iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 10 **Issue:** V **Month of publication:** May 2022

DOI: https://doi.org/10.22214/ijraset.2022.42251

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue V May 2022- Available at www.ijraset.com

Design and Fabrication of Solar Automatic Cow Dung Cleaner

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Abstract: In today`s scenario farmers are having hard time in maintaining the cow shed to clean the cow dung they have to spend more time or they have to hire workers for more money. So in this paper we suggest a mechanism which is used to collect the cow dung and also used to clean the area. We use cow dung cleaning machine which runs under the power generated by solar. By using this process automatically human power will be saved.
Keywords: Animal Cleaner, Solar, Motor, Power Transmission, Torque

I. INTRODUCTION

Cow dung has traditionally been used as a fertiliser, but it is now collected and used to make bio gas. Farmers are having a difficult time keeping their cow sheds in today's environment. They have spent more time cleaning cow poo. As a result, we recommend that this mechanism be used in conjunction with a solar-powered automatic cow dung collection and cleaning system. To gather cow manure, we employed a controller system in this system. Limit switches, DC motors, DC pumps, solenoid valves, and drag are among the mechanical and electrical components used in this project. Cleaning is a daily routine in every home, office, hotel, hospital, animal farm, and so on. Everyone wants easy and quick cleaning, which is why everyone is drawn to electromechanical cleaning systems

II. LITERATURE SURVEY

Cow dung has traditionally been used as a fertiliser, but it is now collected and used to make bio gas. Farmers are having a difficult time keeping their cow sheds in today's environment. They have spent more time cleaning cow poo. As a result, we recommend that this mechanism be used in conjunction with a solar-powered automatic cow dung collection and cleaning system.

Cleaning is a daily routine in every home, office, hotel, hospital, animal farm, and so on. Everyone wants easy and quick cleaning, so electromechanical equipment is attracting everyone's attention, and trendy machines are emerging to meet the demand. The currently available machine is powered by electricity and does not lift rubbish. The machine in this project is specifically developed for cleaning livestock farms.

The machine's operation is based on the operator's manual push. This machine uses a blade to lift the waste, which is then collected in the tub. The front blade for lifting garbage is manually actuated by a lifting mechanism. The machine is built in such a way that the waste collection tub can be removed for unloading. The machine's structure is sturdy and robust to ensure the user's comfort.

III. LITERATURE SUMMERY

We advised the mechanism "sun powered computerised cow dung cleansing gadget for cowshed" to aid farmers in reducing the difficulty of cleaning waste on the shed. These task patterns may be particularly onerous inside the dairy farming industry for quick and efficient cleaning of the farm's surroundings, as well as the storage of water in addition to human labour or human power. Only an operator is required for operation control

IV. NEED AND OBJECTIVES

All One of the most important problems facing the world today is the energy problem. The growth in demand for electrical energy, along with the high cost of fuel, has resulted in this situation. The motive behind developing this equipment is to create mechanizations which will help to minimize effort of dairy farming. It is suitable at minimum costs for the farmers so that he can afford it, of the many products. To create a machine that makes cleaning simple and quick. To develop easy and cheap maintenance cost machine.

V. STATEMENT ABOUT THE PROBLEM

During a visit to a dairy farm, it observed that the hesitation of labours in picking and collecting cow dung by hand. While interacting with the dairy farmer, it is come to know that there was always shortage of manpower due to the nature of work involved. It is observed that in many villages the problem of electricity is very major concern, there is no proper arrangement of electricity to run electric equipment's.

Design and CAD Model of the project

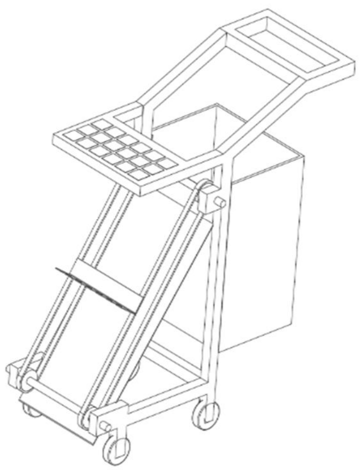

Fig. 1. Conceptual drawing of cow dung cleaner

Fig. 2. CAD Model

VI. MATERIAL PARTS

The major components of solar powered automatic cow dung cleaning system for cowshed are written below: -

1) Battery
2) D.C motor
3) Frame
4) Microcontroller
5) Limit switches
6) Solar panel

VII. DESIGN SPECIFICATIONS OF PROJECT

A. Design Specifications of D.C. Motor

Rated torque - 5.9881 N-m (Newton meters)
St all torque - 19.9983 N-m (Newton meters)
Unload high speed - 50 rpm, 1.5 A
Unload low speed - 35 rpm, 1.0 A
Maximum wattage - 50 W/12 V DC
Motor noise - <45 dB (decibel)
Motor weight - 12.0102 N (Newton)
Approx. size - 7.25"x4"x3.5"

B. Design Specifications of Battery

Voltage -12 Volt
Current - 7.5 AH (Ampere Hour)
Rechargeable type Battery

C. Design Specifications of Solar Panel

Capacity - 24 Watt
Voltage - 12 Volt
Current - 2 AH (Ampere Hour)
Material - Silicon

D. Design Specifications of Bearing

6202 Ball Bearing
Inside diameter - 15 mm
Outside diameter - 35 mm
Width - 11 mm

E. Design Specifications of Waste Lifter

Length - 580 mm
Breath - 140 mm

F. Design Specifications of Wheel

Material Used - Nylon
Radius - 37.5 mm
Thickness - 25 mm

G. Design Specifications of Frame

Breath - 760 mm
Length - 1270 mm
Height - 1400 mm
Material - Mild Steel

H. Design Specifications of Chain Sprocket

No. of Teeth- 20

I. Design Specifications of Spur Gear

Material Used - Cast Iron
Gear Ratio - 1:4
Pitch - 8 mm
Radius - 52.5 mm
Radius hole - 10 mm

J. Design Specifications of Shaft

Length - 910 mm
Outer Diameter - 22 mm
Length between shaft to shaft - 930 mm
Power transmitted by the shaft - 108577.5105 Watt

K. Design Specifications of Collecting Bin

Width of collecting bin - 300 mm
Depth of collecting bin - 380 mm
Length of collecting bin - 750 mm

L. Design Specifications of Chain

Size of Chain - 40
Pitch - 12.70 mm
Maximum Roller Diameter - 7.92 mm
Minimum Ultimate Tensile Strength - 13896.0230 N (Newton)
Measuring Load - 137.2931 (Newton)
Solar Charge Controller-
5 A (ampere)
12 V

VIII. DESIGN CALCULATION OF COMPONENT

A. Calculation of Motor

Motor speed= N = 60 rpm
Power = 15 Watts
$P = 2\pi N T/60$
$T = P \times 60 / 2\pi N$
$T = 15 \times 60 / 2\pi \times 60$
$T = 2.387$ N-m

Torque = 2.3875×1000 N-mm
Force acting on the shaft of the motor

Diameter of shaft "d" = 6 mm
Torque developed $T = F * r$
$F = T / r = 2387.5 / 3$ $F = 795.8$ N
The material being used for the shaft is mild steel
Yield stress $\sigma y = 380$ MPa for M S Material
Shear stress $f s = \sigma y / 2*FOS$ (FOS = factor of safety)
$Fs = 380 / 2 *2$
$Fs= 95$ MPa
Load acting on the motor shaft = 3kg = 3*9.81 =29.43 Newton
Stress = Force/area
$\sigma = 29.43 / \pi/4 \times d^2$
$d = 0.63$mm
Taking diameter of shaft as 6 mm for the motor
Hence the design of the motor shaft is safe.
σs= Shear Strength
Torque acting on the motor for load of 30N (for mild steel $\sigma s = 95$ MPa)
$T= (\pi/16) \times \sigma s \times (d^3) = (\pi/16) \times 95 \times (6^3)$
$T= 4029$ N-mm
Torque = force * radius
Force = $T / r = 4029/3$
Force = 1343 N
The load acting on the motor shaft is 30 N, since it can take load up to 1343 N. Hence, design is safe.

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B. Calculation of Motor Shaft

Load acting on the shafts = 30 N
Shear strength σ s = force/area
$95=29.43/ \pi/4(d^2)$
d=0.63
Taking 6mm
Hence the design of the shaft is safe It can lift the load of the entire machine easily.
Checking for crushing stress
Stress = load / area
380/2*2 = 30 / (π × D × L)
L=1.5 D
95 = 30 / (π × D × 1.5D)
D = 0.26 mm
Taking 6mm
Hence the design for crushing is also safe

C. Calculation of Shaft

Material used = Mild steel
Length = 670 mm.
Length between two shaft = 700 mm
Power transmitted by shaft = 25.31 W
Speed N = 60 rpm
Assuming Electric motor- line shaft
Kl=Load Factor
K1 = 1.75 (from fesign data for machine element book pg. no 112)
P= 2 π N T / 60 * K1
25.31 = 2 * π * 60 * T / 60*1.75
T = 2.31 N-m
T = $2.31* 10^3$ N-mm.
FS = sys / FOS
sys = 183 Mpa
FOS = 2 to 5
Assume = FOS = 3
FS = 183/3
FS = 61 Mpa
$Td = \pi / 16 * FS * (d^3)$
$30.241 * 10^3 = \pi /16 * 61 * d^3$
d = 5.77 mm
Increasing the diameter of shaft by 15% considering the bending moment.
d = 1.5 * 5.77
d = 8.655 mm
Taking standard diameter from design data book.
d = 22 mm.

D. Design Calculation of Gear

Power 15 Watts
14.5 degrees (FDI)
Speed of pinion N1 = 60 rpm
No. of teeth Z1 = 18 teeth
No. of teeth Z2 = 18 teet

GR= Z2/Z1
GR= 18/18
GR= 1

1) Speed Of chain

N1 = Speed of Chain
N2 = N1/GR = 60/1 (from design data for machine element book pg. no. 164)
Stress in pinion and gear -
Sd1 = 140 Mpa (pinion)
Sd2 = 90 Mpa (gear)

2) Lewis Form Factor

Y1 = 0.124 - (0.684 / Z1) (from design data for machine element book pg. no. 167)
= 0.124 - (0.684 / 18)
Y1= 0.086
Y2 = 0.124 - (0.684 / Z2)
= 0.124 - (0.684 /18)
Y2= 0.086
Lewis Form Factor=Y=0.086

3) Torque Developed

T2 = (955 * 10^4 * Power * Cs) / N2 (from design data for machine element book pg. no.93)
T2 = (955 * 10^4 * 0.015 * 1.25) /18
T2 = 9.947 * 10^3 N-mm Torque Developed=T2= 9.947 * 10^3 N-mm

4) Mean Velocity

Vm = (3.142 * N1 * N2) / (60 * 1000) (from design data for machine element book pg. no.173)
= (3.142 * m * 18 * 18) / (60*1000)
Vm = (3.142 * m * 135 * 18) / (60 * 1000)
Vm= 0.169m

5) Velocity Factor

Kv = [3 / (3 + Vm)] (from design data for machine element book pg. no.173)
Velocity factor=Kv=[3 / (3 + 0.169 m)]
Kv=1

6) Module

m^3 = (2T2) / (π^2 * β * Y2 * Z2 * Sd2 * Kv)
= (2 * 9.974 * 1000) * (3+0.169m) / (π^2 * 4 * 0.1189 * 18 * 90 * 1) = 2.61mm
Module=1.37mm

7) Diameters

Pitch diameter of pinion-
D1 = m * Z1 = 1.37*18 D1 =24.66 mm
Pitch diameter of gear-
D2 = M * Z2 = 1.37 *18 D2= 24.66 mm

8) Mean Velocity

Vm = 0.0169 m = 0.0169 * 1.37 Vm= 0.169 m / s

9) Velocity Factor

Kv = [3 / (3 + Vm)] = [3 / (3 + 0.0169] Velocity Factor Kv = 0.994

10) Allowable Stress

Sdall = Kv * Sd2 = 0.994 * 90

Allowable stress Sdall = 89.46 Mpa

11) Induced Stress

m3 = (2T2) / [(π2 * β * Y2 * Z2 * Sdin * Kv]

Sdin = (2 * 9.947 *1000) / [π4 * 4 * 0.1189 * 18 * 0.9943]

Induced Stress Sdin = 23.5 Mpa

Since Sdin is less than Sdall Therefore, the design is safe.

E. Calculation of Battery

Voltage - 12V

Current - 8AH (Ampere Hour)

The power of the battery is given-

Power = Voltage * Current = 12 *8

Power = 96 Watt

We have used this battery because it produces 96 Watt of power which is enough to run the motor of 15 Watts up to 6 hours.

F. Calculation of Solar Panel

Power= 24 Watt

Voltage = 12 V

Current = Power / Voltage = 24 / 12

Current = 2 AH (Ampere Hour)

The choice of the rating of a solar panel depends on the rating of battery used. Generally, a 12V solar panel should be paired with a 12V battery. Here, the rating of battery is 8 AH (Ampere Hour) so we used 12V solar panel in which is enough to charge the 12V battery

G. Charging Time of Battery

T=Charging time of battery

T = Battery rating in amp hours / Total current consume by solar panel

T = 8 / 2

T = 4 hours

Actual Model

Fig. 3. Actual Working Model

IX. CONCLUSION

For the farmers of their cattle shed, the design provides comfort and ease of cleaning. This design has many more advantages than current designs since it aids in the lifting of cow manure. It is a quick procedure that takes little time And there is no consumption of fuel. This design is made by keeping view of cheaper cost for fabrication and maintenance and Environmental Friendly. An important requirement is to make cleaning easy and quick for the farmers.

This cleaning machine is cost effective equipment. There is no cost for fuel usage because an electric motor is utilised to clean. Design and safety has been given utmost importance keeping view of the comfort of the user and also the use of the motor is eco-friendly. Each component was thoroughly tested in order to provide results for the best product possible at most reasonable price.

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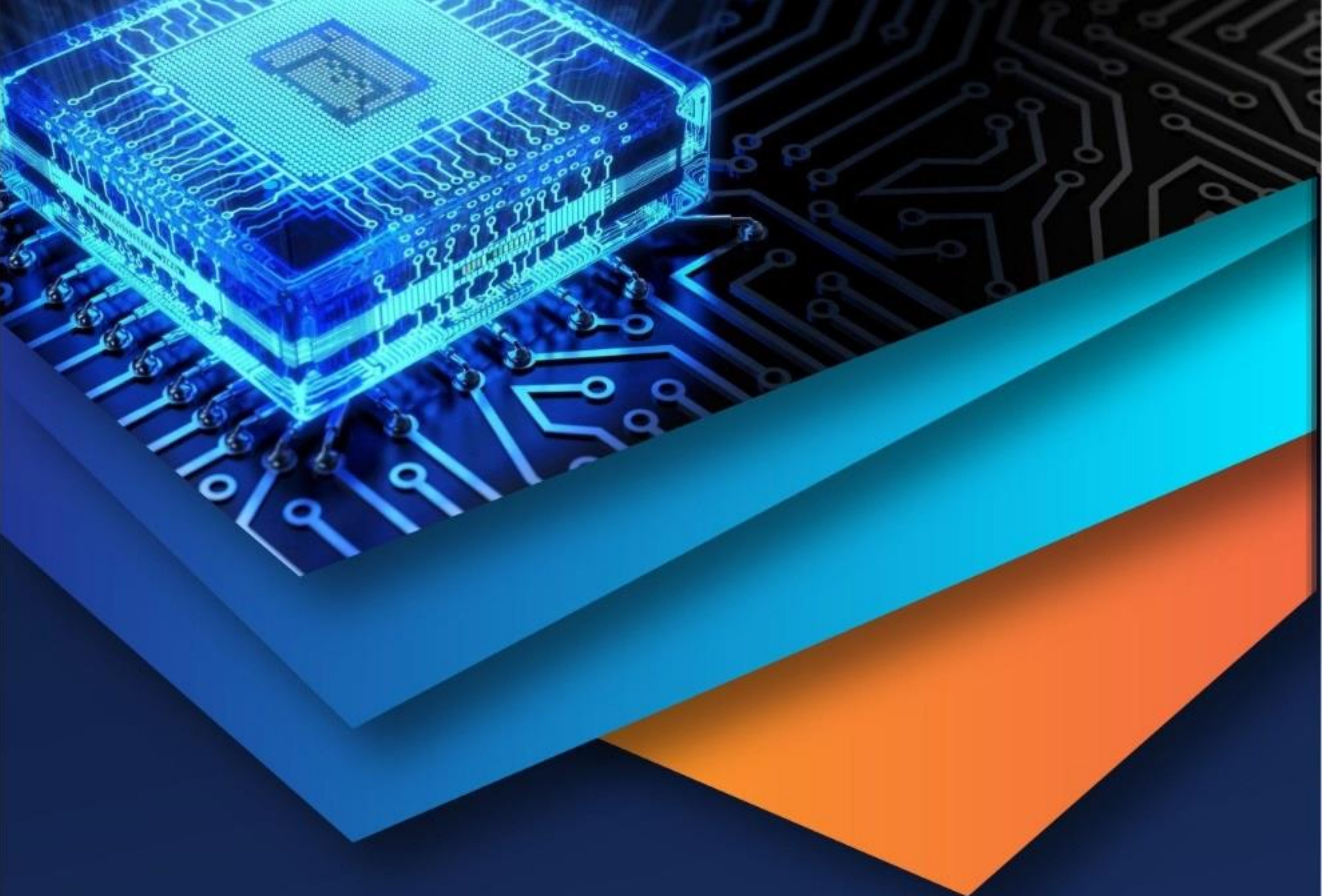

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