

Al based CCTV Analytics for **Cyber-Physical Threat Intelligence**

ECSCI Workshop 25th June 2020 – Adrien Besse, Jürgen Neises (Fujitsu)



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The FINSEC Project

Business Drivers, Results and Concept

- FINSEC motivation: Combined Cyber & Physical Threats
- Integration of physical Security in automated Security event management (i.e. FINSEC platform)
- Facilitate analysis of physical and cyber events for anomaly detection and prediction
- With the spring 2020 COVID-19 crisis, the requests for counting people inside an area and monitoring their distances generated further application scenarios for this technology in Public Safety & Security.





FINESEC VALUE PROPOSITION

Integrated Cyber & **Phyical Security**

Increased Efficiency based on Prediction & Collaboration

Integrated Straategies & **Timely Preparation** leading to Cost-Savings

Reduce Secuity Deployment Costs through a Standards RA

http://www.finsec-project.eu/









Demonstration – Real World at ATM



Video Footage



EVENT_x_event___8ada7874_aedf-11ea-93a2-0242ac1a0002 ; enter body_point; RWnet area_label : atm_hands tracker_id : 3 event_type : enter

EVENT x-event--6b318748-aadf-11ea-93a2-0242ac1a0002 ; alow_down body_speed_part : Neck body_speed_threshold : 10.0 tracker_id : 4 event_type : slow_down

EVENT x-avent--6b5d15ca-aedf-11ea-93a2-0242ac1a0002 : exit body_part : Neck area_label : atm_body tracker_id : 1 event_type : exit

EVENT x—event—6b5d1fd4—aadf—11ea—93a2—0242ac1a00002 ; exit body_part : LWrist area_label : atm_body tracker_id : 1 event_type : exit

EVENT x—event— 6b5d263c—aedf—11ea—93a2—D242ac1a0002 ; exit body_part ; LAnkle area_label ; atm_queue tracker_id ; 1 event_type ; exit

Security Events





Demonstration – Tracking – Floor Map





2020-06-17T20:36:54.889759+00:00

Security Events









Al-based CCTV Analytics

Automated & GDPR compliant detection of physical events that may cause threats

- PIA based on CNIL methodology
- Detection of bodies or body parts in a marked area of a CCTV footage without identification of persons
- Analysis of body poses or actions
- Issuing anonymous FINSTIX events to the FINSEC platform for further security analysis and physical/cyber threat correlation











Finsec Graph	Finsec Table			
🔤 x-event 🧰 x-organization	iC	Name	Description	Created
	ID .	Name	Description.	Crealed
	x event -74574905- e502-1169- 8426- f430058d1090	Exit RWrist	txit field of view of camera	2019-13-08 13:55:16:325861+02:00
	x-event- 7c575114 eSt2-11e9- 842e- (430099d1090	Enter RWrist	Enter field of stew of camera	2019-10-08 13:55:16:329861-02:00
	s-event- -7e575b1e- e9c2-11e9- 842e- f430b9ad1090	Exil LWrist	Exit field of view of camera	2019-10-08 13:55:16.325861-02:00
	x event -7e575ffe- e5c2:11e3- 842e- 1430b9ad1090	Foter LWrist	Enter Reld of view of camera	2019-10-08 13:55:16:325861+02:00
	x-event- -7771e85c- e9c2-11e3- 842c (430b9ad1090	Enter RWnst	Friter field of view of camera	2019-10-08 13:56:18:18/286+02:00





Modified
Modified
2019 10:08 13:55:16.3299
2019-10-08 13:55:16.3298
2019-10-08 13:55:16.3298
2019-10-08 13:55:16.3299
2019-10-08 13:55:18-18/2



Al-based CCTV Analytics Probe

FINSEC CCTV Analytics Probe V2

- Improved detection of bodies including several body parts
- Reduced limitations due to occlusion
- Improved tracing of bodies
- Anonymous x-Events supporting threat detection & prediction
- Implement probe on new form factor for 1st phase of edge computing (NVIDIA) AGX Xavier)















Technology



High-level architecture of the probe.



Body parts definition used by the pose estimation model. Image source: (Platte, 2018).









Al-based CCTV Analytics – Body Parts

List of parameters controlled through the probe API:

Enter/Exit x-Events:

parts_to_track: list of body parts contained in the left figure for the enter/exit events from scene areas.

Proximity x-Events:

parts_body_proximity: a list of body parts contained in the left figure, that will be used in the computation to determine if two human bodies are closer than given thresholds (cf. next slide figure).

body_radius_proximity: corresponding thresholds

Velocity x-Events:

body_speed_part: body part to use to estimate velocity **body_speed_threshold:** threshold to trigger events

[coming] length floormap trajectory x-Event:

length_theshold: threshold to trigger event when length of the trajectory in floormap is too long.













Human Body Enter/Exit x-Events

Example of parameters for Enter/Exit events: parts_to_track: [Neck, RWrist, LWrist]



Event : Exit LWrist Zone 1 agent A Event : Enter LWrist Zone 2 agent A











Human body approaching/distancing events







Example of parameters for body proximity events: parts_body_proximity : [Neck, RShoulder, LShoulder, LAnkle, RAnkle] body_radius_proximity : [30, 15, 15, 20, 20]







Al-based CCTV Analytics - Approaching event







All body parts in parts_body_proximity are closer than corresponding specified body radius in body_radius_proximity

x-Event : « Approaching agent A and B »









Al-based CCTV Analytics - Distancing event









Event : « Distancing agent A and B »







Al-based CCTV Analytics - Body velocity: high speed

Example of parameters for body velocity events:

- body_speed_part : Neck
- body_speed_threshold: 10















Al-based CCTV Analytics - Trajectory length event

Camera View





Example of parameters for trajectory length events:









Recap – Tracking and Events





2020-06-17120:36:59.965229+00:00

EVENT x-event--4b2fd114-b0dg-11eg-g1d6-0242gc1d0002 ; exit body_part : LWriet area_label : passage_2 tracker_id : 2 event_type : exit

EVENT x-event--4b2fd524-b0dp-11eg-a1d6-0242ac1d0002 : enter body_part : LWrist area_label : passage_1 tracker_id : 2 event_type : enter

EVENT x-event--4b2fd8ee-b0do-11ep-o1d6-0242oc1d0002 ; exit body_part ; RAnkle area_label : passage_2 tracker_id : 2 event_type : exit

EVENT x-event--4b2fe71c-b0da-11ep-a1d6-0242ac1d0002 : long_trajectory path_length_threshold : 1500.0 tracker_id : 1 event_type : long_trojectory

EVENT x-event--4b2fecb2-b0da-11ea-a1d6-0242ac1d0002 : long_trajectory path_length_threshold : 1500.0 tracker_id : 2 event_type : long_trajectory

Security Events







Example ATM Use Case

Objectives: Anomaly Detection & Threat Prediction based on x-Events

ATM-UC1 - Attack to Person

CoA: activate the Security Centre

- Min 2 people in scene
- Proximity lower than 1m

ATM-UC2 – Attack to ATM

CoA : Shutdown the ATM & activate the Security Centre

- Enter ATM-Zone (must)
- **Future** : Detect Raising of Hands
- **Future** : Detect Tools (Hammer, etc.)





ATM-UC3 – Loitering

CoA: activate the Security Centre

- Staying in an area/scene for longer than time t_0
- length of trajectory

ATM-UC4 – Introduction of Malware (includes) UC2)

CoA : Shutdown the ATM & activate the Security Centre

- Enter ATM zone
- **Future:** Detect Tools (Hammer, etc.)
- Staying in an area/scene for longer than time t_1

ATM-UC5 – Jackpotting (includes UC2 and UC4) CoA : Shutdown the ATM & activate the Security Centre

- min. 2 people in the ATM zone (must)
- **Future** : Detect Tools (Hammer, etc.)
- Staying in an area/scene scene for longer than time t_2









Towards an intelligent Sensor



Server with GPU

Standard Ecosystem

Processor: X64 OS: Ubuntu 18.04 Libraries: standard Framework: TensorFlow

Transformation towards embedded systems required research and redesign





Optimized Ecosystem (specific build and configuration)

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Processor: NVIDIA-ARM OS: Ubuntu 18.04 Libraries: specific, e.g. Python, etc. Framework: TensorRT, specific Pose Estimation









Takeaways / Conclusions

- Privacy preserving automated CCTV analysis shall benefit physical security and safety of critical and public infrastructures
- FCAS is a privacy preserving probe providing only FINSTIX x-Events to a data or Security platform (e.g. SIEM)
- The development of edge based analytics is ongoing
- FCAS is validated in Data Centre and ATM use cases
- Other application areas:
 - Shops, Malls, Smart City, Public Security & Safety
 - For instance: COVID-19 scenarios (masking, distance, etc.)









