SMART GARAGE SYSTEM

Submitted by: Group 39

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User Requirements & Technical Specifications

Design a smart garage system which can keep track of total number of cars.

User Requirements-

- The capacity of the garage is 2000 cars.
- System is used in underground parking lot of a hotel.
- Each user of the garage has a remote unit which he can use for opening and closing the garage door.
- Remote unit has only a single button.
- User is allowed to retrieve the car at any point of time.
- An LCD Display is available indicating the number of cars in the garage.
- System runs from a standard power inlet available in the garage.
- When the number of cars reaches 2000, the LCD displays “FULL”.
- When there are no cars, the LCD displays “EMPTY”.

Technical Specifications-

- Remote unit button toggles the condition of the garage door- i.e. if the door is opened it is closed and vice versa.
- The remote unit is used for short distances only.
- A DC motor is used for opening and closing the door – The motor is a 50V -3 A motor.
- Maximum frequency input to the motor system cannot exceed 100 KHz.
- The system should be able to distinguish between a person and a car.
- A switch is available that can be closed only by the weight of a car.
- System is used in the hotel- so you can assume that a valet parking system is followed – this indicates that only one person leaves the garage after the car is parked and only a single person enters the garage to retrieve the car.
- The system also has to distinguish between entry and exit. You have to develop a scheme to distinguish between entry and exit of person/car. [Hint: Use any number of IR sensor pairs as required]
- Whether a car enters or a valet enters the door remains open for a period of five minutes.
- The door can close after 5 Minutes or when the valet uses the remote.
- The remote can be used inside as well as outside the garage.

Assumptions & Justifications

Assumptions

- Only one car can enter or leave at a time.
- Press remote to open the gate. Then follow the sequence Outer_IR, Pressure transducer and then Inner_IR. Then close the gate by the remote. (the sequence is reversed for the exiting).
- The pressure transducer has been indicated by a latched switch in proteus simulation.
- The garage is empty at the start of the simulation and the door is closed.
- If the garage is full, no car is allowed to enter.
- Once the car goes inside the garage, the outer IR sensor becomes a don't care until the door is opened again. (Momentary switch action in proteus)
- Once the car goes outside the garage, the inner IR sensor becomes a don't care until the door is opened again. (Momentary switch action in proteus)
- The garage door must complete the action of opening or closing before taking the next command.

Justification:

- There is only one gate available. Hence only one car can enter or leave at a time.
- It follows from the algorithm that the sequence in proteus is followed.
- The capacity constraint is 2000.
- The momentary action is chosen because the sensors need not consume power after detection has been done.

Components used with justification wherever required

CHIP NUMBER /DETAILS	COMPONENTS	QUANTITY USED
INTEL 8086	Microprocessor	1
8284	Clock generator	1
2732	ROM Chip Size-4KB	4
6116	RAM Chip Size-2KB	2
8255	Programmable Peripheral Interface (PPI)	1
8253	Programmable Interval Timer	1
74LS245	Bi-Directional Buffer (8 Bit)	2
74LS373	Octal Latch	3
74LS138	3:8 Decoder	2
7432	OR Gate	8
L293D	Motor Driver	1
DC Motor (Active)	Motor	1
LM016L	LCD Display	1
SW-SPDT-MOM	Switches	4
TSOP 1738	IR Sensor	1
CAT-PTT0000	Pressure Transducer	1
7404	NOT Gate	1

CHIP NUMBER/NAME	PURPOSE/USE
2732	ROM Chip is required to read memory. It is required at reset address which is present at FFFF0H and 00000H where the IVT is present.
6116	RAM chip used for stack and temporary storage of data.
8255	Acts as an interface between i/o ports and 8086
8253	To generate clock signal required for the peripheral devices and 8086
Motor Driver	Acts as current amplifier required for the working of motor.
Motor	Used to open/close the garage door
LM016L	To display the count of cars, present along with the display of ‘FULL’ and ‘EMPTY’.

Weight Sensor (Pressure Transducer)

CAT-PTT0000 – This sensor covers our required pressure range to distinguish between car and person.

Temperature range: -40^{o}C to 125^{o}C

Supply Voltage: 12V to 30V

Output Voltage: 0-10V

IR Sensor

TSOP-1738 – This sensor has high range and wide coverage area.

Supply Voltage: -0.3V to 5V

Typical Voltage: 5V

PIN	SYMBOL	DESCRIPTION
1	GND	Connected to Ground
2	VCC	Voltage Supply
3	Signal	This pin gives out sequence based on IR sequence

LCD Display

LM016L- We have used 16*2 LCD Module

Operating Temperature: 0C to 50C

Supply Voltage: 0V to 6.5V

PIN	SYMBOL	DESCRIPTION
1	VSS	This pin must be connected to ground
2	VCC	Positive supply voltage pin.
3	VEE	Contrast Adjustment
4	RS	Register Selection
5	R/W	Read/Write
6	E	Enable
7	DB0-DB7	Data
8	LED+	Back Light LED+
9	LED-	Back Light LED-

L293D Motor Driver

Supply Voltage: VCC1: 4.5V to 7V

VCC2: VCC1 to 36V

Operating air temperature: 0C to 70C

PIN NO	SYMBOL	DESCRIPTION
1EN	EN	Active High enable
2,7,10,15	A	Driver inputs (Non inv)
3,6,11,14	Y	Driver outputs
9EN	EN	Active High enable
4,5,12,13	GND	Ground
8	VCC1	VCC
16	VCC2	VCC

*Manuals of these components are attached below.

Address Map

Memory Map

ROM1E_Even: 00000H to 01FFEH

ROM1O_Odd: 00001H to 01FFFH

RAM1E_Even: 02000H to 02FFEH

RAM1O_Odd: 02001H to 02FFFH

ROM2E_Even: FE000H to FFFFEH

ROM2O_Odd: FE001H to FFFFFH

I/O Map

PPI (8255)	Port No./Address
Port A	00H
Port B	02H
Port C	04H
Control Register	06H
PIT (8253)	
Port A	08H
Port B	0AH
Port C	0CH

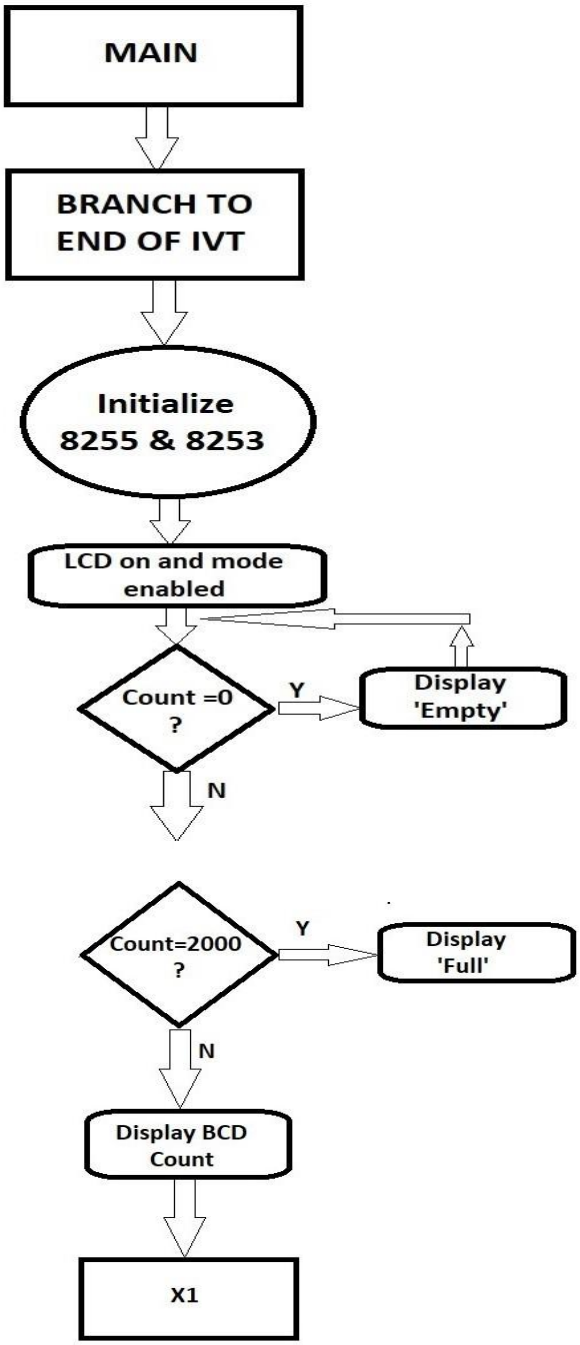
Control Register	0EH

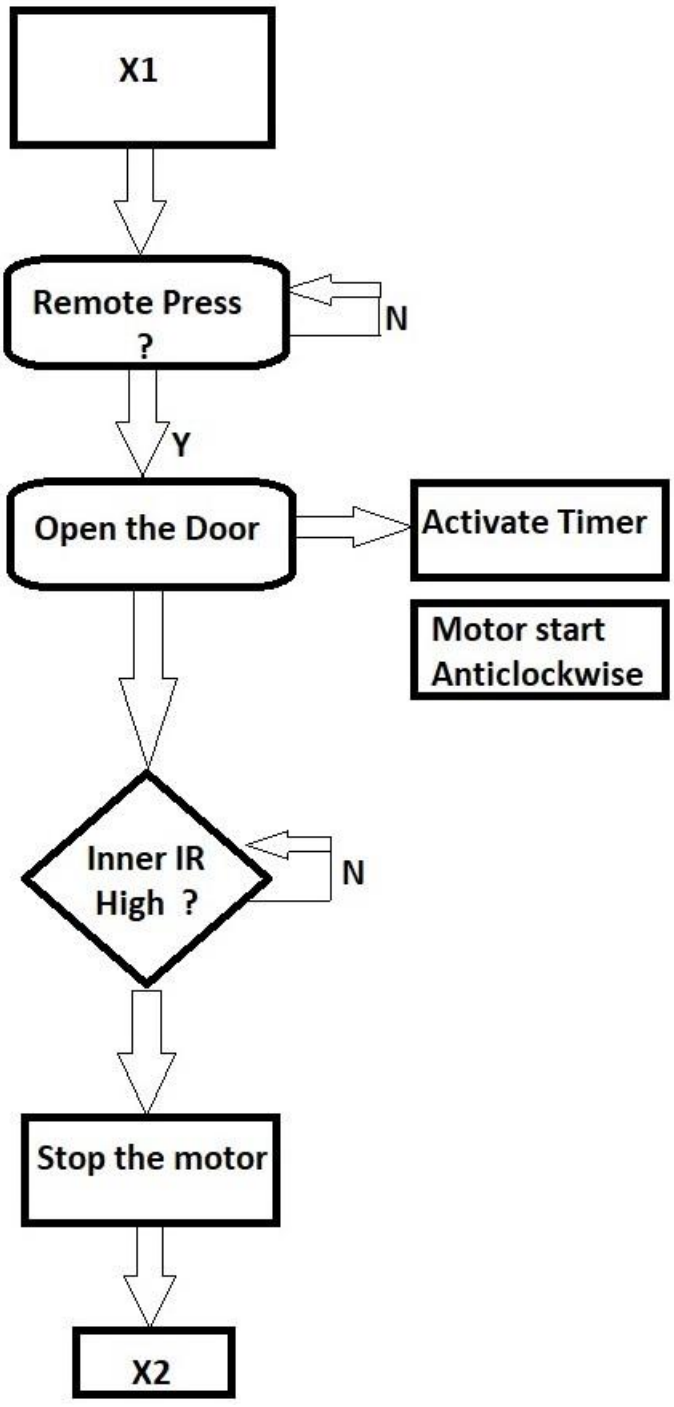
Design

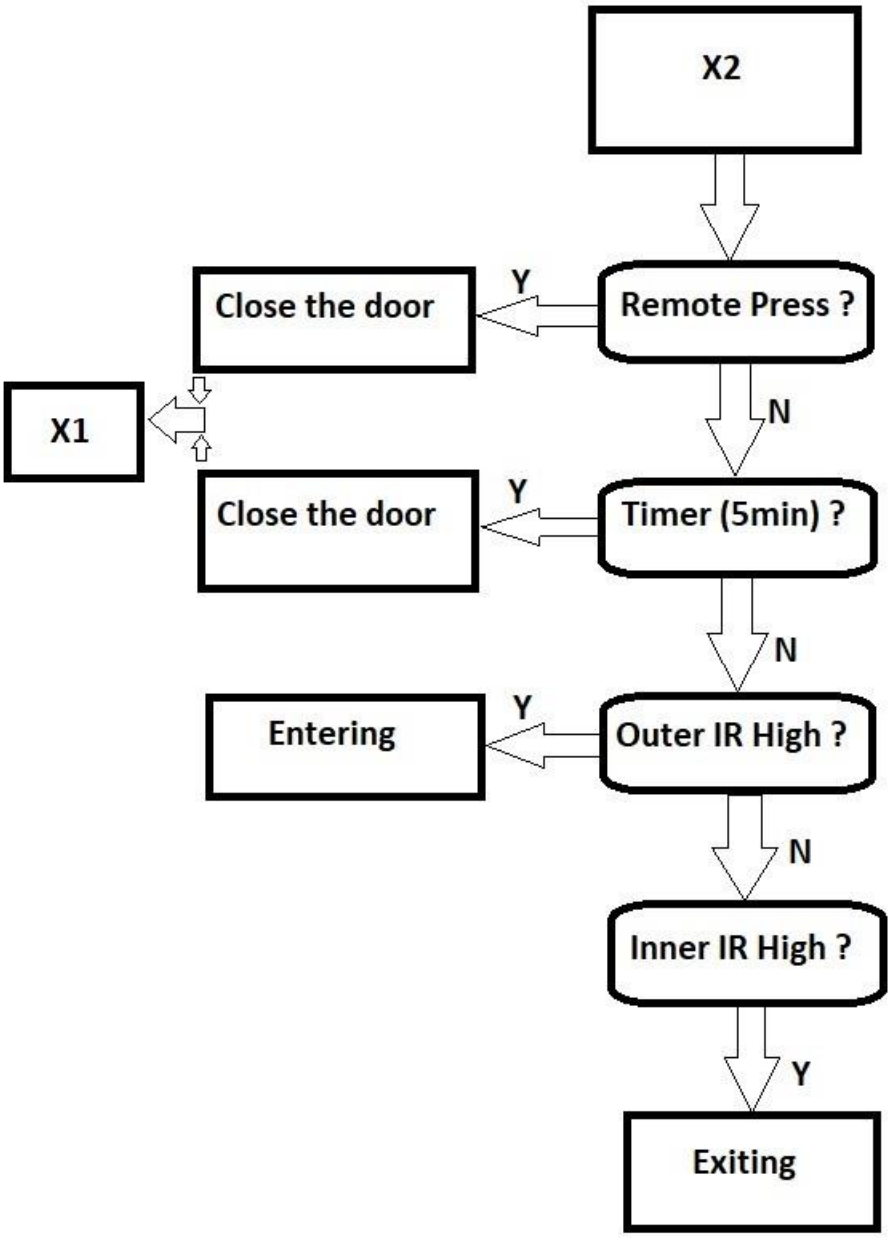
Complete design shown with proper labelling (design attached)

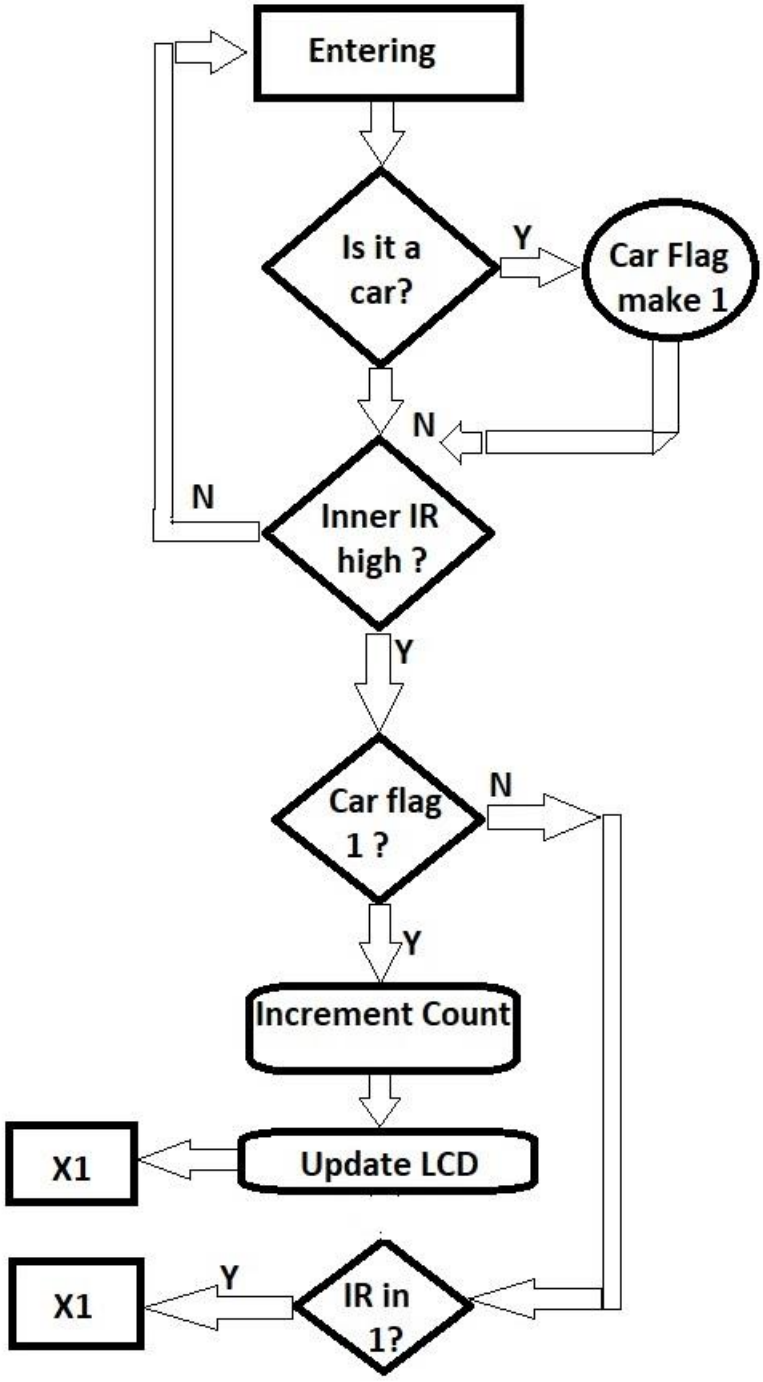
Flow Chart

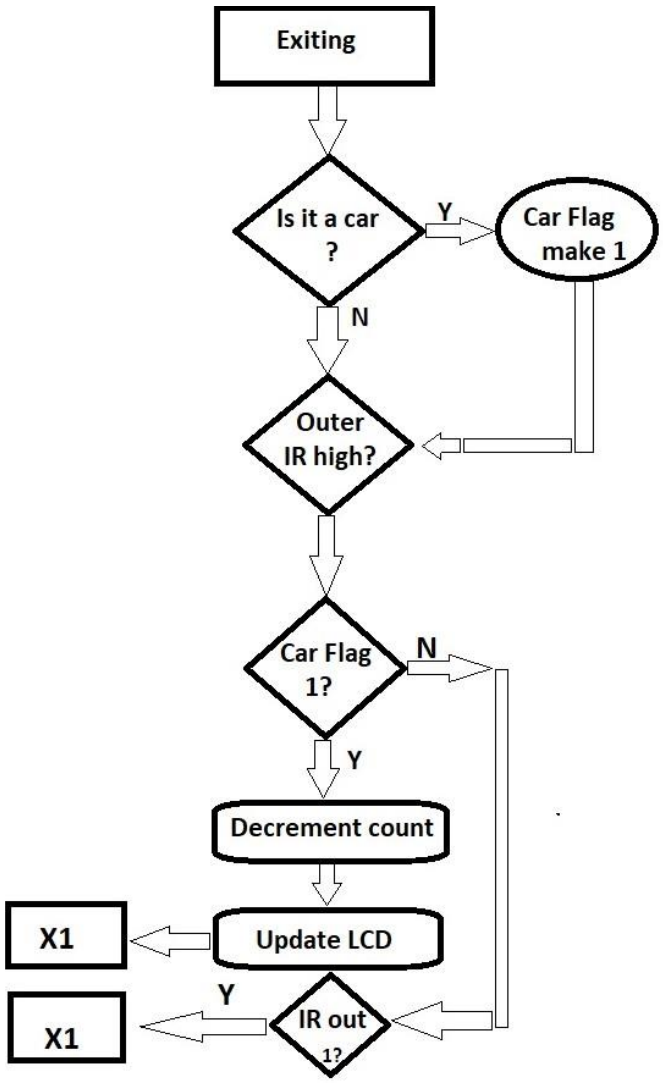
Main Program:




X1
Remote Press ?
N
Y
Open the Door
Activate Timer
Motor start Anticlockwise
Inner IR High ?
N
Stop the motor
X2


X2
Remote Press ?
Y
Close the door
X1
N
Timer (5min) ?
Y
Close the door
N
Outer IR High ?
Y
Entering
N
Inner IR High ?
Y
Exiting


Entering
Is it a car?
Y
Car Flag make 1
N
N
Inner IR high ?
Y
Car flag 1 ?
N
Y
Increment Count
X1
Update LCD
X1
Y
IR in 1?


Exiting
Is it a car ?
Y
Car Flag make 1
N
Outer IR high?
Car Flag 1?
N
Y
Decrement count
X1
Update LCD
Y
X1
IR out 1?

Algorithm

1) Remote condition is checked. If high, the door opens and 5-minute timer is set. Count of cars is updated.
2) To determine the entry or exit of car/person, IR sensors are placed inside and outside the door. Entry is identified when the outer IR sensor is high (detects) first and exit is when the inner IR detects (goes high) first.
3) The differentiating factor between car and person, is the ‘weight’. Sensed by the pressure transducer.
4) The car flag decides whether or not to increment/decrement the count while entering/exiting respectively.
5) The door is closed after 5 minutes if the remote does not respond in that time interval.
6) The LCD screen is constantly updated to show the count of the cars inside. It displays ‘Empty’ when count=0 and ‘Full’ when =2000.
7) Entry and Exit is completely controlled by the Remote unit. i.e. the remote is pressed, sensors determine the condition(entry/exit), weight check, count update on LCD and timer further closes the gate after 5minutes.

Variations in Proteus Implementation with Justification:

1. The switches are of momentary type.
2. Pin 8 in the motor driver can accept any value lying between 4.5V and 36V. We have given a 5V supply to it.
3. All enable pins of components which are constantly kept on are at 5V. This is because 5V is enough to enable the components.
4. The IR sensors (TSOP 1738) are kept as switches as this component is not available in Proteus.
5. The 50V 3A DC motor is not available in Proteus7. Hence, we have used the one available.
6. The pressure transducer CAT-PTT0000 is not available on Proteus. Hence, we have used a SPDT switch.

Firmware

Implemented using emu8086 attached.

List of Attachments

1. Complete Hardware Real World Design – smartgarage_g39.pdf
2. Manuals
    a. CAT-PTT0000
    b. TSOP-1738
    c. LM016L
    d. L293
3. Proteus File – smartgarage_g39.dsn
4. EMU8086 ASM File – smartgarage_g39.asm
5. Binary File after assembly – smartgarage_g39.bin