"DESIGN, DEVELOPMENT & IMPLEMENTATION OF SOLAR OPERATED AUTOMATIC FISH FEEDER"

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ABSTRACT

Fish farming is one of the most important aqua cultural activities, but farmers are facing many serious problems like diseases partly due to problems with the fish having to cope with poor water quality during cultivation. After the long survey with the farmers in different regions about their practices in farming methods, Auto Switch Aqua Feeder with new technologies replace with automation of the farming methods with their traditional practicing methods unchanged, the design was based on specific parameters which included capacity of culture tank, stocking density, fish biomass, diameter of the feed, angle of repose and bulk density and designed a user interface convenient and compactable for farming. User interface design, and timer controls are implemented for automation of feeding methods and substantially reducing the labor cost and improve the quality of commodity. Water quality will directly affect the growth of aquaculture objects which affects the production and economic benefit.

Keyword : - *Fish Farming, Automatic feeding, low cost, automation etc.*

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1. PROBLEM STATMENT

- Existing fish feeder system having less coverage of area of feed distribution.
- Existing fish feeder system having may Spoiled water quality.
- Existing fish feeder system having uneven distribution of fish food.
- Existing fish feeder system having Overfeeding of food that causes detriment of fish.

2. OBJECTIVES

- The project deals with the study, design & fabrication of a solar power automatic fish feeding system.
- The objective of this project is to enhance the use of non-conventional energy & solar panel for fish feeding system.
- Global energy crisis is getting severe day by day along with pollution problem using fuel. This objective is situation use of solar energy for the development of fish feeding system.

- To make solar power fish feeding system which mainly focuses on the basic problem of electrical load sheading faced by the farmer.
- To ensure even distribution of fish food among the tank to cover maximum distance for fish feeding.

3. CONSTRUCTION

Hopper: Hopper is used to store the fish food which is to be fed to the fish. It is cut with the help of saw and stick by using adhesive to form the shape of hopper. **Casing:** The Function of casing is to protect the Rotor from the Different Dust Particles that are present during the working environment and then it provides additional security to the rotor in case of sudden impact. In addition to that While the operation of rotor the food gets Stored for a very short period before getting into feeder. **Feeder:** This is the component throw which the food will get spread The purpose is to distribute the feed over a larger part of the pond, tank or cage. **Rotor:** When the rotor rotates it distributes the food evenly in the feeder & in the measurable quantity. **Splitter:** In feeders a unit for spreading of the feed is attached underneath the distribution mechanism called as splitter. Splitter is place within the feeder & ensures the equal distribution of food in the arms of feeder. **Bearings –** These are used to carry the load of the rotor while allowing the movement. **Bearing plates-** These Plates are used to Basically Prevent the Bearings from the dust particle which if enters will decrease the bearing life and will cause severe problems is smooth functioning. **Feeder Motor and Rotor Motor –** These are used to basically to act as a prime mover for the system, Feeder motor will be connected to the feeder to provide the necessary rotational motion to it and the rotor motor will be used to rotate the rotor.

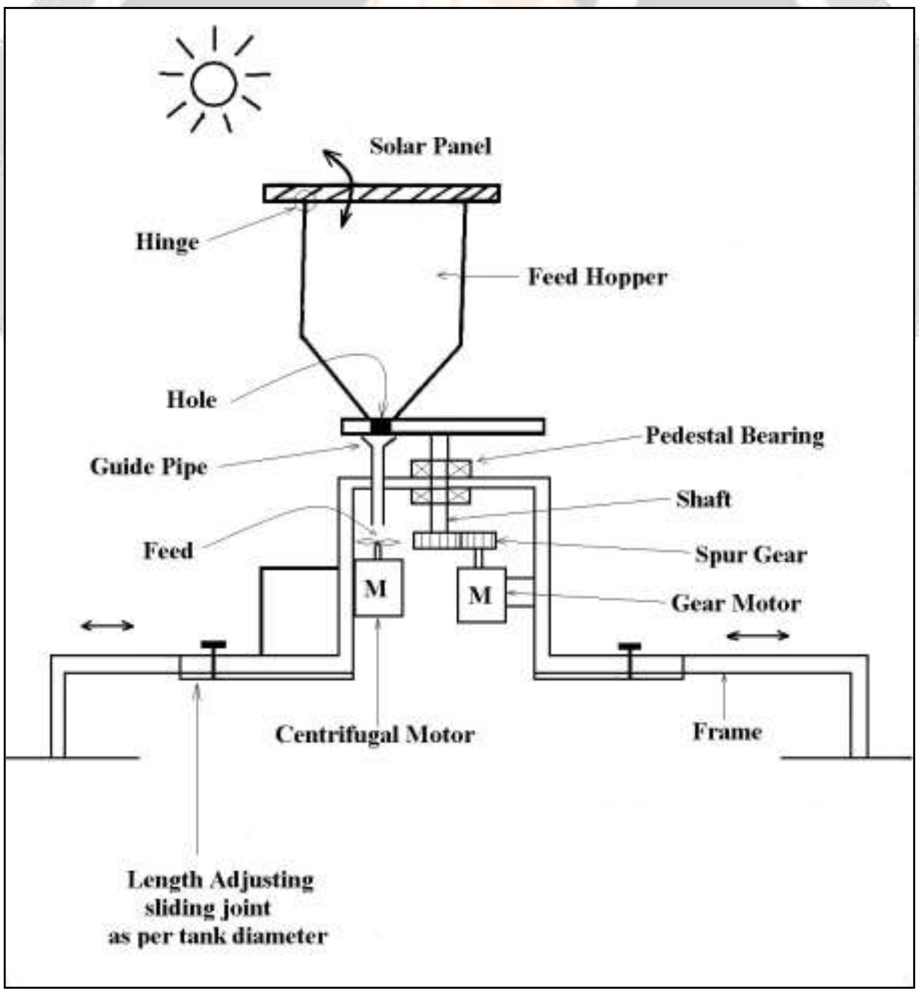

Fig.3.1. Concept of solar operated automatic fish feeder system.

4. WORKING

The system is consisting of four important parts which are hopper, rotor, motor and feeder. Hopper is one of the most important part which collects food granules in required quantity and ensure uniform dropping of food granules in rotor slot. Rotor is the heart of the feeder because it plays very important role like even distribution and create measurable quantity of food it consists of 12 slots and it is mounted on MS shaft which has connected to motor of speed 5 to 6 rpm the function of rotor is when food is dropped from hopper it collects into slots and carried the food along with each rotation of rotor and dropped it on splitter which is mounted into feeder. Feeder is consisting of two sub component like splitter and distributor fins. When food granules dropped on splitter it distributes food in equal two streams which going to pass through fin then it distributed to adequate distance. The food in the hopper passes over the rotor mechanism which is having low speed 5 to 6 rpm. For equal distribution of food low speed is necessary. The gap between rotor blade and outer casing is to avoid jamming of food and slowly equal distribution of food. Then the food is transfer to another small hopper. Hopper having up word conical shape to avoid material spillage in spinning .and inner radius is given for smooth entry of material in throwing tube there is diverter shape as shown in fig to divert a material towards wall during spinning. The extended length of throwing tube is for better throw of material. The lower motor having the speed of 500 to 1000 rpm to cover the long distance and fast distribution of food.

5. DESIGN

5.1. Motor selection:

T = Torque transmitted by the motor N.m.
F = force on motor = 5 kg = 9.81 x 5= 49.05 N. (Assume)
R = gear Dia. = 40mm.
T = Fx R
= 49.05 X 0.040
T = 1.962 N.m.
P = Power of motor
N = Speed of the motor = 60 rpm. (Assume)

$$P = \frac{2 \Pi N T}{60}$$

$$= \frac{2 \Pi \times 60 \times 1.962}{60}$$

P = 18.49 Watt.

Thus selecting a motor of the following specifications

- Single phase DC motor
- Power =50 watt
- Speed= 60 rpm

Motor Torque

$$P = \frac{2 \Pi N T}{60}$$

$$T = \frac{60 \times 50}{2 \Pi \times 60}$$

T = 7.96N-m

Power is transmitted from the motor shaft to the input shaft by means of a gear drive,

5.2. Spur gear pair system:

No teeth on gear Zg = 25

No teeth on pinion Zp=25

Material of gear & pinion both are nylon, DDB. P No.1.41.

Sut p =82 N/ mm^2

Sut g =82 N/ mm^2

Application factor ka = 2

Load distribution factor km= 1

Factor of safety Nf = 1.5

BHN = 24

Power P = 50 Watt.

Np= 60 rpm

Beam strength (δb)

6bp $=\frac{Sup}{3} = \frac{82}{3}$ = 27.33 N/mm^2

6bg= $\frac{Sug}{3} = \frac{82}{3}$ = 27.33 N/mm^2

Assuming 20^0 full depth involution system,

Yp=0.484 - $\frac{2.87}{Zp}$=0.484 - $\frac{2.87}{25}$ = 0.3692

Yg=0.484 - $\frac{2.87}{Zg}$=0.484 - $\frac{2.87}{25}$ = 0.3692

Now, δ_{bp} . Yp = 27.33 ×0.3692= 10.0902 N/mm^2

δ_{bg} . Yg = 27.33 ×0.3692= 10.0902 N/mm^2

As δ_{bg} . Yg $\leq \delta_{bp}$. Yp

Gear is weaker then pinion. Hence, it is necessary to design the gear for bending.

Bending force (Fb)

Fb=6bg.b .m.Yg

=27.33 X $10m\ X\ m\ X\ 0.3692$

Fb =100.902 m^2 N

Wear strength (Q)

$Q = \frac{2Zg}{Zg \quad +Zp} = \frac{2X25}{25+25} = 1$

Load stress factor (K)

$K=0.16[\frac{BHN}{100}]^2 = 0.16[\frac{24}{100}]^2 = 9.216 \times 10^{-3}\ N/mm^2$

Bucking eq^n for the weer strength (Fw)

$Fw = dp \times b \times Q \times K$

$= 25m \times 10m \times 1 \times 9.216 \times 10^{-3}$

$Fw = 2.304\, m^2$

Fb ≤ Fw design should be on wear failure

Effective load

$V = \frac{\pi \times dp \times np}{60 \times 1000} = \frac{\pi \times 25m \times 60}{60 \times 1000} = 0.078\ m\ \ m/s$

Tangential force (f_t)

$F_t = \frac{P}{V} = \frac{50}{0.078\,m}\ N = \frac{636.619}{m}\ N$

As per the gear pair is manufactured by generation, the velocity factor is given by,

$Kv = \frac{3}{3+V} = \frac{3}{6+0.078m}$

$Feff = \frac{Ka.Km.Ft}{Kv}$

Feff=effective load

Ka=application factor

Km=distribution factor

Kv=velocity factor

$Feff = \frac{2\times1}{\frac{3}{3+0.078m}} \times \frac{636.619}{m}$

Estimate the module-

Fw=Nf .Feff

$2.304\, m^2 = 1.5 \times \frac{2\times1}{\frac{3}{3+\sqrt{0.078m}}} \times \frac{636.619}{m}$

Solving by above equation by trial & error, we get, Dimensions of gear pair - m = 1.5

$Z_P = 25$

Zg =25

B = 10 m = 15mm

Dp = m×zp = 1.5×25=37.5mm

Dg = m×zg = 1.5×25=37.5mm

ha = 1m = 1.5mm

hf = 1.2m = 1.857 mm

5.3. Shaft design:

To find diameter of shaft by ASME code.
For commercial steel shaft C40 material, Sut = 680 Mpa.

Actual shear stress $\tau_{act} = \frac{Sut}{2 \text{ X } FOS} = 170 \text{ N/mm}^2$

$T = \Pi/16 \text{ x } \tau_{act} \text{ x} d^3$

$7.96 \text{ x } 10^3 = \Pi/16 \text{ x } 170 \text{ x} d^3$

d= 6.20 mm select d=10 mm. (Application Basis)

5.4. Bearing selection:

As shaft dia. – is 10mm so we have selection a pedestal bearing having shaft outer dia. – 10mm.In selection of ball bearing the main governing factor is the system design of the drive i.e.; the size of the ball bearing is of major importance; hence we shall first select an appropriate ball bearing. Taking into consideration convenience of mounting of ball bearing.

Total load on bearings are (Assume) = 1kg = 9.81 N

Axial load on each bearing's Fa = 9.81 /2 = 4.905 N.
Equivalent dynamic load
Pe = V.Fa. Kr
= 1 X 4.905 X 1.5
Pe = 7.357 N
bearing life is,

$L^{10} = \frac{Lh10 \text{ X } 60 \text{ X } n}{10^6}$

L_{h10} from graph 4.6 PSG Design data book for 20000 rpm maximum speed of ball bearing is 200000 Hours. PSG Design data book P.No. 4.13.

$L^{10} = \frac{200000 \text{ X } 60 \text{ X } 60}{10^6}$

L^{10} = 720 millions of revolutions.

$L^{10} = \left(\frac{C}{Pe}\right)^{(3)}$

$C = (720)^{(0.33)} \text{ X } 7.357$

C = 64.51 N. ≤ 4000 N (Bearing is safe.) PSG D.D.Book.P.No.4.13.

6. CONCLUSIONS

We are happy to state that the in calculation of mechanical field proved to be a very useful purpose in future fabrication parts. Designed system is comfortable as his efforts in fish feeding can be eliminated as compared to old system. Designed system requires unskilled farmers can be assigned the work so it saves the cost of manpower also for fish feeding. Designed system is to maintain quality and hygiene of water. Designed system is to reduce the labor cost, time & efforts during fish feeding. Needless to emphasis here that we will lift no stone unturned in our potential efforts during machining, fabrication and assembly work of the project model to our entire satisfaction to solve the problem in agricultural field for social welfare.

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8. REFERENCES

[1]. Izzeldin I. Mohd, Nurul Hikmah Binti Azizan, Nazar Elfadil, Design and Development of Microcontroller Based Automatic Fish Feeder System, IJESC, April 2020,pp. 25380 -25383.

[2]. D. Prangchumpol, A Modelof Mobile Application for Automatic Fish Feeder Aquariums System, International Journal of Modeling and Optimization, Vol. 8, No. 5, October 2018,pp.277-280.

[3]. Donga Ram Siri Babu, Guduvaka Mahesh, Developing Fish Feeder System using Aurdino,IJSETR, ISSN 2319-8885 Volume.08, Jan-Dec-2019, Pages: 647-651.

[4]. Anoop Srivatsan Balaji, Lokitha T, Suvetha P, Vishnu Prabhakar R, R. Karthi Kumar, automatic fish feeding and monitoring system for aquarium using 555 timers, International Journal of Technical Research & Science, Volume V Issue VI, June 2020,pp.20-23.

[5]. Linet Rose A. S., Thomas Mohan, Vinodkumar Jacob, Automatic Fish Feeder System for Aquaponics using Wi-Fi Based WSN, International Journal of Recent Technology and Engineering (IJRTE) ISSN: 2277-3878, Volume-8 Issue-6, March 2020,pp.835-840.