The Arduino Uno R3 board is the microcontroller board that we used to implement the machine. It has 14 digital input/output pins, 6 analog inputs, a 16MHz ceramic resonator, a USB connection, a power jack, an ICP header and a reset button. The Arduino uses the standard C++ language, built and compiled using the GNU gcc compiler. Although the main sketch is C++, arduino is actually a framework built on top of C++.

The primary power supply of the machine is supported by the two 3.7V rechargeable batteries. A voltage indicator is added to indicate the remaining battery. The schematic of the power system is shown on the left. The voltage indicator was built using an Arduino Uno, a LCD screen, and two resistors with the same resistance work as a reference circuit inside the servo which will produce a standard voltage. These two voltages will compare to each other and the difference will be output. Then the motor chip will receive the difference and decide the rotation speed, direction and angle. When there is no difference between the two voltages, the servo will stop.

The motors are connected to the L298N board based on the diagram. L298N GND is connected to battery box GND. L298N VCC is connected to battery box VCC. UNO board is also connected to battery box.ENA nad ENB control the speed of right motor and left motor separately by PWM. IN1 and IN2 are used to control left motor. IN3 and IN4 are used to control right motor.

The line tracking sensor consists of an infrared transmitter tube and an infrared receiver tube. Light reflectance for the black surface is different from that for the white surface. Hence, the intensity of the reflected infrared light received by the car at the black road differs from that at the white road, and the resistance quantity also changes. According to the principle of voltage division among series resistance, motion path can be determined by inferring the color of road below the car from the voltage of the sensor.

The ultrasonic sensor is used for robot obstacle avoidance, object testing distance, liquid testing, public security and parking lot testing. It works by applying IO port of TRIG to trigger ranging and give high frequency signal at least 1us one time. The module sends 8 square waves of 40kHz to test if there are signals returned automatically. If there are signals received, the module will output a high level pulse through IO port of ECHO, the duration time of high level pulse is the time between the wave sending and receiving. So the module can know the distance according to the time.

To control the motors, L298N board is connected to four motors. ENA and ENB control the speed of left and right motors separately by PWM. IN1 and IN2 are used to control left motor. IN3 and IN4 are used to control right motor. About the principle, look at the sheet below to take the left motor as an example:

The machine consists of a robotic arm that does the job of fruit picking. The TCS3200 is the color sensor that decides which fruit is ready to harvest and triggers the robotic arm to do the actual picking.

The robotic arm consists of three servo motors and they all used to serve the robotic arm. Two of them are put in the top and the bottom of the arm. When the bottom servo starts to move the arm forward, the top servo offsets the new angle one has made to balance the position & orientation of the claw. The third servo is used to control the opening and closure of the claw.

The power system was built as designed. The voltage indicator works well with the whole machine and the battery can provide a stable power. The two pictures below shows the display of the LCD screen under different mode. The left picture shows while the battery is greater than 10%, it is under normal mode and the reading of battery will be displayed on the LCD screen. The right picture shows while the battery is less than 10%, the red LED lights up and “Battery Low” shows to warning the user.

Analysis and Results

In conclusion, we have implemented all the featured that follows our design. The robotic arm moves according to the function of each part. However, because of the pandemic, we were not able to put together all the parts. The actual product is expected to be finished once we gathered all of our work.