

# DESIGN AND FABRICATION OF SOLAR OPERATED VEGETABLE CART

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**Abstract**—The journal paper focusses at design and fabrication of solar operated vegetable cart. Commercially available solid edge software was used for designing the solar operated vegetable cart. Based on the calculations and research, we have obtained optimum values for the fabrication of economically and commercially reasonable solar operated vegetable cart.

**Index Terms**— Solar operated vegetable cart, DC motor, solar panel, mechanism, eco-friendly

## I. INTRODUCTION

A cart is a vehicle that is used for transferring goods, people and poultry from one place to another. Some carts are hauled by animals. A vegetable cart is a type of cart used mainly to transport vegetables and fruits for the nearby distance for the purpose of selling. It is commonly found in Indian market due to its easy availability and mobility. Handcarts pushed by humans have been used around the world for various purposes. Manually operated vegetable carts are commonly used in Indian markets. There are several designs and mechanisms to operate these vegetable carts. The basic principle of solar operated vegetable cart is harvesting solar energy in place of conventional sources of energy. The light energy is converted into mechanical energy using solar panels, controller and a setup of DC motor.<sup>[1]</sup> This setup can be utilized to operate this cart.



Fig. 1. View of a conventional vegetable vending cart

### A. Evolution of Vegetable Carts:

Evolution is defined as the progression from one form to another in a specific matter along the period of time. Technological and technical evolution happens on the basis of evolving nature of humans and technology depending on the needs of both.

As the human civilization progressed there have been drastic changes, improvements and advancements in the technology and techniques that have been continuously used. Similarly, there have been drastic improvements and advancements in the field of controlling, manufacturing and utilizing the

vegetable carts. Humans have evolved over the period of time and have drastically improved their way of living and accordingly based on their convenience they have continuously researched and developed many alternating ways of improving the technology they are using. Similarly, there have been drastic improvements and advancements in the field of controlling, manufacturing and utilizing the vegetable carts. Humans have evolved over the period of time and have drastically improved their way of living and accordingly based on their convenience they have continuously researched and developed many alternating ways of improving the technology they are using. Consequently, there have been many improvements in the field of controlling the driving mechanism of the vegetable pushing and vending carts.

Based on literature review and practical applications, we come across several journal papers and also the practical applications, we have come across several advancements and types in the field of vegetable vending and pushing carts. Below we have discussed few types of vegetable vending carts according to their generation of evolution. Mainly,

- 1) First generation of vegetable cart.
- 2) Second generation of vegetable cart.
- 3) Third generation of vegetable cart.
- 4) Fourth generation of vegetable cart.

### B. First Generation of Vegetable Cart:

Figure 2 represents the first generation of vegetable cart. First generation of vegetable cart is a type of primitive and old type of vegetable cart generation where in the operation of controlling was based on human efforts. This generation of carts are operated with human potential energy.

These types of carts are fully controlled and driven by human efforts. The manufacturing and maintenance of these carts is less.

Since, the maintenance and manufacturing costs of these carts are less, it is still commonly used and practiced in the current markets because of its affordability.



**Fig. 2.** First generation of vegetable

**C. Second Generation of Vegetable Cart:**

As shown in figure 3 the second generation of vegetable cart are a bit more advance than the primitive vegetable cart. Here, the control mechanism consists of cycle chain mechanism instead of pulling it using manual power mechanism. These types of vegetable cart comparatively decrease human efforts but does not completely eliminate the human efforts. Human efforts are still required to paddle the chain. Other than paddling there is no other manual effort required.



**Fig. 3.** Second generation of vegetable cart.

Above figure depicts the second generation of vegetable cart wherein the driving mechanism is merged with cycle chain mechanism. we can see that the driving mechanism is comparatively easier to operate. These types of vegetable carts too are commonly found in Indian markets for transportation in a local place.

**D. Third Generation of Vegetable Cart:**

Figure 4 shows the third generation of vegetable cart is one of the advanced and recent type in vegetable carts. These types of carts use petrol and diesel engines to operate and run the vehicle. These are used to transport the items to longer distances. These are most effective to use.

The third generation of vegetable cart has some demerits and merits. Since it uses petrol or diesel engines, these are very toxic to nature and are very expensive. The advantage of these carts is that these carts can be used to transport items for a longer distance with minimal human efforts.



**Fig. 4.** Third generation of vegetable cart.

As we can see in the above figure, the third generation of vegetable cart is very convenient to use. It works more like a typical vehicle, wherein it uses a petrol or diesel engines. These are not so commonly used for the vending purpose as it is quite expensive and cannot be easily used by the small vendors.

**E. Fourth Generation of Vegetable Cart:**

As shown in figure 5 fourth generation of vegetable cart is one of the advanced hybrid types. These types of vegetable vending carts use electric motor instead of diesel or petrol engines to operate the cart. These types of carts are eco-friendly in nature. The main demerit of these type of carts is that they are not that efficient and it requires different setup for storage of electric power. It also requires high amount of electricity to charge. Since these requires electricity to charge, it cannot be used to transport to a longer distance. This type of vegetable cart is very expensive and needs to be maintained very well.



**Fig. 5.** Fourth generation of vegetable cart

As we can see in the above figure, it is more like a third-generation vegetable cart but the only difference is it uses an electric motor instead of using petrol or diesel engines. These are not commonly found in Indian markets due to its continuous requirement of electric power.

The selection of motor depends on several factors such as for an in-wheel switch reluctance motor has average torque and torque smoothness is high.<sup>[2]</sup> Electric vehicle can act as an alternative to the mobility challenges. Electric vehicles can use solar and wind energy as the source of energy.<sup>[3]</sup> According to the comparison of Permanent magnet synchronous motor (PMSM) and the brushless DC motor (BDCM), both have several similarities but since we are storing energy in the battery we use BDSM.<sup>[4]</sup> Brushless DC motors can produce constant required torque at a specific range.<sup>[5]</sup> Brushless DC motor with attachment of sensor less control scheme is used for 3 phase DC motor and hence reduction in component requirement.<sup>[6]</sup> The comparative of main electric propulsion system such as induction motor, permanent magnet synchronous motor, DC motor and the switched reluctance motor shows the most appropriate parallel hybrid electric vehicle propulsion system.<sup>[2]</sup>

**F. Need for Harnessing Solar Energy:**

We live in an era where we are in dire need for alternative forms of fuels. Since, we all know that the quantity of fossil fuel available is nearing the existential crisis. It is estimated

that the fossil fuel available at present does not satisfy the amount of demand and is rapidly depleting, which makes it an utmost necessary to find the solution for this crisis which lies only in finding the alternative fuel with equal efficiency. There are many other forms of alternative energy formed such as nuclear, geothermal, tidal and solar etc. But many of these forms of energy has some or the other demerits. Which brings us closer to find alternatives amongst the renewable sources of energy. And among the renewable sources of energy it is researched that the solar energy being the most effective, dependable and convenient types from energy.

Solar energy is the natural form of energy; it has unlimited supply from the sun. solar energy is the most affordable of among most of the renewable sources of energy so it is cheapest form of renewable energy.

Solar energy is one of the most infinitely available renewable energy in nature. According to the worlds energy resource scenario it is understood that mankind has heavily relied on the fossil fuels and it is estimated that according to the current consumption the available oil can be used for nearly thirty-five to forty more years. And accordingly, the stock of coal is estimated to be more available for coming ten to twelve years. In addition to the exhaustion of the fossil fuels the consumption of fossil fuels has adverse effect on the nature as the energy is harvested from burning of fossil fuels, the carbon content in the atmosphere increases rapidly thus resulting in the impact of global warming on nature.

Since the most affordable and easy harvesting of energy is from solar, photovoltaic cells are used for the same. As time progressed depending on different conclusions there have been drastic improvements in increasing the efficiency of the photovoltaic solar cells. A simple device like grass cutter was modified keeping solar panels for its operation thus resulting in improved efficiency and practical applications.<sup>[9]</sup> As time progressed the importance of alternative forms of energy is been understood. A normal operating golf cart is infused with a solar panel without much effecting the performance of the cart.<sup>[10]</sup> And similarly many other normal applications is infused with solar to increase the effectiveness and reduce the effect of releasing green house gases and reducing the contribution for the global warming.<sup>[11]</sup>

**G. Types of Solar Harnessing Vegetable Carts:**

During the course of this project we have come across several practical applications and have referred to varieties of journal papers wherein we have acknowledged various types of vegetable carts which uses solar energy directly or indirectly. It is observed that mainly there are three ways of utilizing the solar energy in the vegetable carts. They are,

Type 1: Where the solar energy is used to maintain the cooling for the purpose of storage.



**Fig. 6.** Solar refrigerated vegetable cart

There are several types in vegetable carts which uses solar energy for various other applications such as the solar utilized refrigeration in the vegetable cart.<sup>[12]</sup>

Type 2: Where the solar energy is harvested and stored for the purpose of lighting.



**Fig. 7** Solar harnessed for lighting purpose

Another utilization of solar energy in a cart is for storage in the battery and using it in running the electrical appliances such as fans, lights etc.<sup>[8]</sup>

Type 3: In this complete solar energy is used for the operating and controlling of the vegetable cart.

**H. Solar Operated Vegetable Cart:**

We know that pulling or pushing a cart having a load of certain KGs is a heavily human energy consuming task. To overcome this problem, many methods and techniques have been discovered such as mechanical, electrical and engine-based solutions are in existence. But these methods mentioned above are not eco-friendly as some of them produce greenhouse gases which results in global warming. To overcome all these problems solar operated vehicles plays a vital role.

This is the advanced type of a vegetable cart where it uses solar energy to drive the cart. The solar energy is harvested using PV cells and is stored in a battery. The power stored in the battery is then utilized to power up the motor. This motor in turn rotates the wheel and thus gives the motion to the cart. The speed of the wheel is controlled using motor speed regulators. The cart can be controlled using the brakes, tearing and other accessories.



**Fig.8** solar operated vegetable cart



The figure 8 represents assembled model of solar operated vegetable cart. It consists a cart body with turning mechanism and wheels.

**II. OBJECTIVE:**

To design and fabricate a solar driven vegetable cart. Focus on complete utilization of the cart space. To compare with the current market trend and improve the design and features of the vegetable cart. To make the solar driven vegetable cart more cost effective and market ready.

**III. METHOD:**

Methodology is a process of project planning wherein all the major and minor steps of the project whether it may be logical creative fabrication application steps are neatly explained. Methodology is one of the prime components in project planning where all the possible factors and their aftermath effects are relatively considered for the optimum and effective project management.

In the present work, collection of methods or practices done are as follows:

**A. Literature review:**

The papers are reviewed because to understand and study the recent updates in a specific field. A summarization of literature review helps in simple understanding of the overall activities in a specific topic. It also helps us to implement further up gradation of work in our research.

**B. Designing:**

Here, we have fully designed the model of the solar operated vegetable cart in solid edge software with actual dimensions which will be useful for us during the fabrication work. Designing of any machine is very crucial work. Because, every dimension that we give is very important so that every part is able to connect to each other during the assembly. Table 1. represents the design characteristics of solar operated vegetable.

**Table 1.** Design Characteristics

Motor capacity	0.5 Hp.
Motor type	Brushless dc motor
Battery capacity	24 V
Solar panel capacity	100 watts
Cart dimension	3*2.5 ft
Wheel dimension	23"

**C. Fabrication:**

Fabrication is a sequence of events which is done to create something from its root rather than just assembling it. In this research fabrication work is the building of solar operated

vegetable cart from scratch. Building each part individually and assembling or welding it together is main goal of our project.

**D. Final result:**

Final goal of this research is to complete a fabrication of a solar operated vegetable cart effectively for the optimum market conditions.

**E. Advantage:**

Since, it does not emit any greenhouse gases, it is very eco-friendly. Human efforts are drastically decreased. It relies on renewable source of energy; it can be used eternally. Maintenance cost is comparatively low. It has wide range of applications. As it uses solar power and solar power is one of the non-exhaustible sources of renewable energy, it can be used to transport the cart to a longer distance. Solar energy is free of cost. Solar energy is available in plenty. Preservation of natural resources. Modest available Power. Reduces consumption of electric power.

**F. Disadvantage:**

The main disadvantage of solar related things is that it requires high installation and material cost. However, aided by government in recent in recent years the cost of solar harnessing equipment's are drastically decreased. The other disadvantage of solar related things is that it is not completely dependable.

**IV. CONCLUSION:**

After thoroughly researching and finding the solution we have compactly designed the solar operated vegetable cart, which uses a solar panel of 100 watts and a brushless dc motor of 0.5 hp and a 24-volt battery setup installed on a vegetable cart. And these specifications are for 1:2 scale the solar operated vegetable cart.

The developed solar operated vegetable cart is eco-friendly it relies on renewable source of energy so that it can be used externally. However, initial cost is high but very low maintenance.

**REFERENCES**

- [1] V. Naveen Prabhu and N Manigandan – “Design and Fabrication of Solar Transport Vehicle” IOSR Journal of mechanical and civil engineering PP 14-19.
- [2] X.D. Xue, J.K. Lin, Z.Zhang, T.W.Ng, K.F.Luk, K.W.E.Cheng and N.C.Chueng. – “Study of Motoring Operation of In-wheel Switched reluctance motor Drives for Electric Vehicles” 3rd international conference on power electronic systems and applications 2009.
- [3] Steven E.Letendre – “Ushering in an Era of Solar Powered Mobility” International Workshop on Hybrid and Solar Vehicles Nov 6 2006.
- [4] Ramu Krishnan – “Characteristics of Permanent Magnet Synchronous and Brushless DC Motors” IEEE 1991.

- [5] Pragasen Pillay – “Application Characteristics of Permanent Magnet synchronous and brushless DC motors for Servo Drives” IEEE Transactions on Industrial Applications, Vol 27 No 3 Sep/oct 1991.
- [6] Gui-Jia Su and John W.McKeeever – “Low Cost Sensor less Control of Brushless DC Motors with Improved Speed range “
- [7] Mounir Zeroulia, Mohamed Benbouzi, Demba Diallo – “Electric Motor Drive Selection Issues for HEV Propulsion systems: A comparative Study” IEEE Transaction on vehicular technology, Vol 55, No 6 2006.
- [8] M.E.Glavin , Paul K.W.Chan, S.Armstrong and W.G.Hurley “A Stand Alone photovoltaic supercapacitor battery hybrid Energy Storage System”
- [9] Praful P. Ulhe, Manish D. Inwate, Fried D. Wankhedeand Krushnkumar S. Dhakte – “Modification of Solar Grass Cutting Machine” – International Journal for Innovative Research in Science & Technology, Volume 2, Issue 11, April 2016 ISSN (online): 2349-6010.
- [10] Max Saelzer, Roger Messenger, Ali Zilouchian and Amir Abtahi – “Implementation and Testing of a Solar-Powered Electric Cart”
- [11] Toshiki Kobayashi, Akira Fukami, Junzi Mizuno and Hideaki Sasaya – “ Air Spoiler Apparatus with Solar Cells for Vehicle” United States Patent, April 28 1987.
- [12] Pravin Potdukhe, Ishwar P. Mantriwar, Neeraj S. Punekar, Vaibhav R. Lodhe, Chandrakiran G. Sharnagat,Roshan M. Mogare and Pratik A. Shamkule – “Solar Assisted Vegetable Cart” - International Research Journal of Engineering and Technology (IRJET) Volume: 05 Issue: 06 June 2018.

