

Microprocessor and Interfacing Design Project

Fire Alarm System

Submitted in partial fulfillment of the course:

Microprocessor and Interfacing (INSTR/EEE/CS F241)

Submitted by:

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System to be designed: Fire alarm system

Description:

This system checks for abnormal smoke content in a room and under such conditions throws open all exit doors and windows and opens a valve that releases the gas to put-out the fire. An Alarm is also sounded; this alarm is sounded until the smoke level in the room drops to an acceptable level. The room has two doors and four windows. The smoke detection system is made up of three smoke sensors placed on the ceiling of the room. When at least two of three detectors get turned on, the alarm system is activated. If only one of them is activated a different alarm sound is produced indicating probable malfunction of alarm. The system can be activated or de-activated using a single switch.

1. The photo-electric smoke sensor MQ-2 is made of Al_2O_3 and a heating element of Tin Dioxide (SnO_2) which acts as the sensing layer.

2. LM358 acts as the comparator. The inverting terminal of LM358 is connected to a potentiometer so that the sensitivity can be adjusted. The non-inverting terminal of LM358 is connected to the output of the smoke sensor.

3. When there is no smoke, the MQ-2 sensor has high and the voltage resistance ($\sim 50k$) produced does not exceed the reference value. In the event of fire, when the sensor is filled with smoke, the resistance of MQ-2 falls to $5K$ and the conductivity increases. This provides a higher input at the non-inverting terminal if LM358 than the inverting terminal and the output of the comparator is high this output is use to raise interrupt to 8259.

Assumptions made:

1. Motors are rotated in the clockwise direction and directed to 90 degrees to open and close the door and the gas valves.

2. MQ-2 used as the smoke sensor, the output of which is compared to a reference value (threshold smoke level), using comparator LM358.
3. The outputs of the comparator LM358 are used to raise interrupts.
4. IR0 is raised when one or more sensors are active.
5. In case of fire, if one of the sensor has already detected smoke, then the second sensor will detect the smoke in a span of 4 seconds.

Specifications:

1. Memory mapping:

Chips	Address
ROM1 [4k]:	00000H-00FFFH
RAM1 [4K]:	01000H-01FFFH
ROM2 [4K]:	FF000H-FFFFFH

2. I/O mapping

Chips	Address
8055:	00H-06H
8053:	08H-0EH
8059:	10H-12H

3. Components used

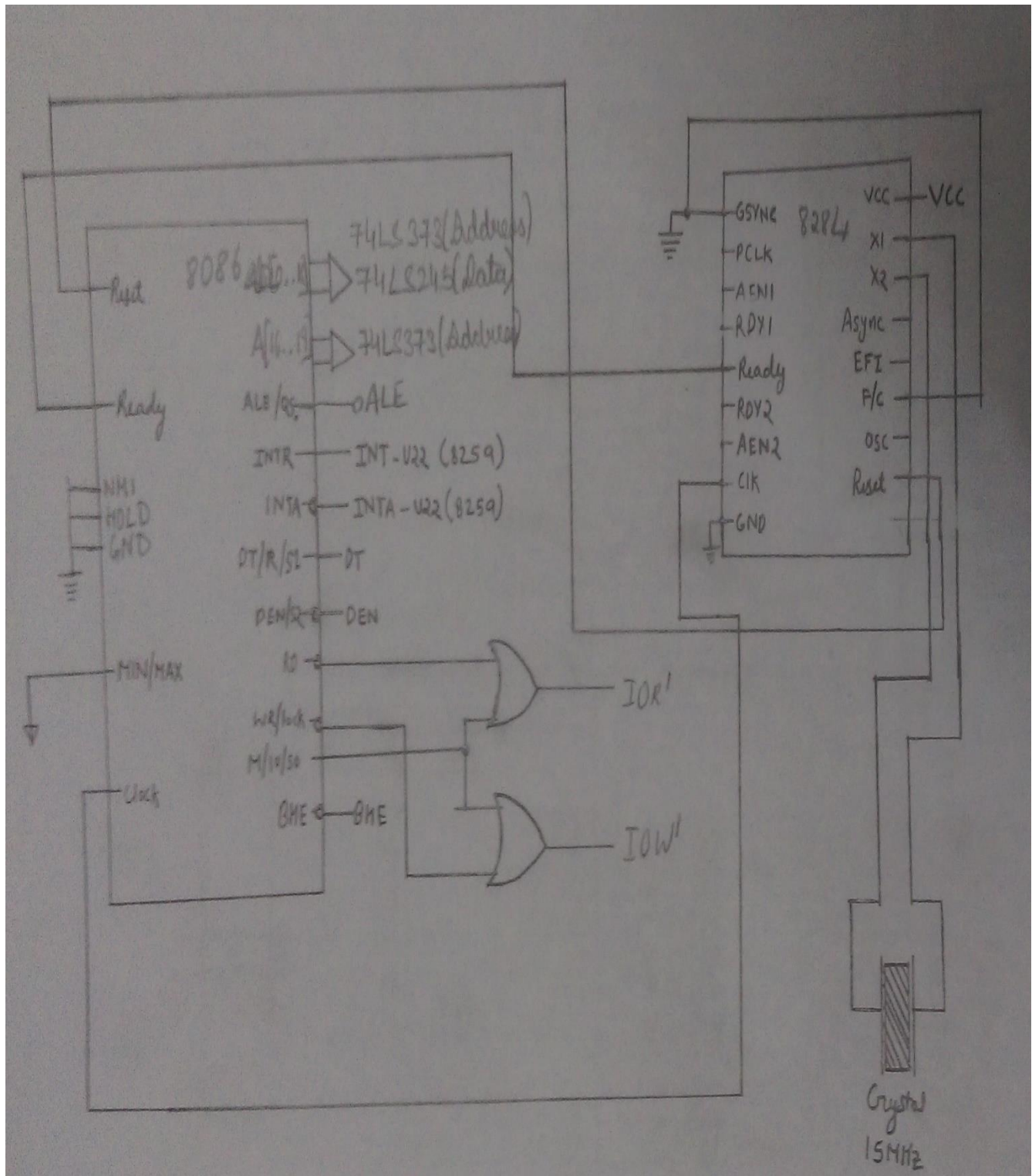
- **8255(Programmable Peripheral Interface(PPI) chip)**
 - Contains three 8-bit ports

- 24 input/output pins
 - Port A is the input line
 1. PA_0 --Sensor 1
 2. PA_1 -- Sensor 2
 3. PA_2 -- Sensor 3
 - Port C is the output line
 1. PC_0 – Alarm 1(Fire Alarm)
 2. PC_1 – Alarm 2(Malfunctioning Alarm)
 3. PC_2 – Gate to 8253
- **6116 (RAM 2K)**
 - 2 units used
 - **2716 (ROM 2k)**
 - 4 units used
 - **8253(Programmable Interval Timer)**
 - 24 pin IC
 - Counter 1 used to produce PWM of frequency 50Hz and duty cycle 10% with a count value of 200
 - **8259(Programmable Interrupt Controller)**
 - Interrupt IR_0 generated when any one of the sensor is activated
 - **8086(Microprocessor)**
 - Operating clock speed-2MHz
 - 40 pins
 - 20 de-multiplexed address lines and 16 de-multiplexed data lines
 - **74LS373(Octal Latch)**
 - 3 units
 - **74LS245(Octal Bus Transmitter/Receiver)**
 - 2 units

- **LM358(Analog Comparator)**
 - Gives high output when smoke level goes above a threshold value level which is 1.5 V
- **Potentiometer**
 - To set the reference voltage for smoke sensor.
 - 1K ohms
- **Alarm**
 - 2 units used
 1. Used for fire alarm
 2. Used for detecting malfunctioning of a sensor
- **74HC4075(3-input OR gate)**
 - 1 unit used
- **74LS32(quad 2-input OR gate)**
 - 2 units used
- **74LS138(3-line to 8-line decoder)**
 - 2 units used
- **MQ-2(Smoke Sensor)**
 - Sensing resistance: $R_s=2K\Omega-20K\Omega/2000\text{ppm}$ smoke
 - O/P voltage $\geq 1.5V$ if smoke level $\geq 100\text{ppm}$
- **Servo-motor**
 - 12V supply
 - 3A current
 - 50Hz pulse frequency
 - 10% duty cycle for 90 degree rotation
 - Gives analog output between 0V-5V

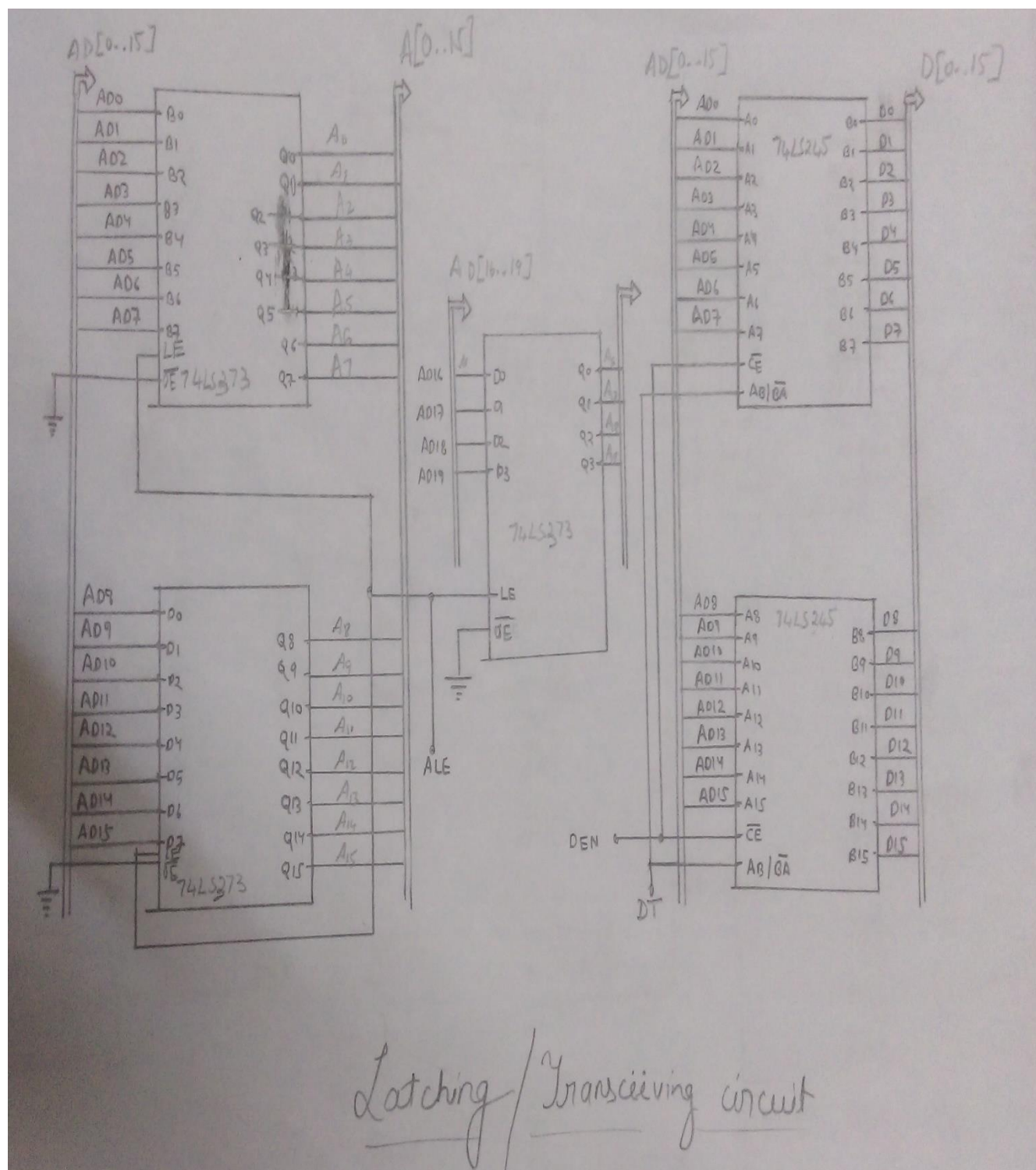
Schematic Diagram

8086 and 8284

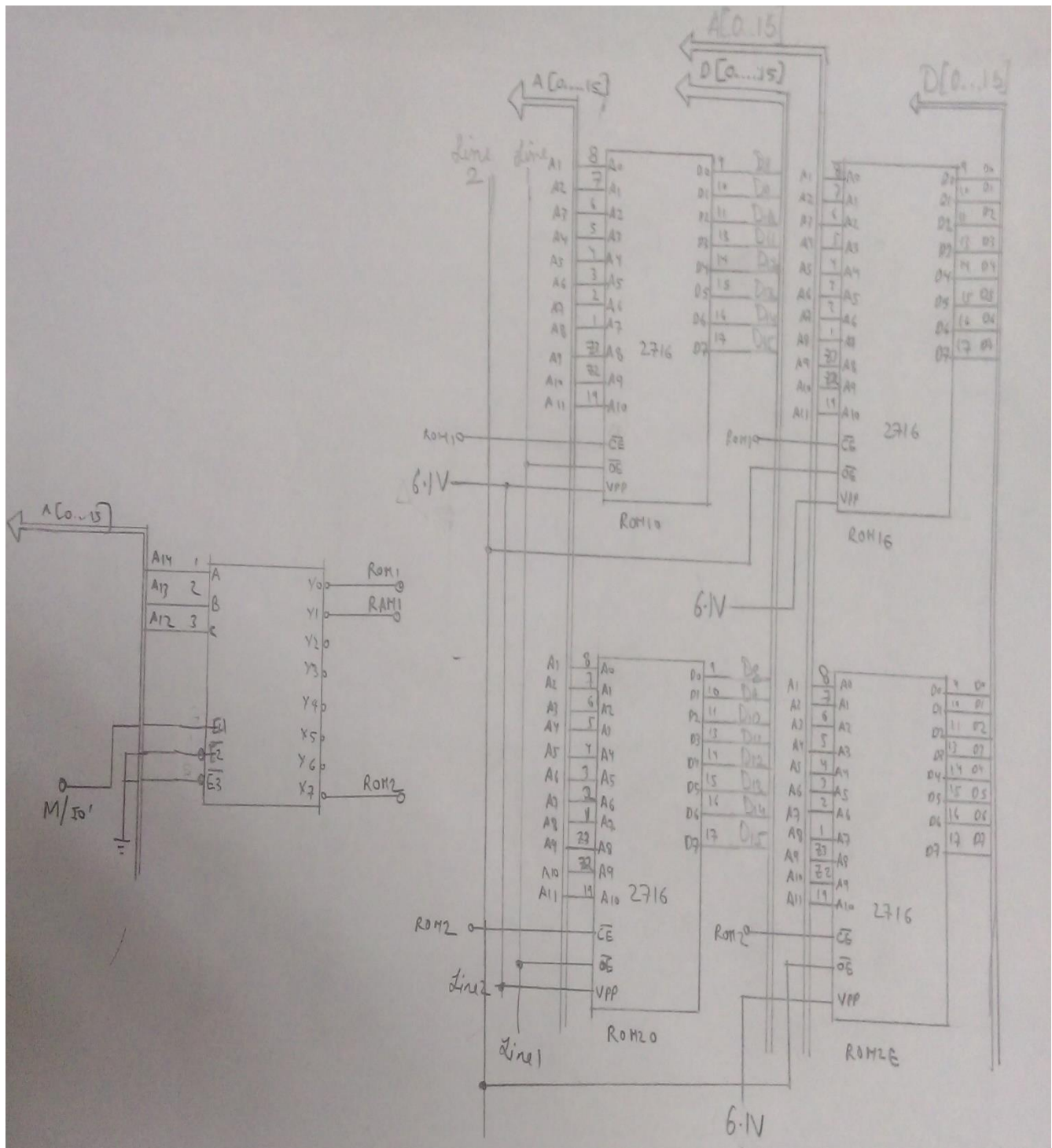


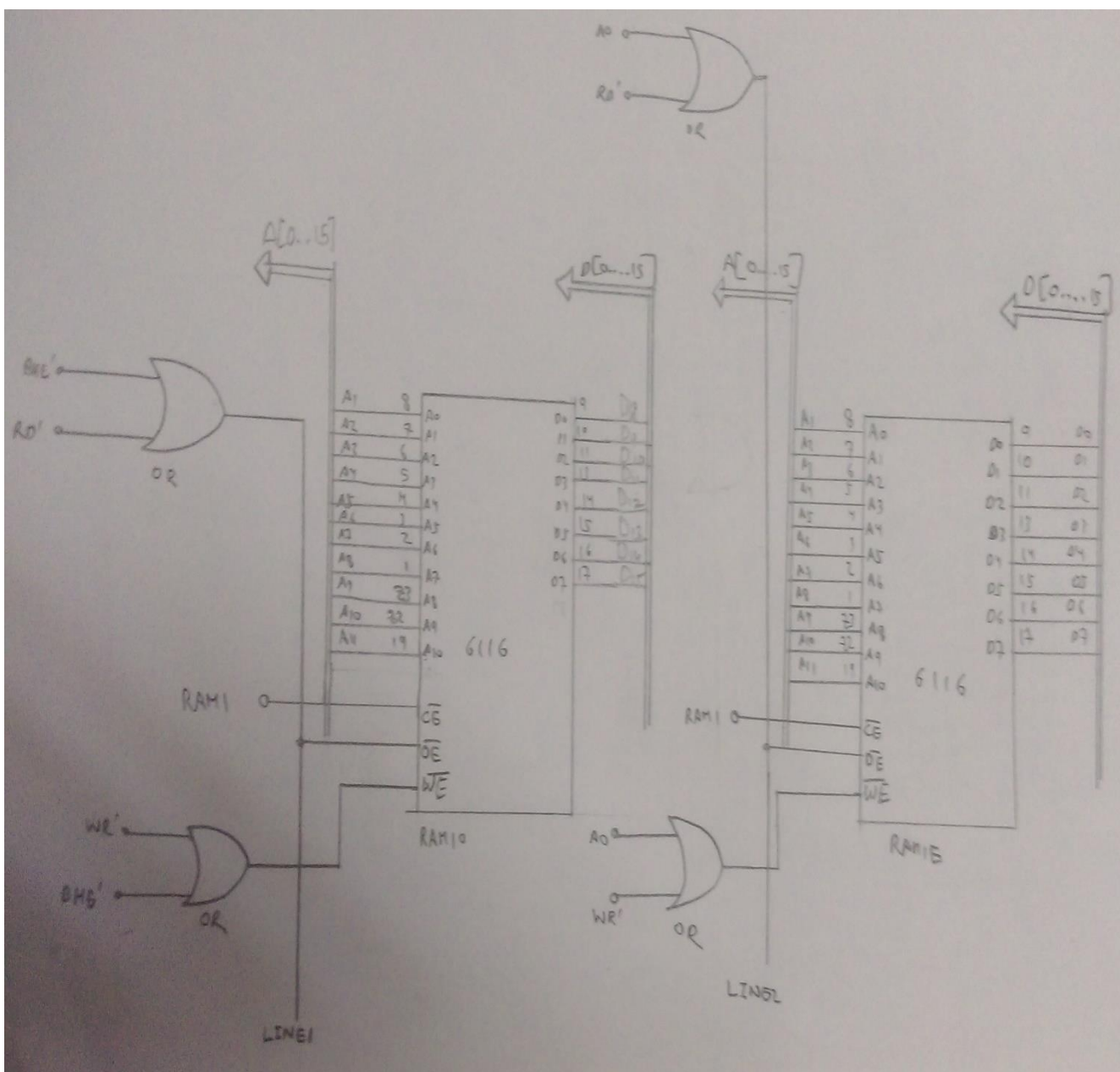
74LS138, 8255, 8253, 8259

Bus Amplification Latches and Buffers

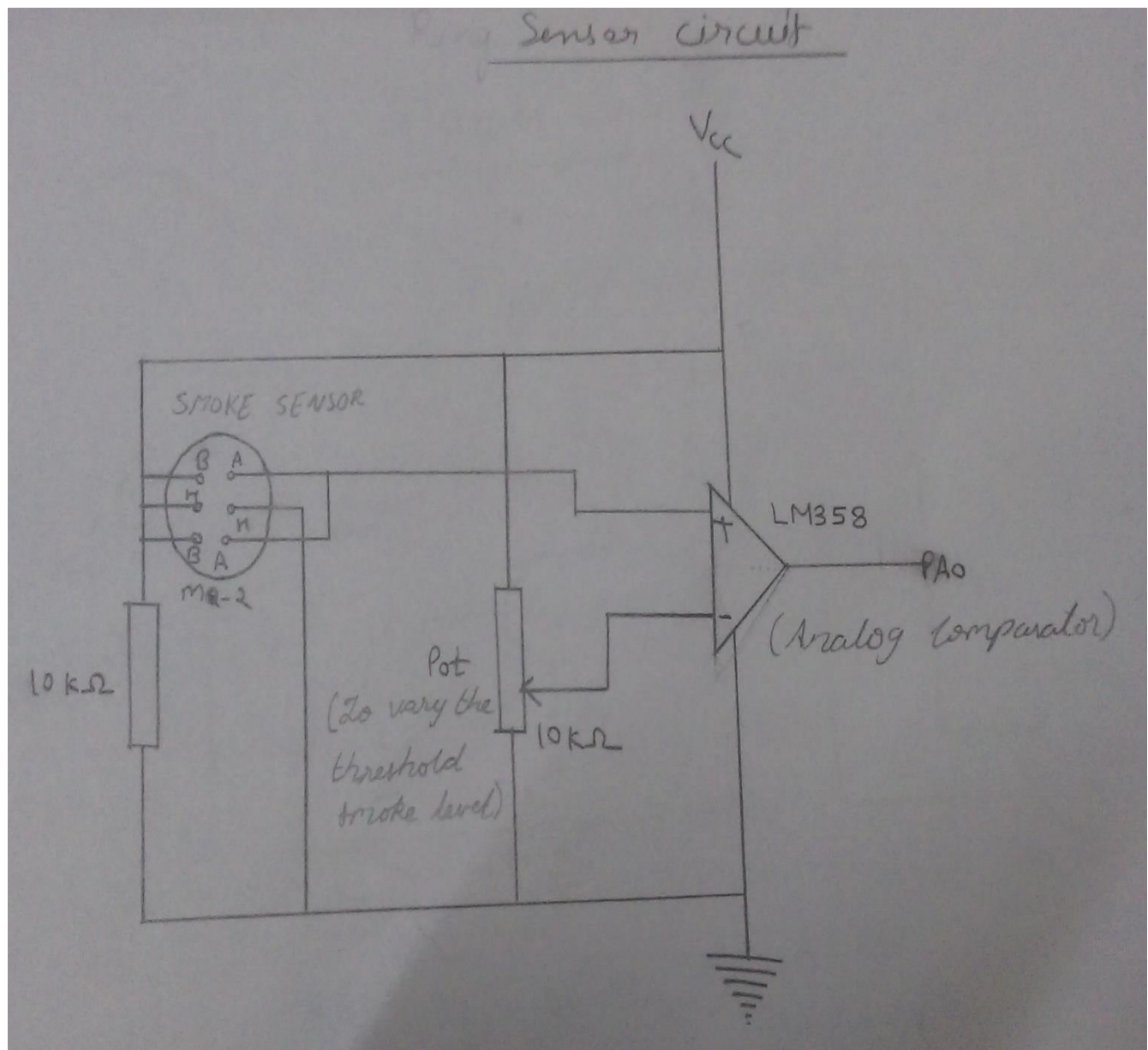


Memory Interfacing

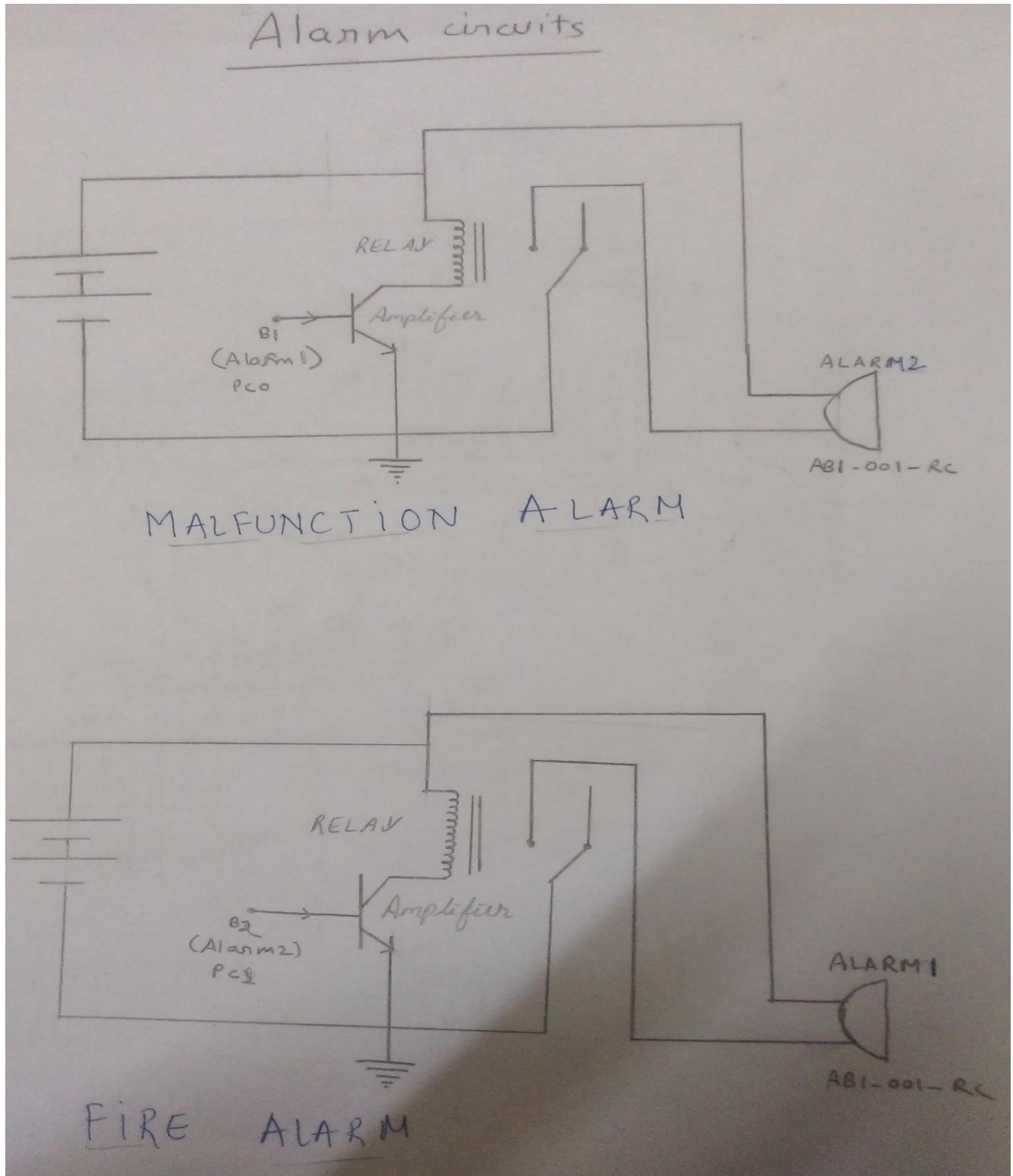




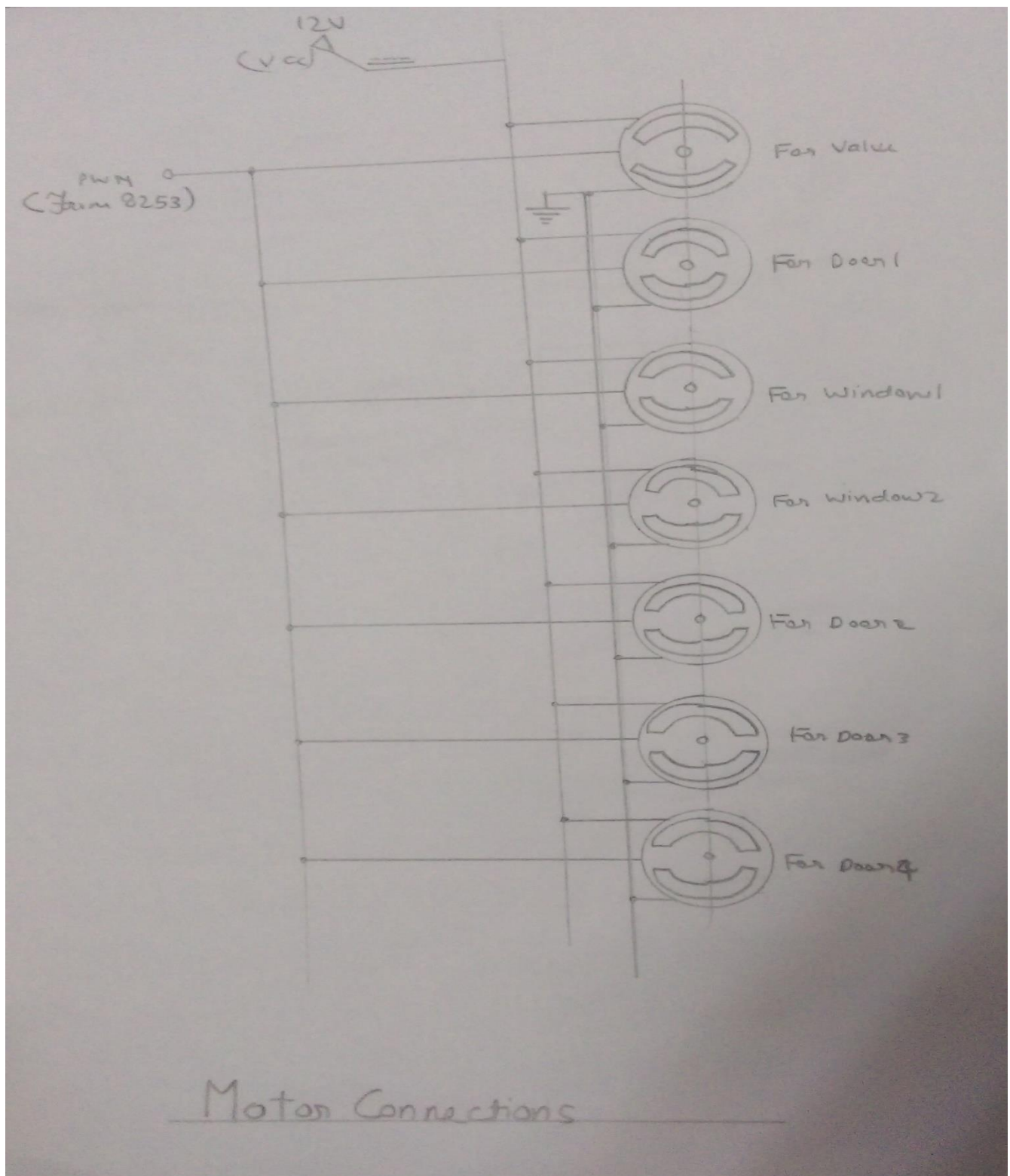
Sensor Circuit



Alarm Circuit



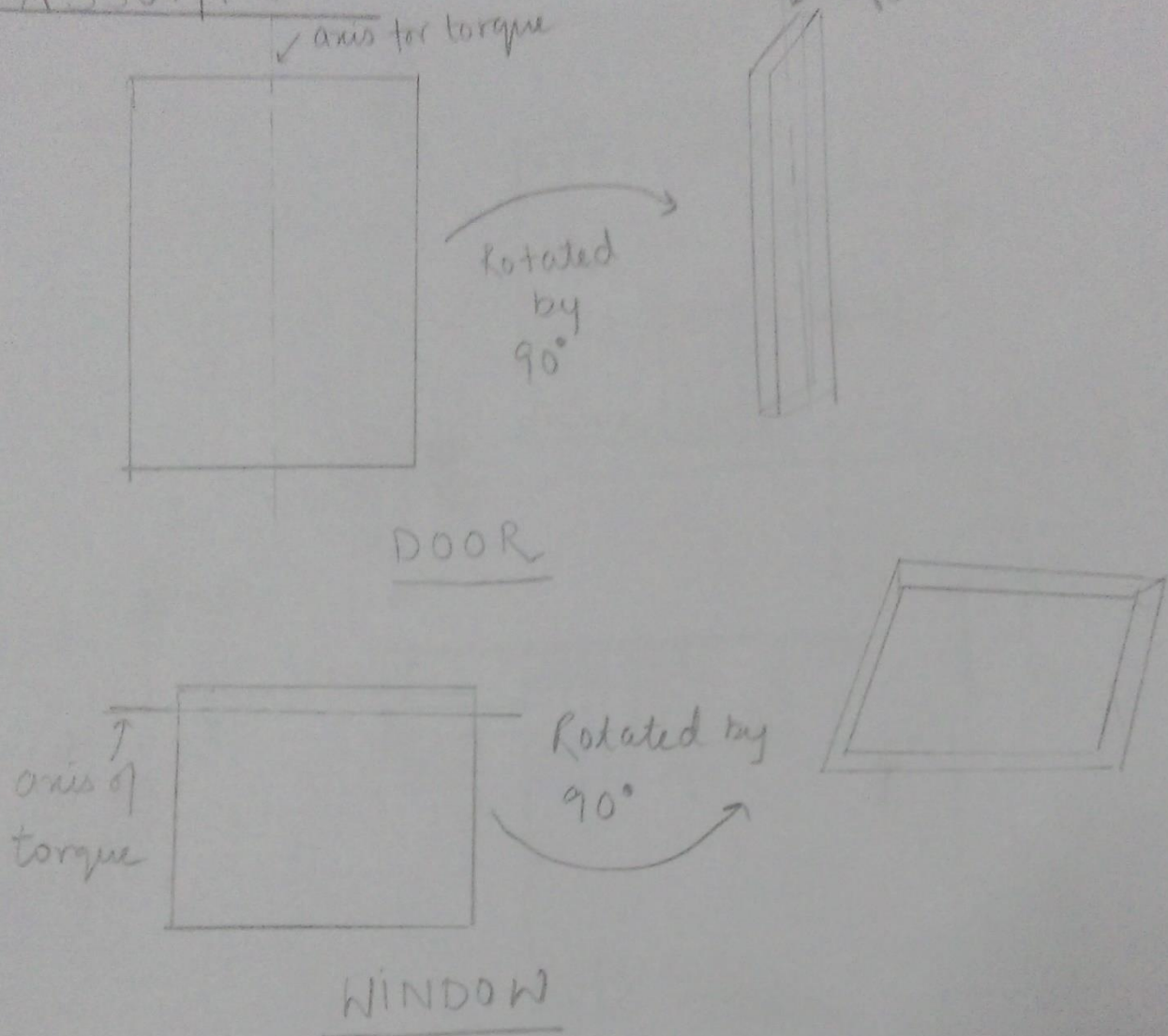
Motor Circuit



Window and Door Assumption

DOOR AND WINDOW DESIGN

ASSUMPTION



Valve follows the mechanism as door.

