OPEND✳28
RED MACARONÉSICA DE DIAGNÓSTICO ABIERTO

Macaronesian Open Diagnostic Network

MAC 2014-2020
Cooperación Territorial

Interreg
Fondo Europeo de Desarrollo Regional
EUROPEAN UNION

OpenDx28 project: open source healthcare software as a service.

An application to early warning for epidemics systems. Technological development and education

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Leibniz Universität Hannover

Content

- ITC-DCCT

- Opendx28 - A European Project under MAC INTERREG Program

- GNU Health integrated into the Train The Trainers Program

- Dockerization of GNU Health

- Development of ETL for the Early Warning System

- Healthcare (O) SaaS - Offering Efficient and Scalable Solutions

Departamento de
Computación Científica
y Tecnológica

Instituto Tecnológico de Canarias

Tecnología e Innovación para un Desarrollo Sostenible

itc INSTITUTO TECNOLÓGICO DE CANARIAS

Gobierno de Canarias

ITC - DCCT SCIENTIFIC COMPUTING DEPARTMENT

Experience:

- **Applied software engineering. Examples:**
  - **I+D+i**
    - Bioinformatics for biodiversity conservation
    - Climate change
    - Sustainable development
    - Support for differents I+D+i areas in ITC
  - **Management:** public administration and business
  - **Others:** agriculture with AI, virtual worlds, websites, etc.
- **~ 26 people**
- **~ 1.7 M€**

Projects:

- **H2020:** MAGIC Nexus, Tilos, Sentinel Energy (subcontracted)
- **MAC, Atlantic Area:** Nextgendem, Climarisk, Datalab, Nauticom, Eeres4water

OpenDx28

MAC 2014 - 2020 149 million (126.5 million ERDF).

Interreg Madeira - Azores - Canarias

Programme Thematic Objectives:

Research and innovation:
- **Improving scientific and technological capabilities in priority sectors**

- **Increase the transfer and dissemination of technology and the cooperation between companies and universities or other research in the priority sectors.**

Better Public administration:
- **Strengthen cooperation strategies between the different actors operating in the programme cooperation area.**

Competitiveness of SMEs

- Creating conditions for the internationalization of enterprises

Combating Climate change

- Increase the transfer and dissemination of technology and the cooperation between companies and universities or other research in the priority sectors

Environment and resource efficiency
- Raising the attractiveness of natural and cultural heritage of tourist areas
- Protect and improve the conservation of natural areas and biodiversity

MAC - Interreg Objectives

1. Economic Development:

- MAC projects bolster economic cooperation, **promoting investment, trade, and enterprise development,** thereby driving regional economies and job creation across the Macaronesian regions, Europe, and Africa.

2. Innovation and Technology:

- They propel innovation and technological advancement, **enabling regions like the Canary Islands to emerge as hubs of knowledge and innovation and promoting technology transfer between Europe and Africa.**

3. Sustainable Development:

- The initiatives champion sustainable development by addressing environmental challenges such as climate change and biodiversity and advocating for the sustainable management of natural resources.

MAC - Interreg Objectives

4. Education and Training:

- **facilitate educational and research cooperation**, enhancing the **human capital of the regions** and aiding the development of skills and knowledge.

5. Social and Territorial Cohesion:

- MAC projects promote social and territorial cohesion by tackling inequalities and fostering social inclusion, thus **improving the quality of life for the populations within the Macaronesian regions, Europe, and Africa.**

6. Infrastructure and Connectivity:

- They enhance infrastructure and connectivity, strengthening transport and communication links and **facilitating mobility and exchange among the regions.**

7. Multilateral Relations:

- They strengthen and cultivate multilateral cooperation and relations among the Macaronesian regions, Europe, and Africa, **enhancing diplomatic and cultural ties** and advocating for peace and stability in the region.

MAC - Interreg program 2014-2020

OpenDx28 - Macaronesian Open Diagnostics Network

Address the difficulties of access to diagnostic procedures for rural communities through the active participation of all public health services in the cooperating territories.

General Objective:

To improve the efficiency of the public health systems of the Canary Islands, Cape Verde, Mauritania and Senegal by strengthening institutional relations **through the exchange of experience, access to medical technology** and facilitating access for the population to improve their health.

Specific Objectives:

1. Improve health management through the implementation of a **health and medical data collection** system and an **early warning system** for communicable diseases.
2. To increase the knowledge and skills of healthcare personnel in the diagnosis and treatment of diseases through a **train-the-trainer programme** in the economic evaluation of health technologies and projects.
3. To set up a system that generates synergies and promotes the exchange of experiences between institutions and people linked to the health sector.

https://www.itccanarias.org/web/es/actividad/proyectos/opendx28

PROJECT PARTICIPANTS

Red Macaronésica de diagnóstico abierto

PARTICIPATING ENTITIES BENEFICIARY OF FEDER (Madeira, Azores,Canary Islands)

Lead Partner: Servicio Canario de la Salud - *Canarias/España*

Socios:

1. Fundación Canaria Instituto de Investigación Sanitaria de Canarias
2. (FUNDACIÓN CANARIA IISC) - *Canarias/España*
3. Instituto Tecnológico de Canarias, S.A. (ITC) - *Canarias/España*
4. Universidad de Las Palmas de Gran Canaria (ULPGC) - *Canarias/España*

PARTICIPANTES DE TERCEROS PAÍSES DEL PROGRAMA (Cabo Verde, Senegal, Mauritania)

Socios:

5. Ministère de la Santé et de l'Action Sociale - *Senegal*
6. Institut de Recherche en Santé, de Surveillance Epidémiologique et de Formation - *Senegal*
7. Ministério da Saúde e da Segurança Social - *Cabo Verde*
8. Hospital Dr. Agostinho Neto - *Cabo Verde*
9. Ministere de la Sante de la Mauritanie - *Mauritania*
10. Centre Hospitalier des Spécialités de la Tête, du Cou et de l´Appareil Locomoteur - *Mauritania*

ITC - DCCT IN OPENDX28

Objective

1. Improve health management through the implementation of a **health and medical data collection** system and an **early warning system** for communicable diseases.

2. To increase the knowledge and skills of healthcare personnel in the diagnosis and treatment of diseases through a **train-the-trainer programme** in the economic evaluation of health technologies and projects.

Our tasks:

1. **Design, prepare and develop infrastructure to support:**
   a. Data collection and health early warning systems
   b. Diagnostic imaging

2. **Transferring knowledge through online courses and workshops.**

OpenDx28 - Train the Trainers

Understanding, replicating and adapting the OpenDx28 services platform and early warning system.

Transfer knowledge acquired by the Scientific Computing Department of the Instituto Tecnológico de Canarias during the development of the OpenDx28 services platform.

The aim is to **train a team of trainers to create teams** with the technical capacity to replicate what was developed during the OpenDx28 project.

At the end of the course the student will be able to **deploy the services: Orthanc, 3DSlicer, DHIS2, GNU Health** in an interconnected way on a server.

OpenDx28 - Train the Trainers

Program Activation:

Initiated in April 2022.

Diverse Participant Pool:

IT technical personnel, university educators, and decision-makers are engaged, fostering a rich learning environment and diverse dialogue.
Enrollment:

The program has attracted around 30 proactive and dedicated participants.

Dynamic Learning Platform:

A comprehensive online course delivering content through enriching video tutorials and interactive video conference sessions, allowing for flexibility and convenience in learning.
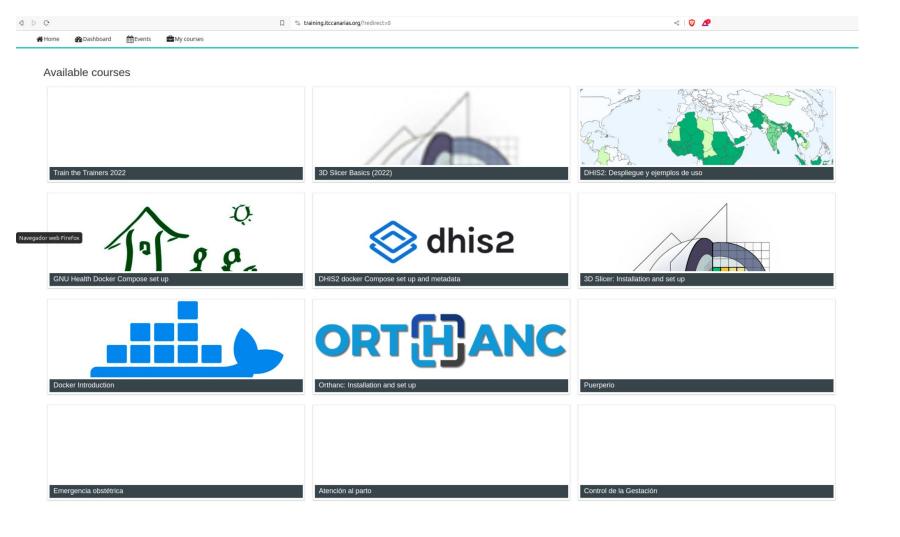
Home   Dashboard   Events   My courses

Available courses

Train the Trainers 2022

3D Slicer Basics (2022)

DHIS2: Despliegue y ejemplos de uso

Navegador web Firefox

GNU Health Docker Compose set up

DHIS2 docker Compose set up and metadata

3D Slicer: Installation and set up

Docker Introduction

Orthanc: Installation and set up

Puerperio

Emergencia obstétrica

Atención al parto

Control de la Gestación

GNU Health & OpenDx28 interreg Project

We first learned about the GNU Health project in summer 2022 and found it could be a great match for Opendx28 because it's:

A Healthcare Management Tool:
- It helps hospitals run smoothly, managing different parts.

Open Source:
- It's free and open for anyone to use or change, fitting well with our open, community-focused values.

Written in Python:
- This makes it easy to change and work with other tech tools.

Flexible:
- It can be adapted to what different hospitals need.

Community and Innovation Focused:
- Its goal to help and innovate aligns well with what we want to achieve in our MAC projects.

GNU Health in the "Train the Trainers" Initiative

Participants (31 in Total) - Delivered Both Online & On-site in Nouakchott:

- Lecturers from the Department of Computer Science at the University of Cape Verde - Cape Verde
- Faculty members from the Department of Computer Science at the Assane Seck University of Ziguinchor - Senegal
- Graduate students from the Computer Science Master's program at the University of Nouakchott

Course Contents:
Guided installation of GNU Health: Both Server and Client sides utilizing Docker - Docker Compose

Main Objective:
To streamline the propagation of the GNU Health system in associated countries through comprehensive training sessions aimed at technical personnel. This is intended to provide them with the requisite knowledge for installing GNU Health demos effectively.

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Engagement and Opportunities - Experience in Nouakchott:

Exceptionally participative and engaging students were afforded the opportunity to attend specialized on-site sessions in Nouakchott, enhancing their learning experience through direct interactions and practical insights working with GNU Health and dhis2.

experience in Nouakchott with both professors and students was incredibly positive

students displayed considerable interest and eagerness in integrating GNU Health within their institutions.

GNU Health Dockerization - Why?

Educational Benefit:

Allows users to explore and understand the program's features in a manageable and easily configurable environment.

Simplification of Installation:

Using Docker significantly eases the installation process of GNU Health for both the server and the client, allowing for speedy, error-resistant deployment.

Accessibility:

Being dockerized, GNU Health can serve as an easily accessible demonstration,giving a quick overview of its capabilities.

Cloud Deployment:

easy cloud deployment, allowing users to access GNU Health anytime, anywhere.

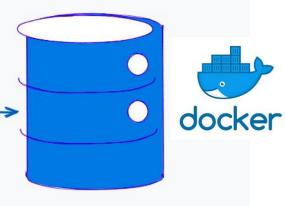**Scalability and Flexibility:**

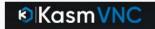y scalability and adaptability to various workloads and needs.
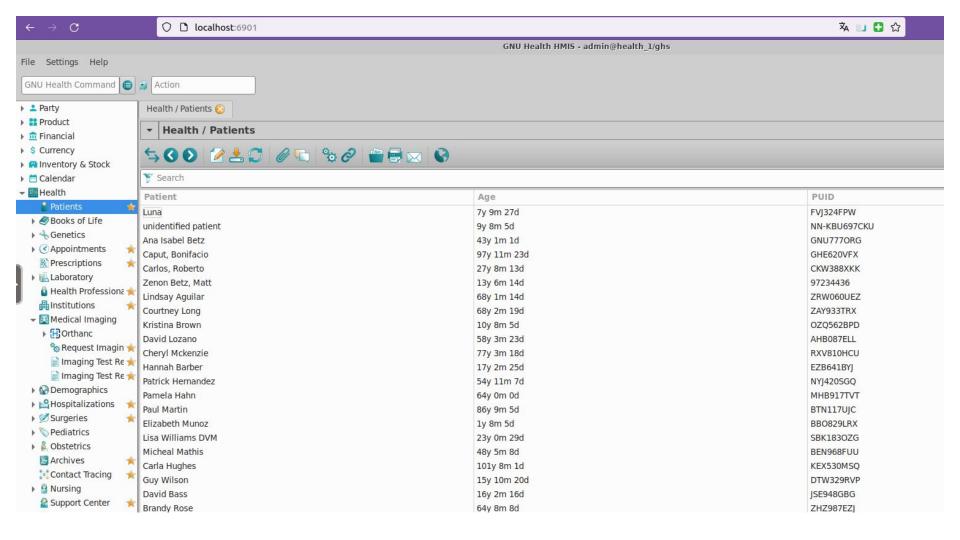
SERVER

POSTGRESQL DB

KasmVNC

WebDav *file system

Client

high-performance, and secure VNC (Virtual Network Computing).
allowing users to interact with remote servers or desktop environments through their web browsers.

File   Settings   Help

GNU Health Command | Action

- ▸ 👤 Party
- ▸ 🛒 Product
- ▸ 🏛 Financial
- ▸ $ Currency
- ▸ 🚁 Inventory & Stock
- ▸ 📅 Calendar
- ▾ 🔬 Health
  - 🩺 Patients ⭐
  - ▸ 📔 Books of Life
  - ▸ ⚛ Genetics
  - ▸ ⏰ Appointments ⭐
  - R Prescriptions ⭐
  - ▸ 🧪 Laboratory
  - 🔒 Health Professiona ⭐
  - 🏢 Institutions ⭐
  - ▾ 🖼 Medical Imaging
    - ▸ 🔗 Orthanc
    - ⚙ Request Imagin ⭐
    - 📄 Imaging Test Re ⭐
    - 📄 Imaging Test Re ⭐
  - ▸ 🌐 Demographics
  - ▸ 🏥 Hospitalizations ⭐
  - ▸ ✂ Surgeries ⭐
  - ▸ 🩹 Pediatrics
  - ▸ 👶 Obstetrics
  - 🗄 Archives ⭐
  - 🔍 Contact Tracing ⭐
  - ▸ 💉 Nursing
  - 🧑 Support Center ⭐

Health / Patients ⊗

▾ **Health / Patients**

🔍 Search

Patient	Age	PUID
Luna	7y 9m 27d	FVJ324FPW
unidentified patient	9y 8m 5d	NN-KBU697CKU
Ana Isabel Betz	43y 1m 1d	GNU777ORG
Caput, Bonifacio	97y 11m 23d	GHE620VFX
Carlos, Roberto	27y 8m 13d	CKW388XKK
Zenon Betz, Matt	13y 6m 14d	97234436
Lindsay Aguilar	68y 1m 14d	ZRW060UEZ
Courtney Long	68y 2m 19d	ZAY933TRX
Kristina Brown	10y 8m 5d	OZQ562BPD
David Lozano	58y 3m 23d	AHB087ELL
Cheryl Mckenzie	77y 3m 18d	RXV810HCU
Hannah Barber	17y 2m 25d	EZB641BYJ
Patrick Hernandez	54y 11m 7d	NYJ420SGQ
Pamela Hahn	64y 0m 0d	MHB917TVT
Paul Martin	86y 9m 5d	BTN117UJC
Elizabeth Munoz	1y 8m 5d	BBO829LRX
Lisa Williams DVM	23y 0m 29d	SBK183OZG
Micheal Mathis	48y 5m 8d	BEN968FUU
Carla Hughes	101y 8m 1d	KEX530MSQ
Guy Wilson	15y 10m 20d	DTW329RVP
David Bass	16y 2m 16d	JSE948GBG
Brandy Rose	64y 8m 8d	ZHZ987EZJ

We need to build 3 different images from Dockerfile repo links

first step vnc base image

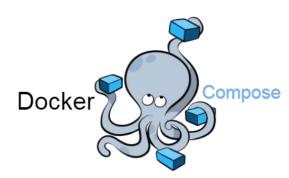https://github.com/OpenDx28/docker-vnc-base

gnu client image:

https://github.com/OpenDx28/docker-gnu-hc
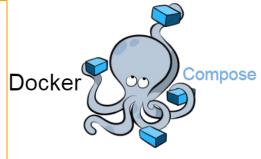
Server, docker compose file and more:

https://github.com/OpenDx28/gnu-health-server-docker

```yaml
1   version: '3'
2   services:
3
4     # docker run -d --name health1 --rm --link postgres -e DB_NAME=ghs1 -p 8000:8000 -p 8069:8069 opendx/gnu_health (DB_NAME cambi
5     health_1:
6       image: opendx/gnu_health
7       build:
8         context: .
9       environment:
10        - DB_NAME=ghs1
11      links:
12        - postgres
13        - thalamus
14      ports:
15        - "8000:8000"
16        - "8069:8069"
17      volumes:
18        - ${VOLUMES_BASE_PATH:-./volumes}/ghs1_local:/home/gnuhealth/gnuhealth/tryton/server/modules/local
19      depends_on:
20        postgres:
21          condition: service_healthy
22
23    health_2:
24      image: opendx/gnu_health
25      build:
26        context: .
27      environment:
28        - DB_NAME=ghs2
29      links:
30        - postgres
31        - thalamus
32      ports:
33        - "8001:8000"
34        - "8070:8069"
35      volumes:
36        - ${VOLUMES_BASE_PATH:-./volumes}/ghs2_local:/home/gnuhealth/gnuhealth/tryton/server/modules/local
37      depends_on:
38        postgres:
39          condition: service_healthy
40
```

Docker Compose

```
# docker run -d --name postgres -e POSTGRES_USER=gnuhealth -e POSTGRES_PASSWORD=gnuhealth -p 5434:5432 postgres:1
postgres:
  image: postgres:15.2-alpine
  environment:
    - POSTGRES_USER=gnuhealth
    - POSTGRES_PASSWORD=gnuhealth
    - PGDATA=/var/lib/postgresql/data/
  volumes:
    - ${VOLUMES_BASE_PATH:-./volumes}/pg:/var/lib/postgresql/data
  ports:
    - "5434:5432"
  healthcheck:
    test: [ "CMD-SHELL", "pg_isready -U gnuhealth -d gnuhealth" ]
    interval: 1s
    timeout: 3s
    retries: 5
```
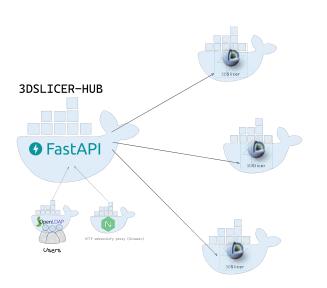
```
# docker run -d --name thalamus_postgres -e POSTGRES_USER=thalamus -e POSTGRES_PASSWORD=thalamus -p 5435:5432 pos
thalamus_postgres:
  image: postgres:15.2-alpine
  environment:
    - POSTGRES_USER=thalamus
    - POSTGRES_PASSWORD=thalamus
    - PGDATA=/var/lib/postgresql/data/
  volumes:
    - ${VOLUMES_BASE_PATH:-./volumes}/pg_thalamus:/var/lib/postgresql/data
  ports:
    - "5435:5432"

# docker run -d --name thalamus --link thalamus_postgres opendx/thalamus
thalamus:
  image: opendx/thalamus
  links:
    - thalamus_postgres
  ports:
    - "8002:8080"
```
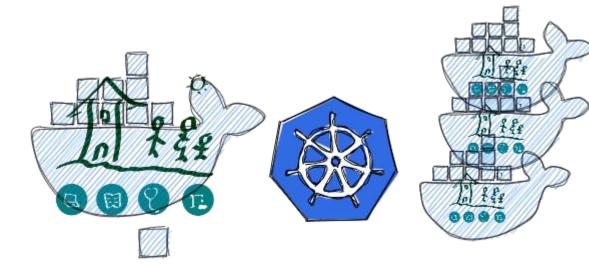
Docker Compose

Next project: GNU Health Client-hub

Leveraging the concept already developed with the 3DSlicer Hub project, we are set to create a launcher for the GNU Health-client.
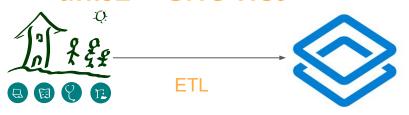
3DSLICER-HUB

Early Warning System:

dhis2 + GNU Health

ETL

Objective:
collects data from each GNU Health instance and DHIS2 displays it as indices, developed in partnership with the Health Economics Department at ULPGC.

2 types of indexes:

1. measure the stress level of a hospital caused by specific diseases, reflecting the strain and demand placed on the hospital's resources and services. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8157374/
2. economic indices that evaluate the hospital's effectiveness, using patient care data as inputs.
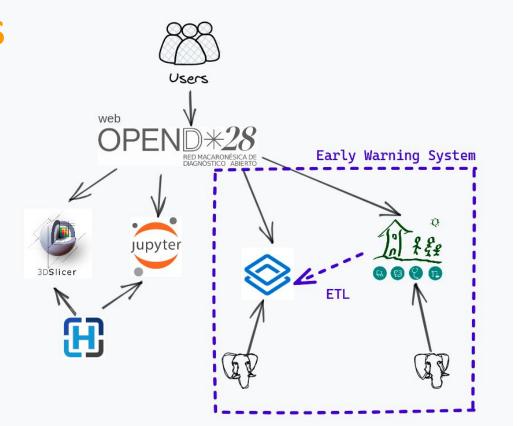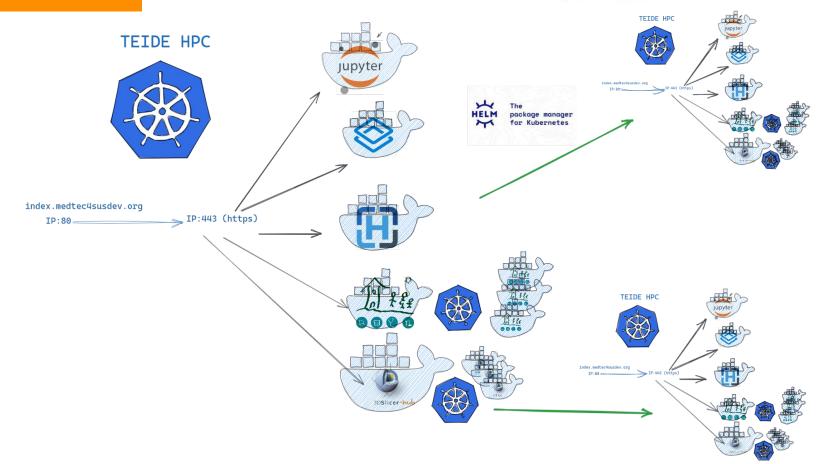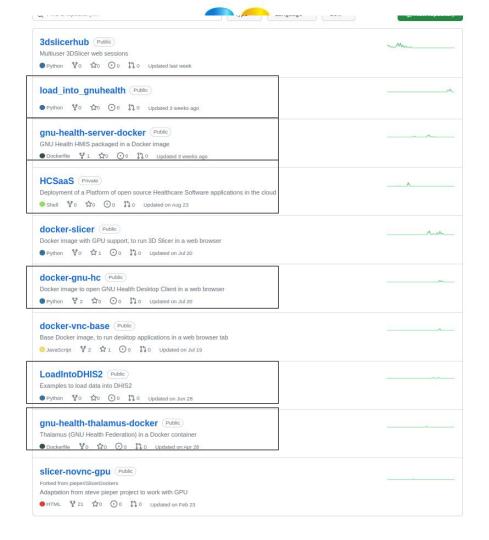
Early Warning System

Healthcare (O)SaaS

+ SSO

Github Public repositories

https://github.com/OpenDx28

Thank you very much

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https://www.itccanarias.org/web/es/