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Wi-Fi Based Remotely Operated Smart Home Automated System using the Concept of Internet of Things

Swati Tiwari[1], Rahul Gedam[2]

PG Student [Digital Electronics], Dept. of ECE, Chouksey Engineering College, Bilaspur, Chhattisgarh, India[1]

H.O.D., Dept. of ECE, Chouksey Engineering College, Bilaspur, Chhattisgarh, India[2]

ABSTRACT: "Smart" word is becoming very popular these days. We have smart phones, smart TVs, smart homes and so on. The main idea behind the "smart" devices is that they can operate to some extent interactively and autonomously thereby helping people in managing the appliances freely and smartly. Based on this approach, a smart home automated system is designed by implementing related software and hardware. The paper proposes an implementation of IoT (Internet of Things) based smart home automated system to remotely control the home appliances using Wi-Fi. A low cost Wi-Fi module ESP8266 along with ATmega 328 MCU is used to build Smart Units. The user can remotely operate home appliances like lights, fan, door lock etc. through Telnet. The lights in any room can be controlled from any place in the house, within the wifi range, through telnet by using a single keyword. Arduino Pro mini is used as a compiler. Wi-Fi module ESP8266 follows some predefined AT command. Telnet will be connected with home access point using one IP address. So the concept of IoT is being used to make home smarter.

KEYWORDS: Home automation, Internet of things, Microcontroller, Wi-Fi module, Telnet.

I.INTRODUCTION

Internet of Things (IoT) is extension of current internet to provide communication, connection, and internetworking between various devices or physical objects also known as "Things". IoT term represents a general concept for the ability of network devices to sense and collect data from the world around us, and then share that data across the Internet where it can be processed and utilized for various interesting purposes.[1]The Internet of things can be defined as connecting the various types of objects like smart phones, personal computer and tablets to internet, which brings in very newfangled type of communication between things and people and also between things [2]. With the introduction of IoT, the research and development of home automation are becoming popular in the recent days.

Home automation system represents and reports the status of the connected devices in an intuitive, user-friendly interface allowing the user to interact and control various devices with the touch of a few buttons. Some of the major communication technologies used by today's home automation system include Bluetooth, Wi-MAX and Wireless LAN (Wi-Fi), ZigBee, and Global System for Mobile Communication (GSM) [3].Here we are using Wi-Fi module. It offers the user complete access control of the appliances through a remote interface. Automation is the use of control systems and information technology to control equipment, industrial machinery and processes, reducing the need for the human intervention [4].

The wide variety of potential IoT applications need a software development environment that ties together the applications, the command, control and routing process and the security of the node and system. While the importance of software in MCU solutions has increased during the past few years, for MCUs supporting the IoT, even more software, tools and enablement will be needed. [4] A broad ecosystem with easily accessible support is the key to enable the development of embedded processing nodes and IoT applications. [5]

II.SYSTEM OVERVIEW

In this section an elaborated design of proposed home automation system and the components used in it is presented.

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2.1 SYSTEM ARCHITECTURE

In this work we will design a system which is based on Home automated system using internet of things concept. Here for communication point of view we are using Wi-Fi module Esp8266 which is worked on AT command set. Basically we are using TCP protocols for communicating with telnet.

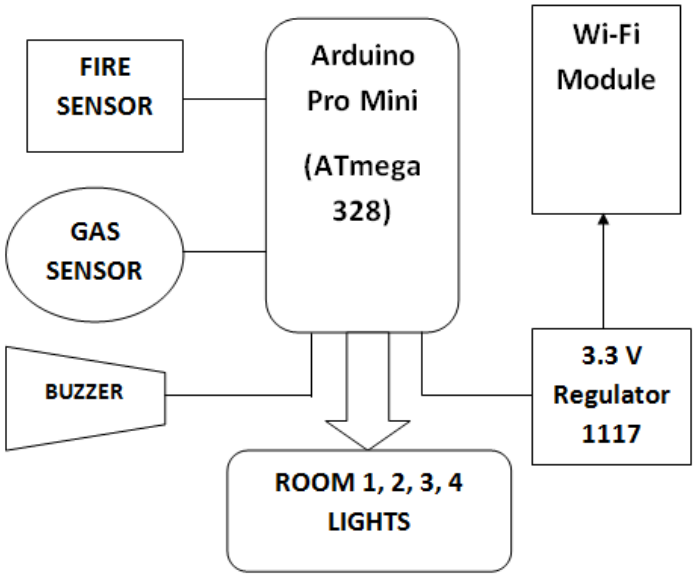

Fig. 1 Home automated system block diagram

2.2 SYSTEM COMPONENTS

Arduino Pro Mini: The Arduino Pro Mini is an ATmega168 based microcontroller board. The board comes with built-in arduino bootloader. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 8 analog inputs, an on-board resonator, a reset button, and holes for mounting pin headers. The board can be connected to the PC using USB port and the board can runs on USB power. There are two version of the Pro Mini. One runs at 3.3V and 8 MHz, the other at 5V and 16 MHz

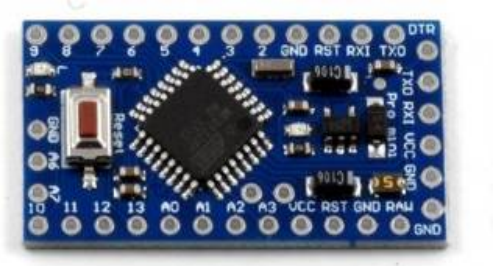

Fig. 2 Arduino Pro Mini Board

Wi-Fi Module (ESP8266): The ESP8266 WiFi Module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware. The ESP8266 module is an extremely cost effective board with a huge, and ever growing, community.

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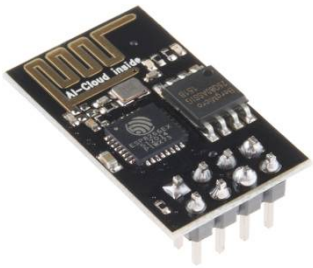

Fig. 3 Wi-Fi Module (ESP8266 ESP01)

GAS SENSOR (MQ-2): Gas Sensor (MQ2) module is useful for gas leakage detection (in home and industry). It is suitable for detecting H2, LPG, CH4, CO, Alcohol, Smoke or Propane. Due to its high sensitivity and fast response time, measurements can be taken as soon as possible. The sensitivity of the sensor can be adjusted by using the potentiometer.

Fig. 4 GAS sensor (MQ-2)

FIRE SENSOR: The Fire sensor is used to detect fire flames. The module makes use of Fire sensor and comparator to detect fire up to a range of 1 meter.

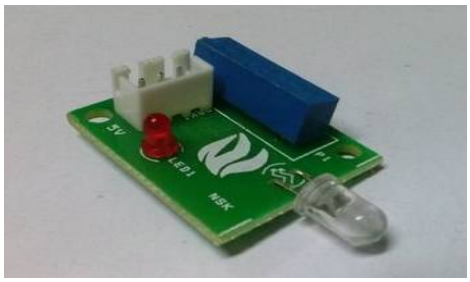

Fig. 5 Fire sensor

Regulator 3.3V (AMS1117): The AMS1117 series of adjustable and fixed voltage regulators are designed to provide up to 1A output current and to operate down to 1V input-to-output differential. The dropout voltage of the device is guaranteed maximum 1.3V, decreasing at lower load currents.
Buzzer: Piezo buzzers are used for making beeps, tones and alerts. This one is petite but loud! Drive it with 3-30V peak-to-peak square wave. To use, connect one pin to ground and the other pin to microcontroller.

III.SYSTEM IMPLEMENTATION

This section deals with the implementation of the proposed system that includes hardware design connecting various components and software requirements for the system.

3.1 HARDWARE DESIGN:

Interfacing of GAS Sensor with Arduino Pro Mini: Gas sensor has 4 pins, V_{cc}, Ground, Analog and digital output. To interface Gas sensor with Arduino pro mini connect as given below:

- Vcc to Arduino 5V pin

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- GND to Arduino GND pin
- Output to Arduino Analog A0 pin

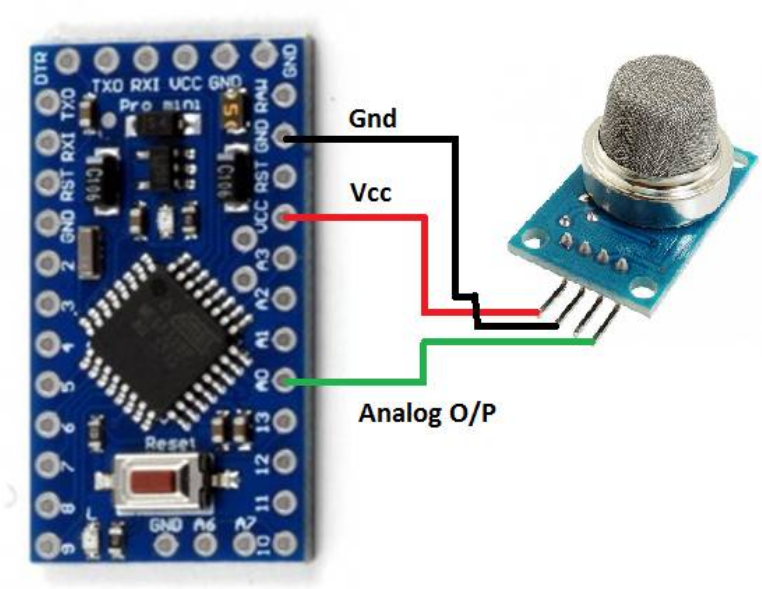

Fig. 6 Gas sensor interface with Arduino pro mini

Interface FIRE Sensor with Arduino Pro Mini: Fire sensor has 3 pins. Vcc, Ground, Output pins. To interface FIRE sensor with Arduino pro mini connect as given below:

- Vcc to Arduino 5V pin
- GND to Arduino GND pin
- Output to Arduino Analog A2 or any digital pin

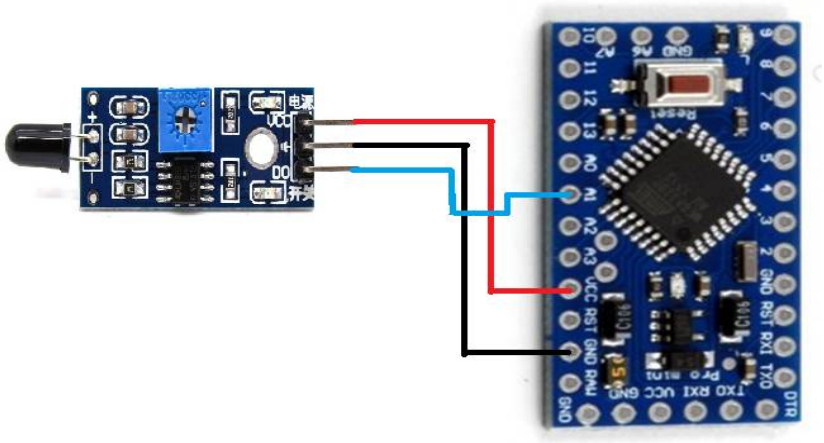

Fig. 7 Fire sensor interface with Arduino pro mini

Interface Wi-Fi Module with Arduino Pro Mini

The connection between Arduino and ESP is very simple: ESP8266-Rx goes to Arduino Tx, ESP-8266 Tx goes to Arduino Rx. Connections are shown in figure below:

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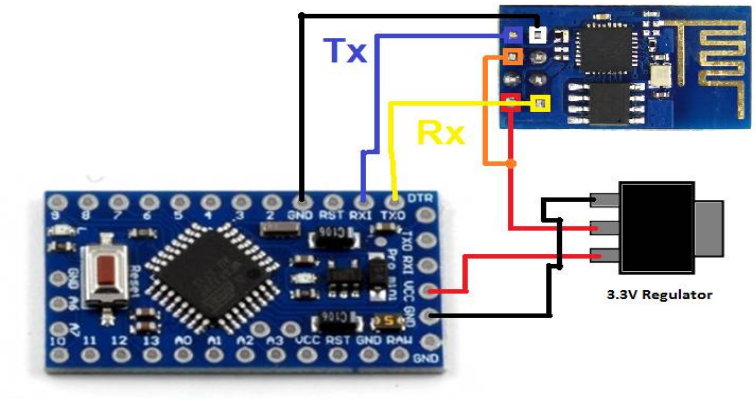

Fig. 8 Interface Wi-Fi Module with Arduino Pro Mini

After interfacing sensors and Wi-Fi module with Arduino pro mini, we will connect buzzer and LEDs as an individual room lights with Arduino pro mini. So here our hardware part is finish. In below figure full hardware interfacing is shown:

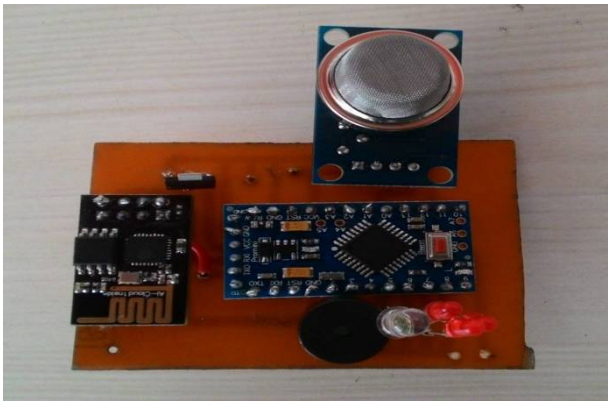

Fig. 9 Final Prototype Hardware

3.2 SOFTWARE DESIGN: First download the Arduino software IDE from Arduino official website. After downloading the software, install it in your system. Here we will write the code for the home automated system and the code is uploaded in ATmega 328 controller.

Upload Code in ATmega 328 using Arduino UNO:

STEP 1: Very carefully remove the Atmel IC from the Arduino UNO, the pins are very gentle so be very careful.
STEP 2: Following connections are made:
Arduino UNO's pin 5v -> Pro mini's main VCC pin
Arduino UNO's pin GND -> Pro mini's main GND
Arduino UNO's pin RX -> Pro mini's RXI,
Arduino UNO's pin TX -> Pro mini's TX0,
Arduino UNO's RESET -> Pro mini's RST
STEP 3: Now open Arduino software in system and select the Board from Tools Menu as follows: Tools>Board>Arduino/Geniuno Uno
STEP 4: Select COM port of Arduino USB cable from Tools>Serial Port>COM3 option.

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STEP 5: Click on verify and then upload the code.After upload the final code we will give power supply through USB cable and check out all the hardware getting power supply or not.
Following keywords are used in the proposed system. We take four rooms light like HALL LIGHT, BED ROOM LIGHT, KIDS ROOM LIGHT and OUTSIDE LIGHT as LEDs. User can control these four lights using single key or sign.
% -> BEDROOM LIGHT ON
$ -> HALL LIGHT ON
^ -> KIDSROOM LIGHT ON
| -> OUTSIDE LIGHT ON
! -> BEDROOM LIGHT OFF
@ -> HALL LIGHT OFF
# -> KIDSROOM LIGHT OFF
[-> OUTSIDE LIGHT OFF

IV. RESULT ANALYSIS

Using telnet application we can communicate with our appliances. Following are the screenshot taken from mobile phone of the Telnet application.As shown in fig. 10 below, write IP address and port in application it will connect with Wi-Fi. So according to special keyword user can easily operate the lights of all rooms.

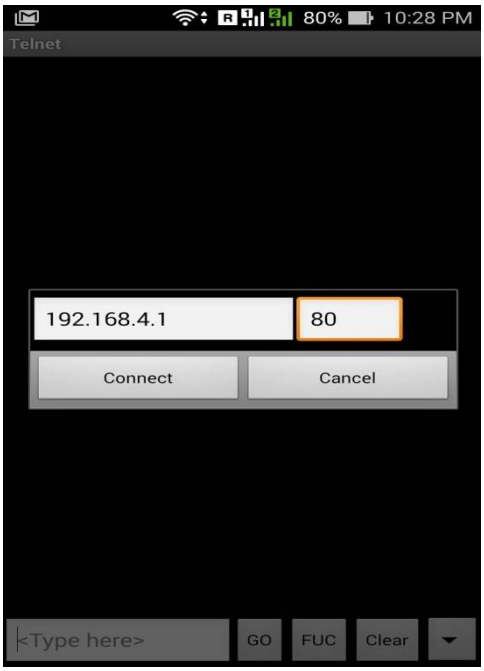

Fig. 10 Connecting to Wi-Fi to Telnet

Following are the screenshots of the result being obtained by pressing different keywords. When % is entered we get the notification on the mobile app and the corresponding LED lights up. It is shown in fig. 11 below:

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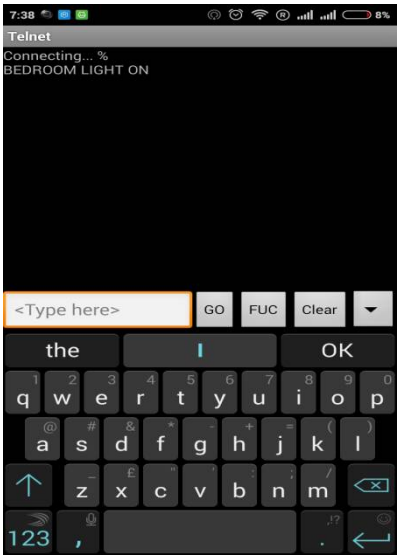

Fig. 11 Result obtained on pressing % in Telnet App

Similarly by pressing $ ^ and | all the LEDs were on. This condition is shown in fig. 12 as follows:

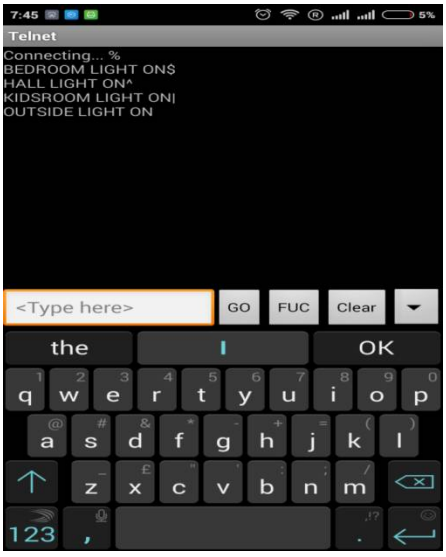

Fig. 12 Result obtained when $ ^ | are pressed.

Similarly all four LEDs are turned off one by one by using @ & # and [keywords.

In the same way the system is checked for any gas leakage and fire and we get an alert on the Telnet application along with the sound of buzzer. A similar notification is obtained in case nearby fire is detected. It is shown in fig. 13 for both the cases.

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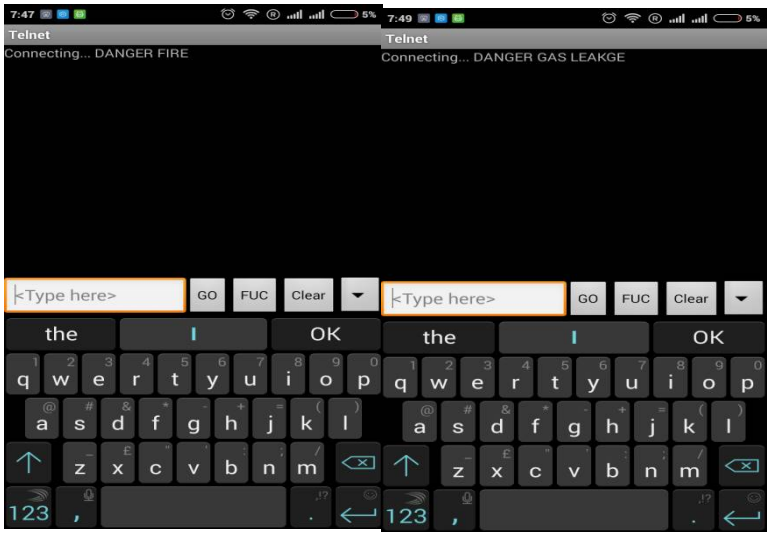

Fig. 13 Screenshot of Telnet app showing notification received in case of fire or gas detection.

V. CONCLUSION

In this work we presented a model of Wi-Fi Based Remotely Operated Smart Home Automated System using the Concept of Internet of Things. As we saw the device got connected with cloud and was operated remotely through a mobile application. Here we tried to reduce the cost issue with proper connectivity and some good features like notification and some basic home control system requirement. This proposed model has a wide variety of applications such as in home automation System, Hospital Automated System and so on. It also has a number of advantages like faster and efficient system, reduces human effort reduces delays and increases efficiency. There are a lot of features that can be added to the presently designed system. As IoT is growing day by day we can see that such smart devices will also grow.

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