GasPressure Design Document

1. Intro

- Period: 6
- Group members: Mai Tran, Vicky Cai
- Group name: $M_1V_1 = M_2V_2$
- Project title: GasPressure

2. Description

- Simulate the difference in gas particle behavior using the Ideal Gas Law and the Van Der Waals equation
- Demonstrate the effect of changing the volume, number of moles, and temperature on pressure
- Include the option to choose different gas compounds (H_2, O_2, NH_3)

- What do the particles do?
    1) Collisions
        a) With each other (use conservation of momentum properties to find new velocity vector)
        b) With walls (this contributes to the gas pressure)
    2) Intermolecular forces with each other
        a) Quantified by Van Der Waals equation's constant a (the strength of the intermolecular forces)
        b) Van Der Waals equation's constant b will represent the size of the molecule

- What does the container do? Allow the user to:
    1) Increase/decrease volume
    2) Increase/decrease pressure
    3) increase/decrease temperature

- Library: LazyGui by Jakub Rak, used to implement user controls such as buttons and sliders

- Equations:
    1) Ideal Gas Law

$$PV = nRT$$

P = pressure
V = volume
n = amount of substance
R = ideal gas constant
T = temperature

2) Van Der Waals equation

$$P = \frac{RT}{V - b} - \frac{a}{V^2}$$

P = pressure

R = universal gas constant

T = absolute temperature

V = molar volume

b = gas constant b

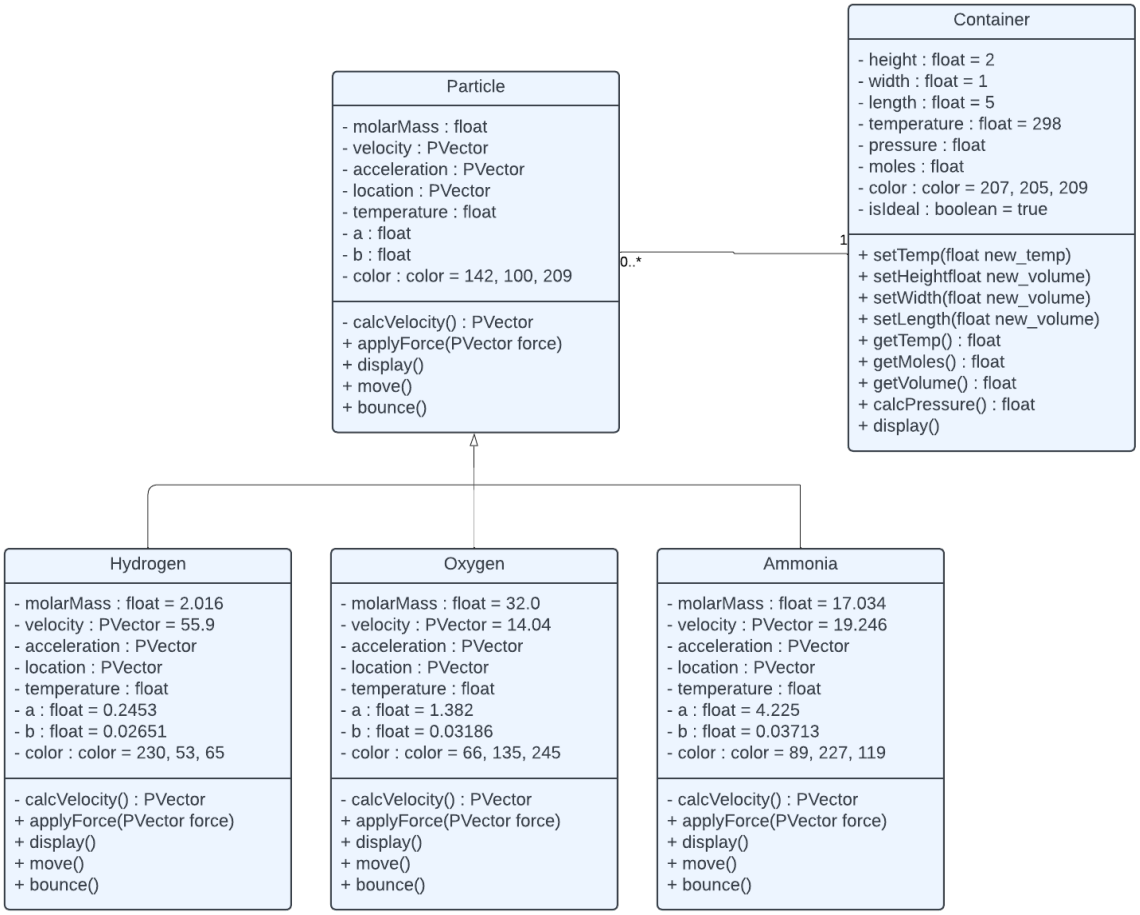
a = gas constant a

V = molar volume

3) Average speed of a gas molecule

points. The mean speed is $\sqrt{(8RT)/(\pi M)}$, where R is the universal gas constant (8.3144 J/K mol), T stands for the temperature in kelvins, and M is the molar mass of the molecule.

3. UML Diagram



4. **How does it work?**

- The user will click on a button to create a new container.
- Using sliders for height, width, length, and temperature, the user can vary these parameters to observe their effect on particle movement and gas pressure.
- To add new particles, the user will click on a button to add either Hydrogen, Oxygen, Ammonia, or a Custom particle. For Hydrogen, Oxygen, and Ammonia, parameters such as a, b, and molar mass are fixed. For the Custom particle, the user can define their values through text fields. If text fields are left blank, random values will be assigned.
- At the top left of the screen, data in terms of pressure, number of moles of each gas, temperature, and volume will be displayed.