Introduction

In this capstone project, we need to build a supply station which can fill 50 bullets into two infantry robots at the same time during the DJI RoboMasters competition. Our goal is to automatically fill the infantry robots as soon as possible, make sure there is no jamming of bullets in the station, and find the most safe and efficient way to build it.

The size of the filling station is limited by 1m\*1m\*1m and it is located in a 2m\*2m filling area. The weight of a bullet is 2.6 g (±5%), which is made by plastic (TPE 90). All the The total bullets that we can get during the competition are 800 (200 bullets initially, 300 bullets at 2 minutes 30 seconds mark, and 300 bullets at 5 minutes mark), and all of them have identical size which is 17 mm (-3% to 0%) in diameter. Our storage unit needs to be large enough. Based on our client requirements, the total station should be able to be carried by two people, and we also need to make it adjustable which can fit their designs.

We divided the station into three parts. For the top parts, we need to make sure that all the bullets can drop smoothly without getting stuck. For the middle part, we need to count 50 bullets in the shortest time and make the quantity as accurate as possible. For the bottom part, we need to actually detect and locate the robot so that the bullets will not drop outside.

The components that we need to use for our design are three 12V motors, one microcontroller, one battery four XXX sensors, and some structural parts. Two motors are used to close and open the gate to release the bullets, another one is used prevent bullets getting stuck on the top part. The microcontroller is used to control all the motors and sensors. The 12V battery is used to power the whole system since most of our components can only be working under 12V DC. The XXX sensors are used to accurately locate the robot which can make sure the bullets are filled into the infantry robot without dropping outside. For the structure part we want the whole station to be built with aluminum which is light and stable, but it is expensive and way over our budget. Then, we are planning to use wood for most parts, but for some important parts, we still need to use metal or plastic.

Objectives

* Be fully automatic. The station need to automatically detect and fill two infantry robots; therefore, we use four XXX sensors are used to locate the infantry robots and use microcontroller to control the filling process. We use XXX microcontroller to control all the three motors and four sensors. For example, since two of the motors are used to open and close the gate while filling, we need to control their rotation angle.
* Minimize the filling time. We have already prepared 50 bullets before the robots come and we simplify our structure to make it most efficient. Because the size of all bullets is identical, we decide to build two tubes which can only load 50 bullets. When all four sensors detect the robot, the Mcu will active the motor and open the gate, and then, fill all 50 bullets from tube into robot. From our experiment, this process only take less than 2 sec.
* Follow restrictions of the competition: not exceed 1000\*1000\*1000mm, the maximum supply voltage of 30 volts, and maximum total power of 200 Wh. Our station design is smaller than the limit. We choose 12V battery as our power supply and since we only has 3 small low rpm but high torque motors, the total power will not exceed 200 Wh.
* Prevent any jamming of bullets in the station. For the top part, we install a high torque but low rpm motor to keep spinning around on the bottom of the storage unit and from our experiments during the lab, it performs great. For the middle part, we use steel to lower the friction of the tubes and built a unique gate which efficiently prevent bullets from getting stuck in the tubes. From our several experiments, it always works.