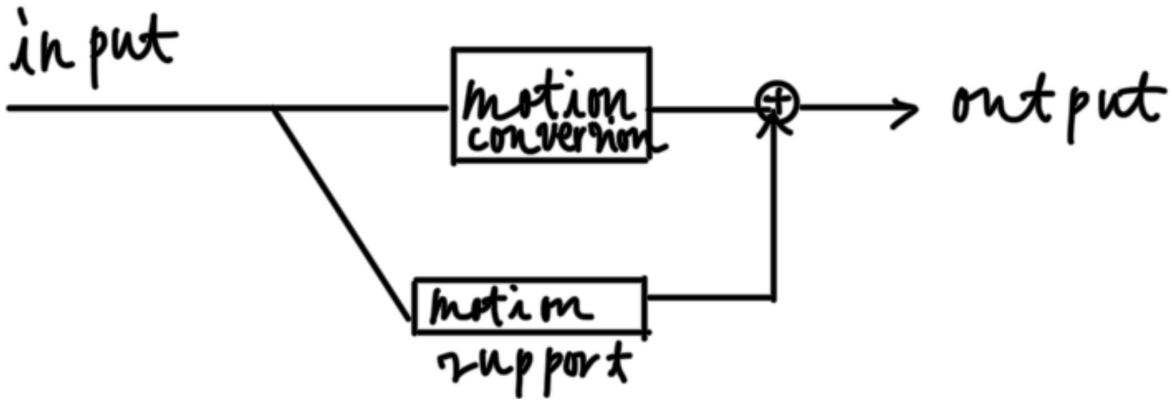
1. Estimate or measure how many turns of the motor shaft it takes to produce one complete motion (up-down-up) of the output. From this, write a very simple engineering specification for the input and output of this design (speed, torque, motion type, and other motion requirements).

- Scotch yoke converts rotational motion into linear motion. The dimension of the follower's slot is around 6mm. The full oscillation of the guided dowel is considered as one full linear oscillation. There should be around 3 oscillations per second with around 1100mm stroke. Then, we should expect to blade's operating speed at about 6600mm per second. (Output motion) In terms of input, the rotation of motor should be rotating at least 3 revolutions per second. Using the power of the motor in the specification of motor, we can figure out the torque available at such frequency.

2. Create a block diagram showing the major parts of your jigsaw, such as motion transmission, conversion, and modification elements. How does this diagram compare to the example from class?



- I modeled the motion conversion to be the input output system where it is also affected by the motion support term, since this usually determines the motion quality and the product life

3. List and identify (open ball bearing vs. sealed roller, etc.) any motion support elements used in the design. Speculate for each on why that particular type of support was used in the design (i.e., what quality/feature is most important).
    - Rotational motion support elements: 46-tooth helical gear, motor shaft, stator, ball bearing, 4mm pin, needle roller bearing, bearing holder and 6mm dowel.
        - The ball bearing stabilizes the motor shaft during rotational motion along with the stator by attaching the case mirror. Motor shaft

rotates the 46-tooth helical gear. The gear is stabilized by needle roller bearing, bearing holder and 6mm dowel while being rotated. The 4mm pin attached to the gear transforms rotational motion on the follower, causing it to move up and down.

- Linear motion (cyclical): guide roller, follower, blade holder.
    - The guide roller, while keeping the follower linearly stable with the case mirror, also offers sliding motion (up and down) by using the inside rollers. The blade holder aligns the blade perpendicular to the cutting surface.

4. Identify any major external and internal forces that you can expect to be present on the mechanism in use. How does the design support against these forces?
    - Shear force: forces that act parallel to the cross-section of a part and tend to cause deformation by sliding one part of material relative to another.
    - Friction force: Guide rollers and blade holder will keep the blade perpendicular to the cutting surface
    - Inertia force: 6mm dowel, needle roller bearing, and bearing holder keep the 46-tooth helical gear stable while being rotated by the motor shaft. Bearings keep the bearing holder stable. The motor shaft keeps the cooling fin, jigsaw stator, and stator rotating stably.
    - Forces generated when turning on the machine: the handle will guide the direction of blade cutting in the most precise way.
5. Speculate on the most likely point of short-term failure (i.e., due to stresses outside the designed-for range). Does the design have an engineered point of failure (i.e., something designed to break first to protect the overall mechanism)? Hint: Be sure to look into the blade as well as the mechanism.

A likely point of short-term failure is in the blade. If the blade gets stuck during operation while the user attempts to continue to operate and maneuver the jigsaw further, damage can be done to the blade. However, the blade has an engineered point of failure, in that it has a reduced cross section close to where it is being supported which will allow the blade to snap when heavy stresses are applied before it damages the inner mechanisms.

6. Speculate on the mode of long-term failure; how and where do you think this design will wear out, and why?
    a. I think for the locations that would wear out in a long term the inner rail of the follower and teeth of the helical gear, since these are the locations where the motion transmission and conversion take place.

7. The TA will operate the mechanism by hand and you will observe its motion. Are the up/down motions symmetrical in terms of velocity and acceleration? Is the torque required to operate the mechanism relatively constant, or does it vary (not including variations due to load)?
    a. Since TA may not apply equal force or maintain a consistent speed in both the up and down strokes. This can result in variations in velocity and acceleration between the two directions.
    b. Yes, the torque required to operate the mechanism relatively constant.