Monitoring Occupancy In Smart Homes

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Overview

The goal for our project is to create a device for human detection and counting, we succeed in achieving that and more. We implements multiple benefits along with the basic function for our project with the benefits of the user in mind.

Benefits

1. Power Saver- Only on when it needs to, save more on electricity.
2. Accuracy- Detect and identify with 100% accuracy.
3. Secure- Blackbox-like design, data is processed and saved locally.
4. Portable- Light and small, perfect for any ages.

Methods

Obstacle Sensing Technology

- Detects objects with Infrared sensor as far as 12 meters.

Power Saver

- Implemented sleep mode using RemotePi and Infrared sensor
- Turns on only when needed

Human Shape Detection

- Detects people in any image using YOLO3 OpenCv model.

Occupancy Monitoring Technology

- Calculates the occupancy the occupancy status of a room using image processing techniques in YOLO3 OpenCV model.

Fully Automatic Processing

- Implements a hands-free system that does not need user interference.
- Turns on and off the system automatically using Python scripts and OS calls.

Local Data Processing

- Eliminates the need of a online database by importing a pre-trained YOLO3 model.

Results

Figure 1: Input snapshot

Figure 2: Image Processed

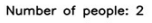

Figure 3: LCD Output

1. IR sensor detects an object.
2. Turns on the device using RemotePi.
3. The input picture will be taken when the device turns on.
4. The input snapshot will then be processed by the YOLO3 model.
5. YOLO3 will then process the input image shown in figure 1.
6. The processed image, Figure 2, will then have human shape indicators labeled on screen with their confidence score.
7. This image will be then be used for our Python script to count the amount of human shapes with confidence score larger than 0.9.
8. The occupancy status will then be displayed on the LCD screen.
9. Script will end, call shutdown routine.
10. Device will save all data and shutdown

Example

Figure 4: Example Input

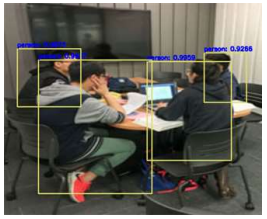

Figure 5: Example Output

Conclusion

In conclusion, we had the simple goal of build a device that can detect and count human shapes in an image using image processing technique. However, as we continue to develop our product, we realize that in order to make a successful product, it needs to have more than “just works”. So we brainstormed many ways to improve and add functions to our initial prototype based around the current events. In the end, we created a device that can avoid the growing concerns of personal privacy and help the environment by being power efficient.

Glossary

- Black box-is a device, system or object which can be viewed in terms of its inputs and outputs without any knowledge of its internal workings.
- OpenCV- is a library of programming functions mainly aimed at real-time computer vision.
- Confidence Score – In computer vision, a confidence score indicates the confidence that the answer is the right match for the given model identification.
- RemotePi – power controller board designed and sold by MSL digital to be an add on board for the Raspberry Pi, it can remotely power on and off with a programmable remote.
- YOLO3 – an open-source model designed to process image with human shapes.
- Infrared sensor -is an electronic sensor that measures infrared light radiating from objects in its field of view.
- Python - an interpreted, high-level, general-purpose programming language. Created by Guido van Rossum and first released in 1991, Python's design philosophy emphasizes code readability with its notable use of significant whitespace.

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Team Illuminati