Application of Science & Math Principles

~ Scientific Principle: Electronics and Circuitry ~

For the implementation aspect, as the design gets further into its production, a continuous set of calculations will be done as a way to ensure that our design upholds the viable constraints placed on it.

Due to the use of a transistor, the voltage running across the vibration motor may differ from the voltage of the motor itself (a value from the datasheet). Therefore, it is important to calculate the motor's voltage with the transistors' added influence at threshold voltage.

First, calculate power dissipation in the MOSFET transistor ($P_{Diss,\ MOSFET}$):

$P_{Diss,\ MOSFET} = I_D \times V_{DS}$

Where:
- I_D is the drain current.
- V_{DS} is the drain-source voltage

$$P_{Diss,\ MOSFET} = 0.00025\ A \times 18\ V = 0.0045\ W$$

*Values From **Datasheet***

Second, calculate power dissipation in the motor ($P_{Diss,\ Motor}$):

$P_{Diss,\ Motor} = I_{Motor} \times V_{Motor}$

Where:
- I_{Motor} is the current through the motor.
- V_{Motor} is the voltage across the motor.

$$P_{Diss,\ MOSFET} = I \times V = 0.07\ A \times 3.3\ V = 0.231\ W$$

*Values From **Datasheet***

Since $P_{Diss,\ Motor} > P_{Diss,\ MOSFET}$, it indicates that the majority of the power dissipation occurs in the motor, not in the MOSFET. This comparison indicates a good sign that the circuit is operating within safe limits regarding power dissipation. This is a positive outcome, as it means your components are not being pushed to their thermal limits, reducing the risk of overheating and potential damage.

~ Scientific Principle: Sensor Technology ~

The essence of this implementation is to confirm the true range of the PIR sensor, which is known to be a key component in this project. Understanding this range is critical because, without this knowledge, the design may lead to inaccurate object detection, potentially compromising user safety. Therefore, the below implementation steps will be taken into consideration:

First, we will place an object (acting as an obstacle) at the maximum specified range of the sensor, which is said to be 25 cm to 20 m. Then, upon activating and connecting the sensor, an accurate indication of the sensor's range can be determined, so that measurements are accurate and repeatable, especially at various distances within the sensor's range. Afterwards, a comparison of the sensor's range measurements to the actual distance of the object from the sensor will be taken into account, which will be used to calculate the difference, thus giving us an accurate depiction of the range.

Test Distance:

- 25 centimetres: ✓
- 30 centimetres: ✓
- 35 centimetres: ✓
- 40 centimetres: ✓
- 45 centimetres: ✓
- 50 centimetres: ✓
- 55 centimetres: ✓
- 60 centimetres: ✓
- 65 centimetres: ✓
- 70 centimetres: ✓
- 75 centimetres: ✓
- 80 centimetres: ✓
- 85 centimetres: ✓
- 90 centimetres: ✓
- 95 centimetres: ✓
- 1 meter: ✓
- 5 meters: ✓
- 10 meters: TBD
- 15 meters: TBD
- 20 meters: TBD

~ Mathematical Principle: Vibration Frequency ~

We will be defining and calculating the various vibration parameters, including frequency and amplitude. Additionally, we will alter the duration of the vibration and the silent (pause) time in between consecutive vibrations in a pattern during the programming and testing phase.

TBD