i-PROGNOSIS:
Intelligent Parkinson's early detection guiding novel supportive interventions

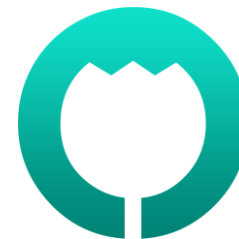# PROTEIN:
Personalized nutrition for healthy living

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U LISBOA | UNIVERSIDADE DE LISBOA   fMH FACULDADE DE MOTRICIDADE HUMANA

i-PROGNOSIS:
Intelligent Parkinson's early detection guiding novel supportive interventions

Project overview & technology

EU-funded Horizon 2020 Research Project

11 EU Clinical, technical & policy-making partners

Coordinated by Aristotle University of Thessaloniki, Greece

> 3,500 stakeholders involved

in design, data collection and system validation

4 years

Project ended March 2020

~ 4,000,000 €

EU funding

1 Early Parkinson's Disease screening

Develop ICT-based tools for the early screening of Parkinson's disease (PD)

2 Novel Supportive Interventions

Develop ICT-based interventions for sustaining the quality of life of persons with Parkinson's (PwP)

José Mourinho
i-PROGNOSIS Ambassador

1 Parkinson's disease screening

Extraction of Digital Biomarkers

1 **Focus on everyday tech**
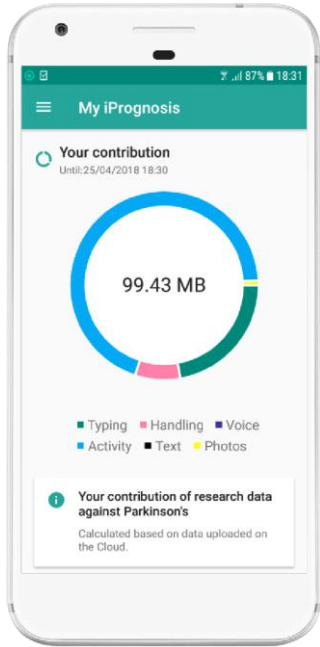Smartphones and wearables

2 **Collect data passively**
Minimize user engagement - boost adherence

3 **Target motor and non-motor symptoms**
Prodromal + clinical phase

4 **Employ AI**
Including cutting-edge machine learning

iPrognosis app

The main data collection
vehicle for Android devices

iPrognosis Wear app

Companion data collection app
for Wear OS wearables

iPrognosis Smart Belt

Prototype device developed during
the project

2 Supportive interventions

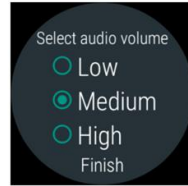## iPrognosis games

A suite of serious games for
Android devices

Skeleton-tracking sensor

For interfacing with Exercise games

(a)   (b)   (c)   (d)

1   2   3   4

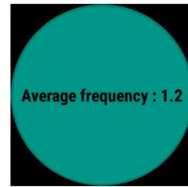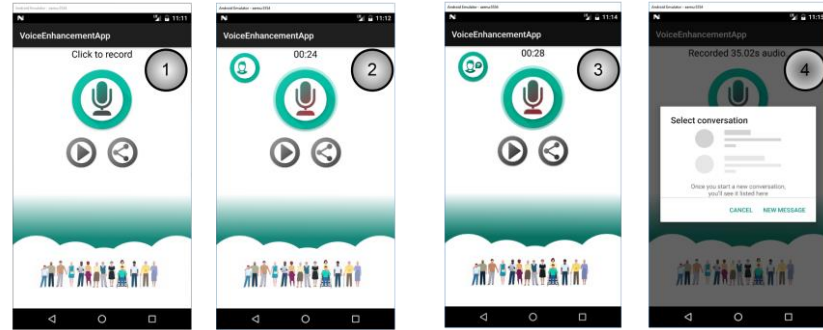## Walking assistant

Early prototype for a smartwatch app that assists PwP with gait based on adaptive rhythmic acoustic and/or vibration cues.

Voice enhancement

A smartphone app targeted for PwP that allows them to record voice messages that are enhanced in terms of voice quality and can be shared to compatible apps, e.g. WhatsApp

Datasets

DATA COLLECTION (ETHICS + GDPR COMPLIANT)

GData study
Remote data crowdsourcing from smartphones via the iPrognosis application for Android (available on Play Store).
- >2,500 participants
- 10 countries (EU, UAE & Australia)
- ~ 200 GB of data

SData study
In-the-wild data collection + clinical assessment study by i-PROGNOSIS clinical partners in UK, Germany and Greece.
- >100 participants
- GData + data from wearables
- Clinical assessment (x2) of participants

IData study
Feasibility study for the iPrognosis games by i-PROGNOSIS clinical partners in UK, Germany and Greece.
- >30 participants
- Game metrics + Skeleton data
- User feedback

Small-scale data collections
Small-scale data collections in lab conditions and under stricter protocols for early proof of concept and algorithm development.
- 6 different experiments
- Data collection related to G/SData
- Clinical assessment of participants

PUBLICATIONS

FEB 2016 – JAN 2017

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[3] S. Hadjidimitriou, et al., "Active and healthy ageing for Parkinson's Disease... perspective within the i-PROGNOSIS framework ☐," *1st International Conferenc*... in Sports, Health and Wellbeing, Vila Real, Portugal, 2016.

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[5] S. Dias, et al., "On supporting Parkinson's Disease patients: The i-PROGN... design approach ☐," *30th IEEE International Symposium on Computer-Based*... Greece, 2017.

[6] S. Dias, et al., "Serious Games as a means for holistically supporting Park... i-PROGNOSIS Personalized Game Suite framework ☐," *9th International Con*... Games for Serious Applications, Athens, Greece, 2017.

[7] L. Klingelhoefer, et al., "iPrognosis – towards an early detection of Parkin... application ☐," *German Society Of Neurology Annual Meeting 2017*, Leipzig, G...

[8] S. Dias, et al., "Moving towards a sustainable management of Parkinson's... Personalized Game Suite approach ☐," *4th Annual Conference of redeSAÚDE,*...

[9] H. Jaeger, et al., "I-PROGNOSIS: Verwendung von sprachmerkmalen als b... Parkinson-erkrankung ☐," *44th German Annual Conference on Acoustics (DAG*...

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[10] D. Iakovakis, et al., "Touchscreen typing-pattern analysis for detecting fine motor skills decline in early-stage Parkinson's disease ☐," *Scientific Reports 8(1)*, 2018. doi: 10.1038/s41598-018-25999-0

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[12] T. Savvidis, et al., "Exergames for Parkinson's Disease patients: How participatory design led to technology adaptation ☐," *Studies in Health Technology and Informatics, Data, Informatics and Technology: An Inspiration for Improved Healthcare*, vol. 251, pp. 78-81, 2018. doi: 10.3233/978-1-61499-8...

[13] M. Tanuadji, et al., "Automatic estimation of the triangular vowel space area from i-... Parkinson's Disease ☐," *ITG Fachtagung Sprachkommunikation/Speech Communication*, Ol... 2018.

[14] D. Iakovakis, et al., "Motor impairment estimates via touchscreen typing dynamics t... disease detection from data harvested in-the-wild ☐," *Frontiers in ICT, section Digital Heal*... 10.3389/fict.2018.00028

[15] A. Grammatikopoulou, et al., "Selfie photo analysis for detecting hypomimia sympto... Parkinson's disease (PD)," *ADVPD 2019 conference*, Lisbon, Portugal, 2018.

[16] K. Kyritsis, et al., "Modeling Wrist Micromovements to Measure In-Meal Eating Beha... Sensor Data ☐," *IEEE Journal of Biomedical and Health Informatics*, 2019. doi: 10.1109/JBH...

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[19] D. Iakovakis, et al., "Early Parkinson's Disease Detection via Touchscreen Typing Analysis u... Convolutional Neural Networks ☐", *IEEE EMB Conference 2019*, 2019.

[20] A. Papadopoulos, et al., "Multiple-Instance Learning for In-The-Wild Parkinsonian Tremor... *IEEE EMB Conference 2019*, 2019.

[21] D. Iakovakis, et al., "Towards unobtrusive Parkinson's disease detection via motor sympto... inference from multimodal smartphone-sensor data ☐", *International Congress of Parkinson's D*... Movement Disorders 2019, 2019.

[22] L. Klingelhöfer, et al., "Medical evaluation as gold standard to control iPrognosis applicati... for early Parkinson's disease detection ☐", Abstract No 2165., *International Congress of Parkins*... Movement Disorders 2019, 2019.

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[27] A. Grammatikopoulou, N. Grammalidis, S. Bostantjopoulou, Z. Katsarou, "Detecting hypomimia symptoms by selfie photo analysis: for early Parkinson disease detection ☐", *Proceedings of the 12th ACM International Conference on PErvasive Technologies Related to Assistive Environments*, 2019.

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[29] A. Papadopoulos, K. Kyritsis, L. Klingelhöfer, S. Bostantjopoulou, K. R. Chaudhuri, A. Delopoulos, "Detecting Parkinsonian Tremor from IMU Data Collected In-The-Wild using Deep Multiple-Instance Learning ☐", *IEEE Journal of Biomedical and Health Informatics*, 2019. doi: 10.1109/JBHI.2019.2961748

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[31] D. Iakovakis, S. Hadjidimitriou, V. Charisis, N. Anastasia, I. Dagklis, S. Bostantjopoulou, Z. Katsarou, L. Klingelhoefer, S. Mayer, H. Reichmann, D. Trivedi, A. Podlewska, K. R. Chaudhuri, L. Hadjileontiadis, "Upper Extremity Motor Symptoms' Severity Estimation with Ecologically Valid Data Arising from Smartphone Touchscreen", *American Academy of Neurology Annual Meeting*, 2020.

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http://www.i-prognosis.eu

Current state and future

Rated as 'Excellent' by the EC

The i-PROGNOSIS project was rated as "Excellent" after the final review by the European Commission and independent monitors

Most Innovative Project award

AgeingFit 2020: The i-PROGNOSIS project was voted as the most innovative project among 200 contenders

ai·prognosis

From i-PROGNOSIS to AI-PROGNOSIS: a new funding proposal will be submitted in June 2022 to EU for a follow-up project and continuation / expansion of R&D.

Real world experience: The proposal foresees that mature i-PROGNOSIS technologies and new ones will be tested with users and healthcare professionals.

EU-funded Horizon 2020 Research Project

20 expert, technical & policy-making partners
Coordinated by Center for Research & Technology (CERTH), Greece

~ 25,000 users involved
25000 users for all 20 pilots for the duration of the pilots

3,5 years
From Jan 2019 to June 2022

~ 7,000,000 €
EU funding

OVERALL OBJECTIVE

The overall objective of the PROTEIN research project is to promote healthy lifestyles, in order to improve the general state of health of the European population, using the latest technologies to offer advanced personalization tools for nutrition and physical activity plans.
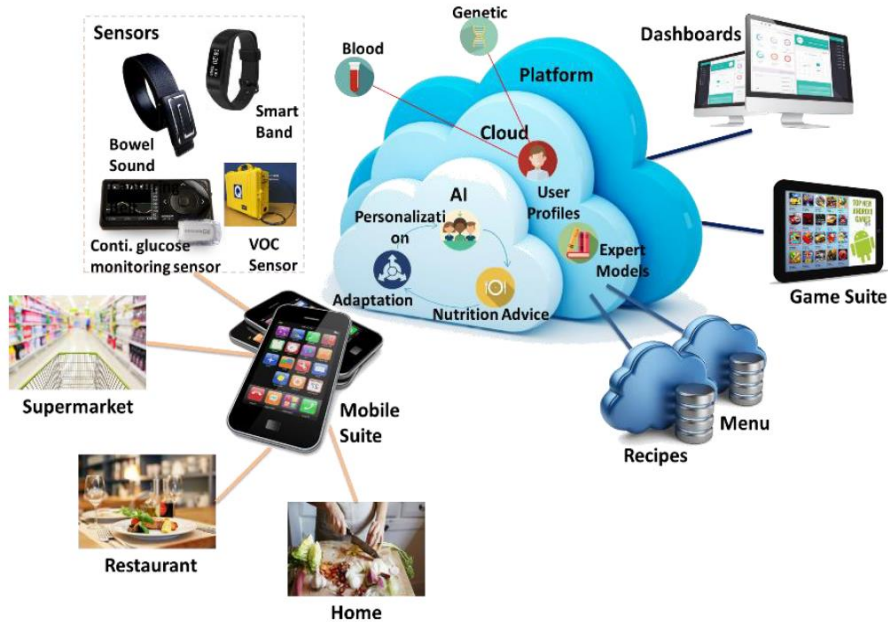
THE PROTEIN APPROACH

1 Multimodal sensing technologies
Smartphone, smart band, smart belt, smart scale, volatile organic compounds sensor (VOC)

2 Mobile technologies
Mobile app suite in various environments (supermarket, restaurant, home)

3 Artificial Intelligence
User modelling, personalization and system adaptation

4 Web technologies
Dashboards for users, nutritionists and medical experts

5 Gamification and games
Dietary games

FOR WHOM IS THE PROTEIN PROJECT?

CITIZENS OF THE EUROPEAN UNION

The general public, including youth and seniors, who are motivated to improve their health through healthy eating and physical activity.

PEOPLE WITH SPECIFIC NUTRITIONAL NEEDS

Individuals living with chronic diseases who are under medical or nutritionist supervision.

HEALTHCARE PROFESSIONALS

Clinicians who provide care for individuals living with chronic diseases or people who special nutrition and physical activity care plans.

DISTRIBUTORS AND FOOD SUPPLIERS

Business leaders in the food retail and restaurant industry who want to offer personalized experiences and services to their clients.

INTERDISCIPLINARY RESEARCHERS

Scientists in areas of nutrition, physical activity, chronic disease, social sciences, and Information and Communications Technologies (ICT).

DECISION MAKERS

Individuals who are working on nutrition, physical activity and chronic disease policies across Europe.

PROTEIN CONSORTIUM

(20 partners from a total of 11 European countries)

HOW DOES THE PROTEIN PROJECT WORKS?

EXPERT KNOWLEDGE

Collection of real life and scientific evidence that will inform the PROTEIN ecosystem in terms of user needs, preferences, and personalized goals.

DATA EXTRACTION

Analysis of data collected through mobile and intelligent devices and deep learning techniques that will inform personalized plans, metrics, and outcomes.

USER PROFILES

Creation of end user profiles leveraging artificial intelligence algorithms that will provide individualized health device through the PROTEIN Game Suite.

PUBLICATIONS

NOISE-ASSISTED MULTIVARIATE VARIATIONAL MODE DECOMPOSITION

INFO@PROTEIN-H2020.EU ☐ February 16, 2021

Charilaos A. Zisou, Georgios K. Apostolidis, Leontios J. Hadjileontiadis The variational mode decomposition (VMD) is a widely applied optimization-based method, which analyzes nonstationary signals concurrently. Correspondingly, its recently proposed multivariate extension, i.e., MVMD, has shown great potentials in analyzing multichannel signals. ...

A DEEP NETWORK FOR AUTOMATIC VIDEO-BASED FOOD BITE DETECTION

INFO@PROTEIN-H2020.EU ☐ January 20, 2021

Dimitrios Konstantinidis, Kosmas Dimitropoulos, Ioannis Ioakimidis, Billy Lang-Le, Petros Daras Past research has now provided compelling evidence pointing towards correlations among individual eating styles and the development of (un)healthy eating patterns, obesity and other medical conditions. In this setting, an automatic, ...

A CROSS-MODAL VARIATIONAL FRAMEWORK FOR FOOD IMAGE ANALYSIS

INFO@PROTEIN-H2020.EU ☐ November 13, 2020

T. Theodoridis, V. Solachidis, K. Dimitropoulso, and P. Daras   Food analysis resides at the core of modern nutrition recommender systems, providing the foundation for a high-level understanding of users' eating habits. This paper focuses on the sub-task of ingredient recognition from ...

SINGLE IMAGE-BASED FOOD VOLUME ESTIMATION USING MONOCULAR DEPTH-PREDICTION NETWORKS

INFO@PROTEIN-H2020.EU ☐ September 18, 2020

Graikos A., Charisis V., Iakovakis D., Hadjidimitriou S., Hadjileontiadis L. (2020) Single Image-Based Food Volume Estimation Using Monocular Depth-Prediction Networks. In: Antona M., Stephanidis C.   In this work, we present a system that can estimate food volume from a single input ...

A SURVEY ON AI NUTRITION RECOMMENDER SYSTEMS

INFO@PROTEIN-H2020.EU ☐ September 18, 2019

Thomas Theodoridis, Vassilios Solachidis, Kosmas Dimitropoulos, Lazaros Gymnopoulos, and Petros Daras   The goal of this work is to provide an overview of existing approaches regarding AI nutrition recommender systems. A breakdown of such systems into task-specific components is presented, as well ...

https://protein-h2020.eu

Obrigada pela vossa atenção

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