

## **Ratchet and Pawl Attachment System**

Knights Robotics' robot design for the VEX Nothing But Net Challenge consists of a single flywheel, a popular design among competitors this year, that rotates at a high speed to propel balls toward the high goal. A problem that emerges with this flywheel design is that pressure is abruptly applied to the gears and motors when the motors are turned off. When the motors stop moving, the angular momentum at which the wheel keeps spinning generates a huge amount of friction on the gears, causing a constant strain which may even rip the internal gears off the motors. This abrupt exertion of force on the gears happens every time the motor is turned off, so the gears will wear out quickly.

To solve this problem, a ratchet system was designed. This ratchet will enable the motors to rotate the flywheel forward, while also allowing the flywheel to keep spinning even when the motors have been turned off and have come to a complete halt. Because the flywheel will not be forced to a stop, any pressure that may hinder the shooter system will be prevented. Another merit of this ratchet system is that the speed of the flywheel can be adjusted by turning on and off the motors. With a ratchet, the speed of the flywheel is not limited to a narrow set of programmed speeds. They can be adjusted so that the projectile can still be fired even when the motors have been turned off. This will enable the user to take a more accurate shot when firing.

For example, when the user is shooting a projectile and notices that the projectile is missing the target, the user can stop the controller and the ratchet will continue to spin the flywheel without using any direct power from the motors, in order to be able to shoot the ball with a little less power so it will hit the target. It is like coasting on a bike. When coasting, the energy that you applied on the bike to propel it forward is not pulled back into you. Instead, it is let go, and keeps the wheels moving. In the same way, the ratchet prevents the energy provided from the motors from simply going back into the motors, instead being channeled into keeping the flywheel running. The ratchet also saves a lot of overall energy, acting as an additional source of energy for the flywheel while the motors are not running. There will be two ratchets placed on the shooter, one on both sides of the flywheel.

We used Fusion 360 for our design, a decision we made primarily because Inventor did not work on our Apple computers. However after a while, we found that Fusion 360 had some unique functions that suited our intended design well. One helpful feature was the fact that different members of the team could work on different components at the same time. After saving and syncing, everyone was able to see the changes that had been made by the other team members. This enabled more of us to collaborate on the ratchet and combine ideas. Because this was our team's first time using Fusion 360, we started with simple methods for making our ratchet, but gradually found ourselves able to use more advanced techniques as we became more proficient at using the program. Fusion 360 was wonderful in that it was easy to use as beginners with almost no experience, while at the same time offering plenty of room to improve and try more advanced models.

Overall, our team learned a lot of new things about 3D modeling, and how we can use it. We learned that 3D modeling is not impossible to do, and the more it is mastered, the more it can help you visualize what you are imagining. 3D modeling is a tool that makes your imagination a reality.

Our team will continue to use Fusion 360 in the future because of the cloud sharing function, the ability to work as a group and test our ideas on the screen. We will use Fusion 360 in the

process of recreating our robot to see how it will flow before we actually build it. Being able to see it will tell us if our design will work before we invest time and effort into constructing it. Although each of us on the team has different ideas about what careers we would like to pursue, whether engineering, robotics or other similar fields, we believe that learning how to use Fusion 360 will benefit us greatly in the future. 3D design is a great tool for all of those fields, and it provides us all with another medium to work in, and in which to envision our projects or ideas. In the end, our team is glad that we learned how to 3D design and we look forward to developing our skills as we use it more in the future.