

Motion Activated Camera "WatchDog"

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Introduction

Project:

- Motion activated security camera with human detection.

IoT client-side development:

- Utilised the Raspberry Pi Zero W's GPIO pins to connect several devices
- Uses CSI interface to connect a camera module
- LKM was developed that would detect a button press and send a signal to userspace application.

Cloud Development:

- Utilised AWS Services to inspect the thumbnails of recorded videos for humans and to inform the user.
- Followed AWS environment security best practices.

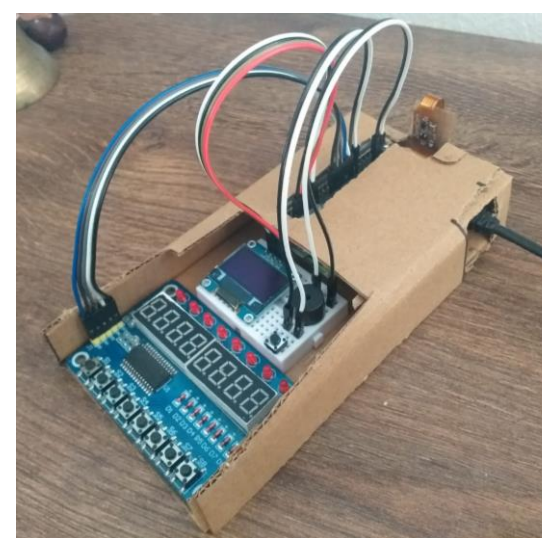
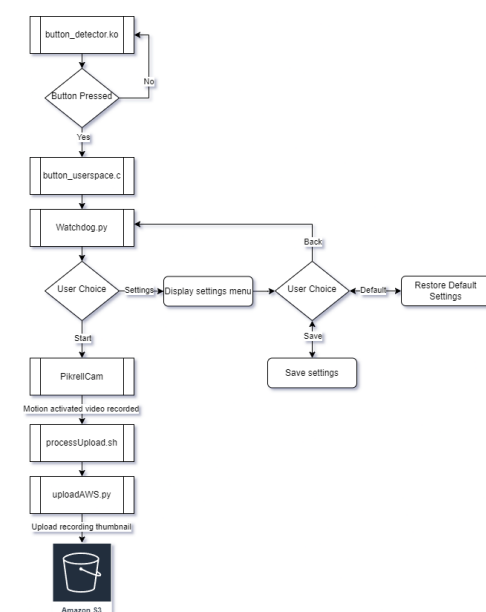
Objectives:

- Create a script which launches motion detection camera recording software.
- Add functions to script to implement a TM1648 board and a SSD1306 display.
- Configure secure AWS environment using AWS Identity Access Management.
- Upload footage to AWS Simple Storage Service as soon as it finishes recording.
- Use AWS Lambda and Step Functions to detect file upload and sent footage to AWS Rekognition.
- Using AWS Rekognition determine if a human is present.
- Send email to user informing them of human detection using AWS Simple Email Service.

Methodology

Raspberry Pi Zero W:

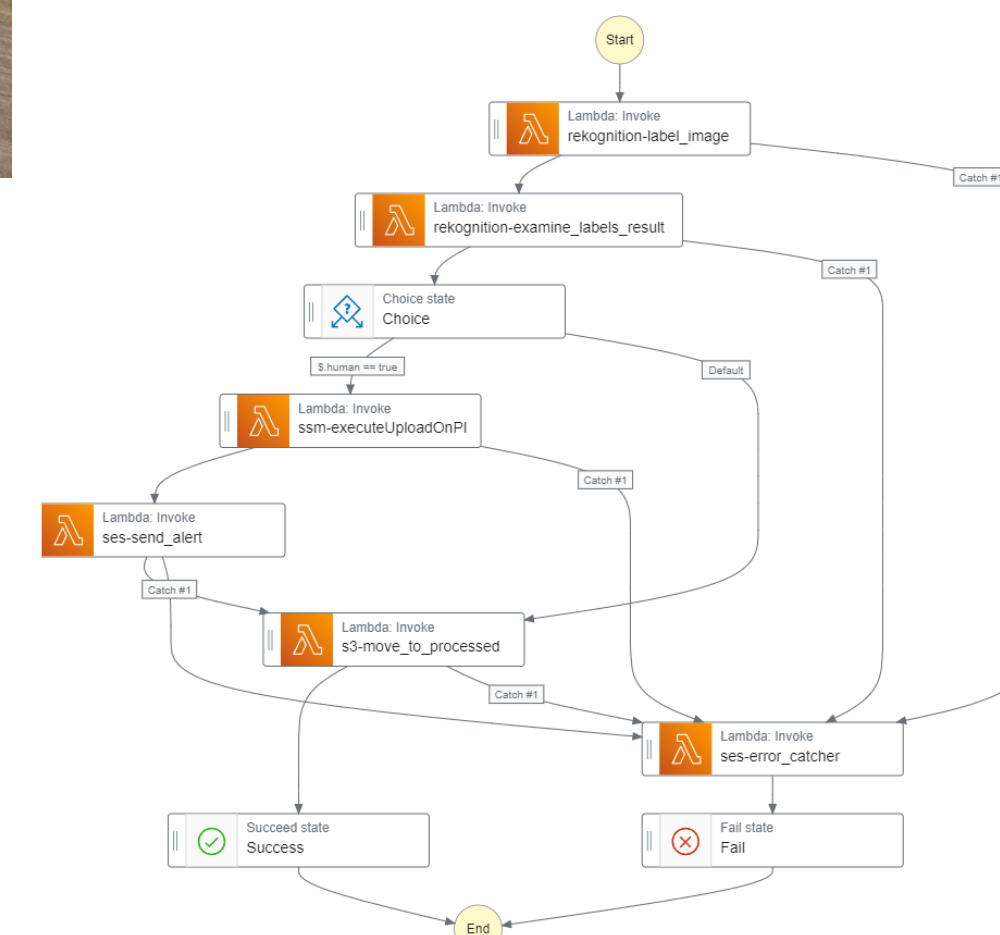
- Evaluated "Pikrellcam", "Motion" and "SentryPiCam" camera software; selected "SentryPiCam" for performance.
- Programmed "WatchDog.py" to display a main menu on ssd1306 and interface with TM1638 board; enables "SentryPiCam" operation and setting adjustments.
- Developed "button_detector.ko" LKM to monitor button presses in kernel space and trigger "button_userspace.c" in userspace using a signal.
- Created "button_userspace.c" to safely run "WatchDog.py", as an intermediary avoiding direct execution from kernel space because it might lead to system stability.
- To upload to AWS "processUpload.sh" would trigger upon motion detection by "SentryPiCam," and runs "uploadAWS.py"
- "uploadAWS.py" sounds a buzzer, identifies the thumbnail, and uploads it to AWS S3.



```
[ 3436.712029] button_detector: Loading out-of-tree module causes kernel.
[ 3436.712764] BUTTON DETECTOR KERNEL MODULE: INITILIATING
[ 3436.713013] BUTTON DETECTOR KERNEL MODULE: SUCCESSFULLY INITILIASED
[ 3436.713029] GPIO PIN IS MAPPED TO IRQ: 160
[ 3452.203857] INTERRUPT TRIGGERED
martin@raspberrymartin:~/WatchDog $ |
martin@raspberrymartin:~/WatchDog $ ./button_userspace
BUTTON USERSPACE: WAITING
BUTTON USERSPACE: RECEIVED RUN SIGNALBUTTON USERSPACE: WAITING
```

Cloud:

- Used AWS IAM, AWS S3, AWS Lambda, AWS Step Functions, AWS Rekognition, AWS Systems Manager and AWS SES to implement human recognition, video storage and email notifications
- Developed seven Python scripts for AWS Lambda, triggered by specific events and integrated with AWS Step Function workflows.
- An error catcher called "ses-error_catcher" would send the user an email informing them of any errors that occur.



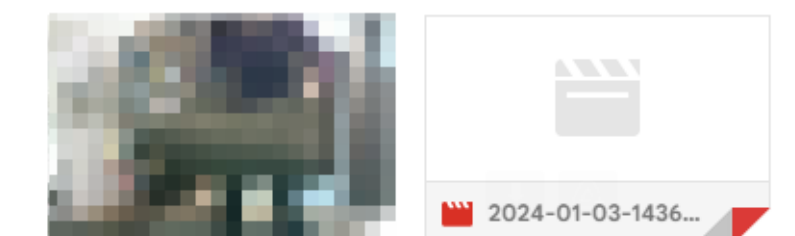
Project Highlights

The project effectively uses IoT and Cloud technologies for a motion-activated security camera. Uses a Raspberry Pi, alongside several peripherals as well as custom scripts and open-source software for motion detection. By using several AWS services human recognition, video storage and email notifications were implemented.

mzhelev01@gmail.com via amazonses.com
to me

WatchDog has detected a human.

2 Attachments • Scanned by Gmail



Future Work

- Develop the settings menu to allow the user to change the flags which will be passed to "SentryPicam".
- Implement two LEDs for LKM status.
- Easy install script for novice users.

References

TinkerTurtle, 2022. GitHub - TinkerTurtle/Sentry-Picam: A simple wildlife camera for Raspberry Pis.. [Online] Available at: <https://github.com/TinkerTurtle/Sentry-Picam>[Accessed 4 12 2023].
West, M., 2023. Smarten up your Pi Zero Web Camera with Image Analysis and Amazon Web Services (Part 2). [Online] Available at: <https://www.bouvet.no/bouvet-deler/utbrudd/smarten-up-your-pi-zero-web-camera-with-image-analysis-and-amazon-web-services-part-2> [Accessed 2 12 2023].