

# Classification of Video Sequences into Specified Generalized Use Classes of Target Size and Lighting Level

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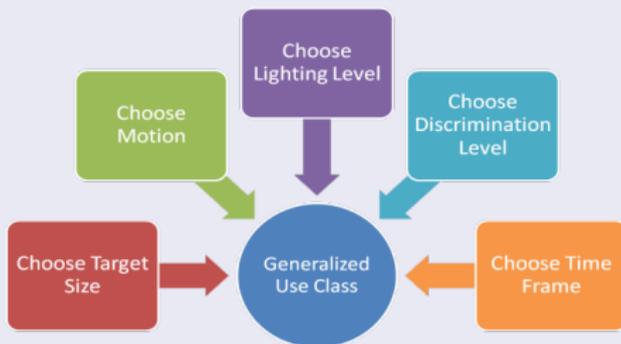
# Introduction

- Transmission and analysis of video frequently used for variety of applications outside entertainment sector, to perform specific tasks
  - Security
  - Public safety
  - Remote command and control
  - Tele-medicine
  - Sign language
- Each application consisting of some type of recognition task
- Different QoE for entertainment and recognition tasks videos
- Video Quality in Public Safety (VQiPS) Working Group, est. 2009 by DHS, developing user guide for public safety video applications
- The approach taken by VQiPS to remain application-agnostic
- Instead of attempting to individually address each of many public safety video applications, approach basing on common features

# Five Parameters Impacting Ability to Achieve Recognition Task, Selected as Being of Particular Importance

- **Usage time-frame** — specifying whether video to be
  - Analysed in real-time
  - Recorded for later analysis
- **Discrimination level** — specifying fine level of detail sought from video
- **Target size** — specifying anticipated Region Of Interest (ROI) in video to occupy relatively small or large percentage of frame
- **Lighting level** — specifying anticipated lighting level of scene
- **Level of motion** — specifying anticipated level of motion in scene

# Representation of Determination Process of Generalised Use Classes (GUCs) Formed from Referred Parameters



**Figure:** Classification of video into generalized use classes as proposed by VQiPS

# Classification of Video Sequences into Specified Generalized Use Classes

- **Objective** — to develop tool that would automatically classify input sequence into one of GUCs
- **Challenge** — description of GUC aspect not defining particular characteristics of targets, usable as criterion for automatic algorithms



# Work Description

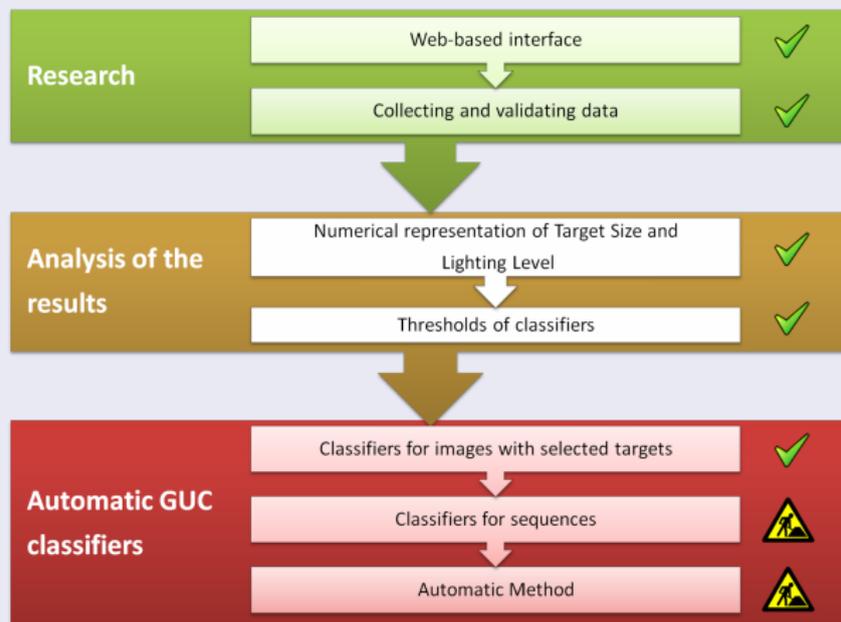


Figure: Block diagram of working on automatic classification into GUC's

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# Asumptions of Research Tool

## Functionalities:

- Watching video samples
- Selecting targets by drawing on frames and describing them
- Selecting lighting level of whole sequence and particular targets

## Features:

- Intuitive
- Easily accessible
- Well performance at most popular web browsers

# Developed Tool

Player(sequence 1/37):

Target Size and Lighting Level Recognition

Frame:

Help

Get frame >>>

Reset target selection

SCENE LIGHTING LEVEL:  Dim  Bright  Variable

**TARGET SIZE**  
 Small  Large

**TARGET LIGHTING LEVEL**  
 Dim  Bright  Variable

**TARGET DESCRIPTION**  
 Target #1: Face  
 Target #2: Watch  
 Target #3: Gun

**OPTIONS**  
 Show Add next  
 Show Delete Add next  
 Show Delete Add next

Figure: Outlook of interface

# Results

The set of answers consisted of 616 target selections. Preparation for analysis:

- Manual validation as a result of subjective character of the test
- Excluded entries contained:
  - actions
  - two or more targets selected at once
  - no particular target selected
  - the same target selected more than once by one end-user
- Finally we have got **553** valid answers.

## Results — Examples of Excluded Entries

	hit with bag
	cap and shirt logo and pattern
	Witnesses

**Figure:** Validated answers, sequentially from top: action, many targets at one selection, no particular target

# Results — Grouping targets

- Commonalities between selections and descriptions
- Conditions
  - Common 66.7% ( $\frac{2}{3}$ ) of size selections and descriptions
  - Target was selected at least twice



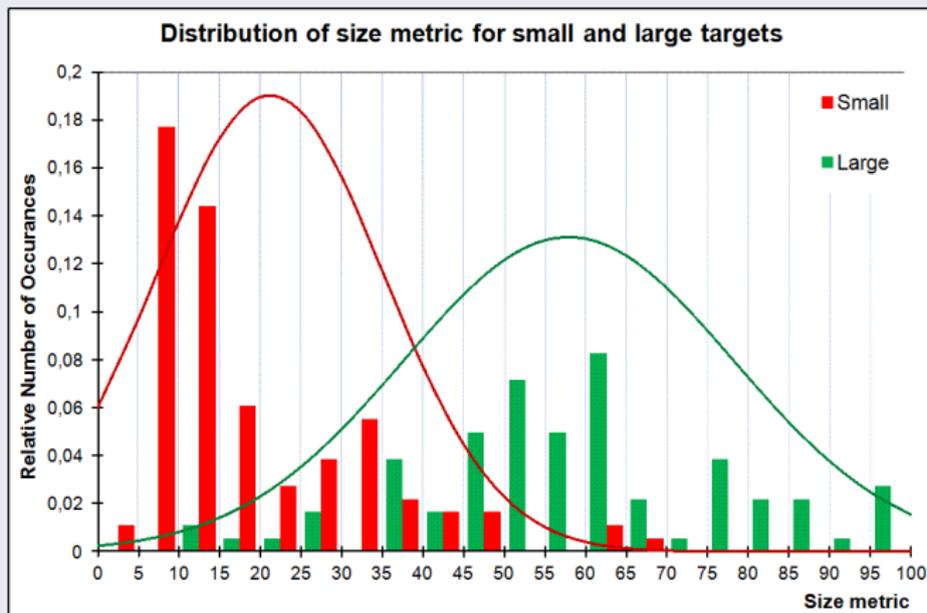
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# Target Size

- VQiPS defining 2 sizes of anticipated ROIs (targets)
  - Small
  - Large
- Finding binary classification criterion based on subjects
- Different numerical metrics of target sizes calculated
  - $F1$  — F1 score
  - $A$  — Measuring accuracy
  - $P$  — Precision
  - $R$  — Recall
  - $TS = \frac{\max(x,y)}{X \vee Y}$ 
    - $TS$  — Target Size metric
    - $x, y$  — Size of selected ROI
    - $X \vee Y$  — Respective length of frame dimension
  - $A_{max}(TS = 40\%) \geq 85\%$

# Target Size — Histogram



Number of occurrences refers to the set of 212 target groups.

# Target Size — Various Metric Values for Statistics

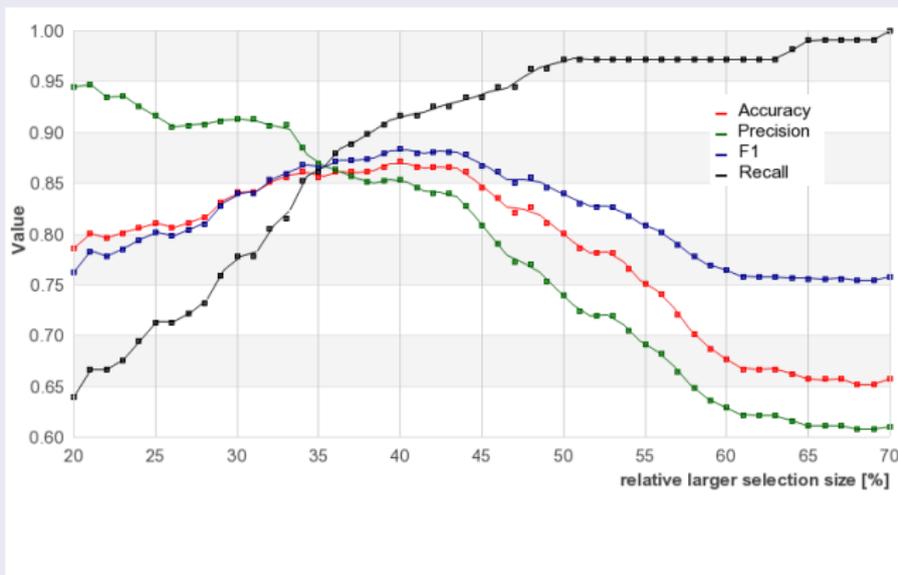
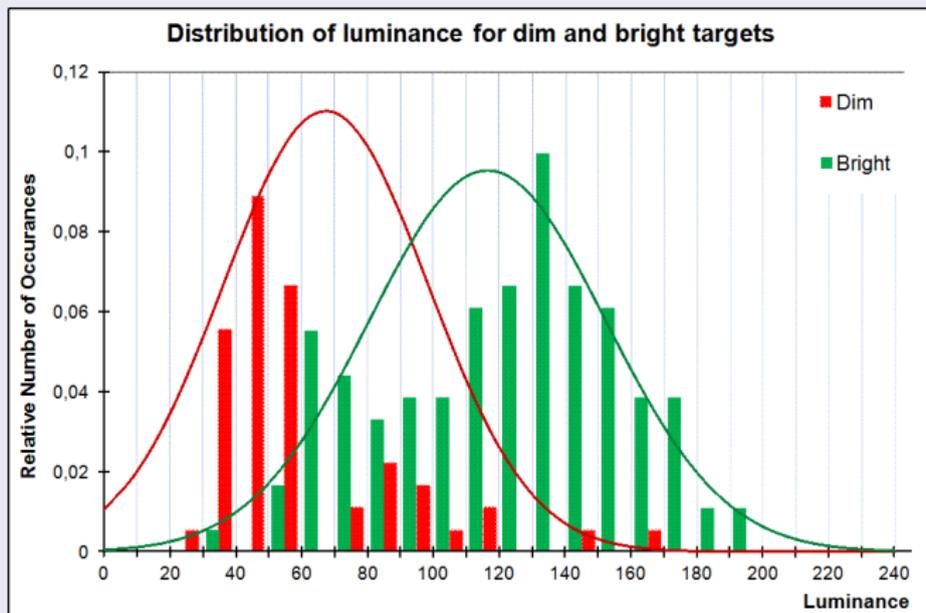


Figure: Measures of target size classifier in function of size metrics

# Lighting Level

- VQiPS defining 3 levels of entire sequence illumination
  - Dim
  - Bright
  - Variable — rejected due to low stability
- Here, per-ROI responses also taken into account
- Finding binary classification criterion based on subjects
- Different numerical metrics of target sizes calculated
  - $F1$  — F1 score
  - $A$  — Measuring accuracy
  - $P$  — Precision
  - $R$  — Recall
  - $LL = avg(L_V(ROI))$ 
    - $LL$  — Lighting Level metric
    - $L_V$  — Luminance
  - $A_{max}(LL = 55) \geq 80\%$

# Lighting Level — Histogram



Number of occurrences refers to the set of 181 target groups.

# Lighting Level — Various Metric Values for Statistics

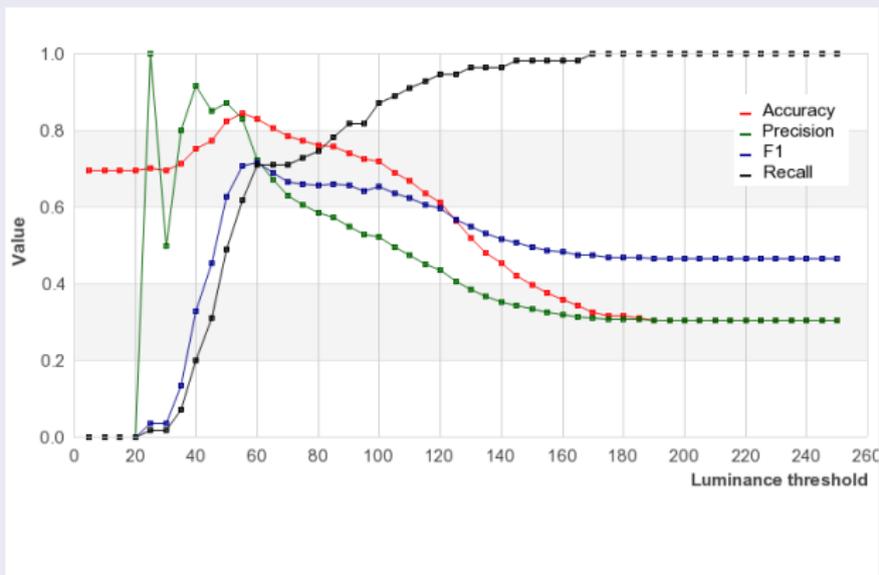


Figure: Measures of lighting level classifier in function of luminance threshold

# Conclusion

- Size metric equal to 40% used as threshold in binary classifier of target size
- Lighting level selected by comparing average luminance with value of 55
- Subjects-driven methods for automatic classification of entire GUC sequence currently under development
- Ongoing algorithms to be based on image processing of each video frame