JSG Industries

Shawn, Gavin, Brendan, Gary

Problem: Understanding and resisting drowsiness

Specifications

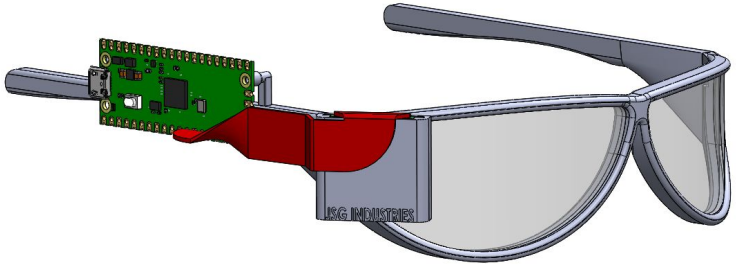
- Low Cost
- Small Size
- Accurate
- Ergonomic
- Monitor and Alert

> Fatigue factors into 13% of all workplace injuries and 20% of all crashes.

- *Occupational Safety and Health Administration*

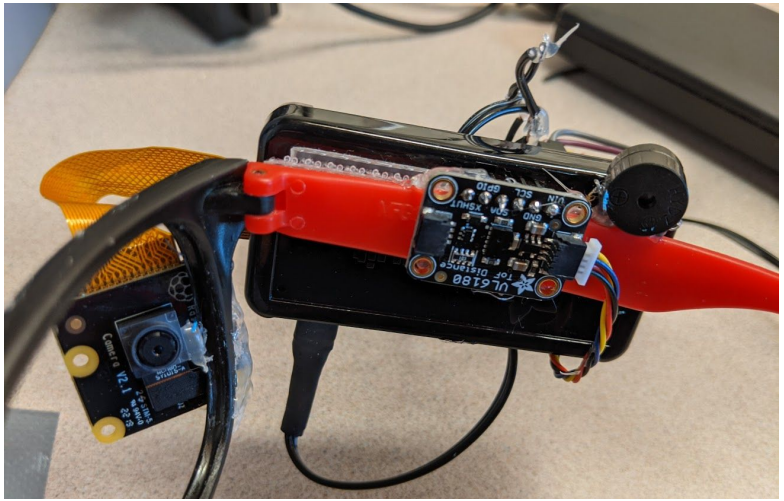
WAKE

Solution: Detect signs of drowsiness and send an alert



JSG
industries

CAD: Solidworks
Design/ Ideation Drawing



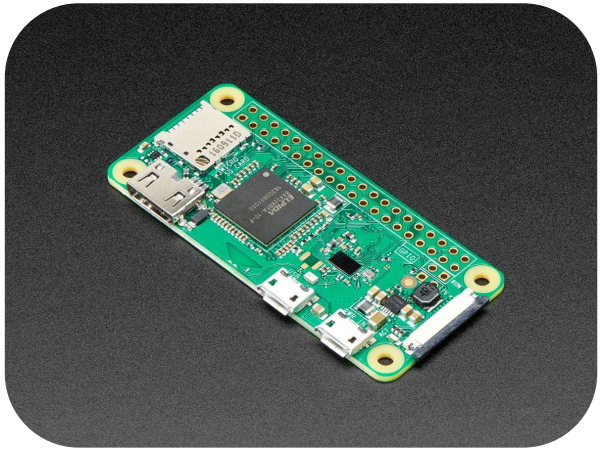
WAKE Concept & Solution

- Use lidar to determine that the device is put “on”
- Grab image data through Raspberry Pi
- TensorFlow model to detect blinks
- Blink-rate-based drowsiness analysis
- Buzzer Alert

Hardware

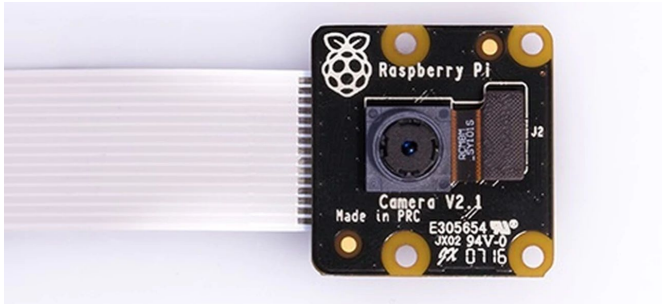
Raspberry Pi Zero W

- Includes ribbon cable slot for a camera
- Wireless connection
- Pins for additional devices



Camera

- Raspberry Pi NoIR
- Monitors eye position over time to determine alertness

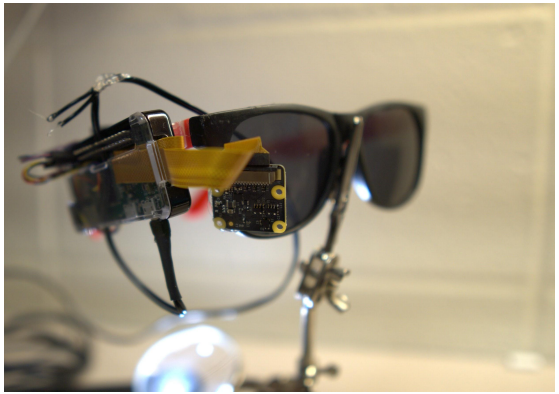


Time of Flight

- Lidar
- Check if the Glasses are being worn, day or night

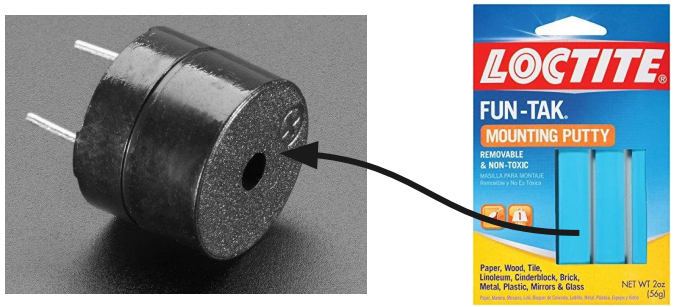
Glasses/Frame

- Carries all electrical components



Active Buzzer

- Used putty to adjust “loudness” of the buzz

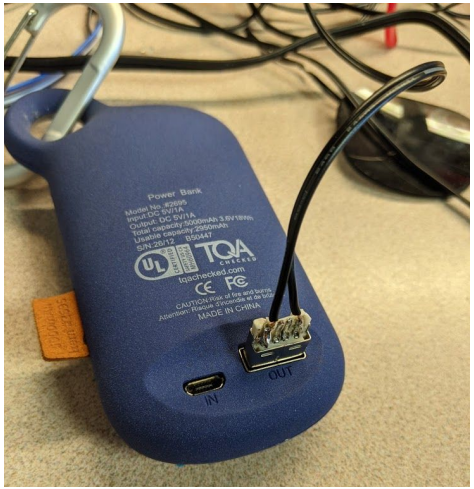


> Residents in America are expected to spend up to 80 hours a week in the hospital and endure single shifts that routinely last up to 28 hours—with such workdays required about four times a month, on average.

-The Atlantic

https://www.theatlantic.com/business/archive/2017/02/doctors-long-hours-schedules/516639/

Battery Pack



Battery Life

Battery Capacity

2950 mAh

Device Consumption

240 mA

BATTERY LIFE FORMULA

Battery Life = Battery Capacity in mAh / Load Current in mAh

12 Hrs 17 Min

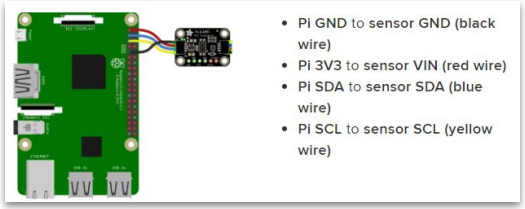
Estimated Hours

= 12.291666667

*This is an estimated output, based on ideal conditions.

https://www.digikey.com/en/resources/conversion-calculators/conversion-calculator-battery-life

Software



- Pi GND to sensor GND (black wire)
- Pi 3V3 to sensor VIN (red wire)
- Pi SDA to sensor SDA (blue wire)
- Pi SCL to sensor SCL (yellow wire)

```
>>> print('Range: {0}mm'.format(sensor.range))
Range: 16mm
>>> print('Range status: {0}'.format(sensor.range_status))
Range status: 0
>>> print('Light (1x gain): {0}lux'.format(sensor.read_lux(adafruit_vl6180x.ALS_GAIN_1)))
Light (1x gain): 1.28lux
>>>
```

```
#lidar proximity detection
if sensor.range > 5:
    continue
```

➢ Proximity Recognition

- Utilizing the VL6180X Library
  - Adafruit vl6180x time of flight micro lidar
  - Documentation [Circuit Python]

➢ Internet Protocol Camera

- Mjpg-streamer + IP Camera Adapter
- Allows cv2 to recognize picamera input remotely

➢ Tensorflow + OpenCV

- Built over TF's Object Detection API for proprietary image (blink) recognition

```
# Load pipeline config and build a detection model
configs = config_util.get_configs_from_pipeline_file(CONFIG_PATH)
detection_model = model_builder.build(model_config=configs['model'], is_training=False)

# Restore checkpoint
ckpt = tf.compat.v2.train.Checkpoint(model=detection_model)
ckpt.restore(os.path.join(CHECKPOINT_PATH, 'ckpt-9')).expect_partial()

@tf.function
def detect_fn(image):
        image, shapes = detection_model.preprocess(image)
        prediction_dict = detection_model.predict(image, shapes)
        detections = detection_model.postprocess(prediction_dict, shapes)
        return detections

#ret: blinks per second
def detectBlink(blinkPerFrame, framerate):
        FRAME_GAP = 120
        if len(blinkPerFrame) < FRAME_GAP:
                return 0
        else:
                total = 0
                for i in range(FRAME_GAP):
                        total = total + blinkPerFrame(len(blinkPerFrame) - i)
                blinkRate = (total / FRAME_GAP) * framerate
                return blinkRate

#@param blinks per second
def isTired(blinkRate):
        ABR = 0.1
        tired = blinkRate>ABR
        if tired:
                print(requests.get("http://http://192.168.137.176/:5000/tired"))
        return tired
```

Scalability

Moving Forward

- Custom PCB design
- Integration with safety glasses
- Adaptations everyday workers
- Find smaller devices and power sources

	A	B	C	D	E	F	G	H
1	Item #	Cost	Description	Link		Cost	Optimized Cost	
2	1	$ 10.00	Raspberry Pi Zero W	https://w		$ 4.99	Micro Center	https://w
3	2	$ 5.95	Raspberry Pi Zero v1.3 Camera Cable	https://w		$ 3.00	Raspberry Pi Zero v1.3 Camera Cable (1 of 3)	https://w
4	3	$ 29.95	Raspberry Pi NoIR Camera Board v2	https://w		$ 4.25	Raspberry Pi Camera v2 (1 of 4)	https://w
5	4	$ 13.95	VL6180 Time of Flight Distance Ranging	https://w		$ 5.82	VL6180 Time of Flight Distance Ranging	https://w
6	5	$ 0.95	Buzzer (active)	https://w		$ 0.57	Buzzer (active) (1 of 15)	https://w
7	6	$ 0.95	JST SH 4 pin with Female Socket	https://w		$ 0.40	JST SH 4 pin (1 of 20)	https://w
8	7	$ 2.95	Micro USB to USB A Cable	https://w		$ 0.07	Female Jumper Wire (1 of 80)	https://w
9	8	$ 14.95	USB Battery Pack 2200 mAh	https://w		$ 1.07	Micro USB to USB A Cable	https://w
10						$ 5.00	USB Battery Pack 3600 mAh	https://w
11								
12		< $5	Sunglasses			< $5	Sunglasses	
13								
14								
15								
16								
17		$ 84.65	Cost From Adafruit			$ 30.17	Cost From Many Sources	
18								
19								

BOM and Optimized Cost

DEMO

jacobsen.65, zwayer.25,
chong.150, sung.223@osu.edu