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Design and Analysis of Multi Operation Farming Rover

Muralidharan K
Assistant Professor, Mechanical Engineering, R.M.K. Engineering College, Chennai, Tamilnadu,
kmd.mech@rmkec.ac.in
Suresh Kumar R
Assistant Professor, Mechanical Engineering, R.M.K. Engineering College, Chennai, Tamilnadu,
rsk.mech@rmkec.ac.in
Saravanan S
Mechanical Engineering, R.M.K. Engineering College, Chennai, Tamilnadu,
saravananshanvadivel@gmail.com

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Abstract:
The main aim is to create a rover which does amultiple tasks of operation in the field of agriculture. This is combination of the working of four operations into a single rover. The characteristics of process like fertilize dispensing, seed spreading, and pesticide sprayer. By implementing this production rate is increased and less time consumption. Now a day farmers facing many problems in day to day life in agriculture, so this reduce the work load of farmers by introducing an auto-farming rover is operated with the help of relay p r i n c i p l e . With the help of this, the farmer does not want to be educated to operate, because it is very ease of operation. So there is no difficulty faced by farmers. Today every field is introducing the technology.

I. INTRODUCTION

Water is the fundamental source of life on earth especially the drinking water is a basic necessity for human beings along with food and air. Although water is abundant on the earth but fresh water is scarce. There is acute shortage of fresh drinking water in remote and rural areas of many countries. Reports state that the amount of fresh water available per person in the world per person was 4000 m^3 a year in the early 1950s. Now, the amount of fresh water available globally has reduced to 1000 m^3 per person per year, which has resulted in water scarcity. The demand for fresh water is growing steadily and is expected to be one of the biggest problems of the world in this century due to unsustainable consumption rates, population growth and increasing trend of the agricultural explosion projects.

The presence of high amount of salts and contamination in water from sources like sea, lakes, rivers and underground water reservoir makes it unsuitable for use directly. At most places, enough saline water is available but it is not suitable for drinking and other domestic, agricultural and industrial applications. In addition to quantity of water, there are many places even in urban areas where water is polluted and is not completely safe for drinking. Most diseases in these areas are caused by polluted water. According to the study made by the World Health Organization (WHO), polluted water and sanitation deficiency are the cause of 80% of all the diseases which can make a person unfit, temporarily or even permanent. It is estimated that around 500 million people in the developing countries suffer from diseases produced by water. To solve these problems, new drinking water sources should be discovered.

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A. Construction

The frame or chassis which is made up of mild steel of (1"*1") square tube, upon this all the equipment's and parts are mounted. The square tube is welded and joined together to form a chassis shape, after that the dc geared motor is coupled or screwed at the centre of the frame. The required spaces are allocated for the parts. The parts like seed hopper, fertilizer tank are mounted upon the chassis. Then the required parts are screwed together to join, this will give the complete structure for the product. Some space is allocated for the relay circuit board, because the functioning of rover highly relies upon the receiver. The three motors are connected to the relay is directly operated through the wireless remote console is working under the principle of radio frequency.

B. Working principle

The Rover which is designed for off-road (or) off-land purposes. It is run under the main source of solar panels and all the activities are controlled under the relay controller. From that all equipment's get powered and the rover which mobiles through the remote console and it operate under specific conditions. The seeds are speeded through the seed dispenser (seed hopper) and the pesticides (liquidmedium) are sprayed through nozzles. When the relay is actuated the rover started to move at the same time another relay is activated , the seed is fallen from the storage and the seed spreader are designed to distribute the fallen seed into the ground, the seed hopper blade is designed for that purpose, because the blade is directly coupled to the shaft of DC geared motor and the pesticides are also stored in the 2 litre capacity tank. The same dimensions for the fertilizer tank. In each tank, the blower type motor is placed, it suck the water and is supplied through the AC coil copper tube.

II. INTRODUCTION TO DC GEAR MOTOR

DC Gear motors can be defined as an extension of a DC motor which already has its in-depth details mentioned here. A geared DC Motor has a gear assembly linked to the motor. Motor speed is rated in terms of rotations of the shaft per minute, the acronym for which is RPM. The gear assembly helps in raising the torque and minimizing the speed. Using the correct combination of gears in a gear motor, its speed can be varied to any desirable figure. This concept wherein gears reduce the speed of the vehicle but increase its torque is called as gear reduction.

A. Working principle

A brushed electric motor with a two-pole rotor i.e. armature and permanent magnet stator is described as below. N and S denote polarities on the inside face of the magnets; the outside faces have opposite polarities. The + and - signs indicate the spots where the DC current is applied to the commutator that supplies current to the armature coils.

B. Safety precautions

Hazardous voltages capable of causing injury or death may be present in the AC Motor system.

The one who handles, wires, tests and adjusts during installation, set – up, tuning, operation etc. must be doubly cautious. Extremities in changes or adjustments to the parameters of AC Motor system must be avoided because it may cause mechanical vibration and result in failure and/or loss. After completion of wiring in the AC Motor system, the On/Off switching of the power supply directly must be avoided. Frequent On/Off switching the power may cause quicker aging of the system components that might significantly reduce the lifetime of AC Motor system.

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Strictly be in accordance with the following rules:

- The Wiring Diagram must be followed with each AC Motor and/or controller.
- The high-volt power cables must be routed separately from low-voltage power cables.
- The input power wiring and AC Motor power cables must be segregated from control.

III. DESIGN AND FABRICATION PROCESS

The design is a complex task which seeks many skill extensive relationships that ought to be categorized into a series of tasks. To design means either to solve a specific problem or to deduce a plan for satisfaction of a specified need. In mechanical design, other considerations include dimension, tolerance units and calculation.

A. Phase of the design process

The entire design process, from start to finish is often shown in the process which begins with an identification of the need and the decision to advance something regarding the design. The process concludes with the presentation of the plan for satisfying the need. This is the final step in the design process. The deflection problem is more specific and must include all the specification for the product that is to be designed.

B. Invention of the concept is also known as concept design or synthesis. This is the first and most important step in the invention concept. It is intimately related to the analysis and optimization. Both analysis and optimization required that is constructed abstract models of the system that will admit some form of mathematical analysis. Evaluation is a significant phase of total design process. Evaluation is the final proof of a successful design.

C. Computational tools

Computational tool viz. Computer Aided Design (CAD) software lets the emergence of the three dimensional (3-D) design from which conventional orthographic projection with auto dimensioning can be produced. There are a great many CAD software packages perform specific engineering analysis and simulation task, but it is not considered a tool for the creation of the CAD design. Such software is categories into two are engineering based and non-engineering specific.

D. Finite element analysis

The finite element techniques are integrated well with CATIA V5 (CAM).

E. The element method

The modem development of the finite-element method began in the 1940s in the field of structural mechanics with the work of Hrennikoff, Me Henry and Newark who used a lattice of line elements (rod and beam) for the solution of stresses in continuous solid. But the expression finite element is anaccredit to Clough. Ever since the very beginning, immense effort has been expended towards the development of this method in formulations and computer implementation of the entire solution process.

F. Element geometries

Many geometry shape of the element are used in this analysisfor specific applications. The various elements used area standard commercial FEM software code constituent which is referred to as the element library of the code. The element can be placed in the following categories:

1. Line element.
2. Surface elements.
3. Solid elements.

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4. Special purposes element.

IV. VARIOUS COMPONENTS USED IN OUR PRODUCT

A. DC Geared motor

Geared DC motors are none but an extension of DC motor which already has its insight details demystified here. A geared DC Motor comprises of a gear assembly aligned to the motor.

B. V- Belt

Why we select a v-belt means frictional force is high and also high torque can be delivered without any slip.

C. Relay

A relay is an electro – mechanical device. Many relays use electromagnet to mechanically operate but other operating principles viz. solid state relays are also used. Relays play a significant role where there is a necessity to control a circuit by a low-power signal or wherever several circuits are in a situation to be controlled by one signal.

The first relays found its usage in the form of amplifiers in long distance telegraph circuits

D. Fertilizer and pesticide tank

Fertilizer tank stores the urea in a liquid state and also the pesticides are stored in separate tank and this is sprayed through specific nozzle.

E. Seed Spreader

The seed spreader is used to dispense the seed with the help of rotating blades. These blades are get powered through DC motor and the same 12V battery supply.

F. Shaft

The shaft is rotated by the movement of the DC

motor, because the shaft is get powered through the
connecting belt from motor pulley to the shaft pulley.

Upon that all the loads are added and al components are
mounted.

G. Ball Bearing

Ball bearing is come in wide variety of designs,
series, sizes and variants. Depending upondesign it

is classified into four classes, Standard, Explorer,
Energy efficient, super precision.

V.FINISHING AND PAINTING

A. Job operation

Before welding, any noted bend inL angle must be removed. Further on, it is sheared to the desired shape with hack saw and fabricated to required dimensional shape by means of arc welding.

B. Finishing and painting

After welding slag if any on the welded area is eliminated by means of the chipping hammer and cleaned with the metal wire brush. Then all the surfaces are rubbed with the emery sheet. Metal primer is applied on the surfaces with the brush. After drying the metal primer, the second coating is applied with the paint.

C. Advantages

- It gives good surface finish.

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- Good aesthetic look.
- It gives a gentle finish working.

D. Limitations

- Complicated areas are difficult to paint.
- It is not suitable for human.

E. Application

- Fertilizer dispensing agent.
- In the field of soil cultivation.
- Crop feeding purpose.

VI. CALCULATIONS

A. Slip calculation of pulley Given data:

Speed = 130rpm, d_1= 20 mm, d_2= 40mm, P= 1KW Total length between the 2 pulleys= 165.957mm, belt thickness =2mm, w =4mm

$^{N}2/^{N}1 = {}^{d}1/{}^{d}2$; Where: $^{d}1 = {}^{N}2 * {}^{d}2/{}^{N}1$
V= $\pi d_1 * N_1/60$= 157.079mm/sec or 0.157m/sec

Slip calculation of pulley
Sin α = r_1-r_2/x = (23.076-20)/2*165.957
Sin α = 0.009267

α= 0.95154 degree ɵ= 180-(2*0.951454) ɵ = 3.10837 rad.

To find T_1 and T_2
2.3log (T_1/T_2)= μ ɵ
2.3log (T_1/T_2) =0.3*3.10832
(T_1/T_2) = 2.52
T_1-T_2
=636N

T_1=105.5 N T_2=418.5N

B. Calculation of helical spring

Selection of material for helical spring = C
50 Outer Diameter of helical spring = 12mm
Wire diagram=2mm , No of coils= 10.5,
Load(P)=40KN,

Modulus of rigidity= $0.85*10^5$ N/mm^2

C. Maximum shear stress
Mean coil dia D =D_o-d=10mm spring index C= D/d=5

Ks= (4C-1/4C-4)+(0.615/C)
C=1.3105 ţ= (Ks * 8* P* C)/ (π * d_2)

ţ= $(1.3105*8*(0.12*10^3)*5)/(\pi*4)$

ţ= 148.252 N/mm^2

D. Total deflection y=
8*P*C^3*n/ Gd
y= 8*
$(0.12*10^3)*(5^3)*10.5/((0.89*10^5)*12)$ y= 1.179775 mm

E. Factor of safety, ns:
σ_y = 340 N/mm^2 n_s = 340/148.252
n_s=2.293 ≤ 3

F. Free length of spring (L_f)

Solid length L_s= d_n + 2d = 25 mm
Free length $L_f = L_s + y$ = 27 mm

VII. CONCLUSION

We made this project entirely different from others projects. Since concepts involved in our project is entirely different that a single unit is used to various purposes, which is not developed by any other team members.

By doing this project we gained the knowledge of multi operation and how automation can be effectively done with rover.

We have successfully completed the project work on using dc motor at our institute. By doing this project work, we understood the working

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principle and uses of various motor, blades, etc. it will be of no doubt that farming rover will be an integral unit of any automation process in any industry.

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