

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

Mikołaj I. Leszczuk Marcin Witkowski

Department of Telecommunications
AGH University of Science and Technology
Kraków, PL-30059

December 9, 2011

Table of contents

- 1 Introduction
- 2 Framework for Describing Public Safety Video Applications
- 3 Classification of Video Sequences into Specified Generalized Use Classes
 - Research
 - Analysis of the results
 - Target Size
 - Lighting Level
- 4 Conclusion

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

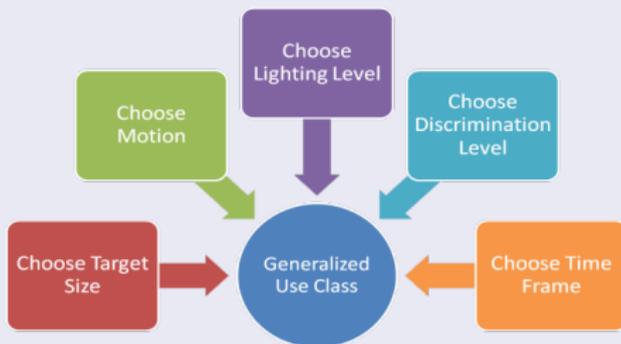


Figure: Classification of video into generalized use classes as proposed by VQiPS

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

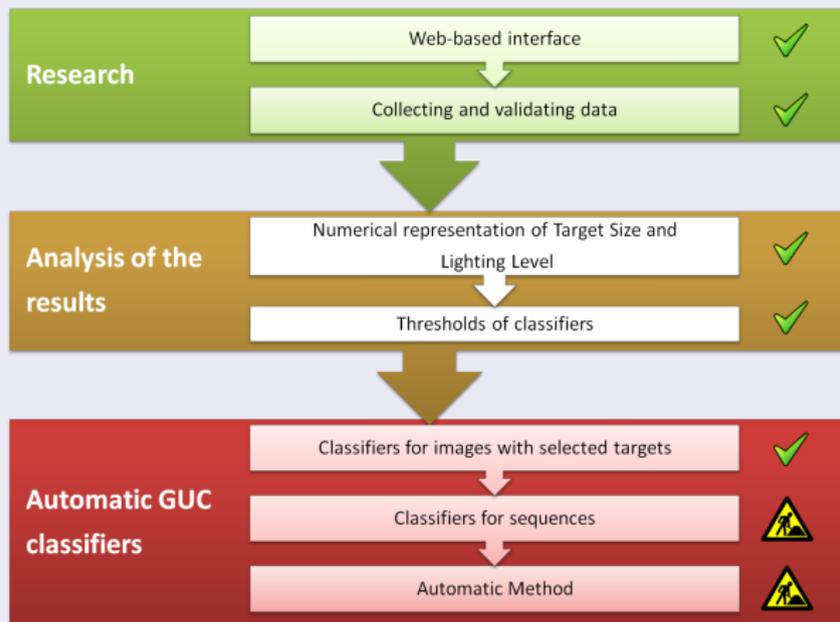


Figure: Block diagram of working on automatic classification into GUC's

Table of contents

- 1 Introduction
- 2 Framework for Describing Public Safety Video Applications
- 3 Classification of Video Sequences into Specified Generalized Use Classes
 - Research
 - Analysis of the results
 - Target Size
 - Lighting Level
- 4 Conclusion

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

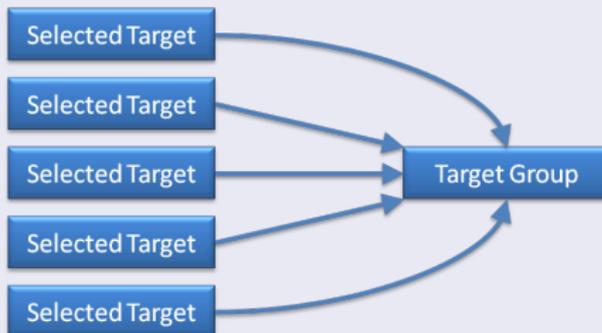


Table of contents

- 1 Introduction
- 2 Framework for Describing Public Safety Video Applications
- 3 Classification of Video Sequences into Specified Generalized Use Classes
 - Research
 - Analysis of the results
 - Target Size
 - Lighting Level
- 4 Conclusion

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

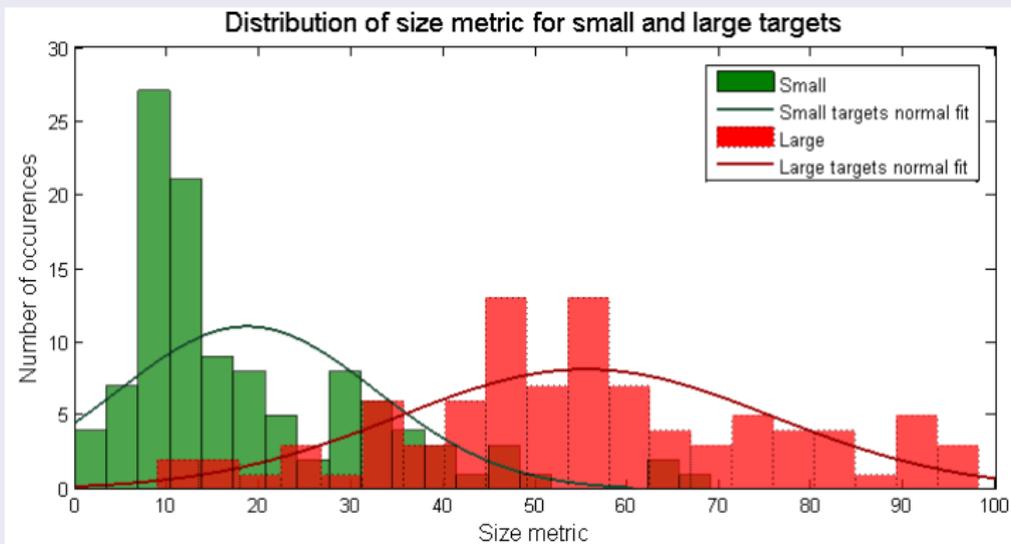


Figure: Number of end-users selections of target size in function of calculated size metrics.

Target Size — Various Metric Values for Statistics

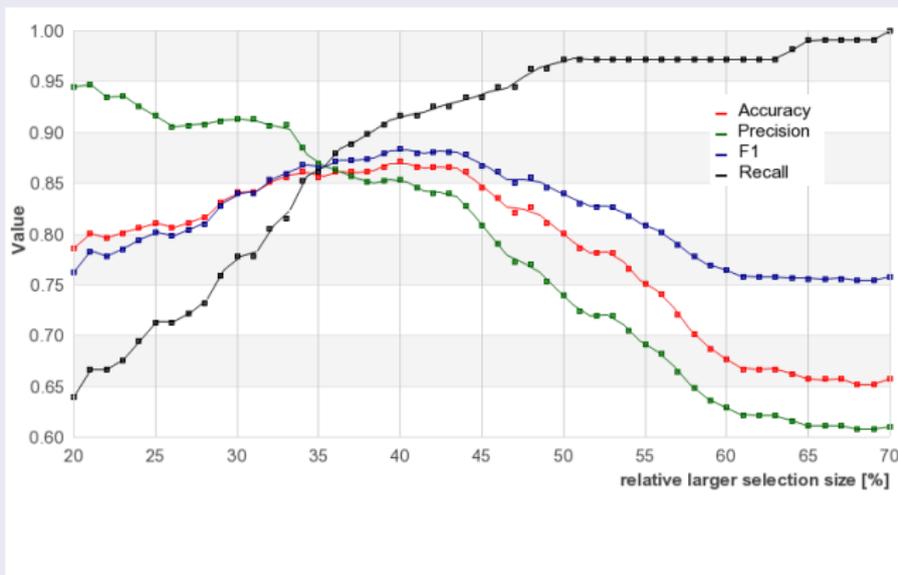


Figure: Measures of target size classifier in function of size metrics

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

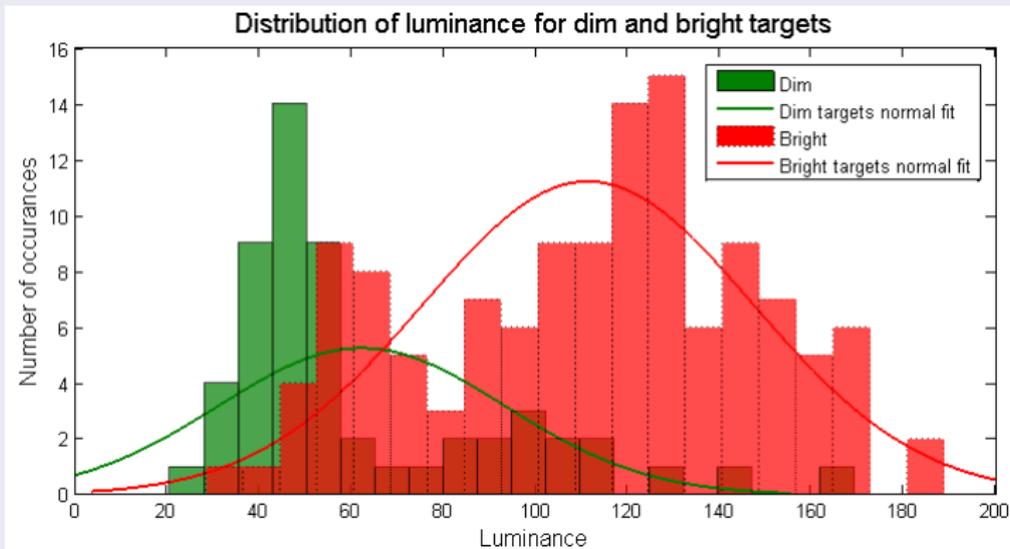


Figure: Number of end-users selections of target lighting level in function of calculated luminance.

Lighting Level — Various Metric Values for Statistics

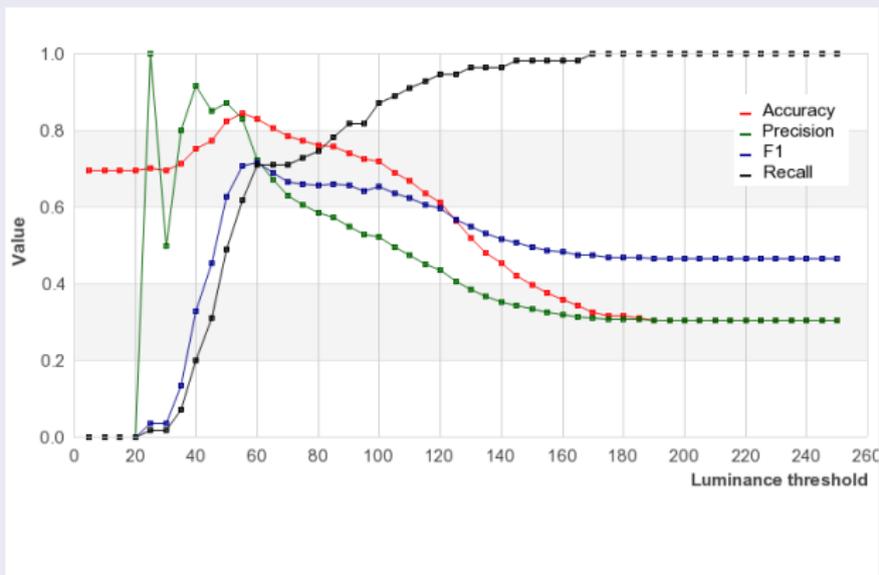


Figure: Measures of lighting level classifier in function of luminance threshold

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