# 360 Security Camera

Personal Project

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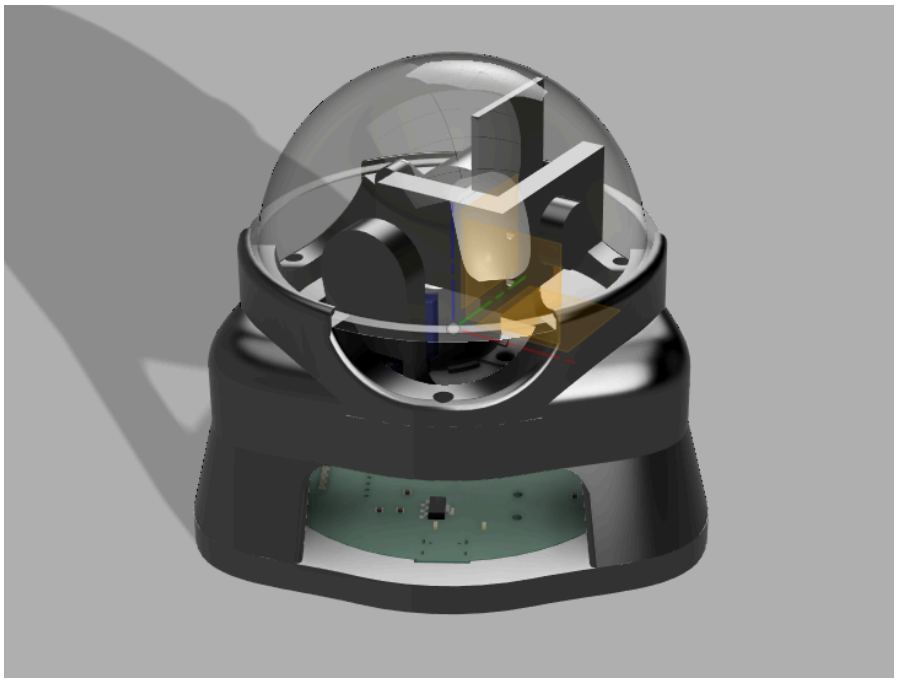
| Notable Disciplines | Fusion 360, Mechatronics, Hardware |
| Motivations | Whenever I print from my Ender 3, I always struggle to leave my room, eyes often glued to the bed as I wait for my designs to print. I wanted to create a device that can livestream or capture images of my prints, so I can instead be productive and touch grass (while watching the status of my print). While I can create a static camera pointing at the device, I wanted to challenge myself and utilize multiple motors and my planetary gearbox to create a 360 degree security camera! |

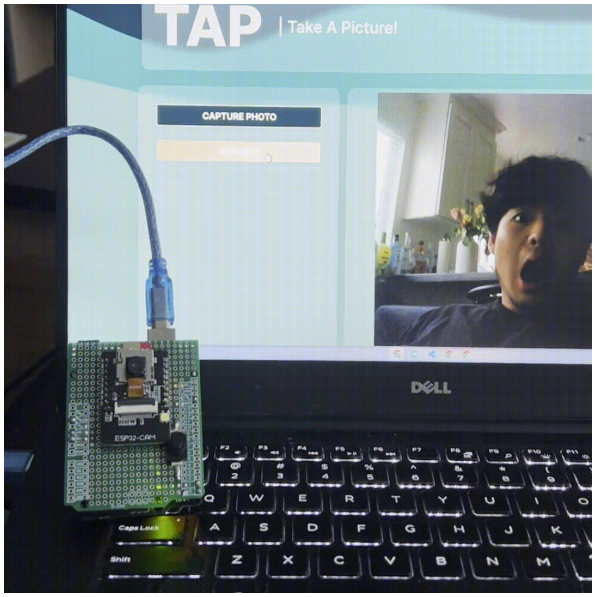


*V2 Security Camera*

Synopsis

## Designing the Camera

I utilized an ESP32-CAM to capture images from web server requests and display accordingly. I connected the ESP32-CAM via an Arduino as a joint MCU network in order to allocate load on the system. The Arduino hosted the webserver, whilst the ESP32-CAM undertook the image processing.




## Prototyping

Utilizing Fusion 360, I was able to design the hardware housing structure of the security camera, installing the Arduino on top of the backplate and the stepper motor controllers on sliding plates that can be removed from the body. This makes for easy prototyping, installation, and maintenance instead of attempting to install all of the parts inside of the cylindrical housing unit.

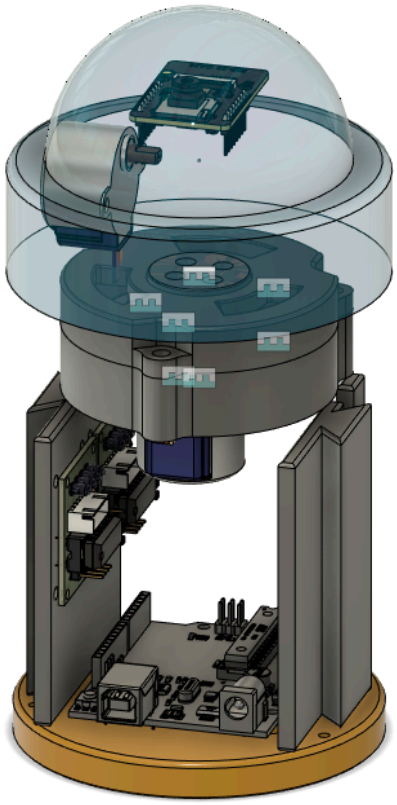
The electronic architecture initially consisted of 2 stepper motors and 2 stepper motor controllers, ESP32-CAM, and the Arduino.

## Problem with Power

When testing the full connection of the device, it was easily evident that the current draw from the devices was too much for the Arduino. The ESP32-CAM draws 180mA at 5V and the stepper motor each drew 240mA, this did not fulfill the Arduino's 5V maximum output of 500 mA (800 mA on the datasheet, but 500 mA max is recommended).

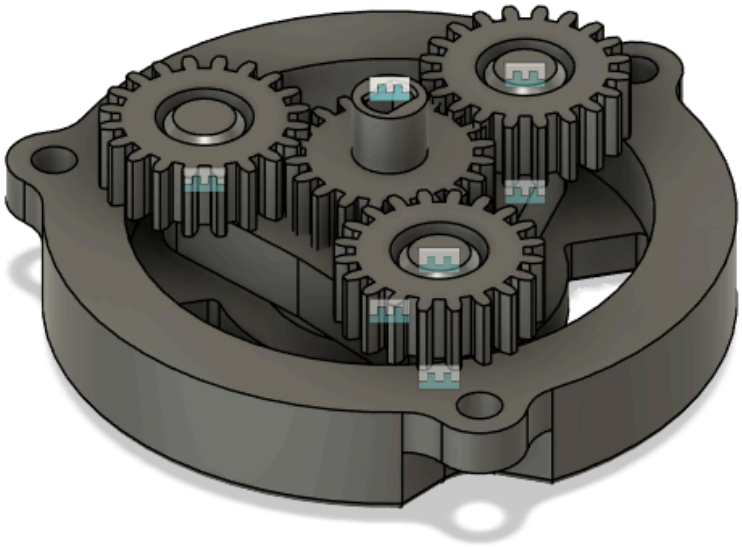
Therefore, I readjusted the hardware architecture, where I am currently utilizing a MOSFET to create 2 separate power supplies. This allows me to turn on and off the motor's DC power supply via the MOSFET that is controlled through the Arduino whilst the motors receive the adequate power supply.

I also switched the ESP32-CAM with a dedicated camera module, the Arducam Mini Module Camera, which draws about 70 mA of power. Now, the Arduino would be able to supply the needed power to control the stepper motors and the camera without overloading the power consumption.



**V1 Project Render**

So far, I have designed the body and the hardware of the security camera to house 2 28BYJ-48 Unipolar Stepper Motors, 1 installed with my 4:1 planetary gearbox as the XY plane rotation in order to provide rotations from the load of the top plate, which includes the second gearbox and the camera module (Arducam Mini Module Camera Shield with OV2640 2 Megapixels).



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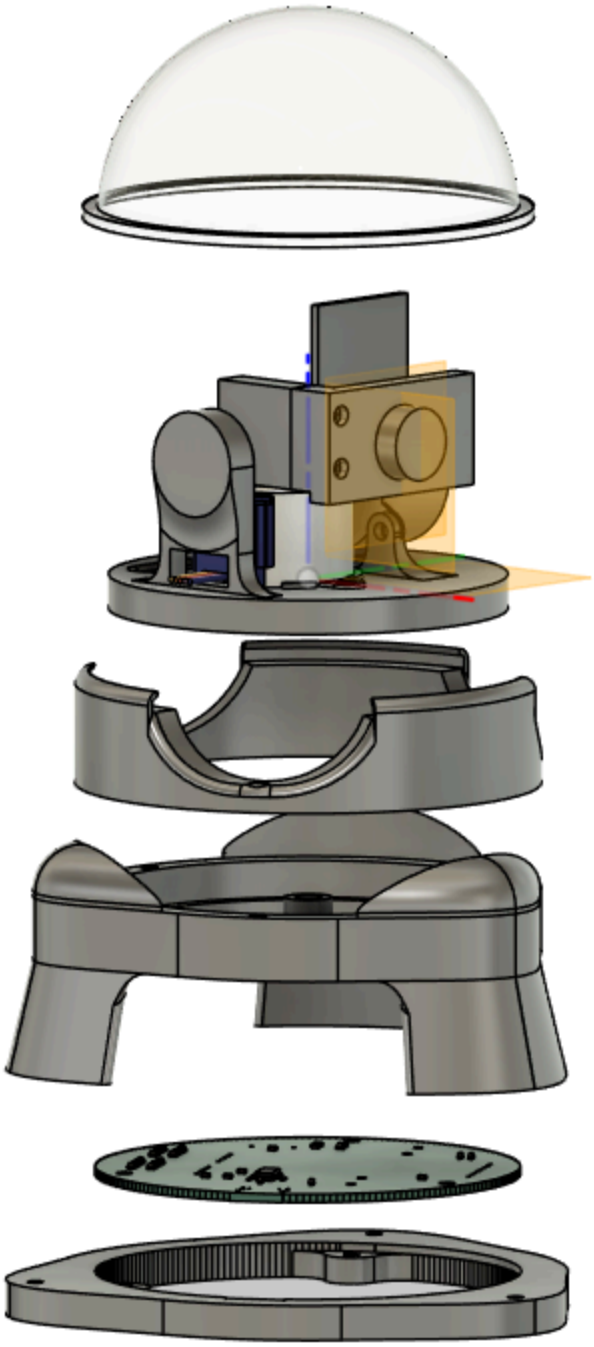
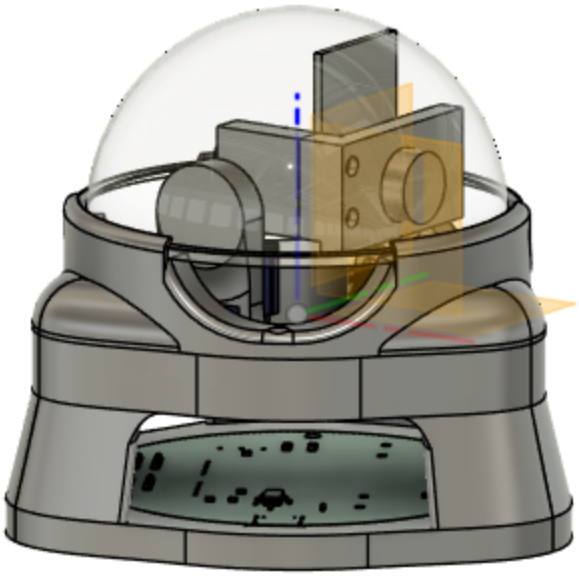
**V2 Structure**



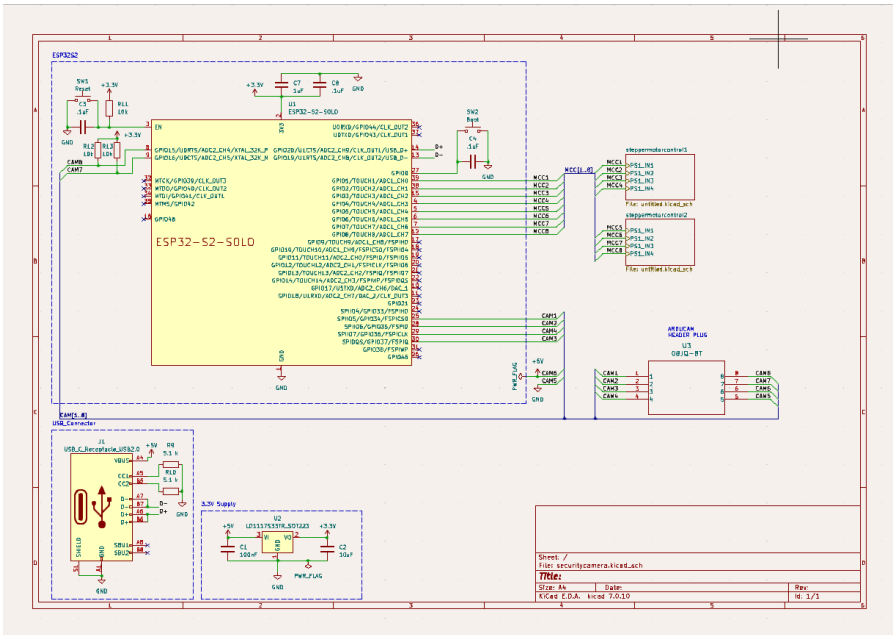
*V2 Assembly Exploded View*



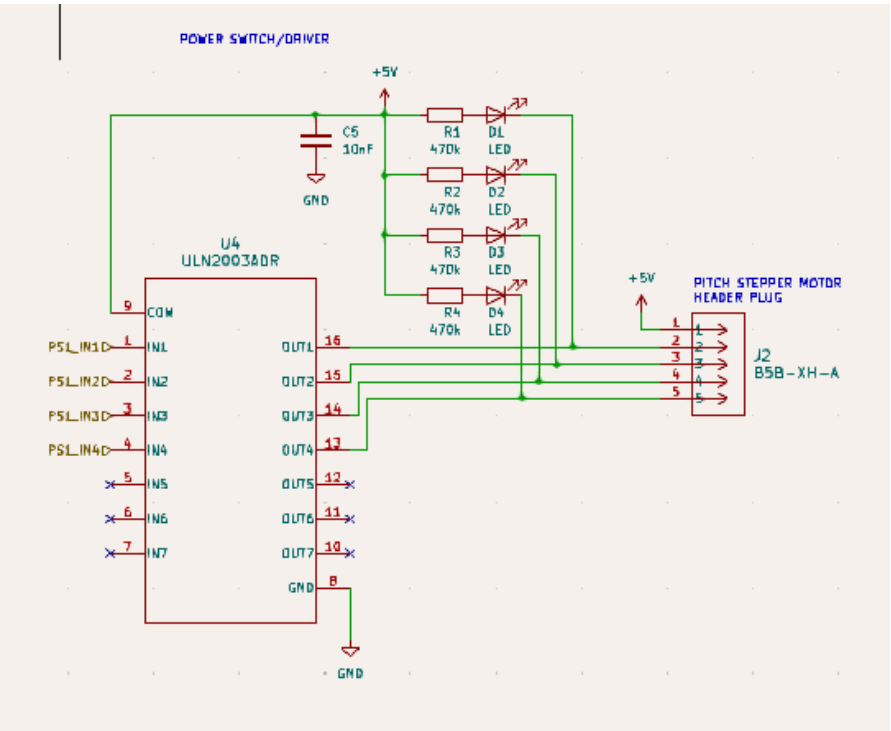
*Assembled V2 Assembly*

**V2 PCB Layout**

KiCAD was utilized to design the layout of the security camera, utilizing an ESP32 chip along with BOOT, RESET, and USB-C peripherals. In addition, the ESP32 is configured to interface with ArduCAM via SPI communication.




*Main KiCAD schematic*




*Stepper motor driver schematic*

The stepper motor driver consists of a ULN2003A transistor array IC to drive the 2 stepper motors for pitch and rotation on the security camera.