HOME SAFETY AND DISASTER PREPAREDNESS MODULE USING ARM

MTech. Embedded Systems

16ES612: Embedded processor Architecture and Design

Mini Project Report

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ABSTRACT

The surveillance of home or industrial places through sensors and the prevention of problems via prediction are of vital importance for the safety of these areas. This project shows how to increase wireless sensor techniques by composing new design methods and improved a low-cost industrial and home safety systems. So as to guarantee and present accurate solutions to the system, where temperature, gas and passive infrared sensors are used. All these sensors communicate to a central node which will thereafter cut the power supply, cut the gas supply, activate an alarm or a sprinkler according to the sensors results. Also, we are using cloud-based monitoring of the information obtained from the weather agency to alert the people in the house through alarm and take included actuations like informing the necessary emergency contacts through SMS and cutting off power or gas supply according to the input obtained. A panic button is provided to raise a flag for emergency situations inside the house.

INTRODUCTION

Home safety begins with making an assessment of your property to see what safety measures are needed to make it a safer environment for your children. Your home safety assessment should take into account every area of your home to include bathrooms, kitchen, patio and yard.

Every year, over a million children suffer home accidents requiring hospital care in the UK alone. Children under the age of 5 are considered most at risk. However, parents should be conscious of danger areas in their home that can cause any of their kid's harm.

Child proofing a home makes it a safer environment for kids to explore. By making a home safety checklist, you'll get a better idea of how to establish a child friendly home. The following home safety tips create greater awareness of potential dangers in the home. They also offer preventative measures that can be taken to improve safety at home.

Accidental injuries that occur at home account for around 45 percent of these deaths. Some of the more common types of injuries that happen at home include falls, suffocation, poisoning,

burns, drowning, fire arm accidents and choking. Whether a child is at home alone or with adults present, injuries can still happen. It's time to work together to prevent these accidents from happening. One of the best ways to make sure that your home is safe is to actively inspect each room for potential hazards. Frequent inspections, along with having a plan for what to do in case of an emergency, are your best tools for preventing injury and death in your home.

BLOCK DIAGRAM

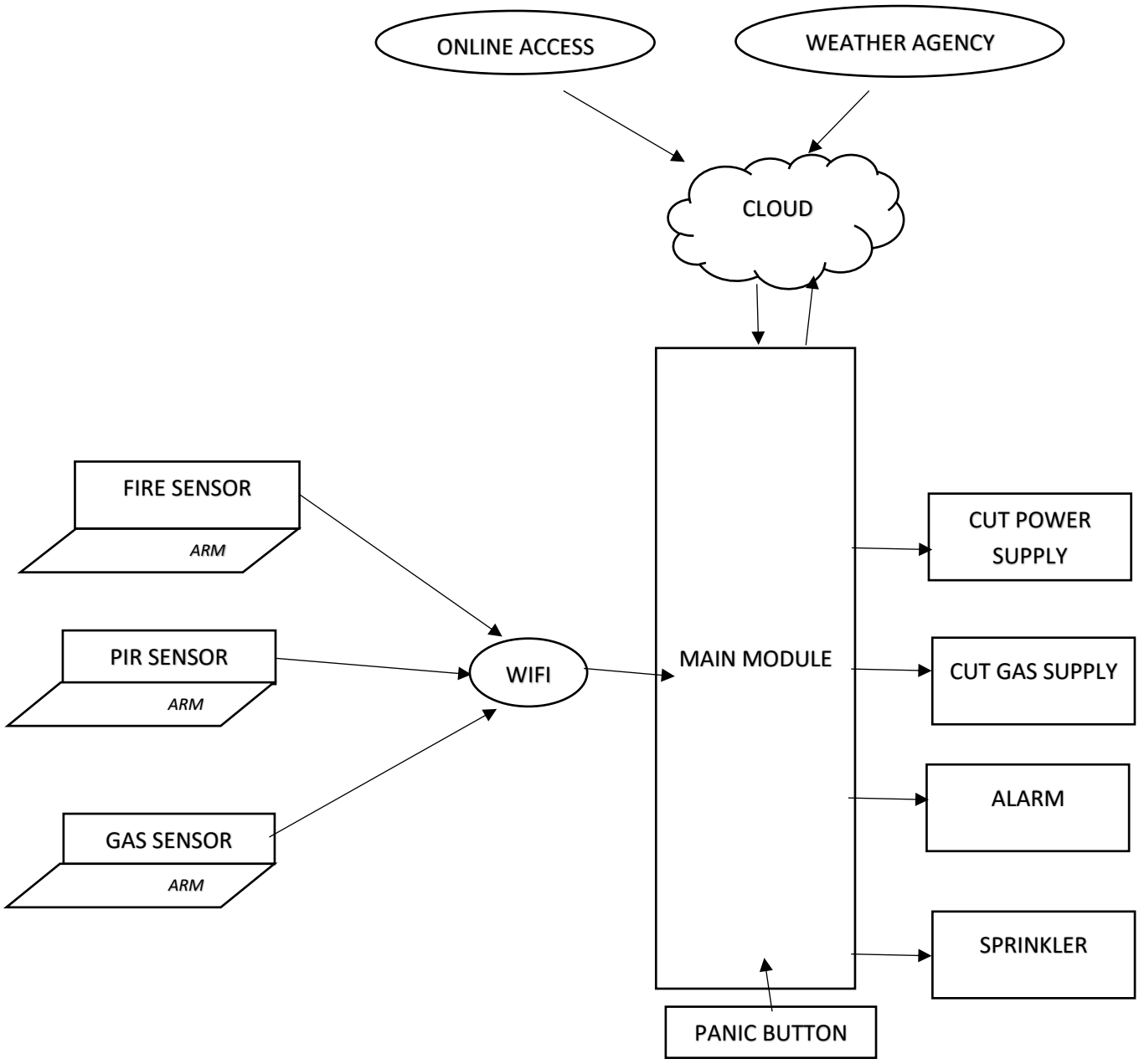
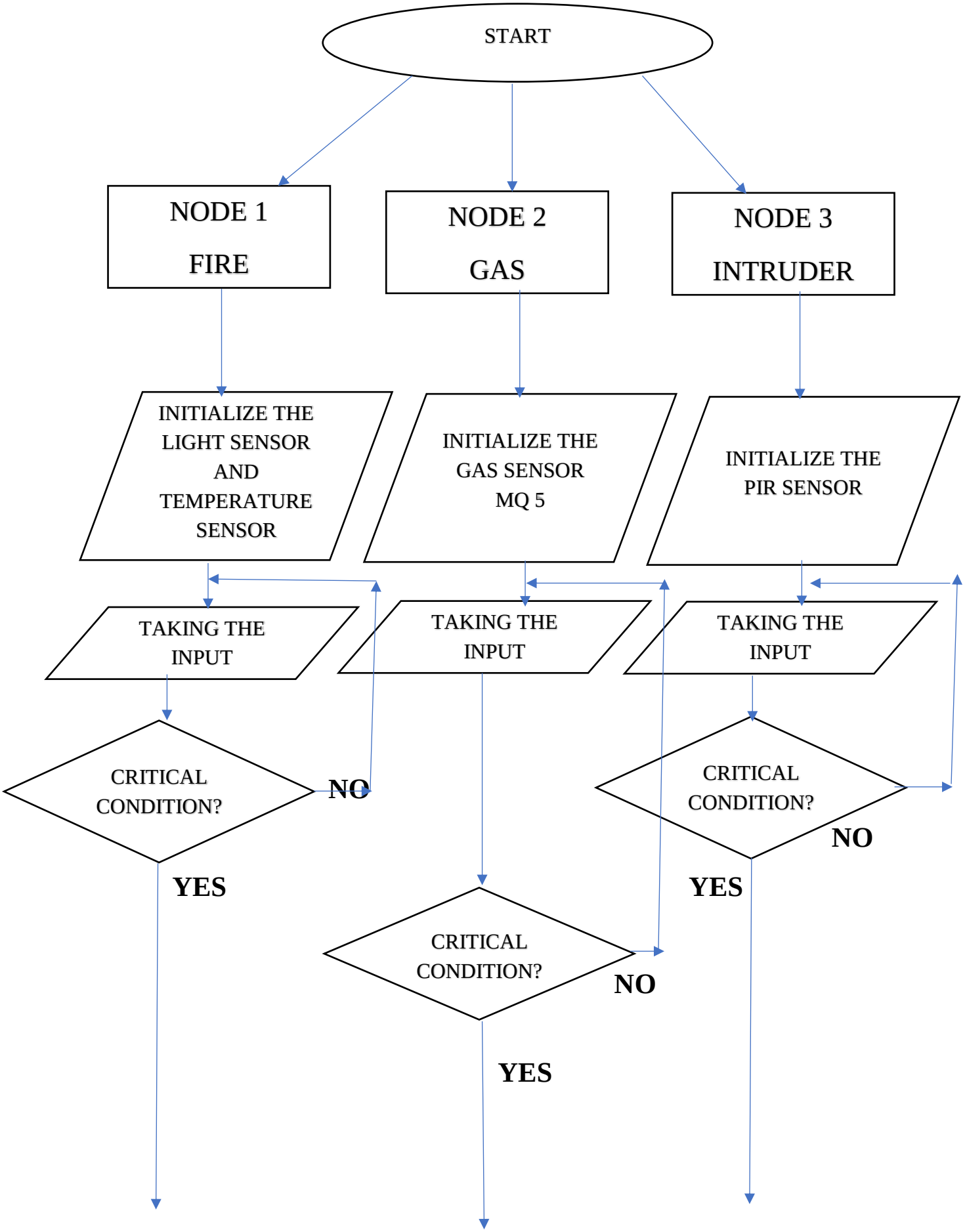


Fig 1: Block Diagram

The microcontroller used in this project is ARM LPC2148.There are four nodes and each node consist of one LPC2148. Among the four nodes, one node does the fire monitoring, one does the gas monitoring, one does the intruder check and the final node does all the actuation. A digital flame sensor along with an analog temperature sensor LM35 is used to monitor the fire in the first node. A gas sensor MQ 5 is used to monitor the LPG gas produced in the room in the second node. A PIR sensor is used in the third node to check the presence of intruder in the room. According to the results produced from the sub nodes, they are communicated to the the main node through WIFI module ESP8266. The receiver module receives all these values and does the required actuation. For a fire alert it turns on the sprinkler, cuts the gas supply and displays a fire alert message. For a gas leakage it cuts the gas supply and displays the message that the gas leakage has occurred. For an intruder alert, an alarm is turned on and an intruder message is displayed in LCD.

FLOWCHART


START
NODE 1
FIRE
NODE 2
GAS
NODE 3
INTRUDER
INITIALIZE THE LIGHT SENSOR AND TEMPERATURE SENSOR
INITIALIZE THE GAS SENSOR MQ 5
INITIALIZE THE PIR SENSOR
TAKING THE INPUT
TAKING THE INPUT
TAKING THE INPUT
CRITICAL CONDITION?
NO
YES
CRITICAL CONDITION?
NO
YES
CRITICAL CONDITION?
NO
YES

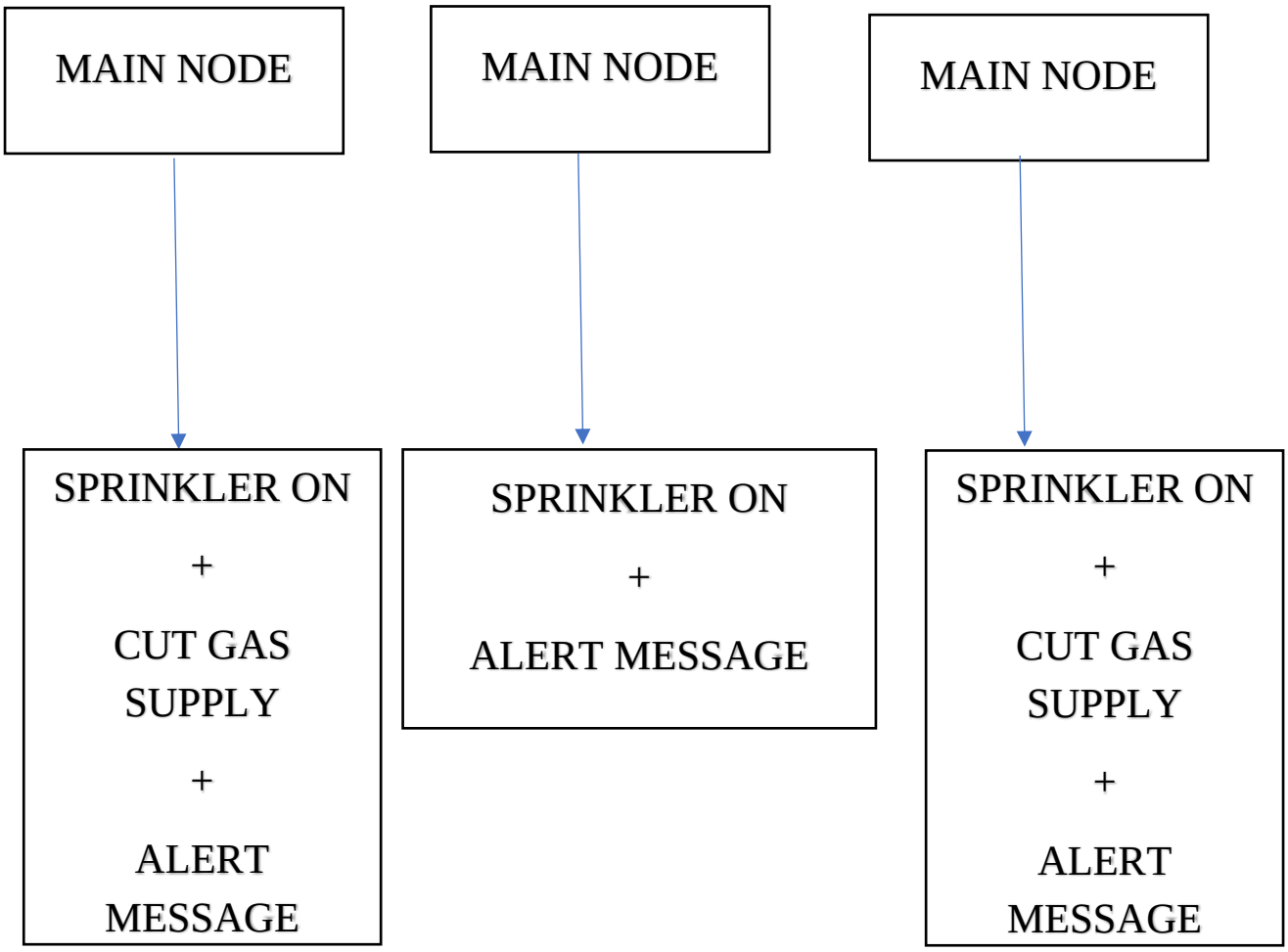


Fig 2: Flow Chart

HARDWARE DESCRIPTION AND INTERFACING

1. ARM LPC2148

Lpc is a family of 32-bit micro controller integrated circuits by NXP Semiconductors. 8 to 40 kB of on-chip static RAM and 32 to 512 kB of on-chip flash program memory.128-bit wide interface/accelerator enables high speed 60 MHz operation. • In-System/In-Application Programming (ISP/IAP) via on-chip boot-loader software. Single flash sector or full chip erase in 400 ms and programming of 256 bytes in 1ms. • Embedded ICE RT and Embedded Trace interfaces offer real-time debugging with

theon-chip Real Monitor software and high speed tracing of instruction execution.
• One or two (**LPC2141/2 vs. LPC2144/6/8**) 10-bit A/D converters provide a total of 6/14analog inputs, with conversion times as low as 2.44 us per channel.
• Single 10-bit D/A converter provides variable analog output.
• Two 32-bit timers/external event counters (with four capture and four compare channels each), PWM unit (six outputs) and watchdog.
• Low power real-time clock with independent power and dedicated 32 kHz clock input.
• Multiple serial interfaces including two UARTs (16C550), two Fast I2C-bus(400 Kbit/s), SPI and SSP with buffering and variable data length capabilities.
• Vectored interrupt controller with configurable priorities and vector addresses.
• Up to 45 of 5 V tolerant fast general purpose I/O pins in a tiny LQFP64 package.
• Up to nine edge or level sensitive external interrupt pins available.
• On-chip integrated oscillator operates with an external crystal in range from 1 MHz to30 MHz and with an external oscillator up to 50 MHz
• Power saving modes include Idle and Power-down.
• Processor wake-up from Power-down mode via external interrupt, USB, Brown-Out Detect (BOD) or Real-Time Clock (RTC).

LPC2138/48 mini development board from rhydolabz is an easy to handle, general purpose development board built around LPC2138/48 (microcontroller based on ARM7TDMI-S CPU) and related peripherals. The board is designed with a variety of hardware to exercise LPC2138/48 microcontroller peripherals. Mini Bread board is also provided to ease the use. Ideally suitable for training and development purposes.

Fig 3: LPC2148

2. PASSIVE INFRARED SENSOR

PIR sensors allow you to sense motion, almost always used to detect whether a human has moved in or out of the sensors range. They are small, inexpensive, low-power, easy to use and don't wear out. For that reason, they are commonly found in appliances and gadgets used in homes or businesses. They are often referred to as PIR, "Passive Infrared", "Pyroelectric", or "IR motion" sensors.

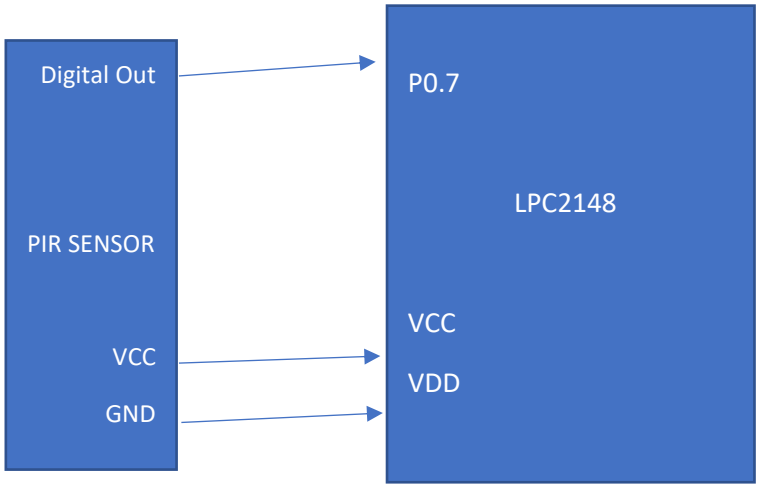


Fig 5: Interfacing PIR sensor with LPC2148

PIRs are basically made of a pyroelectric sensor (which you can see below as the round metal can with a rectangular crystal in the centre), which can detect levels of infrared radiation. Everything emits some low-level radiation, and the hotter something is, the more radiation is emitted. The sensor in a motion detector is actually split in two halves. The reason for that is that we are looking to detect motion (change) not average IR levels. The two halves are wired up so that they cancel each other out. If one half sees more or less IR radiation than the other, the output will swing high or low.

Fig 6: PIR Sensor

3. GAS SENSOR MQ5

Fig 6: MQ5

The Grove - Gas Sensor(MQ5) module is useful for gas leakage detection (in home and industry). It is suitable for detecting H2, LPG, CH4, CO, Alcohol. 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.

- Wide detecting scope
- Stable and long life
- Fast response and High sensitivity

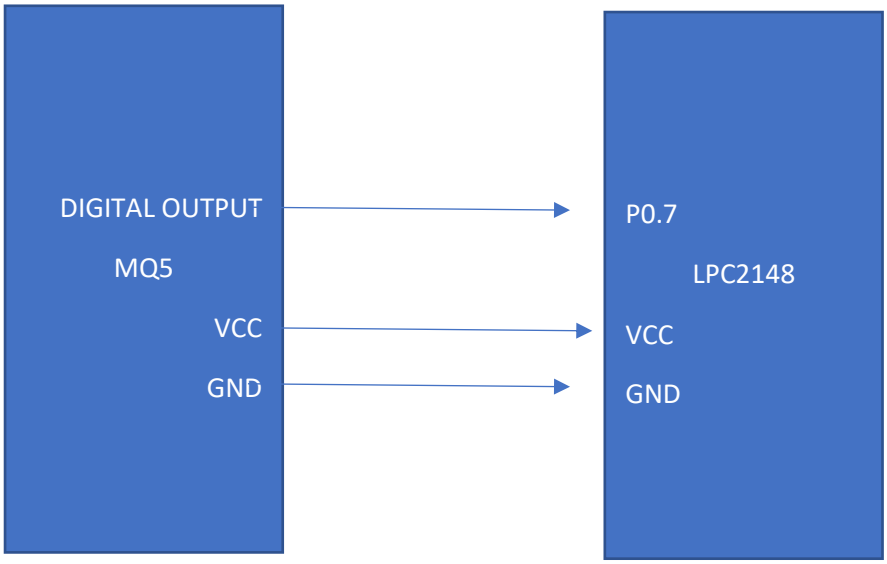


Fig 7: Interfacing MQ 5 with LPC2148

4. FLAME SENSOR

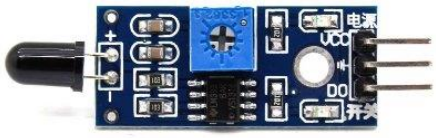


Fig 8: Flame Sensor

Flame Sensor can be used to detect fire source or other light sources of the wavelength in the range of 760nm - 1100 nm. It is based on the YG1006 sensor which is a high speed and high sensitive NPN silicon phototransistor. Due to its black epoxy, the sensor is sensitive to infrared radiation. In firefighting robot game, the sensor plays a very important role, it can be used as a robot eyes to find the fire source.

- Grove Interface
- High Photo Sensitivity
- Fast Response Time
- Easy to use
- Sensitivity is adjustable

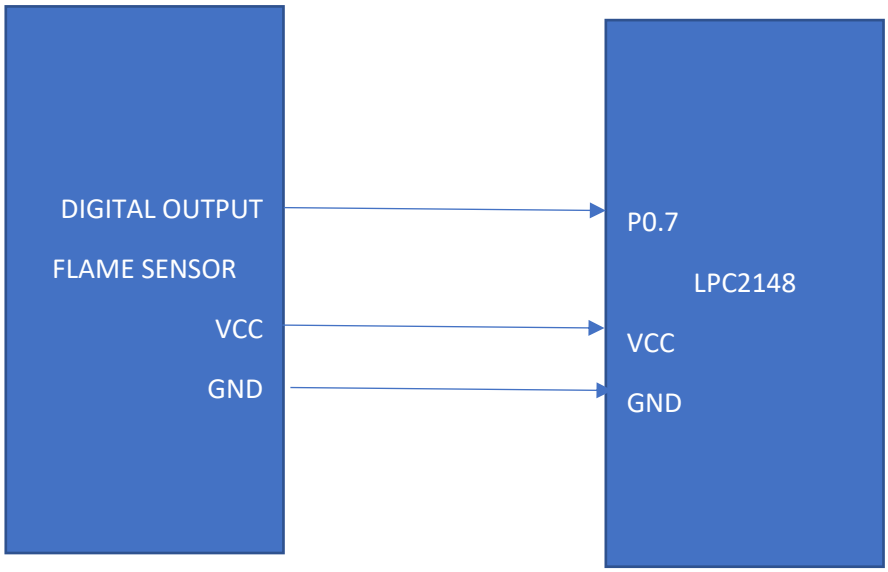


Fig 8: Flame Sensor

5. ESP8266

The ESP8266 is a low-cost Wi-Fi microchip with full TCP/IP stack and microcontroller capability produced by Shanghai-based Chinese manufacturer, Espressif Systems. 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.

The ESP8266EX microcontroller integrates a Tensilica L106 32-bit RISC processor, which achieves extra-low power consumption and reaches a maximum clock speed of 160 MHz The Real-Time Operating System (RTOS) and Wi-Fi stack allow about 80% of the processing power to be available for user application programming and development.

Fig 9: ESP8266

6. SOLENOID VALVE

A solenoid valve is an electromechanically operated valve. The valve is controlled by an electric current through a solenoid: in the case of a two-port valve the flow is switched on or off; in the case of a three-port valve, the outflow is switched between the two outlet ports. Multiple solenoid valves can be placed together on a manifold.

Solenoid valves are the most frequently used control elements in fluidics. Their tasks are to shut off, release, dose, distribute or mix fluids. They are found in many application areas.

Solenoids offer fast and safe switching, high reliability, long service life, good medium compatibility of the materials used, low control power and compact design.

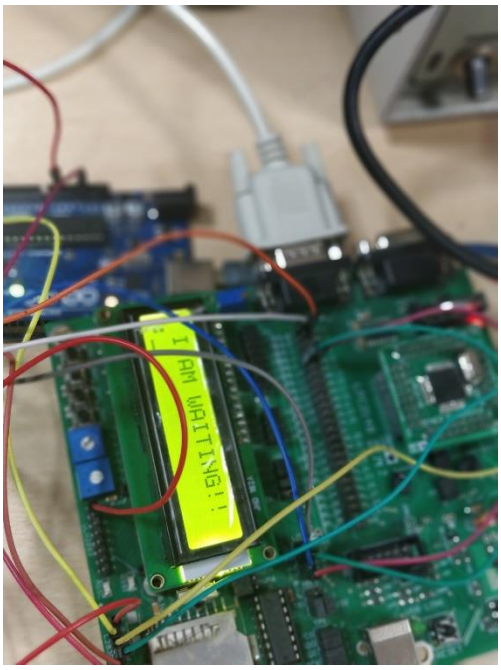
Fig 10: Solenoid Valve

7. DC MOTOR

A DC motor is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current flow in part of the motor.

DC motors were the first type widely used, since they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings. Small DC motors are used in tools, toys, and appliances. The universal motor can operate on direct current but is a lightweight motor used for portable power tools and appliances. Larger DC motors are used in propulsion of electric vehicles, elevator and hoists, or in drives for steel rolling mills. The advent of power electronics has made replacement of DC motors with AC motors possible in many applications.

RESULTS AND DISCUSSION



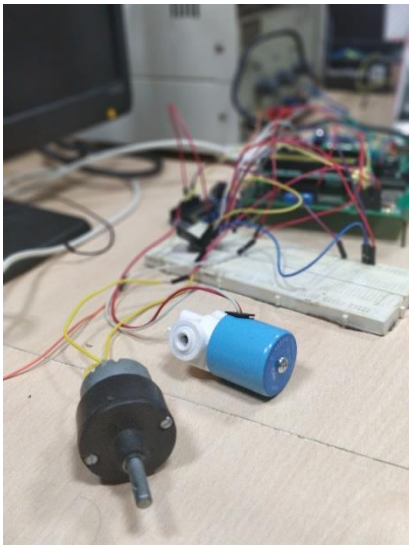


Fig 11: Main Actuator Node

Different scenarios were considered and all the desired actuations were obtained. The fire alert message was successfully send from the fire node to the main node and a sprinkler is turned on and the gas supply is cut. For the gas alert from the gas node, the gas supply was cut in the main node and in case of an intruder, an alert message is send from the intruder node to the main node and in the main node a buzzer is turned on.

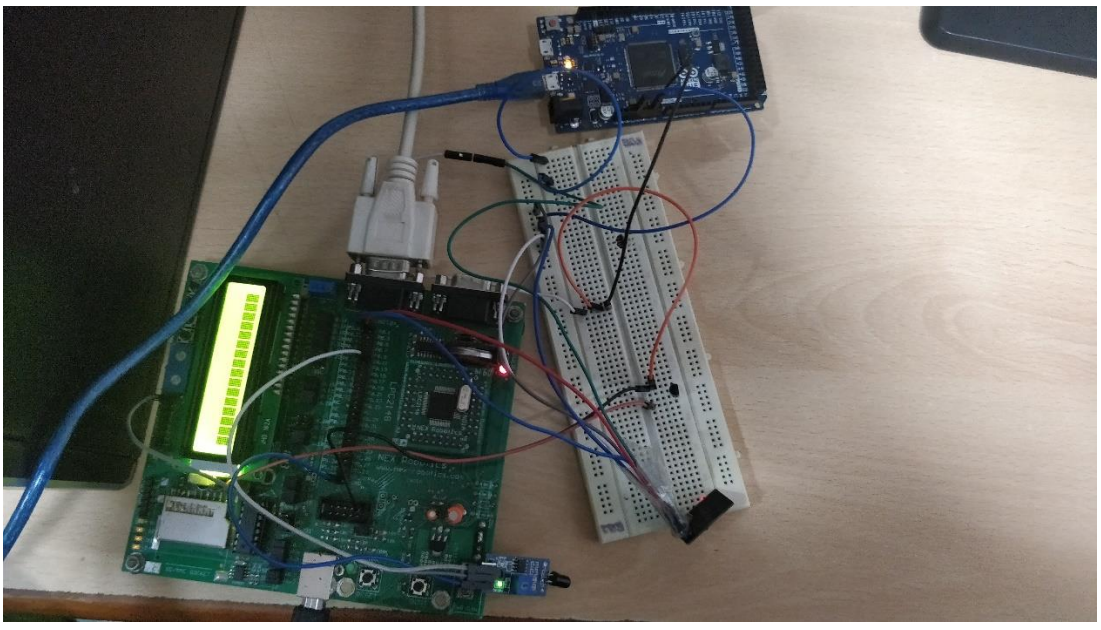


Fig 12: Fire Monitoring Node

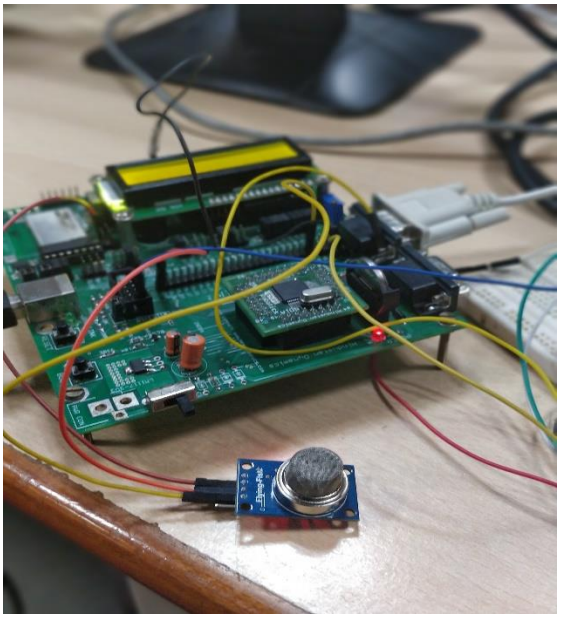


Fig13: Gas Monitoring Node

Fig14: Intruder Monitoring Node

CONCLUSION

This is capable of sensing all the all the threshold values of the sensors involved in different nodes and transmits messages corresponding to the different scenarios like fire alert, gas leakage and intruder alert using WIFI modems. The sink nodes receive all these messages and does the required actuation in the main node.