ABSTRACT

TEAM BESTRAFER

Team Id : RW-190292

Robot Ultor

Team Leader : Vaidehi Som
Email ID : 2017ume0119@iitjammu.ac.in
9149416330

Category 30lbs
TECHFEST, 20
IIT Bombay

Weapon System

Chassis Design

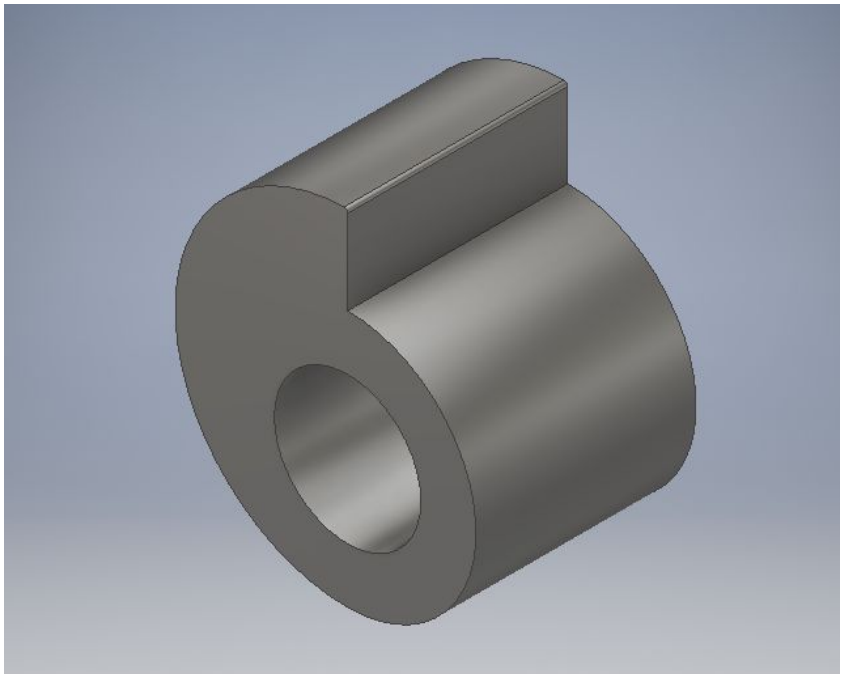
Aluminium grade 6061 T6 is being used for the outer body. VMC machining on Aluminium will be done to give high rigidity to our three-piece uni-body structure. Designing has been done to achieve our goal to evenly distribute the entire impact load on complete body to minimise damage

Wheels are put inside of the body.

Weapon Design

Weapon used in robot is rotating drum with extrusion and wedges. The design in made keeping weapon weight 30% of the total bot weight i.e. 4.5 kg including weapon and bearings. Weapon is made of EN19 grade of steel.

A steel pipe is used for the rotating drum. Drum has extrusion that will be used for attack. Pipe is supported on the shafts fixed inside on both sides. One side shaft has pulley machined in it for power transmission from the motor. These shafts are further supported on bearings fixed on the chassis with brackets.



Drum with extrusion

Weapon Motor

Weapon motor used is 24V AmpFlow A28-400 with 4900 rpm. Motor has weight 6.9 lbs. For power transmission aluminium turned pulley is used. Pulley is for V belt Section A. Pulley is tightened on the motor shaft a socket head cap screw. Motor is mounted on chassis by specific designed bracket

Weapon Motor Control

Weapon system is powered by a relatively high power and high RPM DC motor than drive system motors. Only engage / unengaged plus directional control is required, weapon will just whim from start in the required direction. Weapon motor too operates on fixed input voltage of **24 V** and fetches current as per requirements based on load from weapon system to spin up at maximum RPM it can. Operation is controlled by two relays that are in turn monitored and controlled by a three states battle switch (whose input is RC PWM signals).

Drive System

Drive Motor

Robot has two motor for drive mechanism. These two motors are used for forward-backward and steering. Wheels are placed at the centre of the robot and it is supported by caster wheels on both sides. Drive motors used are AmpFlow A28-150, 360 RPM. Motors specs are calculated by the following method.

Let mass of robot = m kg

Mass of opponent robot = m' = 3*m kg (assumed the force exerted by the opponent on the robot considering their weight and motor torque).

Wheel diameter = d m , maximum velocity = v m/s, acceleration = a m/s^2

F_w = Force given by motor to wheel,

F_r = Frictional (rolling assumed) force

So, $M*a= F_w - F_r$

Put $F_w = T/(d/2)$, $F_r = C_{rr}*N$, $N=M**g$

(C_{rr}, coefficient of rolling friction=0.005, N = Normal reaction)

So, Torque needed from wheels, $T = (M*a+ C_{rr}*M*g)*d/2$

Torque needed per wheel = T/2

{Put M = m for rated torque needed for drive motor,

& put M = m + m' for Stall torque of motor} chosen motor must have both torque more than calculated torque.

Now for rpm of motor, $v = \omega*2*pi*(d/2)/60$ rpm.

And, $P = T*\omega$, power of motor, T = rated torque per motor

Motors are clamped with the chassis with the bracket available for the specific motor used.

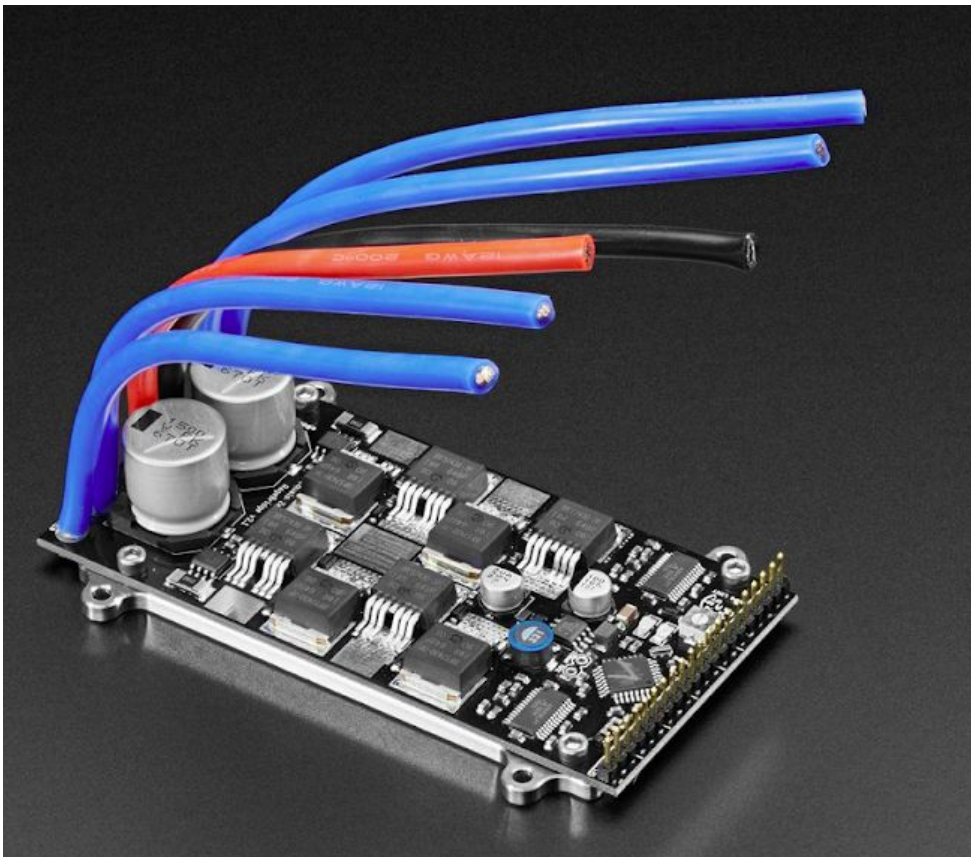
Motor control

Drive system is equipped with two DC drive motors that are responsible for forward/backwards and left-right turn motions. Speed as well as directional control of each motor is required. Signals for control (as available from RC receiver output) are PWM (pulse width modulated). Each motor operates on fixed voltage input of 12 V and current range of 0 - 20 A (based on speed/load requirements of expected motion).

Drive direction is the result of difference in motor speeds and directions, as in differential drive.

E.g. Right motor moving fast will overtake and result in left turn.

For drive-motor current control requirements, a perfect fit is **RageBridge2** from Equals zero Designs. It can supply 40 amps per side continuously and up to 90A (peak).



RageBridge 2

RC Transmitter and Receiver

Radio Control used is 2.4 GHz 6 Channel transmitter and receiver pair, out of 6 only 4 channels are being used (2 channels for drive control and 2 for weapon control system). Transmitter model CT6B and receiver model FS-R6B make use of frequency modulation and Gaussian Frequency Shift Keying (GFSK) to reduce interference with neighbouring channels, bandwidth of 500 kHz.

The transmitter and receiver pair involve PWM signals to control the robot. Transmitter i.e. the broadcast station has the control elements eg. 'two axes joystick' and switches whereas receiver (the listener) has wires (equal to no. of channels) to provide received signal as output. Each wire corresponds to a different channel. A 3 state mechanical switch has been mounted on transmitter to control two channels for weapon system. The switch at its neutral position corresponds to the unarmed weapon system, the top position corresponds to the weapon motor rotating at full RPM in counter-clockwise, the down position will revert the direction of rotation of the weapon motor.

Transmitter is powered by attached battery system whereas the receiver (placed inside the bot) is powered by a regulated 5V line provided by the RageBridge motor driver board, receiver can fetch a max. of 2A current.

Battery and Power

The power requirements of the robot are fulfilled by 8000 mAh Lithium-Polymer battery because it offers the best weight to capacity ratio. It is a 3S battery offering 30C continuous discharge (240 A) and a burst discharge of 60C (480 A) operating at a base voltage of 11.1 volts. Its weight is 615 gms while any other kind of battery having same kind-of capacity will have a greater weight to capacity ratio hence this was the best option.

The battery has a charging rate of 5C (2*6500*5/1000 = 65Ah). A 5 Ah charger has a theoretical charging time of ~96 minutes. The motor driver has an inbuilt 5V BEC that will provide power to the receiver.

Current requirements of robot are as

- Drive Motors — 2 x 40A max. continuous
  2 x 90A max. peak
- Weapon Drive — 30 A max. continuous
  80 A max. Peak

- RC Receiver 2 A max.

Thus, a maximum of 112 A continuous and 262 A peak (upto a max. of 10 seconds) current needs to be drawn at any time.

On full usage battery is supposed to last 8 minutes.