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Design of Prosthetic Limb for Partially Amputated Dog

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Abstract
Prosthetic limbs are an emerging technology that is going to amazing lengths to help those with limb loss. Humans are not the only ones that suffer limb loss, some dogs all over the world have amputations and many of these animals never have the opportunity to regain the function of their limb due to the high cost of prosthetics and time to manufacture. As technology progresses, there are quicker and more inexpensive methods of production being explored such as additive manufacturing. The focus of this work is to design a prosthetic limb for a partially amputated dog. The limb was modeled by using CATIA.
Keywords: Prosthetic limb, Amputated dog, CATIA.

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I. INTRODUCTION

The prosthesis is a system that may be within or outside the human body and animal that covers the missing portion or structure. Prostheses are the parts of the artificial body made for amputees. A significant number of individuals have suffered from a certain type of amputee. Our mission is to provide a solution to this issue that is cost-effective, has a flexible degree of work and can be tailored according to our need. The goal of this project is to design of prosthetic limb for the partially amputated dog. This initiative would also target the use of efficient materials that at the same time, are not heavy and not costly.

II. LITERATURE REVIEW

Amputation of a dog's limb is a difficult decision but is often needed to eliminate a painful or life-threatening condition. Severe trauma, cancer or debilitating birth defects are all reasons for amputation to be considered [1].

The various process is followed to obtain the desired prosthetic leg for dog in order to get the final output as required i.e, Animal Testing, Model Development, Casting, 3D Scanning, 3 CAD Modelling, Prototyping, Assembly Development [2]

Once the prosthetic limb has been fitted, it is necessary for the patient to become comfortable with the device and learn to use it in order to meet the challenges of everyday life. At the same time, they must learn special exercises that strengthen the muscles used to move the prosthetic device [3].

III. OBJECTIVE

The major objective of this project is to design a prosthetic limb for a partially amputated dog by using CATIA V5

Taking Dimensions of the Amputated Dog

Front leg amputees have an increased risk of trauma to the remaining elbow. Dog Leg for Front Leg Amputees provide support and padding for dogs that have undergone forelimb amputation. These braces help prevent and treat a number of conditions. Measurement of the amputated dog was taken while it isin standing position. Measurements initiated by measuring around the neck where the collar sits. measured around the chest, immediately behind the front leg,measured around the waist, just past the last rib. next, measured the distance from the base of the neck to the waist. Measured around the remaining leg at the pointof the elbow, then again four inches below the elbow. Finally, measured the distance from the point of the elbow to the top of the paw.

Table 1: Amputated Dog Leg Measurements

LOCATION OF MEASURMENTS	DIMENSIONS (mm)
Measurement Around the Leg at The Point of Elbow	60
Measurement Around the Leg Below the Point of Elbow	30
Measurement From the Point of Elbow to The Top of Paw	203
Measurement The Existing Leg of a Dog	101.6
Measurement The Broken Leg of a Dog	101.6

The below fig 5.14 shows amputated dog considered for this work.

Fig.1 Amputated Dog

MODELING OF PROSTHETIC LEG

This is the main part of the prosthesis. There are two common types that are usedfor legs.
Below the knee: When a lower prosthetic leg is attached to anintactupper leg.
Above the knee: A lower and upper prosthetic leg with a knee.
The design of it will be dependent on each individual and theirpreferences.

MODELING OF PROSTHETIC LIMB

- Click on the CATIA V5R21 icon, present on the desktop.
- Go to 'START' menu, A dialog box is opened. select 'Mechanical design' option and another dialog box is opened. Select 'Part design' option from the list in the box.
- Select the required plane. (Top plane is selected for this model).
- Select 'sketch' option from "sketcher tool bar".
- Create the rough sketch using "profile" icon of "profile tool bar".
- Give the dimensions to the rough sketch, using 'constraint 'icon of constraint tool bar" shown in fig.2 and finally we get 3D design fig.3.

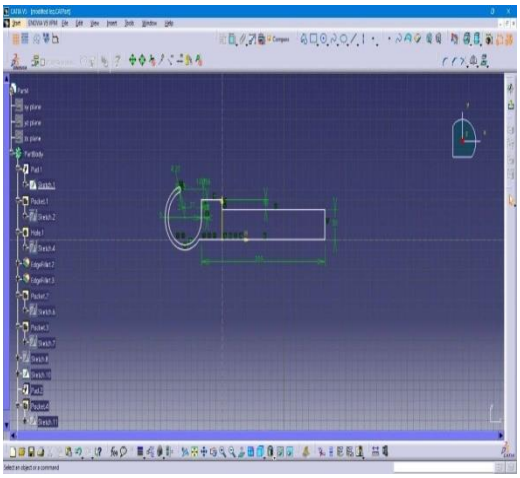

Fig.2 Limb is drawn

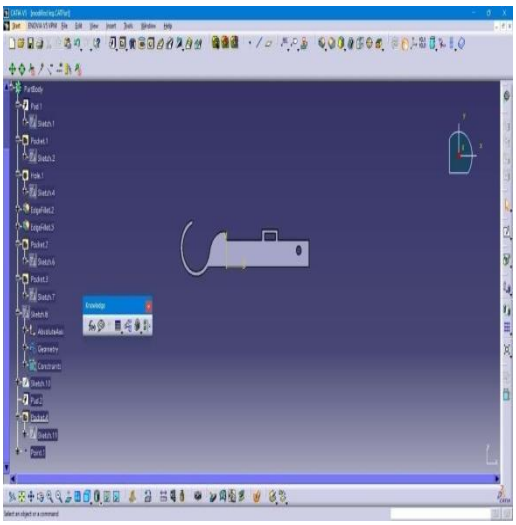

Fig.3 3D model Limb

MODELING OF PROSTHETIC LIMB SUPPORT

A device for joining a prosthetic foot to a prosthetic ankle block with limited, resilient rotation there between includes a generally cylindrical adapter or housing secured in the lower end of the ankle block, coaxial with the vertical pivot axis of the foot.

- Click on the CATIA V5R21 icon, present on the desktop
- Go to 'START' menu, A dialog box is opened. select 'Mechanical design' option and another dialog box is opened. Select 'Part design' option from the list in the box.
- Select the required plane. (Top plane is selected for this model).
- Select 'sketch' option from "sketcher tool bar".
- Create the rough sketch using "profile" icon of "profile tool bar".
- Give the dimensions to the rough sketch, using 'constraint 'icon of constraint tool bar" shown in fig.4 and we use pad tool for 3D designfinally we get the model shown in fig.5.
- Above same process we use for bolt and nut design also shown in fig.6 and fig.7.

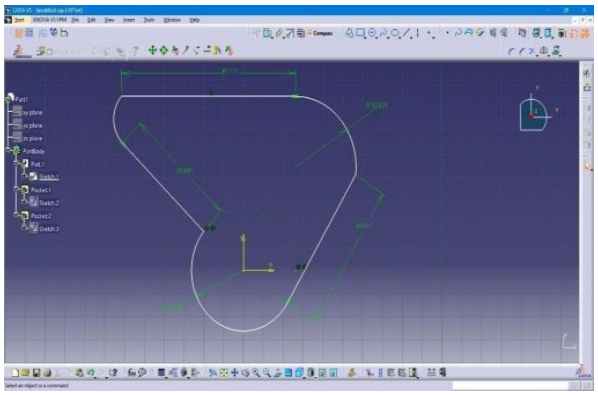

Fig.4 Limb supporter

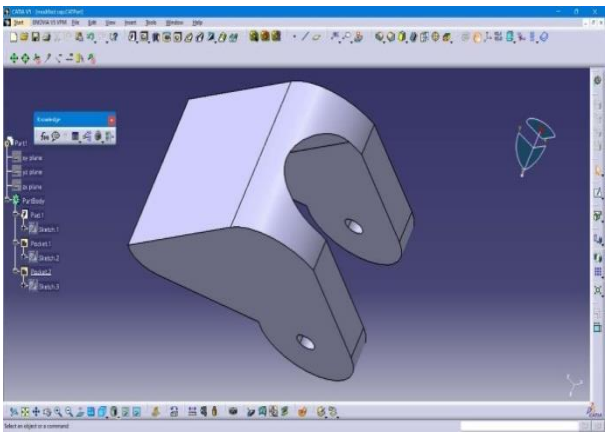

Fig.5 3D limb

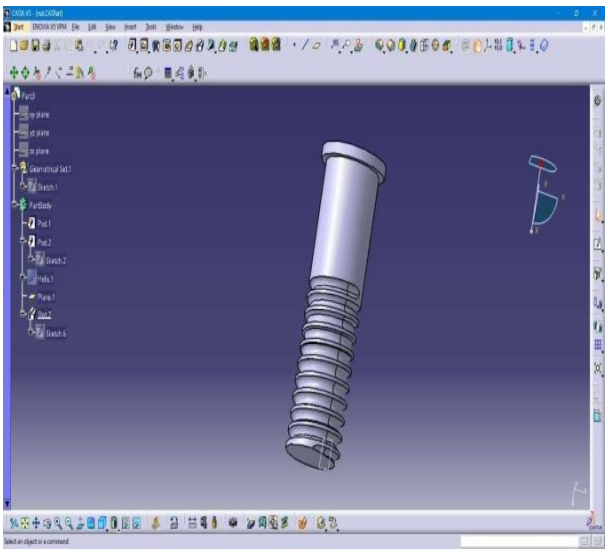

Fig.6 Nut

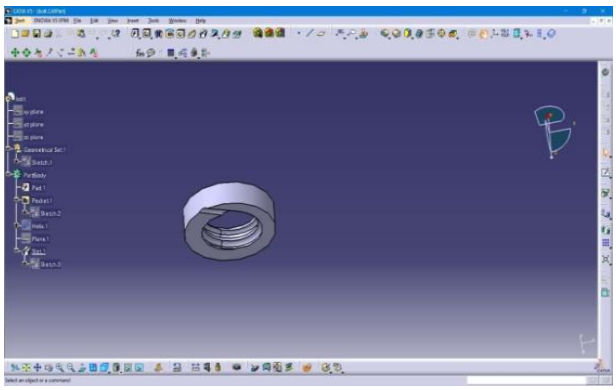

Fig.7 Bolt for nut

IV. FINAL ASSEMBLY OF PROSTHETIC PARTS

This task will show you how to enter the Assembly Design workbench to create a new assembly from scratch.
Select the Start -> Mechanical Design -> Assembly Design command to launch the required workbench.
The Assembly Design workbench is opened. You can see that "Product1"is displayed in the specification tree, indicating the building block of the assembly to be created. To create an assembly, you need products. The application uses the term "product" or "component" to indicate assemblies or parts. You can use parts to create products. Those products can in turn be used to create other products.
The commands for assembling different products (or "components") are available in the toolbar "Product Structure Tools" to the right of the application window shows in fig.8. For information on these commands, please refer to CATIA- Product Structure Version 5.
This task will show you how to open a .part document, that is a CATIA V5 assembly into Assembly Design Product.

1. Click the Open icon or select the File->Open... command.

The File Selection dialog box appears.

2. In the File Selection box, select the file location.
3. Select the .asm document of interest.
4. Click Open the files shows in fig.8.

The application converts the .part document into a .CATProduct document

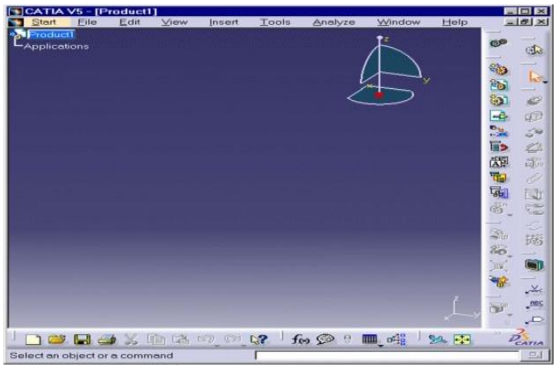

Fig.8 CATIA workbench

Assembly of all parts:

- After creating the various parts of Prosthetic Limb and then store them inSeparate files.
- For assembling the parts of go Prosthetic Limb to start and click on new andthen select assembly.
- Click on assembly and select Limb Part 1 from the existing part models and fix first part by using constraint called "Default" and click on ok button.
- Import Bottom Limb model using same procedure and apply Suitable constraint like "coincidence, distance, offset" and then click on ok button.
- After assembling all the parts, the status of assembly should be "fullyconstrained".

Save the assembly shown in fig.9.

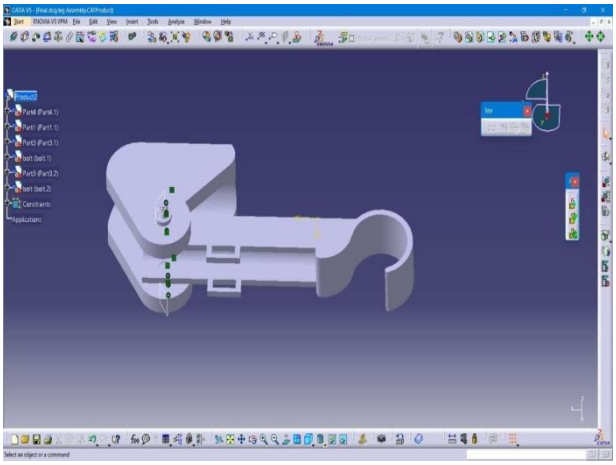

Fig.9 Assembly of prosthetic limb

V. CONCLUSION

The dog which was chosen for this research work is having a limb loss in the front right leg. In the present work measurements were initiated by measuring around the neck where the collar sits. After those measurements were taken around the chest, immediately behind the front leg, measured around the waist, just past the last rib. Next, measured the distance from the base of the neck to the waist. Later measurements were taken around the remaining leg at the point of the elbow, then again four inches below the elbow. Finally, measured the distance from the point of the elbow to the top of the paw. Prosthetic limb was modelled as per the dimensions by using CATIAV5

ACKNOWLEDGEMENT

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