

## PERFORMANCE OF TWO WHEEL AUTOMATIC ELECTRIC FORKLIFT FOR INDUSTRIAL & DOMESTIC PURPOSE

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**Abstract:** The 2 Wheel Automatic Electric forklift is a small electrical vehicle manufactured to build a cheap forklift for industry warehouses & domestic purpose. A goods transportation device which can drive by any one. Safe movement during picking, stacking and traveling with loads. The dynamics of the vehicle is simple to the control the vehicle which means that it is stable. This is prevented by two small supporting wheels for balance the vehicle and its time derivative, controlling the motors to keep the vehicle balancing. The rider controls are supposed to be natural movements; leaning forwards or backwards and the direction of the vehicle is obtain by giving the DC supply only one motor. The vehicle was built using a model-based control design and a top-down construction approach. This kind of vehicle is interesting since it contains a lot of technology relevant to an environmentally friendly and energy efficient transportation industry. The main objective was to build a vehicle capable of lifting the weighing up to 40-60 kg for a minutes or a distance.

**Keywords :** Forklift, DCmotor, Linear Mechanism, Fabrication

### I. INTRODUCTION

Factories, industries and storage go downs need forklifts and cranes for storage and moving large goods. Also there are a number of goods weighing around 40 – 60 kg that are comparatively lighter but cannot be moved around easily by human labor. To fill this need we here propose a 2 Wheel Automatic Electric forklift to lift and transport such medium weightgoods across factories & industrial warehouses. The2 Wheel Automatic Electric forklift is a fast, efficient and low power consumption vehicle that does not require much space to move around. The mini forklift will run on 2 Brushless DC motors and can drive small weight with pickup arrangement across small distances easily. For this we use a mini 2 wheel vehicle body frame designed with a platform with 2 motorized wheel mounts. It has a perpendicular handle ahead to hold on the operator. Also we design a forklift type mechanism on the front handle of vehicle using 2 bent metal strips and lifting mechanism. The lift mechanism comprises of large supporting rod for sliding the carriage. This mechanism is connected to a linear actuator. We now mount the control circuitry on the vehicle with wires that allow the vehicle to be controlled by person. Thus we provide a easily controlled forklift for small goods transportation in industrial sector. The demonstration version can lift 40-60 kg to demonstrate the concept.



Figure 1 Wheel Automatic Electric Forklift

### II. EQUIPMENT USED FOR MANUFACTURING

In the manufacturing of the forklift different type of machine equipment and tools are used. The main tools and machine are used in manufacturing of the machine are discussed below.

#### 1. Welding

Welding is the process of joining of two metal (same/different) with the application of heat with pressure without pressure with filler Rod without filler Rod.

Use of the welding in Today's technology is extensive. Welding is used in every branch of science and technology. Such as computer industries, electronic industries, mechanical industries, petrochemical industrial, etc. In the manufacturing of the forklift we use the two type of welding process namely,

- (a) Arc Welding
- (b) Gas Welding

#### 1.1 Arc Welding

Arc welding is a process that is used to join metal to metal by using electricity to create enough heat to melt metal, and the melted metals when cool result in a binding of the metals. It is a type of welding that uses a welding power supply to create an electric arc between an electrode and the base material to melt the metals at the welding point. They can use either direct (DC) or alternating (AC) current, and consumable or non-consumable electrodes. The welding region is usually protected by some type of shielding gas, vapor, or slag. Arc welding processes may be manual, semi-automatic, or fully automated. First developed in the late part of the 19th century, arc welding became commercially important in shipbuilding during the Second World War. Today it remains an important process for the fabrication of steel structures and vehicles.

### 1.2 Gas Welding

Oxy-fuel welding (commonly called oxyacetylene welding, oxy welding, or gas welding) and oxy-fuel cutting are processes that use fuel gases and oxygen to weld and cut metals, respectively. French engineers Edmond Fouché and Charles Picard became the first to develop oxygen-acetylene welding in 1903. Pure oxygen, instead of air, is used to increase the flame temperature to allow localized melting of the work piece material (e.g. steel) in a room environment. A common propane/air flame burns at about 2,250 K (1,980 °C; 3,590 °F), a propane/oxygen flame burns at about 2,526 K (2,253 °C; 4,087 °F), an oxyhydrogen flame burns at 3,073 K (2,800 °C; 5,072 °F), and an acetylene/oxygen flame burns at about 3,773 K (3,500 °C; 6,332 °F).

Gas welding is still used for metal-based artwork and in smaller home based shops, as well as situations where accessing electricity would present difficulties.

In oxy-fuel welding, a welding torch is used to weld metals. Welding metal results when two pieces are heated to a temperature that produces a pool of molten metal. The molten pool is generally supplied with additional metal called filler. Filler material depends upon the metals to be welded.

### 2. Lathe Machine

A lathe is a tool that rotates the work piece about an axis of rotation to perform various operations such as cutting, knurling, drilling, facing, and turning, with tools that are applied to the work piece to create an object with symmetry about that axis. Lathes are used in woodturning, metalworking, metal spinning, thermal spraying, parts reclamation, and glass-working. Most suitably equipped metalworking lathes can also be used to produce most solids of revolution, plane surfaces and screw threads. In the lathe machine we made the axle shaft by using turning process and also done the thread cutting on the axle shaft.

### 3. Drill Machine

A drill (known in many countries as a drill machine) is a tool fitted with a cutting tool attachment or driving tool attachment, usually a drill bit or driver bit, used for boring holes in various materials or fastening various materials together. The attachment is gripped by a chuck at one end of the drill and rotated while pressed against the target material. The tip, and sometimes edges, of the cutting tool does the work of cutting into the target material.

### Black Smithy

A blacksmith is a metal smith who creates objects from wrought iron or steel by forging the metal, using tools to hammer, bend, and cut. Blacksmiths work by heating pieces of wrought iron or steel until the metal becomes soft enough for shaping with hand tools, such as a hammer, anvil and chisel. Heating generally takes place in a forge fueled by propane, natural gas, coal, charcoal or oil. Some modern blacksmiths may also employ an oxyacetylene or similar blowtorch for more localized heating. Color is important for indicating the temperature and workability of the metal. As iron heats to higher temperatures, it first glows red, then orange, yellow, and finally white.



### MANUFACTURING OF PARTS

#### 1. Chassis

A chassis is the internal framework of an artificial object, which supports the object in its construction and use. An example of a chassis is a vehicle frame, the underpart of a motor vehicle, on which the body is mounted; if the running gear such as wheels and transmission, and sometimes even the driver's seat, are included, then the assembly is described as rolling chassis.

### III. ASSEMBLY OF PART

#### 1. Brushless DC Motor

Two 66W Brushless DC motors are used. Brushless DC electric motor (BLDC motors, BL motors) also known as electronically commutated motors (ECMs, EC motors), or synchronous DC motors, are synchronous motors powered by DC electricity via an inverter or switching power supply which produces an AC electric current to drive each phase of the motor via a closed loop controller. The controller provides pulses of current to the motor windings that control the speed and torque of the motor.

The advantages of a brushless motor over brushed motors are high power to weight ratio, high speed, and electronic control. Brushless motors find applications in such places as computer peripherals (disk drives, printers), hand-held power tools, and vehicles ranging from model aircraft to automobiles.



#### Motor Specification

• Voltage	40 V
• RPM without Gear Box	3150 rpm
• RPM with Gear Box	1313 rpm
• Current	1.65 Amp
• Torque	0.14 Nm
• Power	66 Watt

## 2. Linear Actuator

A linear actuator is an actuator that creates motion in a straight line, in contrast to the circular motion of a conventional electric motor. Linear actuators are used in machine tools and industrial machinery, in computer peripherals such as disk drives and printers, in valves and dampers, and in many other places where linear motion is required. Hydraulic or pneumatic cylinders inherently produce linear motion. Many other mechanisms are used to generate linear motion from a rotating motor.



### Linear Actuator Specification

- Voltage 24 V
- Push load 6000 N
- Pull Load 4000 N
- Speed 4.2 mm/sec
- Current 4 Amp
- Maximum stroke 180 mm

## 3. Battery

An electric battery is a device consisting of one or more electrochemical cells with external connections provided to power electrical devices such as flashlights, smart phones, and electric cars. When a battery is supplying electric power, its positive terminal is the cathode and its negative terminal is the anode. The terminal marked negative is the source of electrons that when connected to an external circuit will flow and deliver energy to an external device. When a battery is connected to an external circuit, electrolytes are able to move as ions within, allowing the chemical reactions to be completed at the separate terminals and so deliver energy to the external circuit. It is the movement of those ions within the battery which allows current to flow out of the battery to perform work.



### Battery Specification

- Voltage 24 V
- Current 3 Ah at 10 hours  
(3/10= 0.3 Amp)

## 4. Sprocket

A sprocket or sprocket-wheel is a profiled wheel with teeth, that mesh with a chain. The name 'sprocket' applies generally to any wheel upon which radial projections engage a chain passing over it. It is distinguished from a gear in that sprockets are never meshed together directly, and differs from a pulley in that sprockets have teeth and pulleys are smooth.

Sprockets are used in bicycles, motorcycles, cars, tracked vehicles, and other machinery either to transmit rotary motion between two shafts where gears are unsuitable or to impart linear motion to a track etc. Perhaps the most common form of sprocket may be found in the bicycle, in which the pedal shaft carries a large sprocket-wheel, which drives a chain, which, in turn, drives a small sprocket on the axle of the rear wheel. Early automobiles were also largely driven by sprocket and chain mechanism, a practice largely copied from bicycles.

### Sprocket Specification

- Outer diameter of driven Sprocket 60 mm
- Outer diameter of driver Sprocket 40 mm
- Inner diameter of driven Sprocket 18 mm
- Inner diameter of driver Sprocket 9 mm
- Teeth on driven Sprocket 15
- Teeth on driver Sprocket 6



## 5. Chain

A chain is a serial assembly of connected pieces, called links, typically made of metal, with an overall character similar to that of a rope in that it is flexible and curved in compression but linear, rigid, and load-bearing in tension.

## 6. Wheels

A wheel is a circular component that is intended to rotate on an axle bearing. The wheel is one of the key components of the wheel and axle which is one of the six simple machines. Wheels, in conjunction with axles, allow heavy objects to be moved easily facilitating movement or transportation while supporting a load, or performing labor in machines. Wheels are also used for other purposes, such as a ship's wheel, steering wheel, potter's wheel and flywheel.



Wheel Specification

- Outer diameter of wheel 280 mm
- Inner diameter of wheel 18 mm
- Outer dia. of support wheel 60 mm
- Inner dia. of support wheel 10 mm

7. Axle Shaft

A drive shaft, driveshaft, driving shaft, propeller shaft is a mechanical component for transmitting torque and rotation, usually used to connect other components of a drive train that cannot be connected directly because of distance or the need to allow for relative movement between them.

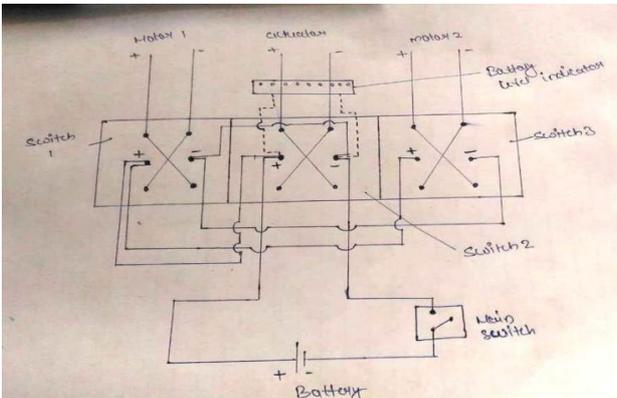


Specification of Shaft

- Length of shaft 240 mm
- Diameter of shaft 18 mm
- Length of thread on shaft 130 mm

8. Control Box

The control box the forklift having the three switches. Two switches are used for control the motion of the forklift in forward and backward direction & also used to taking turn of the forklift. The third switch is used to operate the linear actuator up and down. For this work we used the auto cut switch.



Advantage

- Less costly.
- Easy to operate.

- Easily Attachable & Detachable.
- Reduce time.
- Require less space for riding, parking.
- A clean, green, eco-friendly machine.

Allow for changes of the control parameters without reprogramming.

Calculation:

Rated rpm of motor(N) = 3150rpm

Torque of Motor (T) = 0.14 N-m

Ratio of speed reducer = 12:5

Reduction = (12/5)

$$= 2.4$$

$P_{in} = 7.2$  Watt

$P_{out} = 6.41$  Watt

Efficiency ( $\eta$ ) =  $(P_{out}/P_{in}) * 100$

$$= (6.41/7.2) * 100$$

$$= 0.89 * 100$$

Efficiency ( $\eta$ ) with out load = 89%

Speed without load,

Speed = 8.60 Km/h

Speed with load,

Speed = 5.80 Km/h

Efficiency =  $S_2/S_1$

$$= 5.80/8.60$$

$$(\eta) = 0.67$$

Efficiency with load = 67%

IV. CONCLUSION

- There is a large scope of transportation of goods from one place to another place easily.
- The potential is huge and the return on investment is also very good.
- It uses less time for transportation of heavy goods (Approximately 40-60 kg) from one place to another place & efficiency is 89%(with out load) and 67%(with load).
- It require less space for working and parking.
- It is a clean, green, eco-friendly machine.

REFERENCES

- [1] Dr. R.N. Mall (2013), Automated Guided Vehicle, ISBN 2091 Journal, MMMEC, Gorakhpur.
- [2] Kenneth B. Ackerman (1990), Forklifts and other Mobile equipment, Practical handbook of warehousing
- [3] R S Khurmi, J.K Gupta (2005), A text book of Machine Design.
- [4] S S Rattan (2009), Theory of Machines, Professor of Mechanical Engineering, National Institute of Technology, Kurukshetra.
- [5] J B Gupta (2011), Basic Electrical & Electronics Engineering.
- [6] From vol. IV Number 1 of Warehousing Forum 1998, The Ackerman Co.
- [7] symposium EVS-24. Stavanger, Norway
- [8] Conte M (2010) Super capacitors technical requirements for new application. Fuel cell 10:806-

- 818.
- [9] de Silva, Clarence W. (2009). *Modeling and Control of Engineering Systems*. CRC Press. pp. 632–633. ISBN 1420076876.
  - [10] Moczala, Helmut (1998). *Small Electric Motors*. London: Institution of Electrical Engineers. pp. 165–166. ISBN 085296921X.
  - [11] Xia, Chang-liang (2012). *Permanent Magnet Brushless DC Motor Drives and Controls*. John Wiley and Sons. pp. 18–19. ISBN 1118188365.
  - [12] M. Gopal. *Control systems: principles and design*. 2nd ed. Tata McGraw-Hill, 2002. Page 165.
  - [13] ECMs and HVAC Systems
  - [14] Ohio Electric Motors. *Brushless DC Motors Used in Industrial Applications*. Ohio Electric Motors. 2012. Archived November 8, 2012, at WebCite
  - [15] Peter Campbell. *Permanent Magnet Materials and their Application*. Cambridge University Press, 1996. Page 172.
  - [16] M. Gopal. *Control systems: principles and design*. 2nd ed. Tata McGraw-Hill, 2002. Page 159.