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## Small Aircraft Towing Device

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### Abstract

Small Aircraft Towing Device is an idea inspired by aircraft push back truck which is already being used. The device is now being made focusing on the Cessna 172 Sky-hawk. We are designing the device to be Eco- friendly, less workload for personnel and safer. Push back trucks uses diesel to operate but our device will be operated by a 12V battery which does not release any harmful gases that pollutes the environment. Using tow bars requires man power and consumes energy. So, our device is made to be semi-automated and uses two high torque motors which obviously require less energy. Manual works are done when using tow bars which might be quite dangerous. To have a safe working environment the device is controlled by wired controller. The personnel that is towing the aircraft can stay approximately 5m away from the aircraft. This project has the capabilities to give some major impacts to the aviation world. This project will come handy to many aircraft owners and airlines when if it is upgraded in the future yet for now we will focus on Cessna 172 Sky-hawk.

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*Key-word: - towing, small aircraft, Cessna 172 Skyhawk*

### 1.0 INTRODUCTION

In aviation, there are several of heavy duty machine such as push back truck and tow truck that be used in push the aircraft back from terminal or parking to the taxiway and towing the aircraft to specific place without starting the engines in order to save fuels and increasing efficiency respectively. Short to say, they help the aircraft personnel to move the aircraft when the engines of the aircraft are off and in need of service. Besides, it is also used to park the aircraft in the hangar. There are various type of aircraft tow machines and vehicles which depends on the size of the aircraft. As for Boeing 747 they uses the tow tractor which is due to the size of the wheel of Boeing 747. Unlike the light aircraft as in Cessna 172 they might only need the tow machine instead the tow tractor as Cessna 172 has a smaller wheel size. Other than, types of tow machine and tow tractor, the price of the machines and devices also expensive and only successful, profit earning airlines can afford to buy it.

For private jet owners, they might not able to buy the tow machine for their aircraft since it is expensive. Normally, they own a light aircraft that can fit less than 10 people. Usually, they come from business man community that does a wide range of business. So, every time they fly with their private jet they will need a tow machine for parking. Most of the tow machines in market are not portable which had caused loss money because they had to rent it at the foreign hangar where they park their private jet. Not to forget, those tow trucks also uses diesel for operation. As we all are aware of current condition of pollution on earth, this is playing a major part in releasing polluting gas elements. We are trying to save our mother nature and trying to reduce pollution.

#### 1.1 Introduction of towing

The forward movement of an aircraft, usually with engines off, using the power of a specialised ground vehicle attached to or supporting the nose landing gear. It may occur for the movement of both in service and out of service aircraft. This will affect the promulgation of procedures and the required qualification for those occupying the flight crew seats on the aircraft during the maneuver. As part of out of service repositioning of aircraft supervised by maintenance personnel, it may follow the pushback from a nose-in gate of an empty aircraft with engines off. (Skybrary.aero. "Aircraft towing". 6 January 2016)

### **1.1.2 Definition of Pushback In Aviation**

According to Skybrary.aero, Push back means the movement of an aircraft from a nose-in parking stand using the power of a specialised ground vehicle attached to or supporting the nose landing gear. It is commonly the second part of a 'Taxi in Push Out' (TIPO) procedure at airport terminal gates and will be necessary to depart from all except self- maneuvering parking stands unless the aircraft type is capable of power back and local procedures allow this. Occasionally, a push back may need to be followed by an engines-running pull forward to a position where local procedures allow aircraft to move forward under their own power, but usually, ground vehicle disconnection will occur after the completion of a push back (Skybrary.aero. "Pushback". 6 July 2016)

### **1.1.3 MOVING LIGHT AIRCRAFT**

Human power may move very small airplanes alone. The airplane may be pushed or pulled by landing gear, wing struts, or even the propeller blades, since they're known to be strong enough to drag the airplane through the air. To allow for turns, a person may either pick up or push down on the tail to raise either the nose wheel or tail wheel off the ground, and then rotate the airplane by hand. A less cumbersome method involves attaching a short tow bar to either the nose wheel or tail wheel, which provides a solid handhold and leverage to steer with, as well as eliminates the danger of handling the propeller. These tow bars are usually a lightweight aluminium alloy construction which allows them to be carried on board the airplane. Other small tow bars have a powered wheel to help move the airplane, with power sources as diverse as lawnmower engines or battery-operated electric drills. However, powered tow bars are usually too large and heavy to be practically carried on small airplanes.

### **1.1.4 IDEA OF THE PRODUCT**

So that's how we came up with the idea of producing a portable aircraft tow device that is lightweight, eco friendly with a reasonable price specially for light aircraft owners. The purpose of this project is to mainly help small aircraft owners especially Cessna 172. It is very safe for civilians as it is controlled by a controller from a safe distance. It can be controlled from a radius of 5 meters. Our product is extremely eco- friendly as it is battery powered and does not use any fuel to operate. Lastly, it uses electric motors instead of diesel powered engines which does not produce polluting gases and less heat provided.

## **2.0 METHODOLOGY**

### **2.1 PRODUCT DESCRIPTION**

#### **2.1.1 Product Objectives / Purpose of Product**

The idea of Small Aircraft Towing Device (SATD) actually originated from push back truck and tow truck that is very widely used all over the world for towing purposes. SATD is being created to have the same functions like the rest but mainly focused onto small aircraft. It is very safe for human being as it is controlled by a controller from a good distance. It can be controlled from a radius of 2.5 meters. SATD is also eco-friendly as it is using electric motors instead of fuel powered engines.

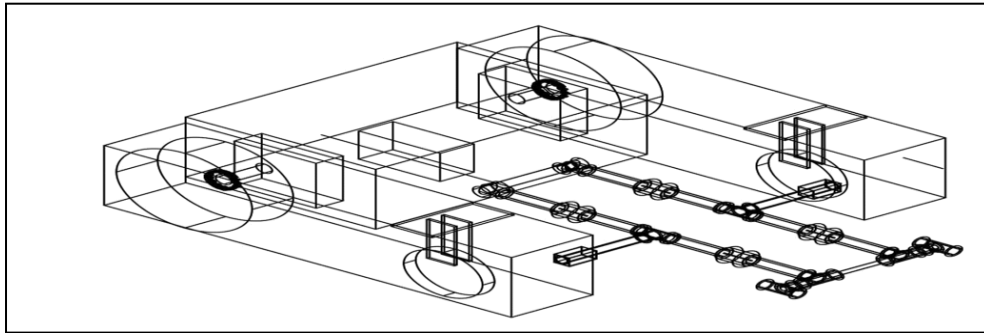


Figure 1: The 3D view

### 2.1.2 Product Features and Functionalities

Small Aircraft Towing Device (SATD) is mainly designed for those who owns small aircraft, let it be an airline or a personnel who is facing troubles in moving aircraft from one point to another. The product is controlled by a controller which says that less human energy is needed to move the aircraft if SATD is being used. This is safer than using tow bars or tow trucks where multiple fatal accidents has been reported that happened during the usage of those. Plus, it does not release gases that harms the environment as in other tow trucks does in accordance with the usage of fuel. As the global is getting advanced day by day, the air being polluted due to release of dirty and toxic gases. SATD is made to teach people how to love and protect mother-nature by using devices or machines that does not release pollutants. SATD is driven by a mechanical device as in winch motor which have a greater tendency to pull heavy objects. They are just as same as starter motor which happens to have a higher torque with low velocity. Rechargeable battery of a voltage of 12V dc is used to power up the motor.

Angle bar is used in designing the rectangular shape as the main cover of SATD. SATD is a light weighted device. In order to give a proper shape and a little bit of weight, mild steel is used too. To secure the heavy winch motors and battery, metal plate is welded at the bottom of the cover. To make SATD look presentable, aluminum sheets will be used to cover the exposed parts. This also prevents any foreign objects or dusts from entering and accumulating inside the device. Heavy duty tires are being used to withstand the force of heavy objects when being towed. This makes it a 4 wheel operation.

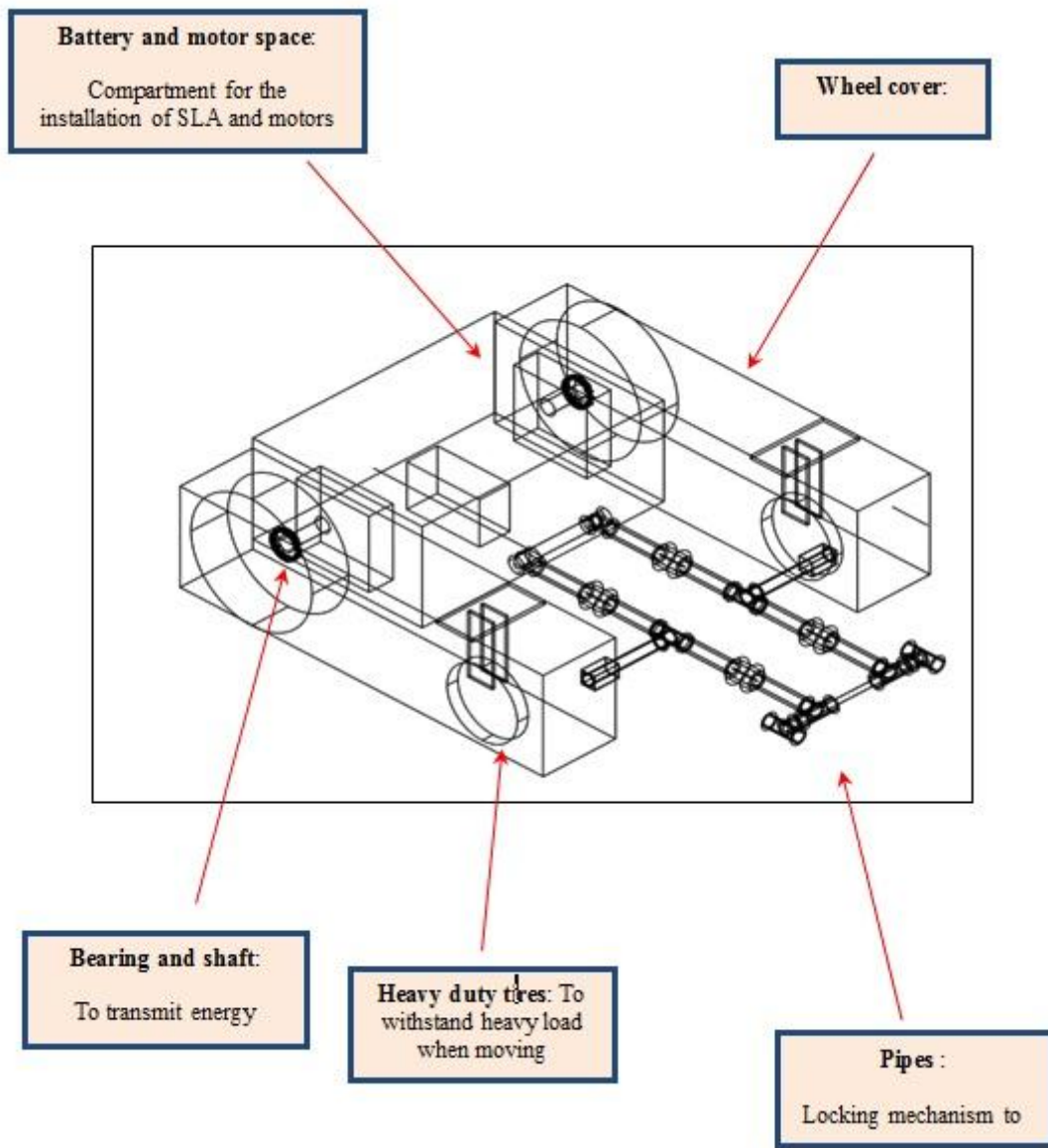


Figure 2 : Functionality of SATD

This Small Aircraft Towing Device comes with a wheel protector, which protects the tire from any damages during the usage of this product or when it is stowed. Besides that, this product also comes with a heavy duty tire that can carry a weight of approximately 1 tonne when all four tires are equipped. The tire also allows this product to move with ease on the dry and flat surfaces. Other than that, it also comes with tire attachment point at the front. This attachment point is suitable for almost light aircraft tire that has a weight of 1 tonne and below. The attachment point is made of Cold Rolled Sheet that has a thickness of 0.6” that is enough to withstand half of the light aircraft weight.




Moreover, the structure of this product is made from a Steel Bar with 12mm thickness. All parts of this structure are from the steel bar to strengthen the product to withstand heavy weight. Besides that, an angle bar with a thickness of 4mm was added to this structure to make it more strong and durable. Small Aircraft Towing Device (SATD) is covered using an aluminum flat sheet with a thickness of 0.21mm. This sheet cover all the parts of this product to protect the tire, motor and electronic instrument installed in this product. Other than that it also makes the product look more attractive.

This product also comes with two high torque motor which is Winch Motor to drive the SATD front, backward, left and right. The shaft of the motor was interconnected with a chain sprocket at each side of the two motor left and right. Furthermore, SATD also comes with controllers that allow the personnel to control the SATD from a good distance. This product also has its limitation, one of the limitation is that it can only tow or pushed a light aircraft that has weight around 1 tonne and below. Other than that, the product should be attached to the aircraft manually as well as locking the tires of the aircraft.

**2.1.3 Operation of the Product**

This product is fully manual in term of movement since the person need to control it using wired controller and also the attachment and locking of tire. Firstly, the battery must be fully charged before starting to operate the device. The battery must be connected and placed securely in Electronics and Motors compartment. To operate the device, the main switch in electronics compartment must be set to 'ON' and the switches of the controller also must set to 'ON' to able it to transmit signal from the control to motor. You may refer table below to understand the control system

Controlling the device to operate the product

Direction of Movement	Control on remote control
Forward	<p data-bbox="967 835 1161 864">Both push forward</p> 
Backward	<p data-bbox="959 1211 1169 1240">Both push backward</p> 
Left	<p data-bbox="820 1547 1313 1576">The left side backward, the right-side forward</p> 

The left side backward, the right-side forward

Right



## 2.2 PRODUCT SKETCHING AND MODELLING

### 2.2.1 Product Sketching (Orthographic View)

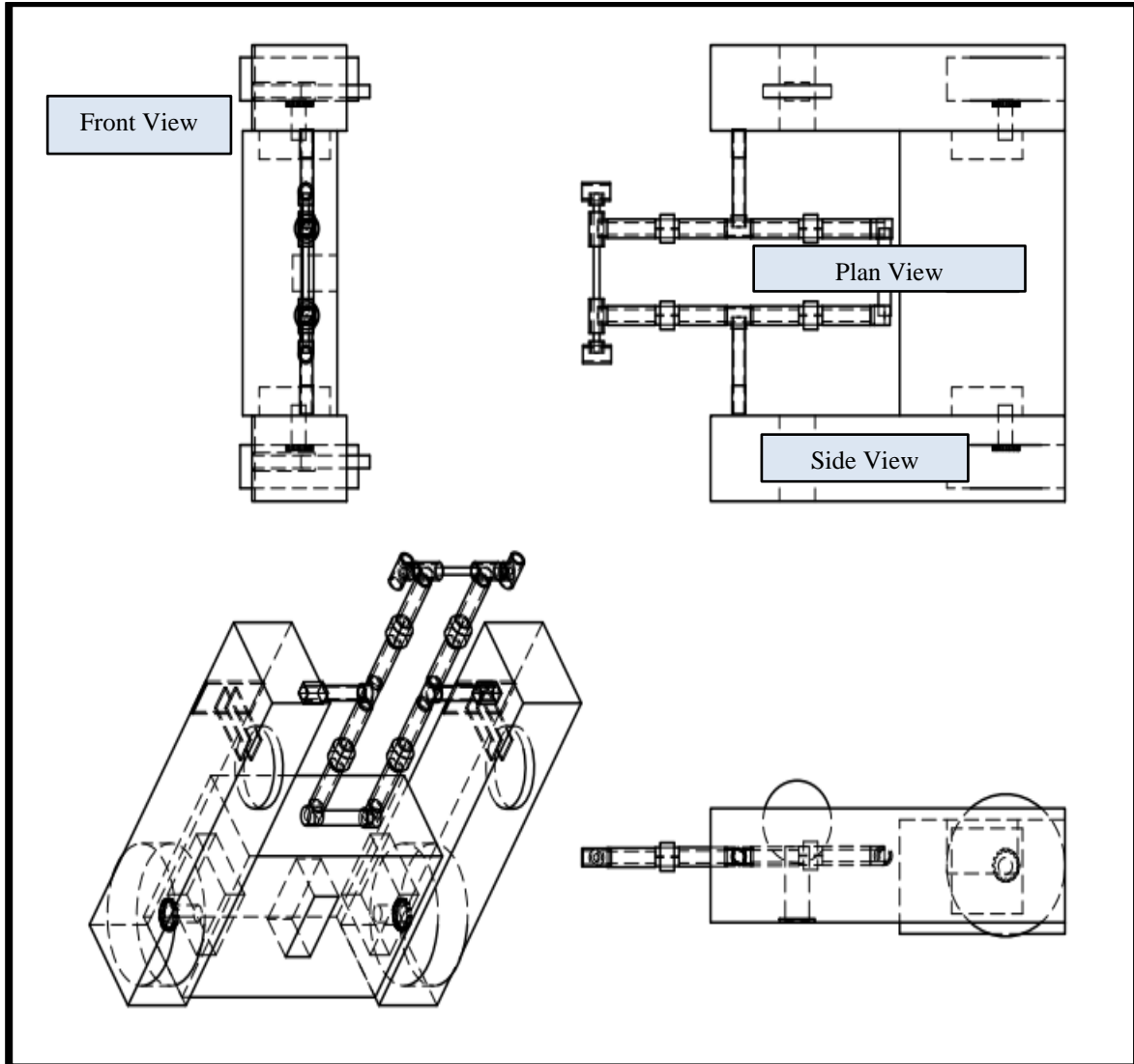


Figure 4 : View of the Product

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**NAME :** Logeishsri Gopalan

**TITLE:** Small Aircraft Towing Device (SATD)

**SCALE:** : 1:1

Orthographic View

**CLASS:** DAM5B

**UNIT:** Inches

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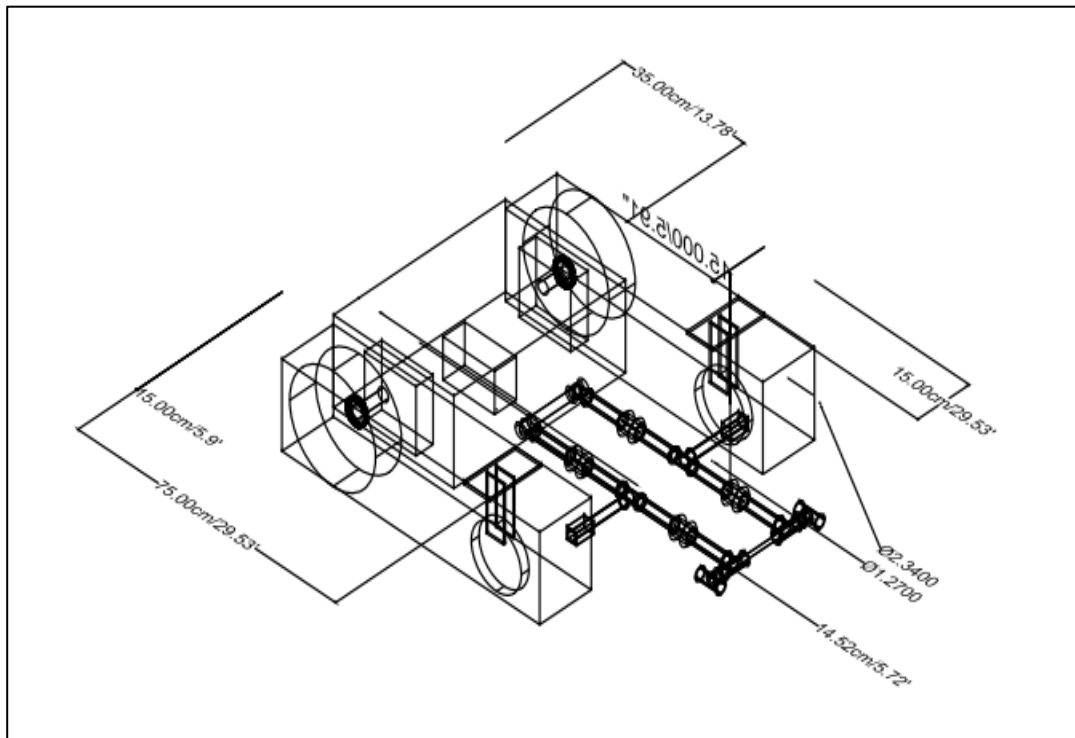


Figure 5: Dimension of the product

### 2.2.3 Expected result

The objective of this project is to design a Small Aircraft Towing Device and assembly them as per the design. The impact of this product is personnel can easily tow the aircraft from point A to point B without any extra tool such as tow bar. This product is expected to be able to reduce workload of personnel and reduce the chance of accidents happening by controlling the device from safe distance without getting too close with nose wheel and propeller that located in front of the aircraft. Furthermore, the device such as SATD may create healthy working environment since the device does not use any fuels but using electricity from the battery installed in the device to power up the device. Finally, the cost of towing would be lower with the usage of this device as it using electronic and mechanical system which is much efficient and clean. The device does not need to be maintained frequently as it using electric motors instead of fuel powered engine which have high maintenance cost.

### 3.0 Conclusion

In conclusion, this project is focusing on general aviation sector, which is small single-engine piston-powered aircraft, operating for recreation out of a small rural aerodrome. Our project can be use in towing the light aircraft or another recreation aircraft such as Cessna 172, Cirrus SRS, Sport Cub, Diamond DA20 and other light aircraft. Hoping to achieve our objectives of the project which are to design aircraft towing device, to construct the project accordingly to the plan and to develop the technology in mechanical, electronic and motors in the innovation device for full range of functionality and the forth is to demonstrate the function of Aircraft Towing Device on the workplace environment. Finally, as the project expected outcome, it would achieve all of the objectives, functionalities and the specification that we planned.

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