

Literature Review on Steering & Braking System for Self Propelled Onion Harvester

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ABSTRACT: India is well known country for agricultural industry. Most of Indian economy based on agricultural products. Country produces variety of products mostly sugarcane, cotton, rice, potato, tea and onion. India is second largest onion producing country in the world. Although techniques and methods used for harvesting onion crop is done by traditional method. This is the main reason for India has ability to produce more onion in little span but still lagging in onion production. SAE INDIA focuses on optimizing the time required to harvest onion after the completion of crop. Our aim of the project mainly focuses on the time and work efficiency. This may include the time and labor cost, thus indirectly it can be compared with machine efficiency against manual efforts required. Indian farmer cropping the onion on short area so convention tractors are not able to harvest onions properly. Today most of the vehicles use front wheel steering and rear wheel as drive member. This causes damage of crop due to more space required to turn the vehicle. Rear wheel steering allows for very sharp turns and high-precision mobility in narrow spaces. Many fork lifters use this kind of manoeuvrability so that pallets can be loaded and unloaded quickly with a great deal of accuracy. We want to use this mechanism for onion harvester. So that it reduces turning radius, reduce damage to other crops and saves idle time. Speed required for harvesting process is small up to 15kmph so according to that braking time and stopping distance is being defined for effective braking.

KEYWORDS: Onion Harvester, Rear Wheel Steering, Turning Radius, Disc Brake, Stopping Distance.

I. INTRODUCTION

India is the second largest onion growing country in the world. Indian onions are famous for their pungency and are available round the year. Indian farmers use traditional method for onion cropping. The reason behind that is lack of technology and instruments available in agriculture. So we decide to develop a onion harvester which is compact, efficient and easy to operate. This paper is mainly focus on steering and braking system for onion harvester. We will go for rear wheel steering The rear wheel steering system mechanism is developed so that to manoeuvre the vehicle effectively. Basically the vehicle has different system closed to the both wheel set. Thus this design gives us better space accommodation available on the vehicle. The rear wheel steering system can be developed in different systems. The simplest way of developing this system is by using mechanical method instead of hydraulic and electronics. Reasons for rear wheel steering : [1] Rear-wheel steering works better in tight spaces- Because the back end pivots around the front, rear wheel steering allows for very sharp turns and high-precision mobility in narrow spaces. [2] Rear-wheel steering helps balance the load of the front- One of the main jobs of the front wheels is to support the weight of load while digging. As the load gets heavier, the front wheels take on more strain. If the front wheels also had to steer, vehicle would consume more energy and experience much more wear-and-tear. Most of the problems associated with rear-wheel steering come from the fact that it's so different from how we were taught to drive. Accelerating or stopping too quickly can lead to instability. Drivers need to learn to take it slow, anticipate where the back end will go, and how to position the machine at the inside of a turn. Disc brakes to front drive wheels are useful to stop the machine. It will develop sufficient torque for jerk free stopping moment of machine.

II. LITERATURE REVIEW

Swapnil S Maheshmale (SAE Tifan) et. al. (2019) studied the onion production all over the world and did detailed analysis of onion production in India and Maharashtra. He also studied the lifecycle of crop, General botany of onion crop, its classification depending on color, size, season, variety. He also understood the conventional steps for onion farming and conventional methods for onion harvesting. He also suggests scope in onion farming for more productivity and efficient harvesting.

P.A.Turbatmath, (Development and field evaluation of tractor operated onion transplanter) et. al. (2011) Onion growers are facing lot of problems in transplanting of onion seedlings with the shortage of farm laborers during transplanting seasons. Therefore, efforts were made to develop tractor operated semi automatic onion transplanter. He mainly focused on onion properties and soil condition.

Promod Reddy et al, (2017): Have explained theoretical aspects of potato harvesting machine. In this, all efforts taken by human being that has to be reduce is considered and aspect as has been kept in front to maximize the quality of the product harvested within required time and low cost.

Ashwini Talokar (Design of Onion Harvester) et al (2014) the attempt has been made to design the harvester for the low power capacity tractors range in the 15 to 20 hp. They suggest design parameters for onion harvester which includes bending moment on blade, determination of soil load on harvester, onion bulb load and power required for harvesting. Harvester design mainly depends on working width, depth of operation and conveying capacity.

Er. Amitesh Kumar, Dr.Dinesh.N.Kamble (Zero Turn Four Wheel Steering System) (2014) This paper focused on a steering mechanism which offers feasible solutions to a number of current maneuvering limitations. They suggested disadvantage associated with conventional steering systems is the turning radius that is possible for the steering action. This is eliminated by employing a four wheel steering system. They explain cases and special requirements at low speed, medium speed, and high speed. They also done time analysis for turning procedure.

Vivek Dhameliya, Nishant Sheta (DESIGN And analysis of Rear Wheel Hub & Steering Knuckle) described process of design and fatigue analysis for rear wheel hub & steering knuckle. They also suggest main objectives and material that fulfills all the requirements for reliable off road vehicle.

Arun Singh et al, (2014) study the concept of four wheel steering and its advantages and disadvantages. Also focus on rear wheel steering with examples of fork lift trucks, camera dollies, early pay loaders, Buckminster Fuller's Dymaxion car and the Thrusts SC. The main advantage of four wheels steering is that taking sharper turns and improve stability of vehicle. During high speed application it is easy to take relatively small corrective turns.

Ramchandru (Dynamic Analysis of Mechanical Braking System) et. al. (2015) give general idea of braking system. Braking system is mainly depend on actuation force. So designer has to design brakes according to requirement. While applying force by brake heat is generated so material should be such that it will not damage and wear out easily.

D. V. Tretisiak (Research in hydraulic brake components and operational factors influencing the hysteresis losses) et. al. (2008) suggested test procedure of braking system along with analysis of experimental results. They suggested influence of braking pressure and velocity on hysteresis value.

III. RESEARCH FINDING AND ISSUES

1. It is very difficult to determine the height, weight, length of the crop because of the uneven growth may occur as its manual operation starting from sowing of the seed till full growth of the crop.
2. In the order to acquire more productivity from each crop it is necessary to use proper method of removal of plant from soil without damaging the leaves as well as the bulb of the onion.
3. In traditional method, no specific steps for removal of the crop, since it was necessary to define a specific method for it. It may include separation of soil around the base of the crop as well as that over the bulb of the plant also it may include proper removal of the plant without damaging the leaves of the crop.
4. Available agricultural machineries are very big in size which damages the crops while turning.
5. Sometimes soil may get slippery which affect braking system.
6. More idle time in machine handling and proper setting of machinery.
7. As we know that, in soil some debris, stones are present which may also come along with the plant. So, it is necessary remove those debris in order to get required results.

IV. PROBLEM DEFINATION

The conventional method of onion harvesting is time consuming also it requires more man power. It increases the cost of harvesting in term of money and efforts. Conveying and collecting process are also time consuming and require skilled operator. In order to achieve more productivity from crops, the farmer must harvest the crop without damaging the onion bulb and leaves. Collecting and packaging of the crop is as important as harvesting the crop from farm. It is possible by efficient working of all the systems. In present world size of agricultural machinery is very big so while harvesting operation it damages the crop. It is mainly due to more space required for turning operation. It is minimized by reducing turning radius and smooth steering operation. Braking is most important operation in any machine. It minimizes stopping distance. Power available is comparatively small so while designing a harvester power must be consumed properly for every operation.

V. PROPOSED WORK

1. Minimizing the steering turning radius to optimize Non-harvesting time required for the harvester
2. Providing effective braking for the vehicle in order to have better control over the vehicle during operation as well as travelling from one point to another point
3. Efficient harvesting of the crop- The onion bulb should not be damaged during harvesting by the vehicle itself.
4. Reducing human efforts and labour Machine should reduce the human's efforts and overall labour cost which will be profit to the farmer.
5. Machine should be easy to repair within short time period with minimum expense.
6. As many farmers in India do farming on smaller area so machine should be compact in size.
7. Reducing time expense- As large time is involved in onion harvesting physically hence machine should be able to harvest the land in less time increasing the overall productivity.

VI. REQUIREMENTS

1. All technical information, design data and experiment setup for material testing
2. Computer with internet facility, reference book and library facility
3. Necessary raw materials will be procured from vendors.
4. Softwares are necessary for design, drafting and testing purpose.

VII. METHODOLOGY

1. We are participating in participating SAE TIFAN competition. This organization itself provides guidelines in rule book prior to the competition. We follow those guidelines for further operation.
2. Design frame according to requirements such that it is helpful for rear wheel steering and front wheel drive machine.
3. Deign of well-balanced vehicle to facilitate easy manoeuvrer.
4. Design and optimizing of transmission system to achieve required speed reduction.
5. Design and optimizing of self-packaging system for collecting the harvested crop.
6. Interpretation of results.
7. Conclusion and documentation.

VIII. SCOPE

1. The Steering geometry has to be more accurate and centre rack can be used
2. Try to achieve zero turning radius
3. Deign of digging blade which offers lesser draft force to the machine
4. Selection of proper material for the supporting blade having smooth surface finish.
5. Provision for the vibratory system to increase the separation index.
6. Provide the collecting system for the onion.

7. Automatic hydraulic control system for the depth adjusting mechanism.

The onion harvester can be used where the large-scale farming is being carried out in India. The Auto-Matic onion harvester is another face of this project which will lead to cost effective harvesting with increased economic growth. Thus, with reference to this various other harvesting machine can be developed for the crops like potato, beetroot, ginger, carrots and radish.

IX. CONCLUSION

Main purpose of this project is to develop compact, simple, reliable and efficient low cost harvester which helps for onion harvesting. After doing literature survey and field survey we conclude with following points:
Rear wheel steered vehicle is very efficient and suitable for low speed harvester. It fulfills all the requirements. It gives low turning radius and smooth operation while shifting bed to bed. Force required to steer the vehicle is also reduced. Disc brakes for front drive wheels prove best choice. Machine requires minimum effort for braking. Stopping distance and stopping time is also reduced. Machine qualifies all traffic rules. So this machine is become first choice for harvesting the field.

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