Smart Home

ITI – Summer Training

Final Project

Team Members

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Agenda

1. Introduction
2. Microcontroller 1
3. Microcontroller 2
4. Microcontroller 3
5. Simulation

Introduction

Introduction

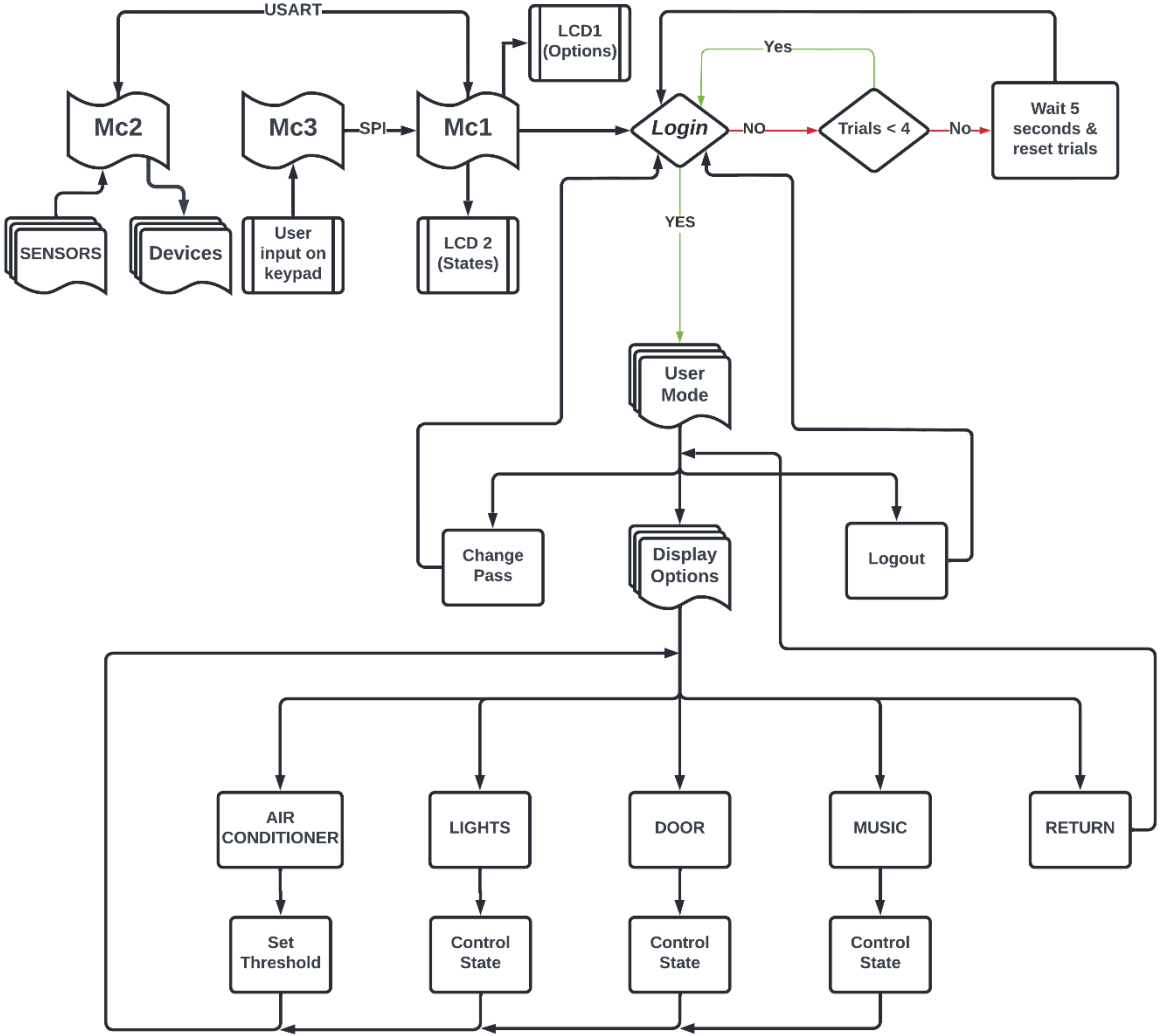
- This is a Smart Home project based on three atmega32 microcontrollers.

- These microcontrollers communicate with each other using two different communication protocols, USART and SPI

Introduction

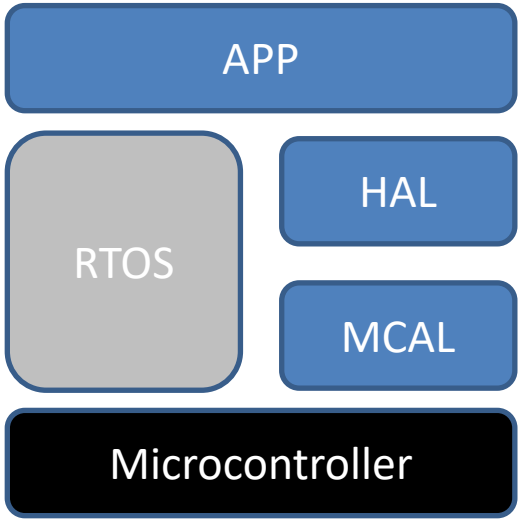
- This project supports the following features :
  - User interface with keypad and LCD to take user choices
  - Login system with the capability of changing password
  - The user can control various smart systems and choose to enable or disable them
  - These systems are Air Conditioner, Lights, Door and Music
  - There is another automatic system which is Gas/Smoke detection with alarm
  - Display all systems stats and the current temperature degree on another LCD

Overview


USART
LCD1 (Options)
Yes
Mc2
Mc3
SPI
Mc1
Login
NO
Trials < 4
No
Wait 5 seconds & reset trials
SENSORS
Devices
User input on keypad
LCD 2 (States)
YES
User Mode
Change Pass
Display Options
Logout
AIR CONDITIONER
LIGHTS
DOOR
MUSIC
RETURN
Set Threshold
Control State
Control State
Control State

Introduction

Architecture



Microcontroller 1

Microcontroller 1

- Login system
  - User has 3 tries to enter the correct combination for the ID and password using the keypad.
  - Each time the combination is incorrect, LCD 1 should display “Try Again!”.
  - If all combination trials are exhausted, LCD 1 should display “Please Try Again Later!” , and the user is granted three more tries after 5 seconds.
  - If the user manages to login, the user mode options should be displayed on LCD 1.

Microcontroller 1

- User Mode
  - The user can choose from three things:
    - Display options: shows all the configurable systems.
    - Change pass: the user can update his/her password.
    - Logout: user returns to the login screen.

Microcontroller 1

- Display Options:
  - AC : allows the user to edit the threshold required to enable the fan system.
  - LDR : allows the user to enable the automatic light system controlled by the LDR.
  - DOOR : allows the user to open and close the door which consists of a servomotor.
  - MUSIC : allows the user to enable the music system which is handled by the speaker and power/audio generator.
  - RETURN : user goes back to the user mode screen.
- Wrong user inputs are also handled.

Microcontroller 1

- Communication Protocols:
  - Microcontroller one sends the user-edited data to and receives display data from Microcontroller two using USART.
  - Data is sent as a register file with each control reserving a bit except for the temperature threshold which is sent alone.
  - USART alternates between sending and receiving every 150ms to optimally run the code without noticeable delays.

Microcontroller 1

- Communication Protocols:
  - Microcontroller one receives numbers entered on the keypad from Microcontroller 3 over SPI.
  - SPI starts as soon as the user confirms the inputted number.
  - The sent number is stored in a buffer until Microcontroller 1 receives it.
  - Microcontroller 3 is the master while Microcontroller 1 is the slave in this process.

Microcontroller 2

Microcontroller 2

- This microcontroller is responsible of all sensors data.
- We used RTOS by implementing simple scheduler to handle different tasks.
- Using USART protocol every 150ms :
  - It sends sensors readings and systems stats to microcontroller 1
  - It receives control signals from microcontroller 1 to control different modules like : (Door, Critical Temperature, Music and Lights).

Microcontroller 2

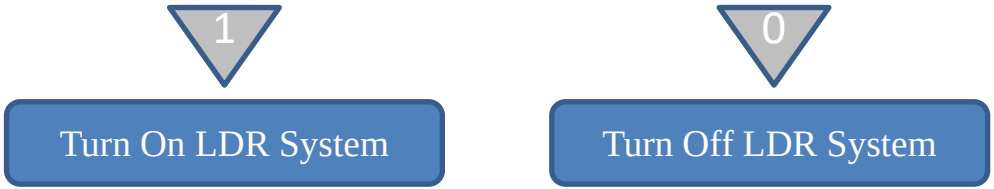
- Initialization
  - Scheduler based on Timer 2 peripheral
  - Input/Output pins direction for all sensors and devices
  - USART protocol to communicate with microcontroller 1
  - ADC peripheral to
    - read temperature using LM35 sensor
    - read light intensity using LDR sensor
  - Timer 1 on Fast PWM mode to control the door motor

Microcontroller 2

- Scheduler Tasks :
  - Communication with microcontroller 1
  - Control Gas/Smoke System
  - Control Air Conditioner System
  - Control Lights System
  - Control Door System
  - Control Music System
- Start the Scheduler
- Scheduler Dispatcher in the main super loop to switch between tasks

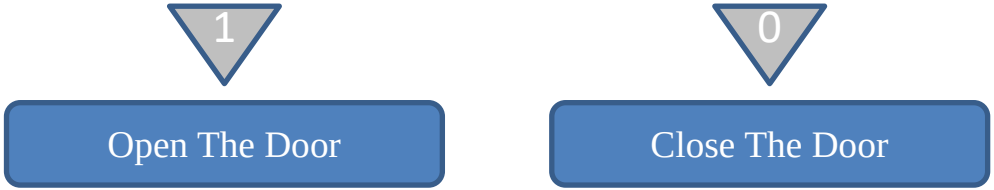
Microcontroller 2

- Communication with microcontroller 1 :
  - This task will be executed every 150ms
  - It receives control signals from MC1 as follows :
    - Critical temperature which controls the FAN
    - Control LDR Signal

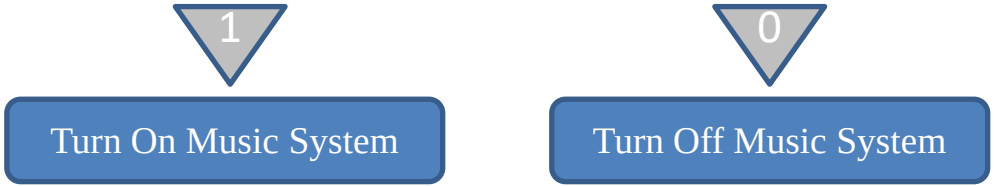


Microcontroller 2

- Control Door Signal

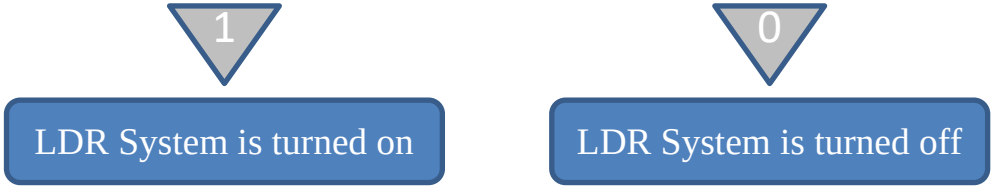


- Control Music Signal



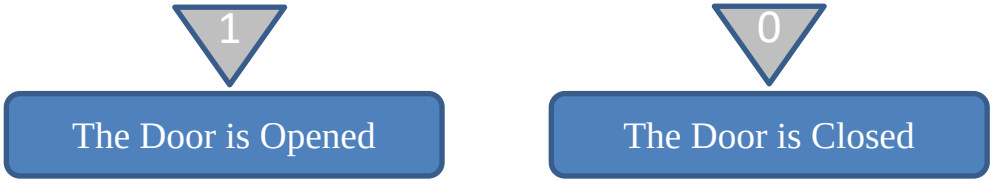
Microcontroller 2

- Communication with microcontroller 1 :
  - It transmits systems stats like follows :
    - Current Temperature Degree
    - LDR System

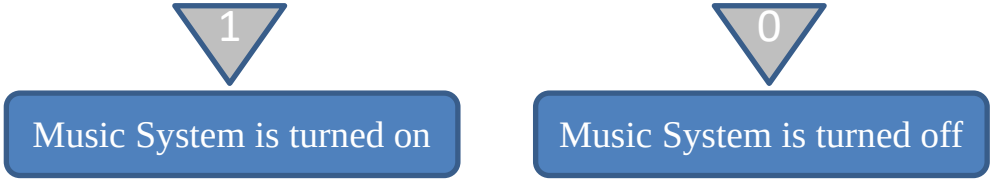


Microcontroller 2

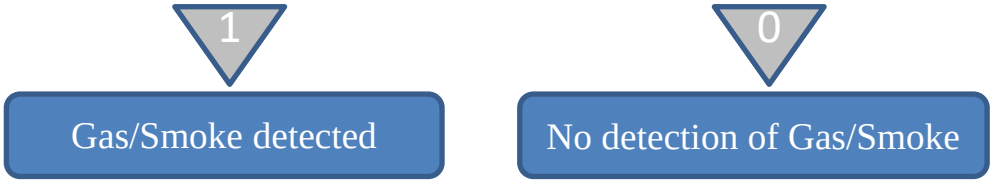
- Door Status



- Music System



- Gas/Smoke Status

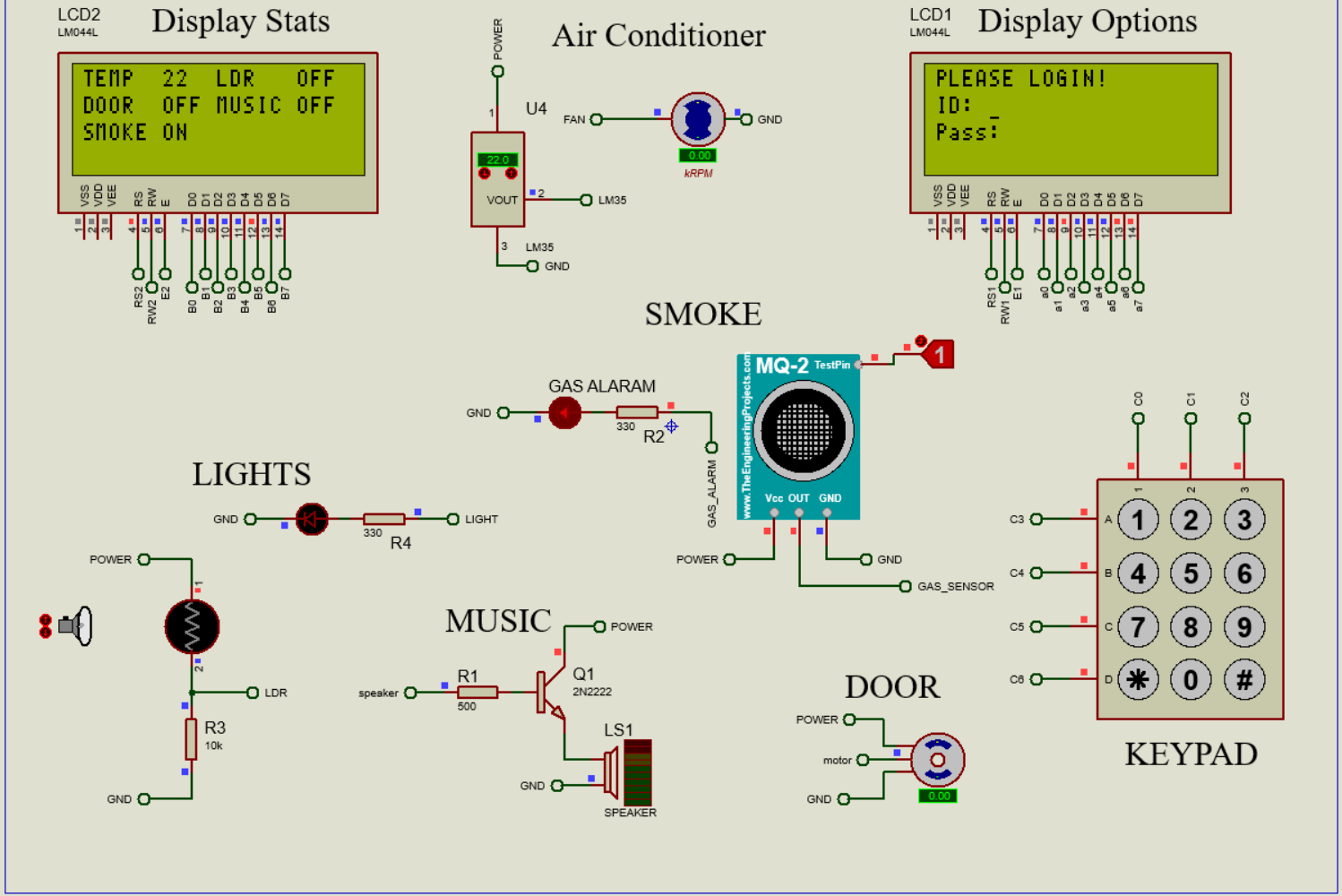


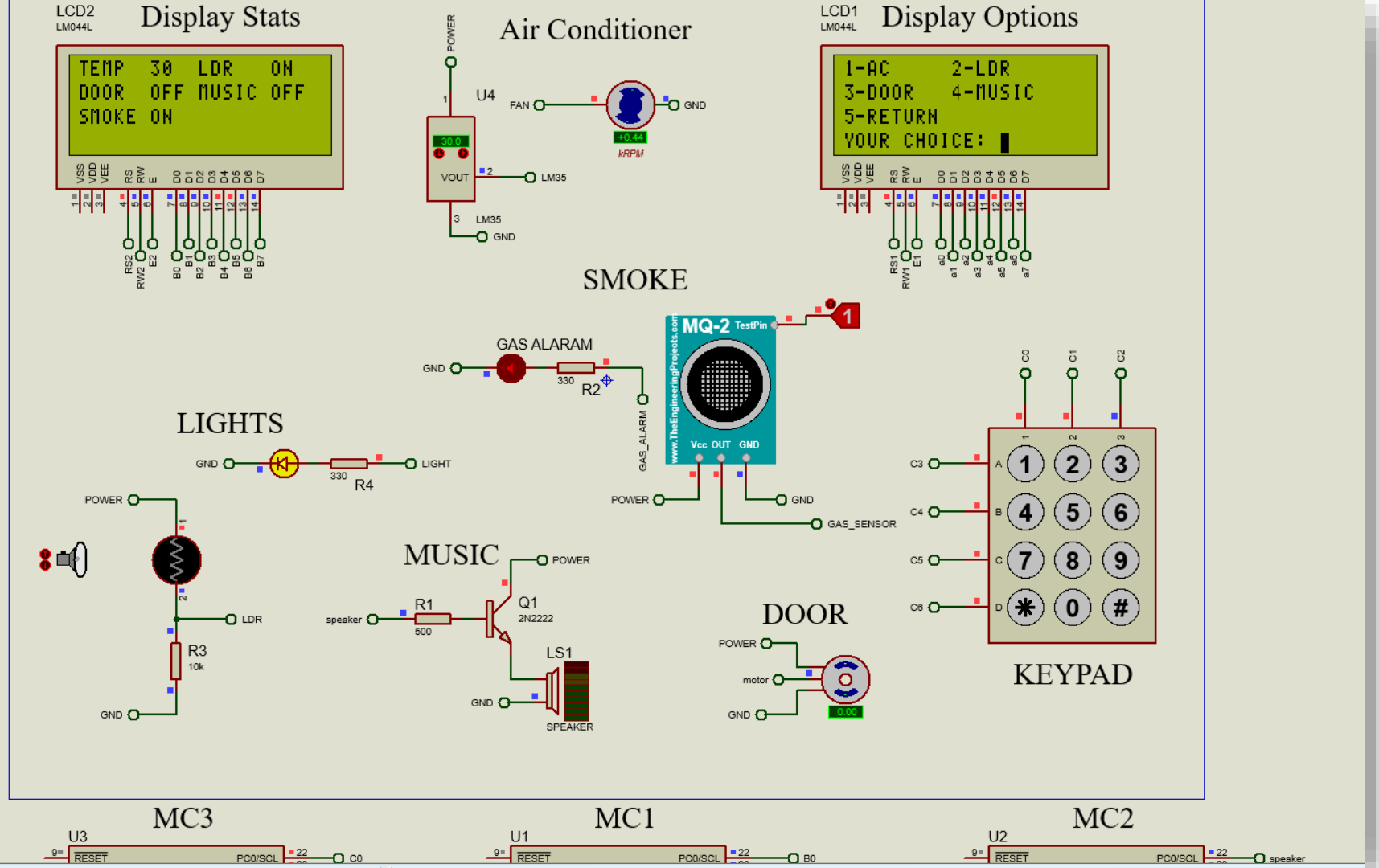
Microcontroller 3

Microcontroller 3

- Keypad
  - User interacts with the system using the keypad.
  - User can type any number then press “#” to confirm that he/she has finished typing.
  - User can delete a number by pressing the “*” button.

Simulation


LCD2
LM044L
Display Stats
TEMP 22 LDR OFF
DOOR OFF MUSIC OFF
SMOKE ON
Air Conditioner
POWER
U4
FAN
GND
0.00
kRPM
VOUT
LM35
LM35
GND
LCD1
LM044L
Display Options
PLEASE LOGIN!
ID:
Pass:
SMOKE
GAS ALARAM
GND
330
R2
GAS_ALARM
MQ-2 TestPin
www.TheEngineeringProjects.com
Vcc OUT GND
POWER
GND
GAS_SENSOR
LIGHTS
GND
330
R4
LIGHT
POWER
LDR
R3
10k
GND
MUSIC
POWER
speaker
R1
500
Q1
2N2222
LS1
GND
SPEAKER
DOOR
POWER
motor
GND
0.00
C0
C1
C2
C3
C4
C5
C6
A
B
C
D
1
2
3
4
5
6
7
8
9
*
0
#
KEYPAD
MC3
U3
RESET
PC0/SCL
C0
MC1
U1
RESET
PC0/SCL
B0
MC2
U2
RESET
PC0/SCL
speaker


LCD2
LM044L
Display Stats
TEMP 30 LDR ON
DOOR OFF MUSIC OFF
SMOKE ON
Air Conditioner
POWER
U4
FAN
GND
+0.44
kRPM
30.0
VOUT
LM35
LM35
GND
LCD1
LM044L
Display Options
1-AC 2-LDR
3-DOOR 4-MUSIC
5-RETURN
YOUR CHOICE:
SMOKE
GAS ALARAM
GND
330
R2
GAS_ALARM
MQ-2 TestPin
www.TheEngineeringProjects.com
Vcc OUT GND
POWER
GND
GAS_SENSOR
LIGHTS
GND
330
R4
LIGHT
POWER
LDR
R3
10k
GND
MUSIC
POWER
speaker
R1
500
Q1
2N2222
LS1
GND
SPEAKER
DOOR
POWER
motor
GND
0.00
C0
C1
C2
C3
C4
C5
C6
A
B
C
D
1
2
3
4
5
6
7
8
9
*
0
#
KEYPAD
MC3
U3
RESET
PC0/SCL
C0
MC1
U1
RESET
PC0/SCL
B0
MC2
U2
RESET
PC0/SCL
speaker

Thanks