DEVELOPMENT OF SOFTWARE SYSTEM FOR MOTION DETECTION AND GARAGE DOOR CONTROL

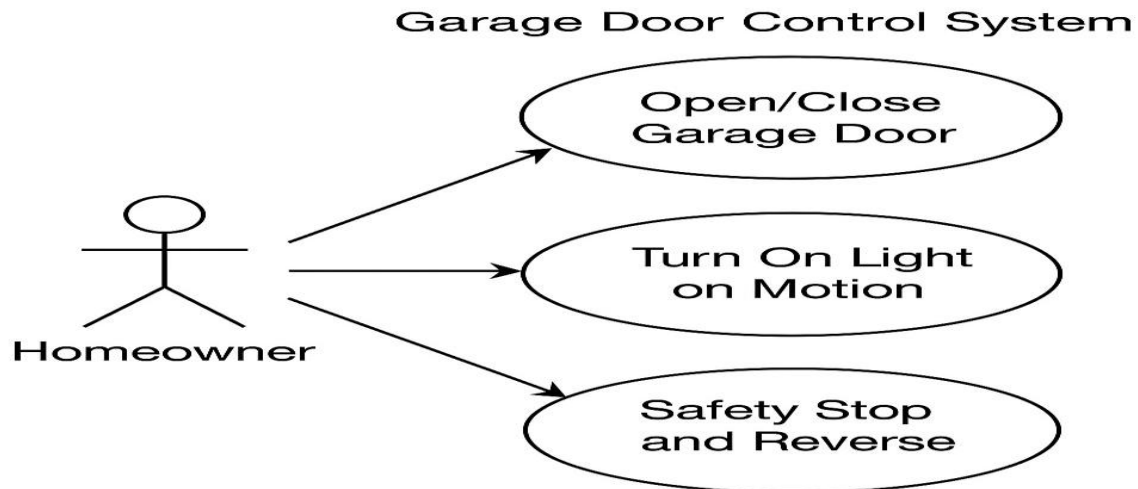## (a) Identify the Actors and Their Goals

- **Homeowner (User)**:

  o Goal: Open or close the garage door via remote transmitter or manual button switch.

  o Goal: Ensure safety by stopping/reversing the door if obstruction is detected.

  o Goal: Turn on external light upon motion detection.

- **Motion Detector**:

  o Goal: Detect the motion and signal the system to turn on the external light.

- **Electric Eye Sensor**:

  o Goal: Detect obstruction under the garage door during closing and signal to stop and reverse the door.

- **Remote Control Radio Transmitter and Receiver**:

  o Goal: Allow the homeowner to wirelessly open/close the garage door.

- **Manual Button Switch**:

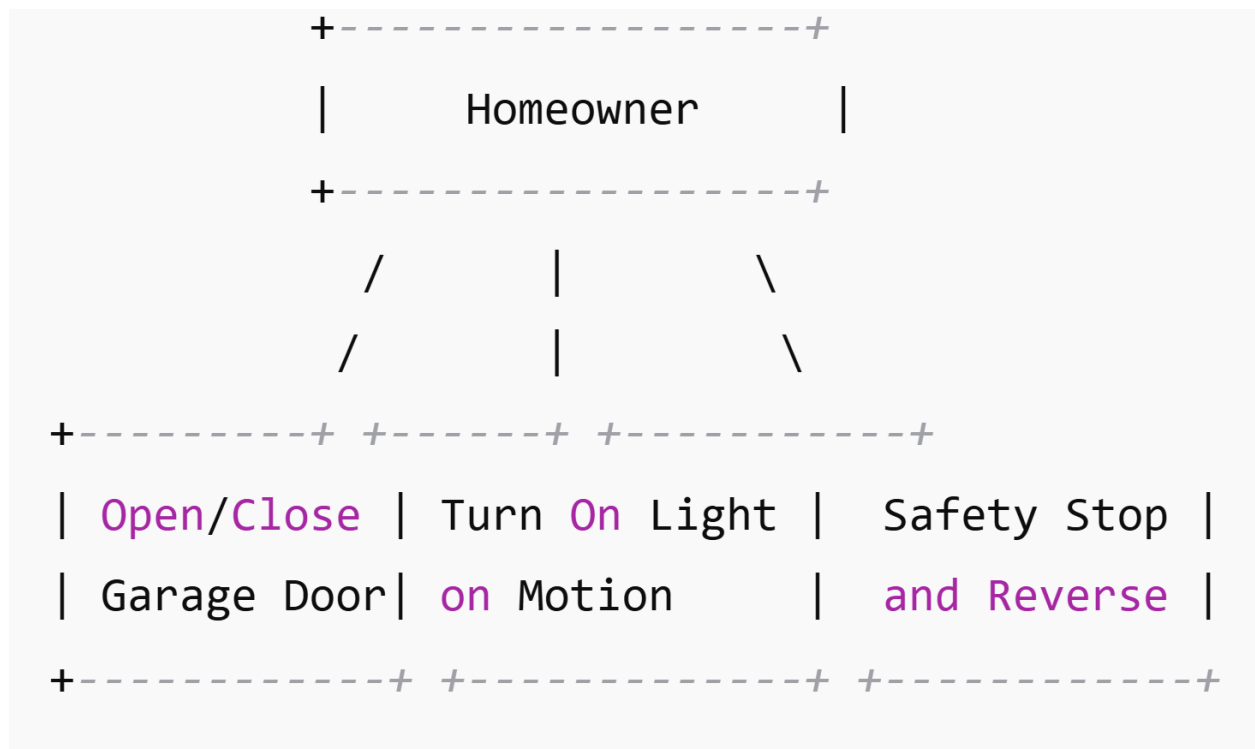 o Goal: Provide a manual method to open/close the garage door.

(b) Relevant Use Cases and Brief Description

1. **Detect Motion and Turn on Light**: When motion is detected within the perimeter, the external light automatically turns on.

2. **Open/Close Garage Door Using Remote Control**: The homeowner uses a remote transmitter to open or close the garage door.

3. **Open/Close Garage Door Using Manual Button**: The homeowner presses the manual button to open or close the door.

4. **Safety Reversal During Door Closing**: If the electric eye detects an obstruction while the door is closing, the motor stops and reverses the door.

5. **Auto Light Off Timer**: After a set period of inactivity (no motion), the external light automatically turns off.

These use cases ensure safety, convenience, and energy efficiency (Sommerville, 2016).

(c) Use Case Diagram

```
+-----------------------+
|      Homeowner        |
+-----------------------+
   /       |       \
  /        |        \
+----------+ +--------+ +-------------+
| Open/Close | Turn On Light |  Safety Stop  |
| Garage Door| on Motion     |  and Reverse  |
+----------+ +--------------+ +-------------+
```

Actors: Homeowner, Motion Detector, Electric Eye Sensor

System: Garage Door Control System

(*Adapted from similar designs in Laplante, 2017*)

(d) Fully Dressed Use Case: Remote-Controlled Garage Door Opening

Use Case Name: Remote-Controlled Garage Door Opening

Primary Actor: Homeowner

Goal: Open or close the garage door using a remote transmitter.

Preconditions: The garage door system is powered and operational.

Postconditions: Garage door is either fully opened or closed.

Main Success Scenario:

1. The homeowner presses the remote transmitter button.

2. The system receives a remote signal via receiver.

3. The system activates the garage door motor.

4. Door starts moving (either opening or closing).

5. Motion completes successfully unless an obstruction is detected.

Extensions:

- **Obstruction detected**: The electric eye triggers door to stop and reverse.
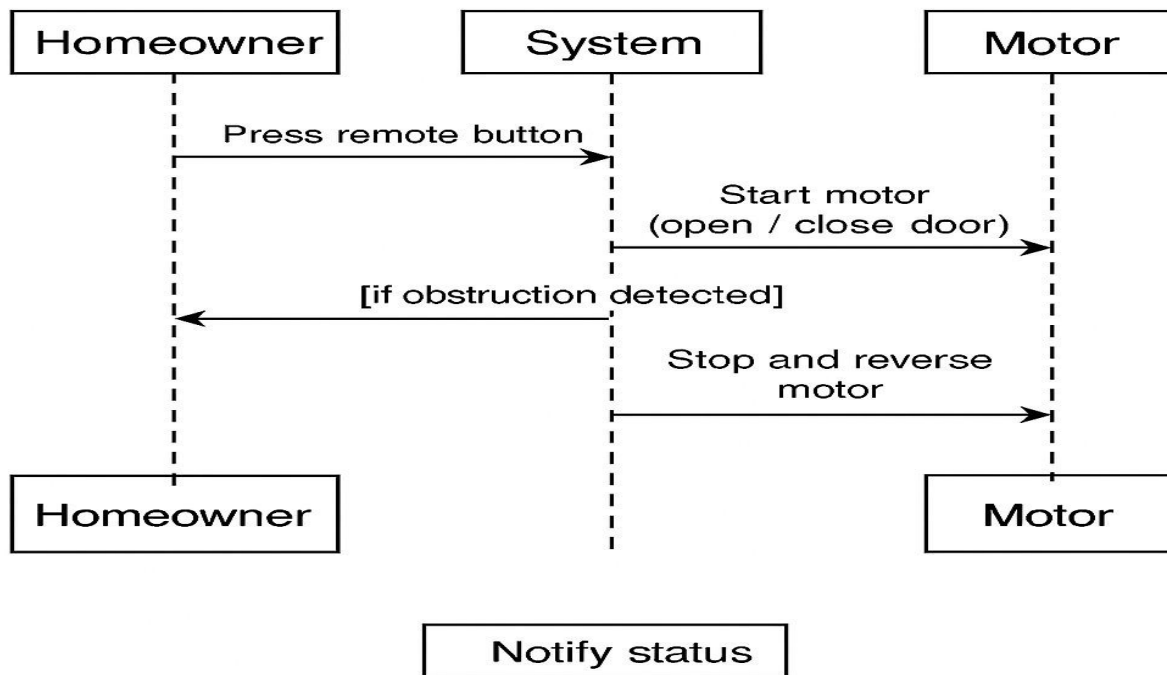
Special Requirements:

- The system should confirm door status via a light or sound indicator.

- Remote should work within a specific range (e.g., 50 meters).

(e) System Sequence Diagram (SSD) for Remote-Controlled Opening

```
Homeowner --> System: Press remote button
System --> Motor: Start motor (open/close door)
[if obstruction detected]
System --> Motor: Stop and reverse motor
System --> Homeowner: Notify status (optional beep/light)
```

(*Structured following the approach of Larman, 2005*)

```
Homeowner          System           Motor

    │                 │                │
    │ Press remote button            │
    │────────────────>│                │
    │                 │  Start motor   │
    │                 │ (open / close door)
    │                 │───────────────>│
    │  [if obstruction detected]       │
    │<────────────────│                │
    │                 │ Stop and reverse
    │                 │     motor       │
    │                 │───────────────>│
    │                 │                │
Homeowner                           Motor
```

             Notify status

(f) Operation Contracts for Remote-Controlled Garage Door Opening

Operation	Remote-Controlled Door Activation
Name	activateDoorMotor
Responsibilities	Start the garage door motor to open or close the door
Preconditions	System is powered; receiver detects valid signal
Postconditions	Garage door changes state (open <-> close); if obstruction, door reverses
Exceptions	If no signal is received, no action is taken; if obstruction detected, door reverses

Wordcount: 512

References

Larman, C. (2005). *Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development*. Prentice Hall. https://www.amazon.com/Applying-UML-Patterns-Introduction-Object-Oriented/dp/0131489062

Laplante, P. A. (2017). *Real-Time Systems Design and Analysis: Tools for the Practitioner*. Wiley-IEEE Press. https://www.wiley.com/en-gb/Real-Time+Systems+Design+and+Analysis%3A+Tools+for+the+Practitioner%2C+4th+Edition-p-9780470768648

Sommerville, I. (2016). *Software Engineering* (10th ed.). Pearson. https://www.pearson.com/en-us/subject-catalog/p/software-engineering/P200000003258/9780137503148