AUTOMATED AND WIRELESS CONTROLLED PICK AND PLACE ROBOT MANIPULATOR

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Abstract - *In this paper, discussion will be related to Robot Manipulator which has been controlled by Mobile App remotely.*

Key Words: Wireless Controlled, Robot Manipulator, Design, APPs, Pick and Place Robot, Solid Modelling.

1. INTRODUCTION

In manufacturing industries, the pick and place robot invented to be used as hardware to solving and accomplishing most of task that cannot be done by human being and also to be faster and pinch the production time. For this project the main objectives are-

1. To study the concept on how pick and place robot function and operate.
2. To design hardware for pick and place robot.
3. To design software for pick and place robot by using microcontroller.

To design combination of electrical and mechanical system.

1.1 Design
Design of base unit:

Base unit is main part of the robot manipulator, used to support the whole system & absorbs vibrations if there are any. Base unit consists base plate, supporting legs, nuts, shaft sand gears. Base unit also supports motors and helps to transfer motion to shoulder unit of manipulator.

The model shown below is drawn using CATIA V-R15, shows the base unit of the assembly.

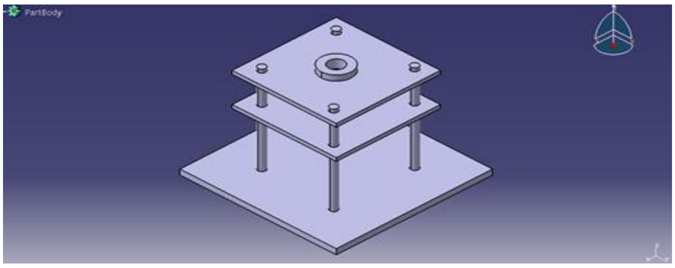

Fig -1: Design of base unit

Figure shown is the detailed sheet of top view of base unit, drafted using CATIA V-R15.

1.2 Design of Shoulder unit:

Shoulder unit is placed on base unit of manipulator, having two degree of freedom up-down & clockwise-anticlockwise. This motion of up-down is powered by dc motor attached at side plate of c-clamp. Shoulder unit also consist of dead weight for balancing upper side of manipulator. Shoulder unit consists of c-clamp, arm, dead weight and gear-pair.

The model shown below is drawn using CATIA V-R15, shows the shoulder unit of the assembly.

Figure shown below is the detailed sheet of shoulder unit, drafted using CATIA V-R15

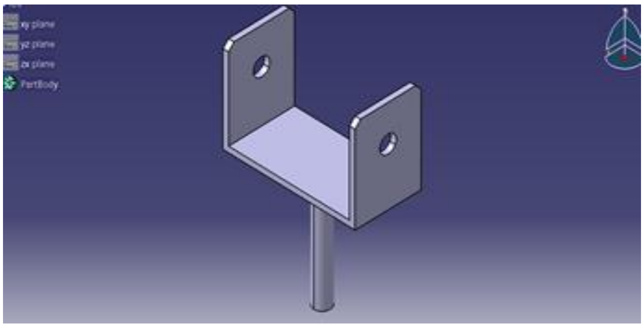

Fig -2: Design of shoulder unit

1.3 Design of Elbow unit & gripper

Elbow unit is placed at arm of the shoulder unit having one degree of freedom. Motion is provided using dc motor placed at shoulder arm. Gripper consist of M.S. steel strip attached to elbow arm. It is operated using dc motor, consist of not bolt pair, another M.S. strip is welded on bolt. The model shown below is drawn using CATIA V-R15, shows the elbow unit & gripper of the assembly.

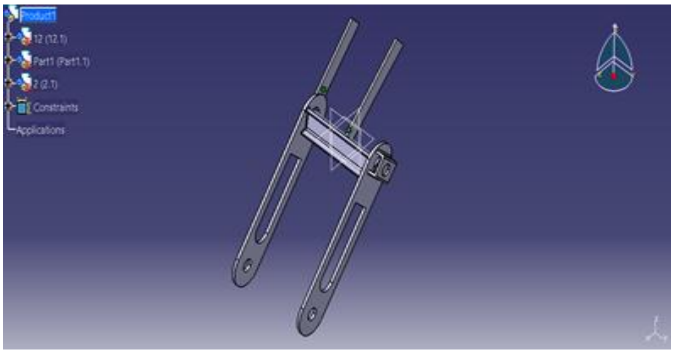

Fig -3: Design of elbow arm & gripper

1.4: Design of Gears:

Assuming dimensions of gears

Teeth of pinion (Zp) =24

Teeth of gear (Zg) =120

Module =4mm

Centre distance:-

a = m(Zp+Zg)/2

a = 4(120+24)/2

a =288mm

Pitch circle diameter of pinion& gear

dp' =m * Zp = 4*24 =96mm

Dg' = m * Zg = 4*120 =480mm

Addendum & deddendum:-

Addendum (Ha) = m =4mm

Deddendum (Hf) = 1.25*m =1.25*4 =5mm

Tooth thickness

Tooth thickness = 1.5708 *m

= 1.5708*4

= 6.2832mm

Calculating beam strength

Sb=m*b*σb*y .... (1)

b = 10m

σb = 600/3 =200 N/mm2

Assuming factor of safty 1.5

Calculating of motor torque (Mt)

Mt = 21.7 kg *cm

= 21.7*10*9.81

Mt = 2126.6 N-mm

Beam strength from eqn 1

Sb = m*b*σb *y

Taking 'y' form Design data book for consider a teeth of a pinion--.

Y = 0.337 .... For 24 teeth

Sb = m* 10m*200*0.337

Sb = 674 m2

Calculating tangential force (Pt)

Pt = (2*Mt)/dp

Pt = (2*2126.6)/24m

Pt = 177.21/m

Peff= CsPt/Cv .... (2)

Considering service factor =1.5

Assuming the velocity (v) =5m/s

Cv = 3/ (3+v) =3/ (3+5) =3/8

Peff = (1.5*177.21)/ ((3*m)/8)

Peff = 708.86/m

Calculating the module of gear

Sb = Peff *F.s .... (3)

614 m2 = (708.86*1.5)/m

m3 = (708.86*1.5)/674

m = 2

But, We are assuming module = 4

m = 4

Calculating beam strength from eqn 1

Sb = m*b*σb *y

Sb = 4*40*200*0.334

Sb = 10688N

Calculating wear strength:-

Sw = b*Q*dp*k .... (4)

b = 10*m =10*4 =40

Q = 2*Zg/(Zg+Zp) =2*120/(120+24) =1.666

dp = mZp =4*24=96

K= 0.16*(BHN/100)2=0.16*(400/100)2=2.56

Sw = 40*1.66*96*2.56

Sw = 16318.46N

Sb < Sw

For pinion,

ф = m+0.25√dp'

= 4+0.25√96

ф =6.44µm

$ep = 16+1.25*\phi$

$= 16 + 1.25*6.44$

$=24.06\mu m$

For gear

$\phi = m+0.25\sqrt{dg'}$

$= 4+0.25\sqrt{480}$

$\phi = 9.477\mu m$

$eg =16+1.25*\phi$

$=16+1.25*9.477$

$=27.84\mu m$

$e=ep+eg$

$e=24.06+27.84$

$e=51.90\mu m$

$e=51.90*10^{-3}mm$

Dynamic load

Pd =(21v*(Ceb+Pt))/ (21v√ (Ceb+Pt)) ………………(5)

= (21*5(11400*(51.90*10^3)*40+4.30))/ (21*5(√(11400*51.90*10^-3*40) +44.30))

Pd = 155.98N

Peff= CsPt+ Pd …………………… (6)

Peff = 1.5*531.05+155.98

Peff = 9530.3N

Factor of safety

F(s) = Sb /Peff ……………. (7)

F(s) = 10688/9530.3

F(s) =1.12

Therefore design is considered as safe.

2. SOLID MODELING

The model shown below is drawn using CATIA V-R15, shows the complete model of manipulator.

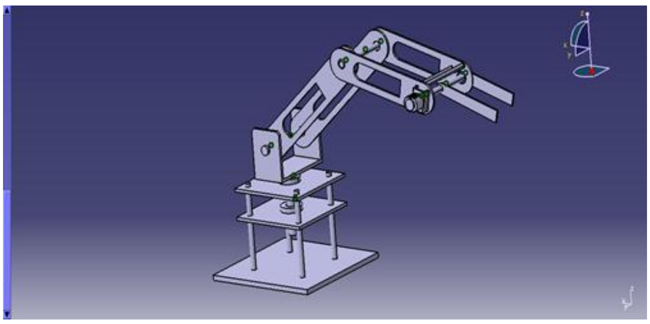

Fig -4: Assembly of robot manipulator

Figure shown below is the assembly of manipulator, drafted using CATIA V-R15.

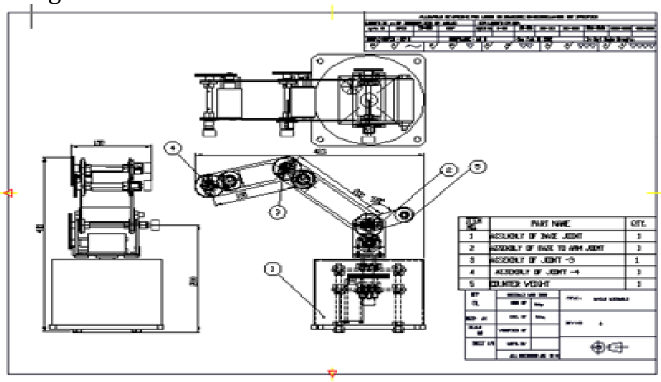

Fig -5: Assembly sheet of robot manipulator

3. MANUFACTURING

Fig. 6 shows manufactured assembly of Robot Manipulator.

Fig -6: Manufactured assembly of robot manipulator

In this electronic control unit it operate on wireless Bluetooth module.by using mobile phone Bluetooth connect to control unit. Motor drive used give motion to dc motor. Manipulator control by using microcontroller 89C52. Microcontroller the program is damped. The program is developed in embedded ‘c’. Below show the figure is electronic control unit of manipulator.

Fig -7: Electronic control unit of manipulator

4. CONCLUSIONS

The robot implementation was scoped to be mechanical design, manufacturing, assembly, electronic design, programming microcontroller, and integrating software and hardware. It has mapped the concept of combining the mechanical and electronic system to achieve an optimum mechatronics system.

It can be operated remotely by using Mobile APP.

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