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IoT based smart home Automation System using ARM7 LPC2148 & GSM/GPRS

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ABSTRACT

The idea behind home automation is to have greater security, make people's life easier and comfortable. In today's life IoT plays vital role in automation, which offer people to control home appliances in proficient manner over internet by using the advanced communication technologies and automation system. The innovation in electrical appliances industry that has introduced a GPRS-enabled based home appliances in a market, which subsequently offers an alternative for implementing the automated smart home system at reasonable cost. Considering the Energy management, security benefits of IoT, we have designed IoT based collaborative affordable home automation and data gathering system to display the data on web page using internet via GPRS. The proposed system uses GSM or GPRS technology for controlling, monitoring home appliances & atmosphere. The prototype is been implemented on ARM

Keywords—*HA, ARM LPC2148 Controller, GSM/GPRS, Embedded C Language, LPC2148 controller board, Relays, Bulbs, Motor, Sensors and Embedded C.*

1. INTRODUCTION

The concept of IoT is used to interface all the appliances and sensing devices to the internet and allow them to communicate with each other over the internet. With IoT, all the objects extended through internet around us can communicate resulting in enhanced competence, accuracy and monetary benefit [10 ,11]. Home automation system provides automatic control and monitoring of electrical or electronic home appliances with minimal human intervention, which provides better security and more efficient use of energy. The main characteristics of home automation are automation and remote control and process involves controlling of electrical and electronic home appliances automatically using various control system techniques through internet [9-11]. In addition to that, the modern homes are automated through the internet and the home appliances are controlled. Usually it consist of sensing element, which collect different kind of data like temperature, smoke, light intensity etc. controlling unit controls the appliances by analyzing the gathered data. The exchange of data and user commands over the internet can be obtained by the communication technologies GSM/GPRS, Wi-Fi, Bluetooth etc [2,12-14]. The core objective of this paper is to build a affordable smart home system, that can be used to control the home appliances, monitor gas, temperature, light via GSM/GPRS. The collected parameters through various sensors is analyzed by ARM7 LPC2148 controller and then transmitted over internet. GSM/GPRS module interfaced with ARM7 LPC2148 controller board is used to provide the wireless communication interface with internet [2,12-13].

Fig. 1. Smart Home

2. LITERATURE REVIEW

One of the researcher, established smart home system using Arduino microcontroller, WI-FI module EP8266 and Android-Based smartphone [1]. The home machines and the sensing devices are interfaced with I/O pins of Arduino controller. The purpose of Arduino board is to measure & collect the readings from the sensors. A local controlling done through Wi-Fi whereas the remote controlling is done over IoT. Virtuino android application is used to monitor & control the home appliances via android base mobile phone.

Another researcher set the automation system with Node MCU as main controller integrated with Node MCU EP8266 [2]. The Node MCU is used for collecting the sensors data however the Node MCU EP8266 is used to connect to internet by using the IP address so, system can be controlled through Wi-Fi.

There is publication on proposed smart home system which consist of STM32F407VGT6 microprocessor is used to control

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the home appliances and monitor the environmental conditions and SIM800A is used for wireless transmission for sensor data and command information [3].

There is a design of the Home Automation System using Raspberry Pi to monitor and control home appliances such as light, fan etc and also alarm indication for hazardous condition [4].

There is a proposed home automation system using Bluetooth technologies for controlling the Home Appliances. Handler can use the cell phone to control the home appliances. The only drawbacks of using Bluetooth technology is that it operate over a short range [5].

There is another related work using the GPRS. SMS & Email services used to alert, control & monitor the electrical appliances [6].

3. SHORTCOMING OF EXISTING SYSTEM

- Drawbacks of Bluetooth in home automation Limited to Short distance

Data Rate is low

- Home Automation System using Raspberry-pi is high since the Raspberry-pi device cost is comparatively high
- Smart Home System using the Arduino have less processing & high operating voltage.
- Multitasking is not supported in Arduino.

4. PROPOSED SYSTEM WORK

The proposed block diagram explains the working modules involved in the solution

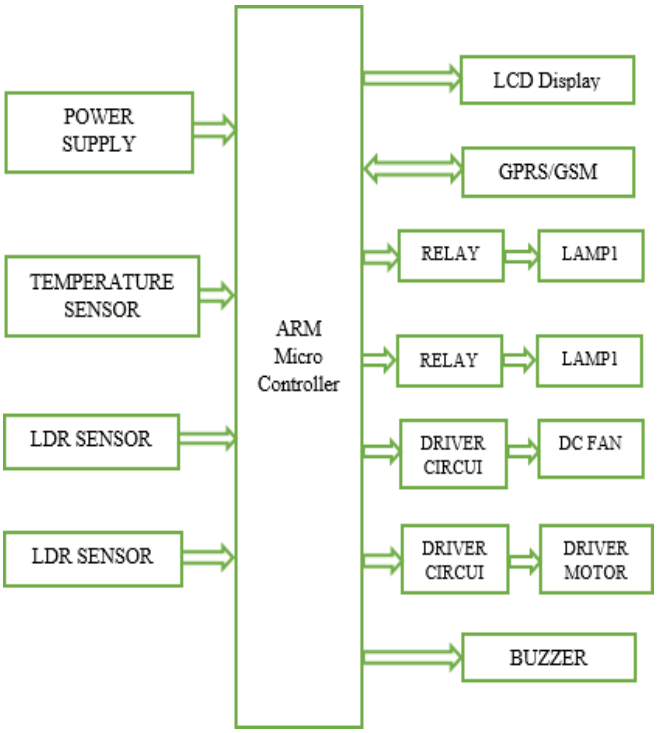

Fig. 2. The Complete System Flow

A. System Details

This proposed system includes

1) Sensor: In this design different kinds of sensors are used to get the physical condition, like temperature sensor is used detect the temperature value, gas sensor is used to detect the smoke, LDR sensor is used to evaluate the light intensity. The microcontroller will receive this sensor information and will send over GPRS to display over GUI. A relay switch used to send a control signal received from the microcontroller to electronic devices to perform the switching action i.e ON and OFF.

2) Microcontroller: ARM7 microcontroller programmed in way that, it will serves as the centre of all systems and regulates all activities.

3) Remote Operation: For this GSM/GPRS module and the SIM 800L GSM/GPRS modem are used.

5. SYSTEM DESIGN

A. Conceptual Framework

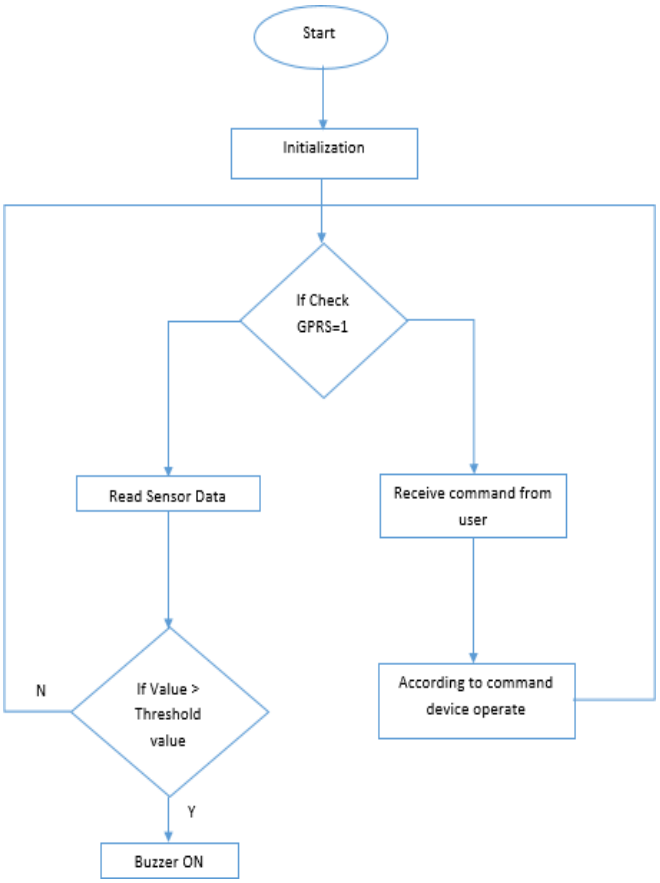

Fig. 3. The Complete System Flow

The flowchart from the Figure.3 shows the entire home automation system. After powering on the system, SIM800L module get initialized and login automatically. After initialization system start collecting the sensor data and matching with the defined threshold. If value crosses the defined threshold then the buzzer alarm will triggered. And also system will accept the user command and will act accordingly like turn on the bulb/A.C etc.

6. HARDWARE DISCRIPTION

Major hardware component for this proposed systems are ARM7 LPC2148 microcontroller which is used for controlling the functions and second one is SIM800L used for GPRS transmission.

A. ARM7 Microcontroller

ARM is a 32-bit Advanced Risc Machine, particularly used for high-end application & mostly found in robotic application. The LPC2148 specifically a 16 bit or 32 bit ARM7 based microcontroller and available in a small LQFP64 package. It has static on chip RAM of 8 kB to 40 kB and has on chip non-volatile memory of 32 kB to 512 kB. It has 128-bit wide interface/accelerator enables high-speed 60 MHz operation. Many serial interfaces like two 16C550 UARTs, It has two I2C-buses which have a speed of 400 kbit/s.

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Fig. 4. ARM7 LPC2148 Board

B. SIM800L(GSM/GPRS)

SIM800L used as cellular unit which enables GPRS transmission, sending and receiving SMS and allowing and receiving voice calls. SIM800L is low cost and support quad-band 850/900/1800/1900MHz.

Considering the features & specification, this module is unique for the project where long range connectivity needed. After connecting SIM800L module to supply unit, it came up & login to the cellular network automatically. LED status of SIM800L indicate the connection state (If there is no network then LED blink very fast and if there is network coverage then LED blinking slowly).SIM800L unit encompassed with two antennas. First the wire antenna solders to NET pin on PCB which is very useful in narrow places. Second - PCB antenna with double sided tape and attached pigtail cable with IPX connector. SIM800L has greater performance and due to small in size which fit in small place.

Fig. 5. ARM7 LPC2148 Board

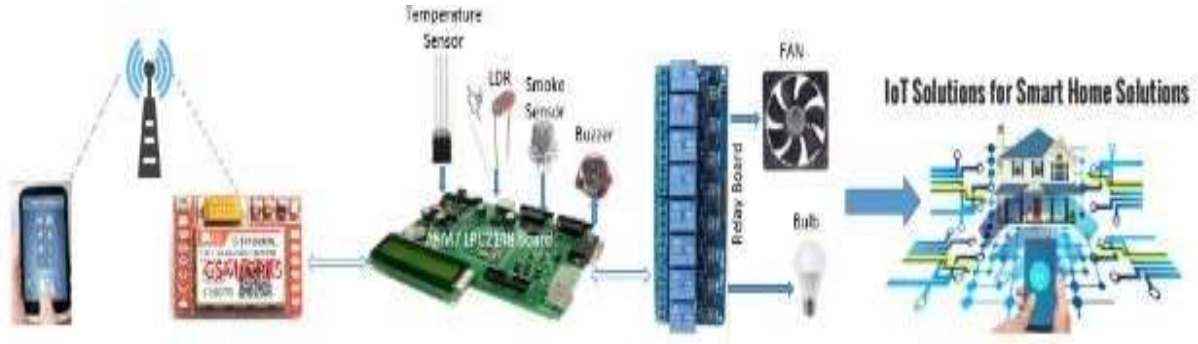

Fig. 6. The proposed system architecture

7. WORKING SETUP

This interconnectivity allows them to create a system that can monitor, analyse, control, and automate. In this prototype, we have connected the load to ARM7 LPC2148 board through relay and DC Driver circuitry.

The ARM7 LPC2148 board is used to gather the data from the sensing node (sensors) and send this gathered information from sensing node (sensor) to the web site by using the GPRS

Fig. 7. Implementation of home automation system based on ARM7 LPC2148 Board

8. EXPERIMENT RESULT AND OBSERVATION

The microcontroller within the coordinator unit uses to gather the info from sensing node and send the knowledge data to the online site by using GPRS. Fig.8 shows the representation of status of home appliances & the sensed data on web site.

Fig. 8. Result of sensors & Appliance status

In addition to that homeowner has a privilege to control home appliances such as light, conditional system via Short Message Service (SMS) by using GSM.

9. CONCLUSION

This paper summarizes the development of Home Automation System using ARM7 LPC2148 board & GPRS/GSM. Our main objective is to develop the cost effective "IoT based Home Automation System" to enable automating the majority of electronic, electrical and technology-based tasks within a home to provide ease to the people to regulate their home appliances.

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Implemented prototype enabled the monitoring & controlling of home electronic & electrical devices using IoT concept. Hence the cost effective "IoT based Smart Home Automation System Using ARM7 LPC2148 & GSM/GPRS" has been successfully designed and tested. The next scope of our work will be connecting the more number of devices and various type of sensors as ARM7 LPC2148 have more number I/P pin comparative to other microcontroller such as Arduino, Raspberry Pi (B+) for enhancing safety, security and insure fully-automated of home appliances for better user experience.

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