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Technical report

Material and manufacturing of 3D model used in robotic end-effector

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Abstract

This paper describes a new proposed 3D model, which can be used in robotic gripper. The basic purpose of this model is to measure the unknown applied load on the model through its already determined stiffnesses and concerned compressed displacements. These stiffnesses were determined practically. In this paper, the choice of material for this model is discussed. The manufacturing processes for fabrication of model components are also described. For this fabrication specifications are also given. Besides these, geometrical parameters are also briefed. The future work for the improvement and modification has also been described in its end.

Keywords: Materials properties; Model components; Design specifications

1. Introduction

The soft finger contacts are commonly used to grasp the objects. The soft finger is in the shape of the patch on the surface of the grasped objects. It can be replaced by a number of primitive point contacts in the form of the cluster [1].

The grasp obtained as the result of the primitive point contacts can be frictionless or frictional as appropriate [2]. In case of the cluster, which represents a finite area of contact, it is hard to insure that resulting grasp is the frictional.

The material properties of aluminum alloy is light in weight as well as possesses the strength in comparison to other metal alloy which do not have light weight in comparison to aluminum [3]. This aluminum alloy with combination of other metals becomes hard. Other metals like carbon steels are though hard but heavy in weight. While in aluminum alloy there is no chance of corrosion [4].

This paper discusses the fabrication of the parts of the proposed model design for possible measurement forces and induced motion. As the purpose of the model is to provide means of induction and measurement of motion through the application of externally applied forces, it is desired to be compliant in nature [5]. In order to materialize the design, fabrication of the design is the first step. It is also considered to be an important, because its functionality solely depends upon the correct fabrication. A perfect fabrication is one, which does not have loose joints/connection or any unnecessary plays in the mechanism and has been finished for good outlook. This illustrates how, the fabrication of the model design has been carried out. The specification of the material used and the dimensions obtained in the end have also been mentioned.

2. Methodology

Here, the reasons for selection of the material for 3D model are enumerated. Then, the various manufacturing processes are described for fabrication of components used in the model.

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2.1. Selection of material

The selection of material in the phase of fabrication of any part is very important, depending on the type of use of the part, the material of the part is decided [5].

The material used for the fabrication of proposed model is Aluminum alloy. There are number of reasons for selection of this material for this model, and these are

2.1.1. Weight of the model

It is always major factor for engineers in the selection of material that it should be light in weight. Aluminum alloy is one of the materials, which have properties of lightweights as compared to the steel.

2.1.2. Strength

This is another major factor to be considered for selection of material. The strength of the model is considered to be important, because it is made to bear external loads. As a result of external loads, the motion to the upper plate is induced. The strength of the model therefore has to be of the value, that it can bear such loads and can move without any deformation and deflection.

2.1.3. Cost and availability of material

There are many materials in the market these days, which are lighter and stronger than Aluminum alloy, but have not been selected for this model. The main reason for this is, these are cost effective and are rarely available. Aluminum alloy has been chosen as the material of the main structure of the model.

2.1.4. Material and merchantability

The Aluminum alloy has been selected as the material of most of the components of the proposed model. The required surface finish and parallelism was achieved on milling machine.

2.2. Manufacturing of model components

The summery of the components and material is as under

2.2.1. Upper and lower plates

These are made of Aluminum alloy. These plates were cut according to specified diameters, respectively. Then these circular plates were machined for smoothness by milling machine.

2.2.2. Legs, joints and sockets

These are also made of Aluminum alloy and were machined by various processes adopted by lathe machine. The internal hole was made in lower legs by drill machine. Sockets were surfaced initially by shaper machine then drilled and tapered according to design specification. The universal joints of the legs and special recesses were made on milling machine. These special recesses are made specially for measuring scale and for sliding of screw connected in the prismatic joint.

2.2.3. Springs

These are made of medium carbon steel with some other constituents to resist against permanent deformation. These springs are used for compressive loading.

2.3. Fabrication design specifications

2.3.1. Upper part

Diameter of upper plate = 5.5 inches = 139.7 mm
Thickness of plate = 0.3875″ = 9.8425 mm
Length of leg (without socket) = 3.0″ = 76.2 mm
Diameter of leg = 0.4375″ = 11.1125 mm
Distance between legs = 2.5″ = 63.5 mm
Distance between centre of leg and corner of plate = 0.6875″ = 17.4625 mm
Space occupied by socket = 1.375″ = 34.925 mm
Thickness of socket = 0.375″ = 9.525 mm
Upper length of socket = 1″ = 25.4 mm
Lower length of socket = 0.25 = 6.35 mm
Distance between socket and centre of plate = 1.125″ = 28.575 mm

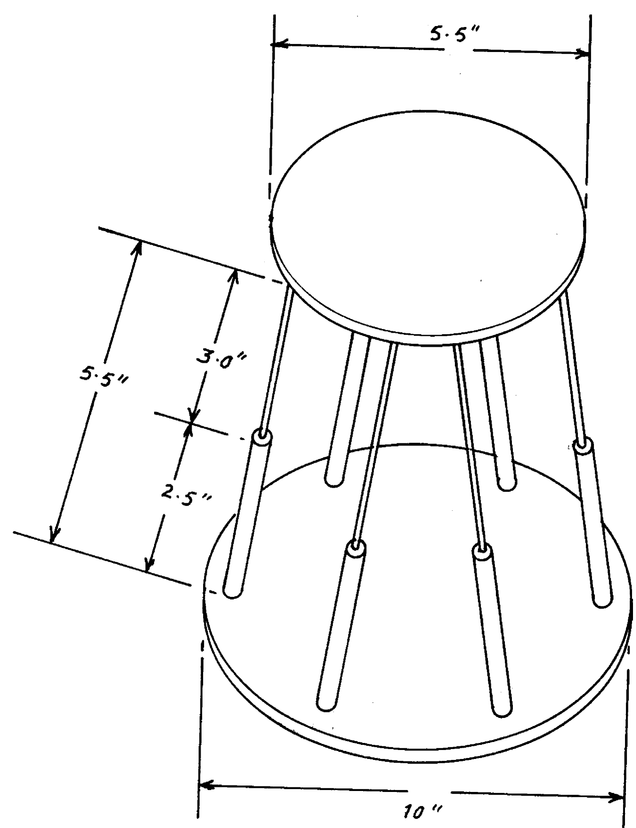

Fig. 1. Elevation of proposed model.