Smart Home Automation System based on Bluetooth (Android Platform)

Problem Statement/Description of System Functionality

- This project aims to develop a smart home automation system wherein general electrical home appliances and emergency alert systems are interfaced and controlled wirelessly via Bluetooth of an Android-based smartphone.
- The smartphone-based GUI provides the user, the ease and comfort of controlling one's home in the palm of their hands.
- The GUI has buttons on it to give control of lights (LEDs), analogous to physical switches. Moreover, the system also provides the feedback of the current status of each of the LEDs, whether it is ON or OFF.
- The system also consists of a smoke sensor, which triggers an alarm on the connected smartphone and alerting the user, if it detects presence of gases/smoke beyond safety limits.

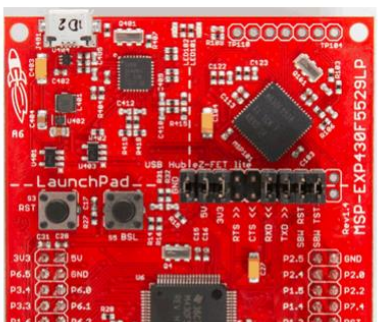
Hardware Components

1. MSP430F5529 Microcontroller (Launchpad)

- The MSP430F5529 belongs to TI MSP430 family of ultra-low-power microcontrollers which consists of several devices featuring peripheral sets targeted for a variety of applications. The architecture, combined with extensive low-power modes, is optimized to achieve extended battery life in portable measurement applications. The microcontroller features a powerful 16-bit RISC CPU, 16-bit registers, and constant generators that contribute to maximum code efficiency. The digitally controlled oscillator (DCO) allows the devices to wake up from low-power modes to active mode in 3.5 µs (typical).
- The MSP430F5529 microcontroller has integrated USB and PHY supporting USB 2.0, four 16-bit timers, a high-performance 12-bit analog-to-digital converter (ADC), two universal serial communication interfaces (USCI), a hardware multiplier, DMA, a real-time clock (RTC) module with alarm capabilities, and 63 I/O pins.
- Typical applications include analog and digital sensor systems, data loggers, and others that require connectivity to various USB hosts

Key Features

- USB-enabled MSP430F5529 16-bit MCU



- Up to 25-MHz System Clock
- 1.8-V to 3.6-V operation
- 128KB of flash, 8KB of RAM
- Five timers
- Up to four serial interfaces (SPI, UART, I 2C)
- 12-bit analog-to-digital converter
- Analog comparator
- Integrated USB, with a complete set of USB tools and libraries

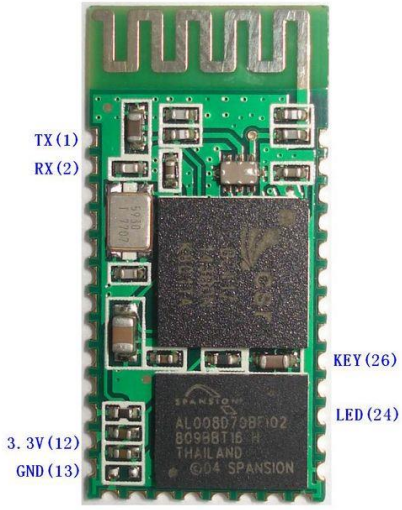
The MSP430 LaunchPad™ Development Kit Datasheet.

2. **Bluetooth Transceiver HC-06**

Serial port bluetooth, Drop-in replacement for wired serial connections, transparent usage. Simple usage for a serial port replacement to establish connection between MCU and GPS/Mobile phones, PC to embedded projects and etc.

Key Features

- Bluetooth protocol: Bluetooth Specification v2.0+EDR
- Frequency: 2.4GHz ISM band
- Modulation: GFSK(Gaussian Frequency Shift Keying)
- Speed: Asynchronous: 2.1Mbps(Max) / 160 kbps Synchronous: 1Mbps/1Mbps
- Security: Authentication and encryption
- Power supply: +3.3VDC 50mA
- Working temperature: -20 ~ +75 Centigrade
- Slave, 9600 baud rate



The Bluetooth Transceiver HC-06 Datasheet

3. **MQ2 Smoke Sensor**

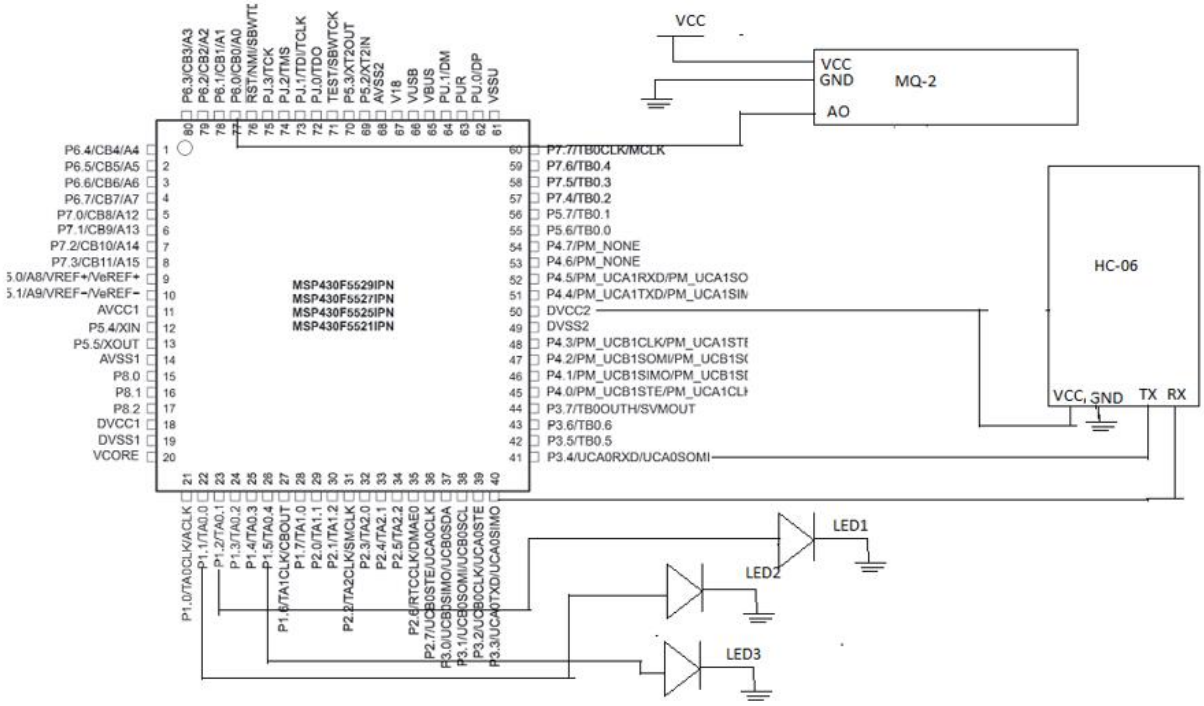
This flammable gas and smoke sensor detects the concentrations of combustible gas in the air and outputs its reading as an analog voltage. The sensor can measure concentrations of flammable gas of 300 to 10,000 ppm. The sensor can operate at temperatures from -20 to 50°C and consumes less than 150 mA at 5 V.

Key Features

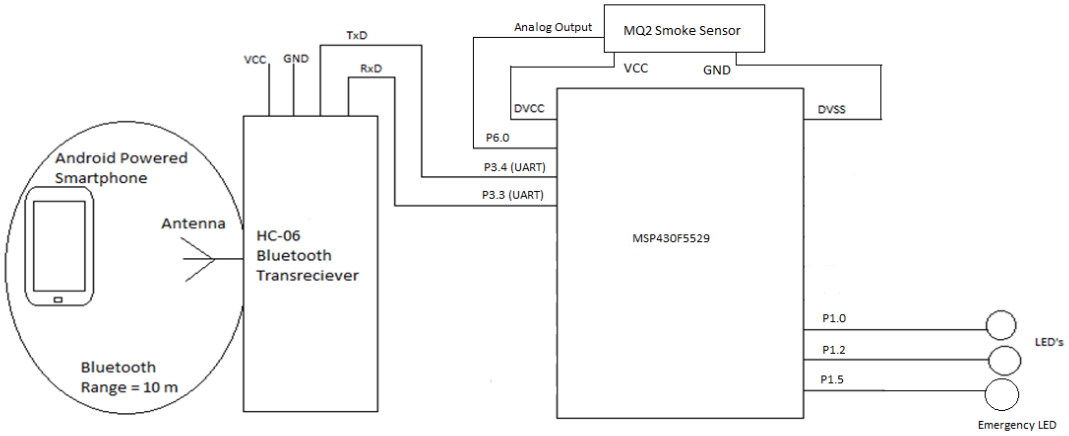
- Wide detecting scope
- Fast response and
- High sensitivity
- Simple drive circuit

The [MQ2 Datasheet]

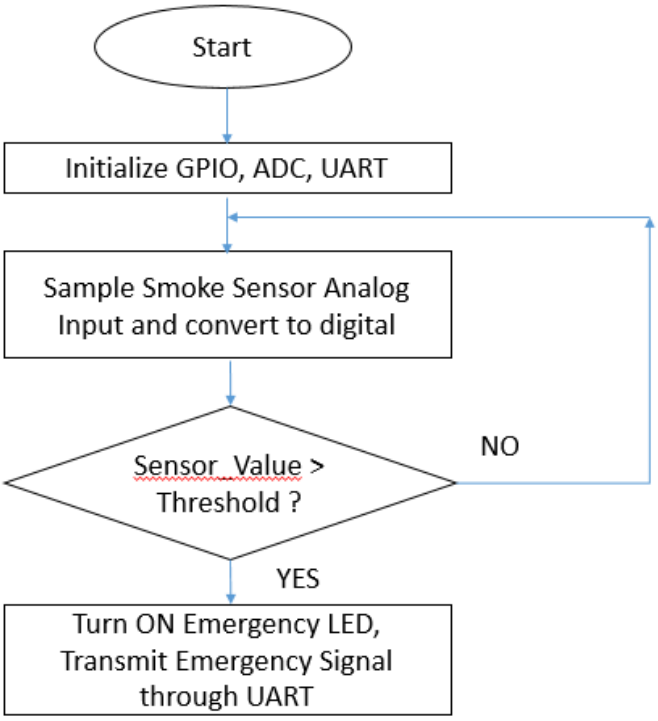
Hardware Schematic Diagram



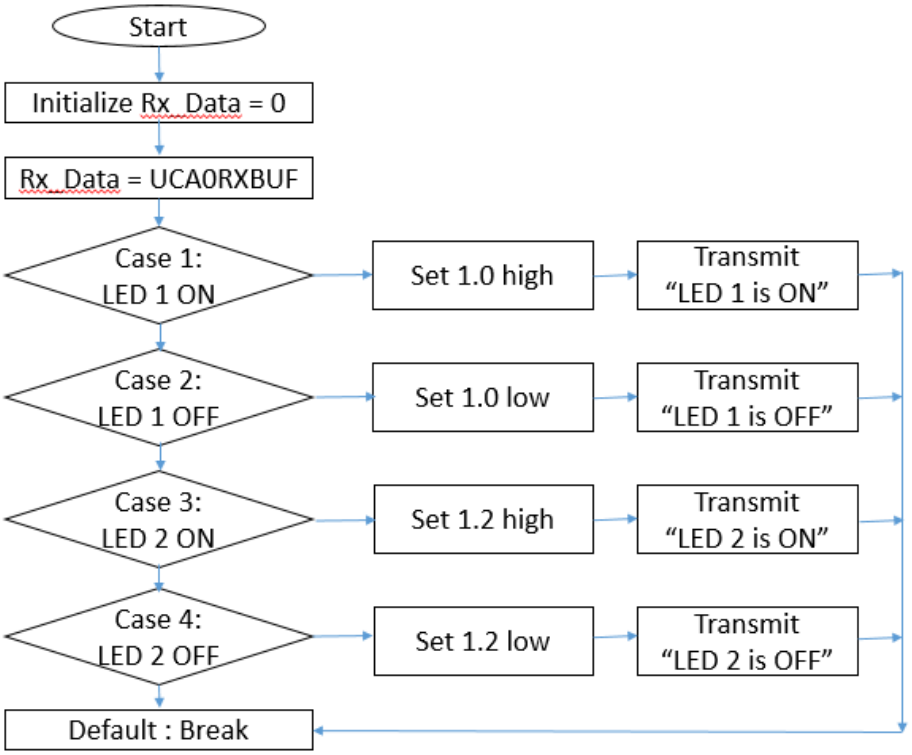
Hardware Logic Diagram



1: Software Flow Diagram (MSP430 Main)

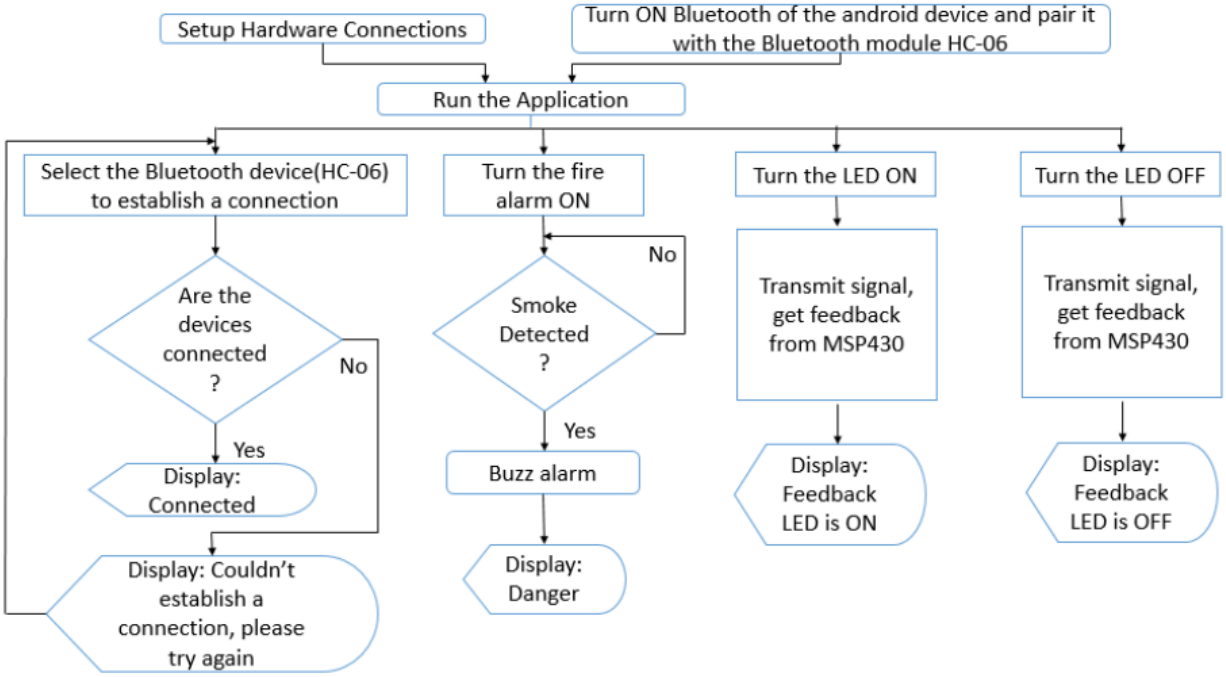


2: Software Flow Diagram (MSP430 UART ISR



Project Setup: Hardware – Software Integration

Issues Encountered



- Issue – The in-built Digital output pin on MQ-2 sensor malfunctioned
- Resolution – Used the Analog output pin instead, then used MSP's in-built ADC to convert into digital value

Future Scope

We can interface many other sensors to this system which are normally found in a modern home control system, including but not limited to, temperature sensor, intrusion detection sensors, etc. In our prototype we controlled LEDs indicative of lights and appliances in a home. The same logic can be further enhanced by controlling AC appliances using AC relays and switches. This system can also be controlled by integrating voice commands from the user, which can be captured on his/her smartphone device and then forwarded to the microcontroller. This further enhances the ease of controlling one's home through a smartphone device.

Conclusions

The project is successful in controlling multiple lights (LEDs) based on the buttons pressed by the user on his/her smartphone GUI. It also acquires feedback from the MSP430 about the current status of a light, whether it is ON or OFF, for each of the lights individually, and then displays it on the GUI. The Fire alarm system is based on the detection of smoke and/or gases by the MQ2 Gas sensor. The MSP430 sends an emergency signal to the smartphone, in case of detection of gases/smoke beyond safety limits, which triggers an alarm on the smartphone device alerting the user of the emergency. Thus, the system is capable of functioning as a modern home automation system with easy-to-use GUI on one's smartphone.