UNIVERSITÄT ZU LÜBECK

UAT

VERDAD, BELLEZA, PROBIDAD

Role of Semantic IoT in HealthCare

Sanju Tiwari (PhD, Post-Doc) SMIEEE
Teacher by Passion
Researcher by Choice
Mentor by Demand
Collaborator by Nature

Academic Journey

Current Position

- Sr. Researcher at Universidad Autonoma de Tamaulipas, Mexico
- Adjunct Professor at Vardhman Engineering College Hyderabad, India
- Director of ShodhGuru Research Labs, India.

Teaching Experiences

>10 years in Teaching from Lecturer to Assistant Professor

Academic Background

- PostDoc from Ontology Engineering Group, UPM, Spain (2019)
- PhD from Teerthankar Mahaveer University, Moradabad, India(2018)
- Post Graduation (2007)
- ORACLE Certified (9i)

Research Background(just an overview)

Authored Activities

>50 publications in Scopus, SCIE Journals, Conference Papers and Book Chapters.

Editorship

- Edited Books: 1as a main editor (Elsevier) + 3 as co-editor (ISTE, Taylor and Francis, River)
- Conference Proceedings: 4 (Springer)
- Guest Editorship: 4 in Scopus (Emerald, IGI, River, Inderscience) + 1 in SCI (MTAP)

Scientific Services

Roles in Conferences

- General Chair: KGSWC 2020-2022, EGETC-2022
- Program Chair: FTSE-2021, AMLDA 2021-2022
- Workshop Chair: TEXT2KG-2022 Co-located with the Extended Semantic Web Conference (ESWC 2022)
- Publicity Chair: RTIP2R 2021-2022
- Program Committee: ESWC-2021, CIKM 2020-2021, SEMANTiCS 2019-2021, SVC-2021, ICDAR-2021, CIIR-2021, ISIC 2021-22,
- Steering Committee: THE INTERNATIONAL WORKSHOP ON BIG DATA IN EMERGENT DISTRIBUTED ENVIRONMENTS **(BIDEDE 2022)** In conjunction with ACM SIGMOD 2022.

Talks

- Delivered Talks: >20
- Conference Speaker: 2
- Speaker on Women Empowerment: 2 (Networking-Networking Women @ IEEE WoWMoM 2021)

Reviewer : >25 Journals reputed Journals (IEEE, IET, Springer, Elsevier, etc.)

Project Roles with Outcomes

International Project

Worked as a Post-Doctoral Researcher for a **European Project (BIMERR)** at Ontological Engineering Group at UPM, Madrid, Spain.

- DELIVERABLE D4.1 Report on Semantic Alignment & Linking of EEB-related Ontologies (Authored)
- DELIVERABLE D3.2 Survey of data models, ontologies and standards in the wider Energy Efficient Buildings domain (Co-authored)
- https://bimerr.eu/deliverables/

National Project

Worked as a Research Associate in **DRDO**, New Delhi, India in a Department of Science and Technology Project.

- Developed a Military Resource Ontology for Intelligent Decision Support System with ontological framework to support military commanders in taking the best decisions in emergencies by providing them enhanced resource management assistance and situation awareness in real time.
- This whole work is published in two Scopus Journal for Military Resource Ontology (MRO) Development and Evaluation.

Awards

Recognized on Women's Day-2021 by **Rai University** Gujarat, India

PhD Degree awarded by **Deputy CM of Uttar Pradesh, India** in Convocation-2021

Index

Part 1

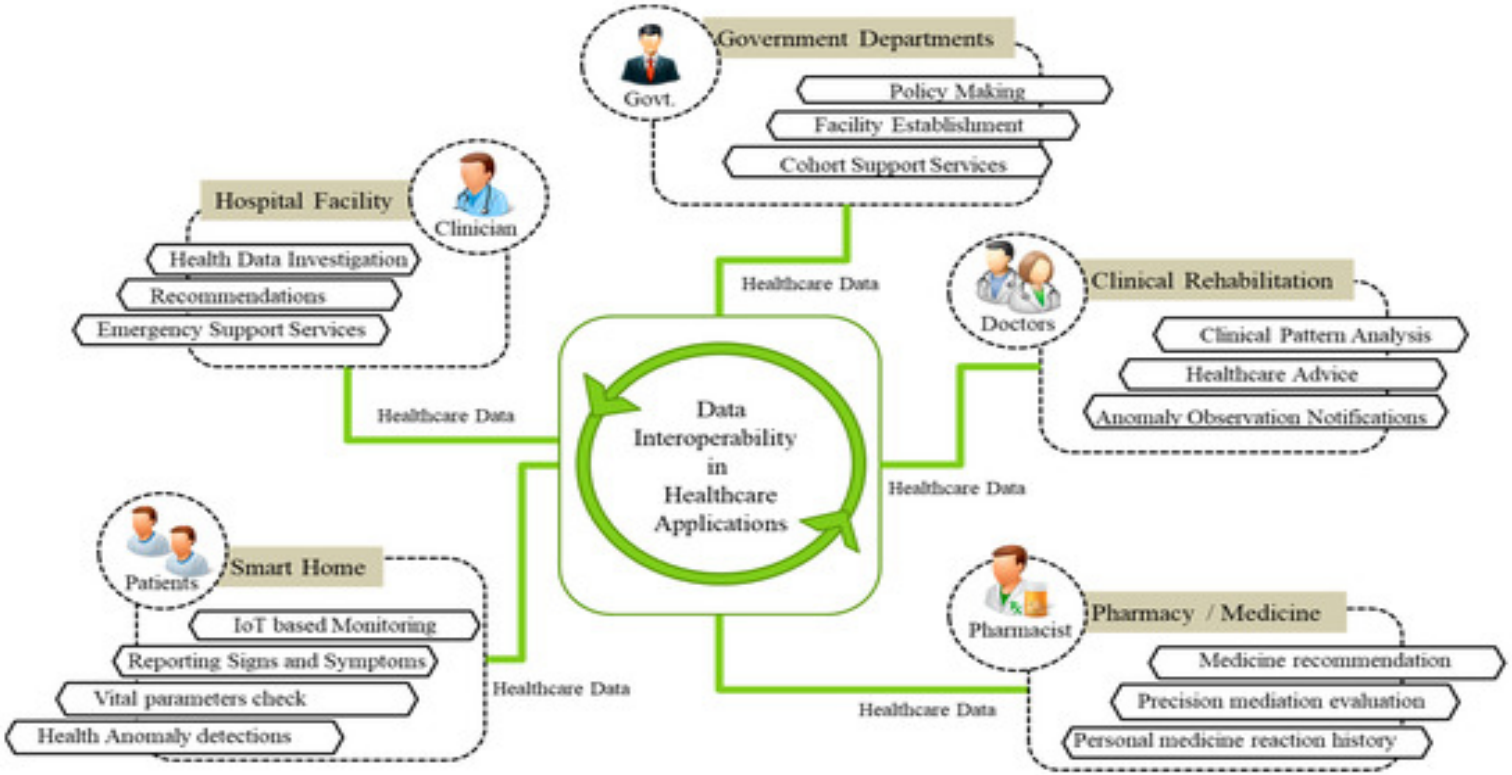
- IoT in Health
- IoT Data Challenges
- IoT Applications in Healthcare
- Knowledge Organization in Context of IoT
- Semantic, Cognitive and Perceptual Representation
- Recent Healthcare Projects (kHealth, kBoat, kAO, SAREF4health, SAREF4ehaw etc.)
- Health Knowledge Graphs

Part 2

Semantic Representation and Modeling in IoT Healthcare

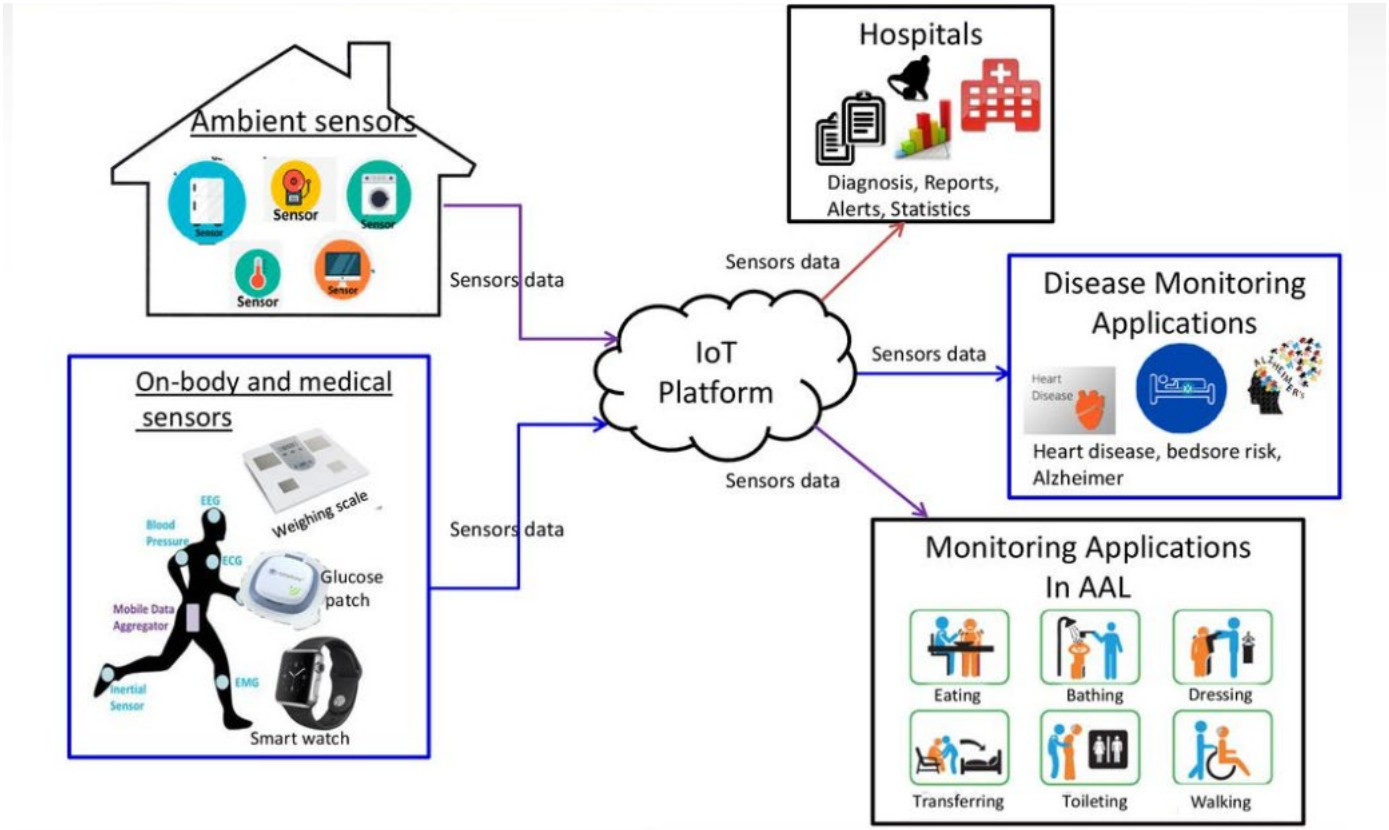
(Ontology Construction, Evaluation, Publication)
Existing Health-IoT Semantic Models
Published Semantic Models, Catalogs, Standards etc.

Connected Objects in Health



Source: Semantic Mediation Model to Promote Improved Data Sharing Using Representation Learning in Heterogeneous Healthcare Service Environments, Ali, S., & Chong, I. (2019).

Connected Objects in Health



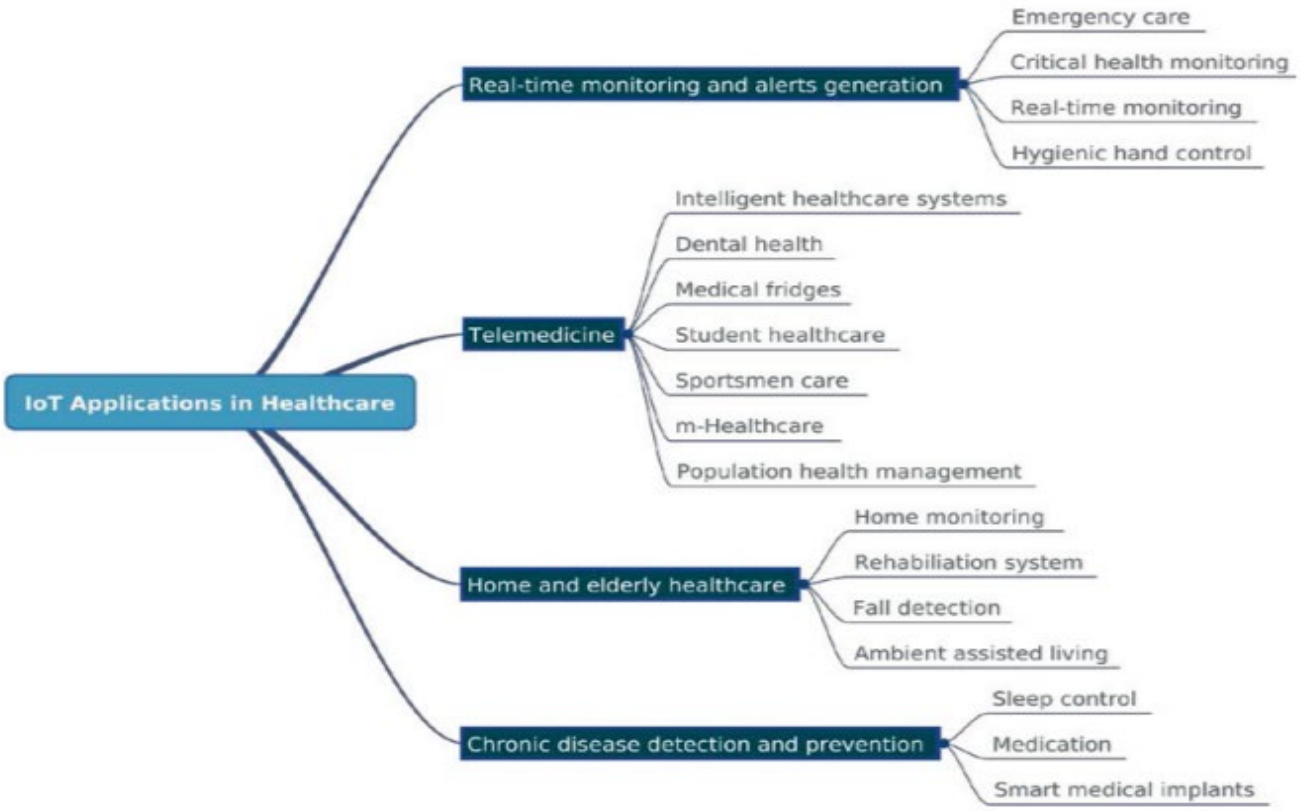
Source: https://slideplayer.com/slide/17285578/

IoT Data-Challenges

- Multi-modal, distributed and heterogeneous
- Noisy and incomplete
- Time and location dependent
- Dynamic and varies in quality
- Crowdsourced data can be unreliable
- Privacy and security are important issues
- Data can be biased- we need to know our data!

Source: P. Barnaghi, A. Sheth, C. Henson, "From data to actionable knowledge: Big Data Challenges in the Web of Things," IEEE Intelligent Systems, vol.28 , issue.6, Dec 2013.

IoT Applications in Healthcare



Source: Internet of Things in Healthcare: Architecture, Applications, Challenges and, Solutions, 2020

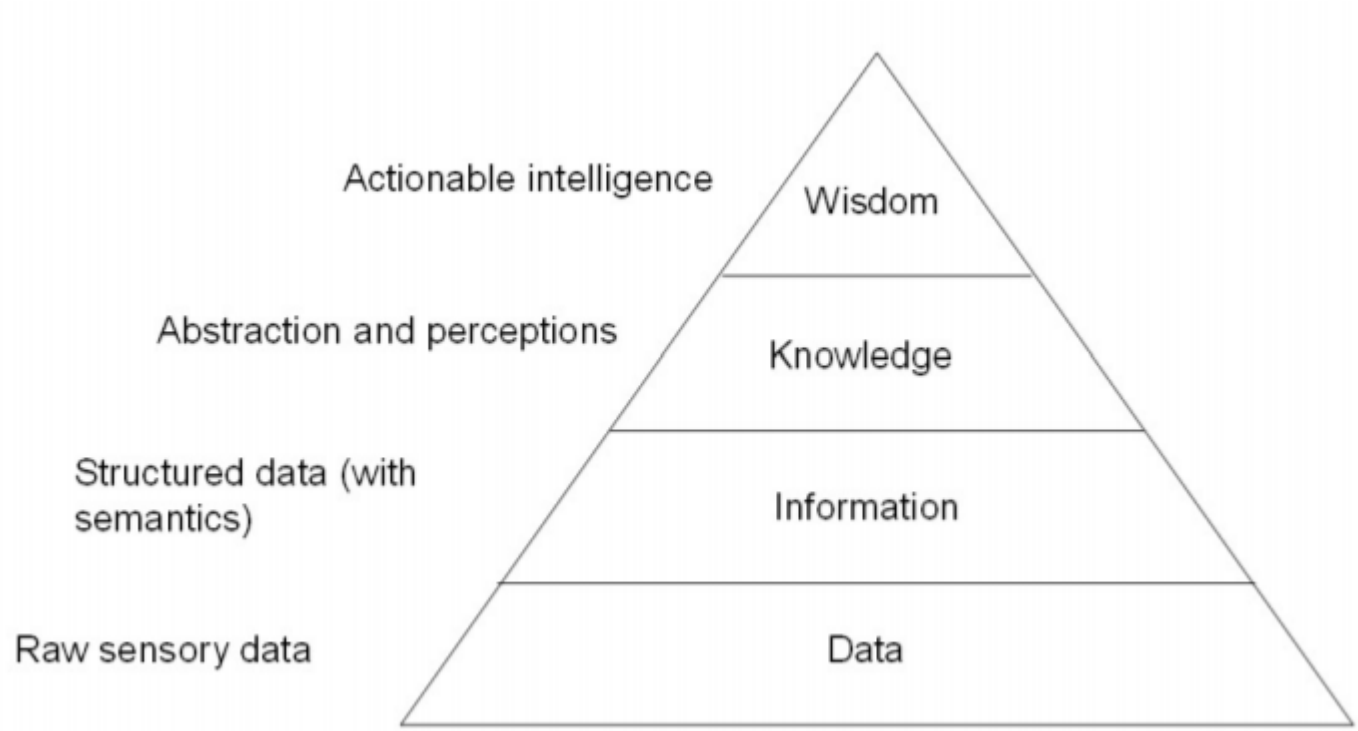
IoT Applications in Healthcare

- Medication management apps
- Fitness apps
- Body, activity, & sleep tracking apps
- Pregnancy monitoring apps
- Individual health recording apps

Major Challenges

- Data representation and information homogeneity
- Semantic interoperability
- Classification accuracy and information modeling
- Enable strong reasoning and inference
- Heterogeneity (different conceptual structures, or even different units of measure)
- Reusing and sharing of data
- Sensitive data security
- Scalability
- Storage
- Constant updates

Knowledge Hierarchy in Context of IoT



Source: Barnaghi, P., Wang, W., Henson, C., & Taylor, K. (2012). Semantics for the Internet of Things: early progress and back to the future. *IJSWIS)*, *8*(1), 1-21.

Semantic, Cognitive, and Perceptual Computing

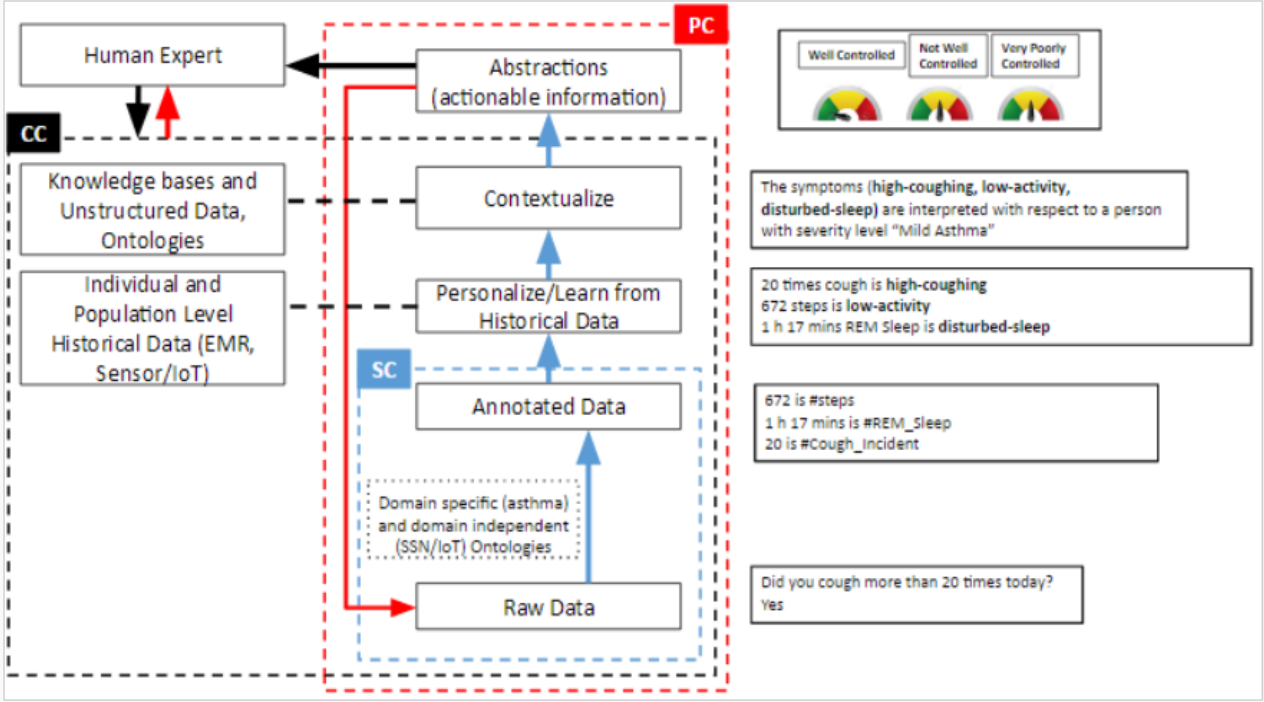
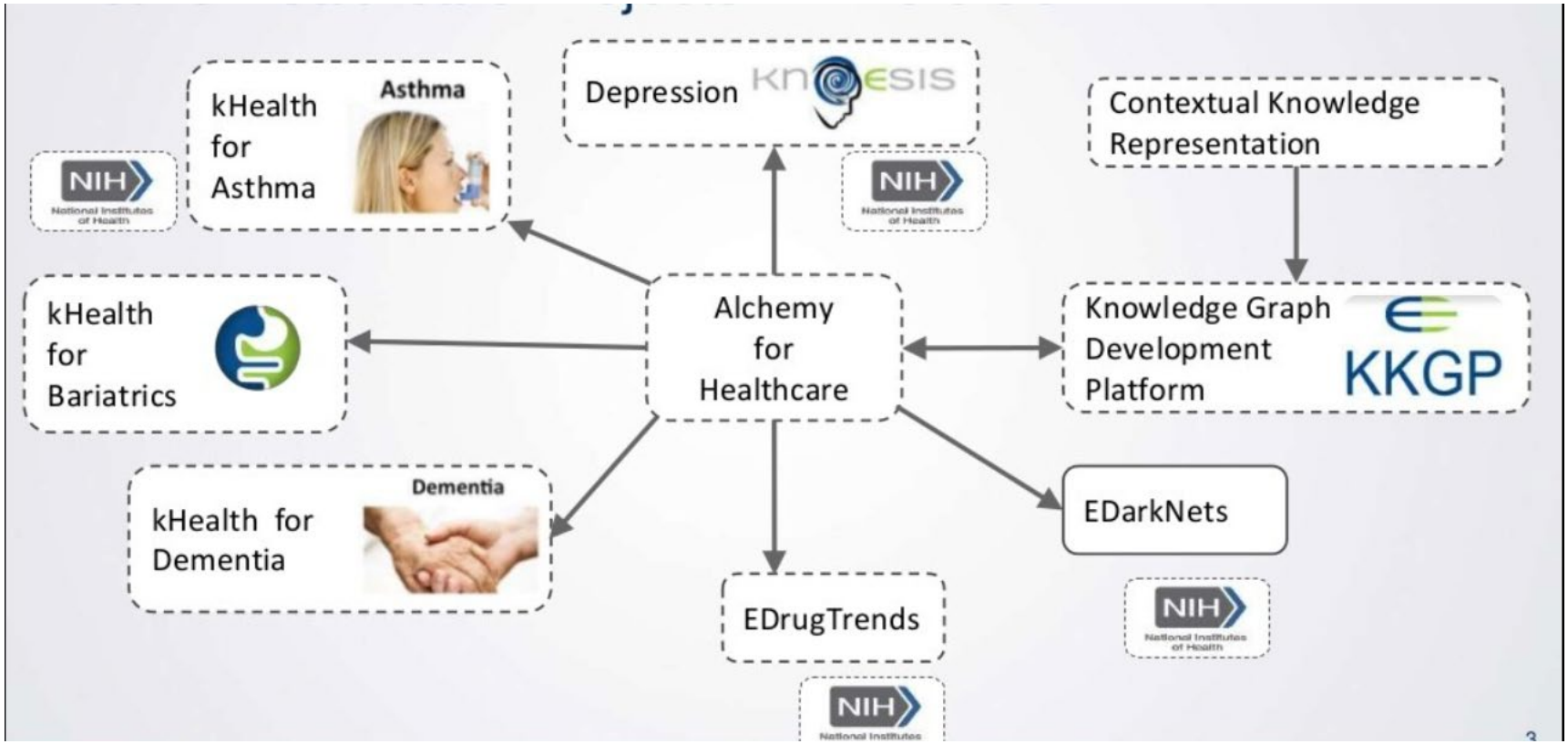


Fig. 1. Semantic, Cognitive, and Perceptual computing in an asthma-management scenario. The Semantic Cognitive (SC) system gives meaning to the raw data. The Cognitive Computing (CC) system gleans statistics and abstractions from patient observations and asthma literature to enable human interpretation, and the Perceptual Computing (PC) system iteratively interprets and explores them to learn personalized and context-specific normalcy for the patient and from it anomalies. REM: Rapid eye movement [7]).

Source: http://wiki.aiisc.ai/index.php/Augmented_Personalized_Health:_How_Smart_Data_with_IoTs_and_AI_is_about_to_Change_Healthcare

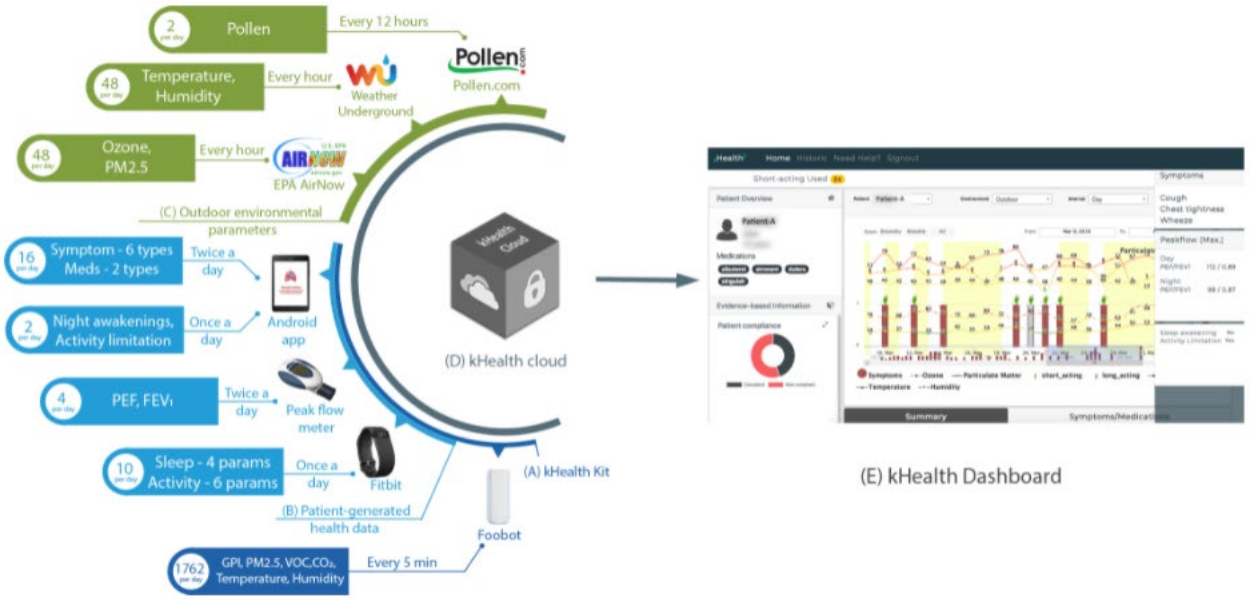
Recent Healthcare Projects at Kno.e.sis



Source: http://wiki.aiisc.ai/index.php/Augmented_Personalized_Health:_How_Smart_Data_with_IoTs_and_AI_is_about_to_Change_Healthcare

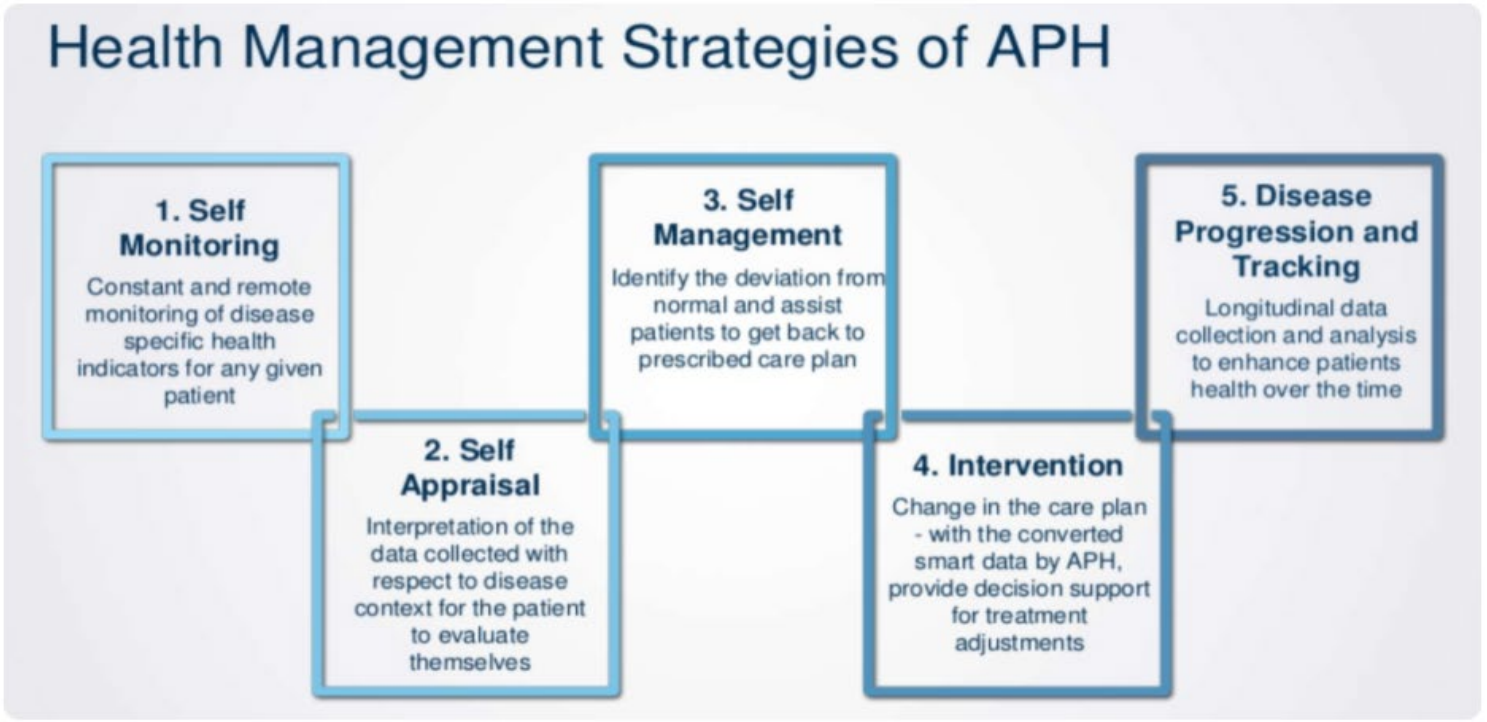
kHealth: Augmented Personalized Health System

This system can collect up to ***1852 data points*** of ***29 types*** for the patient every single day. On a personal scale, it fits the definition of big data.



Source: https://www.linkedin.com/pulse/augmenting-health-personalized-data-ai-amit-sheth/

kHealth: Knowledge, Personalization, Context



Source: https://www.linkedin.com/pulse/augmenting-health-personalized-data-ai-amit-sheth/

kBot: A Knowledge-enabled Personalized Chatbot System

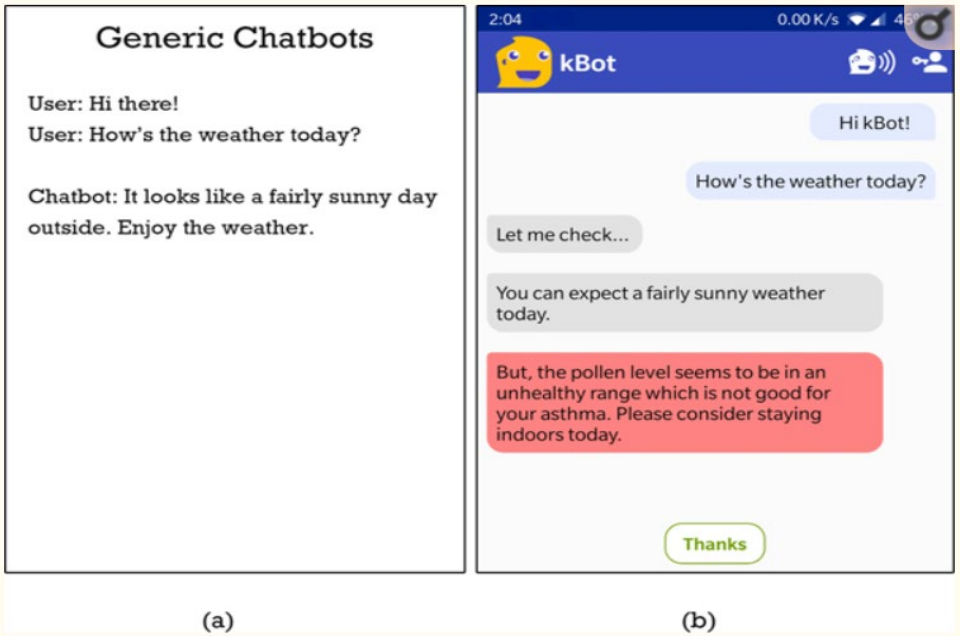


Fig. 2.

(a) Generic chatbot without contextualization and personalization (b) kBot with contextualization and personalization

kBOT Primary Aim

FLORENCE reminds patients regularly to take their pills and also tracks their health factors, it also helps patients to find a doctor or pharmacy location.
SMOKEY, another Facebook messenger bot, alerts patients when the air quality is unhealthy.

kBot, as a **multi-functionality personal assistant, distinguishes**, itself by offering a personalized approach to **track patients health** and their **medication intake, remind and encourage** them towards **medication adherence, alert** them about asthma triggers.

Source: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7432964/

kAO: Knoesis Asthama Ontology

- The knoesis Asthma Ontology (kAO)[a,b] integrates:

1) W3C SOSA ontology to semantically annotate sensor observations (e.g., peak flow meter is a subclass of the sosa:Sensor class),
2) The Asthma Ontology (AO) from BioPortal to reuse relevant concepts,
3) FOAF ontology to describe people, and
4) Weather ontology to deduce meaningful information from weather datasets

- The kAO has been designed for the needs of the kHealth Asthma project in collaboration with Dayton Children's Hospital and evaluated with Semantic Web tools.
- The asthma dataset consists of data generated by IoT devices such as peak flow meter, Foobot, Fitbit, AirNow, and from Web Services obtaining air quality parameters[c], pollen index and type[d], outside humidity, and temperature.

[a] http://wiki.knoesis.org/index.php/KHealthAsthmaOntology
[b] https://corescholar.libraries.wright.edu/cgi/viewcontent.cgi?article=2554&context=kn
[c] https://www.airnow.gov/aqi/aqi-basics/oesis
[d] https://www.pollen.com/

Saref4EHAW:Healtcare Ontology for Ageing Wellbeing

- SAREF4EHAW ontology aims:

1. Monitoring and support of healthy lifestyle for citizens
2. Early warning system (EWS)

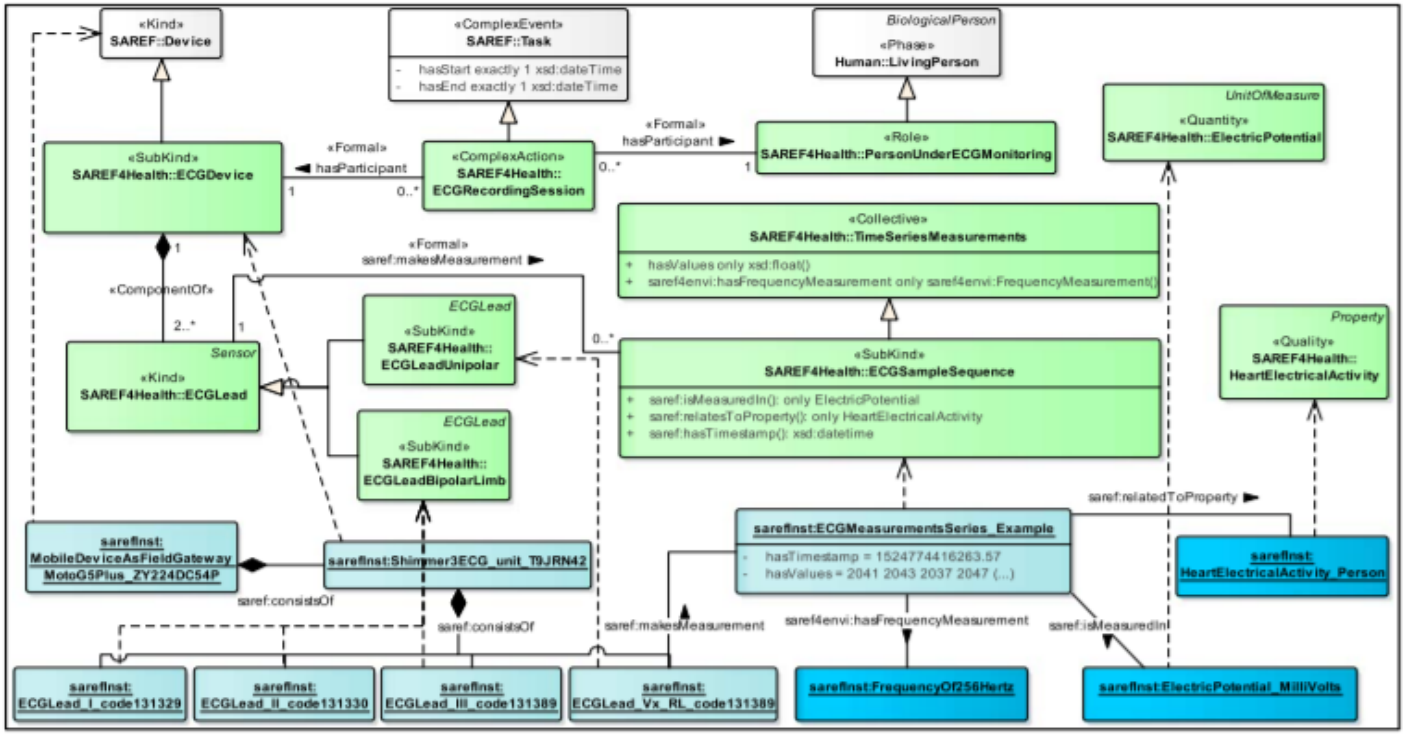
- SAREF4EHAW has reused the existing ontologies:

1. Measurement ontologies: OM, SSN/SOSA, SensorML, Semantic Sensor Web, NASA QUDT
2. eHealth domain ontologies

https://saref.etsi.org/saref4ehaw/v1.1.1/

Saref4health: IoT standard-based ontology-driven cardiac e-health systems

- SAREF4Health has been designed to provide proper semantic grounding to the interoperability of EWS for health-related information.
- SAREF4Health was designed in the scope of a broader development, namely the "SEmantic Model driven development for IoT Interoperability of emergenCy serviceS" (SEMIoTICS) framework (Moreira et al., 2015a; 2015b; Moreira et al., 2018c).



Source: https://content.iospress.com/download/applied-ontology/ao200232?id=applied-ontology%2Fao200232

Health Knowledge Graphs

- Seneviratne et. al. (2021) has designed Personal Health Knowledge Graph[e] for capturing dietary preferences and personal context to provide personalized dietary recommendations.
- Li et. al. (2020) introduce a systematic approach to build medical KG[f] from electronic medical records (EMRs) with evaluation by both technical experiments and end to end application examples.
- The Google health knowledge graph, first announced in 2015[a], aims to empower users in their health decisions.
- Rotmensch et. al.(2017) proposed a learning health KG[b] from EMR and Shi et. al. (2017) proposed a Semantic Health Knowledge Graphs[c].
- Huang et. al. (2017) constructed a DepressionKG[d]. It is a small KG designed as a disease-centric knowledge-graph. It is more convenient for doctors to explore the relationship among various knowledge resources and to answer realistic clinical queries.

[a]Ramaswami, P. A remedy for your health-related questions: health info in the Knowledge Graph. in Google Official Blog (2015)
[b]Rotmensch, M., Halpern, Y., Tlimat, A., Horng, S., Sontag, D.: Learning a health knowledge graph from electronic medical records. Scientific reports (2017)
[c]Shi, L., Li, S., Yang, X., Qi, J., Pan, G., Zhou, B.: Semantic health knowledge graph: Semantic integration of heterogeneous medical knowledge and services. BioMed Research International (2017)
[d]Huang, Z., Yang, J., van Harmelen, F., Hu, Q.: Constructing knowledge graphs of depression. In: ICHIS. (2017)
[e]Seneviratne, O., Harris, J., Chen, C. H., & McGuinness, D. L. (2021). Personal Health Knowledge Graph for Clinically Relevant Diet Recommendations. *arXiv preprint arXiv:2110.10131*.
[f]Li, L., Wang, P., Yan, J., Wang, Y., Li, S., Jiang, J., ... & Liu, Y. (2020). Real-world data medical knowledge graph: construction and applications. *Artificial intelligence in medicine*, *103*, 101817.

Health Knowledge Graphs

Authors	Year	Subject	KG	ML	Health KG
Seneviratne et al. [14]	2021	Health KG and Diet	✓	No	✓
Li et al. [15]	2020	Medical KG from EMRs	✓	✓	✓
Shi et al. [18]	2017	Health KG	✓	✓	✓
Yu et al. [20]	2017	KG TCM Visualization	✓	No	✓
Ruan et al. [21]	2017	KG TCM	✓	No	✓
Weng et al. [22]	2017	KG TCM	✓	No	✓
Wilcke et al. [23]	2017	KG and ML	✓	✓	No
Rotmensch et al. [17]	2017	Health KG and EMR	✓	✓	✓
Huang et al. [16]	2017	Depression KG	✓	No	✓
Paulheim et al. [12]	2016	Survey KG	✓	No	No
Guha et al. [13]	2016	Google KG, Schema.org	✓	No	No
Nickel [24], Murphy, Tresp, Dong, Gabrilovich et al. [11]	2016 2014	KG and ML, Google KG Knowledge Vault, Google KG	✓	✓	No
Le-Phuoc Graph of Things [25]	2016	KG for IoT	✓	No	No
Ramaswami et al. [WR36]	2015	Google Health KG	✓	No	No
Sheth et al. [19]	2007	Ontology and rule-based system for EMRs - Active Semantic Electronic Medical Record (ASEMR)	✓	No	✓

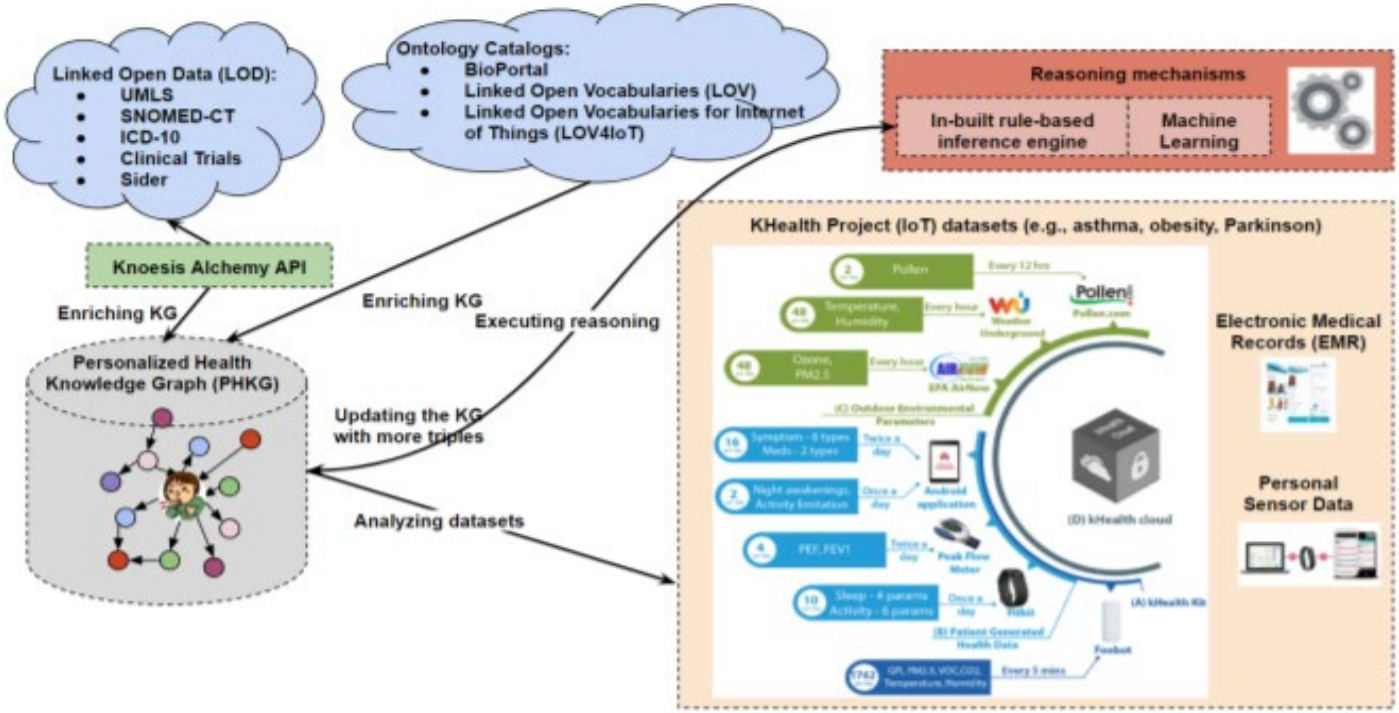
TABLE 1.1 Summary of (Healthcare) Knowledge Graph (KG) using or not Machine Learning (ML).

Source: Reasoning Over Personalized Healthcare Knowledge Graph: A Case Study of Patients with Allergies and Symptoms, Amelie Gyrard et. al., (2022), https://www.elsevier.com/books/semantic-models-in-iot-and-ehealth-applications/tiwari/978-0-323-91773-5

Personalized Health Knowledge Graphs

A Personalized Healthcare Knowledge Graph (PHKG)[a, b] considers a patient's health condition (personalized knowledge) and enriches with contextualized knowledge from environmental sensors and Web of Data (e.g., symptoms and treatments for diseases).

PHKG[b] can be serve as a foundation for assisting physicians in understanding the symptoms, hypothesizing and explaining disease progression, and then inferring a potential management and treatment plan.



Source: https://corescholar.libraries.wright.edu/cgi/viewcontent.cgi?article=2554&context=knoesis

[a]Gyrard, A., Gaur, M., Shekarpour, S., Thirunarayan, K., & Sheth, A. (2018). Personalized health knowledge graph.

[b]https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8532078/

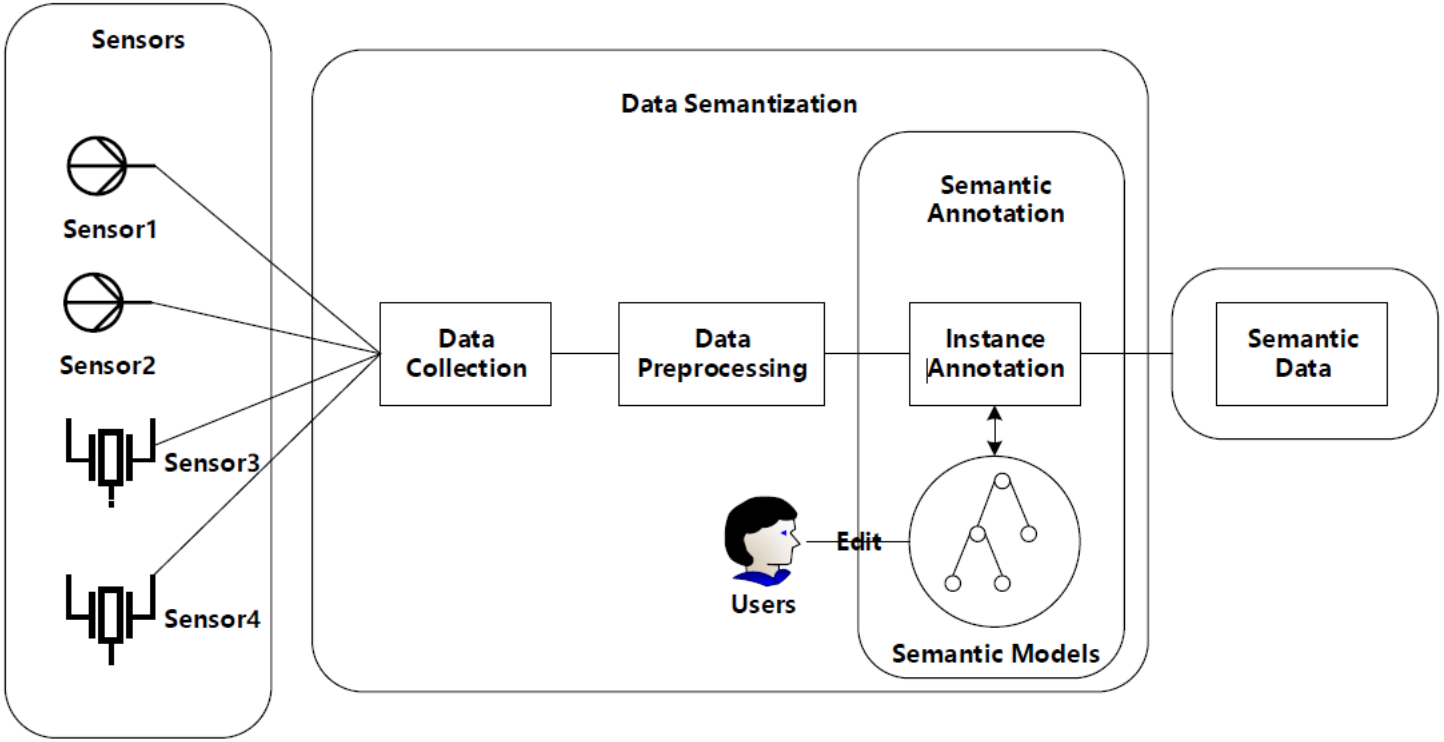
Findings of the existing Projects

Projects	Strength	Type Public/Private	Reused Existing Model ?
kHealth	Reduced the payload of in Person movement of **patients** and **health experts.** It allows patients to **take control** of their health without a **clinicians**	Private	NA
kBot	**Track patients health** and their **medication intake, remind and encourage** them towards **medication adherence, alert** them about asthma triggers	Private	NA
kAO	Organize the asthama data with devices concepts to take the input	Private	Yes
Saref4EHAW	Monitoring and support of healthy lifestyle for citizens with Early warning system (EWS) to make reminders.	Private	Yes
Saref4health	Provide proper semantic grounding to the interoperability of EWS for health-related information	Private	Yes
PHKG	Health condition (personalized knowledge) and enriches with contextualized knowledge	Public/Private	Yes

Semantics in IoT

- Machine can interpret the meaning of a piece of data that can be preserved across different domains
- Declarative models and logic statements (semantic models) encoded in a formal vocabulary
- An explicit and unambiguous representation
- Effective data access and integration
- Semantic Sensor Web an extension of present web for better enabling the device, person, and object to work in cooperation

Semantic Modeling in IoT

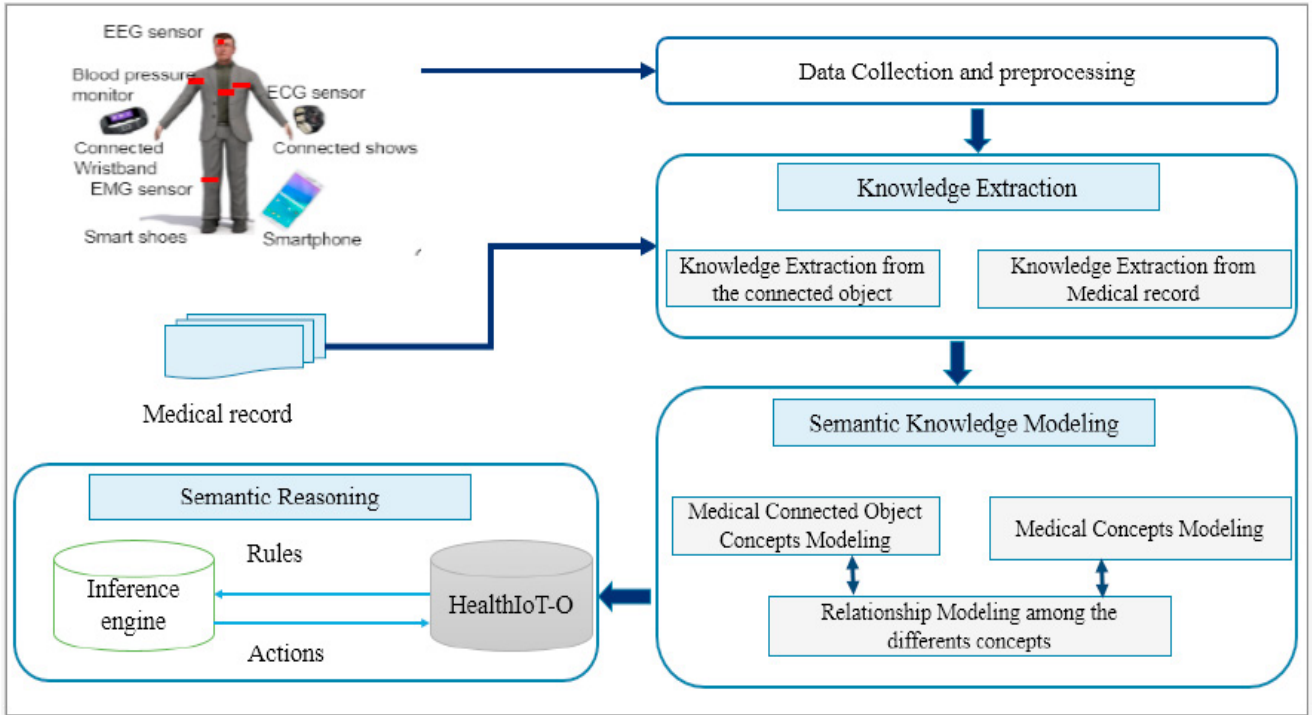


Source: Shi, F., Li, Q., Zhu, T., & Ning, H. (2018). A survey of data semantization in internet of things. *Sensors*, *18*(1), 313.

Semantic Representation in eHealth

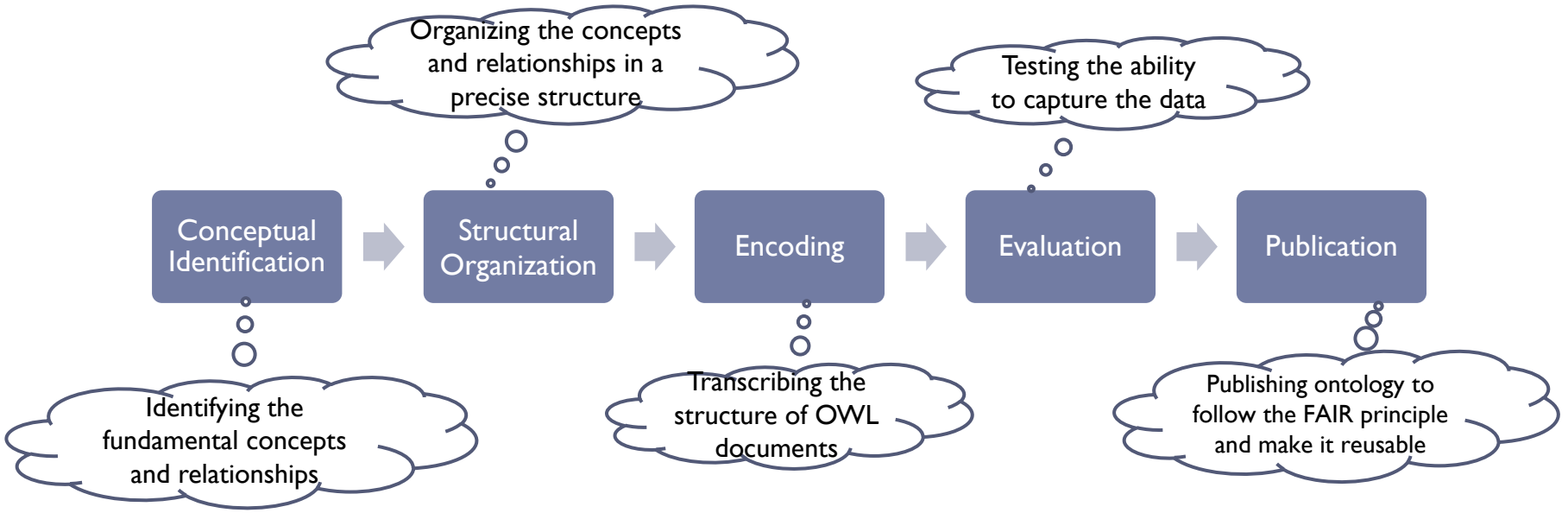
- Facilitate domain's reusability and generalized representation
- Knowledge representation, information integration and extraction, and reasoning
- High-quality remote services
- Semantic modeling covers semantic annotation, semantic linking, construction process, and semantic representation
- To propose KGs from existing standards and ontologies of medical diagnosis
- Wellness of wellbeing
- Semantic Interoperability
- Provide strong reasoning

Semantic Modelling of eHealth Data

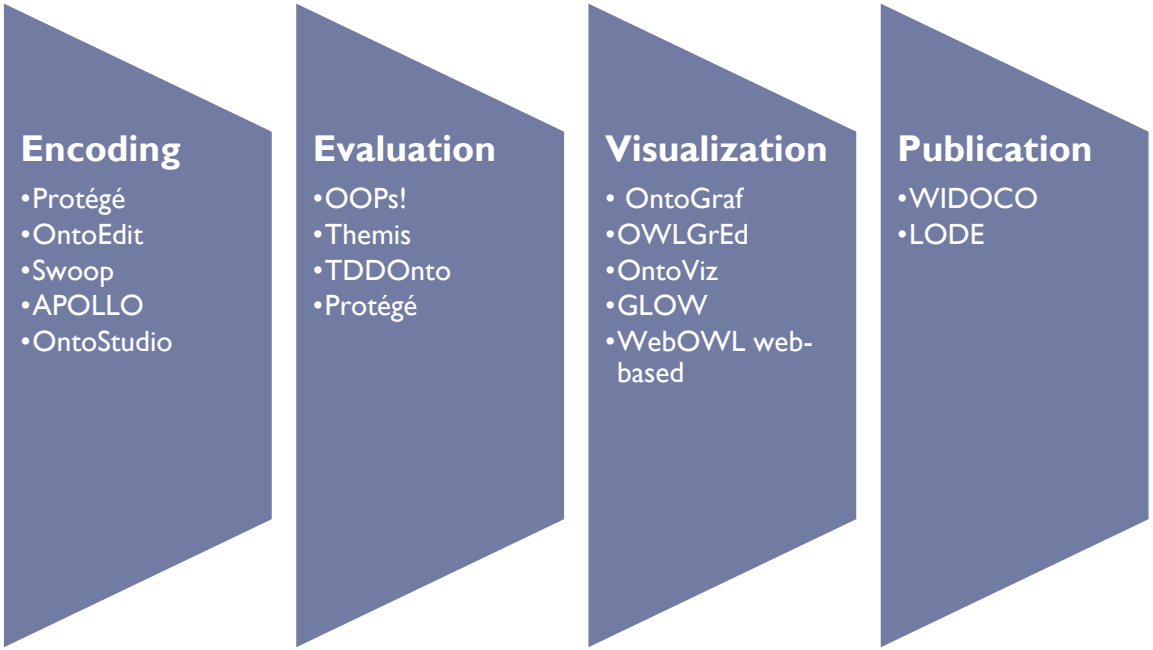


Sources: Ontology-based system for patient monitoring with connected objects [Rhayem et. al., 2017]

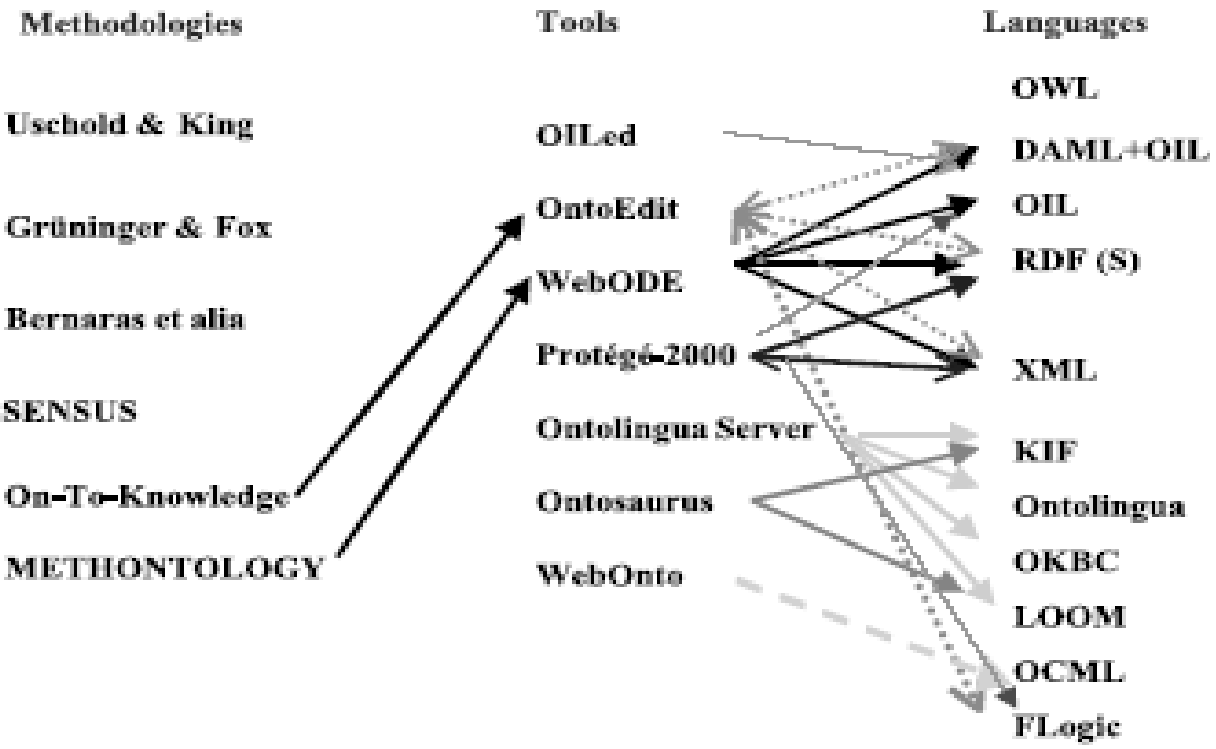
Semantic Modeling Phases



Semantic Modeling Tools



Methodology, Tools, Languages

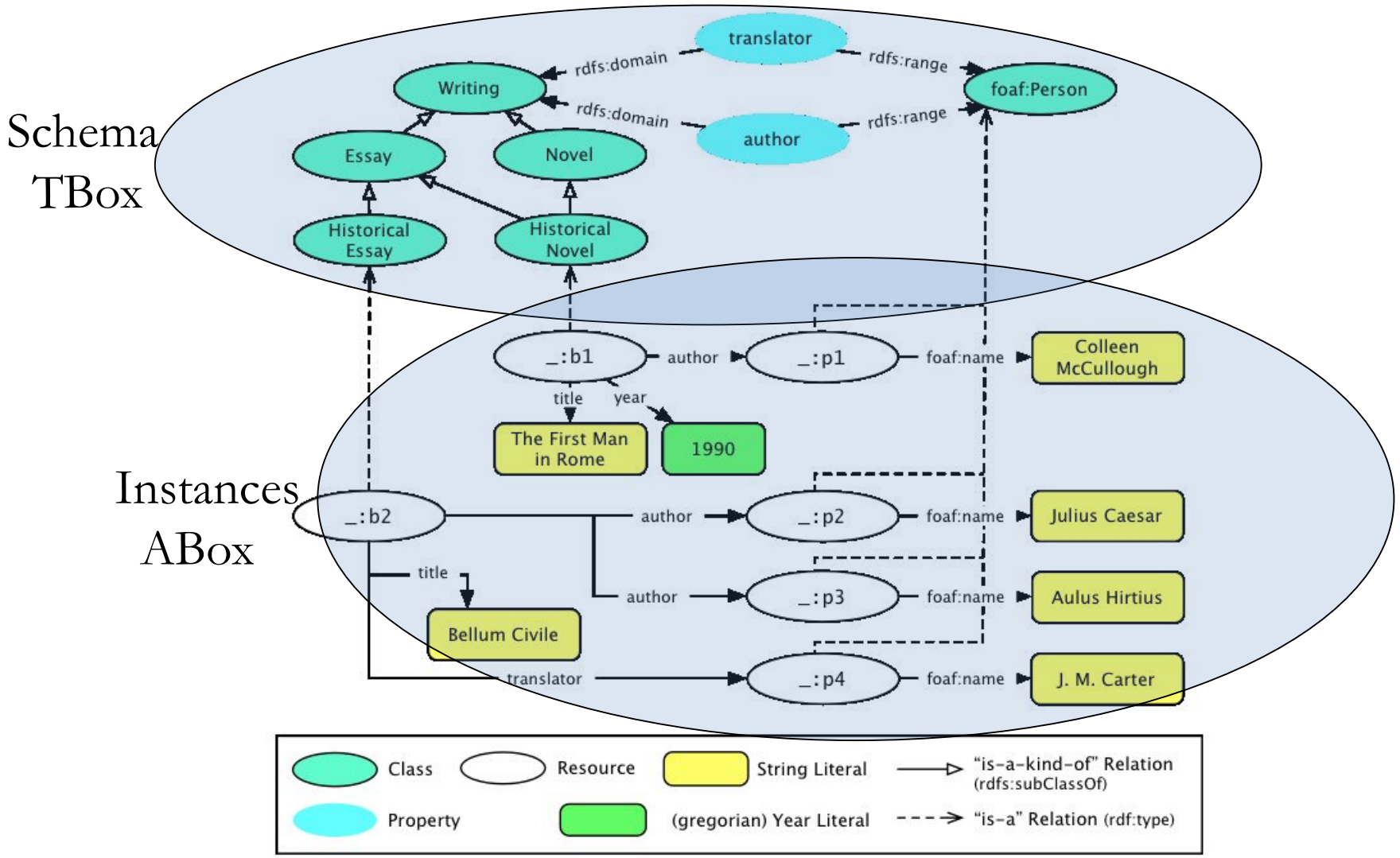


Source: Methodologies, tools and languages for building ontologies. Where is their meeting point?
Oscar Corcho, Mariano Fernandez-Lopez, Asuncion Gomez-Perez

Ontologies as Semantic Model in IoT

- Ontologies are perfect to respond: What, Who, Where, When and How
- It is required to model the relationships and concepts that represent and allow interoperability between IoT entities
- Recently IoT providers have started to add semantics to their frameworks to make Semantic Sensor Web as an extension of current web which provides well-described meaning of concepts, enabling interaction between devices, objects and human and machine-machine communications [IoT-Lite]
- The SSN ontology [W3C] is one of the most significant and widespread models to describe sensors and IoT related concepts

Example Ontology*



*** F. Bry, T. Furche, P. Pâtrânjan and S. Schaffert 2004**

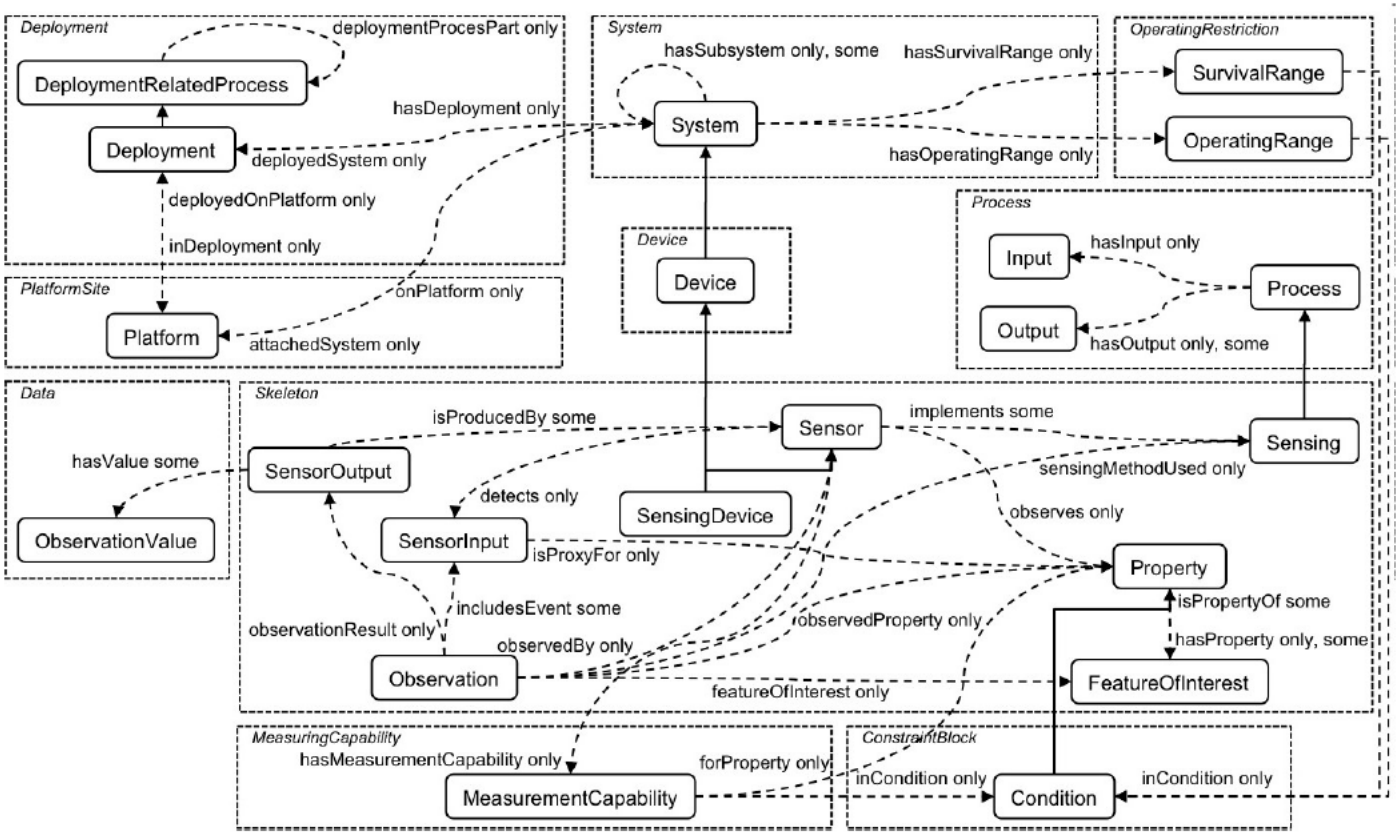
Existing IoT Ontologies

- Semantic Sensor Network (SSN) https://www.w3.org/TR/vocab-ssn/
- Smart Appliance REFerence (SAREF) https://ontology.tno.nl/saref/
- SEAS(system ontology)https://ci.mines-stetienne.fr/seas/SystemOntology-1.1#System
- IoT-lite http://www.w3.org/Submission/iot-lite/
- The oneM2M base ontology https://www.onem2m.org/technical/onem2m-ontologies
- Linked Open Vocabularies for the IoT (LOV4IoT)

  https://lov4iot.appspot.com/

  https://hal.archives-ouvertes.fr/hal-01467853v2/file/EKAW2016.pdf

Example of SSN Ontology

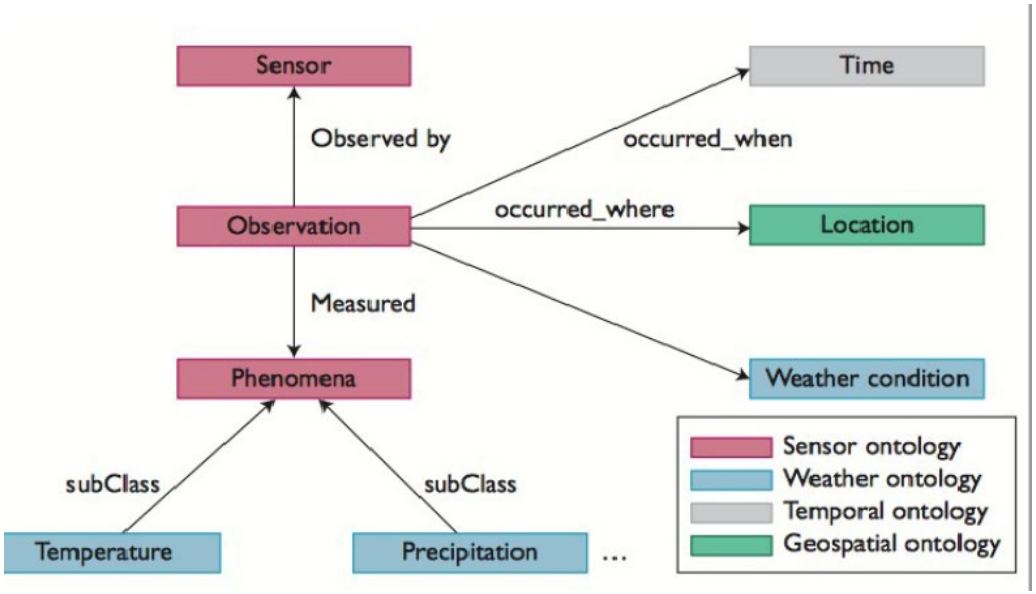


Ontology Link: http://www.w3.org/2005/Incubator/ssn/ssnx/ssn

M. Compton, P. Barnaghi, L. Bermudez, *et al*, "The SSN Ontology of the W3C Semantic Sensor Network Incubator Group", Journal of Web Semantics, 2012.

Semantic Sensor Web

- "The semantic sensor Web enables interoperability and advanced analytics for situation awareness and other advanced applications from heterogeneous sensors." (Amit Sheth *et al.*, 2008)



Source: https://www.slideshare.net/PayamBarnaghi/semantic-technolgies-for-the-internet-of-things

Move to Part-2

Semantic Representation and Modeling in IoT Healthcare (Ontology Construction, Evaluation, Publication)

Existing Health-IoT Semantic Models

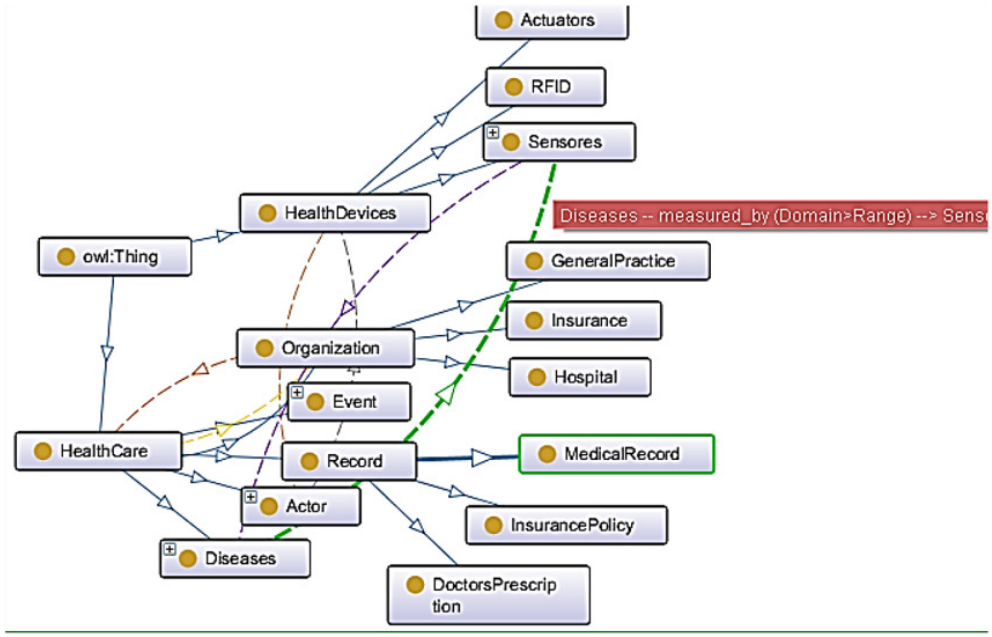
Published Semantic Models

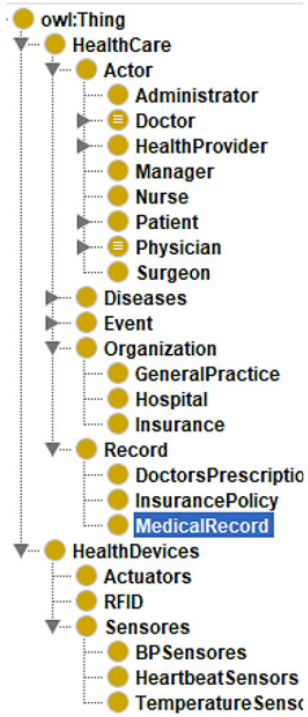
Existing IoT-Healthcare Ontology

Creator	Healthcare Ontology	Online Available	Reused Ontologies
Rhayem et al. (2017)	HealthIoT	No	NA
Moreira et al., 2018	SAREF4Health	**Yes**	SSN, SAREF
Jin and Kim, 2018	e-Health	No	SSN
Reda et al., 2018	IFO	No	NA
Peng and Goswami, 2019)	Linked Health Resource (LHR)	No	SSN, SOSA
Sondes et al. (2019)	healthcareIoT	No	NA
Tiwari et. al.(2020)	**SHCO**	**Yes**	**SSN/SOSA, SAREF**

Source: Semantic assessment of smart healthcare ontology. *International Journal of Web Information Systems*.

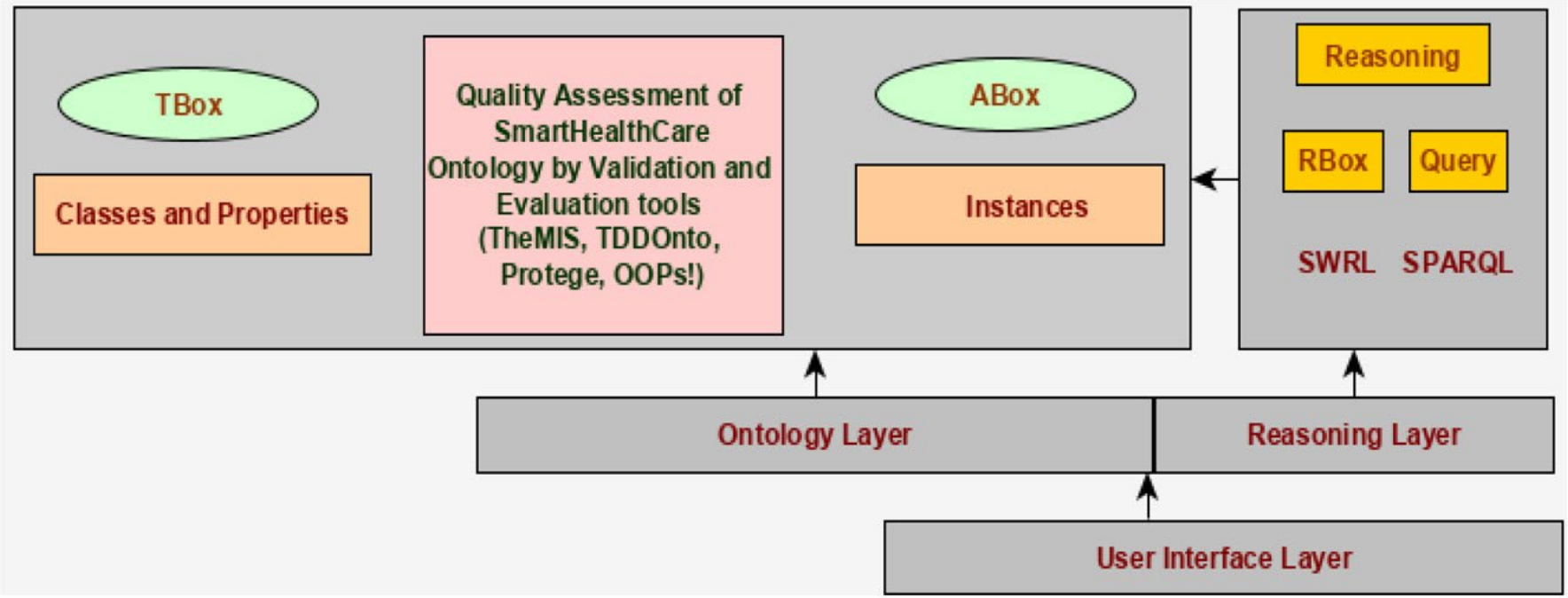
SHCO (Smart Health Care Ontology)





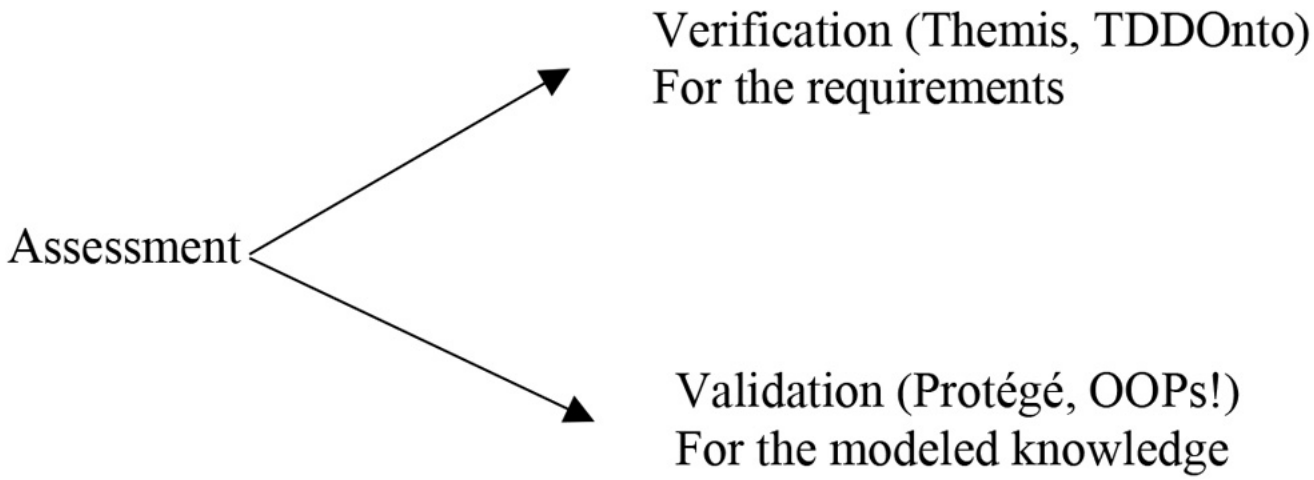
Source: Semantic Assessment of Smart HealthCare Ontology (SHCO)

SHCO Methodology



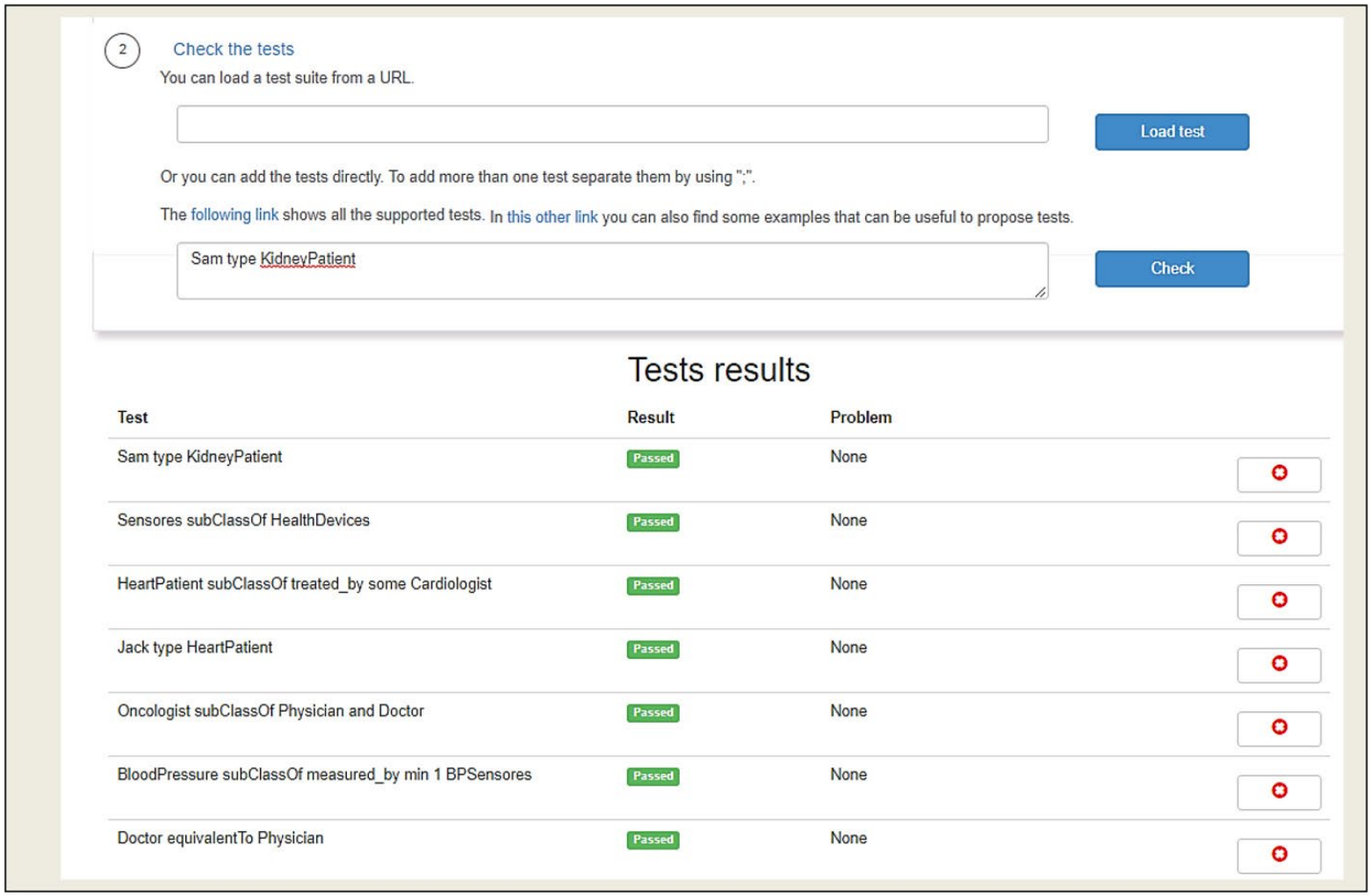
Semantic Assessment of Smart HealthCare Ontology (SHCO)

Ontology Evaluation

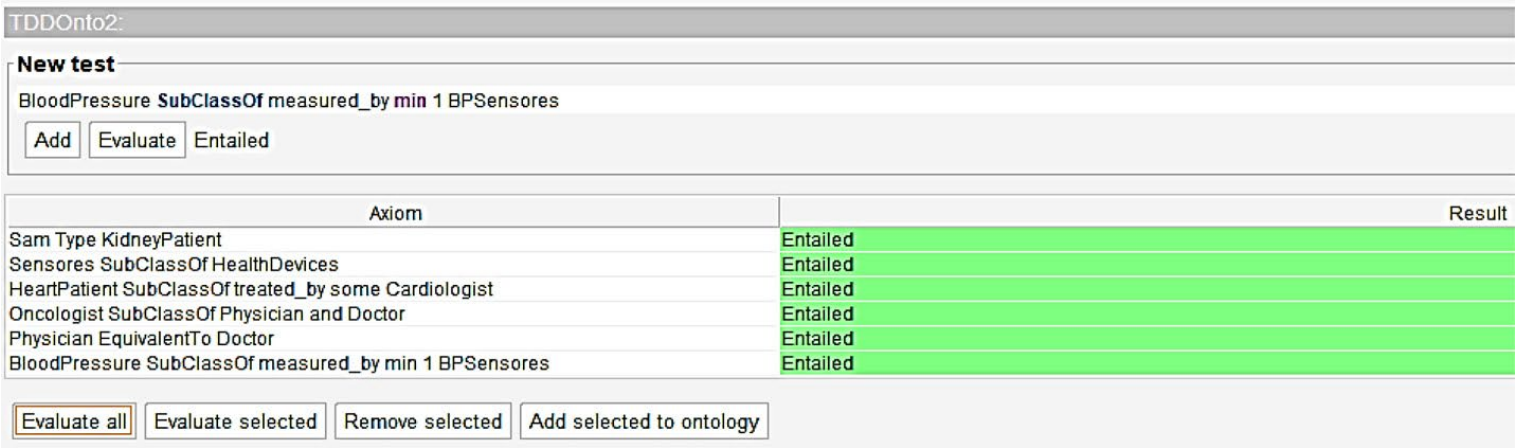


Semantic Assessment of Smart HealthCare Ontology (SHCO)

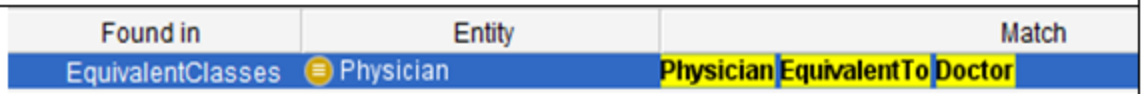
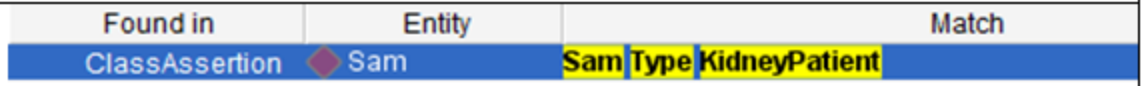
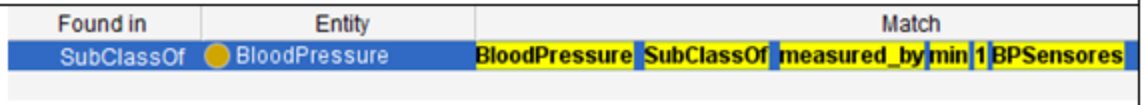
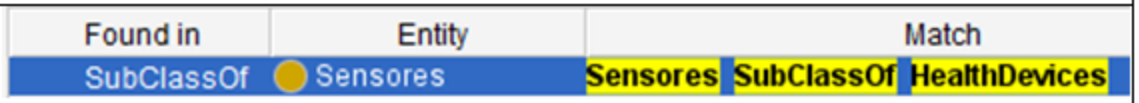
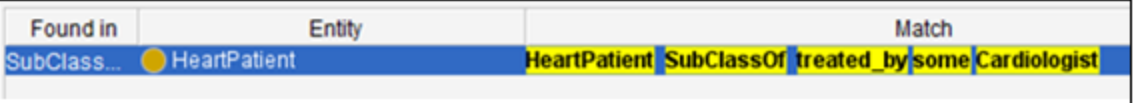
Ontology Evaluation with Themis



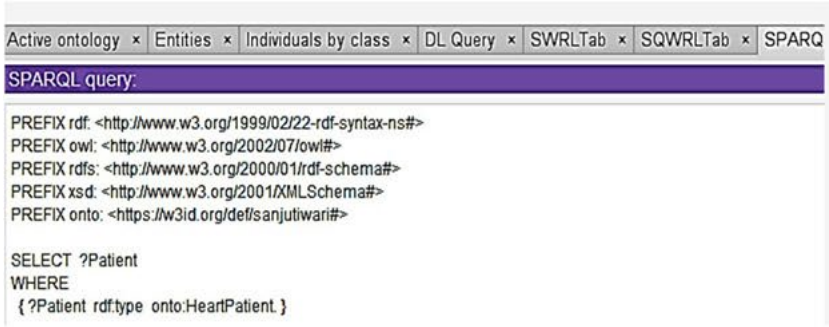
Ontology Evaluation with TDDOnto



Ontology Evaluation with Protege

Test Cases	Test Result in Protégé
Doctor and Physician are equivalent entities	
Sam is a patient of Kidney Problem	
Blood Pressure is measured by at least 1 device	
Sensores is subclass of HealthDevices.	
Heart Patients should be treated by some cardiologist.	
Oncologist can be a Doctor or Physician	*Not Found*

Ontology Evaluation with SPARQL



	Name	Rule
✔	S1	autogen0:Patient(?P) ^ hasSymptoms(?P, "cough") ^ hasSymptoms(?P, "fever") -> doTest(?P, "corona")
✔	S2	autogen0:Patient(?P) ^ hasWife(?P, ?R) -> doTest(?R, "corona")
✔	S3	autogen0:Patient(?P) ^ hasChild(?P, ?Q) -> doTest(?Q, "corona")

Ontology Evaluation with OOPs!

Evaluation results

It is obvious that not all the pitfalls are equally important; their impact in the ontology will depend on multiple factors. For this reason, each pitfall has an importance level attached indicating how important it is. We have identified three levels:

- **Critical** : It is crucial to correct the pitfall. Otherwise, it could affect the ontology consistency, reasoning, applicability, etc.
- **Important** : Though not critical for ontology function, it is important to correct this type of pitfall.
- **Minor** : It is not really a problem, but by correcting it we will make the ontology nicer.

[Expand All] | [Collapse All]

Results for P22: Using different naming conventions in the ontology. **ontology* | Minor**

Comparative Results

Ontologies	Protégé Reasoner	TDDOnto	Themis	OOPs
OntoDiabetic	✓	X	X	X
HealthIoT	✓	X	X	X
SAREF4Health	✓	X	✓	✓
e-Health	✓	X	X	X
IFO	✓	X	X	X
Linked Health Resource (LHR)	✓	X	X	X
healthcareIoT	✓	X	X	X
SHCO	✓	✓	✓	✓

Published Semantic Models

- https://w3id.org/def/SmartHealthCare
- https://saref.etsi.org/saref4ehaw/v1.1.1/#ref-6
- http://w3id.org/codo/1.3

SHCO Publication

Ontology Specification Draft

1. Introduction

back to ToC

This is a place holder text for the introduction. The introduction should briefly describe the ontology, its motivation, state of the art and goals.

1.1. Namespace declarations

Table 1: Namespaces used in the document

[Ontology NS Prefix]	<http://w3id.org/def/sanjutiwari>
smarthealthcare	<https://w3id.org/def/SmartHealthCare>
owl	<http://www.w3.org/2002/07/owl>
rdf	<http://www.w3.org/1999/02/22-rdf-syntax-ns>
terms	<http://purl.org/dc/terms>
xsd	<http://www.w3.org/2001/XMLSchema>
9	<http://www.semanticweb.org/ontologies/2018/9>
rdfs	<http://www.w3.org/2000/01/rdf-schema>
dc	<http://purl.org/dc/elements/1.1>

2. Smart Health Care Ontology for Health Care: Overview

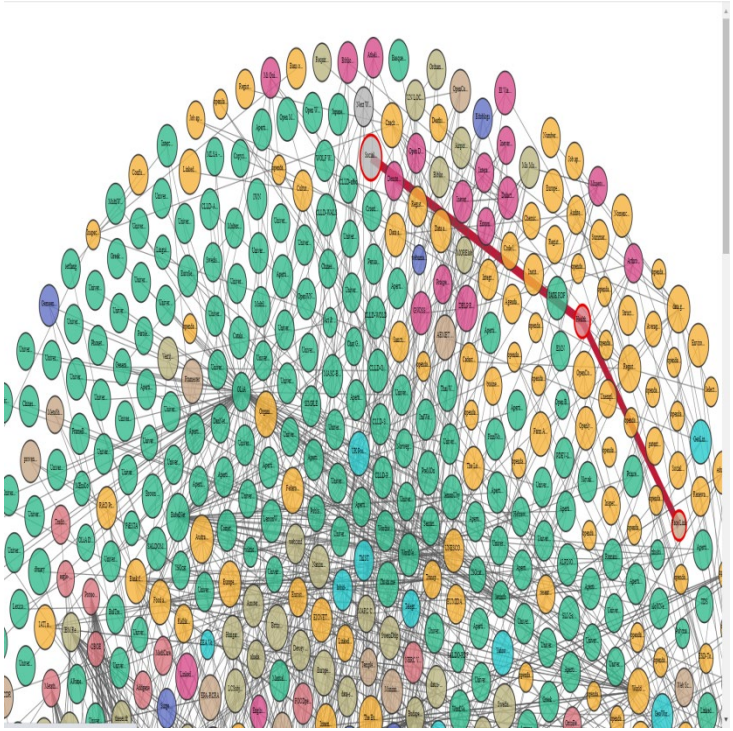
back to ToC

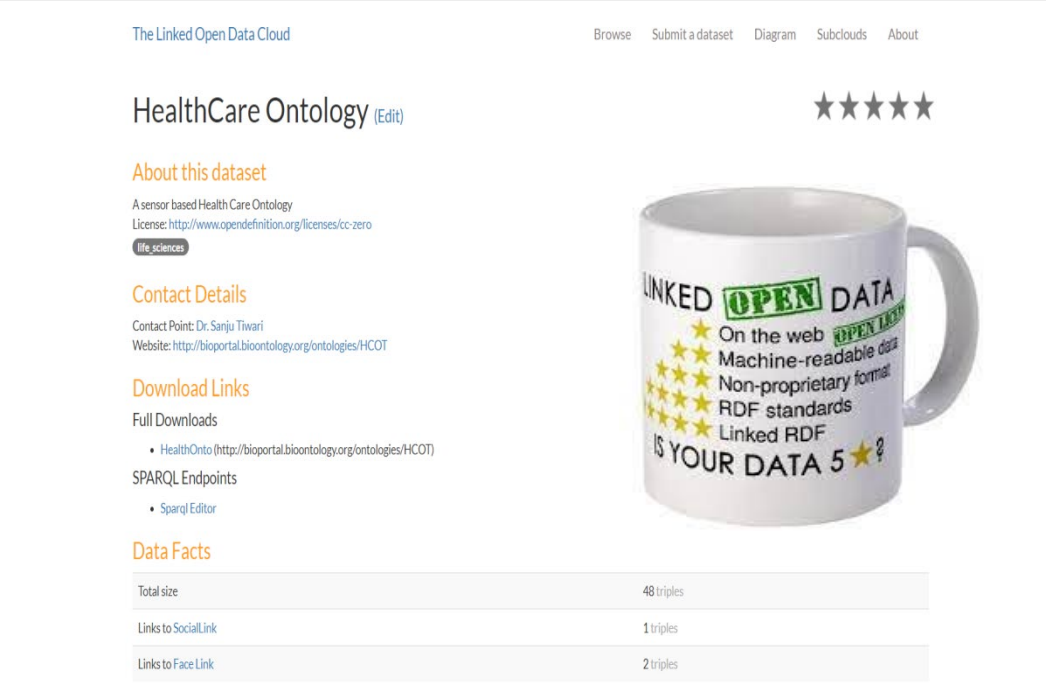
This ontology has the following classes and properties.

Classes

Actor Actuators Administrator BloodPressure Body_Temp BPSensores Cardiologist ChestPain ClinicalPharmacist CommunityPharmacist Consultation Cough Diagnosis Diseases Doctor DoctorsPrescription Event Fever GeneralPractice Headache HealthCare HealthDevices HealthProvider HeartBeat HeartbeatSensors HeartDisease HeartPatient Hospital Insurance InsurancePolicy KidneyPatient LeverPatient Manager Medical_Oncologist MedicalRecord Nurse Oncologist Oncology_Pharmacist Organization Patient Pharmacist Phychiatric_Pharmacist Physician Pulmonologist Radiation_Oncologist Record Referral RFID Sensores Surgeon Surgery Symptoms Temperature Sensors Treatment

SHCO Publication on LOD Cloud





https://lod-cloud.net/dataset/HealthCare%20Ontology

Achieved 5 star rating according to Linked Data Principle

Current Impact of Semantic IoT in HealthCare

- VICINITY https://cordis.europa.eu/project/id/688467

Open virtual neighborhood network to connect intelligent buildings and smart objects

Start date1 January 2016 **End date**31 December 2019

- CrowdHEALTH https://cordis.europa.eu/project/id/727560

Collective wisdom driving public health policies

Start date1 March 2017 **End date**29 February 2020

- ACTIVAGE https://cordis.europa.eu/project/id/732679

ACTivating InnoVative IoT smart living environments for AGEing well

Start date1 January 2017 **End date**30 September 2020

- SERUMS https://cordis.europa.eu/project/id/826278

Securing Medical Data in Smart Patient-Centric Healthcare Systems

Start date1 January 2019 **End date**30 June 2022

Current Calls

(HORIZON-HLTH-2022-STAYHLTH-01-two-stage)

Trustworthy artificial intelligence (AI) tools to predict the risk of chronic non-communicable diseases and/or their progression

https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/horizon-hlth-2022-stayhlth-01-04-two-stage

Future Scope

- IoMT integration and adaptation is the only logical way of development for advanced medicine of the future
- Augmented Personalized Healthcare
- Semantic, Cognitive, and Perceptual Computing in Healthcare

Possible Co-operations

Current Projects

MEXIN: Multidialectal Ontology supporting NLP approach to improve government electronic communication with the Mexican Ethnic Groups (**Partially accepted)**

KG4ASTRA: Knowledge Graph Construction for Indian Missiles, Ships, Fighters etc. (**Seeking for funding and interns**)

SHCO: Enhancing and extending the **SHCO** ontology with new ideas (**Seeking for funding and interns**)

Research Labs

ShodhGuru Lab India: A research lab for students, scholars, researchers, programmer and trainers. (Open to conduct any research activities and for internship with Dr. Sanju Tiwari) http://shodhguru.epizy.com/

AII Lab Mexico: Open for AI researchers, students, scholars with **Professor Fernando Ortiz, UAT, Mexico**

FORRK Lab, Nigeria: Open for AI researchers, students, scholars with **Dr. Patience Usoro Usip, University of Uyo, Nigeria**

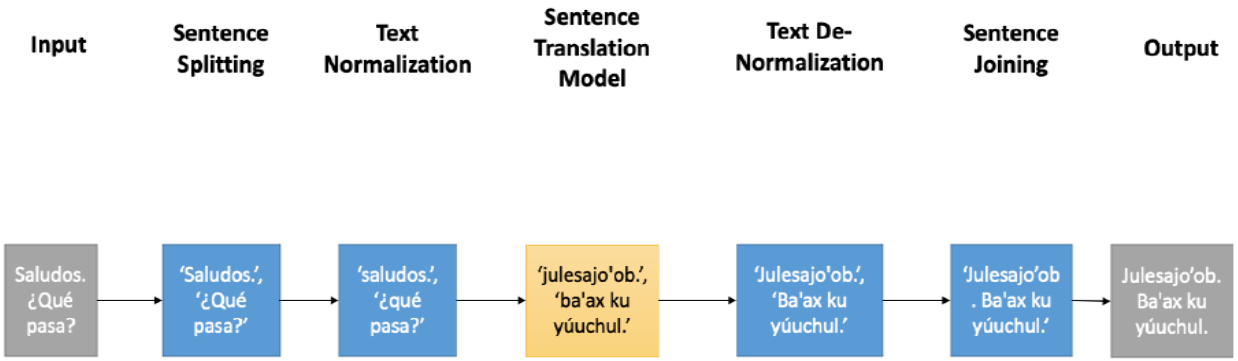
AI Institute of South Carolina (AIISC): Open for internship of graduate, masters students and PhD scholars

Editorial

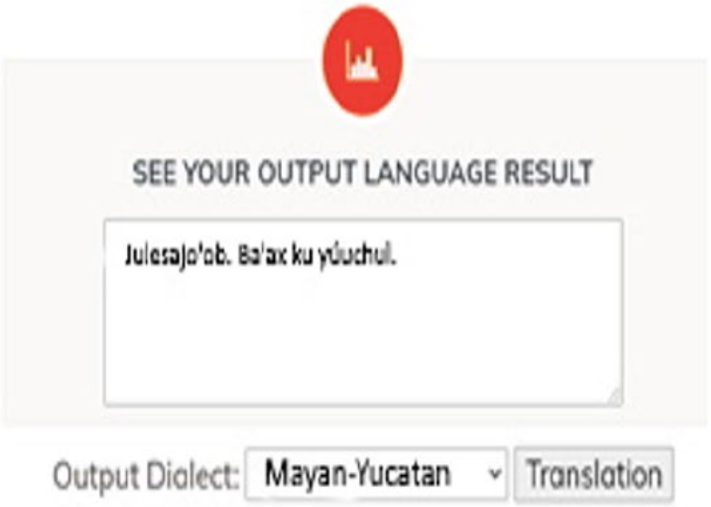
Open to collaborate for:

- Books: authored books or edited books.
- Workshops
- Special Issues
- Conference Proceedings

MEXIN

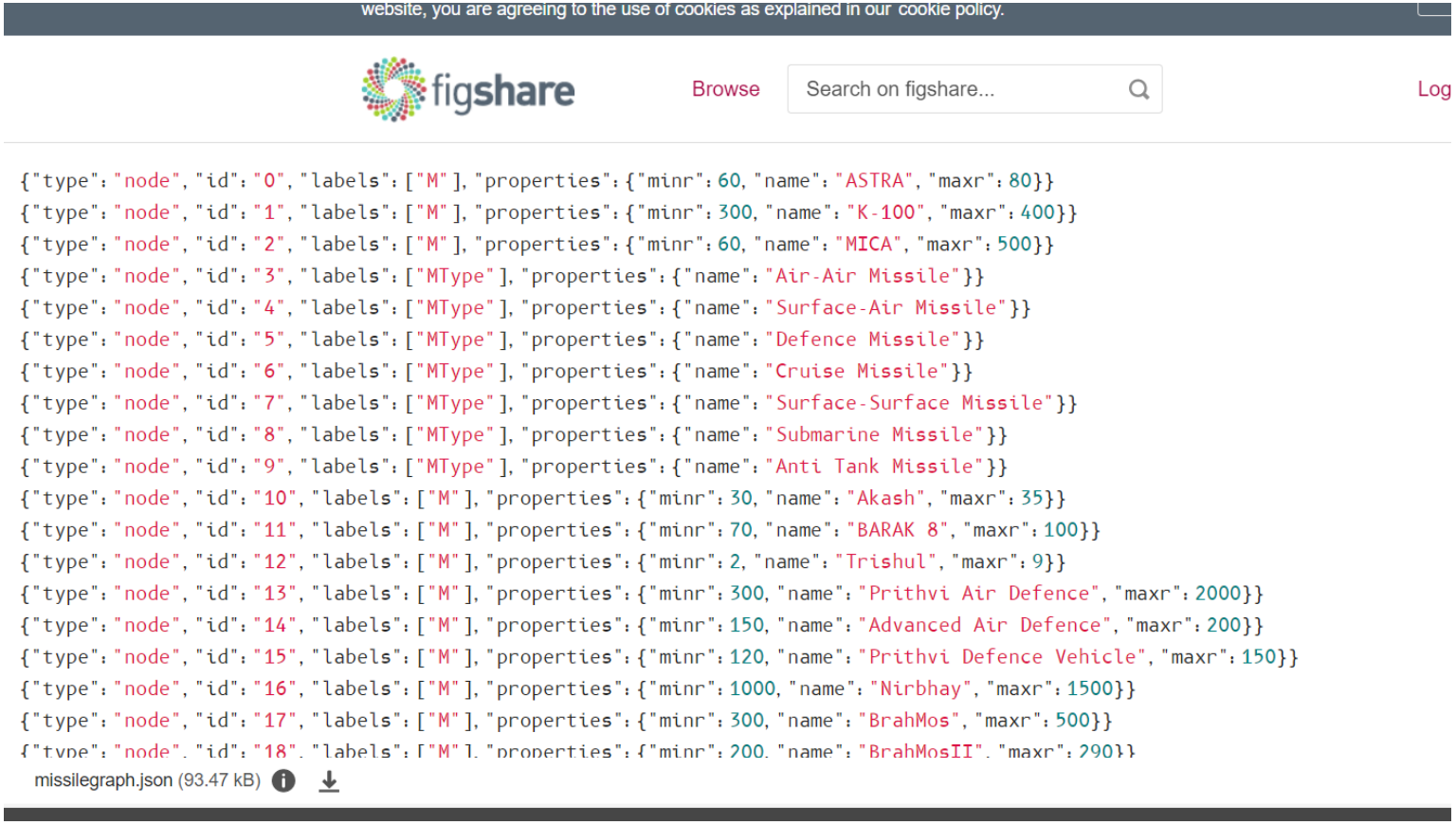

Input
Sentence Splitting
Text Normalization
Sentence Translation Model
Text De-Normalization
Sentence Joining
Output
Saludos. ¿Qué pasa?
'Saludos.', '¿Qué pasa?'
'saludos.', '¿qué pasa?'
'julesajo'ob.', 'ba'ax ku yúuchul.'
'Julesajo'ob.', 'Ba'ax ku yúuchul.'
'Julesajo'ob . Ba'ax ku yúuchul.'
Julesajo'ob. Ba'ax ku yúuchul.


PUT YOUR LANGUAGE HERE
¿Saludos, como estas?
Input Dialect: Spanish


SEE YOUR OUTPUT LANGUAGE RESULT
Julesajo'ob. Ba'ax ku yúuchul.
Output Dialect: Mayan-Yucatan
Translation

KG4ASTRA

KG4ASTRA is constructed as a set of triplets Neo4J and organized all missile information at one place as a complete missile dataset. This dataset is publicly available on the following link: https://figshare.com/articles/dataset/KG4ASTRA_dataset/14248769



KG4ASTRA

Fig. 7 Indian Missile Knowledge Graph

Recent Publications

Journal Papers:

1. Tiwari, S., Al-Aswadi, F.N. & Gaurav, D. Recent trends in knowledge graphs: theory and practice. *Soft Comput* Springer **25,** 8337–8355 (2021). https://doi.org/10.1007/s00500-021-05756-8
2. Dogan, O., Tiwari, S., Jabbar, M.A. A systematic review on AI/ML approaches against COVID-19 outbreak. *Complex Intell. Syst.* **7,** 2655–2678 (2021). https://doi.org/10.1007/s40747-021-00424-8.
3. AISHE-Onto: A Semantic Model for Public Higher Education Universities, Poster in ACM conference DGO 2021. https://dl.acm.org/doi/10.1145/3463677.3463750 (2021)
4. Gupta, S., Tiwari, S., Ortiz-Rodriguez, F. *et al.* KG4ASTRA: question answering over Indian Missiles Knowledge Graph. *Soft Comput* **25,** 13841–13855 (2021). https://doi.org/10.1007/s00500-021-06233-y.

Edited Book:

- Semantic Models in IoT and eHealth Applications, 1st Edition - July 1, 2022, Sanju Tiwari, Fernando Ortiz Rodriguez, M.A. Jabbar, ISBN: 9780323917735, View series: Intelligent Data-Centric Systems: Sensor Collected Intelligence.

https://www.elsevier.com/books/semantic-models-in-iot-and-ehealth-applications/tiwari/978-0-323-91773-5

Running Events-2022

Workshop and Conferences

- TEXT2KG-2022 Co-located with the Extended Semantic Web Conference (ESWC 2022) https://aiisc.ai/text2kg/
- Workshop and Tutorial Co-Chair in Knowledge Graph Conference-2022
- Electronic Governance with Emerging Technologies Conference (EGETC-2022), Springer http://egetc.org/
- Knowledge Graph and Semantic Web Conference (KGSWC-2022), Springer

Upcoming Book Projects:

- "Semantic AI in Knowledge Graphs", Taylor & Francis, Scopus.
- "Personal Health Knowledge Graphs", IET Scopus

Students

Intern Student

- Shivansh Gupta, JIIT Noida (working on KG4ASTRA)
- Anshul Tripathi, University Institute of Technology, RGPV, Bhopal
- Ronak Panchal, Cognizant, India (working with MEXIN)

Master Student

- Baldomero Ferrer Martinez, University of Autonoma de Tamaulipas, Mexico (working on Thesis)
- Ruben Barerra, University of Autonoma de Tamaulipas, Mexico (working with MEXIN)

PhD Scholars

- Yogeshvari Jashvantbhai Makwana, Rai University, Gujarat, India (working with Lietrature Review)
- Patil Madhuri Balasaheb, Rai University, Gujarat, India (working with Literature Review)

Students

UNIVERSIDAD AUTÓNOMA DE TAMAULIPAS

Unidad Académica Multidisciplinaria Reynosa Rodhe

"Desarrollo de interfaz para control estadístico de procesos"

Presenta
Ing. Baldomero Ferrer Martinez

Programa educativo
Maestría en Ciencias y Tecnologías Computacionales

Materia
Expresión Profesional I

Director
Dr. Fernando Enrique Ortiz Rodríguez
Co-Director
Dr. Sanju Tiwari

Q&A

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