UNIVERSITY OF NEBRASKA-LINCOLN

DEPARTMENT OF MECHANICAL & MATERIALS ENGINEERING

MECH 492-001

MAKER FOR INNOVATION

FINAL REPORT

Manual Dog Carpet Mill

University of Nebraska-Lincoln

Mechanical Engineering

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Executive Summary

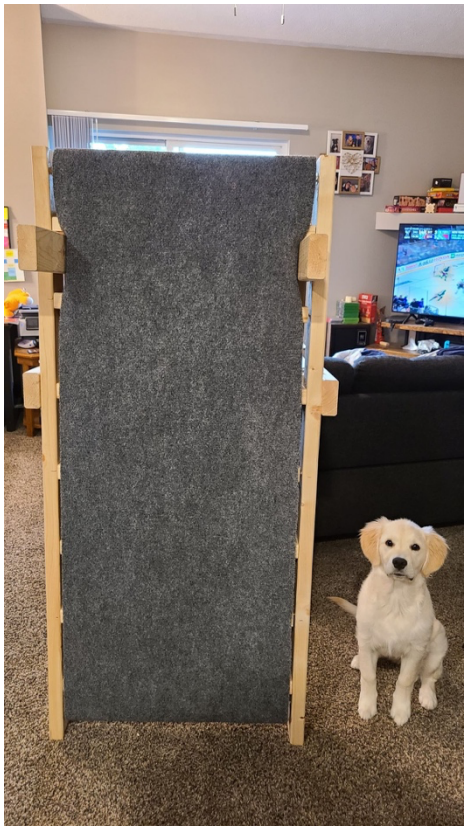
Every year, dogs across the United States are diagnosed with obesity. This is an issue in canines that is very important to address. On average, any dog diagnosed with obesity is expected to live anywhere from 6-12 months less than a healthy canine. Obesity in canines is also known to cause a wide variety of other health problems; these include many types of cancer, diabetes, heart disease, arthritis, bladder issues, and many more complications. These issues can typically occur in any dog but are sure to occur much more often in certain breeds of dogs.

Upon discovery of the final project requirements from Dr. Shane Farritor, I immediately thought of my dogs at home. With all the health issues in dogs listed above, the health and well-being of our dogs is of utmost importance to me. We have two dogs at home; our oldest, Tucker, is a mixed breed with pit, black lab, border collie, and several other unknown breeds in him. Pits and labs are both known for their struggles with weight issues and large needs for exercise. Our second dog, Oakley, is an English Cream Golden Retriever; this breed is well known for suffering from hip and joint issues, both of which are issues directly relating to obesity in dogs. Upon consideration of different toys to make for them, I came up with the idea to either do a carpet or slat-mill. This project was chosen because of the typical cold winter and rainy springs we have in Nebraska. When such events occur, our dogs often do not get enough exercise and get stuck inside the small apartment for days at a time only getting to go out for bathroom breaks. Being a college student on a tight budget, I decided to go with a carpet mill for budgetary reasons as well as its ability to fit inside a small apartment and be stored easily. Once deciding upon this, a manual carpet mill was sketched up by myself and I immediately began to design, manufacture, assemble, and test the treadmill as quickly as I could. What I have since created is a functional prototype for a new type of carpet mill that will be manually powered by my dogs.

The final design found a balance of cost, safety, and ease of use. The intended use for this prototype is medium to large sized dogs, but I plan to adapt this design in the future to hopefully create something adaptable for all dogs I have throughout my entire life. This is capable of changing slopes to mimic running up hill. It can also be locked by fixing anything underneath the rear of the belt on it. The carpet that runs across the top is also light enough that the dogs can easily propel it along themselves, but if they stumble it will stop under their feet with them rather than continuing to rotate. There were various designs that were considered and ruled out; these included making it powered, the type of material to use for the belt, and how to attach the dogs to the treadmill for their safety. It was also designed so that these can be interchanged and adapted in the future the more the dogs become trained to run on the treadmill properly. An image of very expensive treadmills compared to what the end product should be close to is shown below.

Treadmill Features and Details

The first image below is a view from the bottom of the treadmill. As you can see, this system is supported by two legs towards the front of the treadmill. These are positioned in two key positions, both on the inside of the frame to support the plywood sheet on top, as well as a short distance back from the front in order to sit directly under where the dogs' paws will land most often when in a run. This helps to maintain the loading that the structural members of the treadmill will see. Also seen from the bottom is the legs effect on the carpet. Originally, the legs were going to be positioned on the outside of the treadmill to avoid the carpet, but during testing, it was discovered that the carpet shifted side to side as the dogs ran and wanted to buckle up against the edge. By positioning the legs inside of the frame, the carper can fold in and be pushed back towards the center much like the edges of a pulley wheel would influence a rope or belt running through them. Our currently 30 lb. puppy is also in the image for size comparison.

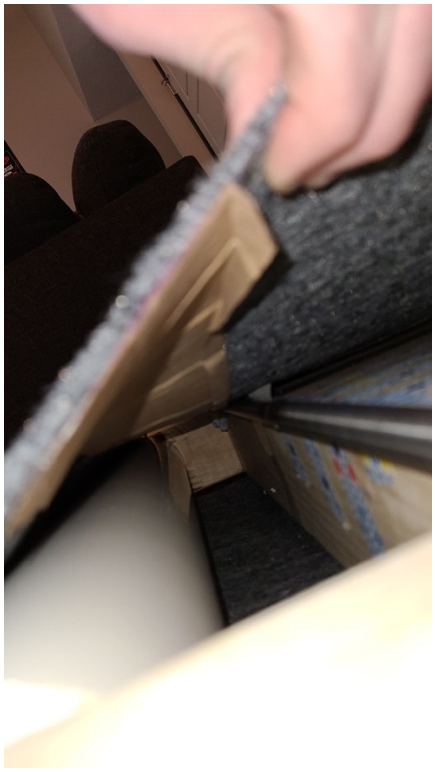


The next image is the top rail of the treadmill where the dogs are tied into. Currently, there is a carabiner run through an eye hook that we can attach their leashes to. For future designs, once both dogs are close to the same size, there is a flat nylon rope that will attach directly to the eye hook and be irremovable. This will offer a very strong and rigid support for the dogs to be attached to. The purpose of this being rigid and fixed is to offer the dogs slack as they hop and run on the treadmill to relieve pressure on their “gate” or what would be known to us as chest and shoulder structure. The hook is strong enough to hold more than 5 times the dog’s weight if they are to fall and will be very inelastic to ensure they are caught and not hurt. The member on the top is also doubled and anchored into the frame with several screws in both layers. This ensures the top will remain rigid and will direct the loading to the outer support arms rather than down the long slim boards on the bottom portion of the treadmill where most force is applied.

This third image shows one of the roller systems on the front end of the treadmill. As can be seen, there are three important aspects to how this was designed. The first aspect is the metal rod seen in the bottom center of the image below. This is fixed in place directly in front of the ¼" plywood sheet that sits on top of the frame beneath the carpet. Initially it was only the plywood in the design, but the carpet seen kept coming apart; the second solution to this issue will be talked about in the paragraph following the next. The initial solution to the carpet coming apart at the seam was to eliminate the sharp, rigid edge the carpet had to roll over. I had some leftover ½' D-shaft from a separate project and this was a perfect solution. By placing this in front, it offered a smooth, slick surface for the carpet to glide over while maintaining its speed. The second and third aspect is the roller and its attachment. The roller is made of a PVC pipe because this is both sturdy, rigid, and lightweight. This made it easy to make it spin without implementing expensive bearings into the design. Finally, the bolt attachment aspect of the design was important in determining how smoothly the system would spin. By drilling a pilot hole into the PVC caps 1/16" bigger than the bolt size, it glides and rotates on top easily.

This portion of the treadmill is again the front bottom portion of the treadmill. As can be seen, the bolts used for the PVC to ride on were given washers for support because the bolts need to be tightened down to eliminate the chances of them spinning and creating more resistance on the PVC rollers. Also seen are the screws used for anchoring and supporting the leg portion of the treadmill. The triangulated group of screws were placed and numbered strategically to ensure that all the loading seen on the front joint would be handled and deflected appropriately. Also in this image, it can be seen again the path the carpet takes as it comes from underneath the mill to roll back over the top. It is important to see how the carpet has enough flex to bend around the legs and keep it in alignment while also not pressing and creating a ton of resistance for the mill.

This image is referenced to the earlier paragraph speaking about the carpet seam coming up. As is seen in this picture, the corner of the seam tape is slightly peeled as a result of the sharp plywood edge it originally ran over. Once the metal D-shaft was added, it offered a rounded, slick edge for this paper backed tape to run over. To ensure the tape stuck even more and remained fixed, I also ran a cross stitch down the entire seam of the carpet as added support. Once the carpet is up over the front edge, it is also important that it was to glide smoothly across the plywood, but also maintain enough friction that it works the dogs as well as stays in place enough that the treadmill will stop or stay in place if the dogs slip and fall or are standing in place between runs. This solution was accounted for by running strips of very slick tape down the middle parallel to the edges of the treadmill. This tape was staggered every few inches to ensure there were slick contact points for the dogs to make the treadmill go, but also to maintain a little friction from the plywood surface beneath. This provided a perfect pace for the dogs and also works similarly for humans when I stepped on the treadmill and tested out how it works.



The final image shown below gives a more in-depth view of what the framework of the treadmill looks like as well as the materials used. As seen below, the frame is made from 2x4 studs. These are most commonly used for house construction and are very sturdy for this application. It can be seen these are run horizontally across the running surface to offer the most overall coverage in a compact space. This pattern also helps direct all the forces evenly across the running surface and dissipate them into the sturdiest part of the treadmill into the floor. The ¼” plywood can also be seen. This is a finished sheet of plywood; it is important to also see the direction of the grain in the wood runs with the belt direction to ensure low enough friction for the belt to spin while still being sturdy. This was all fastened with 3.5” deck screws into predrilled holes to ensure the wood did not split while the frame was still attached everywhere in a very sturdy manner.

Conclusion

Overall, this project was decided upon to help conquer the chances of obesity and future health issues in our dogs. With how common these issues are in canines, especially the two breeds of canine that my dogs are, this project hit very close to home for me and was a project that caught my full attention early. With the final product completed as is above, several tests as mentioned throughout the paragraphs above were run and completed to great success. Many changes and redesigns were able to be completed to ensure the product was safe and easy to use for both of our dogs. We have had this treadmill set up in our apartment since late March and it has brought many successes so far. Since beginning use, Oakley has very quickly learned how to use it which is very beneficial to her mental growth as well as keeping healthy joints as a puppy. Prior to this project, we had also noticed Tucker had begun to get overweight and wanted to ensure he had something similar to this to get him back to shape with our busy schedules. Again, beyond completion of this process, Tucker has lost 5 lbs. of weight solely from treadmill use and is very near his ideal body weight again. Overall, this project was a lot of fun to complete and is a great success.