University of Messina
MIFT Department
Bachelor Data Analysis

UNIME Internship Project Proposal

ID	PTI_Distefano Salvatore_21/10/2023 17.06.47
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Project Supervisor

Surname	Distefano
Name	Salvatore
Department	MIFT
Laboratory	HPCALAB
Email	sdistefano@unime.ut
Phone Number	

Project Co-Supervisor (not compulsonary)

Surname	
Name	

Job Position	
Department	
Laboratory	
Email	
Phone Number	

Internship Project Details

Title	Human Digital Twins HDT

Detailed Description: The project proposes a methodological and technological framework for the assessment and improvement of physical and mental health and well-being. In spite of the diffusion of smart and wearable biomedical devices for health applications, existing solutions suffer from several limitations. First, there is a lack of approaches able to exploit, in a secure way, the multi-modality of existing health and well-being devices. Second, common health and well-being indicators (e.g., stress level, sleep quality) are evaluated by comparing person measurements to reference models, with little to no personalization to subject-specific characteristics. Third, and perhaps most important, current methods focus on physical well-being, mostly ignoring the subject mental state. However, mental well-being and awareness of mental disorders are becoming critical in today's society, with increasing efforts being directed to prevention and treatment, especially in light of the psychological effects of the COVID-19 pandemic.
We propose a novel methodology for physical and mental health and well-being assessment and improvement, which frames the task - from data capture to well-being prediction, behavioral analysis and recommendations - within a Cyber-Human System (CHS), where we adapt the concept of Human Digital Twin (HDT) into a hierarchical model that encompasses sensory, perceptual, cognitive and awareness/behavioral aspects of an individual.
The project will advance multiple research directions. The HDT sensory infrastructure will face challenges associated with the configuration of heterogeneous, multi-modal devices, including "soft" sensors, e.g., for monitoring user activity on social media or clinical records. The framework perceptual level will focus on securely collecting, storing and aggregating heterogeneous data into a uniform representation, within a publicly-accessible dataset, exploiting Distributed Ledger Technologies (DLT). Well-being assessment models will need to handle the lack of manual data labeling, which would be infeasible due to the scale of the expected datasets and the required domain expertise. Hence, a mixed approach based on formal knowledge representations and on weak/self-supervision will be investigated to train robust and personalized predictive

models. Finally, the digital model of the user health state will be matched to medical guidelines and best practices for identifying and correcting unhealthy behaviors. A case study, monitoring elderly people with chronic diseases, will be implemented to support the design and development of an HDT platform proof of concept. Given the strategic importance of preventing health disorders and associated costs, and the difficulty in identifying and addressing states of mental stress, fatigue and depression, the success of the project may have a significant positive social impact, as well as pave the way towards a new technological framework for well-being assessment and improvement.

Duration (months – max 12)	2
Duration (hours)	100
Potential deadline	
Number of open position	6

Internship Skills

Required skills: Programming	
Other skills	AI, BlockChain, IoT, Cloud