

Automatic Clamping Phone Holder for Car

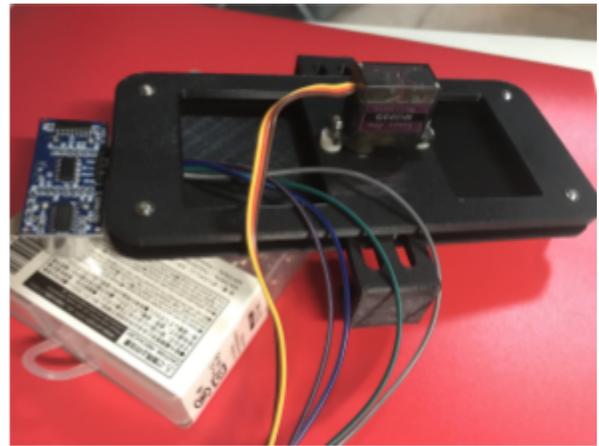
By Ericson Li

Description of the product:

I have been using my current car phone holder for almost 2 years, while there are many advantages such as simple design, lightweight, and easy installation, there is one thing that I don't like about it which is that it required both of the users' hand to attach and detach the phone every time the users want access to my phone, this caused some inconvenience as both of the users' hand will be occupied when they are driving. After taking ME 102B, I had learned many things such as controlling motors, and how to design a machine that integrates mechanical parts and circuits together. After doing some research and brainstorming, I was motivated to apply the skills and knowledge I learned to make an automatic clamping phone holder that would have a feature that I want for a long time. With this feature, the users will be able to have access to their phone by simply extending one of their hands close enough to let the phone holder know that it is time for it to detach the phone.



Front view



Back view

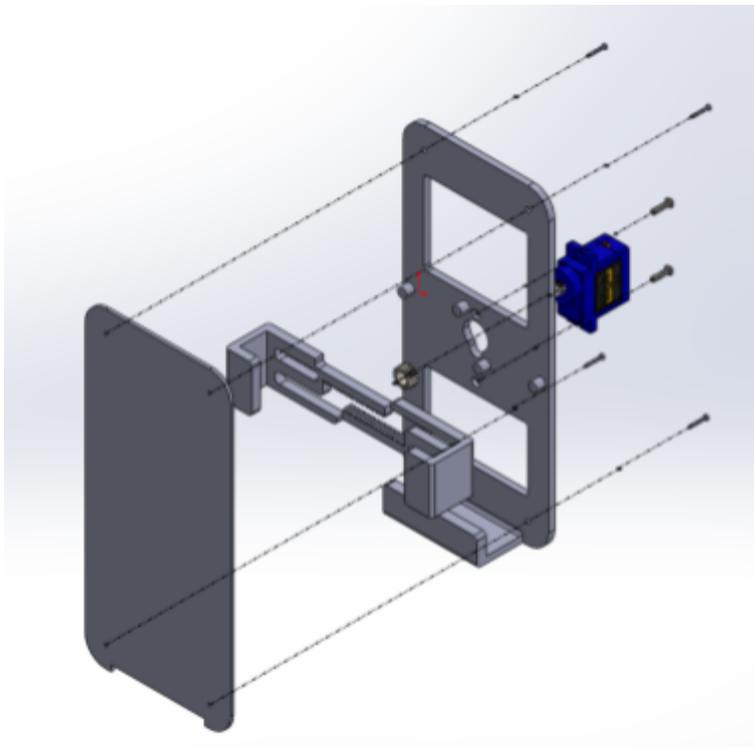


Front view with Phone

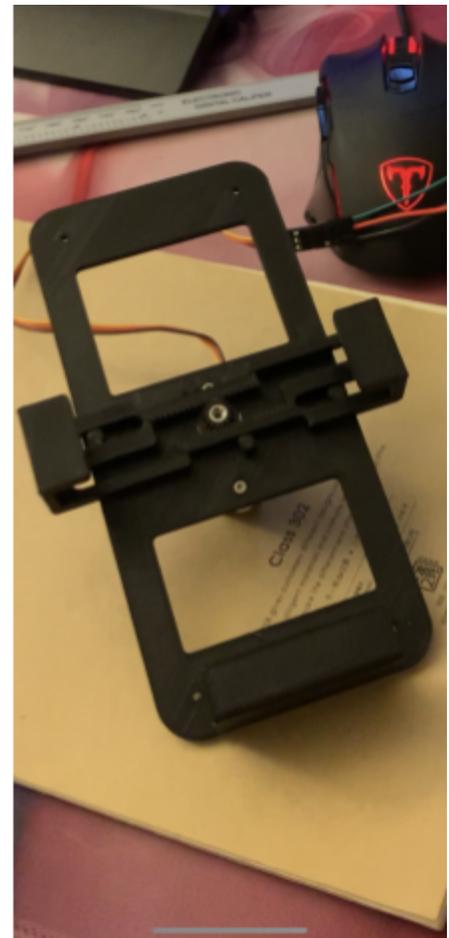
For a video example of the device's operation: https://youtu.be/IYTfYo_XpTs

Description of mechanical parts:

The phone holder consists of five parts including a front plate, a back plate, a gear, two arms, and six screws. The picture below is the exploded view of the phone holder which shows the connection between each part (without the ultrasonic sensor). All the mechanical parts were printed by 3D printer then assembled together. As shown in the picture, the servo motor is placed in the back of the holder which means all the power cables are located in the back which makes the phone holder look simple and clean. There is also an ultrasonic sensor which is placed on the top of the device but it is not showing in the picture.

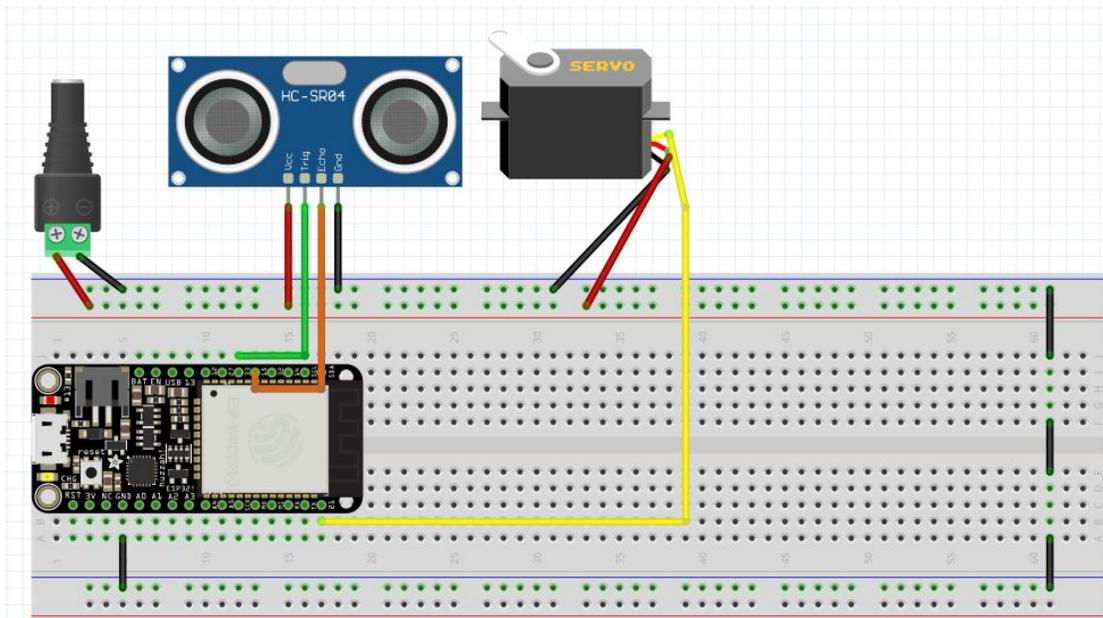


Exploded view



Inside's structure

Circuit:



The key idea of this project is to control the position of the servo motor with the help of an ultrasonic sensor. There were two main components in the project: (1) Servo motor(MG90S), (2) Ultrasonic sensor(HC-SR04).

- (1) Servo motor(MG90S): Since the machine is a phone holder, I want my motor to get to an accurate position in order to achieve the “expand” and “contract” states. Therefore, I picked a servo motor instead of a DC motor. To control the position of the servo motor, I simply sent a PWM signal to it, and the duration of the positive pulse determines the position. The operating voltage of this motor is from 4.8V to 6V, therefore, I used the 5V external power source to power this motor.
- (2) Ultrasonic sensor(HC-SR04): In order to achieve the automatic clamping feature, I used an ultrasonic sensor that is capable of measuring short to medium distances from solid surfaces via sonar location. Ultrasonic sound waves will be emitted from the device which bounce off the surfaces, then return waves are measured and the time taken to return will be used to calculate distance. With the help of this sensor, I was able to control the position of the servo motor. The operating voltage of this ultrasonic sensor is 5V, so I also used the 5V external power source to power it.

Finite state machine diagram:

The behavior of my phone holder is straightforward, there are only two states which are “contract” and “expand”. The machine will start from the “contract” state, if the ultrasonic sensor senses the distance is less than 30 cm between the hand and the phone holder, it will expand its arm automatically, and if the distance is more than 30 cm, then the phone holder will contract its arms.

