We designed a ratchet-gear combination for the “Make It Real” CAD Design challenge. Early in our VEX season, we came across an issue where we already used seven of the eight allowed motors, but needed two more motors in order to create an efficient and reliable system. Using the principle of a ratchet, we were able to perform different tasks when the motor spun in opposite directions, essentially eliminating the need for one motor.

While we created and implemented a ratchet system with existing VEX parts, a gear and sprocket positioned side-by-side took up too much space to be efficient. We determined that the a ratchet and a gear could be placed inside each other concentrically and would only occupy the space of a single gear - a reduction in footprint of about 50%. Since VEX does not make a part like this, we decided to design our own theoretical part for this challenge. A combined part would eliminate the problem of a bulky mechanism and help make a more compact and efficient robot.

We would use our part to run two stages of our ball intake independently with only one motor. We run a system that uses VEX parts but this part would dramatically shrink the size of our mechanism, and make it more reliable. When the motor turns one direction, the first stage of the intake spins but the second stays still. When the motor turns the other direction, it spins both intake stages. This allows us to intake one ball, then keep the first part of the intake running to pick up another ball, without shooting the first ball. Doing this enables us to shoot two balls simultaneously without having to pay attention to where the balls are in the intake path. The need for a complex system like this arises from our use of a flywheel, since the flywheel needs to stay spinning as it takes a few seconds to get up to the right speed. If both parts of the intake were synchronous, the balls would shoot respective to the time they got picked up, and not necessarily when in a position to shoot at the flags.

To create the new ratchet system we took a standard 84 tooth VEX gear and nested a ratchet gear - which has a smaller diameter - inside of it. We then used VEX ratchet pins and placed them on the hollowed-out portion of the 84-tooth gear. These pins are placed to slide over the ratchet and push down

to lock in, exactly like a regular ratchet, but more compact. Our new part takes the function of a gear-ratchet system and combines it into the size of a single gear. In order to make sure this would be usable in VEX robots, we used the same dimensions as preexisting VEX parts and even put it into our robot's CAD model to verify compatibility.

We used Autodesk Inventor Professional 2017 to create our part. In order to make sure that everything will run smoothly, we decided to run two tests: creating an animation and a stress analysis. The animation allowed us to see how the gear would work in an actual setting and verify if the part moves smoothly. The stress analysis looked at whether or not the system was structurally sound or not.

In the end, we learned that planning and brainstorming can help eliminate parts or even combine different parts into one. We will be using 3D design software in the future because it is the most efficient way we have found to plan our robot and keep all the components as small and compact as possible. 3D design software, such as CAD, is also useful in future workforce applications. Nearly all manufacturing has converted to computer controlled systems, which take CAD files as inputs. Similarly, the design process has migrated to computer driven drawings, since they can produce extremely accurate drawings much faster than a human can. They also automatically figure out dimensions which can expedite the design process since fewer calculations have to be made by humans.