



## Protecting Your Online Privacy: Insights on Digital Twins and Threat Detection

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# AGENDA

## ■ ADRIAN

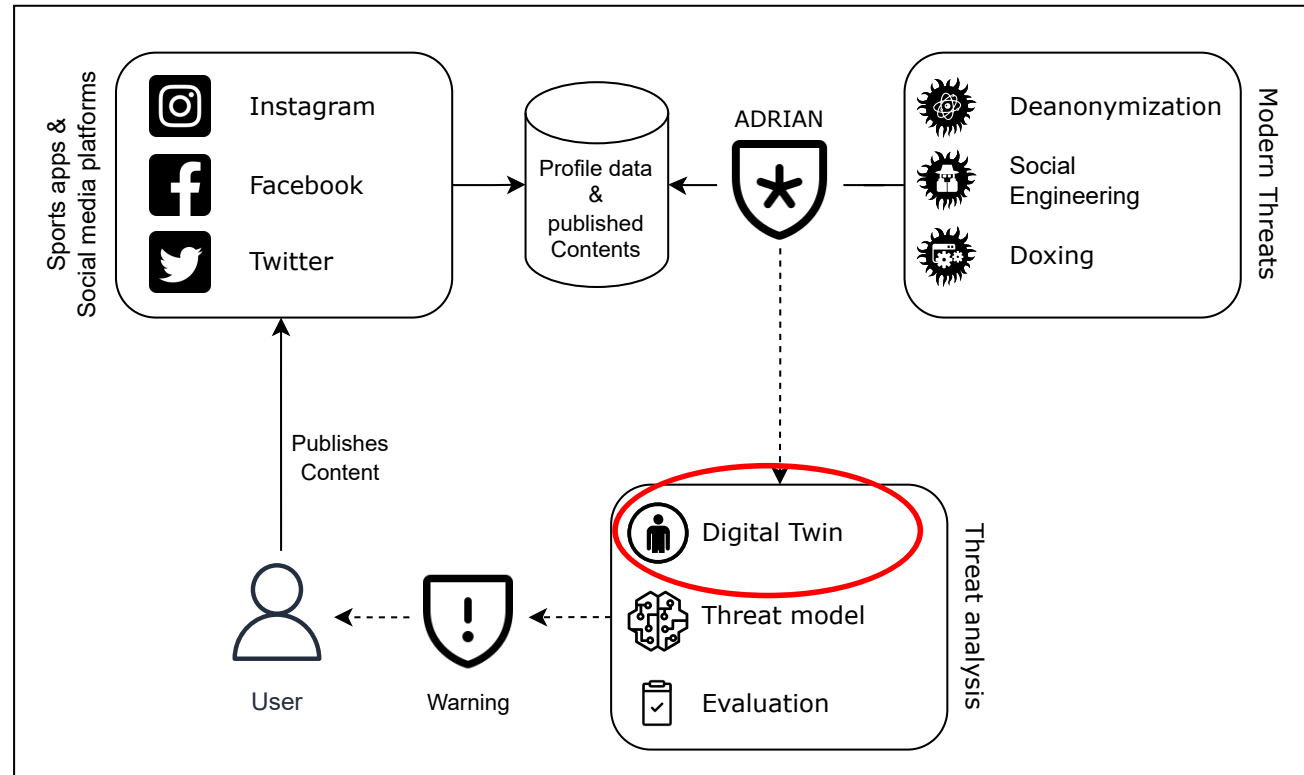
### ■ (Human) Digital Twin

### ■ Modelling and Enriching the Human Digital Twin

### ■ Discussion and Conclusion

# ADRIAN RESEARCH PROJECT

## I Vision of an **early warning system** for the threat identification to individuals in OSNs



# DIGITAL TWIN

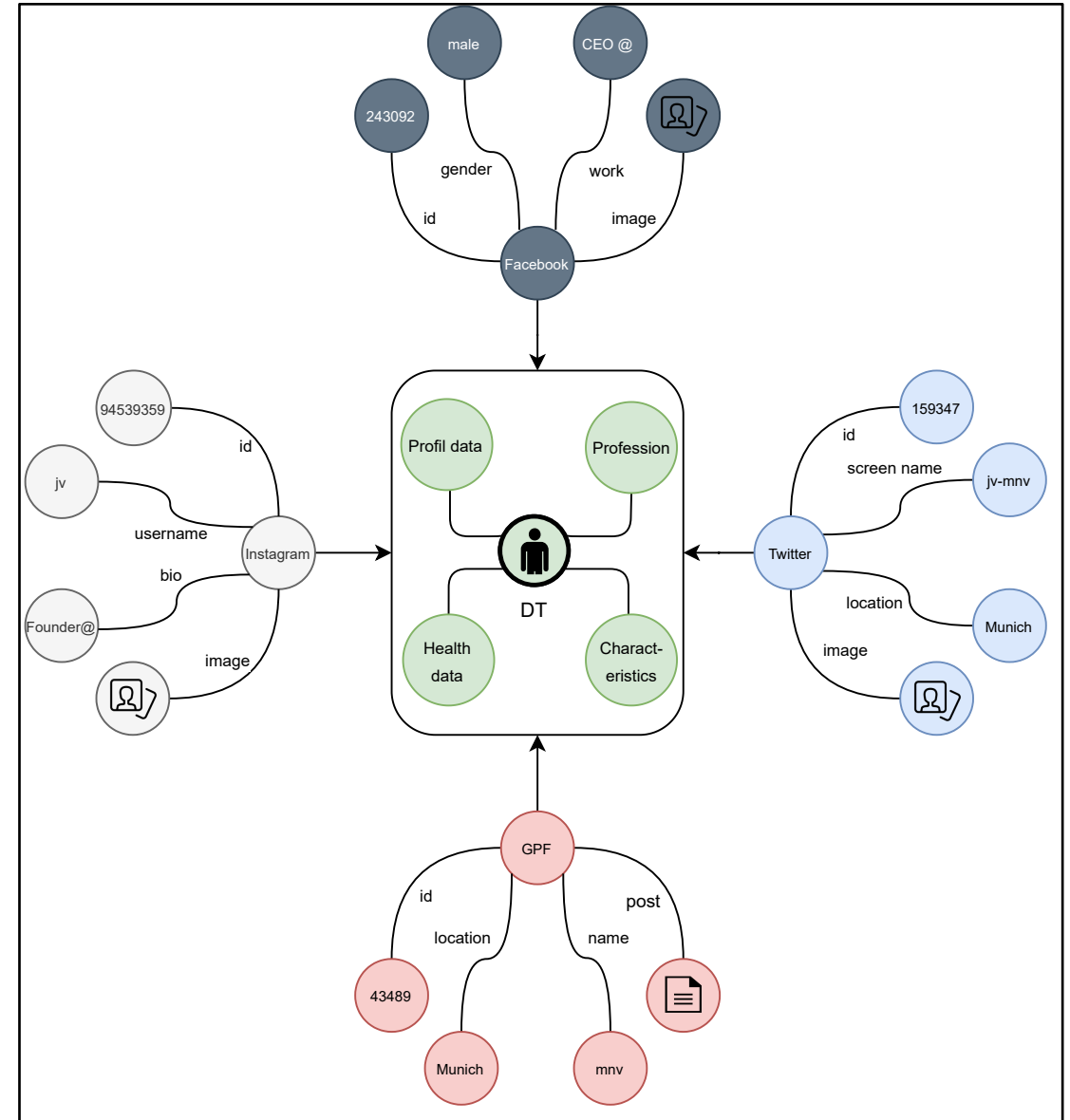
- Concept of a Digital Twin (DT) is **ambiguous** and used across various fields including **mechanical engineering, medicine, and computer science**
- Three levels of integration for DTs:
  - **Digital Model:** A static, virtual representation of a physical system or object without automatic data exchange
  - **Digital Shadow:** An advanced, dynamic digital model allowing unidirectional data transfer from the physical system to the digital world
  - **Complete Digital Twin:** The highest level of digital representation permitting bidirectional data transfer between the virtual and real worlds

# HUMAN DT

- There is **no standard definition** or understanding of HDT
- In the ADRIAN Project, the HDT is defined as the **digital representation** of a **real person**, **instantiated** through available **web-based information**
- The HDT is designed for **storing** and **analyzing relevant characteristics** of a **person**
- The HDT is used to **measure** the **vulnerability** of a **person**

# MODELLING THE HDT

- I Data collection and analysis from **multiple OSNs**
- I **Structured data** (e.g., profile information) and **unstructured data** (e.g., texts, images, and videos) are analyzed within user profiles
- I **Profile matching techniques** are applied to correlate user profiles




# ENRICHING THE HDT

## Information extraction

techniques are applied to access relevant information

For images, image captioning and visual question answering methods are utilized

For texts the named entity recognition is used



Are there people visible in the image?	Yes
How many people are visible?	1
What gender is the person?	Female
What color is the person's hair?	Black
Where is the person located?	None
Is the person wearing glasses?	Yes

I had **hip surgery** (TREATMENT) in **2008** (DATE) ( **Aachen University Hospital** (ORG) ) and have been taking numerous **painkillers** (DRUG) since then, which cause me to have **tingling legs** (SYMPTOM) and be somehow **absent** (SYMPTOM) .

# IMAGE ANALYSIS

- I Developed a **new dataset** for **person characteristics** analysis
- I **Evaluated** the **efficacy** of the **Vision-Language Model** of **person characteristics** and **documents** analysis

Label [# of Images]	Prompt & Answer Candidates
a1_age_approx [1711]	How old is the person? [ <b>child, adult, elderly</b> ]
a4_gender [1863]	What is the gender of the person? [ <b>male, female</b> ]
a5_eye_color [1348]	Which color are the eyes of the person? [ <b>blue, green, gray, brown</b> ]
a6_hair_color [1759]	Which color is the hair of the person? [ <b>black, blond, brown, gray, red</b> ]
a11_tattoo [45]	Does the person have a tattoo? [yes, no]
a12_semi_nudity [247]	Is the person partially nude? [yes, no]
a13_full_nudity [11]	Is the person fully nude? [yes, no]
a17_color [1914]	What is the skin color of the person? [ <b>black, brown, white</b> ]
a29_ausweis, a30_credit_card, a31_passport, a32_drivers_license, a33_student_id [47, 97, 263, 70, 70]	Which document is in this picture? [national identification card, credit card, passport, driver's licence, student ID]
a39_disability_physical [41]	Does the person have a disability? [yes, no]



# TEXT ANALYSIS

- I Developed a new **German NER dataset** for **health information** analysis
- I The dataset opens the way for future **relationship extraction** tasks

Entity	Examples	# Labels
Anatomy	Eyes, Vessels, Intestine	1294
Diagnosis	ECG, Ultrasound, Gastroscopy	635
Diseases	Flu, Hemorrhoids, Stroke	3022
Drug	Omeprazol, Fluoxetine, Ibuprofen	390
Symptoms	Headache, Fever, Tired	1249
Treatment	Eyeglasses, Massage, Physiotherapy	361

# DISCUSSION AND CONCLUSION

- I Exploring HDTs in the context of OSNs:** Modeling individual vulnerability to cyber privacy threats
- I Standardization:** Developing standardized methods for HDT instantiation and evaluation
- I ADRIAN research project:** Impossibility of complete DTs due to data volume and complexity
- I HDTs for Vulnerability Assessment:** The results demonstrate that HDTs, in conjunction with OSNs, hold significant potential for modeling and predicting individual vulnerabilities to cyber threats



Thank you for your attention!