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An imec.icon research project | project results

ICT

AORTA

Self-learning scheduling algorithms and a wearable device to improve logistics and patient transport in hospitals

When hospitalized, patients have to undergo a whole range of examinations and treatments at various locations. As a result, they are constantly ferried around. The same applies to medical equipment and consumables.

Moreover, nursing staff handles patient transfers, while logistics personnel takes care of the transportation of goods. To plan all these movements, each flow has its own dispatching system. Can this transport be done more efficiently?

The imec.icon project AORTA investigated how hospitals can achieve efficiencies through dynamic allocation of tasks and resources to hospital staff, for instance by combining the transportation of patients with that of medical equipment and goods. The goal was to support the different logistic processes through technology that continuously monitors and adapts to the changing environment of a hospital, with a view to increasing cost efficiency, reducing waiting times for both patients and staff, relieving nursing staff of non-care related tasks, and improving quality and patient safety.

THE OUTCOMES

1. Wearable device communicates tasks through messaging architecture

Today, when moving a patient from A to B, hospital staff need to consult various devices, such as a whiteboard in the nursing station, or a smartphone. It would be easier if all relevant information could be displayed on one screen that can be consulted hands-free without additional actions. In the latter regard, smartphones are impractical. Wristwatches are not allowed for hygiene reasons. Therefore, AORTA engineered a smartwatch screen that is attached to an elasticated ribbon hanging from the breast pocket of the employee. Given the small screen, the interface displays a minimal amount of maximally relevant information.

To communicate tasks to staff, a transport management system and messaging architecture were developed. A task is triggered from a central database and sent to a staff member's wearable device. In this way, staff receive new tasks as they go. The system also takes into account important information available in other databases, such as the hospital's patient record or its stock management database. For example, if the patient needs to be handled with gloves, this extra information will be added to the dispatched job. The screen can also indicate whether a wheelchair needs to be collected along the way. The system follows up on the progress of tasks until completion.

User tests in a simulated environment show that hospital staff rated the application highly on efficiency and attractiveness. New staff also said that it made their job more straightforward because the wearable device gave them clear, chronological instructions.

2. Scheduling algorithms become dynamic and self-learning

In order to schedule patient transport more efficiently, dynamic optimization algorithms were developed that rearrange the schedule each time new information comes in. For example, tasks can be redistributed among employees if certain transports that have already been started take longer than expected. Additionally, the algorithms target optimization of KPIs as specified by hospital management. Simulation results show that these algorithms outperform conventional techniques, such as dispatching based on earliest due date, by 20 to 30 %. The new algorithms can be used in hospitals, but also in other situations that involve scheduling and transport.

The scheduling algorithms were combined with a self-learning module. This module takes into account the changing environment of the hospital and the profile information of staff and patients. For example, the system is able to 'learn' that there is always a delay if transports involve a wheelchair. So when the fastest route is calculated, this self-learned information is also used as one of the inputs to optimize the task scheduling. What is more, learned information can be visualized to hospital management, so that they can tune their policies.

NEXT STEPS

The insights gained in AORTA can now be implemented in the products and services of the industrial partners. Xperthis, as an ICT specialist for hospitals, has performed the necessary research to allow the integration of the AORTA solution as a separate functional module into healthcare information systems. Televic will incorporate the obtained results along with new technology in its current range of smart nurse-call systems to boost staff efficiency.

AGENTSCHAP INNOVEREN & ONDERNEMEN Vlaanderen is ondernemen

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AORTA project partners:

televic healthcare

zna

xperthis committed to care

MARIA MIDDELARES

FACTS

NAME	AORTA
OBJECTIVE	Adaptive Optimization for Resource and Task Allocation in Hospitals
TECHNOLOGIES USED	Wearable devices, Wifi, NFC, HTTP REST, Semantic Web Technologies, Inductive Logic Programming, Association Rule Mining, Triple Stores, Graph Databases, Reasoning, Metaheuristics, Mixed Integer Programming
TYPE	imec.icon project
DURATION	01/01/2015 – 31/12/2016
PROJECT LEAD	Matthias Slaats, Xperthis
RESEARCH LEAD	Greet Vanden Berghe, imec - ITEC - KU Leuven
BUDGET	2,421,927 euro
PROJECT PARTNERS	AZ Maria Middelares, Televic Healthcare, Xperthis, Ziekenhuis Netwerk Antwerpen
IMEC RESEARCH GROUPS	IDLab - UGent, ITEC - KU Leuven, mintlab - KU Leuven

WHAT IS AN

IMEC.ICON PROJECT?

The imec.icon research program equals demand-driven, cooperative research. The driving force behind imec.icon projects are multidisciplinary teams of imec researchers, industry partners and / or social-profit organizations. Together, they lay the foundation of digital solutions which find their way into the product portfolios of the participating partners.

AMERICAS
raffaella.borzi@imec.be
T +1 408 386 8357

CHINA
timo.dong@imec-cn.cn
+86 13564515130

EUROPE & ISRAEL
michel.windal@imec.be
+32 478 96 67 29

JAPAN
isao.kawata@imec.be
T +81 90 9367 8463

TAIWAN & SE-ASIA
mavis.ho@imec.be
T +886 989 837 678

VIETNAM, BRAZIL, RUSSIA, MID EAST, INDIA
max.mirgoli@imec.be
T +1 415 480 4519