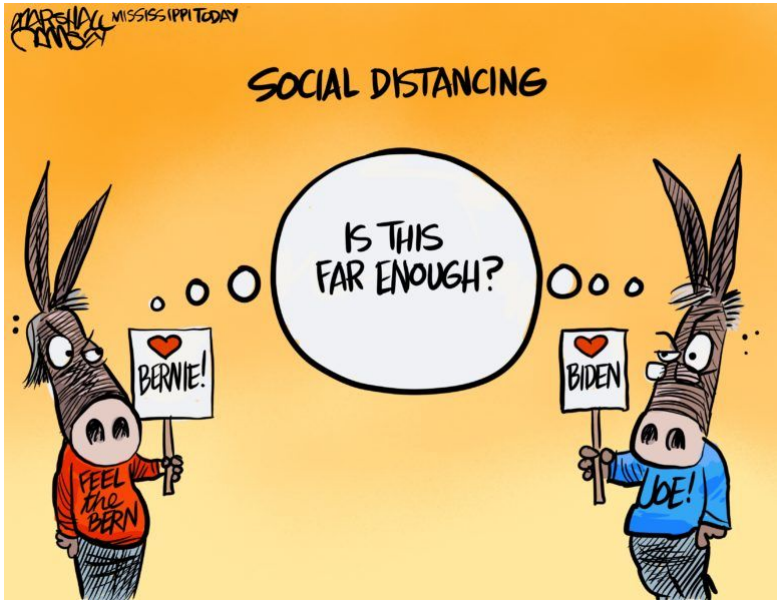
Social Distancing Face Shield for COVID-19 - 2.0

Submitted by
Manthan Pawar
Zewen Wu

Guided by
Professor Vikram Kapila

Social Distancing for COVID-19

- **People who are in close contact contract COVID-19**
- **Social Distancing - Need of reducing the ways people come in close contact**
- **CDC's definition of social Distancing - you should stay at least 6 feet (2 meters) from other people**



Face Shields - COVID-19

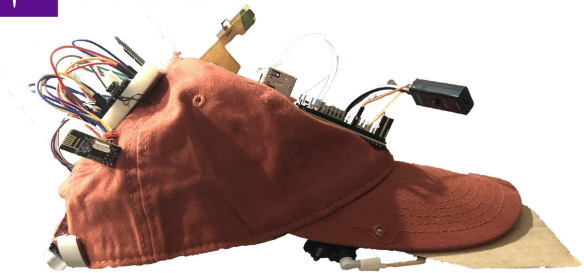
Study done by National Institute of Allergy and Infectious Diseases -

- **One of the silver linings of this pandemic**
- **Offer more effective protection against coronavirus than masks and should be worn by the public whenever they leave home.**
- **More effective than masks at protecting the eyes, nose and mouth from Covid-19 infection**

Proposed Solution

- **A cap whose shade converts into a face shield when it detects a presence of human within 6ft radius from the user and notifies the user.**
- **Some adjustments for the prototype**

NYU



The device

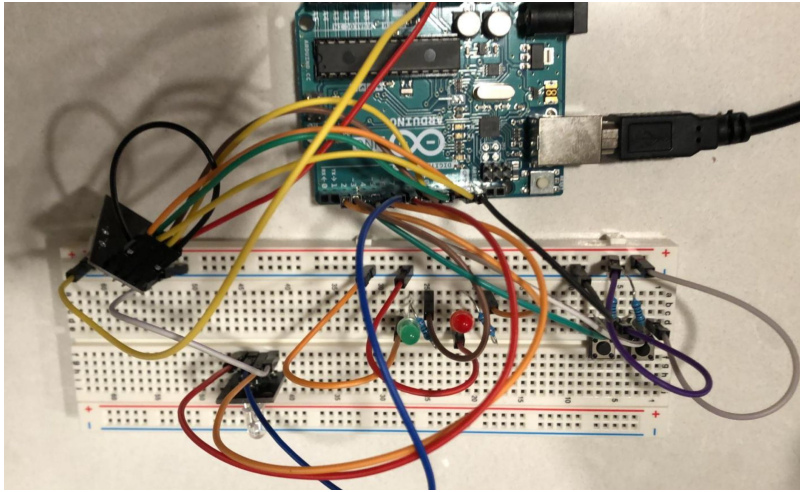
The Remote:

1. **Arduino UNO**
2. **Switches A&B**

   - control cap modes (UI)
3. **LED**

   - indicate modes (UI)
4. **Radio Transmitter nRF24L**

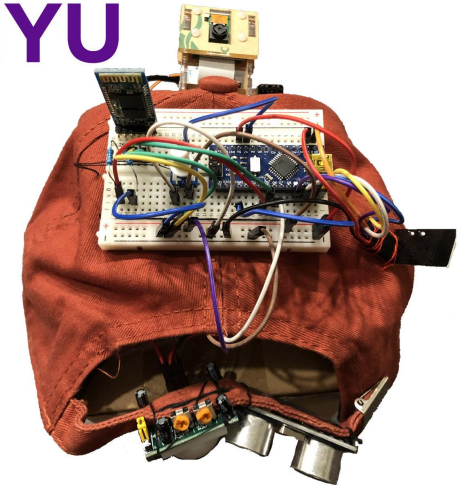
   - communication between Uno and Nano



The device

Cap Module 1:

1. **Arduino NANO**
   - Control Servo, Calibration
2. **Servo Motor**
   - Shield actuation
3. **Potentiometer**
   - Calibration
4. **Radio Transmitter nRF24L**
   - Communication between the remote and cap
5. **HC05**
   - Communication between Nano and Raspberry Pi



The device

Cap module 2:

1. **Raspberry Pi**

   - Main Decision based on image processing

   - BT communication with Nano

2. **Pi CAM**

   - Vision

3. **Passive Infrared Sensor (PIR Sensor)**

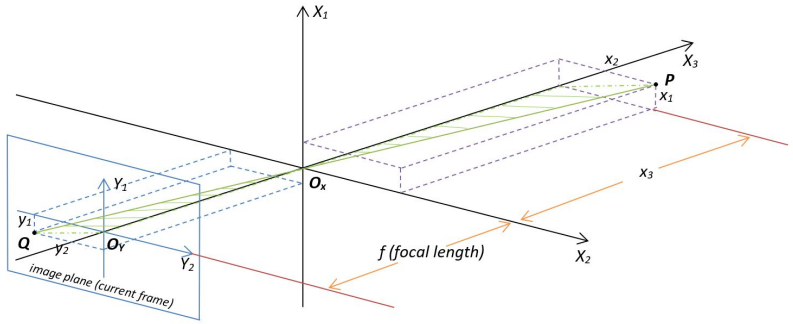
   - Additional sensor to ensure human motion

Bill of Material

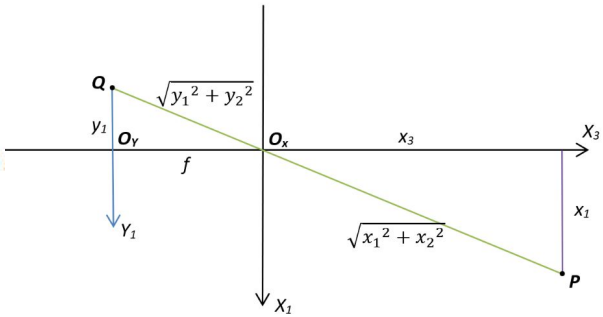
Components	Price
Arduino UNO	12.99
Arduino NANO	7
Raspberry Pi	61.7
Pi CAM	8.77
Passive Infrared Sensor (PIR Sensor)	9.95
Servo Motor	12.95
Potentiometer	0
Radio Transmitter nRF24L	6.69
HC05	8.99
Switches	0
LEDs	0
Cap	9.99
Breadboard	4.95
Total	143.98

Distance sensing - Pinhole Camera Model

- **Human Detection**
  - HOG Full Body Detection
  - Face Detection using OpenCV cascade
- **Distance Measurement**
  - Pinhole Camera Model - triangular similarity



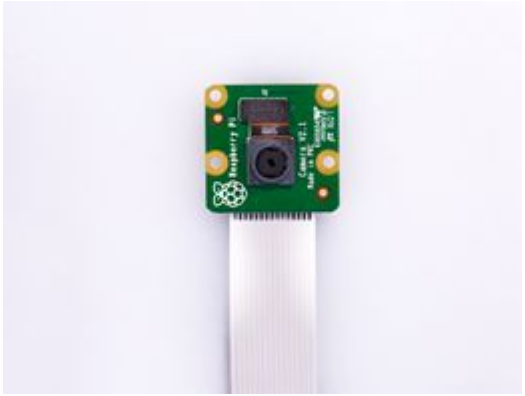
$$object\ distance = focal\ length \times physical\ size \div measured\ size$$



PIR

As Machine Learning can not be 100% accurate, in this prototype, we are using data from both Pi camera and PIR to increase reliability of the decision

- Motion Detection: PIR, which is an electronic sensor that measures infrared (IR) light radiating from objects in its field of view



User interface

Overall procedure of user interface:

a) Turn on the power

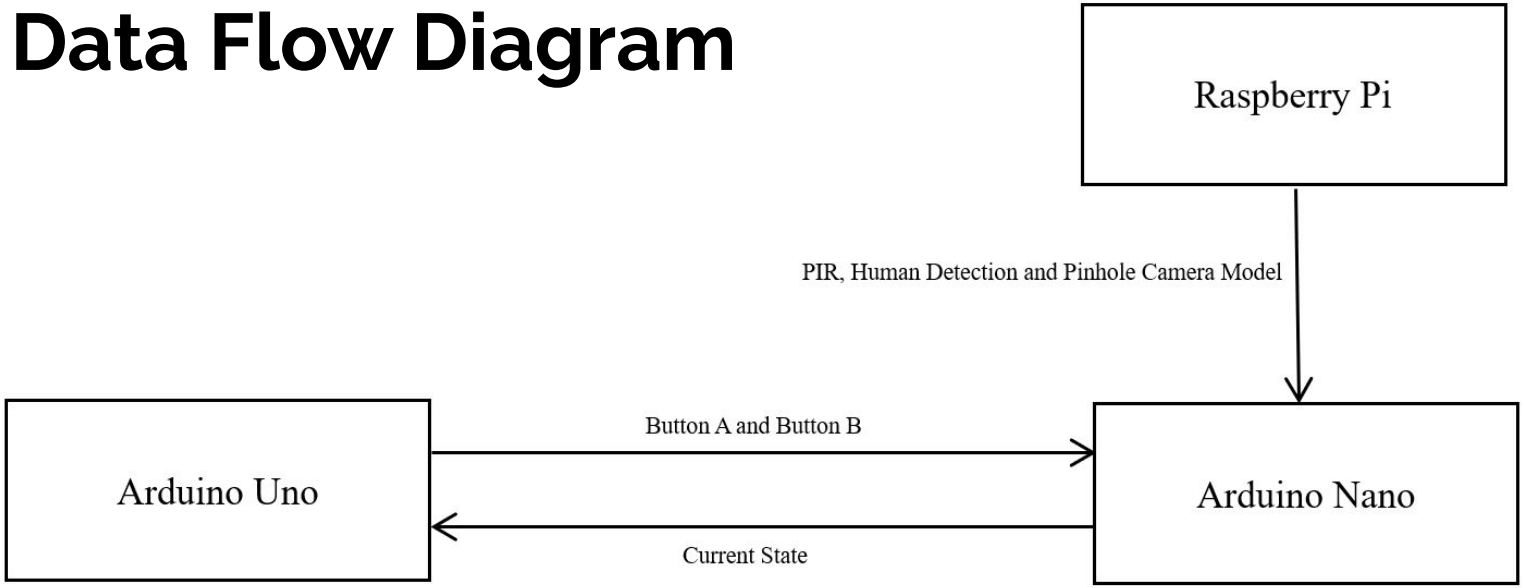
b) Press button A (green LED will be on, which indicates that the user can start set the rotation angle of the mask based on personal preferences)

c) Rotate the potentiometer to adjust the setting (the default rotation angle is 90 degree)

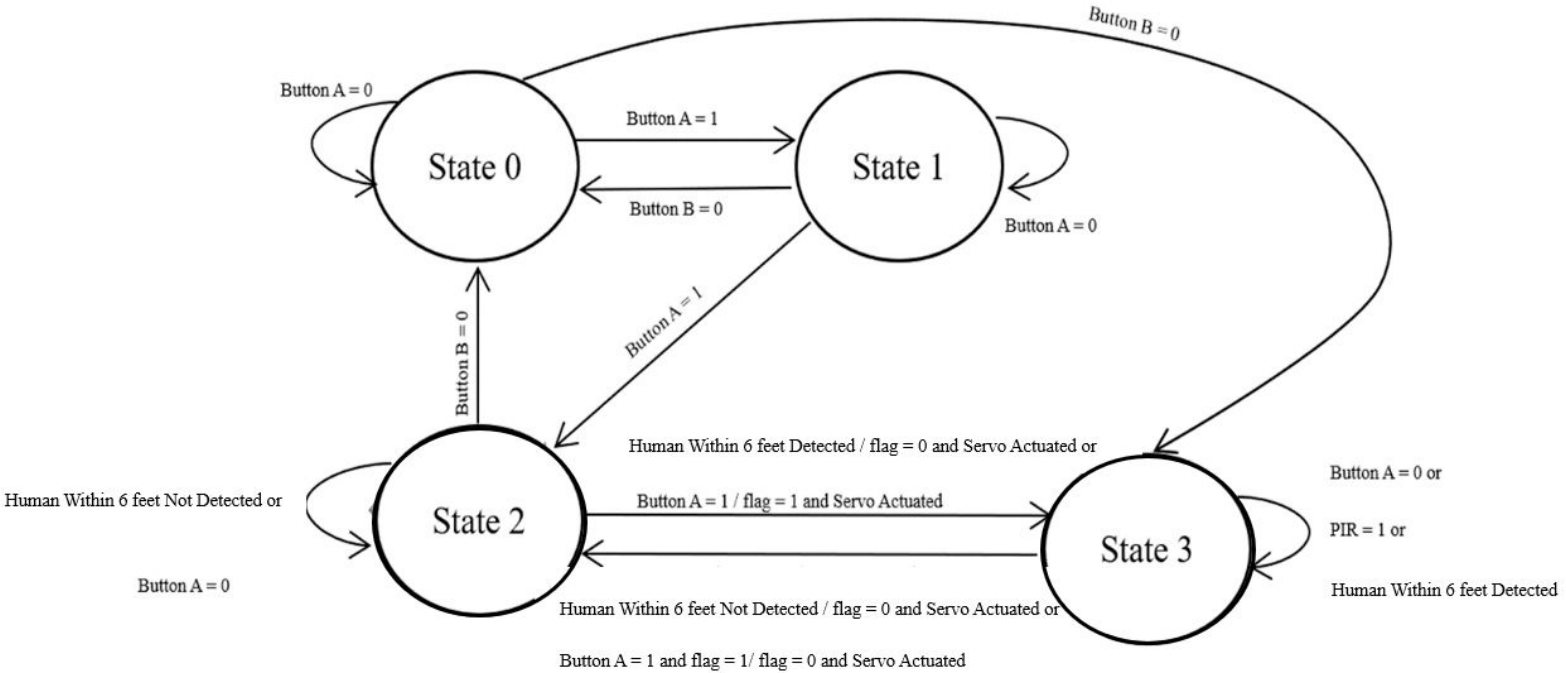
d) Press button A to activate the system (RGB LED indicate if the surrounding environment is safe)

e) Press button B so that the system will return to its initial state (Red LED will on and button B can be pressed anytime during the progress)

Data Flow Diagram



Finite State Machine (FSM)



UI Demo

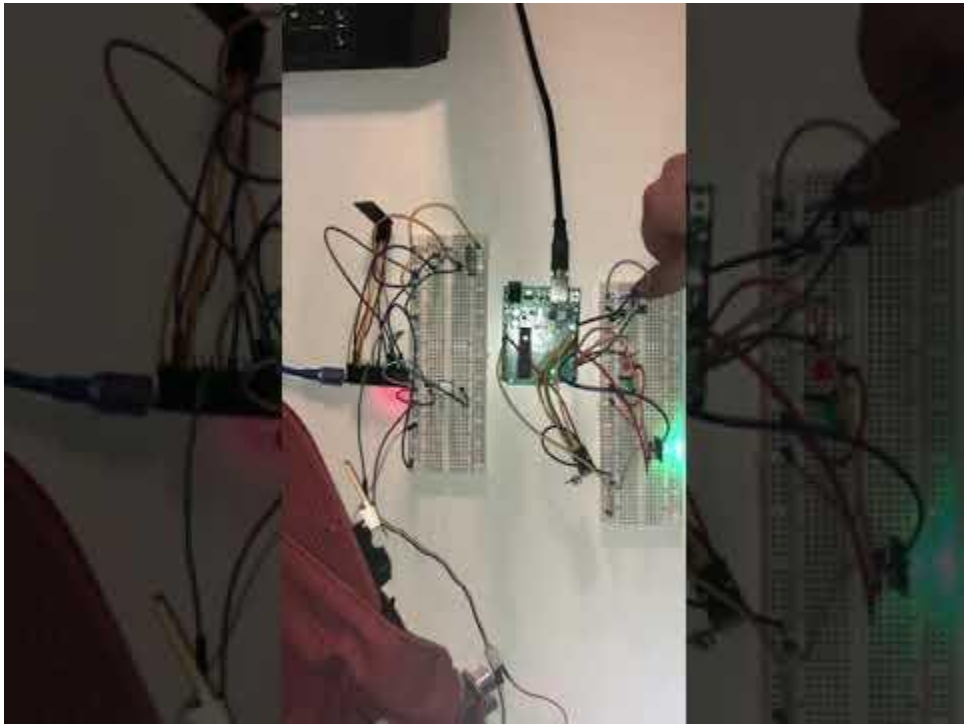


Image Processing

Prototype Demo