# PEGASO

## FIT FOR FUTURE

# Prevention as a lifestyle: the project
## "PEGASO, FIT FOR FUTURE"

*Smartphones, wearable devices, community and videogames
as instruments of health*

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*"Poor dietary habits and a lack of physical activity also mean coping with associated serious public health issues such as obesity. With about half of the population in Europe now considered over-weight or obese, the occurrence of diabetes and metabolic syndrome is on the rise." (Copenhagen Research Forum – Visions for Horizon 2020)*

**Introduction**

Today obesity represents a big challenge for healthcare, in particular in the western world where the related costs amount to about 8% and on the rise. More specifically childhood obesity is a predictive factor for obesity in adulthood and an indicator of high-risk for the insurgence of related pathologies such as hypertension, type 2 diabetes, metabolic diseases, sleep disorders in addition to presenting critical issues for the social and psycho-logical aspects. Prevention, therefore, is to be considered not just in terms of its economics for its potential to contribute to the reduction of healthcare related costs – which is nonetheless an urgent need for the future of public healthcare in the western society – but foremost a human and ethic aim and a challenge for the development of new generation services.

Here are some key figures on obesity. Worldwide obesity has more than doubled since 1980. In 2014, more than 1.9 billion adults, 18 years and older, were overweight. Of these over 600 million were obese. 39% of adults aged 18 years and over



Fig.1 The key teenagers' challenges focused by the PEGASO project.

were overweight in 2014, and 13% were obese. Most of the world's population live in countries where overweight and obesity kills more people than underweight. 41 million children under the age of 5 were overweight or obese in 2014.

If current trends continue the number of overweight or obese infants and young children globally will increase to 70 million by 2025. Without intervention, obese infants and young children will likely continue to be obese during childhood, adolescence and adulthood. Obesity in childhood is associated with a wide range of serious health complications and an increased risk of premature onset of illnesses, including diabetes and heart disease. These comorbidities at cardiovascular and metabolic level represent the main death causes and health expenditure. But Obesity is preventable.

Prevention is a very difficult subject, first of all because it starts from the absence of pathological

Fig.2 The main blocks of the PEGASO platform.
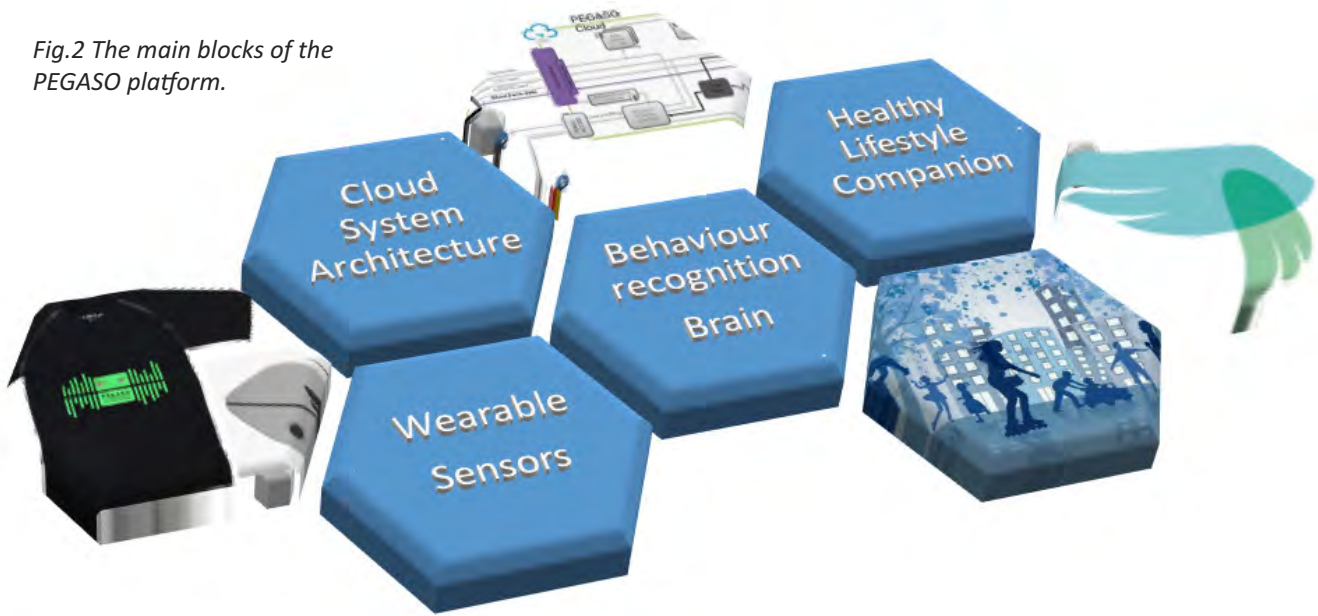
states, which as such does not push individuals to worry about things that are not evident in their everyday life. In addition, prevention is something that considers the individual as a whole, not only in the physical/physiological dimension, but also in the social, psychological and behavioural dimensions. Furthermore, by definition, prevention must start in the younger age to ensure that diseases do not occur in the later stages in life. From these considerations, the Pegaso project moved its first steps and, at the same time, it is possible to understand the intrinsic complexity of the project; such complexity exponentially increases when considering subjects, such as the teen-agers, who are not always cooperative and for whom growth and development go hand in hand with a rebel attitude towards rules and customs. Indeed, prevention is not just a clinical fact and does not consist on taking medications (as there no pathology to be cured), but must be implemented by means of the adoption of a balanced and healthy lifestyle in terms of nutrition, physical activity and overall behaviour implying a real cultural change.

For the above reasons, prevention can be implemented only by an inter-generational approach involving education, collaboration and co-responsibility that take place in all contexts where young people live: home, schools, groups of friends, sports and hobbies.

Recent developments identify Serious Games as an interesting motivational instrument in healthcare to ensure a better adherence to rehabilitation or pharmacological pathways. This instrument fits well in the younger generations – the digital natives – with the most advances communication technologies and with the multimedia tools (smartphones, tablets, etc.) nowadays inseparables companions and instruments of socialization. Such instruments represent the shared technology platform that is used by the project to provide prevention services with a novel mHealth approach.

Such services, however, are not provided in a top-down manner but they are designed together with the users: the methodological approach of User Centred Design leads the shared and participatory development of services for and with the teen-agers, with a potentially winning strategy for the success of the project.

**The "PEGASO – Fit for Future" project**

Challenging teenagers in the context of their own areas of interest, PEGASO – Fit 4 Future aims at promoting sustainable behaviours geared towards achieving healthy lifestyles. These goals of the PEGASO Project were achieved by implementing innovative Mobile Solutions for Prevention in HealthCare thanks to the development of a multi-

*Fig.3 The PEGASO sensors kit with the smart bracelet, the sensorized t-shirts and the related electronic device.*

dimensional and cross-disciplinary ICT system that includes game mechanics to influence behaviours in order to fight and prevent overweight and obesity in the younger population by encouraging them to become co-producers of their wellness and take an active role in improving it by.

PEGASO leverages a modular behaviour change platform targeting teenagers in preventing obesity and related comorbidities in which the Smart-phone is thought as central element and agent for behaviour change and additional sensors could be used with a modular approach. The platform is designed as a positive message and tool dedicated to teenagers, to improve their lifestyle according to 4 dimensions:

• Move, i.e. adopting an active lifestyle because increasing sedentariness together with unhealthy eating habits in our everyday life are producing negative effects on the health of the younger generations, in particular in terms of increased body weight and potential development of metabolic diseases;

• Play, i.e. enjoy for a continuous engagement and, therefore, compliance;

• Eat, i.e. know and like food for a tasty but balanced nutrition;

• Share, i.e. you are not alone but thanks to the social approach…

The project has developed an educational platform able to motivate people by means of games and group challenges – virtual and real – with a social approach where people influence each other: an ecosystem of coordinated mobile apps, a virtual community, an educational game and wearable devices to monitor physiological parameters.

PEGASO is based on a mobile platform in which the smart-phone is the converging technology, i.e. the first and key sensor system. The mobile device also acts as communication gateway towards the other sensors. In addition, with a modular approach, wearable sensors can be added to the system, according to the users' preferences:

• A bracelet that monitors physical activities, called WWAT (Waterproof Wearable Activity Tracker). Sensors embedded in a bracelet give more precise measurements than the phone and can be worn 24/7.

• A smart garment that monitors fitness/sport activities, and its WES (Wearable Electronic System). It is expected that while in the everyday activities people will not want to wear complex sensor systems, they might be willing to put on additional sensors when performing specific activities oriented at improving the level of fitness.

The Feedback System of the PEGASO system is the Companion. The PEGASO Health Companion represents the guidance system and is the main interface between the user and the PEGASO system. The PEGASO Health Companion is a Personal Digital "Friend" acting as a daily-life guide for Coaching, Caring for, and Empowering teenagers in their activities toward healthy habits. Main attributes of the PEGASO Companion are:

• Digital: The Companion exists in the smartphone;

• Personal: The Companion is customized to the single user;

• Friend: The Companion would establish an affective relationship with the user;

• Daily-life guide: The Companion accompanies the users (coaching, caring and empowering) during their daily activities toward healthy habits: supporting behaviour change to promote healthy lifestyles is the main goal of the Companion and PEGASO project in general with special focus on obesity prevention.

The Companion is an ecosystem of different elements, apps and services. In the PEGASO vision for teenagers, the Companion wants to be a compass to guide towards a healthy lifestyle. From the user perspective, the Companion is structured as follows:

The main app is the Companion, that represents the entry point for the user inside the PEGASO universe. A set of other Apps are integrated in the Companion: They are different apps in support of development of awareness and support of motivation towards healthy behavior, and that are accessed via the Companion:

• eDiary, to record food consumption;

• Challenges, to set goals against the system or among friends;

• Dashboard, providing an overview of current achievements;

• PEGASO City, linked to gamification and city marketplace;

• Mobile Serious game, a key component to provide education and motivation;

• Report app, linking PEGASO to healthcare system.

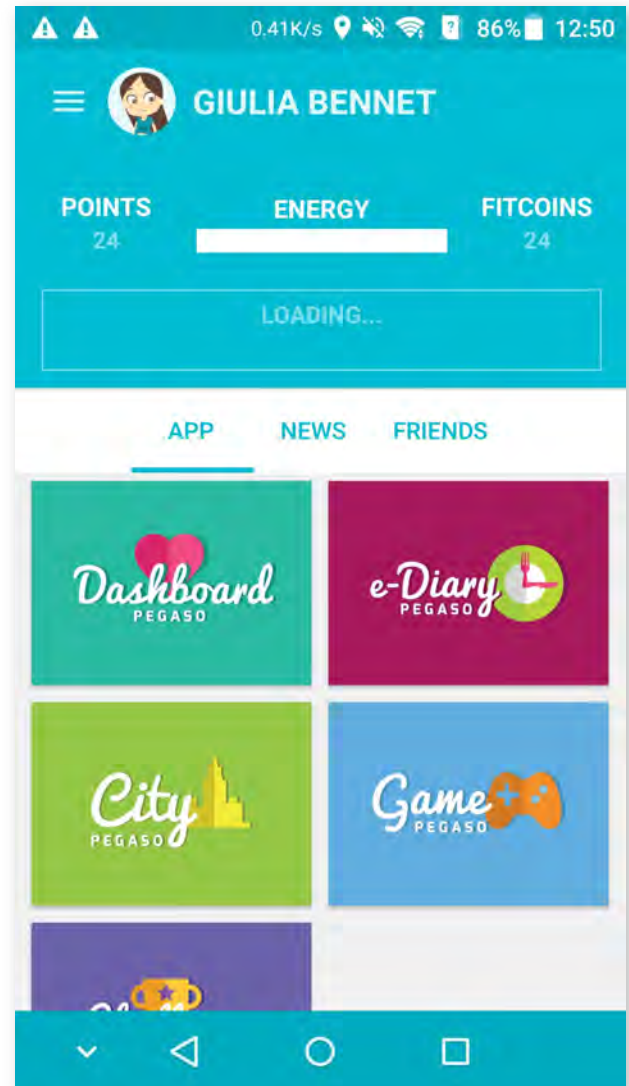Through an innovative and multidimensional



*Fig.4 The PEGASO Companion main window.*

PEGASO Virtual Individual Model, a conceptual framework of basic relations between the individual's status and behaviours in different domains, which are considered to dynamically concur to health, have been built.

This allowed to set up an efficient User Feedback System: The PEGASO Behaviour Recognition is the core of the reasoning system aiming at the identification of behaviours and match with Target Behaviours. The scoring system is based on 3 levels:

• A short-term analysis;

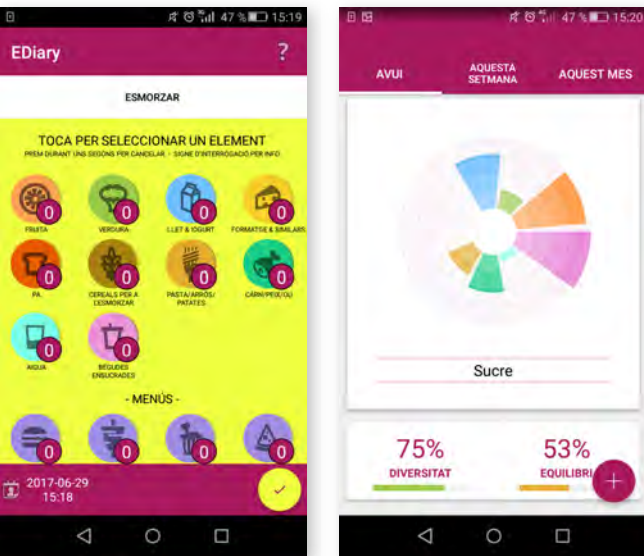• A long-term analysis;

• An overall Risk analysis.
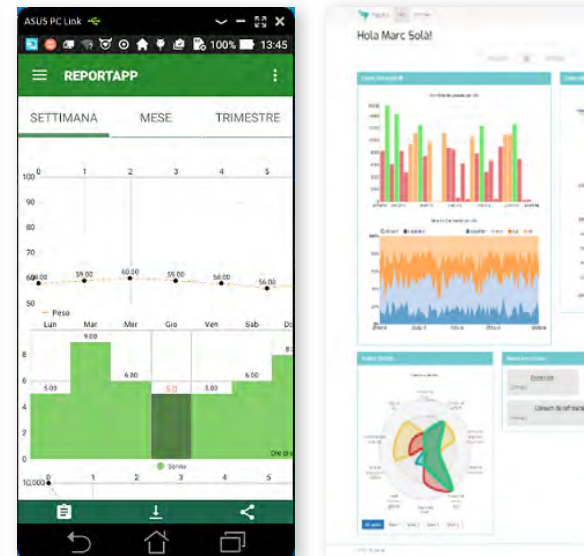
Fig.5 The PEGASO eDiary App in the catalan version.

Fig.6 The PEGASO link to the personal health Folder:
Report App (left) Catalan Web portal (center) and We

The gaming approach in PEGASO wants to exploit social connectivity (Share) and engagement (Play). The overall gaming system in PEGASO is managed via the Companion and is based on a three-fold approach:

• The PEGASO game: a 3D serious game aimed at increasing nutritional awareness and promoting physical activity – motivational component;

• The PEGASO gamified approach: linking 'real world activity with online & gaming applications – social component;

• The PEGASO minigames: addressing specific aspects of healthy behaviour – educational component.

The PEGASO minigames are small games with very specific goals; they can be completed in a short timespan and provide information in a playful manner. The main goal is to develop awareness and encourage healthy behavior developing the intrinsic (autonomous) motivation. Education and awareness are important triggers for developing autonomous motivation. Minigames have been embedded within the PEGASO serious game: examples are SCAVENGING, i.e. to collect as much food as possible and match the food icons belong-

ing to the same nutritional category, or RESEARCH, i.e. to match a single food item, collected through the scavenging mini-game, to a recipe requirement (Fig. 6). Stand-alone minigames have also been developed to be played as separate elements for education and entertainment.

400 students (aged 13-17) in 4 european pilot sites tested the PEGASO System: Lombardy in Italy, Catalunya in Spain, England and Scotland in the United Kingdom participated in this phase. The Evaluation Approach was mainly dedicated to the System and Technology acceptance, usability and long-term use: these factors are also a secondary assessment of motivation and engagement. The reliability in assessing the teen-agers lifestyles and their changes (with focus on the eating habits and on physical activities) and related efficacy on the sensors' network system was investigated too. Subjective assessment was adopted for awareness.

**Summary and Conclusions**

There is a perceived clear need at all policy levels that healthcare needs to be addressed through prevention to ensure sustainability of the healthcare system; well-being is a complex concept to which several determinants contribute at different levels

*examples of the Lombardy*
*eb app (right).*



*Fig.7 The PEGASO Game in night (left up and down) and day (right up)*
*settings, and one of the embedded minigame (right down).*

in the different stages of an individual's life. Well-being and the self-perception of health go beyond the dynamics of the healthcare sector only;

PEGASO addressed the prevention of obesity and overweight in teenagers with an holistic approach embracing the full ecosystem and healthcare value network as a first step towards the design of a new healthcare model.

The following key issues however have to be adequately addressed and are at the centre of the PEGASO rationale:

• Knowledge of how to stay healthy is ubiquitous; however, obesity and lifestyle-related illness are still among the top healthcare challenges in Europe.

• Motivating individuals to change behaviour is not just a clinical issue. Successful programs include incentives along with personalised programs and, increasingly, the inclusion of behavioural science.

Gamification has emerged as a recognisable trend that can have a significant positive impact on all businesses and is yet to be leveraged by wellness and healthcare.

The strategy proposed by PEGASO, based on behaviour changes, is expected to have favourable effects in reducing the risk of overweight/obesity and associated diseases and social costs in proportion to the national prevalence of body mass excess in this age class taking advantage of the possibilities offered by innovative ICT and of teens' affection to mobile and social network.

**Acknowledgments**

For more information: **www.pegasof4f.eu**

# Highlighting the key Italian research priorities

*Open Access Government's Ciara Ruane details research funded by the Italian Ministry of Education, Universities and Research and their key priorities*

The Italian Ministry of Education, Universities, and Research (MIUR) works to implement international policies and standards in science, education, and innovation. Funding offered by the Ministry covers 3 categories: basic research, projects of relevant national interest (PRIN), and industrial research.

Basic research, as outlined by the Ministry, covers research that is not linked to specific industry. For example, climate and biodiversity research is driven by the 'curiosity' of the researcher, with the broader aim of improving society in the future or advancing science. The basic research fund backs up the creation of public and private networks, both in Italy and internationally. A priority for the funding is to encourage participation in European initiatives: promoting a collective use of people and resources available within the EU. The dual goal of strengthening science and research in Italy, and collaborating with other EU Member States is mirrored in other areas of the MIUR. The ministry also supports Eurostars 2, a research and development programme that funds projects run by participants from 2 or more EU Member States. Ideas are submitted through the MIUR and managed by Eureka, an international network of research and development.

PRIN covers research of 'national interest'. This funding aims to reinforce the ideas of collaboration and peer review within Italy, and specifically targets research taking place in institutes of learning. The MIUR is part of the Inter-Ministerial Committee for Economic Planning (CIPE) which includes the Min-



*Image: © Ministero Istruzione*

*The Minister for Education, University and Research, Valeria Fedeli*
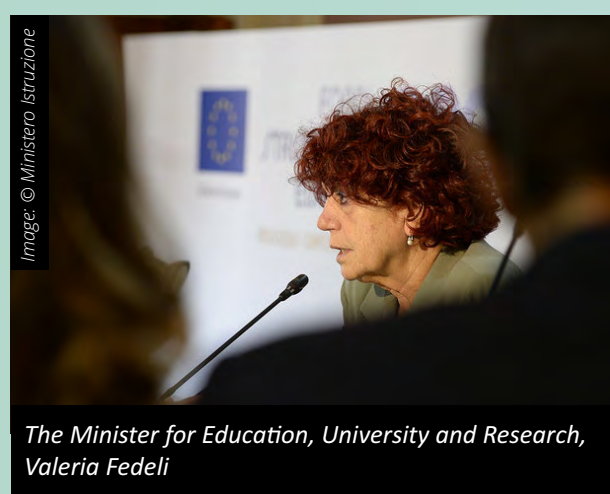
istry of Foreign Affairs and the Ministry of Labour and Social Policy. Industrial research funded through the MUIR covers projects related to industry and infrastructure, again with the intention of economic growth within the country itself.

**The Ministry's position on pan-EU projects**

The MIUR's position as a collaborating member of pan-EU projects and programmes is an essential component of its existence. The Minister for Education, University and Research, Valeria Fedeli has spoken about the need to foster these relationships. In July of this year she spoke about Italy being selected to host the 2020 science forum in Trieste. She said that Italy has always 'worked as a team', and that the city is perfectly situated as a meeting point for several other states. She also reasserted the government's desire to continue investing in universities, calling them 'essential' for the development of the country.

Fedeli has also spoken recently about the concepts of global citizenship and the <u>future of the EU</u>. In a speech at the 'Erasmus and the Future of Europe Conference', which took place in Florence earlier this year, she praised the European values of peace, collaboration, and multiculturalism, and the need to protect these qualities for future generations. The speech focussed on the chance given to Italian students to study in other EU countries, and for foreign students to study in Italy. Minister Fedeli said that the programme improves employment and on a personal level, increases confidence and helps to teach students important skills for life and work. She also praised the Erasmus free movement program for reinforcing a sense of community among EU countries and fostering academic links between them.

## Global citizenships role in education

At a conference taking place at the University of Bologna, the Minister spoke about global citizenship to an audience of politicians from in and outside of the EU. She outlined the need to solidify ideas of global citizenship through legislation, especially in regards to its role in education. She stated that they must take 'concrete' action to ensure an atmosphere of global collaboration, and to end racial and gender based discrimination.

She also believes that there would be 'no answer' to questions of gender based violence without countries across the globe working together to address inherent societal problems. In her speech, Fedeli emphasised the importance of looking to the attitudes of younger generations as an example of forward-thinking community and cultural exchange. In reference to the history of the Bologna University she said 'knowledge has no boundaries', and emphasised the role universities have to play in forging a global identity.

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