Week 1

Day 1-3

KWR Chart

Idea one: Thermal Imaging on a Door (good for letting pets in)

What do we know about the problem?
We know that nowadays many people are working jobs and required to leave their dog or pet at home. These pets need to be let out many times during the day so that they can relieve themselves and also get exercise. It can cost hundreds a day to have a dog watched or board them at a dog kennel. We also know that some of these dog kennels keep these dogs stuck in cages and don't allow them to roam free.

What do we need to figure out?
We need to figure out a way to fit a door with a thermal sensor that can detect a dog or pet that needs to be let in. We need to find the right thermal sensor to detect the pet. We would also need to come up with a motor to open and close the door so that you don't leave a door wide open.

What resources do we need?
We would need a thermal camera (to begin most likely an arduino camera) and we would also need to have a motor strong enough to move a small door. We would need a 3D printer to print parts and then something like a raspberry pi to hold the code that will activate the mechanism.

Idea Two: Automatic Sliding Glass Door Opener

What do we know about the problem?
Pets often want to go outside when their owners aren't home. This way the owner can leave a pet at home and allow them to go out during the day. This relates to the first problem stated above that many pets are not able to get out during the day due to their owners being away. It also saves money that the owner would otherwise spend on sending a dog to a kennel.

What do we need to figure out?
How to connect a button on our phone to a mechanical arm which can extend and pull the

sliding glass door. We also need to find a way to fit a sensor to a door that will slide the door open for the pet and then close it as it goes outside. We also need to figure out where to mount a motor that will open a sliding glass door so that it is not in the way of anything. Lastly we will need to figure out safety measures to keep intruders from using it.

What resources do we need?
We would need a motion sensor, a 3D printer to help print custom parts, a motor and a replica of a sliding glass door. This would allow us to design the parts needed to create the automatic door for the pets.

Idea Three: Motion sensor door opener

What do we know about the problem?
We know that there is a big problem in opening doors in the house for many daily tasks. This does not only pertain to letting pets in, but also relates to carrying large things, helping the elderly and children get in. For those unable to open a door in their house, a motion sensor door can make their lives a lot easier.

What do we need to figure out?
We need to find out the opportune place to put a motion sensor on a door and what type of motor and camera to use. We also need to find the most commonly used door in the house to install the camera and motor. We also need to figure out how to properly code this idea and what to code it on (potentially arduino).

What resources do we need?
We would need an arduino and a camera to detect movement outside of the door. We would need a very small scale model of a door to test on. We would need a 3D printer for custom parts and we would need many resources like people to help us with how long they'd like a door to be open.

Day 3-5

Planning

Project Title/Topic	Thermal Imaging door opener

Goal	
Goal: Formulate an inquiry question or statement that clearly shows your goal, based on your personal interests. Be concise but specific and clear.	We want to design a door which can be opened using thermal imaging and a regular camera as well so that a pet owner can let their pet out at the opportune time.
What is the purpose of the goal? What do you hope to achieve?	The main purpose of this is for pets when owners aren't home. This would achieve the problem of pet owners not being able to let their pets out and leave them at home during the day due to them not being able to let their pets outdoors.
What prior learning and subject specific knowledge is relevant to the project? How does the project relate to an academic class you are currently enrolled in or have taken?	In a previous project, we learned how to build and code a thermal camera. In addition, we have experience with automation and mechanics in our engineering classes.

Global Impact	
Identify how this will impact the community/world:	This would greatly help the community and the world as many people can't afford to send their dogs to a kennel for many years. An automatic door opener would be a 1 time payment and would last a very long time thus giving them their money back over time.

Product/Outcome	
What product/outcome will you create in response to the goal, global context and criteria?	We will create an automatic door opener which can be used in homes and will be connected to a thermal camera

Form: Function: User/Audience: Costs:	Mechanical arm + camera Open door for pets/elderly Pet owners Mechanical parts + camera

Research	
What will be the focus of your research?	How to build the mechanical parts of a door opener.
Media: (Includes books and articles, etc.)	Internet. Articles. Surveys on what pet owners think of cat doors and what they would rather have in their household.
Surveys: Would surveying your potential audience be useful?	It would be useful to survey our potential audience to determine their preferences when it comes to different aspects of our design.
Interviews:What human resources can you tap into for your project?	Pet owners. Mechanics. Carpenters (door design). People that deal with doors and the idea of automatic door openers.
Other sources for research?	This should be sufficient.

Specifications

Prompts	**Student Designed Criteria**	**Test or method of evaluation**
Form: What will your project look like? What materials will you use? What size will your project be? What tools will you use? How will you assemble your project?	Our final design will consist of a mechanical door opener connected to a thermal camera. We will use motors and metal/plastic parts for the arm. Our project will be compact and will fit on a standard sized door. Tools: 3D printer, handsaw, screwdriver. Electrical cords. We will use a screwdriver to assemble the arm and assemble the camera using our hands.	The project should fit inside a door and be relatively unseen. We will make sure that all of the wires and mechanical bits will be put in the door. We make sure that it fits the constraints of a door and does not pop out. The arm will be above the door and a neutral color so that it does not stand out. We will survey those in the class on the looks.

Function: What is the purpose of your project?	Open doors for pets so that owners can save money over time and not have to continually send their dogs to a kennel and lose money. This also saves money in comparison to the idea of a cat door or dog door because those let in a lot of air.	The product will open the door and then will stay open for a small period of time and then close fully so that the door does not leave any cold air coming in. We will make sure the door closes completely and that the door and cameras detect the pet that wants to go out or get in.
User/Audience: Who is your project for? What needs do you expect your project to satisfy? Where/why will you project be used?	Our main audience is for those with pets that want to leave their pets at home while they're at work. This is for those that may not want to or cannot afford to send their pets to a kennel daily or weekly.	We will do a survey of pet owners that are away during the day. Based upon this we will determine whether the product is meant for pet owners that are away during the day. We will put these results into a bar chart to compare these results.
Costs: How much will your project cost to make? ***How much will you sell it for? ***How much profit could be made on your item/project?	A rough estimate of our costs would be $30 for a camera that would plug into an arduino. We already have an arduino, thermal camera, and wires necessary. Including the parts and 3D printed would cost around $100-$200. We would retail it for $200 or $250 to make a profit but not too pricey for the consumer. We would make about $100 profit per product.	In order to test if the cost is correct we will keep a chart of all of the costs of the project and make sure that the total is at or below $100. We will then survey the audience we surveyed before and see if they agree on the retail price or not. If they don't we will tailor the retail price so that we make enough profit to continue to produce these mechanisms.

Week 2

Day 1-2:

Progress Check #1

1. Decision Matrix

	Ease of Coding	Ease of building	Originality	Ease of use	Price	Total
Thermal Imaging on Swinging Door	7	7	4	5	6	29
Automatic Sliding glass door (Thermal and regular camera)	4	6	9	6	6	31
Motion sensor door opener (winch)	6	7	2	6	7	28

Justification: We decided to choose the sliding glass door because it seemed like the most applicable idea out of the three. Many pet owners have sliding glass doors at home and the idea of creating an automatic sliding glass door is relatively unique, unlike an automatic swinging door. We also liked the idea of using two types of cameras as safety and backup so that we don't create many mistakes. Oftentimes we see pet owners wanting to check if their pet is okay and whether or not they REALLY want to come inside. By using the joint cameras we can create a failsafe. If the pet is running by and the camera activates and the owner sees, she or he can put their phone down and not have to worry about letting their dog in at that time. When the dog or cat comes to the door, however, the thermal camera will pick up on the heat from the dog and the activate the regular camera to show the owner that they want to be let in. This means that owners don't have to worry about the door opening automatically without their input and letting cold air and perhaps other animals inside the house. This project is ambitious and potentially tough to code, but with the right parts and some tinkering with the Raspberry Pi we can create an amazing product, unlike the other two ideas which would just be a slight change from what is already out there. Due to this, Design #2 is the best design possible.

2. Design Constraints:
-Must be able to detect a pet or animal 5 times out of 6 with the thermal camera when a living thing is placed close to the door
-Must be able to show the living thing on the camera once detected by the thermal imaging and track the animal with a rotating camera
-Must have a motor that opens the door for five seconds and then closes the door thus sealing the home from the outside elements
-Must be able to the display rotating camera to a phone
-Must be able to be put on a sliding glass door at a house
-Must be in the budget for pet-owning people (survey)

Day 3-4:

3. Parts list
1.Motor for the door: 2183-1205-ND motor for Arduino
2. Raspberry Pi
3. Breadboard for wiring
4. Wires for breadboard
5. PIR motion sensors for Arduino camera
6. Servo motor for motion tracking camera
7. LED status indicators
8. Computer for coding
9. Thermal camera for PITFT
10. PITFT display for initial output
11. Wifi module to output data to a phone
12. Phone to receive data
13. Relay module
14. Pushbutton
15. Ultrasonic sensor

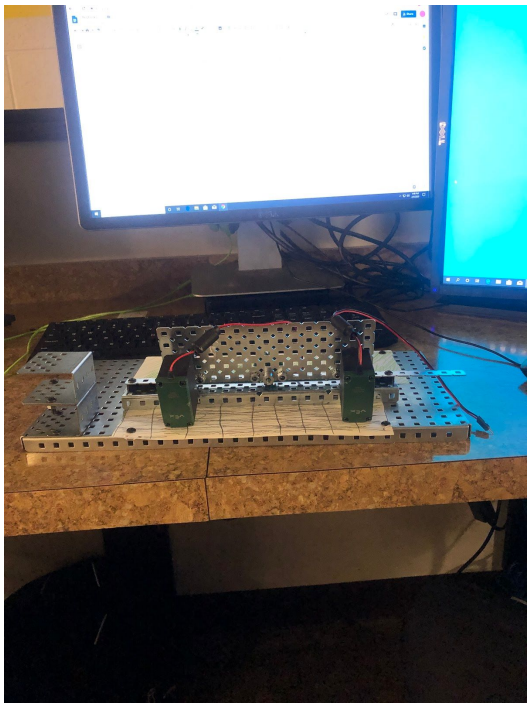
Things to help:
Sliding door help:
https://create.arduino.cc/projecthub/DVDMDN/automatic-sliding-door-for-the-garage-c7b1ba

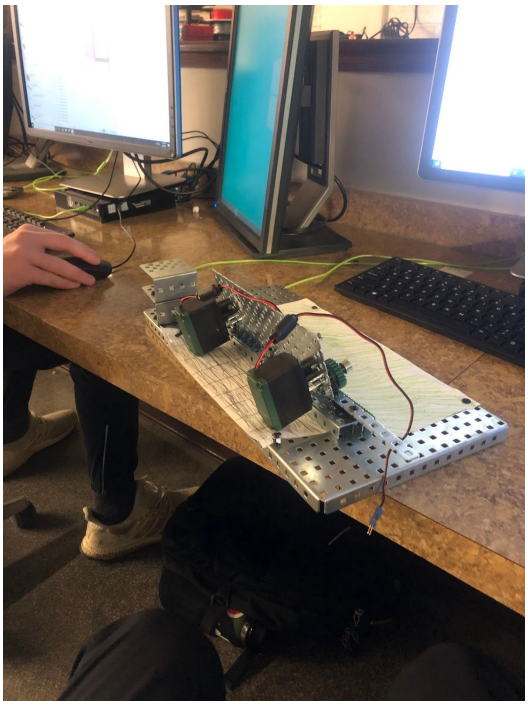
Motion detector help:
https://create.arduino.cc/projecthub/walid-mafuj/android-motion-detector-camera-with-arduino-mcu-306789
Advanced thermal imaging help:
https://www.google.com/search?q=thermal+camera+raspberry+pi&rlz=1C1CHBF_enUS840US840&oq=thermal+camera+raspberry+pi&aqs=chrome.0.0l8.8122j0j4&sourceid=chrome&ie=UTF-8

Multiple projects on one pi:
https://www.raspberrypi.org/forums/viewtopic.php?t=144490

Day 5:

4. Working Illusion





This is the working illusion that helps demonstrate the way the door would work with the motors and potentially where the camera would be to sense the pet on the inside and outside. This camera would potentially also go on the door. The basic concept is that the cameras (the

boxes) would pick up the animal and then send the data to a phone. The owner would then be able to say whether they wanted to let their pet in or not. If their pet was still playing at it was a false alarm, the owner does not have to let their pet in. The green is for grass and the black is on the inside. This isn't a completely working prototype, rather a demonstration of what it would look like.

Week 3

Day 1:

Problem:

Pet owners don't have a reliable method of letting their pets outside during the day or while they're on vacation. In addition, often pets want to go in and out frequently during the day, which can be a hassle for pet owners as they have to deal with barking and/or scratching. It would be convenient if they could simply press a button to let their pet out rather than having to walk to the other room and open the door themselves. Heating and cooling account for almost half of the energy used in the average home, so inefficiencies, like air leaks, matter. Since a pet door creates a sizable opening in your home's conditioned envelope, it can easily let your heated air escape in the winter, and allow hot outdoor air in when you're cooling your home in the summer.

Possible Solutions

We had many possible solutions for this idea, but mainly we wanted to incorporate the idea of a camera so that the pet owner could view their pet before letting them out and then again before letting them in. This would give the pet owner extra assurance so that their pet is safe and also to make sure that we can limit the amount of false alarms with doors opening and closing randomly. Our three mains possible solutions were:

1. Thermal imaging on a swinging door
2. Automatic sliding glass door with thermal imaging and a motion sensor
3. Motion sensor on a door that opens vertically

Day 2:

Research

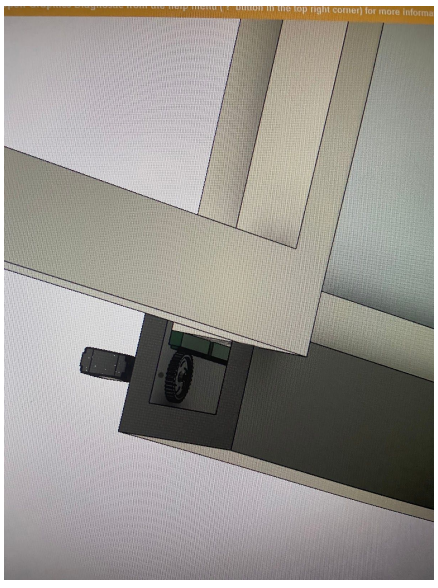
One of the main cons to installing a dog door are the safety concerns that go along with it. If you live in an area where **coyotes** or other wild animals are prevalent, you may not want your dog outside when you're not home.

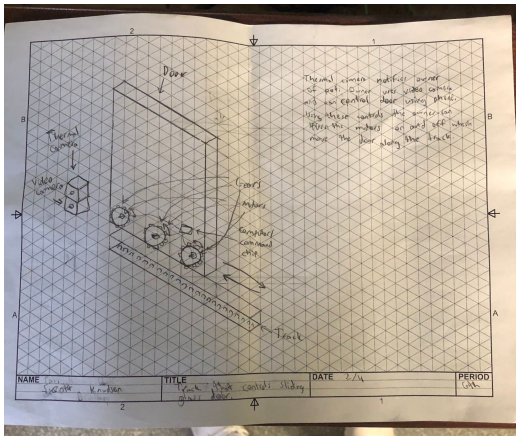
Dog doors can bring excess mud caked on from the outside when a dog has been playing. Wet weather causes havoc in the household.

Similarly, if you have a **pool** a dog door may not be the best option. Not only does it allow for a wet dog to go traipsing through your house, but it can be dangerous for your dog to swim unsupervised. And, of course, there is always the potential for stray animals or criminals to enter your home.

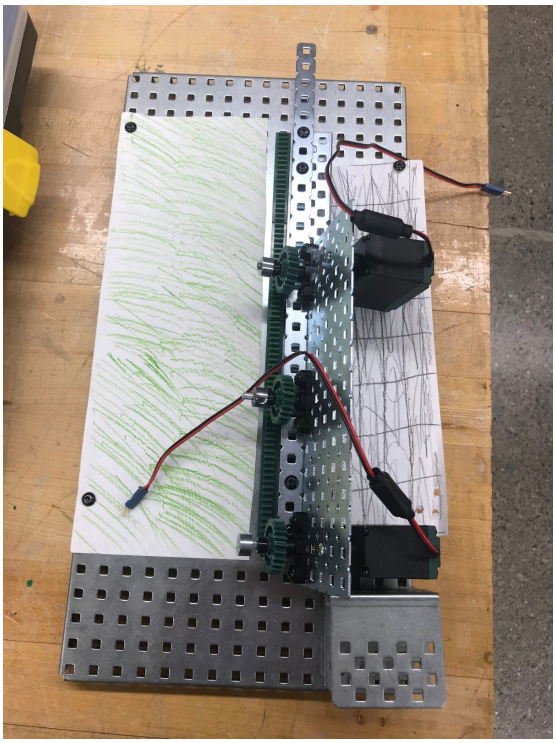
Another con of dog doors is that they only work for certain households. They require a fenced yard, and a dog that is well-behaved enough to not escape the yard when left unattended. They are also difficult to use in households with other pets, such as cats.

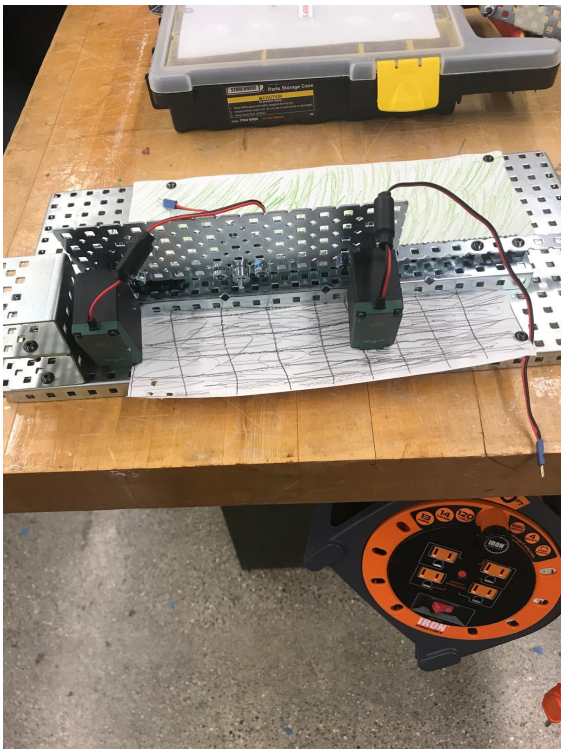
CAD and Sketches:

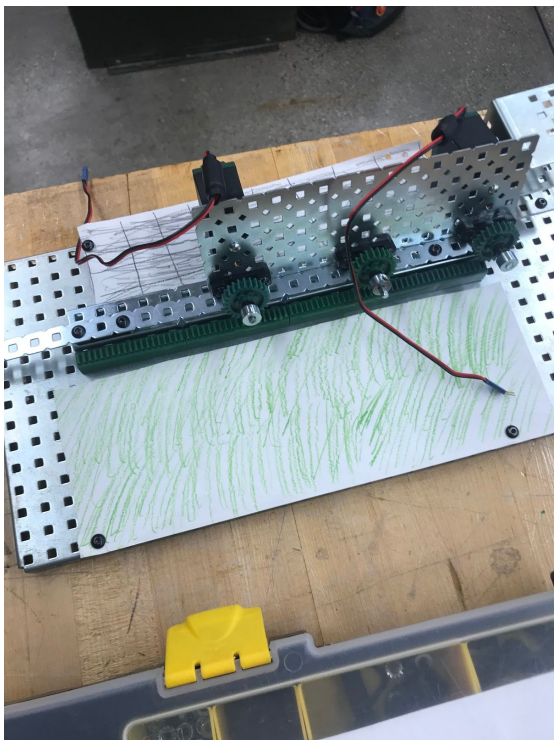




Prototype 1:

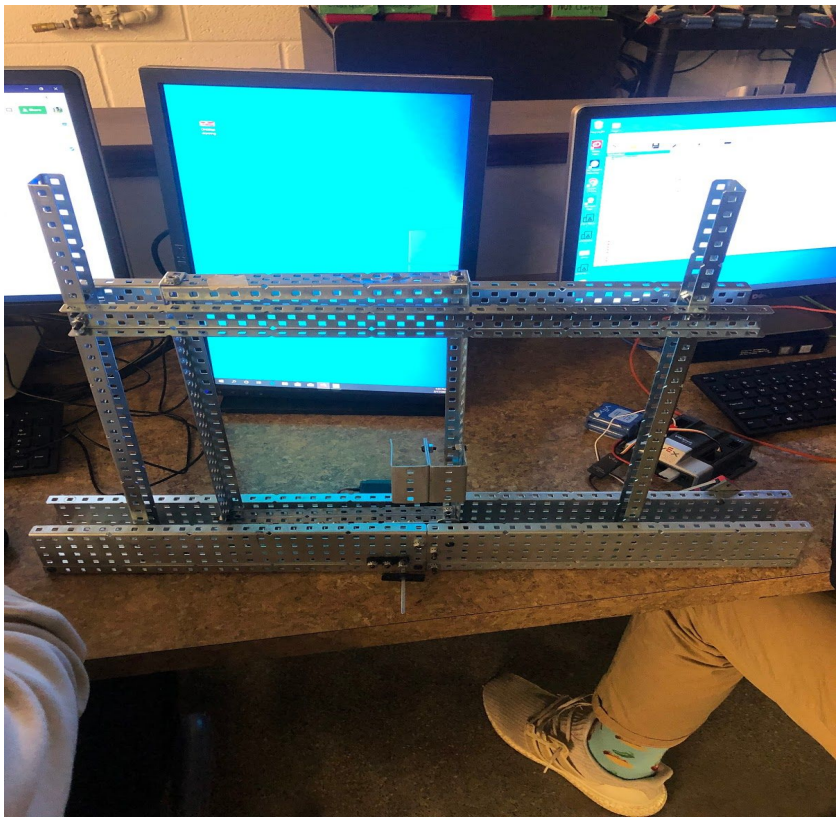






Day 3:

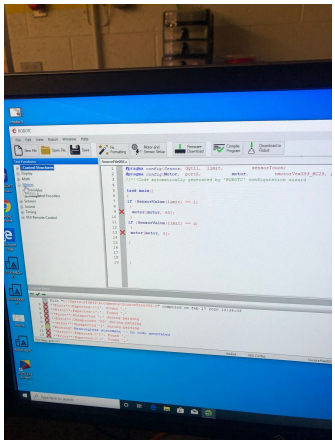
Prototype 2:



Coding:

-The coding in our second prototype was accomplished using a robot coding language called RobotC

-For our final prototype, which includes a thermal camera, video camera and the movement of the door, we utilize a Raspberry Pi



Day 4:

Differentiation from Existing Products:

Different aspects of our design may be observed in existing products, however, our product is the only one that incorporates all of the following aspects:

- Thermal camera utilized to alert owner when pet is at the door
- Mechanics to open door are permanently installed into door frame to ensure product is viable for owner
- Door can be opened or closed when owner isn't home
- Video camera so owner can observe area around door

Market Value and Social Impact

-This product has potential to help cut down on energy consumption by a large amount.

-Normal pet doors are extremely inefficient with their energy consumption and allow a lot of cold air to be let in.

-This causes a home to expend a lot more energy than necessary. With this product allows more environmentally conscious pet owners to implement a door that can let their pets out and also keep the warm air in.

-This product will use cameras and motors which may warrant slightly more energy use than before, but there will not be nearly as much energy loss as there is a complete seal between the door and the rest of the house compared to alternative options.