Design and Development of Automatic Drip Irrigation Pipe Winder Machine

[1]Bharat S Dange, [2]Rushikesh W Nile, [3]Ganesh R Pendhari, [4]Yogesh B Rode, [5]Adinath B Mind, [6]Mahesh R Maind.

[1&2]Assistant Professors, [3-6]UG Students, Mechanical Engineering Department, SND College of Engineering and Research centre, Yeola-423401, India.

ABSTRACT :- The main aim of this project is to develop an automatic drip side tube winding machine that can be used in various winding processes, reducing the work of the machine and gaining knowledge about the concept of automation of the tube winding machine.

When winding is done by hand on the drip branch pipe, the binding process is difficult due to the weight of the hands and the folding that occurs during the winding process. Hand pulling and bending of drip branches may occur, resulting in branch breakage. Likewise, when placing and wrapping branch pipes, workers have to work without energy in the body, which causes the work to be affected, so workers need more money. In addition to these limitations, manual winding and unwinding is ineffective, and improper winding and unwinding can damage the branch pipe and shorten the life of the branch pipe.

I. **INTRODUCTION :-** Agriculture has been the foundation of human civilization for thousands of years; provided health, nutrition and financial security. But the face of agriculture is still evolving; with technology playing an important role in improving productivity, saving resources and increasing manufacturable products. One of these innovations is the drip hose reel, an amazing device that has changed the way we water crops, especially in dry and water-scarce areas. Drip irrigation is a method of controlling water and delivering it to the root zone of plants. It reduces water waste, reduces energy costs and saves resources. The drip irrigation hose reel is a device designed to improve the installation and maintenance of drip irrigation systems, making them easier and more convenient to use for farmers around the world. This article takes an in-depth look at the world of drip irrigation, the challenges it solves and the benefits it provides, focusing on the ground breaking drip irrigation pipe wrapping technology.

II. **LITERATURE REVIEWS :-**

[1] Ameer Hussain Jarwar (2020) and others concluded that methanol indicates that the drip irrigation system is a micro-irrigation system capable of recycling water and other nutrients by slowly injecting water into the sewer. Other plants from or buried in the topsoil. The main purpose of drip irrigation is to reduce evaporation by injecting water directly into the root system. Water faucets release water through different pipes, emitters, pipes and valves of different shapes. Drip irrigation systems are more efficient than other types of irrigation, such as irrigation or surface irrigation, depending on how well they are designed, stored, installed and operated.

[2] DS Karale, (2017) et al., Tractor Operated Drip Irrigation Cross Winder, Dr. Panjabrao Deshmukh Krishi Vidyapeeth (PDKV), Akola belonging to the Ministry of Agriculture, Energy and Machinery and its implementation in real field conditions Feasibility test was evaluated. When wrapping the drip branch pipes

manually, the weight of both hands makes bundling very difficult and folding occurs during the wrapping process. Hand pulling and bending of drip branches may occur, resulting in branch breakage. Likewise, when placing and wrapping branch pipes, workers have to work without energy in the body, which causes the work to be affected, so workers need more money. In addition to these limitations, manual winding and unwinding performance is poor, and incorrect winding and unwinding will damage the branch pipe and shorten the life of the branch pipe. It was determined that the average efficiency of cross winders was 87%, the average efficiency of manual winders was 78.26%, and the average efficiency of manual winders was 63.46%. The operating cost of tractor-driven crosscoiler is Rs 468/ha, while the cost of manual coiler and manual coiler is Rs 650/ha and Rs 1280/ha respectively. Cost savings were calculated for the drop cross coil machine and found to be 28% and 63.43% savings for manual coil winders and manual coil methods respectively.

[3] Meng Fanqiang, (2021) et al., Automated guided vehicle (AGV) is an unmanned vehicle that can transport, store, load and transport goods. It can complete tasks according to advance plan, has protection and safety protection, and is widely used in machinery manufacturing. The design and development of AGV carts was introduced to realize the development of agricultural drip tapes production line. According to the drip irrigation design using rolling AGV carts for production line transformation, based on the previous design knowledge and technology of automatic steering carts, starting from the actual needs of engineering application, combined with steering technology using embedded control systems, sensing AGV cart using sensing technology, control module and control technology Introduction The lifting module is designed to realize the wrapping, transportation and storage of drip irrigation tapes.

[4] Meng Yanmei (2023) and others, an automatic pipe collection machine for collection and release, targeting the time-consuming and energy-intensive problem of workers manually collecting and releasing water when watering or spraying Pesticides in agricultural production. water was created. Design the teaching method, winding mechanism and pipe output mechanism of the pipe winding machine, proposed PID-based automatic control method for pipe output, and a strict control system for rewinding and unwinding, and proposed PID-based automatic control. Pipe releasing method and tension control method for rewinding and unwinding. By making a model of the automatic pipe winding machine, the pipe winding effect and the tension control effect of the automatic pipe winding machine were tested and analyzed. Test results show that at a speed of 4.0 km/h, the maximum angle of the automatic pipe winding machine is 3.32°, the average error is not 0.95°, the pipes are well prepared and tight. The maximum relative error of pipe tension is 9.3%, and the maximum relative error of speed step change from 0~4.0 km/h is 16.3%. The speed of retracting and unwinding the pipe will change automatically according to the speed of the vehicle and the change of pipe tension within a reasonable range. The pipe output and winding performance of the automatic pipe winding machine can meet the requirements.

[5] Moataz Elnemr (2019) and others completed the closed-loop automatic flow model to accommodate flow control. This control is designed to control water flow by collecting data from soil moisture sensors in three different locations; It works to account for transmitter flow along the outer direction by changing the soil moisture content distribution on the third side. The humidity used to start and stop watering will be based on the average of three sensor readings. Materials needed to control water supply include soil capacity (FC), wilting point (WP), and percent moisture (MAD). Irrigation will begin when the moisture content equals the required percentage of water availability and will stop when soil capacity is reached.

III. METHODOLOGY :-

1) Problem analysis and data analysis.
2) Create products and choose materials.
3) Preparation of 3D CAD models.
4) Equipment production.
5) Equipment installation.
6) Project testing.

IV. MATERIAL:-

1) Frame :

The frame is usually made of small metal. It is strong enough to withstand all kinds of load-based work. All other equipment is mounted on the frame. Columns are supports that help support many lights. The frame shows that it is quite round. Every machine needs a good model. Since the frame is the same as other machines, the frame material needs to have high strength. The framework plays an important role in our project. Vertical pulleys and gears are mounted on the vertical support of the shaft. Our project usually collects the entire project of the post.

Fig.1: Frame

2) Wheels :-

An important part of many cars and machines, a wheel is a circle designed to facilitate movement by rolling over a surface. Their positions in transportation and technology reflect their important roles in various applications in the industry. The basic model of the wheel has a circle connected to the central hub. The outer part of the rim is usually equipped with tires that provide traction and flexibility. Depending on the specific application, the size, material and configuration of wheels vary from small wheels on furniture to large wheels on machines.

Fig.2: Wheels

3) Arduino :

Nowadays, choosing the right microcontroller can be a daunting task because microcontrollers are relatively cheap and easily available in the market. But there is one particular model that is a good starting point for users. The prototype is the ATmega328p, an 8-bit AVR microcontroller. It usually appears as standard on Arduino boards such as Arduino Fio and Arduino Uno. Following are its features :

Two 8-bit timers/counters with independent prescalers and comparator modes,

Programmable serial USART and watchdog timer with independent on-chip oscillator,

Special features compared to other microcontrollers (ARM, 8051, PIC),

Power reset and Reset Programmed Dimming Detection,

Internal Calibrated Oscillator,

External and internal noise sources,

For Sleep mode: Idle, ADC noise reduction, power save, Power off, Standby and extended Standby.

4) Shaft :

Shafts are rotating machine elements used to transmit power from one place to another. Power is transmitted to the shaft by some tangential force and, as a result, a torque (or torque) set on the shaft, which allows power to be sent to various machines connected to the shaft. Pull, power, etc. are used to transmit power from one pole to another. Various devices such as are used. These materials and the forces that cause the poles to bend. So we can say that the frame is used to transmit torsional and bending moments. Many components are mounted on the shaft with keys or wedges. The shaft is usually cylindrical but can also be square or cross-shaped in cross-section. Their cross-section is solid, but sometimes hollow shafts are used.

Fig.4 : Shaft

5) Wiper Motor :

The windshield wiper motor is an electrically powered part of your vehicle that works by moving the wiper blades smoothly and efficiently. Like other motors, wiper motors constantly rotate in one direction when operated forward and reverse. The standard voltage required for wiper motors is 12 volts DC. The generator in a moving car usually outputs between 13 and 13.5 volts, so it's safe to say that the engine can handle up to 13.5 volts without any problems.

Fig.5 : Wiper Motor

6) Bluetooth Module :

HC-05 is a Class 2 Bluetooth module designed for transparent wireless communication. It is pre-configured as a Bluetooth slave device. When paired with a key Bluetooth device such as a PC, smartphone or tablet, its functions become transparent to users. All data received from the serial port is instantly transmitted wirelessly. After the module receives wireless data, it immediately sends it via the serial port. There is no need for a user code specific to the Bluetooth module in every microcontroller program.
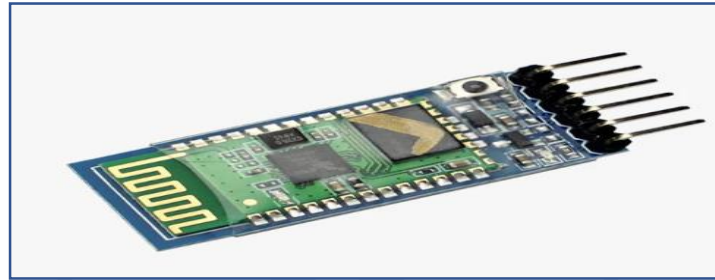
Fig.6 : Bluetooth Module

7) Solar panel :

A solar panel is a photovoltaic (PV) device that converts sunlight into electricity. Photovoltaic cells are made of materials that produce electricity when exposed to light. Electrons flow through the circuit and produce electricity, which can be used directly to power various devices or stored in batteries. Solar panels are also called solar panels, solar panels or photovoltaic modules. A photovoltaic system consists of one or more solar panels, an inverter that converts direct current to alternating current (AC), and sometimes other components such as controllers, meters, and trackers. Photovoltaic generators can be used to generate electricity on the power grid, such as in rural or residential buildings, or to feed the energy into the grid and receive credit or money from electric companies. This is called a line-connected photovoltaic system.
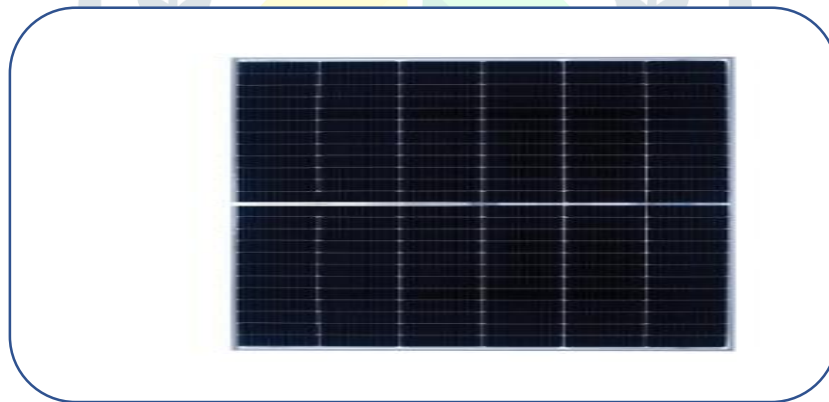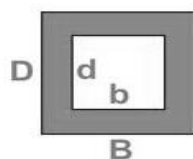
Fig.7 : Solar Panel

V. DESIGN CALCULATIONS :-

1) Frame :
    Load on frame considered P = 5 kg =49.05N
    $y = D/2 = 25/2 = 12.5mm$
    D = 25 mm B = 25 mm t= 2mm thickness

Hollow Sections obtained by subtraction
$$= \frac{BD^3}{12} - \frac{bd^3}{12}$$

    Cross section Area of frame is 16345.33 mm2
    Moment of inertia in x direction

I = 130208 mm^4

$Mb = \frac{WL^2}{12} = \frac{49.05*600^2}{12} = 1471500$ Nm

Bending stress of pipe:

$$\frac{Mb}{I} = \frac{\sigma b}{y}$$

$\sigma b = \frac{1471500*12.5}{130208} = 141.264$ N/mm^2

Theoretical bending stress

$\sigma b(th) = \frac{Syt}{f.s} = \frac{310}{1} = 310$ N/mm^2

$\sigma b < \sigma b(th)$

   Hence design is safe.

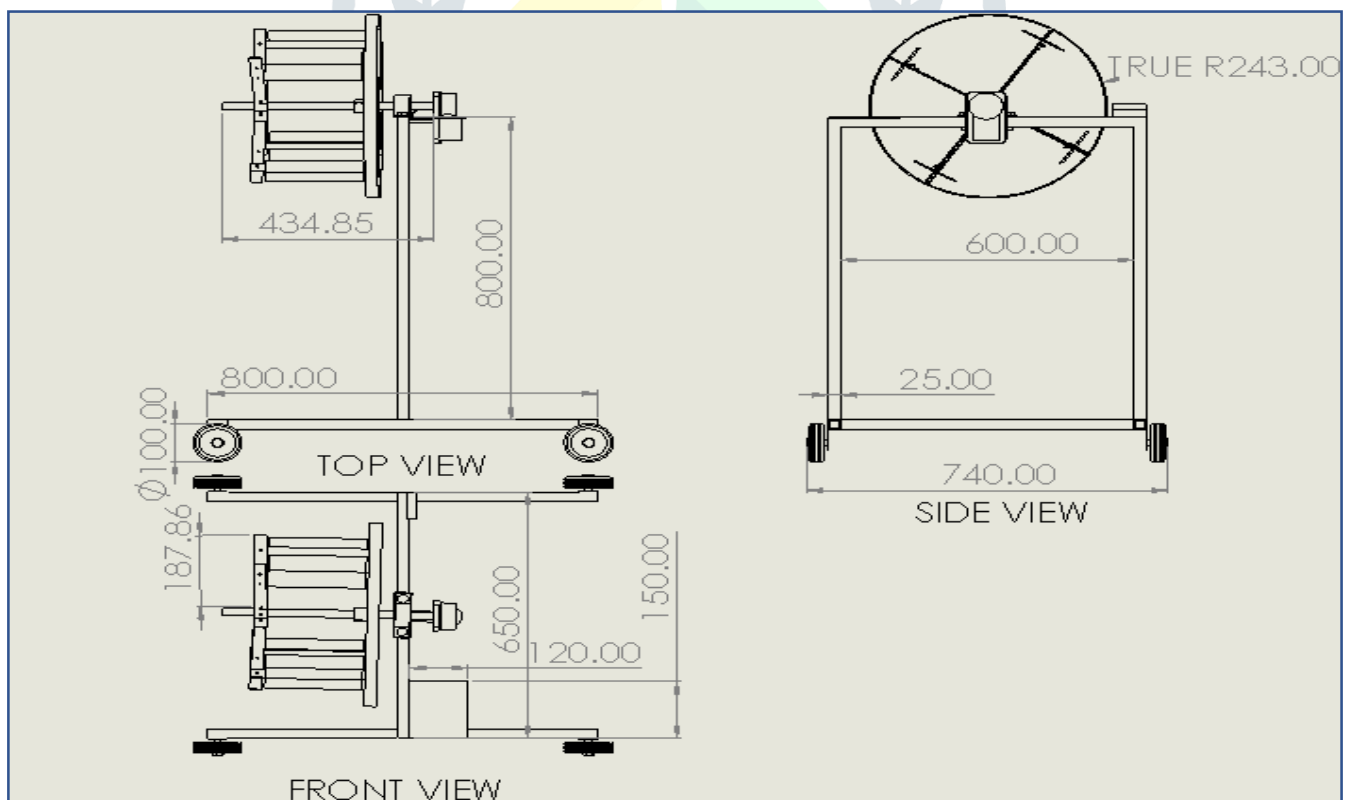2) Viper motor:

   Speed (rpm) = 55 rpm

   Power (p) = 120 w

   Torque $= \frac{60*P}{2*\pi*RPM}$

   Torque $= \frac{60*120}{2*\pi*55}$

   $= \frac{7200}{110\pi}$

   Torque = 20.83 nm

VI. 2D & 3D MODELS :-
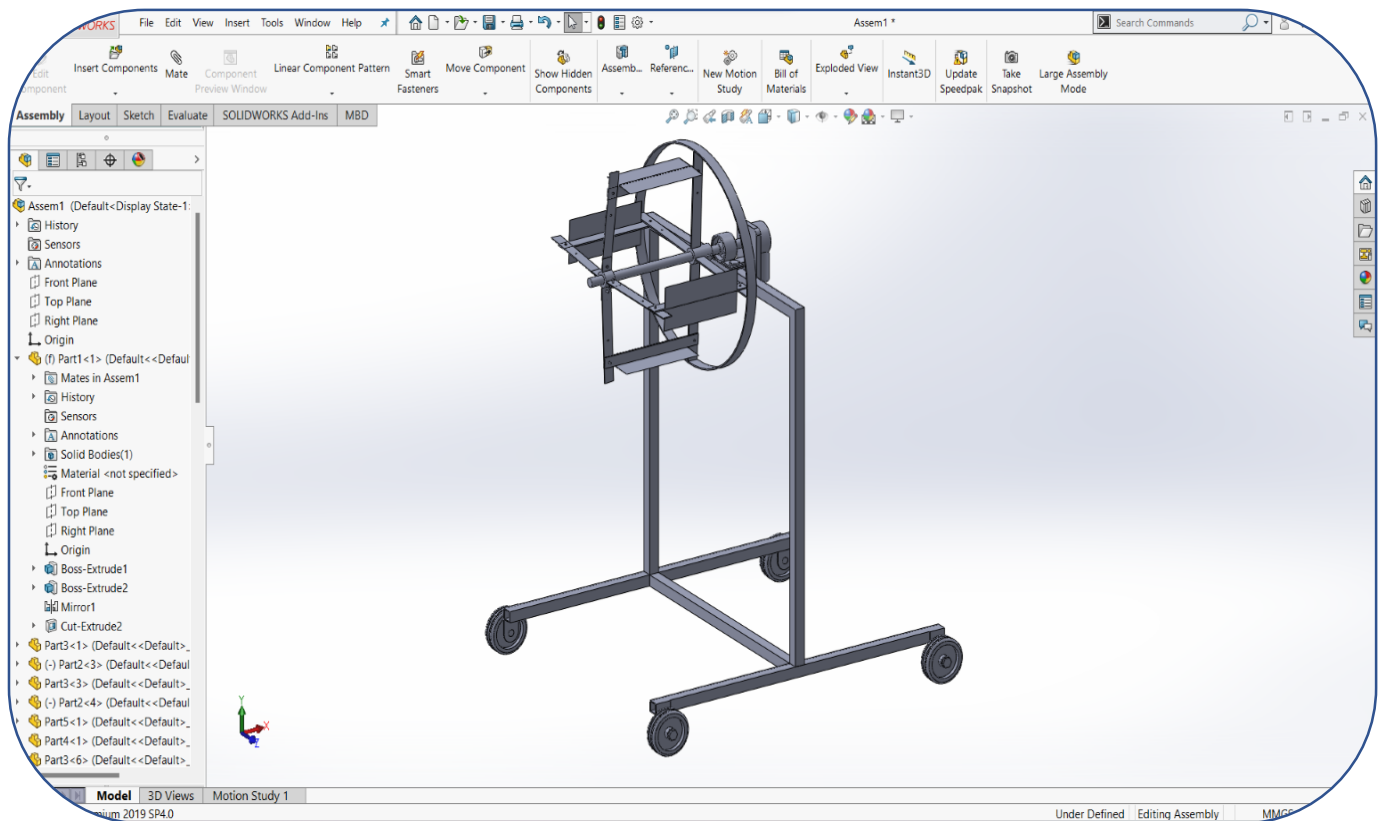
VI. CONCLUSION :

Pipe drip wrapping machine can automate the process of wrapping drip irrigation pipes, reducing the time and labor required to work manually. The pipe drip wrapping machine can wrap the pipe on the pipe accurately and follow the human operator, which will help reduce the risk of errors and ensure accurate pipe wrapping. Pipe drip wrap machines can help reduce waste by keeping drip pipes tightly closed. This helps prevent the pipe from being bent or damaged during storage or transportation. Pipe drip wrapping machines can help improve safety by eliminating the need for workers to carry heavy rolls of drip irrigation pipe. This will help reduce the risk of injury and damage.

VII. ACKNOWLEDGMENT :

VIII. REFERENCES :

1) Cao S. 2021. Analysis of winding tension control method of winding machine. China Rubber Ind. 68:212-5. Cuello G.H., Carbajal E.R., Petiton J.P. 2019.

2) Mechanization of irrigation in Latin America. AMA-Agr. Mech. Asia AF. 50:52- 6. Drexler D.A., Virágh E., Tóth, J. 2018.

3) Controllability and reachability of reactions with temperature and inflow control. Fuel. 211:906-11. Fan X., Zhang W., Chen W., Chen B. 2020.

4) Land-water-energy nexus in agricultural management for greenhouse gas mitigation. Appl. Energ. 265:114796. Ge M., Wu P., Zhu D., Zhang L., Cai Y. 2020.

5) Optimized configuration of a hose reel traveling irrigator. Agr. Water Manage. 2401:106302. Li Q., Bai J., Fan Y., Zhang, Z. 2015. Study of wire tension control system based on closed loop PID control in HS-WEDM. Int. J. Adv. Manuf. Tech. 82:1089-97.