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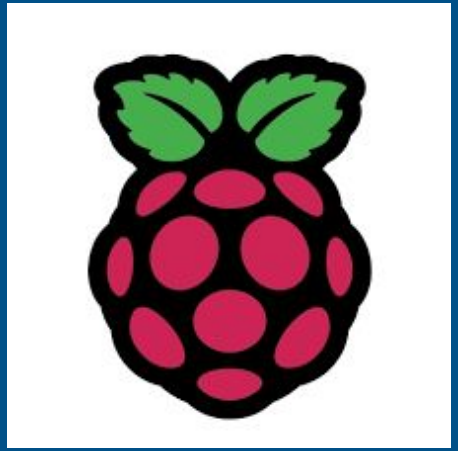
Raspberry Pi Solar Powered Game Camera



Davey Getchell

Dr. Scott Valcourt

CS7680

1. Introduction
2. Design
3. Build Process
4. Experimentation and Results
5. Conclusion and Future Work

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Wildlife cameras have wide-ranging applications and benefits

- They allow us to monitor and learn about wildlife while reducing human-animal interaction
- Understanding our natural world is critical
- It's fun!
- Custom built solar-powered game camera leveraging the C programming language and the Raspberry Pi platform to create a blueprint for hobbyists to build their own.

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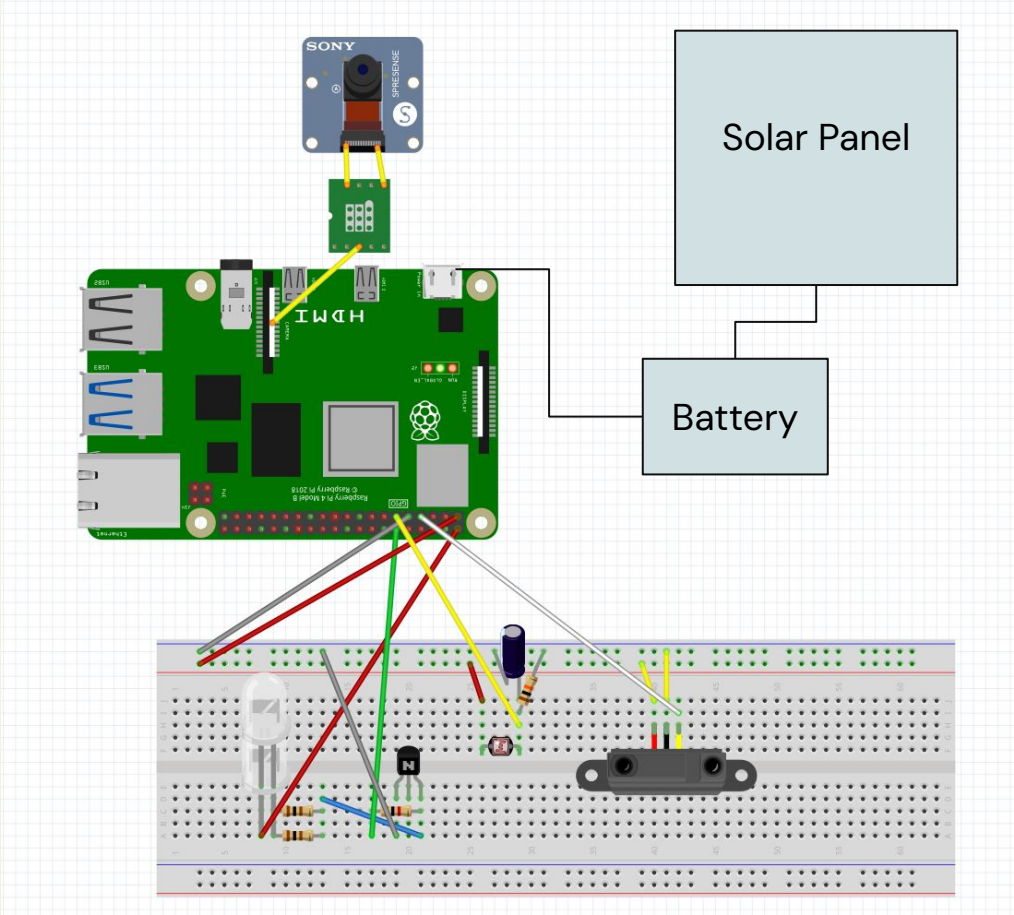
Design

Hardware

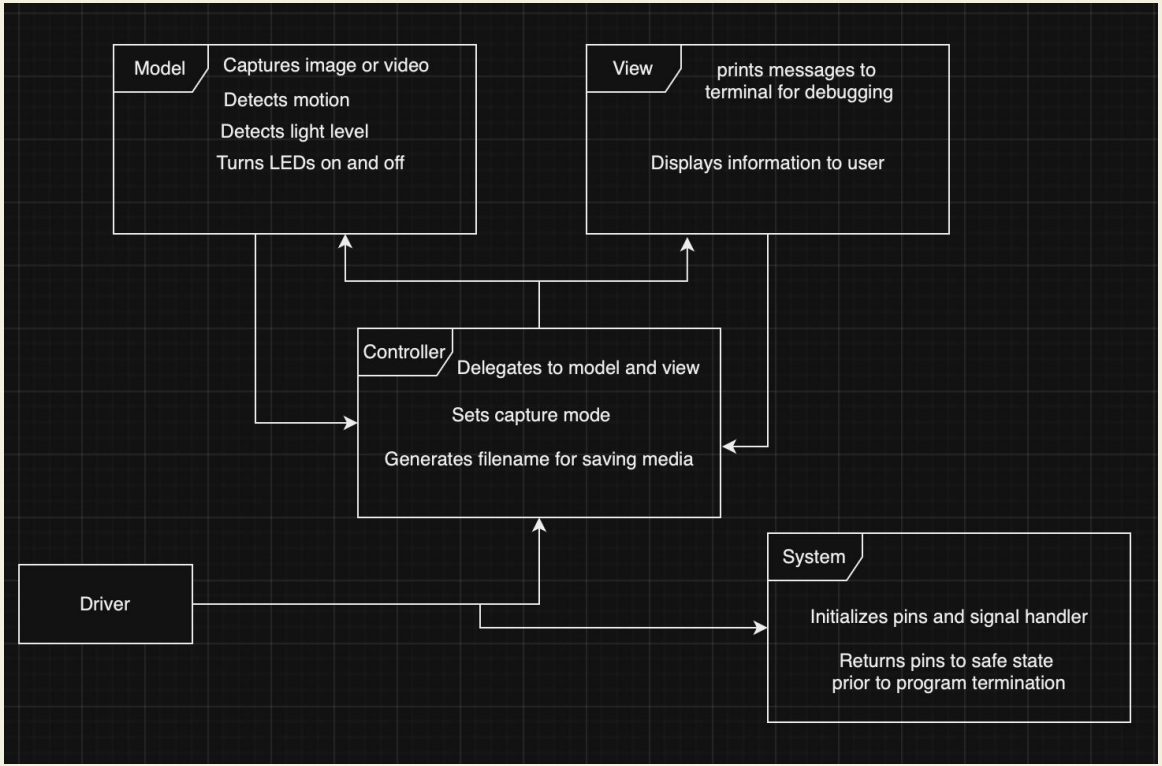
- Solar powered – 10W 12V
- 10,000 mAh battery
- PIR Sensor
- IR LEDs (2)
- Photocell Receptor
- RPi NoIR 2 Camera Module



Design

Software

- MVC Design Pattern
- C codebase
- Libcamera C++ Library for media capture via System() call



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Build Process

- Original concept was for a Pi Zero WH, abandoned due to time constraints and configuration issues
- Installed camera and chose software dependency for implementation
- Tested camera resolution in various lighting conditions
- Connected PIR sensor - tested with print statements, then as a trigger
- IR LEDs - iterative process
- Photocell
- Battery and Solar Panel

```c
int main(){
    /*
     *  Initialize GPIO and get pins ready
     * contains function to capture media when state changes from idle to motion detected
     */
    setup();

    // Gracefully exit if CTRL+C is entered
    signal(SIGINT, sigint_handler);

    // Loop to keep program running
    // Default state is idle
    while(!signal_received){
        sleep(1);
    }

    // Set pins to safe state and terminate GPIO
    cleanup();

    // Exit program
    return 0;
}
```

```
// Initializes GPIO and Sets Pins to ready state
void setup(){
    if(gpioInitialise() == PI_INIT_FAILED){
        log_message(LOG_ERROR, MSG_GPIO_INIT_FAILURE);
        exit(EXIT_FAILURE);
    }
    log_message(LOG_INFO, MSG_GPIO_INIT_SUCCESS);

    gpioSetMode(IR_LED, PI_OUTPUT);
    gpioWrite(IR_LED, PI_LOW);
    // PIR calls handle_motion when a state is changed (movement is detected)
    setup_sensor(PIR_SENSOR, handle_motion);

    gpioSetMode(PHOTO_SENSOR, PI_INPUT);
}
```

Github Repo

https://github.com/OuroborosOuroboros/RPiGameCamera

```c
/*
 * If motion is detected then helper methods are called to capture image or video
 */
void handle_motion(int gpio, int level, uint32_t tick){
    if(level == 1){
        log_message(LOG_INFO, MSG_MOTION_DETECTED, gpio, level, tick);

        // 1 for Dark, 0 for light
        int dark = is_dark();

        if(dark){
            // Turn on IR LED if it is dark
            led_on(IR_LED);
        }

        // Helper method to capture video or image
        capture_based_on_mode();

        // sleep for 3s
        usleep(3000000);


        if(dark){
            // turn off IR LED after capture
            led_off(IR_LED);
        }
    }
}
```

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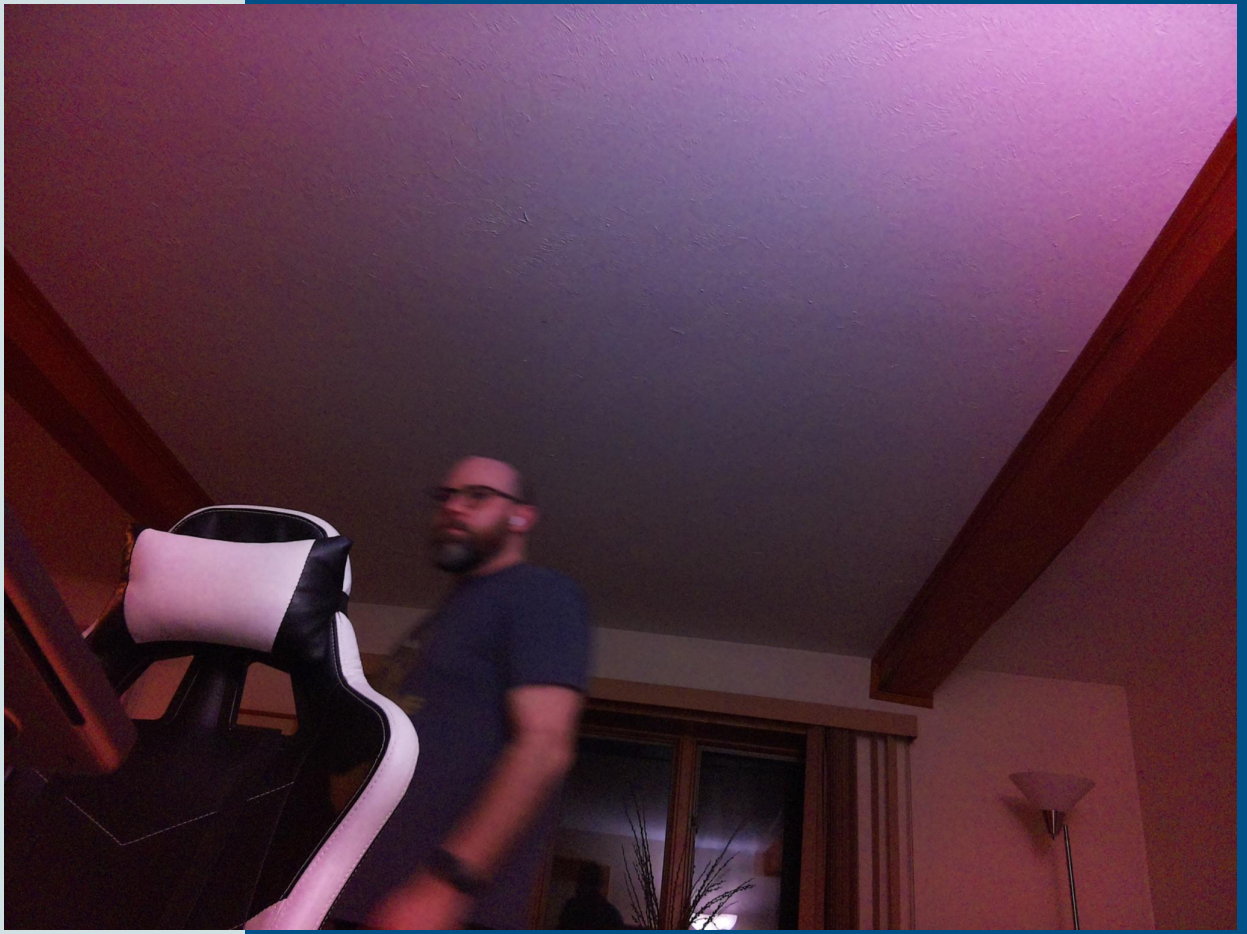
Testing PIR Distance

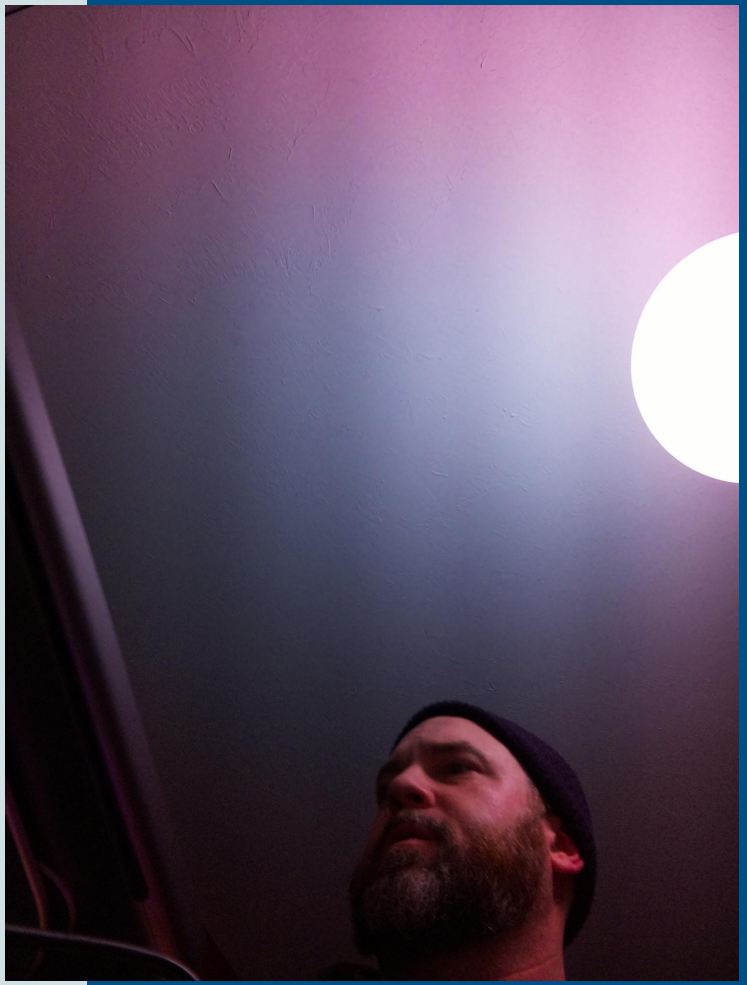
Reliable and accurate

Few false positives

Successful up to ~ 10 feet

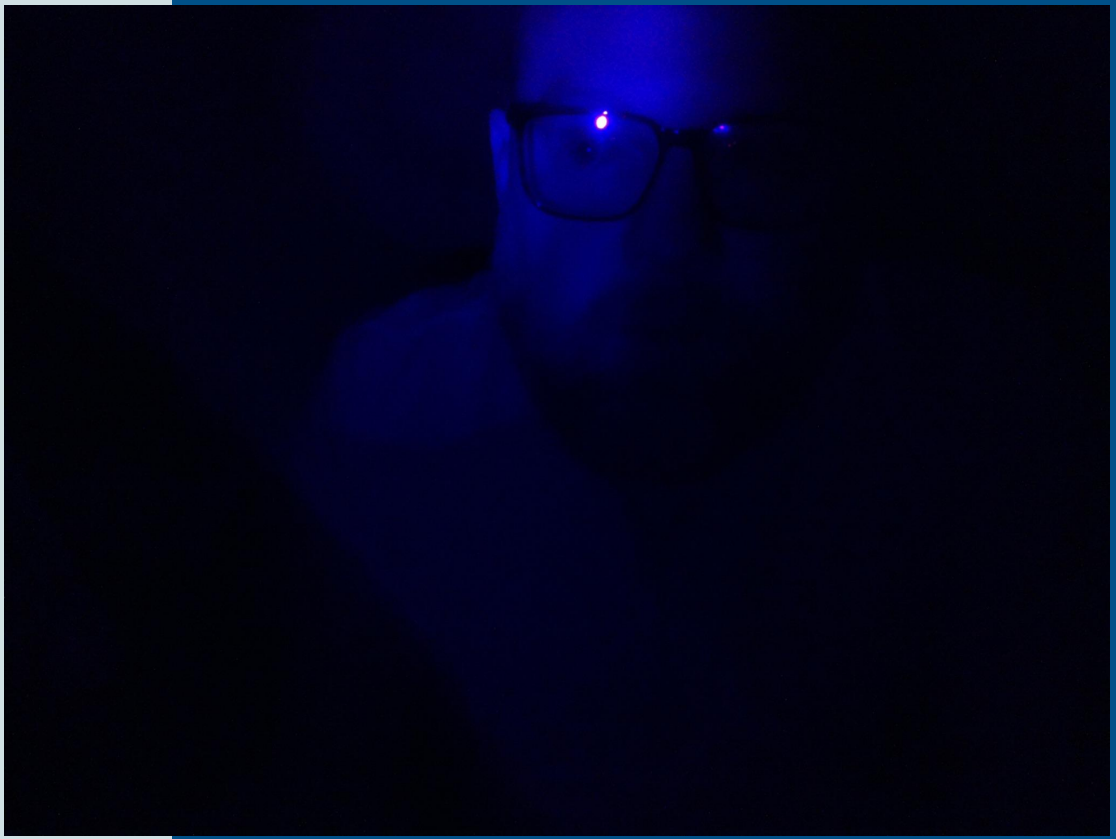


Initial Full Light Result



Full Dark Initial Result

Full Dark After Hardware Modification



Media retrieval

Proposed solution to this aspect of the project encountered severe limitations. Unable to complete SSH connection over phone hotspot.

Current solution suboptimal

Further research necessary

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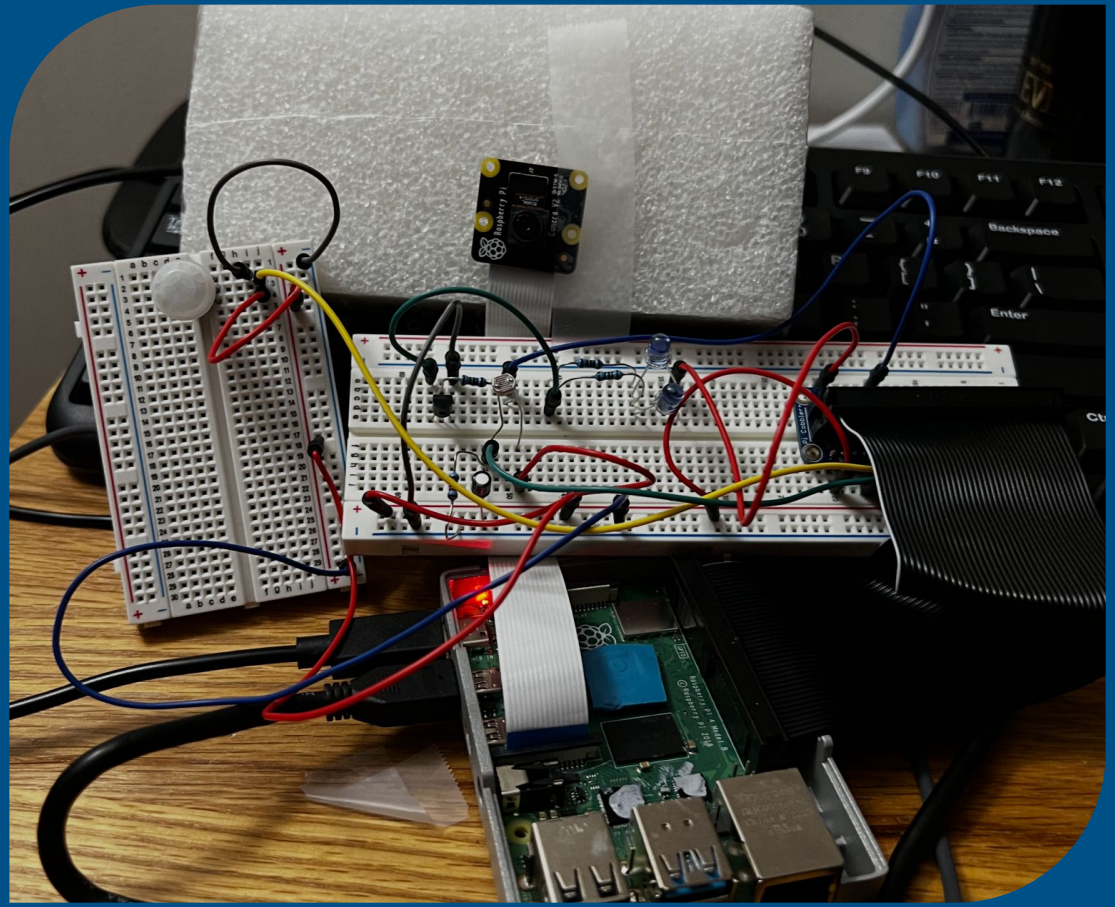
Conclusion

- Valuable learning experience, encountered obstacles which led to better understanding of flaws in design process
- Proof-of-concept but not a fully working prototype as originally envisioned.
- Testing led to multiple avenues for future work]
- Not particularly cost-effective. If you're not interested in the experience of creating an embedded system from the ground up, just buy one.

Future Work

- Enhance user experience
  - Media retrieval
  - Toggle Switches/Buttons
  - Display component
- Improve nighttime illumination
- Weatherproof housing
- Testing in the elements
- Battery Testing




And now my
watch has ended
LONE•WOLF