

BICYCLE POWERED PRODUCE DRYER

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Problem To Solve

Create an energy efficient product that addresses the need to be more sustainable and uses less natural resources to spin dry large volumes of produce in order to maximize production for a farmer with a sustainable operation

Design Constraints

- Provide the same capacity as an electric commercial salad spinner
- Produce the same horsepower as an electric commercial salad spinner
- Made with primarily recycled and easily obtainable materials
- Small overall footprint
- Simple design with no electronics
- Comfortable pedaling cadence for the average human
- Weather resistant materials that are easy to clean

Experiments & Data

The following experiments and data collection were performed to obtain valid data:

- Performed calculations using recycled washing machine bin dimensions to find the necessary RPM required of the drying bin to meet the same speed of an electric commercial salad spinner
- Researched studies done to analyze and evaluate cycling cadences for the average user without excessive force and effort
- Using the required output RPM of the produce dryer and the appropriate input RPM from the user, calculations were performed with various pulley and sprocket dimensions to find the rated horsepower requirements of the 90 degree gearbox to transmit mechanical power from the bicycle to the produce drying bin

References

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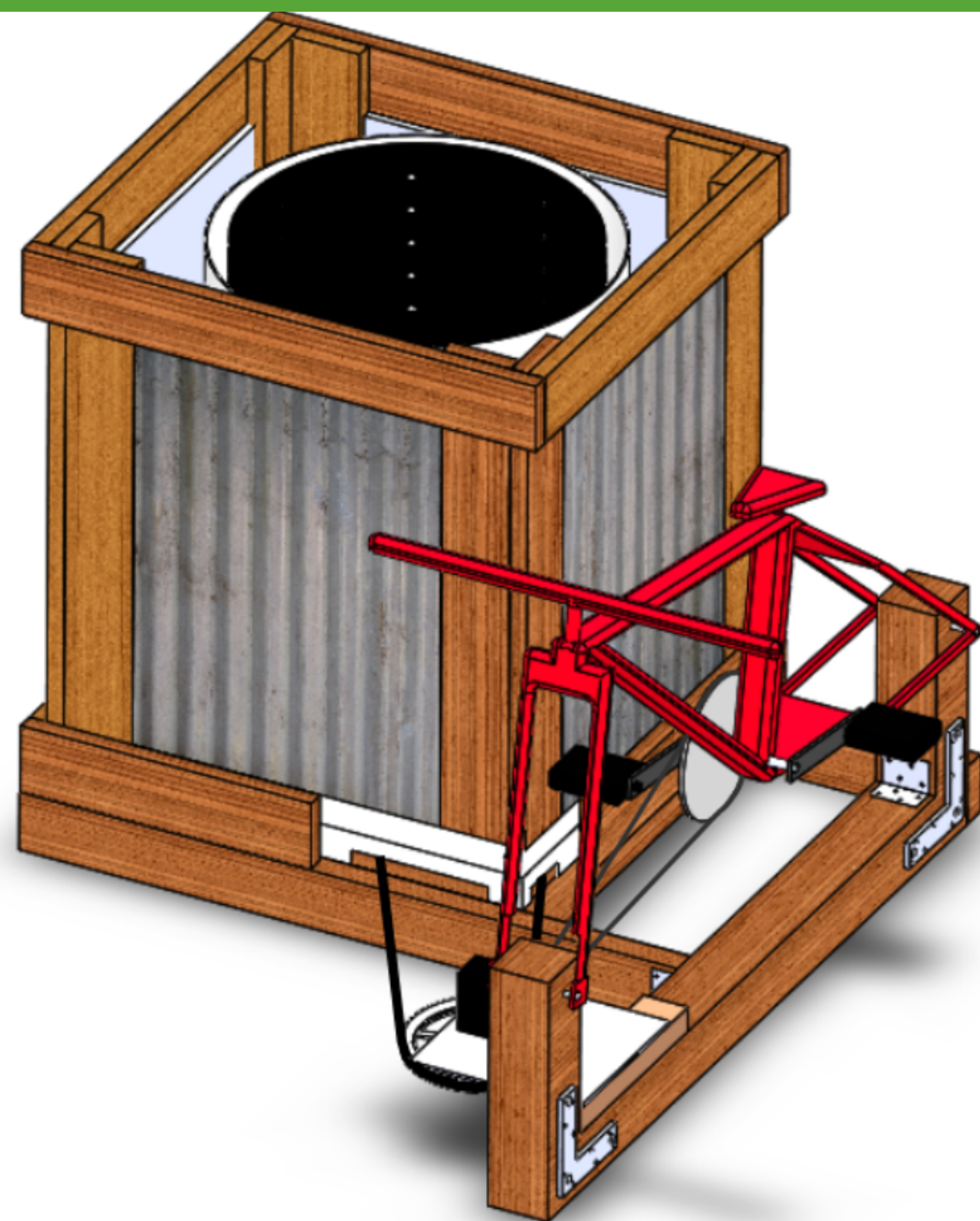


Figure 1

Figure 1: Bicycle Powered Produce Dryer made from recycled and easily obtainable materials. Overall dimensions are 48"L x 42"W x 38.2"H. All materials are weather resistant and easy to clean

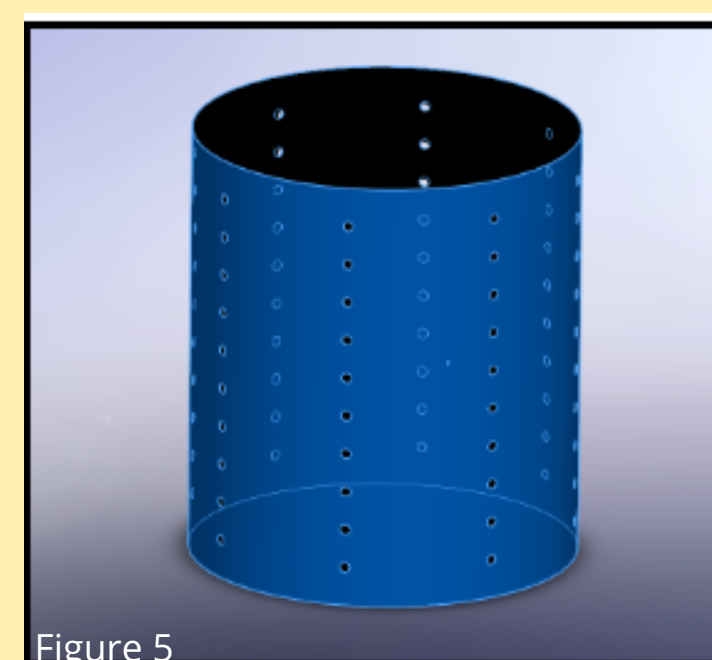


Figure 5

Figure 5: 20 Gallon trash can with holes is repurposed to be used as a removable bin for drying the leafy greens

Figure 2: 90 degree gearbox is attached to the bike stand with input sprocket in-line with the bike sprocket

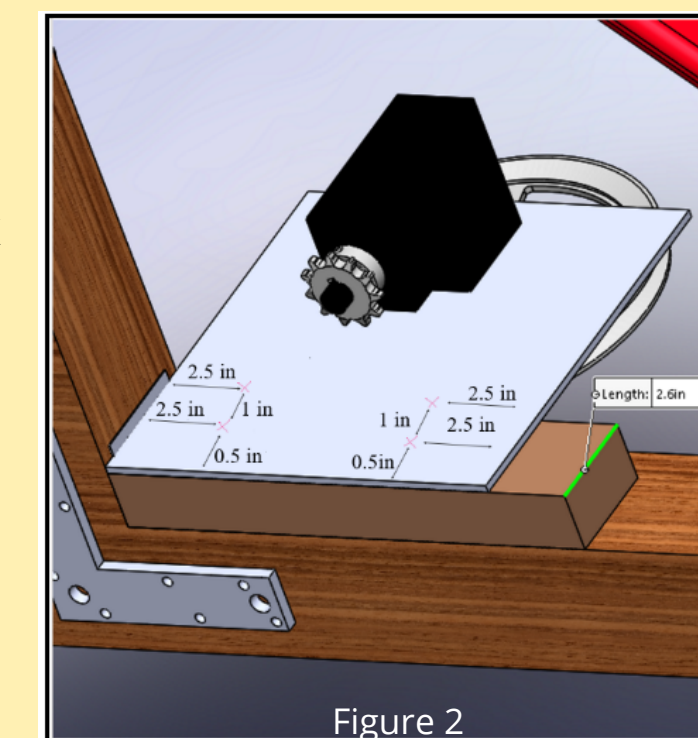


Figure 2

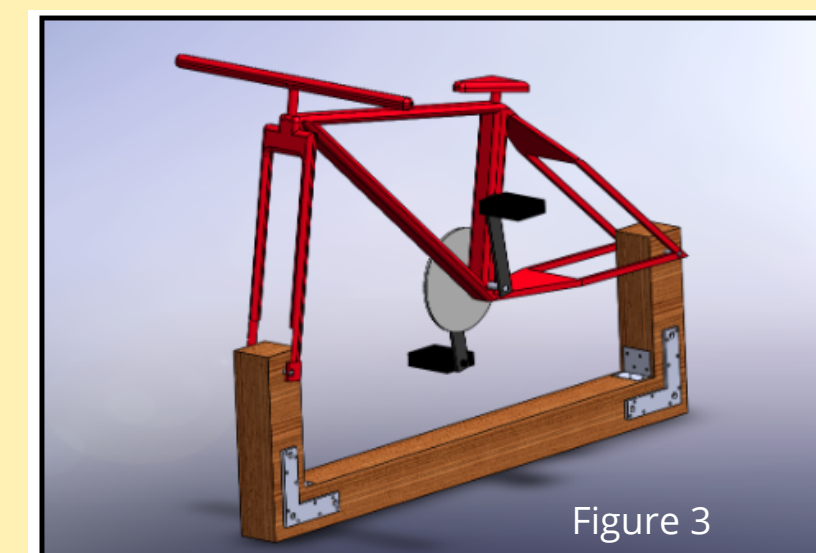


Figure 3

Figure 3: Bicycle stand constructed from lumber to support the bicycle and user is easy to construct and compact

Figure 4: Broken down recycled top load washing machine bin used for drying leafy greens

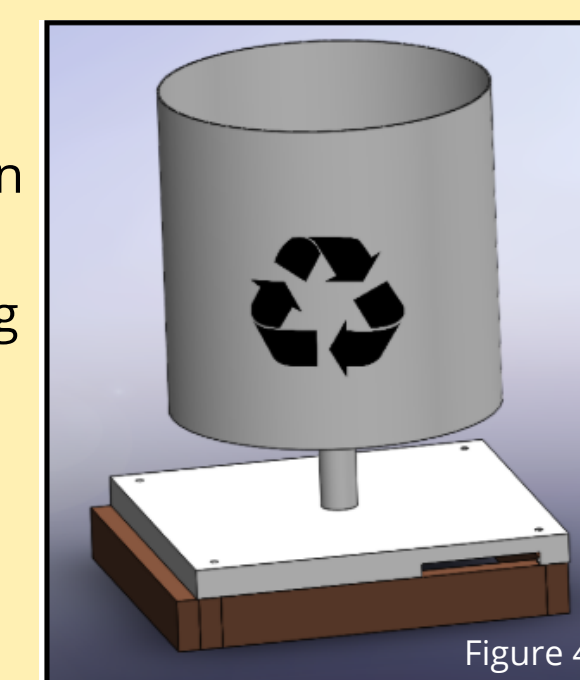


Figure 4

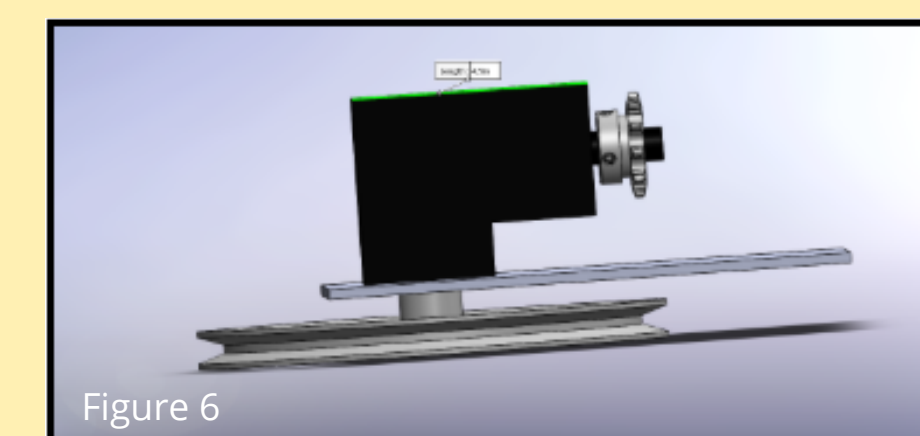


Figure 6

Figure 6: 90 degree gearbox with 2" diameter sprocket on the input shaft and 9" diameter pulley on the output shaft. Input sprocket is driven by the bike chain. The output pulley drives the drum pulley with a v-belt.

Data Collected

The following data was collected from the experiments and data collection performed:

- A Hobart SDPE-11 20 Gallon Commercial Salad Spinner has a speed of 406 RPM. For the dimensions of the recycled washing machine, the bin requires a speed of 370 RPM to produce the same centripetal acceleration.
- Studies researched concluded that 60 to 80 RPM is the average cycling cadence without expending excess energy.
- A rated horsepower of 1.95 hp for the 90 degree gearbox would be necessary to match that of an electric salad spinner with input sprocket diameter of 2" and an output pulley diameter of 9"

Analysis of Experimental Data

- Using 370 RPM as the design output RPM, and 80 RPM as the design input RPM, the produce dryer would require a 2" diameter sprocket on the input shaft of the 90 degree gearbox, and a 9" diameter pulley on the output shaft to meet the design requirement RPM
- A 90 degree gearbox with a maximum horsepower rating of 1.99 hp was selected to support the maximum input force from the user

Problems & Improvements

A 90 degree gearbox was necessary to transmit the required power to the produce dryer from the bike within the size constraints, however is the most expensive component. Improvements can be made to transmit power in a compact space at a lower cost

What We Built

We created an intuitive DIY method to modify a washing machine and bicycle to create a bicycle powered salad spinner that can produce the same results as an electric commercial size salad spinner

- Spins up to 370 RPM with an input cadence of 80 RPM from the user
- Total footprint of 48"L x 42"W x 38.2"H

Design Conclusions

- Using the data collected, power transmission components were able to be selected for the final design
- A bicycle stand was designed to minimize the footprint and create a compact design that could easily be attached to the washing machine bin used for drying the leafy greens
- The dryer housing was designed to protect the dryer and minimize any safety hazards with spinning components
- The final product is an easy and environmentally friendly solution to get large amounts of leafy greens from farm to table safely, clean, and with zero emissions

Future Work

- Construct the bicycle powered produce dryer with the DIY building manual provided
- Design other attachments for the bicycle to power, such as apple grinder, a washing bin, or other equipment needed for a sustainable farming operation