


## AÇÕES DE DIVULGAÇÃO

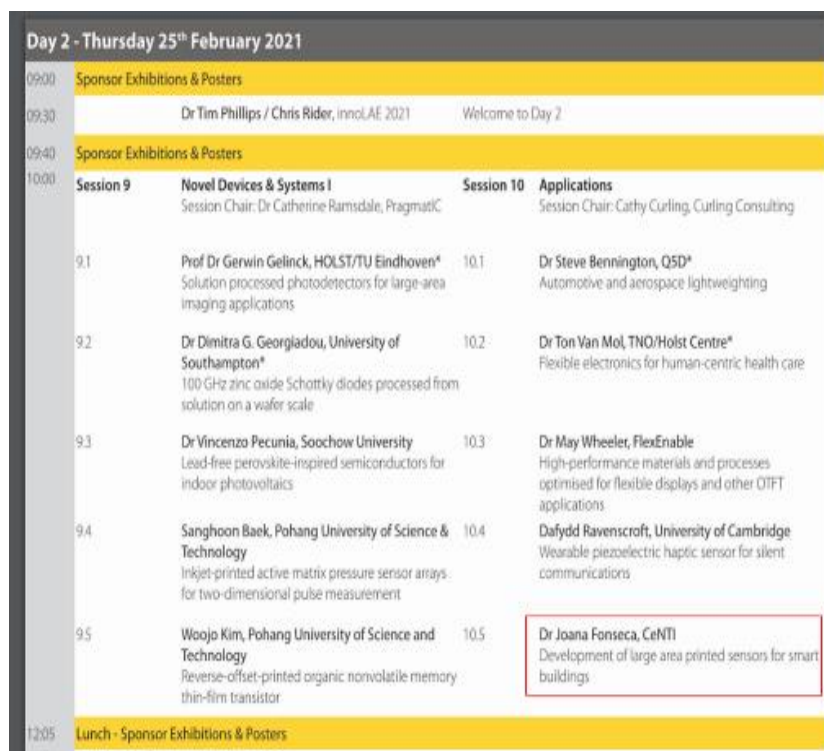
<b>Ação de divulgação</b>	Notícia no jornal Expresso – Economia
<b>Local e Data</b>	Portugal, 18 de dezembro de 2020
<b>Formas de divulgação</b>	- Notícia no jornal Expresso – Economia- , “Uma janela com cibervista” (que teve uma tiragem de 82 175), na publicação de 18-12-2020os
<b>Evidências</b>	 <p><b>vícios</b> <b>TECNOLOGIA</b> POR HUGO SÉNECA</p> <p><b>Uma janela com cibervista</b> A Smartframe é uma janela portuguesa, com certeza</p> <p><b>A</b>través de uma app, de um gesto ou do puxador? A escolha fica ao critério dos primeiros compradores das janelas desenvolvidas pelo projeto Smartframe. A nova geração de janelas tecnológicas vai chegar ao mercado no final de 2021, depois de um trabalho de investigação em parceria entre a EcoSteel e o <b>Centro de Nanotecnologia e Materiais Técnicos, Funcionais e Inteligentes (CeNTI)</b>. O preço ainda não é conhecido, mas já há descrições que prometem cativar os fãs dos gadgets e da comodidade. Estas janelas inteligentes distinguem-se por poderem ser abertas com recurso a uma app de telemóvel ou então através de gestos que são captados pelos sensores que se encontram incorporados nelas. Além disso, há outra funcionalidade que promete fazer a diferença: as janelas dispõem de um sistema de renovação incorporado. Na eficiência energética, destaque para o aquecimento automático de perfis que evita o congelamento dos canais de escoamento da água da chuva. Esta funcionalidade é ativada automaticamente sempre que é detetada uma temperatura que o justifique. A comercialização das janelas inteiras é uma hipótese, mas os mentores do projeto admitem que muitos consumidores poderão optar apenas por alguns módulos tecnológicos, tendo em conta os cenários ou a tipologia das janelas que pretendem instalar. ●</p>

<b>Ação de divulgação</b>	Clip no jornal Expresso – Economia
<b>Local e Data</b>	Portugal, 31 de dezembro de 2020
<b>Formas de divulgação</b>	- Clip no jornal Expresso – Economia (que teve uma tiragem de 82 175), - “Quando a inovação entra pela janela” (publicado da edição do dia 31-12-2020),
<b>Evidências</b>	 <p>The image shows a newspaper clipping from 'Expresso' magazine. The main headline is 'Quando a inovação entra pela janela'. Below it, a sub-headline reads 'O que pode mudar? Ventilação, acústica, temperatura e o sono'. The article is by Margarida Cardoso. The text discusses smart window technology, mentioning 'ECOSTEEL' and 'CENTI'. A photo shows a man looking out of a window. The article highlights how smart windows can improve indoor air quality, reduce energy consumption, and enhance comfort.</p>

<b>Ação de divulgação</b>	LOPE-C 2021 ( <a href="https://www.lopec.com/en/">https://www.lopec.com/en/</a> )
<b>Local e Data</b>	Portugal, 23 a 25 de março de 2021
<b>Formas de divulgação</b>	- Apresentação online oral “Printed heating systems for intelligent window frames”
<b>Evidências</b>	 <p><i>Figura 1- Seleção de diapositivos apresentados.</i></p>

<b>Ação de divulgação</b>	Innolae 2021 ( <a href="https://innolae.org/">https://innolae.org/</a> )
<b>Local e Data</b>	Portugal, 22 e 25 de fevereiro de 2021
<b>Formas de divulgação</b>	- Apresentação online em poster “Active defrosting printed systems for windows frames”

**Evidências**



Day 2 - Thursday 25 <sup>th</sup> February 2021			
09:00	Sponsor Exhibitions & Posters		
09:30	Dr Tim Phillips / Chris Rider, innolAE 2021	Welcome to Day 2	
09:40	Sponsor Exhibitions & Posters		
10:00	<b>Session 9 Novel Devices &amp; Systems I</b> Session Chair: Dr Catherine Ramsdale, Pragmatic	<b>Session 10 Applications</b> Session Chair: Cathy Curling, Curling Consulting	
9.1	Prof Dr Gerwin Gelinck, HOLST/TU Eindhoven* Solution processed photodetectors for large-area imaging applications	10.1	Dr Steve Bennington, Q5D* Automotive and aerospace lightweighting
9.2	Dr Dimitra G. Georgiadou, University of Southampton* 100 GHz zinc oxide Schottky diodes processed from solution on a wafer scale	10.2	Dr Ton Van Mol, TNO/Holst Centre* Flexible electronics for human-centric health care
9.3	Dr Vincenzo Pecunia, Soochow University Lead-free perovskite-inspired semiconductors for indoor photovoltaics	10.3	Dr May Wheeler, FlexEnable High-performance materials and processes optimised for flexible displays and other OTFT applications
9.4	Sanghoon Baek, Pohang University of Science & Technology Inkjet-printed active matrix pressure sensor arrays for two-dimensional pulse measurement	10.4	Dafydd Ravenscroft, University of Cambridge Wearable piezoelectric haptic sensor for silent communications
9.5	Woojo Kim, Pohang University of Science and Technology Reverse-offset-printed organic nonvolatile memory thin-film transistor	10.5	<b>Dr Joana Fonseca, CeNTI</b> Development of large area printed sensors for smart buildings
12:05	Lunch - Sponsor Exhibitions & Posters		

Figura 2- Agenda com referência à apresentação online do projeto.

<b>Ação de divulgação</b>	EPoSS Annual Forum 2021
<b>Local e Data</b>	Alemanha, 4 a 7 de outubro de 2021
<b>Formas de divulgação</b>	- Apresentação de um póster, “Intelligent Gesture Recognition System to control Smart Windows”.
<b>Evidências</b>	<div> </div> <p><i>Figura 3- Evidência da apresentação oral do projeto na EPoSS Annual Forum 2021.</i></p>

## MATERIAL GRÁFICO

Roll-up / Flyer / Poster Científico:

### Active defrosting printed systems for windows frames

Ana Lúcia Popas<sup>1</sup>; Daniela Campanhã<sup>2</sup>; Sarah Bogas<sup>1</sup>; Joana Fonseca<sup>1</sup>; Isaque Sá<sup>1</sup>; André Leite<sup>1</sup>; Frederico Ferreira<sup>2</sup>; André Almeida<sup>2</sup>

<sup>1</sup> CeNTI - Centre for Nanotechnology and Smart Materials [Rua Fernando Mesquita, 2785, 4760-034 V. N. Famalicão, Portugal]

<sup>2</sup> EcoSteel [Rua Manuel Dias, 4495-129, Amorim, Portugal]

#### Abstract

Nowadays, home automation solutions are becoming more complex, gaining new functionalities to improve comfort, security, and air quality. Hence, we present the results from R&D project SmartFRAME, which main objective is to develop a smart window frame, namely a printed heating system to be integrated into a window frame to prevent the formation of ice. The research work was focused on the optimization of the heating systems design and the efficiency of the overall system. The heating systems were dimensioned to operate at 24 V and were characterized in a climate chamber at  $-10\text{ }^{\circ}\text{C}$  and  $-20\text{ }^{\circ}\text{C}$ , to simulate extreme weather conditions. The optimized systems were able to defrost water accumulated in a typical window frame in less than 12 min.

#### Motivation and Purpose



The SmartFRAME project result from a partnership between CeNTI, a Portuguese Centre of Nanotechnology and Smart Materials, and ECOSTEEL, a renowned Portuguese windows manufacturer. This R&D project aims to develop a window frame with new features that allow effective ventilation, automatic sealing, gesture control, among other functionalities, to improve comfort, security, indoor air quality and user interactivity. One of the developed systems was printed heating to be applied in window frame to prevent ice formation. Compared with more conventional systems, printed systems present some advantages, such as their flexibility, lightweight, and easiness to adapt to several surfaces.

#### Equipments

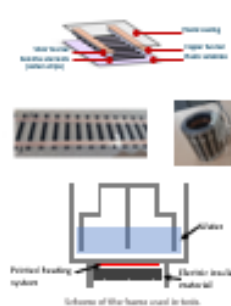


Screen printing



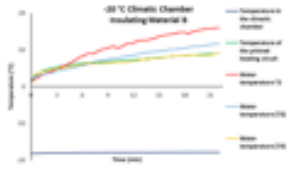
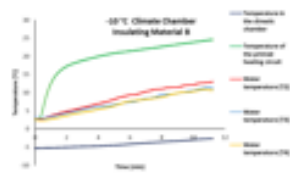
Microfilm

#### Procedure



- The heating system, with 2.5 m of length, was printed using printing technologies;
- It was encapsulated and laminated on the aluminium frame;
- An insulating material was applied to improve the energy efficiency of the defrosting system;
- These heating circuits were characterized in a climate chamber imposing conditions to mimic extreme weather conditions,  $-10\text{ }^{\circ}\text{C}$  and  $-20\text{ }^{\circ}\text{C}$ , with water accumulation.

#### Results



- Good heating uniformity was verified along 2.5 m.
- The insulating material promoted a faster defrost and reduced the heat losses. At  $-20\text{ }^{\circ}\text{C}$  the water temperature rise from about  $0$  to  $10\text{ }^{\circ}\text{C}$  in about 12 min.

#### Final Remarks

- The optimized systems were able to defrost water accumulated in a typical window frame in less than 12 min.
- The use of insulating materials revealed to be an effective way to improving the heating systems performance.

#### Acknowledgment



The project consortium is composed by ECOSTEEL, the promoting company and CeNTI, as R&D entity as co-partner. With an overall investment of 753,872,34 €, SmartFRAME project is co-financed by Portugal 2020, under the Operational Programme for Competitiveness and Internationalisation (COMPETE 2020), in the amount of 523,006,65 € from European Regional Development Fund (ERDF).

Figura 4- Poster "Active defrosting printed systems for windows frames" apresentado na Innolae 2021.

## Intelligent Gesture Recognition System to control Smart Windows

P. Henriques<sup>1</sup>, G. Meneses<sup>1</sup>, J. Fonseca<sup>1</sup>, I. Sá<sup>1</sup>, A. Leite<sup>1</sup>, F. Ferreira<sup>2</sup>, A. Almeida<sup>2</sup>

<sup>1</sup>CeNTI – Centre for Nanotechnology and Smart Materials, Rua Fernando Mesquita 2785, 4760-034 V. N. Famalicão, Portugal  
<sup>2</sup>EcoSteel, SA, Parque Industrial de Laúndos, lote 40, 4570-311 Laúndos, Portugal

### ABSTRACT

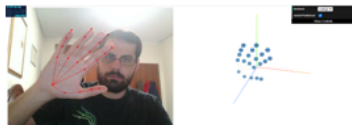
Over the last decade, technological evolution had a great impact on domestic systems. The incorporation of new sensors, new actuators and even artificial intelligence, make them more friendly to use, more energy-efficient and with more functions and capabilities. Following this trend, EcoSteel has established a partnership with CeNTI, resulting in an R&D project, SmartFRAME. The main objective is to integrate new innovative solutions to assure better and more efficient management of the domestic environment. The project aims to develop an innovative window frame with new features that allow adequate ventilation, automatic sealing, gesture control, along with other features that enable it to improve energy efficiency, comfort, security, and the ability to interact with the end-user.

### GESTURE RECOGNITION SYSTEM

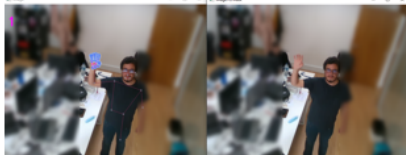
Focused on the ease of user interaction, an innovative gesture recognition system was developed to allow users to control a motorized window by dynamic and static gestures. Dynamic gestures were used to control windows' movements and static gestures to initialize dynamic gesture recognition and stop the window. In order to get a robust system, for the recognition of desired gestures and the manipulation of the background scenario different libraries were combined.

#### Mediapipe's Handpose

- Mediapipe's handpose was used to recognize hands through skeleton joints identification;
- Comparing the relative positions of those joints, it was possible to recognize static gestures. Following the absolute position of a given joint through time, dynamic gestures can be recognized;

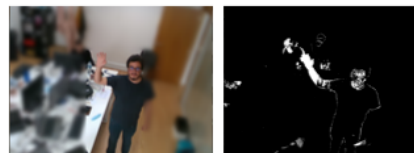


- In a second development stage, it was also possible to identify a person through points on the torso, arms and legs.



#### Opencv

- In parallel, the Opencv library was used to transform selected parts of the captured image, by changing colours and blurring or removing irrelevant parts.



#### Intel RealSense SDK

- In the last development stage, Intel Real Sense SDK was used to control the depth of the image to be detected. With this algorithm, it was possible to control more efficiently the area to be considered in detection.
- To explore all the potential of this algorithm, the Intel RealSense Depth Camera D435i was used (<https://www.intelrealsense.com/depth-camera-d435i/>).

### FINAL REMARKS

- Good results regarding person's hands and body recognition were obtained by combining different libraries;
- Promissory results were achieved in the identification of different gestures, static and dynamic, which will be used to control a motorized window;
- In the future, new approaches will be explored to optimize static gesture recognition, in particular the detection and identification of the person that intends to interact with the window, in order to reduce false positives.

#### PROJECT



#### CONSORTIUM



#### CO-FUNDED



**Acknowledgment:** This work was developed in the framework of SmartFRAME project, co-financed by Portugal 2020, under the Operational Programme for Competitiveness and Internationalisation (COMPETE 2020), from European Regional Development Fund (ERDF).

Figura 5- Poster "Intelligent Gesture Recognition System to control Smart Windows" apresentado na EPOSS Annual Forum 2021.

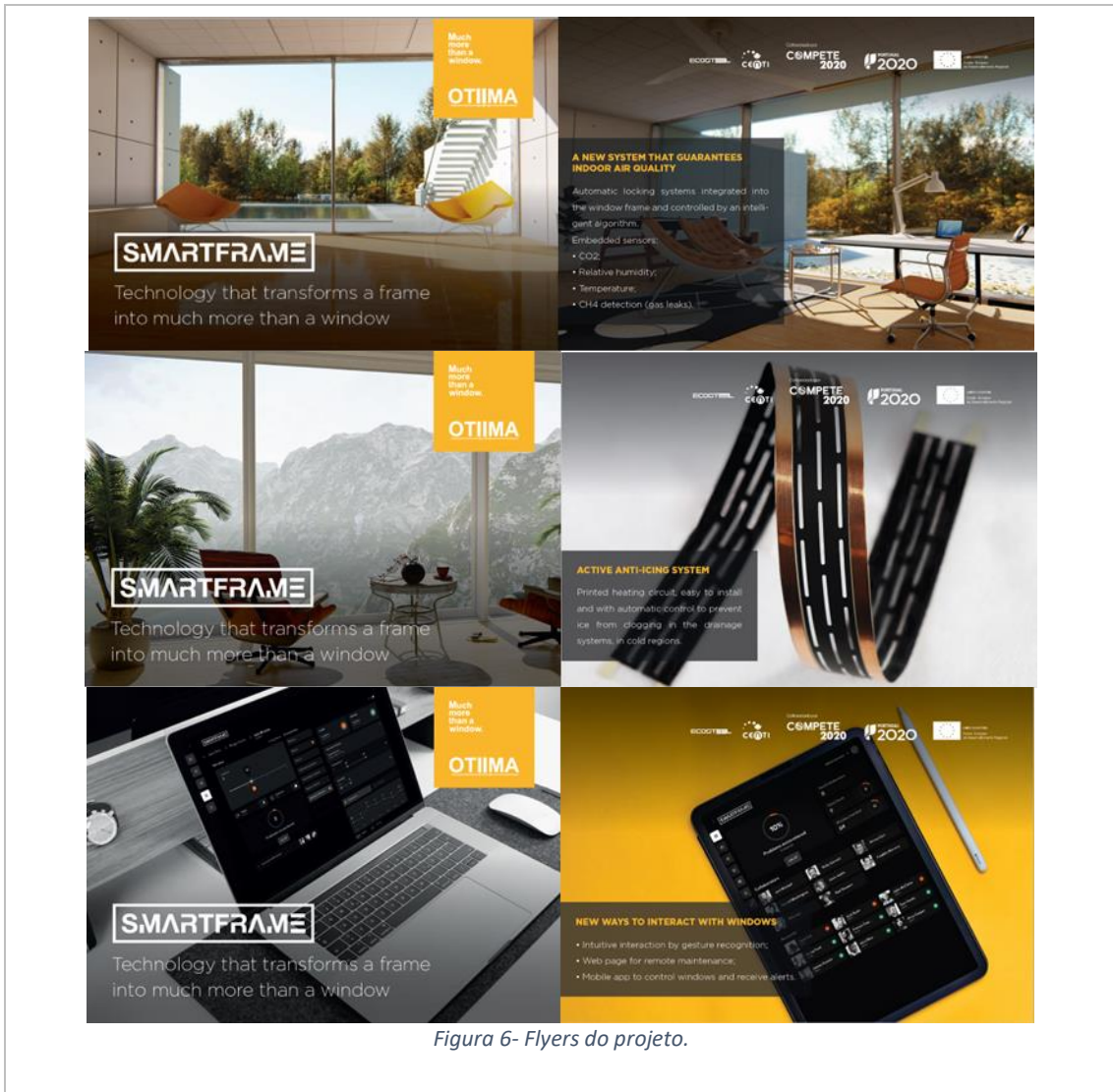


Figura 6- Flyers do projeto.