TerpVengers: Solenoid-Refrigerator Door Opener

Objective

Customer Requirements

1) No Interference with Refrigerator Seal
2) Doesn’t get Stuck under Operation
3) Quick response
4) No interference with manual opening
5) Convenient Trigger
6) Gap of Door Opening
7) Universal
8) Quick Installation
9) No or little extra space

Engineering Requirements

1) Force to trigger
2) Response time
3) Velocity of the door in motion
4) Weight of Device
5) Jamming Probability
6) Frequency to Failure
7) Installation time
8) Gap Opened

Constraints

- Must comply with all federal and state regulations regarding Refrigerator and Refrigerator Door safety.
- The device should not be heavy and should occupy little space, as most of the refrigerators are installed in the wall or with batteries.
- Our objective is to create a hands-free device that will allow a user to open a refrigerator door without using their hands.

Market Size

- Estimated that 99.6% of households own a refrigerator
- Over 2 million refrigeration units are sold in Maryland per year on average
- Estimated that 10% would possibly use the product giving us a market size of over 200 thousand households.

Function of Product

- Sensor operated linear solenoid breaks the seal of a refrigerator by pushing a force plate attached to the refrigerator door.
- Photo sensors utilized to send a signal to activate the solenoid.
- Operating code is installed in the selected controller.
- Fast response trigger, approximately 1-2 seconds in opening the refrigerator door.
- The force plate is attached to the refrigerator door on the side near the end with door.
- No technician required for installation.
- System can be installed on single swing door refrigerators

Prototype and Testing

Prototype

- Linear Solenoid in wooden framing
- Steel force absorbing plate
- Arduino Uno Microcontroller
- Two photosensors integrated into a circuit
- 24V Power source

Testing

- Tested the accuracy of photosensors in various lighting conditions
- Distance the door opens by solenoid measured
- Gap opened test before actuation of solenoid
- Gap opened test after actuation of solenoid

Test Results and Future Work

Test Result:

- 62% of successful response by Sensor
- 21% success on Opening the Refrigerator Door
- Lack of full power supply to Solenoid

Future Work and Recommendation:

- Improved power supply system to Solenoid, possibly a better solenoid
- Enhance device to be compatible on multiple models of refrigerators
- Implement plans to make the device an internal system of the refrigerator
- Alternate sensor mechanism for better human-device interaction

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