HEART:

HEalth related Activity Recognition system based on IoT –
an interdisciplinary training program for young researchers

Fellowship Call for Application

DEADLINE: October 14th 2017 – 17.00 CET

ESR1 - HEALTH BEHAVIOR ANALYTICS ON HETEROGENEOUS DATA

ESR2 - SCALABILITY OF DATA ANALYTICS

ESR3 - SCALABILITY OF DATA PROCESSING

ESR4 - PRIVACY AND SECURITY ANALYTICS

ESR5 - PRIVACY BY DESIGN AND BY RESEARCH. THE LEGAL ISSUES FROM CONCEPTUALIZATION TO COMMERCIALIZATION

ESR6 - UNDERSTANDING CHINA: FROM CUSTOMERS' NEEDS TO MARKET PENETRATION

BACKGROUND OF THE HEART RESEARCH PROJECT

Six research fellowships are offered within the framework of **HEART: HEalth related Activity Recognition system based on IoT,** a project funded by the European Union's Horizon 2020 research & innovation programme under the Marie Skłodowska-Curie – ITN, Industrial Doctorate (GA n. 766139).

HEART is an international, inter-sectoral, interdisciplinary project providing Marie Skłodowska-Curie PhD Fellowships to 6 Early Stage Researchers (ESRs), with the potential to become the leaders of tomorrow in the Internet of Things domain applied to the Health sector.

More specifically, the HEART research program aims for a personalized approach of mobile health coaching programs that involve the user and that are tailored to individual needs (putting the user at the HEART of the system). Programs will leverage on a **health integrated activity recognition platform** that can detect activities from heterogeneous data, using scalable algorithms, while safeguarding the privacy of the person. When developing such technology, special attention will be devoted to the definition of a penetration strategy for the Chinese market that ensures: i) protection of personal information and acquired sensitive data; and ii) adaption to the needs of the Chinese consumers.

The following PhD students (also indicated as Early Stage Researchers- ESR) will collaborate within the HEART ITN research program: 4 PhD students in Information&Communication Technology (ICT), 1 Phd student in legal studies and 1 Phd student in the international business domain.

TRAINING AND MOBILITY

The project will offer an ambitious and innovative doctoral program for six new PhD students, combining academic excellence with strong international business attitude, inspired to innovation-oriented mind-set.

PhD students will develop a completely new profile, based on a strong interdisciplinary attitude, integrating technical skills, socio-economic sciences' perspectives, creativity and entrepreneurial allure. They will also acquire strong teamwork capabilities and ability to cooperate in the EU-China framework for business.

Mobility plays a central role in the programme: PhD students will follow a secondment scheme training them in academic institutions as well as companies, moving from analytics, business, security and privacy as well as between academic research and company based development projects (all PhD students are required to spend at least 50% of their time at non academic institution, mainly at Philips' premises). Mobility periods are foreseen both in European countries and in China (eg. Fudan University, Graduate University of Chinese Academy of Sciences, Philips Research China). Indicative planned secondments for each PhD position are illustrated in the attachment.

The rotation of PhD students among the partners will bring PhD students to learn complementary techniques and methods, which will broaden their perspectives and capabilities, and enhance their career development.

POST DESCRIPTION

Number of available positions: 6 positions (ESR1, ESR2, ESR3, ESR4, ESR5, ESR6) as listed in the attachment.

Title: Marie-Sklodowska-Curie Doctoral Fellow

Hiring institutions and PhD Enrollment

ESR1 and ESR4 will be hired by Philips Electronics Nederland B.V. (the Netherlands);
ESR2 and ESR3 will be hired by KU Leuven (Belgium);

ESR5 and ESR6 will be hired by the University of Macerata (Italy).

PhD Enrollment: ESR1, ESR2, ESR3, ESR4 will be enrolled at the Doctoral School of KU Leuven, while ESR5 and ESR6 will be enrolled at the Doctoral School of the University of Macerata. Tuition fees –where foreseen- will be charged to HEART's budget.

DESCRIPTION OF HIRING INSTITUTIONS

Philips Research is the source of many advanced developments in Healthcare, Lifestyle and Technology. Building on 100 years of experience in industrial research and our world-leading patent position, we are dedicated to bringing meaningful innovations that improve people's lives.

We provide technology options for innovations in the area of health and well-being, targeted at both developed and emerging markets. Positioned at the front-end of the innovation process, we work on everything from spotting trends and ideation to proof of concept and first-of-a-kind product development.

Philips has a long history of successfully introducing innovative products to the market (lamps, CD players, medical imaging equipment, patient monitors, etc). Today, Philips is connecting its products to the digital world, introducing new services and integrated solutions based on digital technologies. Therefore, Philips Research and Philips product divisions rely more and more on digital security technologies, which are playing a crucial role in new Philips products, services, software and solutions. We are looking for a candidate to join the Data Science department of Philips Research to work on which will be used / integrated into Philips products and services. For more insights you can visit: www.research.philips.com

KU Leuven

Founded in 1425, KU Leuven is the largest Belgian university (http://www.kuleuven.be/english/) with over 41,000 students and 8,084 researchers (2015). KU Leuven is a breeding ground and attractive destination for the world's best researchers, including Starting and Consolidator ERC Grantees and hundreds of Marie Curie fellows. About 40% of our researchers come from abroad. KU Leuven conducts fundamental and applied research in all academic disciplines with a strong international orientation. KU Leuven is one of the founding members of LERU (League of European Research Universities). KU Leuven is ranked 1st in Reuters' "Europe's Most Innovative Universities" Ranking. The success in the FP7 and Horizon 2020 Marie Sklodowska Curie Actions is a manifestation of the three pillars of KU Leuven: **research, education and service to society**. In our 199 Actions, hundreds of young researchers have been trained through research and have acquired the necessary skills to transfer their knowledge into the world outside academia. To strengthen international collaboration, KU Leuven has its own international research fellowship programme and supports international scholars in international funding applications. KU Leuven Research & Development (LRD) is the **technology transfer** office (TTO) of KU Leuven. Since 1972, LRD acts a multidisciplinary team of experts that guides researchers in their interaction with industry and society and the valorization of their research results to industry and society (e.g. via the >100 established spin off companies).

University of Macerata

The University of Macerata (UNIMC), founded in 1290, is the only university in Italy that focuses exclusively on Socio-economic Sciences and Humanities (SSH). University's motto "Humanism that innovates" illustrates its mission: to contribute to the development of people and society through the added value that social and human sciences bring to the understanding of complex socioeconomic and political issues, according to an interdisciplinary perspective.

UNIMC is member of international and national research networks including: European Consortium for Humanities Institutes and Centres, European Connected Health Alliance, Economic Policy Forum, Chinese Globalization Association, E-living regional cluster on Ambient Intelligence and Ambient Assisted Living.

In 2014, UNIMC was awarded by the European Commission with the 'Excellence in Research Logo'.

UNIMC has a good reputation for **entrepreneurship programs for young researchers**, especially through LUCI and Eureka initiatives. The Humanities Laboratory for Creativity and Innovation (LUCI) is a laboratory opened to SSH post graduate students, PhD and young researchers promoting innovative and entrepreneurial attitude among young people to support the creation of innovative business initiatives SSH-driven. Eureka is a PhD industrial scholarship program co-financed by the University, the local Regional government and companies. Students are trained for half of their time in local firms and half of their time in the academia, both in Italy and abroad. Started in 2012, the program allowed enrolling about 60 PhD candidates.

UNIMC has a strong international reputation for **Chinese studies**, which are developed through the China Center and the Confucius Institute. Every year, Winter and Summer Schools, as well as international conferences and EU-China Workshops are organized, involving scholars, the business community, PhDs, and local high schools.

Duration of the employment: expected start date January 2018, duration 36 months. for ESR5-6 (at Uni Macerata), and 48 months for ESR1-2-3-4 (at KU Leuven and Philips).

Income:
- for ESR1 and ESR4 - 3.243,73€ Gross per month (38.924,76€ / year).
- for ESR2 and ESR3 – 3110,00€ Gross per month (37.320,00€ / year).
- for ESR5 and ESR6 - 3.318,37€ Gross per month (39.820,44 € / year).

Benefits
600€ Mobility Allowance per month (7200€ / year)
500€ Family Allowance per month (6000€ / year) - When applicable according to the Marie Skłodowska-Curie.

NB: this is a gross EU contribution to the salary cost of the researcher. The net salary will result from deducting all compulsory (employer/employee) national social security contributions as well as direct taxes

CAREER DEVELOPMENT PROSPECTS

ESRs will gain highly valuable research skills, linked to the booming market of the products/services connected to the increased life expectancy and attention to well being, and to the Internet of Things sector. Fellows will be also provided with transversal skills (IPRs, grant application, etc) and with the capacity to conduct their specific research according to an **interdisciplinary approach and to create innovation**. This combination of skills will increase their attractiveness for both academic and business sector. Moreover, exposure to the Chinese context and enhanced capacity to create business/research relationships (thanks to basic knowledge of the Chinese language and culture) will make all ESRs attractive to organizations interested in this crucial Asian country and to international Business settings.

NON-DISCRIMINATION

Philips has adopted family friendly policies as part of its equal opportunities policies for male and female employees. The ESRs will be located at the Philips premises at the High Tech Campus in Eindhoven, with the following facilities at hand:
- Dedicated breast feeding rooms in every building
- On-site day care facilities for young children
- An international school, within 5 kilometers of the High Tech Campus

KU Leuven pursues an equal opportunities and diversity policy and seeks to foster an environment where all talents can flourish, regardless of gender, age, cultural background, nationality or impairments (https://www.kuleuven.be/personeel/jobsite/en/working). KU Leuven makes continuous efforts to provide an optimal work-life balance, amongst others, by providing nurseries and various services for childcare (e.g.

home care for sick children, university day care centers, and childcare during school holidays). KU Leuven aims to create a working environment which puts openness, collaboration and respect for personal dignity first, and ensures every employee's well-being and room for personal growth; the university offers support to employees who experience psychological and/or physical problems (https://admin.kuleuven.be/thema/welzijn/en/intranet/psychosocial_wellbeing).

The **University of Macerata** pursues an equal opportunities and diversity policy as well. Among facilities, a kindergarten is available for university's employees. Specific facilities and services are also dedicated to employees with disabilities (transportation services, specific technologies for studying).

ELIGIBILITY CRITERIA

Degree: Master degree or equivalent providing access to PhD programmes. See attachment for required degree for each position. Applicants must not have a doctoral degree.
Language: English proficiency must be attested either through a previous English language diploma, or an internationally recognised proficiency test (at least C1 level of the Common European Framework of Reference for Languages i.e. IELTS, IBT, TOEFL or Cambrigde).
Career: When starting their contract (January 2018), selected researchers should be within the first four years of their research careers. This means being both within a four year window following their most recent graduation and not having been awarded a prior doctoral degree so far.
Mobility: At the date of recruitment, the researcher must not have resided, or carried out his/her main activity (work, studies, etc) in the country of the hiring institution for more than 12 months in the 3 years immediately before the recruitment date.
Application: Complete and timely submission exclusively via the HEART on-line application system. Documents submitted must be in English. If supporting documents (eg. letters of academic references and scan of degree qualification) are not in English, they must be submitted together with a certified translation in English).

Please note that, in addition to the above mentioned eligibility criteria further essential or desirable requirements are detailed for each PhD position (see attachment).

HOW TO APPLY
Applications must be sent exclusively in English and through the HEART online Application System open and accessible through the HEART website (www.heart-itn.eu). Applications sent through other means or in other languages (other than English) will not be evaluated.

Candidates must apply through the HEART online application system, which will request the following information:

1. a complete CV in Europass Format in English that must highlight activities and place where the activities have been carried out in order to give evidence of fulfilling the mobility eligibility criterion (see above). Use the template available at https://europass.cedefop.europa.eu/it/documents/curriculum-vitae/templates-instructions

2. a complete academic CV in English with references to past research and training experiences;
3. a motivation letter, in English, highlighting the consistency between the candidate's profile and the chosen ESR position for which you are applying;
4. at least 2 letters of Academic reference, in English or in certified translation
5. scan of the degree qualification, with certified translation in English (if the degree qualification is not in English).
6. proof of language proficiency
7. scanned copy of valid identification document (identity card or passport)

8. Declaration of Honour according to the template available in the website.
9. (OPTIONAL) any further and relevant supporting documents (eg. research publications).

Candidates possessing the relevant requirements, may opt for applying for one or more positions. If candidates apply for more than one position they are required to submit one application for each position.

TIMING OF SELECTION PHASE

- **By 14th October 2017** Candidates must apply by submitting required documents through the HEART online application system available at www.heart-itn.it
- **By 23rd October 2017** Shortlisted candidates will be invited to submit to a interview (also via videoconference) with their supervisory team. Interviews will be held from 30 October 2017 to 10 November 2017. Candidates may be required to have a further interview to be held face to face (in this case costs of travel and accommodation will be reimbursed).
- **By 17th November 2017** Shortlisted candidates will be informed about final decision.
- **By 27th November 2017** Selected candidates will have to confirm in writing their decision to accept the offered position, otherwise they will lose the position and the following candidate in the ranking list will be recruited.
- **Within December 2017** Selected candidates will be recruited by hiring institutions.
- **Within January 2018** employment contracts will start**.**

The above timing may be subject to slight changes that will be – in case - promptly notified.

SELECTION CRITERIA

All eligible applications will be assessed by a Selection panel according to the following criteria:

Selection criteria for the admission to the shortlist	Score
Qualifications and previous experience:	**0-50,0**
A. Master degree in the scientific field relevant to the project	
B. Other qualifications relevant to project/area, incl. letter of references	
C. Authorship of research outputs	
D. Previous experience of research in specific project area	
Total maximum score to be assigned	**50,0**

Candidates will be ranked for each foreseen position they have applied to. The threshold to be shortlisted is 35. If candidates have been awarded with the same score, priority will be based on scores for the sub criterion B "Other qualifications relevant to project/area, incl. letter of references".

For each position, up to 5 candidates awarded with the highest scores in the ranking list will be invited for an interview. The interview may be conducted also using a videoconference system.

During the interview the candidates will be evaluated according to the following criterion "Research abilities and personal skills".

Selection criteria of shortlisted candidates	Score
Research abilities and Personal skills:	**0-50,0**
1. Abilities to design, conduct and project manage original research in the subject area; 2. Ability in relevant research methods 3. Other relevant skills specific to project , including industry experience	
4. Excellent oral communication in English, including the ability to communicate complex subject orally 5. Good communication and interpersonal skills	
6. attitude of a natural team player and capability to work in an international research group 7. Enthusiasm, proactivity, creativity and commitment	
Total maximum score to be assigned	**50,0**

For each position the final ranking list will be obtained by adding the score obtained by the shortlisted candidate according to the criterion "Qualifications and previous experience" with the score obtained after the interview assessment according to the criterion B "Research abilities and personal skills". When scores are equal, priority will be based on scores for the sub criterion 3 "Other relevant skills specific to project , including industry experience".

The selection panel will assess the profile of each candidate according to the above mentioned criteria; In case a candidate will not reach a minimum score of 35 points out of 50 points on the criterion "Research abilities and personal skills", the selection panel has the right to not proceed with recruitment.

CONTACT: Enquiries can be sent to the relevant project supervisor(s) via email.

ATTACHMENT - DESCRIPTION OF EACH ESR POSITION

ESR1 - HEalth Behavior Analytics on heterogeneous Data

ESR2 - Scalability of data analytics

ESR3 - Scalability of data processing

ESR4 - Privacy and security analytics

ESR5 - Privacy by design and by research. the legal issues from conceptualization to commercialization

ESR6 - Understanding China: from customers' needs to market penetration

ESR1 - Health Behaviour Analytics on Heterogeneous Data

HIRING INSTITUTION: Philips Electronics Nederland B.V. (the Netherlands)
PHD ENROLLMENT: PhD position in Computer Science at the Arenberg Doctoral School KU Leuven (Belgium, http://set.kuleuven.be/phd)

YOUR TEAM

You will work in the Personal Health department of Philips Research Europe. The department develops solutions that empower people to manage their health and support professionals in providing better care. A strong focus of the research is on measuring and monitoring people's health status and habits in their own home and to provide motivating feedback to come to a healthier lifestyle. Application domains that the department is focusing on are cardiovascular, sleep, and elderly care, where the group is closely collaborating with the business units of Personal Health Solutions, Sleep and Respiratory Care and Population Health Management. The department has various clinical collaborations across Europe.

OBJECTIVES

Human activity recognition and vital sign monitoring play a significant role in tailoring personal health and behaviour change coaching solutions to each individual. With the advent of wearable sensors and devices, a unique opportunity for healthcare is emerging where it becomes possible to monitor the health parameters and health related parameters for continuously for long periods, outside the lab or doctor's office setting, and for large numbers of people. This represents a unique opportunity to gain insight into how behavior and lifestyle influences the health of people and in how changing of lifestyle can improve the health of people.

The following objectives are proposed:

1) **Activity recognition and detection of critical situations:** Recent wearable devices measure multimodal data streams. Different physiological properties are measured such as physical activity, galvanic skin response and heart-rate. Other data include in-home Internet-of-Thing (IoT) sensors and device data, smart phone sensor data and interaction data. The objective is to combine these heterogeneous data streams from wearable and IoT sensors to recognize health-related activities of the user and physiological parameters to extract actionable insights for example detection of critical situations as e.g. epilepsy seizures, unusual heart rhythms or unusual behavior and activities.
2) **Relation between activities and health parameters:** Aggregating parameters as activity levels, vital signs and context will allow to create a person specific health profile. This health profile consists of different levels: a) health parameters (heart rate, blood pressure, weight, mental wellbeing); b) behavior and activity related parameter, such as the amount of sleep, physical activity, amount of stress full activities or relaxing activities, amount of work-related activities, food intake, social activities, etc. The objective is to use data analytics and machine learning to find person-dependent patterns in the link between behaviors and health parameter.
3) **Data-acquisition:** ESR1 will support the **data-acquisition** of a multimodal database consisting of motion, & vital sign modalities. An efficient approach to come to a high-quality labelled set is investigated.

These objectives will likely involve analysis of time series data with new advanced methods, such as, deep learning. A key challenge is to combine common knowledge with pattern recognition methods.

EXPECTED RESULTS

- Algorithms for the recognition of complex activities based on multimodal and heterogeneous data.
- A multimodal data-driven health-profile classifier based on vital sign and accelerometer data.
- Quality runtime code for the use of these such models, calibrated on preliminary and historical data.

INDICATIVE PLANNED SECONDMENTS- *Institution, place and timing expressed in contract month (M)*

- University of Macerata (Macerata, Italy) - M4
- KU Leuven (Leuven, Belgium) - M7-8 ; 9-11
- Fudan University (Shanghai, China) - M15-19
- University of Macerata (Macerata, Italy) - M25
- KU Leuven (Leuven, Belgium) - M34-36

Further analysis might be required, based on the development of the research project.

SUPERVISORS: Dietwig Lowet (dietwig.lowet@philips.com), Bart Vanrumste (bart.vanrumste@kuleuven.be), Stijn Luca (stijn.luca@kuleuven.be – www.kuleuven.be/advise)

ADDITIONAL ESSENTIAL REQUIREMENTS: Master degree with distinction (cum laude) in computer science (or equivalent).

DESIRABLE REQUIREMENTS: a clear interest in and knowledge of machine learning, e.g. deep learning. Expertise in data analytics/classification and affinity for computational modeling. Good programming skills are desired. Knowledge of either Matlab/Pyhton/R is required.

ESR2 Scalability of Data Analytics

HIRING INSTITUTION: KU Leuven (Belgium)
PHD ENROLLMENT: PhD position in Engineering at the Arenberg Doctoral School KU Leuven (http://set.kuleuven.be/phd)

YOUR TEAM

You will be working with the research groups of *e-Media* situated at group-T Leuven, and *Advise* (www.kuleuven.be/advise) of the faculty engineering technology. The e-Media Lab investigates, develops and implements novel techniques to enhance the human condition with electronic media. Applications are found in the domain of health care, learning and entertainment. The eMedia research group has in the past developed systems for activity recognition based on audio sensors, video sensors, accelerometers, home automation sensors and occupancy sensors. The group has a strong expertise in the development and implementation of machine learning methods, data visualization and engagement tools to interact with the end-user. Advise - Advanced Integrated Sensing lab unites a broad experience in both software (real-time processing and statistical analysis of large multimodal datasets) and hardware (design and testing of both PCB and integrated circuit implementations). This unique combination of expertise enables the development of integrated sensing and communication systems for different applications including health monitoring, quality control monitoring, audio monitoring among others. You will work on the topic "machine learning for scalable data analytics" that includes the following objectives:

OBJECTIVES

1) ESR2 will investigate the **classification of activities** in a subject specific setting based on multimodal datasets consisting of motion, & vital sign modalities. A focus will be made on activities that play a fundamental role in the follow-up of lifestyle of people, e.g. cooking, washing, eating and doing sports. Such activities are composed of a collection of primitive activities and are termed complex activities. The follow-up of these activities may demand additional contextual information like time of the day, spatial location, or interaction with other people and objects. Also, specific conditions and typical situations in China are considered, in the consumer and market perspective.

2) ESR2 will investigate the **difficulty of scalability** of recognition and classification tasks. The inter variability between different persons in executing complex activities demands subject-specific models. However the training of a personal activity model requires a tremendous amount of labelled data, which is infeasible in practice as this is not available. Therefore we will aim to develop machine learning approaches that can mitigate the problem of limited availability of labelled data. Transfer-based and multi-task approaches will play a crucial role in this.

3) ESR2 will support the **data-acquisition** of a multimodal database consisting of motion & vital sign modalities. An efficient approach to come to a high-quality labelled set is investigated.

EXPECTED RESULTS

- Algorithms that are able to learn in an online and incremental fashion a person specific model of complex activities.
- A library of software code for the use of such models, calibrated on preliminary and historical data.

INDICATIVE PLANNED SECONDMENTS - *Institution, place and timing expressed in contract month (M)*

- University of Macerata (Macerata, Italy) – M4
- Philips Electronics Nederland B.V. (Eindhoven, The Netherlands) – M5-M7
- Philips Electronics Nederland B.V. (Eindhoven, The Netherlands) - M12-M14
- Philips Research China (Shanghai, China) - M15-19
- University of Macerata (Macerata, Italy) - M25
- Philips Electronics Nederland B.V. (Eindhoven, The Netherlands) – M26
- Philips Electronics Nederland B.V. (Eindhoven, The Netherlands) – M27-28; 29-33

Further analysis might be required, based on the development of research project.

SUPERVISORS: **SUPERVISORS**: Bart Vanrumste (bart.vanrumste@kuleuven.be), Stijn Luca (stijn.luca@kuleuven.be – www.kuleuven.be/advise), Milan Petkovic (milan.petkovic@philips.com)

ADDITIONAL ESSENTIAL REQUIREMENTS: Master in industrial engineering elo-ict graduate, computer science, statistics, electrical engineering or equivalent, with distinction (cum laude).

DESIRABLE REQUIREMENTS: a clear interest in and knowledge of signal processing and machine learning or advanced statistics, based on education, work or research experience.

ESR3 Scalability of Data Processing

HIRING INSTITUTION: KU Leuven (Belgium)
PHD ENROLLMENT: PhD position in Engineering at the Arenberg Doctoral School KU Leuven (http://set.kuleuven.be/phd)

YOUR TEAM

You will work in the imec-DistriNet research group (http://distrinet.cs.kuleuven.be), which belongs to the Department of Computer Science of KU Leuven. The imec-DistriNet group brings together over 80 researchers, of which 11 are professors, 6 are research managers and 16 are postdoctoral researchers. imec-DistriNet is acknowledged for its leading role in **secure and distributed software**. Microsoft's academic ranking lists KU Leuven (mentioned as "Catholic University of Leuven") first in the 100 top organizations in Europe in the category "security and privacy" over the past five years. Imec-DistriNet is actively involved in over 35 national and international research projects.

imec-DistriNet has considerable expertise in initiating, executing, and delivering **application driven research**, often in close collaboration with industry partners. Currently, imec-DistriNet is actively involved in about 35 national and international research projects, ranging from fundamental through strategic-basic to industrial/applied research. The know-how of imec-DistriNet was at the basis of multiple spin-offs, including Ubizen (now part of Verizon Business), a company that specializes in secure e-business and related security services, and VersaSense, which provides wireless Internet of Things (IoT) products and services that radically reduce the total cost of ownership for industrial sensing and control systems (https://www.versasense.com/).

OBJECTIVES

1) ESR3 will **investigate the real-time and energy efficient in-network data analysis** in large-scale wireless sensor networks by:
   - Benchmarking to what extent the network load can be decreased by pre-processing data on the sensor nodes (instead of sending large amounts of raw data to the cloud).
   - Modeling trade-offs between in-network processing and cloud processing, for example in terms of network load, energy efficiency, privacy, or data quality.
   - Investigating how to migrate data processing elements into or away from the sensor network, according to dynamically changing operational conditions (e.g. energy restrictions, connectivity or availability of the sensor device).
   - Designing and developing distributed middleware architecture that enables deployment of data processing algorithms to the available sensors, remote configuration of the sensors, and seamless integration of the sensor network with local gateways and the cloud.

2) ESR3 will **investigate privacy and security risks** (e.g. leaking sensitive information about a person's gender, illness, or activity patterns) associated with large-scale deployments of e-health applications by:
   - Designing & developing middleware services for privacy preservation and data protection.
   - Assessing the legal compliance of these privacy and security services in the European and Chinese context.

3) ESR3 will evaluate the middleware by **designing and developing a Proof-of-Concept prototype**, using state-of-the-art sensor devices and in close collaboration with the other ESRs.

EXPECTED RESULTS

- An architecture, capable of providing transparency on the sensor network.
- A model of a sensor network to simulate sensor/cloud deployment trade-off and to monitor the network and processing load.
- Embedded software implementation that executes the protocols and algorithms.
- Efficient privacy-preserving data algorithms developed based on trade-off determined by the place where the data is processed (cloud vs on-device computation).

INDICATIVE PLANNED SECONDMENTS - *Institution, place and timing expressed in contract month (M)*

- Philips Electronics Nederland B.V. (Eindhoven, The Netherlands), M2-3,
- University of Macerata (Italy), M4,
- Philips Electronics Nederland B.V. (Eindhoven, The Netherlands), M9-11,
- University of Macerata (Italy), M12-13,
- Philips Research China (Shanghai, China), M15-19,
- University of Macerata (Italy), M25,
- Philips Electronics Nederland B.V. (Eindhoven, The Netherlands), M26,
- Philips Electronics Nederland B.V. (Eindhoven, The Netherlands), M27-28; 29-34

Further analysis might be required, based on the development of research project.

SUPERVISORS: Hans Hallez (hans.hallez@kuleuven.be), Danny Hughes (danny.hughes@kuleuven.be), Dietwig Lowet (dietwig.lowet@philips.com)

ADDITIONAL ESSENTIAL REQUIREMENTS: Master degree with distinction (cum laude) in computer science (or equivalent).

DESIRABLE REQUIREMENTS: a clear interest in and knowledge of IoT security, based on education, work or research experience.

ESR4: Privacy and security analytics

HIRING INSTITUTION: Philips Electronics Nederland B.V. (the Netherlands)
PHD ENROLLMENT: PhD position in Computer Science at the Arenberg Doctoral School KU Leuven
(Belgium, http://set.kuleuven.be/phd)

YOUR TEAM

ESR will work within **Philips' Data Science department** whose mission is to lead Philips into the Digital era
through world-class innovations based on data science. The focus of the department is on applying and
advancing the automated methods used to extract new insights/knowledge from data. The department
builds on several interconnected competences including machine learning, statistics, probability models,
pattern recognition, computer vision, signal processing and data engineering. We use the advances in the
aforementioned scientific disciplines, as well as new digital platforms to create innovation for Philips
businesses by extracting insights from various sources like health records, sensors, mobile devices, Web,
and social networking sites. Next to that, security and privacy are addressed and taken into account already
in the design phase of Philips digital propositions. The department plays a crucial role in digital and data
intensive research projects using these competences.

OBJECTIVES

In the domains of smart homes and healthcare, the life of people is improved by devices that gather
personal data and process it, into relevant health information using third party smart services and
technology providers (e.g. cloud and Big Data analytics services). While the use of IoT devices can bring
advantages in terms of efficiency, convenience, and costs, their use raises privacy concerns regarding the
users and their personal activity data. The sensitive nature of this data and sharing it with a centralized
server (e.g. cloud) raise privacy concerns, even if the latter is well protected. These privacy concerns can be
addressed by using an end-to-end approach to privacy and data protection and building systems with
privacy embedded in the system architecture, while coherently integrating health-specific privacy, security
and legal requirements.

The following objectives are proposed:

- Perform security and privacy threat assessment of the proposed HEART architecture;
- Create a reusable domain-specific IoT knowledge base for state-of-the-art security and privacy
  threat assessment.
- Design systems with privacy embedded in the system architecture design (e.g. using early risk
  assessment)
- Identify existing privacy and security solutions that can enhance a wearables-centric architecture.
- Design and develop threat analysis and analytics for security in order to identify irregular,
  undesired and/or prohibited system behavior
- Invent and validate in industrial project teams new digital security technologies for use in Philips
  products and services;
- Participate in research projects that address digital security challenges, create intellectual property
  and transfer the results to Philips businesses;
- Contribute to the Philips research roadmap by new ideas and winning new proposals.

EXPECTED RESULTS

- Novel privacy-enabled system architectures.
- Efficient privacy by design for data sharing systems.

- Adoption of the newly designed solutions in industry (Philips products).

INDICATIVE PLANNED SECONDMENTS - *Institution, place and timing expressed in contract month (M)*

- University of Macerata (Macerata, Italy) – M4
- KU Leuven (Leuven, Belgium) – M7-8
- University of Macerata (Macerata, Italy) - M12-13
- KU Leuven (Leuven, Belgium) - M14
- Fudan University (Shanghai, China) – M17-19
- KU Leuven (Leuven, Belgium) - M24
- University of Macerata (Macerata, Italy) - M25
- KU Leuven (Leuven, Belgium) - M34-36

Further analysis might be required, based on the development of research project.

SUPERVISORS: Milan Petković (milan.petkovic@philips.com), Daniel Pletea (daniel.pletea@philips.com) Wouter Joosen (Wouter.Joosen@cs.kuleuven.be)

ADDITIONAL ESSENTIAL REQUIREMENTS: Master degree with distinction (cum laude) in computer science, mathematics or another relevant area.

DESIRABLE REQUIREMENTS: A strong inclination to and background in digital security and /or cryptography, software engineering, privacy protection and security risk analysis, preferably proven by relevant scientific results.

ESR5: Privacy by design and by research. The legal issues from conceptualization to commercialization

HIRING INSTITUTION: University of Macerata (Italy)
PHD ENROLLMENT: PhD position in Legal studies at the University of Macerata (Italy)

YOUR TEAM

ESR will work within the School of Law of the University of Macerata. The PhD program in Legal Studies at the University of Macerata is designed to prepare PhD students for careers as legal scholars through a three-year program aimed at the production of a substantial body of academic research and writing. The program is directed at students who wish to pursue advanced studies in law also from an interdisciplinary perspective. The three-year program offers young scholars the opportunity to acquire the ability to apply scientific research methods critically, to contribute to the development in the field, as well as to conduct applied research on law-related issues.

OBJECTIVES

The following objectives are proposed:

1) New corporate data protection standards for the production of IoT health products and services in Europe and China

The goal is to analyse the most relevant regulation in EU and China on data protection in order to support the creation of a transparent corporate model of privacy by design and privacy by default (in particular in the healthcare sector) and therefore a "corporate data protection standard" (proportionate regulatory framework). Particular importance should be devoted to role of national and European data protection Authorities, including a clarification on when and how to interact with them during the creation, implementation and commercialization of new products.

2) New protocols of privacy by design and by research in the commercialization of IoT health products and services

When creating a new health technology product or service, it is necessary to focus on how the privacy by design (and by research) protocols contribute to give intrinsic value to the same product/service and make easier, safer and legal to sale them to customers living in different countries (Europe and China in this case). This implies the ability to focus on the consequences of relevant data protection regulation into contracts, procedures, and consumer policies.

EXPECTED RESULTS

- New corporate data protection standards for the production of IoT health products and services.
- New protocols of privacy by design and by research in the commercialization of IoT health products and services.

INDICATIVE PLANNED SECONDMENTS- *Institution, place and timing expressed in contract month (M)*

- Philips Electronics Nederland B.V. (Eindhoven, The Netherlands) – M7-8
- Philips Electronics Nederland B.V. (Eindhoven, The Netherlands) – M9-11
- Philips Research China (Shanghai, China) - M15-19

- Philips Electronics Nederland B.V. (Eindhoven, The Netherlands) – M26
- Philips Electronics Nederland B.V. (Eindhoven, The Netherlands) - M27-28; 29-34

Further analysis might be required, based on the development of research project.

SUPERVISORS: Paolo Palchetti (palchetti@unimc.it;   http://docenti.unimc.it/paolo.palchetti) - Milan Petković (milan.petkovic@philips.com)

ADDITIONAL ESSENTIAL REQUIREMENTS: Master Degree in Law or Political Sciences.

DESIRABLE REQUIREMENTS: Preferably an inclination to and background in legal issues concerning data protection and privacy protection.

ESR6: Understanding China: from customers' needs to market penetration

HIRING INSTITUTION: University of Macerata (Italy)
PHD ENROLLMENT: PhD position in Global Studies at the University of Macerata (Italy)

YOUR TEAM

ESR will work within the China Center of the University of Macerata. The PhD program in Global Studies at the University of Macerata is designed to prepare PhD students for careers as experts in global issues, including international business topics through a three-year program aimed at the production of a substantial body of academic research and writing. The program is directed at students who wish to pursue advanced studies in International Business from a very broad interdisciplinary and intersectoral perspective. The three-year program offers young scholars the opportunity to acquire the ability to apply scientific research methods critically, to contribute to the development in the field, as well as to conduct applied research on International Business-related issues.

OBJECTIVES

ESR6 will have to support successful market penetration strategies of products and services in China, by:

1) comparing and contrasting customer perspective in Europe and China (including the level of acceptability of TRL), using appropriate Consumer analysis;

2) defining the right approach to tackle the Chinese market. Key analyses include: political and institutional context, the industry context and firm level analysis on best practices of Chinese firms;

3) developing foresight scenario for implementation and market development of innovation, to support the identification of sustainable and effective innovation priorities in the remote monitoring systems and in the use of big data in Europe and in China.

EXPECTED RESULTS

- Map of customer needs, perspectives, acceptability of TRL for remote monitoring systems, in Europe and in China
- Definition of the entry strategy for the Chinese market.
- Definition of a long-term vision for the adoption and development of remote monitoring systems and the use of big data, both in China and in the EU.

INDICATIVE PLANNED SECONDMENTS - *Institution, place and timing expressed in contract month (M)*

- Philips Electronics Nederland B.V. (Eindhoven, The Netherlands) – M7-8
- Jacobs University (Bremen, Germany) – M9
- Philips Electronics Nederland B.V. (Eindhoven, The Netherlands) - M10-12
- Graduate University of Chinese Academy of Sciences (Beijing, China) - M15
- Philips Research China (Shanghai, China) – M16-19
- Philips Electronics Nederland B.V. (Eindhoven, The Netherlands) – M26
- Philips Electronics Nederland B.V. (Eindhoven, The Netherlands) - M27-28; 29-34

Further analysis might be required, based on the development of research project.

SUPERVISORS: Francesca Spigarelli (francesca.spigarelli@unimc.it) - Gerhard Spekowius (gerd.spekowius@philips.com)

ADDITIONAL ESSENTIAL REQUIREMENTS: Master degree in Business, Economics, Political Science, Global Health or Healthcare Economics or equivalent.

DESIRABLE REQUIREMENTS: Use of statistical methods for data, econometric skills, previous international mobility experience.