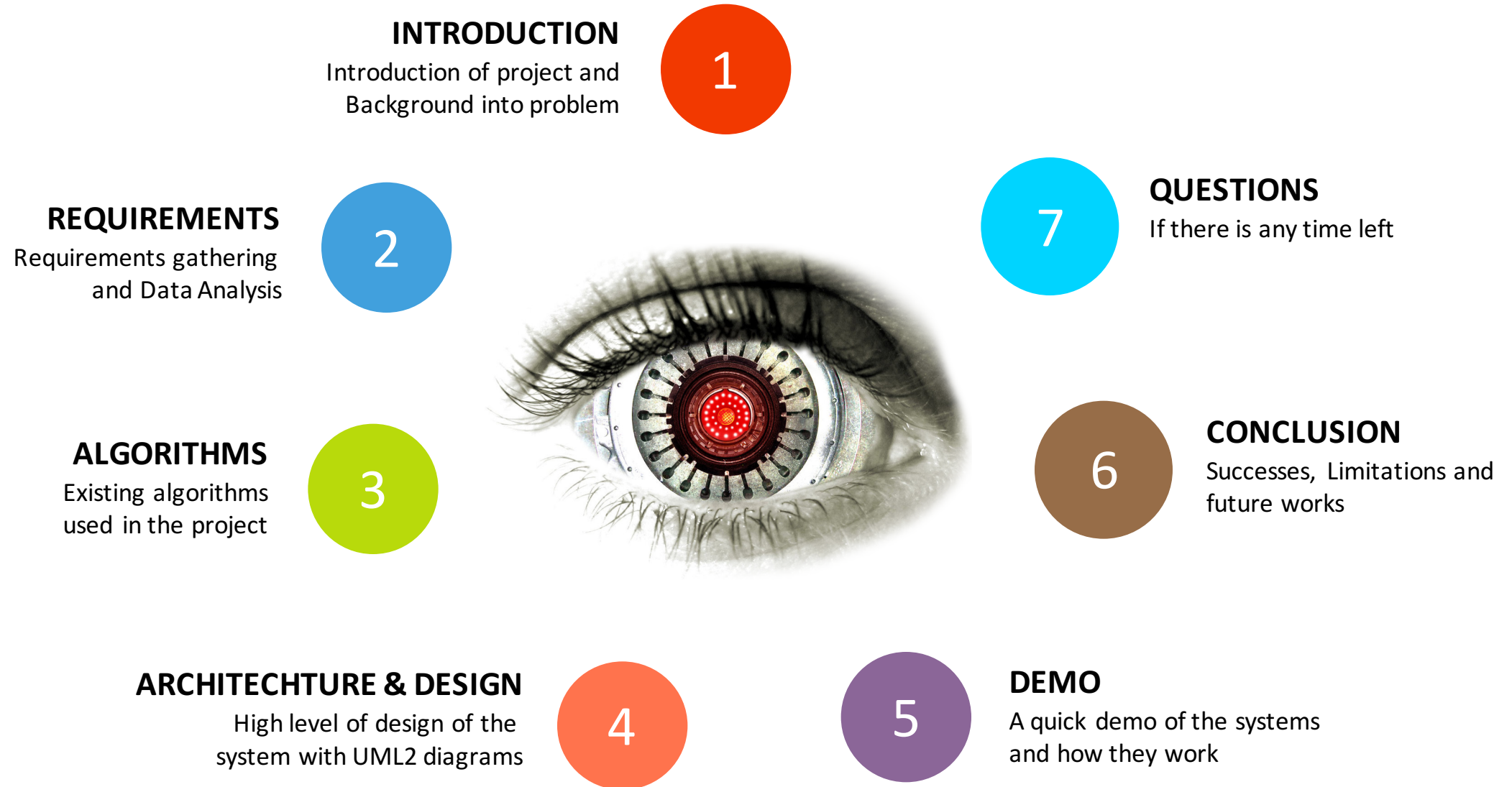# TRANSFORMING HOME SECURITY AND TRAFFIC LIGHT SYSTEMS WITH COMPUTER VISION AND HUMAN DETECTION

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Applied Project

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Overview

INTRODUCTION
Introduction of project and Background into problem

1

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Existing algorithms used in the project

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High level of design of the system with UML2 diagrams

4

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A quick demo of the systems and how they work

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CONCLUSION
Successes, Limitations and future works

6

QUESTIONS
If there is any time left

7

INTRODUCTION

TRANSFORMING HOME SECURITY AND TRAFFIC LIGHT SYSTEMS WITH COMPUTER VISION AND HUMAN DETECTION

Introduction
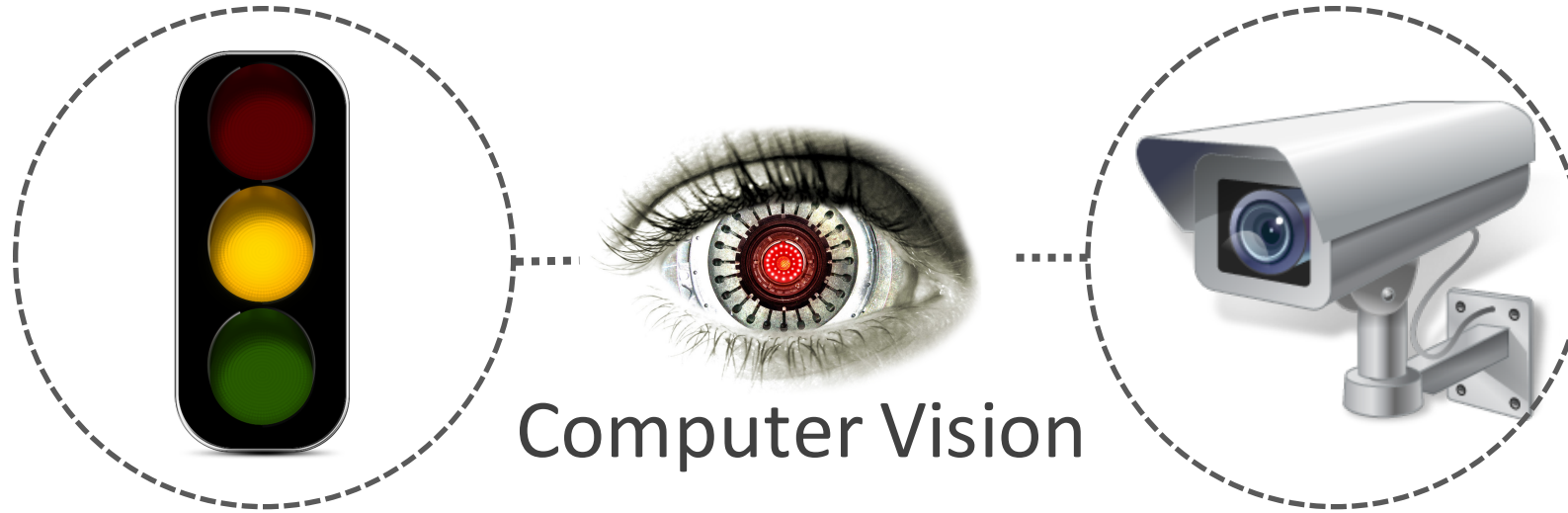
Computer Vision

Smarter • Human Centered • Robust

Introduction

PROJECT AIM

This project observed some important issues in Ghana, namely home security and road transport efficiency and I made an attempt at solving them through two computer vision based applications. I developed an affordable and smart home surveillance system and an intelligent traffic light system to increase transport efficiency and safety in crossing roads with this technology
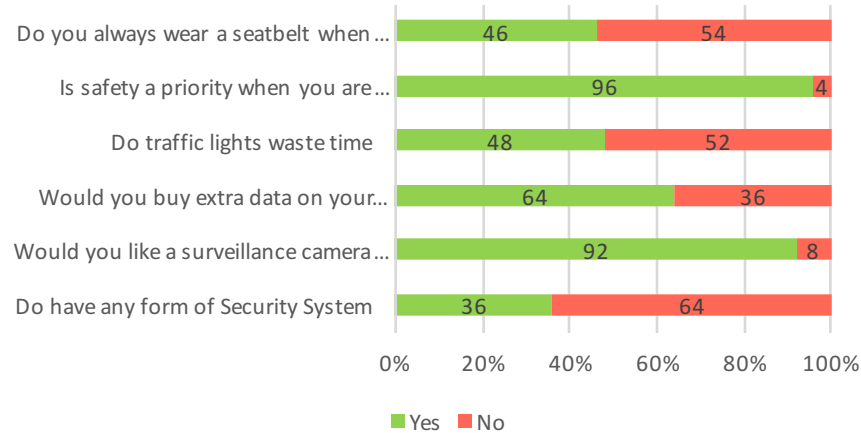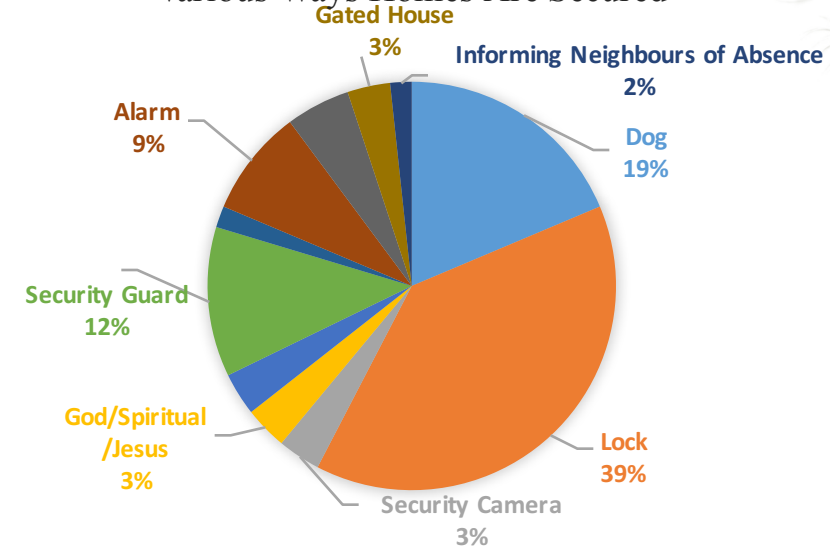
REQUIREMENTS

TRANSFORMING HOME SECURITY AND TRAFFIC LIGHT SYSTEMS WITH COMPUTER VISION AND HUMAN DETECTION
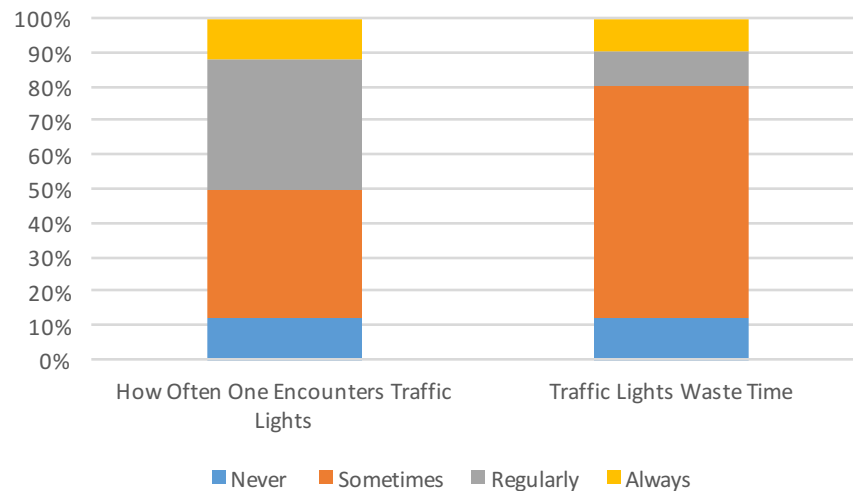
DATA ANALYSIS

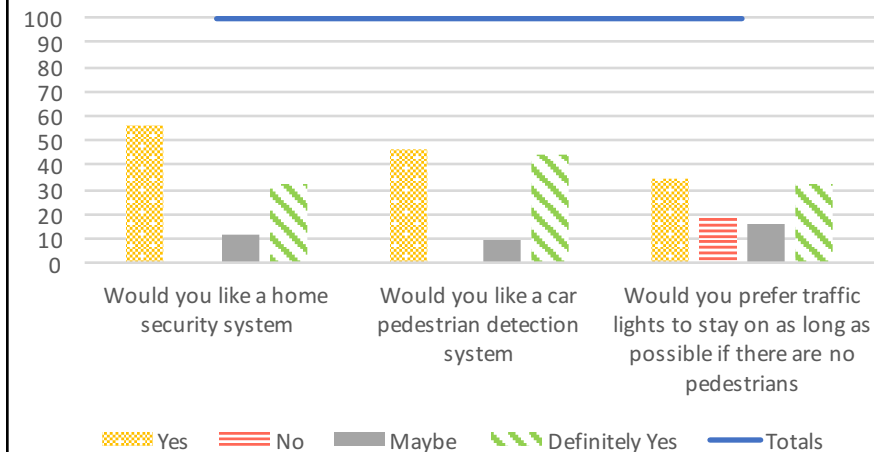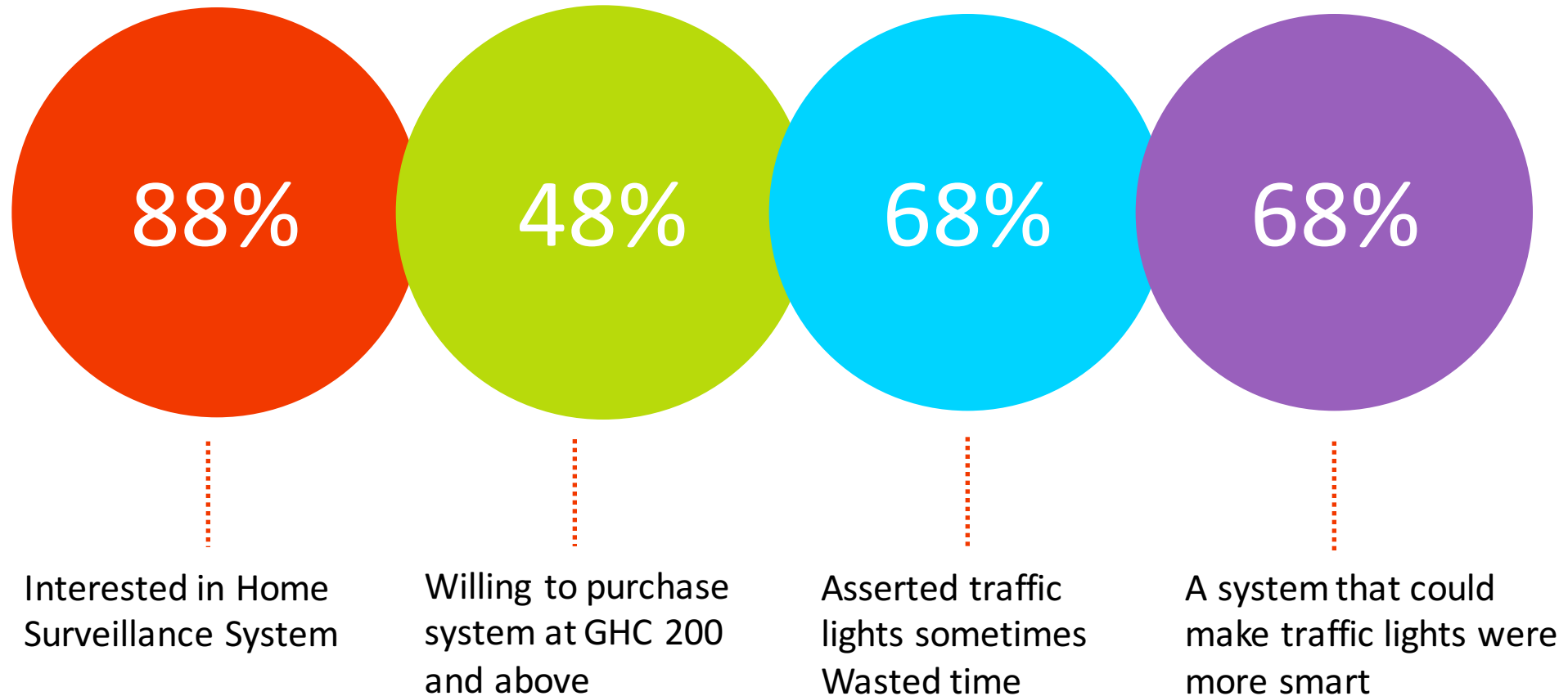Responses of Participants to "Yes" or "No" Questions (%)

Question	Yes	No
Do you always wear a seatbelt when …	46	54
Is safety a priority when you are …	96	4
Do traffic lights waste time	48	52
Would you buy extra data on your…	64	36
Would you like a surveillance camera …	92	8
Do have any form of Security System	36	64

Various Ways Homes Are Secured

- Gated House 3%
- Informing Neighbours of Absence 2%
- Dog 19%
- Lock 39%
- Security Camera 3%
- God/Spiritual/Jesus 3%
- Security Guard 12%
- Alarm 9%

Experiences with Traffic Light Systems

Categories: How Often One Encounters Traffic Lights, Traffic Lights Waste Time

Legend: Never, Sometimes, Regularly, Always

A Graph Showing Interest of Respondents to Proposed Solutions (%)

Categories: Would you like a home security system, Would you like a car pedestrian detection system, Would you prefer traffic lights to stay on as long as possible if there are no pedestrians

Legend: Yes, No, Maybe, Definitely Yes, Totals

Data Analysis -Summary

88%

48%

68%

68%

Interested in Home
Surveillance System

Willing to purchase
system at GHC 200
and above

Asserted traffic
lights sometimes
Wasted time
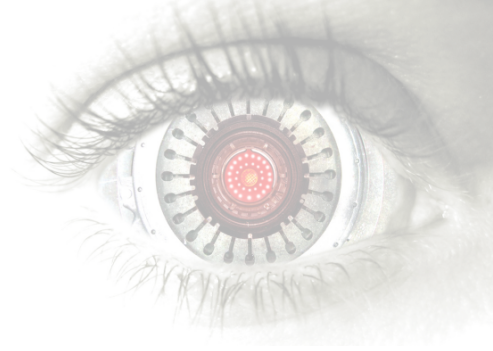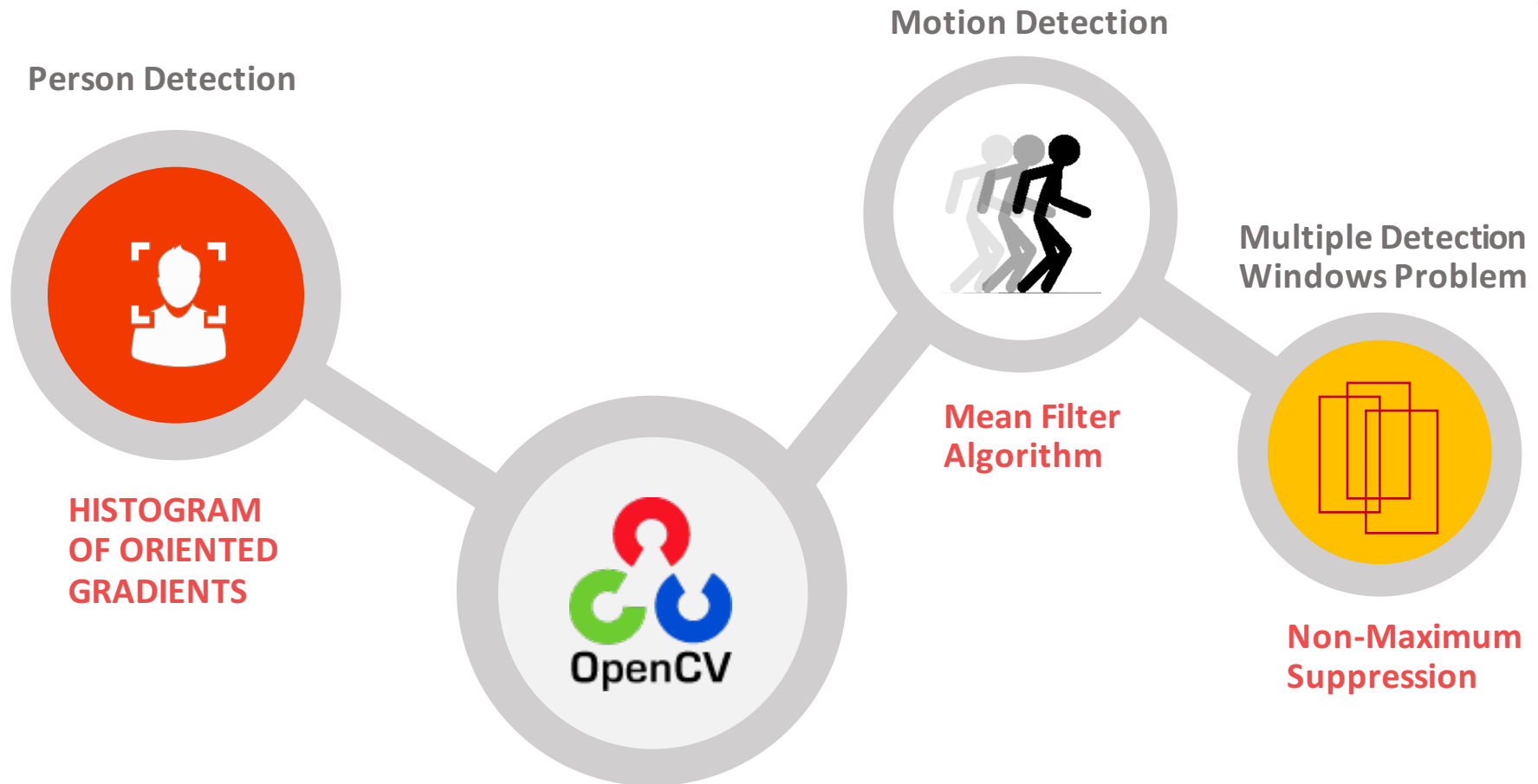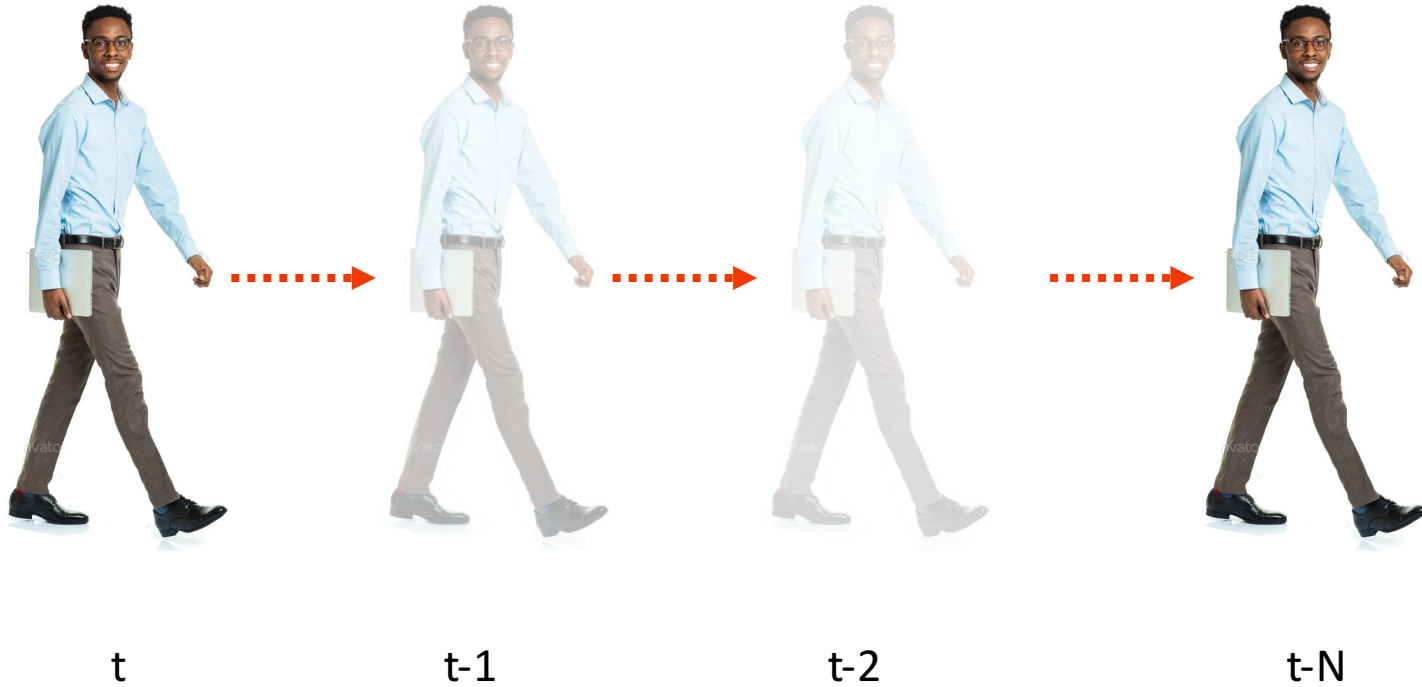
A system that could
make traffic lights were
more smart

ALGORITHMS

TRANSFORMING HOME SECURITY AND TRAFFIC LIGHT SYSTEMS WITH COMPUTER VISION AND HUMAN DETECTION

Existing Algorithms

Person Detection

Motion Detection

Multiple Detection Windows Problem

HISTOGRAM OF ORIENTED GRADIENTS

OpenCV

Mean Filter Algorithm

Non-Maximum Suppression

Background Subtraction (Mean Filter)

t

t-1

t-2

t-N

Frame Difference

$$B\ (x, y) = \frac{1}{N} \sum_{i=1}^{N} V(x, y, t-1) \quad \text{,where B = Averaged background}$$

$$|\ V\ (x, y, t+1) - B\ (x, y)\ | > Th$$
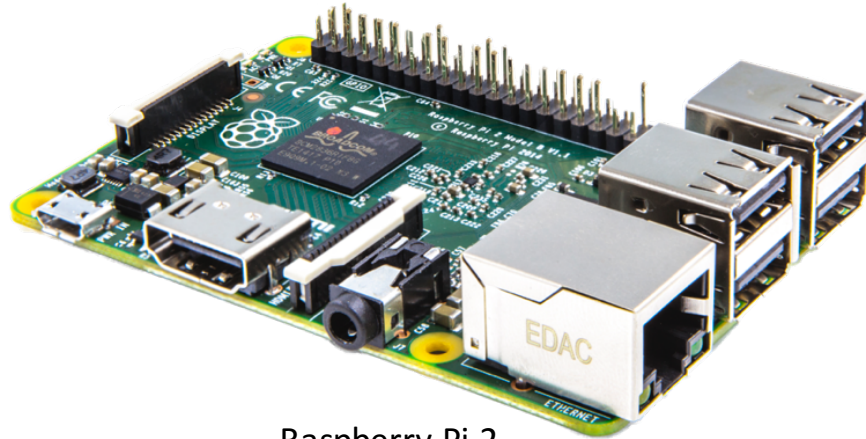
ARCHITECTURE & DESIGN

TRANSFORMING HOME SECURITY AND TRAFFIC LIGHT SYSTEMS WITH COMPUTER VISION AND HUMAN DETECTION
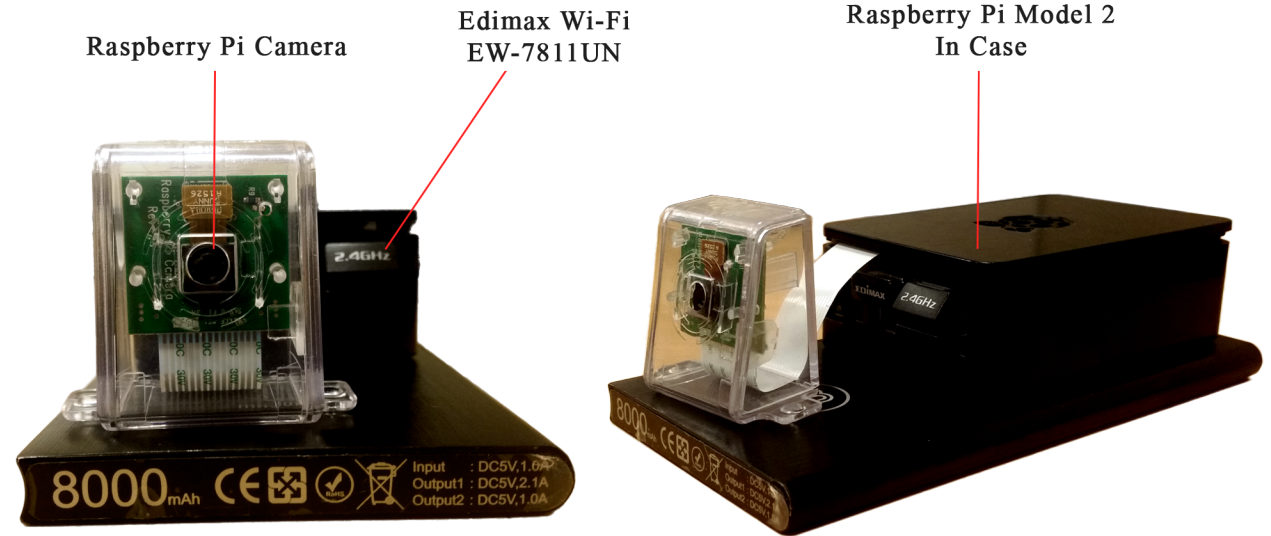
Hardware Setup

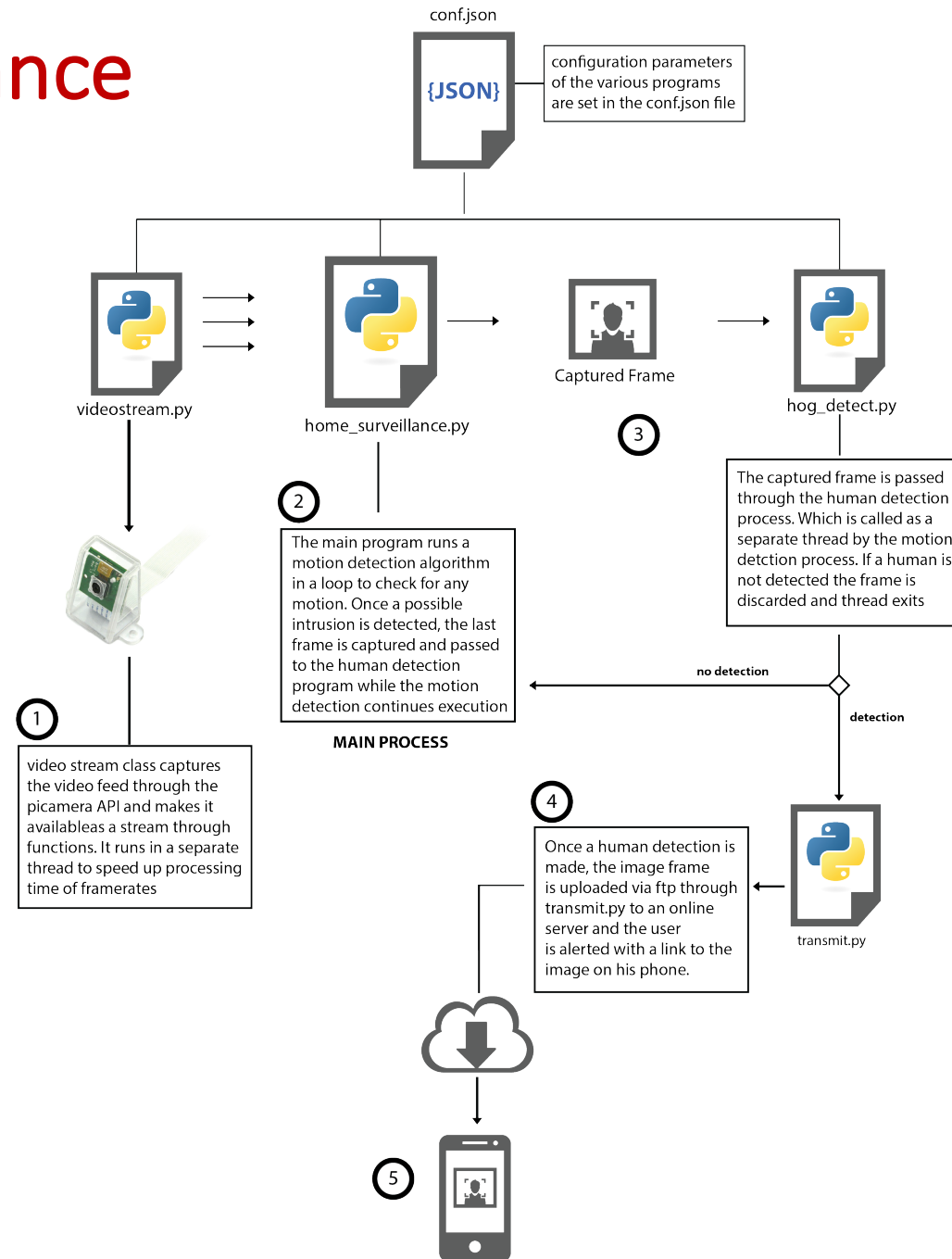Pi Camera

+

Raspberry Pi 2

+

Edimax Wi-Fi Dongle

=

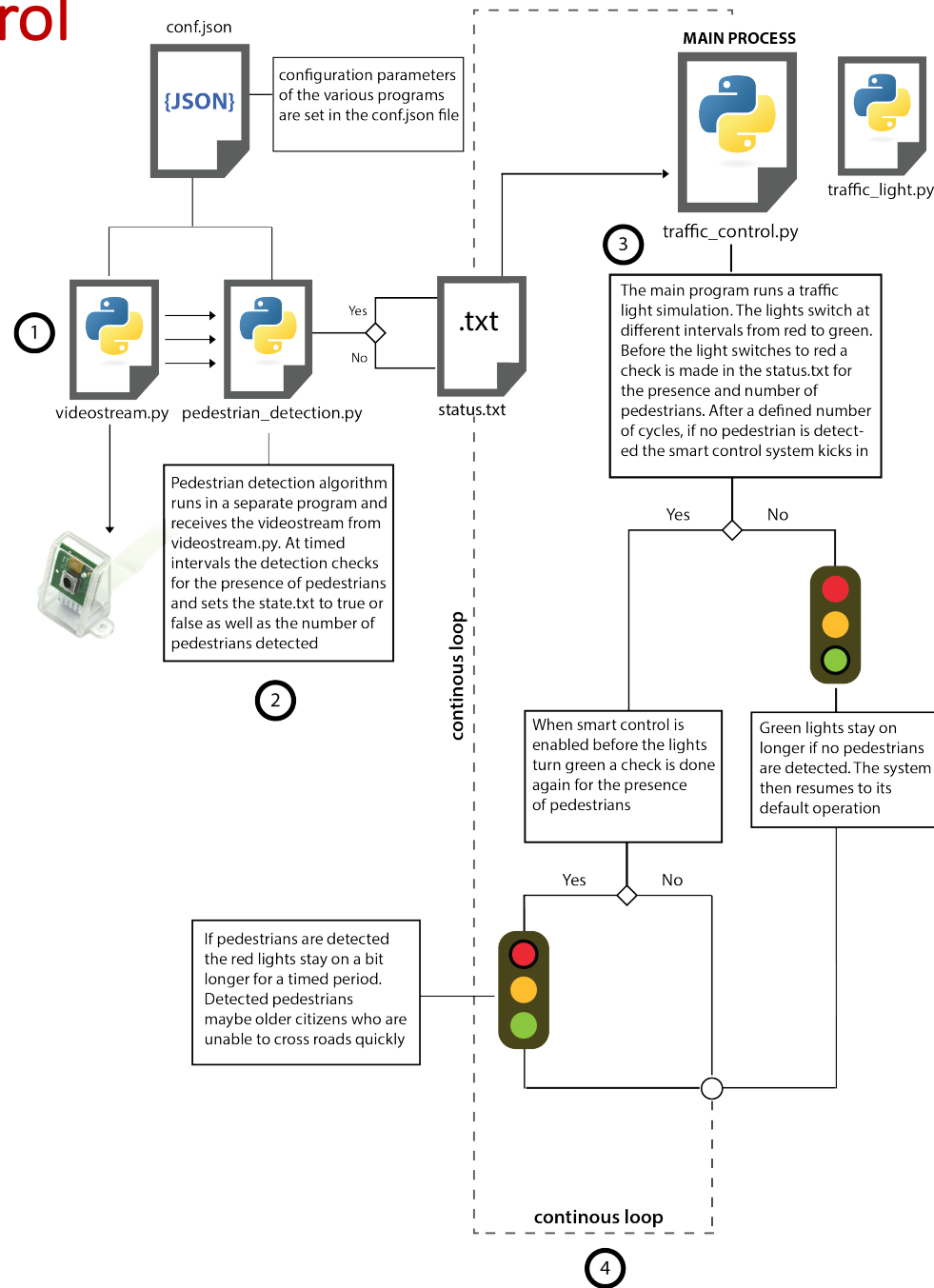Raspberry Pi Camera

Edimax Wi-Fi
EW-7811UN

Raspberry Pi Model 2
In Case

Home Surveillance

conf.json

{JSON}

configuration parameters of the various programs are set in the conf.json file

videostream.py

home_surveillance.py

Captured Frame

hog_detect.py

3

2

The main program runs a motion detection algorithm in a loop to check for any motion. Once a possible intrusion is detected, the last frame is captured and passed to the human detection program while the motion detection continues execution

MAIN PROCESS

The captured frame is passed through the human detection process. Which is called as a separate thread by the motion detction process. If a human is not detected the frame is discarded and thread exits

no detection

detection

1

video stream class captures the video feed through the picamera API and makes it availableas a stream through functions. It runs in a separate thread to speed up processing time of framerates

4

Once a human detection is made, the image frame is uploaded via ftp through transmit.py to an online server and the user is alerted with a link to the image on his phone.

transmit.py

5

Smart Traffic Control System

conf.json

configuration parameters of the various programs are set in the conf.json file

{JSON}

MAIN PROCESS

traffic_light.py

(3) traffic_control.py

(1)

videostream.py   pedestrian_detection.py

Yes

No

.txt

status.txt

The main program runs a traffic light simulation. The lights switch at different intervals from red to green. Before the light switches to red a check is made in the status.txt for the presence and number of pedestrians. After a defined number of cycles, if no pedestrian is detected the smart control system kicks in

Pedestrian detection algorithm runs in a separate program and receives the videostream from videostream.py. At timed intervals the detection checks for the presence of pedestrians and sets the state.txt to true or false as well as the number of pedestrians detected

(2)

Yes   No

When smart control is enabled before the lights turn green a check is done again for the presence of pedestrians

Green lights stay on longer if no pedestrians are detected. The system then resumes to its default operation

continous loop

Yes   No

If pedestrians are detected the red lights stay on a bit longer for a timed period. Detected pedestrians maybe older citizens who are unable to cross roads quickly

continous loop

(4)

DEMO

TRANSFORMING HOME SECURITY AND TRAFFIC LIGHT SYSTEMS WITH COMPUTER VISION AND HUMAN DETECTION
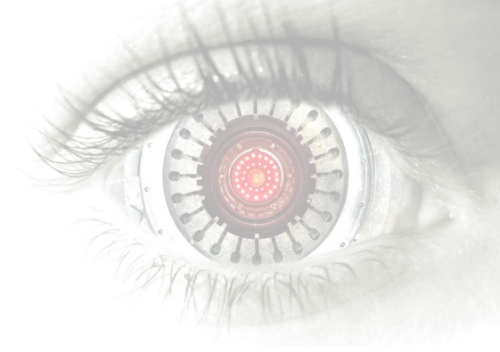
Smart Traffic Light

Phone Notification
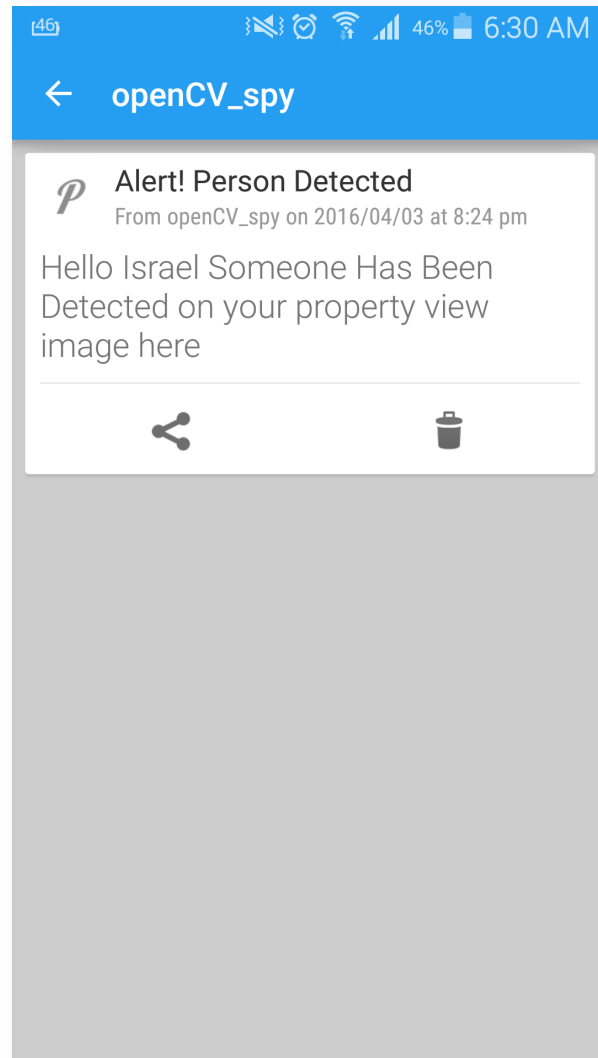
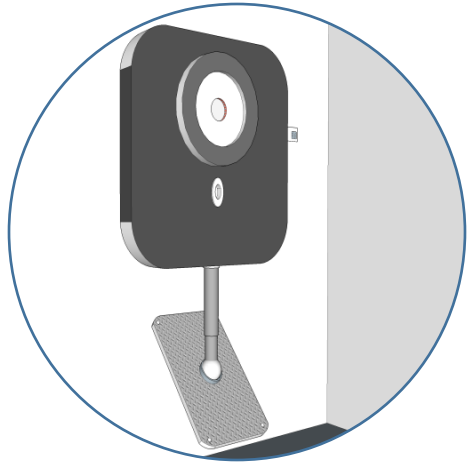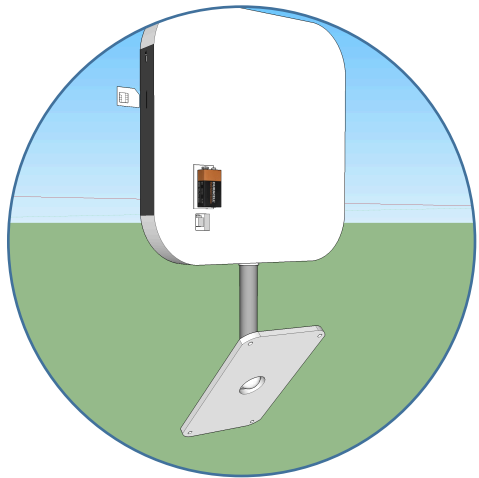# Collage of Captured images from home surveillance system

CONCLUSION

TRANSFORMING HOME SECURITY AND TRAFFIC LIGHT SYSTEMS WITH
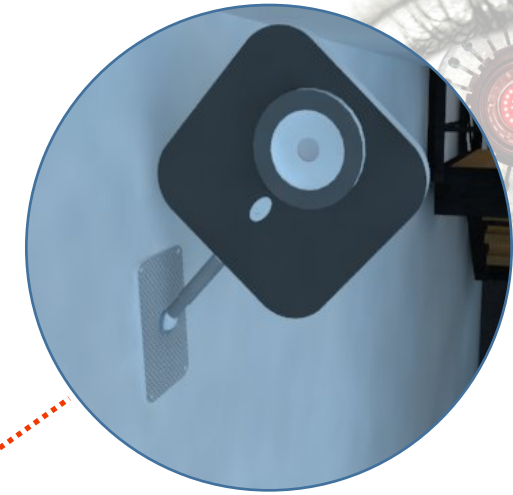COMPUTER VISION AND HUMAN DETECTION

Future Works

Sleek Design For Easy Mobility and Interior Appeal
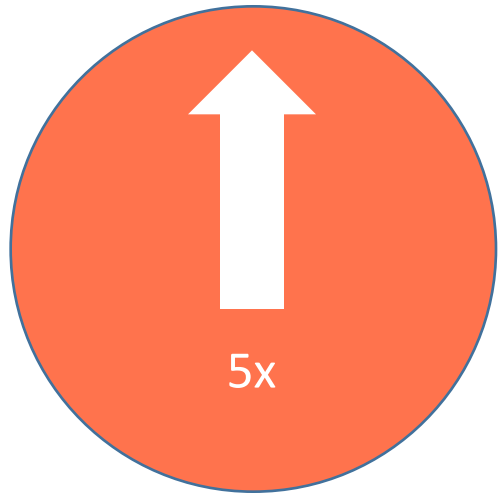
Internet Connection Via Networks/9v Cells or Solar

3D Render of House Fitted With Home Surveillance System

Future Works

Redesign of Detection System

Integration with Real Traffic Light Systems

5x

Increased Computing Power to enhance Human Detection

Improve Technology to work at traffic lights at cross-sections