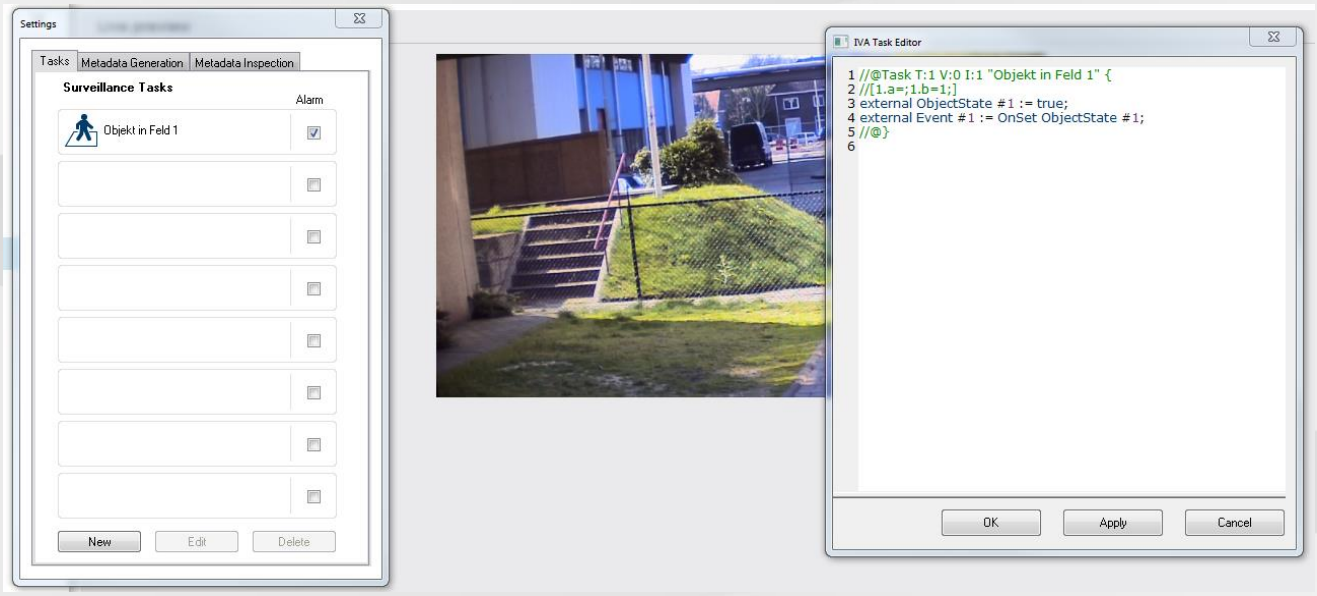
How to use the VCA Task Script Language

Including examples for several use cases



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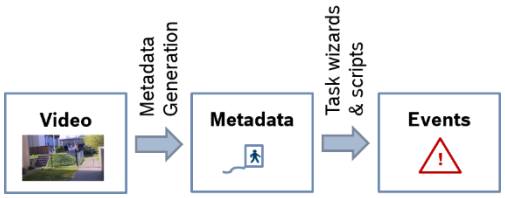
1 What is the VCA task script language?

VCA stands for video content analysis. The VCA task script language

- describes every predefined and configured Intelligent Video Analytics, Essential Video Analytics and MOTION+ task and task wizard
- can combine tasks to form more complex ones
- can NOT configure the metadata generation



1.1 When to use the VCA task scripts?

The VCA task scripts are used implicitly whenever an Intelligent Video Analytics, Essential Video Analytics or MOTION+ task is configured via the GUI. However, manual configuration of the VCA task scripts is also possible and advised whenever the predefined tasks are not enough:

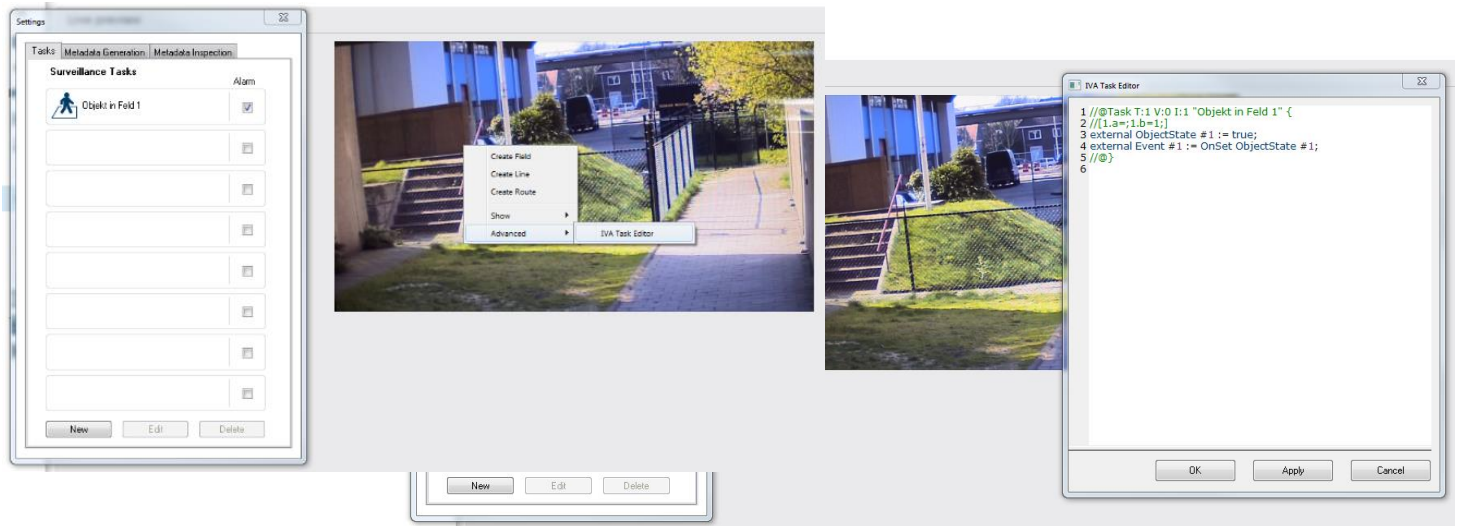
- For backup and exchange of the configured tasks, the script can be copied from and pasted into the task script editor.
- When more than 8 alarm tasks are needed: 16 external alarm tasks are configurable via VCA task scripts.
- Fine tuning the position of lines and fields.
- Line combinations for counting with FW < 6.30.
- Don't touch (museum mode) with FW < 6.10: Alarm needs to be triggered by any part of bounding box, not only by the object center.
- Logical combinations of predefined events are needed.

1.2 How to use VCA task scripts?

(1) Define all tasks via task wizards as far as possible.
(2) Change to the VCA task script editor. The already defined tasks can be found there with all details.
(3) Make your modifications.
(4) Change the defined tasks into task type scripted so accidental use of the task wizards will not overwrite your changes.

1.3 How to access the VCA task script language?

Go to the Intelligent Video Analytics, Essential Video Analytics or MOTION+ configuration and open the task page. Right-click on the video and select Advanced -> VCA Task Editor. A separate popup with the current VCA task script will appear:



1.4 Task & object filter overview

A task consists of

- A task primitive
- An object state or interaction with a task primitive
- A filter on the object properties if task is based on objects

Note that not all tasks and filters are available in every FW version.

MOTION+:

Task Primitives	Tasks
Field	Motion in Field
Image	

Intelligent Video Analytics & Essential Video Analytics (the latter w/o flow tasks):

Task Primitives	Tasks	Flow Tasks	Object Filter
Line	Detect any object	Flow in field	Object area
Field	Crossing line	Counterflow in field	Aspect ratio
Route	Object in field	Crowd detection	Speed
Image	Entering field	Tampering	Direction
	Leaving field		Color
	Following route		Head
	Loitering		Object class
	Removed object		
	Idle object		
	Condition change		
	Similarity search		
	Counter		
	BEV people counter		
	Occupancy		
	Crowd detection		
	Tampering		

1.5 Object state and event overview

From the task primitives, the tasks and the object filter as defined in the GUI via the task wizards, target object states and events are derived. These can also be defined directly in the VCA task script language.

Events are always temporal relations

- Up to 8 external events can be shown in GUI
- Up to 16 external events can be defined in total
- Up to 32 events can be defined in total

States can be, amongst others, spatial relations, object properties, tamper states, counter values

- Up to 16 external states can be defined
- Up to 32 states in total can be defined

Events and states can be internal or external. Only external events and states are outputted.

Simple states are used whenever a property has no corresponding objects. Examples are Motion+, Flow, counter values and tamper states.

Object Properties	Object States	Object events	TamperStates	Other SimpleStates
Direction	InsideField	CrossedLine	SignalTooNoisy	DetectedMotion
Velocity	ObjectsInField	EnteredField	SignalTooDark	DetectedFlow
AspectRatio	IsLoitering	LeftField	SignalTooBright	EstimatedCrowdDensity
ObjecSize	SimilarToColor	FollowedRoute	SignalLoss	Counter
FaceWidth	HasDirection	Appeared	GlobalChange	ObjectsOnScreen
MaxFaceWidth	HasVelocity	Disappeared	RefImageCheckFailed	ObjectsInField
	HasAspectRatio	Idle		ObjectsInState
	HasObjectSize	Removed		
	HasColor			
	HasFace			
	HadFace			
	HasClass			
	HadClass			

1.6 Combining & converting object states and events

The combinations of object states and events listed below are possible. Object states can be also converted into events, but only the onset or leaving of an object state is an actual event, not the actual duration of the object in this state.

Logical combination of states / conditions:
- and
- or

Event conditions:
where

Event combination via temporal relations:
- before
- before (<from>,<to>)
- not before

State changes as events:
- OnChange
- OnSet
- OnClear

Convert event to state:
- within (<from>,<to>)

1.7 Position descriptions

There are two different ways to describe the position information of lines, fields and routes:

- Absolute pixel position, e.g. Point(103, 30). You need to know exactly which resolution is used in the video analytics for that.
- Relative coordinates, e.g. specifying
  Resolution := { Min(-1, -1) Max(1, 1) };
  Line #1 := { Point(-0.85, 0.95) Point(-0,6, 0.4)};
  Here, the coordinates are defined within the specified resolution and transferred automatically to the real resolution used in the video analytics. This is the preferred syntax.

1.8 Temporal conditions and relations

There are several ways to describe temporal conditions and relations in the VCA task script language. The syntax depends on the type to which the temporal relation is applied.

- Line, Field have an optional DebounceTime(<time>) in their description. This debounce time says how long an object has to be inside the field, or have been observed before and after the line or field boundary, before the field or line will trigger. Examples:
  Resolution := { Min(-1, -1) Max(1, 1) };
  Line #1 := { Point(0,-1) Point(0, 1)
  DebounceTime(0.10) Direction(1) };
  Field #2 := { Point(-0.5, -0.5) Point(0.5, -0.5)
  (0.5, 0.5) Point(-0.5, 0.5)
  DebounceTime(0.50) };
- Routes don't have any temporal conditions, but model the amount of path the object has to travel along the route in order to trigger instead.
- Since FW 7.60, object properties also have an optional debounce time. Object properties are modeled via conditions, and the debounce time is added to the condition by adding with DebounceTime(<time>). Example:
  ObjectState #1 := (Velocity within (30,*) with DebounceTime(5));
- Event combinations are always temporal and describe which event has to happen or not to happen before another event via <event> before(<from>,<to>) or <event> not before(<from>,<to>)
- Events don't have any duration by themselves but are always instantaneous. To extend events for a certain duration, e.g. for the alarm extension time, they need to be transformed into SimpleStates or ObjectStates, depending on whether an object ID is associated with the event: <simple state> := <event> within (<from>,<to>) or <object state> := <event> within (<from>,<to>). Note that SimpleStates continue even if the involved object vanishes, as they don't have any connection to the object, while ObjectStates will be gone along with the object.

2 Examples & Explanations

2.1 Understanding the VCA task script language: Line Crossing, GUI

```
//Definition of task primitives
Line #1 := { Point(103, 30) Point(159, 77)};
Line #2 := { Point(26, 65) Point(82, 122)
             DebounceTime(0.50) Direction(1) };

//Definition of alarm task shown in GUI
//@Task T:2 V:0 I:1 "Crossing line 1" {
//[1.a=s1:1;1.b=1;1.c=32;1.d=31;4.a=i:1;]
external Event#1 :={CrossedLine#1};
//@}

//Definition of self-defined task shown in GUI
//@Task T:0 V:0 I:2 "Crossing line 2" {
external Event#2 :={CrossedLine#2};
//@}

//Definition of alarm task not shown in GUI
external Event#3 :={CrossedLine#2};
```

Line: 2 end points 

Direction of Line :
// any
Direction(1) //forward
Direction(2) //backward

DebounceTime of Line/Field is optional

CrossedLine #x is an event that triggers when an object crosses Line #x in the specified way

external is keyword for alarms / statistics

Task wizard definition:
//@Task T:x V:y I:z
T:x describes the task number (Object in Field, Line Crossing,... see icon for correct task!)
T:0 describes a self-defined task. Use this for your own scripts to avoid the task wizards overwriting it
V:0 is the version number, currently always 0 I:z is the slot in the tasks page
I:1 describes the occupied slot in the GUI task list. For the slot to change to red in case of alarms, the external event / state defined in the task needs to have the same number as the task
[1.a=s1:1;....] describes the task wizard values

2.2 Understanding the VCA task script language: Polygonal lines

```
//Definition of task primitives
Resolution := { Min(-1, -1) Max(1, 1) };
Line #1 := { Point(-0.85, 0.95) Point(-0.6, 0.4)
             Point(0.6, 0.4) Point(0.85, 0.95)
             DebounceTime(0.50) Direction(2)
             TriggerPoint(FootPoint) };

//Definition of alarm task shown in GUI
//@Task T:2 V:0 I:1 "Crossing line 1" {
//[1.a=s1:1;1.b=1;1.c=32;1.d=31;4.a=i:1;]
external Event#1 :={CrossedLine#1};
//@}
```

Polygonal Line: 2-16 vertices 

Available from FW 6.30 onwards

Relative description of line points via Resolution

TriggerPoint of Line:
// center point
FootPoint //FootPoint from FW 6.30 onwards

2.3 Understanding the VCA task script language: Line crossing with object filters

```
//Definition of task primitives
Line #1 := { Point(103, 30) Point(159, 77)};

//@Task T:2 V:0 I:1 "Crossing line 1" {
//[1.a=s1:1;1.b=1;1.c=32;1.d=31;3.o=(b1:1,
b2:0.1,b3:500, c1:1,c2:0.02,c3:34.00,d1:1,
d2:0,d3:27.78,e1:1,e2:315, e3:45,f1:1,f2:135,
f3:225);4.a=(c:2b19,i:1,pr:2);5.a=(c:1,p:1);
6.a=(d1:8,d2:33,r:2,u:1);]
ColorHistogram #1:= { HSV(60,38,100,25)
        Similarity(75) Outlier(75) };
external Event#1:={CrossedLine#1
        where ObjectSize within(0.1,500)
        and AspectRatio within(0.02,34.00)
        and Velocity within(0,27.78)
        and (Direction within(315,405) or Direction within(135,225))
        and SimilarToColor #1
        and HadFace and MaxFaceWidth within(8,33)};
//@}
```

where restricts events by object properties
and / or combine properties
within restricts to value range

The wildcard * describes undefined values

Example for modeling via object state:
ObjectState#1 := Velocity within (30.0,*);

ColorHistogram uses HSV color space with hue (0-360), saturation (0-100), intensity (0-100). In addition, a weight can be specified in the HSV.
Similarity (0-100) specifies how similar a color histogram must be in order to be regarded as a match, with higher numbers for closer colors.
Outliers (1-100) specifies how much of the object needs to have the target colors, and how much is ignored as outlier, with higher numbers allowing more differences.

SimilarToColor#x compares the color histogram of the object to the specified ColorHistogram#x

2.4 Understanding the VCA task script language: Fields

```
//Definition of task primitives
Field #1 := { Point(56, 24) Point(106, 24)
            Point(106, 74)};
Field #2 := { Point(56, 24) Point(106, 24)
            Point(106, 74) Point(56, 74)
            DebounceTime(0.50)
            ObjectSet(BoundingBox)
            SetRelation(Covering)};

//@Task T:1 V:0 I:1 "Object in field 1" {
//[1.a=1;1.b=1;3.a=i:1;]
external ObjectState #1 := InsideField #1;
//@}
```

Field: 3-16 vertices 

DebounceTime of Field is optional

ObjectSet of Field:
ObjectSet(BaryCenter) #default
ObjectSet(BoundingBox)

SetRelation for BountingBox:
SetRelation(Intersection) #default
SetRelation(Covering)

States of Field:
InsideField#x
ObjectsInField#x

Events of Field:
EnteredField#x
LeftField#x

2.5 Understanding the VCA task script language: Routes

```
//Definition of task primitives
Route #1 := { Point(34, 111) Distance(5)
              Point(92, 125) Distance(5)
              Point(140, 104) Distance(5)
              Point(143, 72) Distance(5)
              MinPercentage(80) MaxGap(10) };
```

Route: 2-8 vertices
+distance

Direction of Line / Route:
any
Direction(1) #forward
Direction(2) #backward

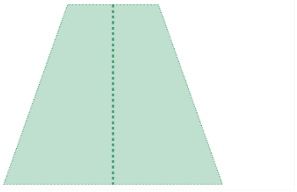
```
//@Task T:6 V:0 I:1 "Follow route 1" {
//[1.a=id:1;1.b=1;3.a=i:1;]
external Event #1 := { FfollowedRoute #1 };
//@}
```

FollowedRoute #x is an event that triggers when an object follows Route #x in the specified way

2.6 Example: Alarm if object enters a field and afterwards crosses the line

```
//Definition of task primitives
 Resolution := { Min(-1, -1) Max(1, 1) };
 Field #1 := { Point(-0.6, 0.95) Point(-0.25, -0.95)
               Point(0.25, -0.95) Point(0.6, 0.95)
               DebounceTime(0.50) };
 Line #1 := {  Point(0.0, -0.95) Point(0.0, 0.95)
               DebounceTime(0.50) };
 //@Task T:0 V:0 I:1 "Enter Field and Line" {
 external Event#1:={EnteredField #1
                    before (*,30) CrossedLine #1
                    where first.oid == second.oid };
 //@}
```

Application: Reduction of false alarms, especially for insects attracted by infrared illumination



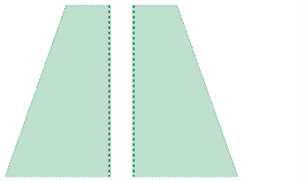
before(*,30) means the object needs to cross the line 0-30 seconds after entering the field. As the object needs to enter the field in order to cross the line, the other temporal direction is not checked.

The same object has to trigger both events. Thus using where first.oid==second.oid

2.7 Example: Alarm if object enters first one field and then the other

```
//Definition of task primitives
 Resolution := { Min(-1, -1) Max(1, 1) };
 Field #1 := { Point(-0.6, 0.95) Point(-0.25, -0.95)
               Point(-0.1, -0.95) Point(-0.1, 0.95)
               DebounceTime(0.50) };
 Field #2 := {  Point(0.6, 0.95) Point(0.25, -0.95)
               Point(0.1, -0.95) Point(0.1, 0.95)
               DebounceTime(0.50) };
 //@Task T:0 V:0 I:1 "Enter Field and Line" {
 external Event#1:={EnteredField #1
                    before (*,30) EnteredField#2
                    where first.oid == second.oid };
 //@}
```

Application: Reduction of false alarms, especially for insects attracted by infrared illumination



before(*,30) means the object needs to cross the line 0-30 seconds after entering the field. As the object needs to enter the field in order to cross the line, the other temporal direction need not be checked.

The same object has to trigger both events. Thus using where first.oid==second.oid

2.8 Example: Perimeter protection with two fields

```
//Definition of task primitives
 Resolution := { Min(-1, -1) Max(1, 1) };
 Field #1 := { Point(0.406, -0.644) Point(0.250, -0.656)
               Point(-0.213, 1.000) Point(0.400, 1.000)
               DebounceTime(0.10) };
 Field #2 := { Point(0.181, -0.667) Point(-0.388, 1.000)
               Point(-0.588, 1.000) Point(0.088, -0.678)
               DebounceTime(0.10) };
 //@Task T:0 V:0 I:1 " Field combination" {
 ObjectState #16 := InsideField #1 and ObjectSize within(0.7,10) ;
 ObjectState #17 := InsideField #2 and ObjectSize within(0.7,10) ;
 external Event #1 := { OnSet ObjectState #16
                        before OnSet ObjectState #17
                        where first.oid==second.oid};
 //@}
```

Application: Reduction of false alarms, especially for insects attracted by infrared illumination

Restricting object size to further filter false alarms

The same object has to trigger both events. Thus using where first.oid==second.oid

2.9 Example: Combining lines for counting

From FW 6.30 onwards lines support up to 16 vertices. Manual line combination is not necessary.

```
//Definition of task primitives
Line #1 := { Point(0, 90) Point(60, 90)
             DebounceTime(0.10) Direction(1) };
Line #2 := { Point(60, 90) Point(90, 60)
             DebounceTime(0.10) Direction(1) };
Line #3 := { Point(90, 60) Point(90, 0)
             DebounceTime(0.10) Direction(1) };

//@Task T:0 V:0 I:1 "Counter 1" {
Event#32 :=CrossedLine#1 or CrossedLine#2
           or CrossedLine#3;
external Counter#1 := { Event#32 Text("Corner Count1:")
                        TopLeft(-0.9,-0.9) Mode(Wraparound)
                        within(0,999999999) };
//@}
```

Make sure that one lines end point is the start of the next line to leave no gaps

Set the same debounce time the same for all lines

Combining line crossing line events via or

Counter defines the counter task. The event on which it counts is configured as well as the placement and label for the count text. The mode selected here says that when reaching max count, the counter then starts from 0 again.

2.10 Example: Crossing line1 with 60km/h and line 2 with 20km/h

```
//Definition of task primitives
Line #1 := {Point(50,0) Point(50,144)};
Line #2 := {Point(120,0) Point(120,144)};

//Definition of line crossing events
Event#11 :={CrossedLine#1 where
            Velocity within(13.89,19.44) };
Event#12 :={CrossedLine#2 where
            Velocity within(2.778,5.556) };

//Combination of line crossing events
//@Task T:0 V:0 I:1 "Two Line Speed Check" {
external Event#1 :={Event#11 before Event#12
                    where first.oid==second.oid};
//@}
```

Actually alarming when velocity on first line between 50 km/h and 70 km/h and on second line between 10 km/h and 30 km/h.

The velocity range is not in km/h here, therefore the conditions were generated with GUI default line crossing tasks

Approach:
(1) Defined two line crossings via GUI with velocity filters
(2) Removed all external keywords and task definitions, keeping task primitives and event definitions
(3) Added combination of both line crossing events as user-defined task

The same object has to trigger both line crossings. Thus using where first.oid==second.oid

2.11 Example: Stopping in area after crossing line

```
//Definition of task primitives
Line #1 := { Point(130, 0) Point(130, 144) };
Field #2 := { Point(50, 0) Point(115, 0)
              Point(115, 144) Point(50, 144)};

//@Task T:0 V:0 I:1 "Loitering after Line Crossing" {
Event#11 :={CrossedLine #1};
Loitering #13 := { Radius (15) Time (10) };
ObjectState #14 := InsideField #2 and IsLoitering #13;
external Event #1 := {Event #11 before OnSet ObjectState #14
                      where first.oid==second.oid};
//@}
```

Using loitering instead of idle for demonstration purposes

Note that only Event #1 is external and thus generating alarms!

The same object has to trigger both the line crossing and the loitering. Thus using where first.oid==second.oid

2.12 Example: Alarm When Object Touches Area

```
//Definition of task primitives
Field #1 := { Point(100, 0) Point(175, 0)
              Point(175, 144) Point(100, 144)
              ObjectSet(BoundingBox)};

//@Task T:0 V:0 I:1 "Object Touches Field" {
ObjectState #1 := InsideField #1;
external Event #1 := OnSet ObjectState #1;
//@}

//Alternative, objects have to come from the outside of the field:
//@Task T:0 V:0 I:2 "Object Touches Field" {
external Event #2 := EnteredField #1;
//@}
```

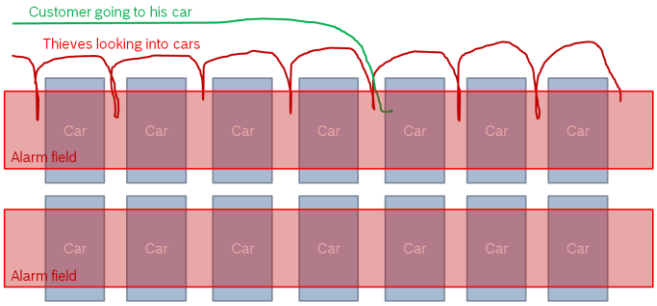
Alarm on object touch instead of center of gravity of the object via ObjectSet(BoundingBox)

Events and States are enumerated separately, thus both ObjectState and Event may have #1

Using state InsideField when objects appearing in the field shall also trigger the alarm

Using event EnteredField when alarming only on objects which have been outside before

2.13 Example: Alarm when object enters an area at least 4 times




```
//Definition of task primitives
Resolution := { Min(-1, -1) Max(1, 1) };
Field #1 := { Point(-0.244, -0.922) Point(0.325, -0.944)
              Point(0.350, 0.944) Point(-0.231, 0.944)
              DebounceTime(0.50) };

//@Task T:0 V:0 I:1 "Thieve detection" {
Event #11 :={EnteredField #1 before EnteredField #1
                          where first.oid==second.oid};
Event #12 :={Event #11 before EnteredField #1
                          where first.oid==second.oid};
external Event#1 :={Event #12 before EnteredField #1
                          where first.oid==second.oid};
//@}
```

Application: protecting parked cars

Using before to concatenate events

Using an alternative way to define coordinates by setting a resolution range

2.14 Example: Alarm when a second object crosses a line within 3 seconds of the first

```
//Definition of task primitives
Resolution := { Min(-1, -1) Max(1, 1) };
Line #1 := { Point(-0.187, -0.967) Point(-0.156, 0.911)
             DebounceTime(0.50) Direction(2) TriggerPoint(FootPoint) };
//@Task T:0 V:0 I:1 "Tailgaiting" {
Event#21:={CrossedLine#1};
Event#22:={CrossedLine#1};
external Event#1:={Event#21 before(0,3) Event#22
                   where first.oid!=second.oid};
//@}
```

Using before(0,3) for “within 3 seconds”

Two different objects have to trigger the line crossing. Thus using where first.oid!=second.oid

2.15 Example: Alarm when at least 2 object are in an area

```
//Definition of task primitives
Resolution := { Min(-1, -1) Max(1, 1) };
Field #1 := { Point(-0.656, -0.700) Point(0.350, -0.767)
              Point(0.469, 0.644) Point(-0.694, 0.644)
              DebounceTime(0.10) };

//@Task T:0 V:0 I:1 "Alarm on more than two objects" {
external ObjectState #1:= ObjectsInField#1 within (2,*);
//@}
```

From FW 6.30 onwards, the occupancy task offers this functionality directly via the GUI.

ObjectsInField#1 returns the number of objects in field 1. Here, the range for the alarm is set from 2 to infinity.

2.16 Example: Count the number of objects in an area

```
//Definition of task primitives
Resolution := { Min(-1, -1) Max(1, 1) };
Field #1 := { Point(-0.656, -0.700) Point(0.350, -0.767)
              Point(0.469, 0.644) Point(-0.694, 0.644)
              DebounceTime(0.10) };

//@Task T:0 V:0 I:1 "Count of objects in field " {
external Counter#1 := { ObjectsInField#1 Text("Counter:")
                        TopLeft(-0.9,-0.9) };
//@}

//@Task T:18 V:0 I:2 "Count of objects in field " {
//[1.a=1;1.b=1;1.c=32;2.a=(,b3:1);]
ObjectState #32 := InsideField #1;
external Counter#2 := { ObjectsInState#32 Text("Occupancy:")
                        TopLeft(-0.9,-0.8) };
//@}
```

ObjectsInField can be used as input for a counter as well

From FW 6.30 onwards, the occupancy task offers this functionality directly via the GUI.

2.17 Example: Alarm on empty reception desk

```
//Definition of task primitives
Resolution:= { Min(-1, -1) Max(1, 1) };
Field #1:= { Point(-0.150, -0.700) Point(0.250, -0.700)
             Point(0.250, 0.600) Point(-0.150, 0.600)
             DebounceTime(0.10) };
Field #2:= { Point(-0.600, -0.700) Point(-0.200, -0.700)
             Point(-0.200, 0.600) Point(-0.600, 0.600)
             DebounceTime(0.10) };

//@Task T:0 V:0 I:1 "Unmanned reception" {
external SimpleState #1:= ObjectsInField#1 within (1,*)
                          and ObjectsInField#2 within (0,0);
//@}
```

By using a state for the alarm, it will be active as long as that situation occurs. For an example where the alarm is only send shortly at the onset of that situation, see 2.18.

ObjectsInField#2 within (0,0) is a simple state as it refers to an amount of objects, not to an object itself.

2.18 Example: Alarm if one queue is empty and the other has at least 3 persons

```
//Definition of task primitives
Resolution:= { Min(-1, -1) Max(1, 1) };
Field #1:= { Point(-0.150, -0.700) Point(0.250, -0.700)
             Point(0.250, 0.600) Point(-0.150, 0.600)
             DebounceTime(0.10) };
Field #2:= { Point(-0.600, -0.700) Point(-0.200, -0.700)
             Point(-0.200, 0.600) Point(-0.600, 0.600)
             DebounceTime(0.10) };

//@Task T:0 V:0 I:1 "Only one queue" {
ObjectState #1:= ObjectsInField#1 within (3,*);
external Event #1:= {OnSet ObjectState #1
                     where ObjectsInField#2 within (0,0)};
//@}

// To see the results of the no object check, use the following:
//@Task T:0 V:0 I:2 "No object" {
external SimpleState #2:= ObjectsInField#2 within (0,0);
//@}
```

By using an event for the alarm, it will only be active shortly at the onset of that situation. For an example with an ongoing alarm see 2.17.

ObjectsInField#2 within (0,0) is a simple state as it refers to an amount of objects, not to an object itself.

2.19 Example: Virtual room for counting with one in and one out line

```
//Definition of task primitives
Resolution:= { Min(-1, -1) Max(1, 1) };
Line #1 := { Point(-0.1, -0.8) Point(-0.1, 0.8) DebounceTime(0.10) Direction(1) };
Line #2 := { Point(0.1, 0.8) Point(0.1, -0.8) DebounceTime(0.10) Direction(1) };
//@Task T:0 V:0 I:1 "Virtual Room" {
Event#31:={CrossedLine#1};
Event#30:={CrossedLine#2};
external Counter#1 := { Event#31 Text("Linie 1:") TopLeft(-0.9,-0.9) };
external Counter#2 := { Event#30 Text("Linie 2:") TopLeft(-0.9,-0.8) };
external Counter#4 := { Counter#1 - Counter#2 Text("Virtual Room:") TopLeft(-0.9,-0.7) };
//@}
```

Counters can be added and subtracted

2.20 Example: Virtual room for counting with two in and one out line

```
//Definition of task primitives
Resolution:= { Min(-1, -1) Max(1, 1) };
Line #1 := { Point(-0.7, -0.7) Point(0.7, -0.7) DebounceTime(0.10) Direction(1) };
Line #2 := { Point(-0.7, -0.7) Point(-0.7, 0.7) DebounceTime(0.10) Direction(1) };
Line #3 := { Point(-0.7, 0.7) Point(0.7, 0.7) DebounceTime(0.10) Direction(1) };
//@Task T:0 V:0 I:1 "Virtual Room" {
Event#31:={CrossedLine#1};
Event#30:={CrossedLine#2};
Event#29:={CrossedLine#3};
external Counter#1 := { Event#31 Text("Linie 1:") TopLeft(-0.9,-0.9)  };
external Counter#2 := { Event#30 Text("Linie 2:") TopLeft(-0.9,-0.8) };
external Counter#3 := { Event#29 Text("Linie 3:") TopLeft(-0.9,-0.7) };
Counter#32 := { Counter#1 + Counter#2};
external Counter#4 := { Counter#32 - Counter#3 Text("Virtual Room:") TopLeft(-0.9,-0.6) };
//@}
```

Counters can be added and subtracted

2.21 Example: Alarm on any object that is not yellow

```
//@Task T:0 V:0 I:1 "No yellow object" {
ColorHistogram #1:= { HSV(60,100,100,20) HSV(60,100,60,20)
                      HSV(60,100,30,20)
                      Similarity(75) Outlier(55) };
external ObjectState #1 := not SimilarToColor #1;
external Event #1 := OnSet ObjectState #1;
//@}
```

ColorHistogram uses HSV color space with hue (0-360), saturation (0-100), intensity (0-100). In addition, a weight can be specified in the HSV.
Similarity (0-100) specifies how similar a color histogram must be in order to be regarded as a match, with higher numbers for closer colors.
Outliers (1-100) specifies how much of the object needs to have the target colors, and how much is ignored as outlier, with higher numbers allowing more differences.

SimilarToColor#x compares the color histogram of the object to the specified ColorHistogram#x

2.22 Example: Count all red objects

```
//Definition of task primitives
Resolution:= { Min(-1, -1) Max(1, 1) };
Line #1 := { Point(-0.1, -0.8) Point(-0.1, 0.8) DebounceTime(0.10)
Direction(1) };

//@Task T:0 V:0 I:1 "Count red objects" {
ColorHistogram #1:= { HSV(0,100,100,20) HSV(0,100,60,20)
                      HSV(0,100,30,20)
                      Similarity(75) Outlier(55) };
Event#31:={CrossedLine#1 where SimilarToColor #1};
external Counter#1 := { Event#31 Text("Linie 1:") TopLeft (-0.9,-0.9) };
//@}
```

ColorHistogram uses HSV color space with hue (0-360), saturation (0-100), intensity (0-100). In addition, a weight can be specified in the HSV.
Similarity (0-100) specifies how similar a color histogram must be in order to be regarded as a match, with higher numbers for closer colors.
Outliers (1-100) specifies how much of the object needs to have the target colors, and how much is ignored as outlier, with higher numbers allowing more differences.

Color description see 2.21

2.23 Example: Debouncing object size by 5 seconds

```
//Definition of task primitives
Resolution:= { Min(-1, -1) Max(1, 1) };
Field #1 := { Point(-0.7, -0.7) Point(0.7, -0.7) Point(0.7, 0.7) Point(-0.7, 0.7)
DebounceTime(5.00) ObjectSet(FootPoint) };
//@Task T:0 V:0 I:1 "Debounce Size" {
ObjectState#21 := ObjectSize within(5,500);
ObjectState#22:=OnChange ObjectState#21 within (0,5);
external ObjectState#1:=InsideField#1 and ObjectState#21 and !ObjectState#22;
//@}
```

OnChange ... within: Checking whether ObjectState#21 changed within the last 5 seconds
Available in this combination from FW 6.60 onwards.

2.24 Example: Give 30 sec alarm on any object (aggregation time)

```
Resolution:= { Min(-1, -1) Max(1, 1) };
//@Task T:0 V:0 I:1 "30 sec alarm" {
external SimpleState#1:= Appeared within(0,30);
//@}
```

Available from FW 6.60 onwards.

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