IPHSDM

INTELLIGENT
PERSONAL
HEALTH AND
SAFETY
DOMOTIC
MONITORING

CLUSTERSCC
LOMBARDIA

12 dicembre 2018

Body Network indossata

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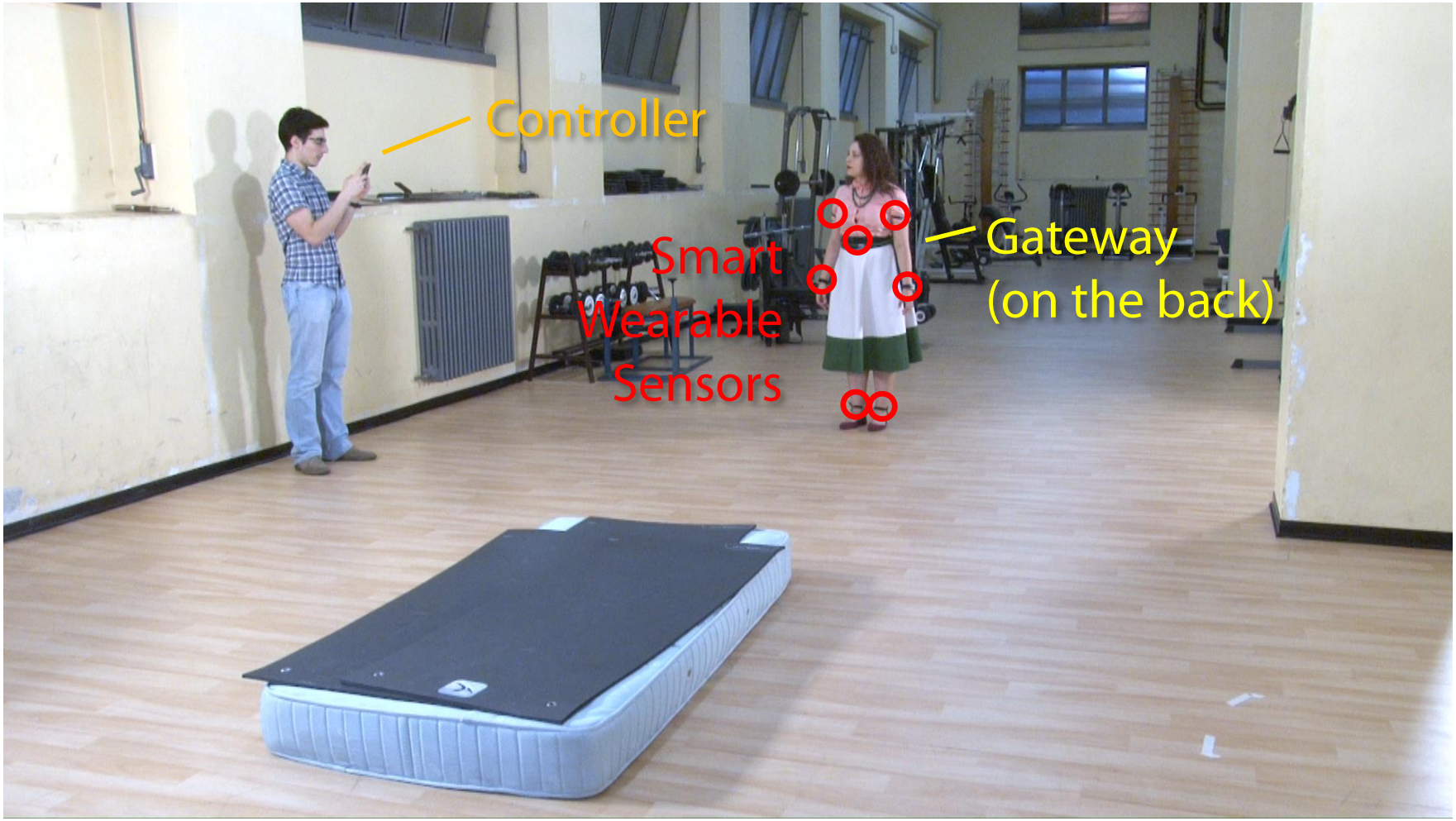

Body Network connessa

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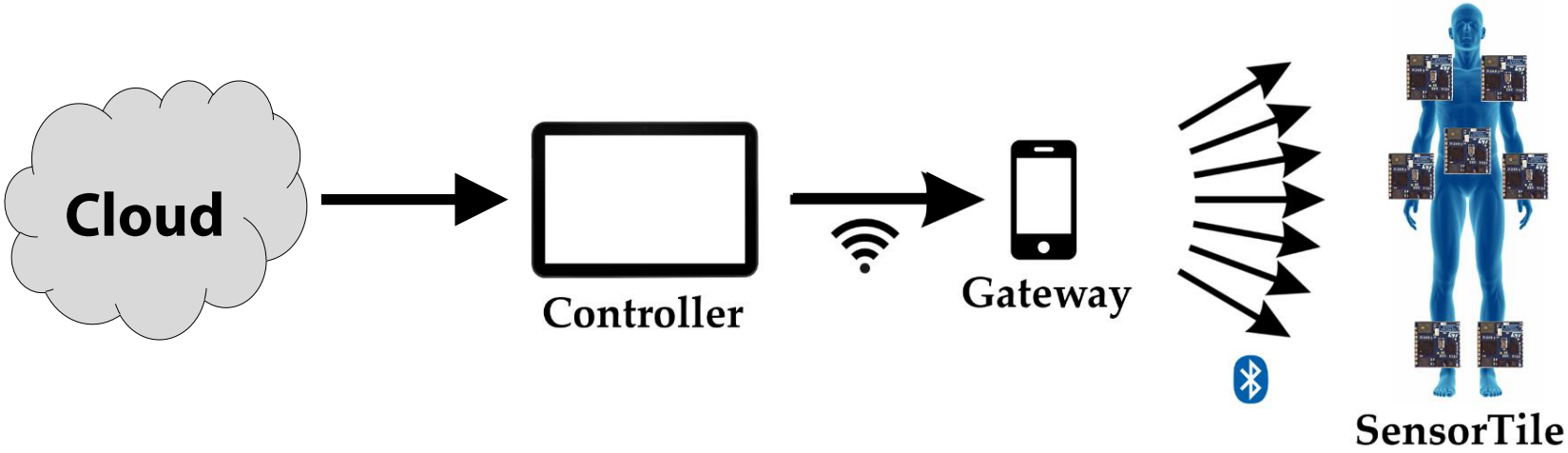

STM SensorTile

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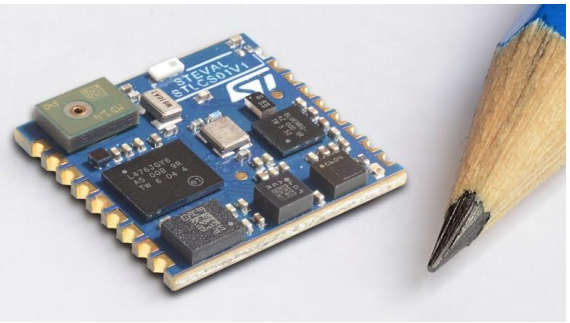
- Microcontroller STM32 (ARM Cortex M4)
  - 80MHz Clock Frequency
  - 128KB SRAM
  - 1MB Flash memory
- Multiple Onboard Sensors
  - Microphone
  - 3D Accelerometer + 3D Gyroscope
  - e-Compass, 3D Accelerometer, 3D Magnetic sensor
  - Barometer
- Peripherals
  - 100 mAh Li-Ion battery
  - Bluetooth Low Energy (BLE) radio module



life.augmented

arm

Edge Computing and IoT: le ragioni

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Edge computing *is a method of optimizing* ***cloud computing systems*** *by taking some portion of an application, its data, or services away from one or more central nodes (the "core") to the other logical extreme (the "edge") of the Internet which makes contact with the physical world or end users* [Wikipedia]

- Problema *cruciale* di **tutti** gli Smart Sensor wireless:

  La trasmissione wireless dei dati grezzi a un nodo centrale per l'elaborazione richiede una potenza eccessiva (ad esempio il SensorTile si scaricherebbe in 2 ore)

  I protocolli IoT Low-Power Wide Area (LPWA: Lora, Sigfox, NB-IoT) ma anche BLE sono ottimizzati per messaggi brevi e sporadici

  In uno Smart Sensor la event detection deve avvenire ***localmente****: i messaggi inviati devono descrivere solo* ***eventi*** *o transizioni di stato*

Reti neurali ricorsive sui sensori

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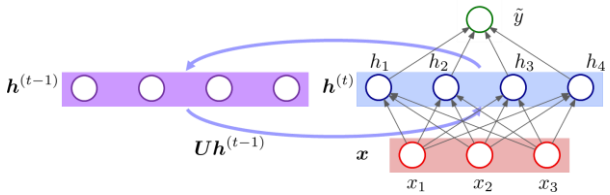
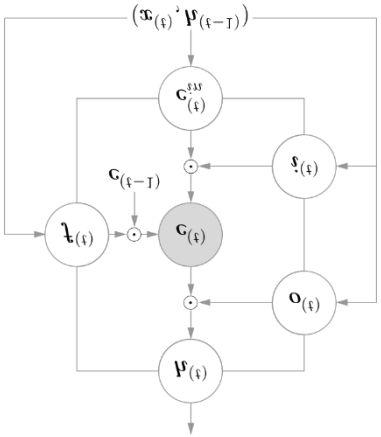
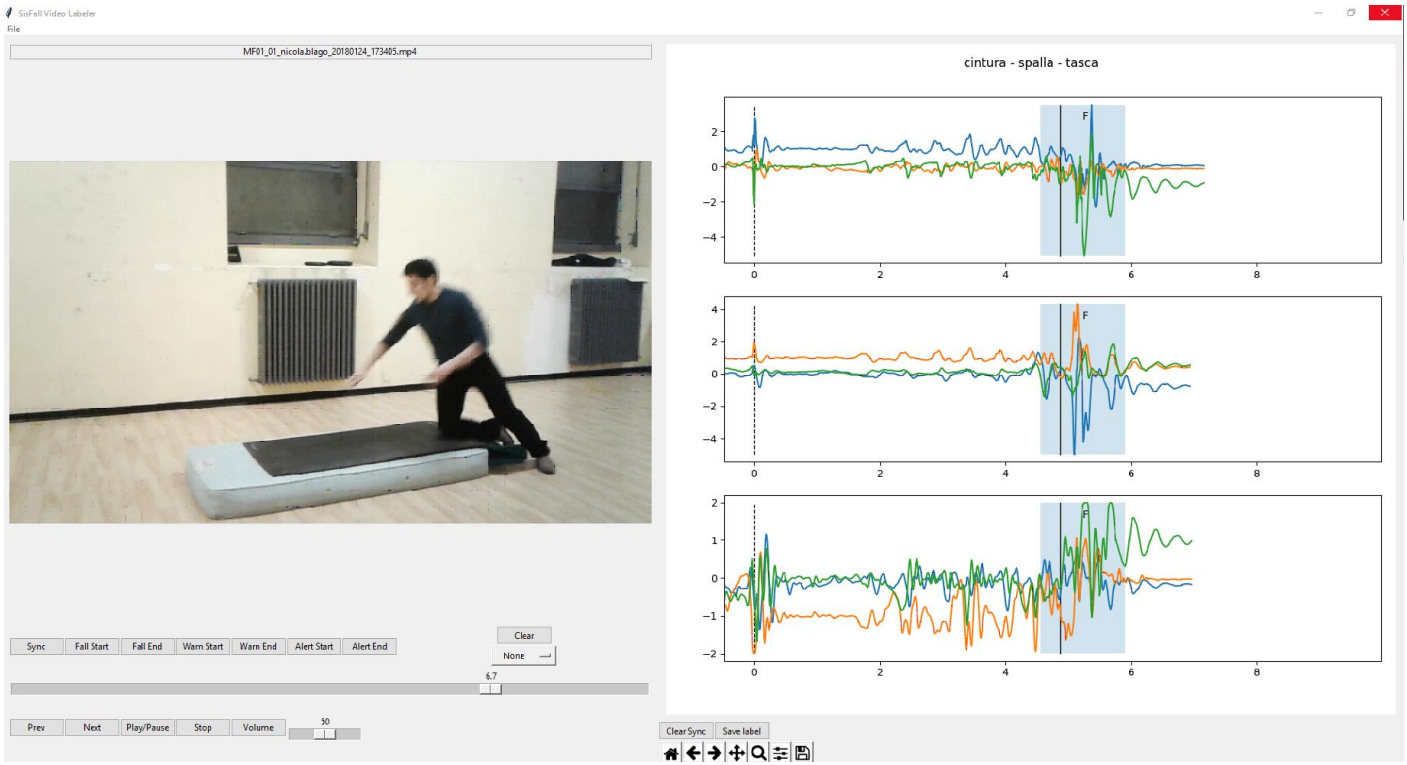
- ***Reti neurali ricorsive***

  Analisi online delle serie temporali (accelerometri, giroscopi)



Long-Short Term Memory (LSTM)





Offline Training, Online Inference

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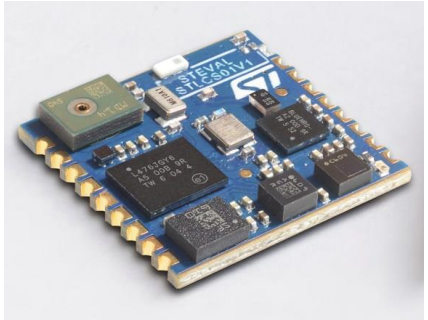
- ***Training su workstation, inferenza embedded nei sensori***

  Deep Learning per sistemi embedded (ARM microcontroller)
  - Training su workstation o in cloud utilizzando TensorFlow con accelerazione GPU
  - I modelli addestrati (in forma binaria) vengono trasferiti sui microcontroller
  - Run-time sviluppato 'ad hoc' per ARM Cortex M4



TensorFlow

NVIDIA

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arm

ML *run-time* per SensorTile

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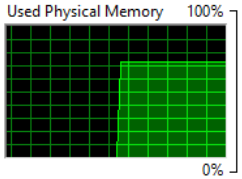
- ***Sviluppo ottimizzato***

  ARM Cortex M4, basso consumo di energia



- I parametri sono tutti memorizzati in RAM

- Classificazione real-time -> tracce di durata di 1 s classificate in 150 ms

- Durata della batteria stimata 72 ore *(in progressivo miglioramento)*

Architettura complessiva

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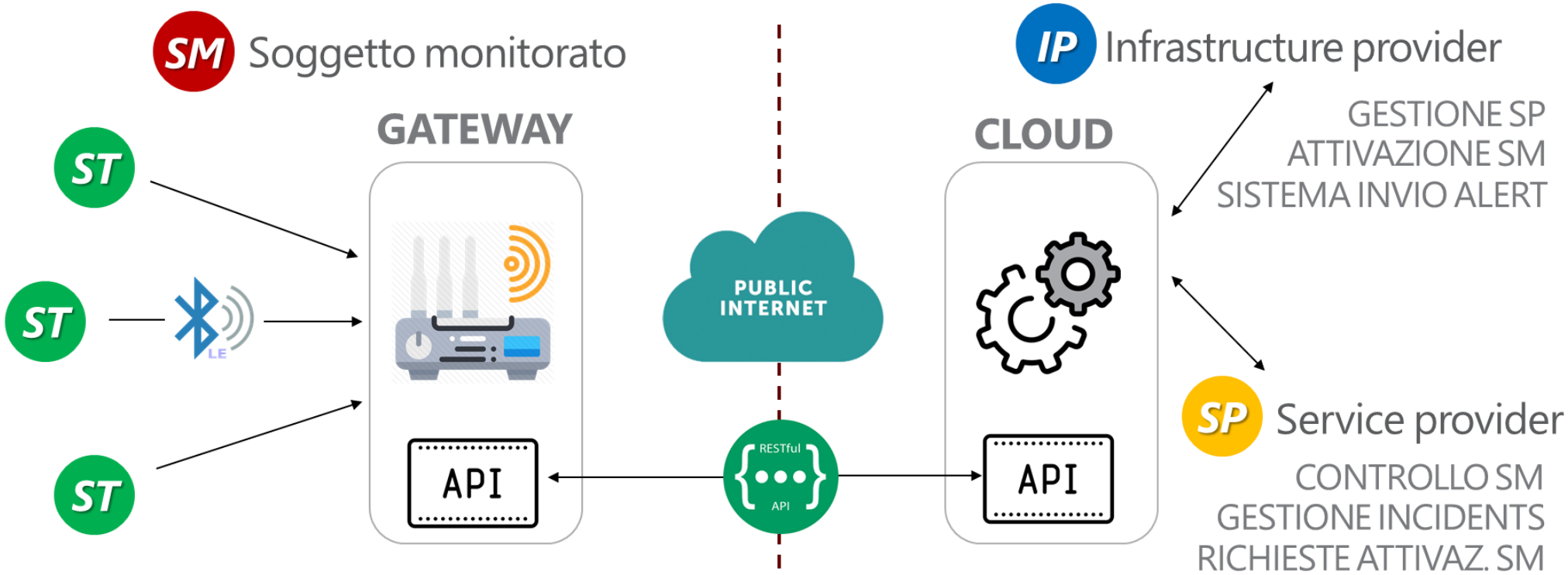

LEGENDA

- SM Soggetto monitorato
- ST Sensor tile
- IP Infrastructure provider
- SP Service provider

Abstract

IPHSDM
INTELLIGENT PERSONAL HEALTH AND SAFETY DOMOTIC MONITORING

Il progetto IPHSDM ha l'obiettivo di sviluppare un'infrastruttura tecnologica intelligente e distribuita per il monitoraggio domiciliare remoto e personalizzato dello stato di salute e del benessere delle persone tramite una rete domotica integrata di Smart Wireless Sensor collegata in cloud con un sistema centralizzato

IPHSDM
Intelligent Personal Health and Safety Domotic Monitoring

Regione Lombardia

Progetto Co-Finanziato
Decreto n. 14782, 24/11/2017 (ID Progetto: 379273)

Inizio: 15 gennaio 2018

Fine: 23 maggio 2019

Partenariato

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Università degli Studi di Pavia capofila

ST Microelectronics Srl

Elexes Srl

Meridionale Impianti Srl

M.T.M. Srl

S.N.J. Media Studio Srl

Grazie per l'attenzione!