | If value of MQ6 sensor is greater than the threshold value then controller start the relay and dcmotor, curtains are open. |
| Music controlling | Sound value from user through android app | User interacts through the slider bar in application to the server, value sent to the controller and sound increases or decreases |
| Fan on/off | Command from user is forwarded to temp. sensor (LM35) to controller: (Automatic ) | server checks the ip address of corresponding device and sends this command to controller(LM35 Sensor),and fan on/off as per reading |
| Status Retrieve form device | Get status (Automatic) | Send the current status of system to end users mobile application. |
| Gate open/close: | Command with password | Controller starts the relay and dcmotor, and open or close the door if password matches. |

private shared drop box . The module comes with an access point predefined (SSID of ESP –service set identifier) but we can define own with: AT+CWSAP command. The first parameter is the SSID (name; the second parameter is the password; the third the Wi-Fi Acting as a Wi-Fi Access Point channel.

- pick one not used in your area and the null parameter is the encryption standard to use. An encryption value of 0 turns encryption 0, which means the password is ignored, but it still can't be an empty value. Hence encryption is not done as it will create an unencrypted network.
- To actually enable the network to be created we need to set the Wi-Fi mode of the module to AP ( 2 ) or Both ( 3 ): AT+CWMODE=3 Now you will be able to connect to your module as an access point from another device (e.g. a laptop or a phone).
- You can list the IP address etc of any device connected to the network with: AT+CWLIF Which generates the response: 192.168.4.100


Figure 6: Android application interface

*C. Product Functions: User interfaces*

User Login user can login to his android application with id and password.

Sending Signals: To perform the specific action user can send the signal to controller through web server.

Receiving Status: User can known the status of devices immediately when he login to the application. And also retrieving the status from refreshing the window.

Processing Client Request: Web server can get the client request from user and transfer to controller.

Send Signal to Controller :

Controller can performs following operation

1. Processing request: Controller can get the request from web server and process it.
2. Generating Response: After generating the response controller can perform specific action and send data back to web server to user.
3. User can control the devices from anywhere and can read the status.

Table 2 User interfaces

| | |
|---|---|
| Log in | Log into the application |
| Device List | This displays all control list with its status. To control the device click on particular device button, it displays Device Status window. |
| Device Status | In this window we can switch on or switch off device. According to the device window displays mode of operation. |

## V. CONCLUSION

The home automation using Internet of Things has been experimentally proven to work satisfactorily by connecting simple appliances to it and the appliances were successfully controlled remotely through internet. This intelligent, low cost, flexible designed system not only monitors the sensor data, like temperature, gas, light, motion sensors, but also actuates a process according to the requirement, for example switching on the light when it gets dark. It also stores the sensor parameters in the cloud (Gmail) in a timely manner. This will help the user to analyze the condition of various parameters in the home anytime anywhere. This concept can be used for any big as well as small organization such as Hospitals, colleges, schools can also use this concept and the most important thing, it can be scaled up as per the requirement in distributed systems environment.

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