CONTRACT N° : 101130125

ACRONYM : FLUFET

TITLE: FLow detection of virUses by graphene Field Effect Transistor microarrays

Instrument: HORIZON-EIC-2023-PATHFINDEROPEN-01

PROJECT WEBSITE

Project Starting Date:	1 March 2024
Project End Date:	31 August 2027
Duration:	42 months

PROJECT CO-ORDINATOR:	UDC
Coordinator's Organization Name:	Universidade da Coruña

REPORTING PERIOD: **n.1** from 1 to 12

Reference Work packages:

WP5 Dissemination, Communication and Exploitation – (Lead Beneficiary **UDC**)

Project funded by the European Commission within HORIZON-EIC-2023-PATHFINDEROPEN-01		
Dissemination Level		
PU	Public	X

Project Officer: LUCIA FARINA

Document information

GA Number	101130125	Type of Action		EIC Pathfinder
Project name	FLow detection of virUses by graphene Field Effect Transistor microarrays			
Project name:	FLUFET			
Start Date	March 1st, 2024	Duration		42 months
End Date	August 31st, 2027			
Deliverable	D5.1 Kick-Off Meeting			
Work Package	WP5			
Project Month of Delivery	Contractual	M2	Actual	M2
Nature	Data	Dissemination Level		SE
Lead Beneficiary	UDC – Universidade de A Coruña			
Responsible Author	Alejandro Criado – UDC			
Contributions from	Miguel Cuerva – UDC			

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History of Changes

Version	Issue Date	Stage	Description	Comments	Contributor
1.0	22.04.2024	Draft	First Draft of D5.1		Miguel Cuerva
2.0	25.04.2024	Final version	Final version of D5.1		Alejandro Criado

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Background on FLUFET

FLUFET will be the first **automated** sensing device capable of continuously detecting a **broad spectrum** of viral targets in animal farms. The core of this project is the use of **graphene Field Effect Transistors** (gFETs) emerging as highly sensitive analytical platforms. Due to the versatility of the proposed detection method, this device will also offer the unprecedented capability of detecting **unknown viruses,** sending an alarm and warning of the potential danger of propagation. Furthermore, inherent to the measuring strategy, we will **automatically get the list of its target receptors when a virus is detected**. This invaluable information is very difficult to obtain with current methods (*e.g.*, PCR- and antibody-based detection).

To this end, FLUFET will develop a new **disruptive concept** using as never before:

1) **Human receptors** that make the sensor ready to detect known, unexpected and unknown viruses that can infect humans. Only viruses that can potentially infect humans, both unknown and known, will bind to the human receptors and give a signal.

This first step will significantly simplify any further characterization compared to a random sample. FLUFET will exploit the multiplexity of the envisioned device by performing parallel measurements of the same sample with transistors functionalized with antibodies sensitive to a portfolio of known viruses (Fig. 2).[9] This parallel measurement will work in perfect syntony with our human receptor-based sensors. Thus, when the concentration determined by the signal from the human receptor's sensors is larger tan the one from the antibody's sensor, it means that we are dealing with a new potential threat for humans. On the other hand, if the concentration determined by the antibody sensors is larger or equal to receptors one, then the signal originates from known viruses. Additionally, FLUFET will rank the threat level.

FLUFET could also reveal evolution events of known viruses that eventually enable them to bind to new human receptors. **All events will be logged for time and geographical statistics.**

2) The **multivalency** (multiple simultaneous bonds between the viral proteins and human receptors) combined with a flowcontrolled **shear force** will enhance the selectivity towards the whole viral entity and remove viral fragments or fouling agents, hence avoiding false positive measures. Such precise control will be achieved by embedding the gFET sensor element into a microfluidic system. In addition, stronger forces generated by higher flows will break the reversible virus-biomolecules interaction and **clean** the sensor surface. Hence, the sensor will be ready for new measurement cycles. If necessary (*e.g.*, in case of detected new threats), the washed material will be collected for proper **identification** by post-sequencing.

The FLUFET device will therefore use human receptors and antibodies to minimize the risk of false alarms and differentiate known and unknown viruses. It will also permit simultaneous measurements and post-measurement recovery of a virus-enriched sample for further characterization. The device can be integrated into the daily routines of farms to continuously monitor a wide number of zoonotic diseases, using microfluidics to load samples and measurements automatically. gFET devices as microarrays will allow miniaturization, highly sensitive detection and automatized measurements.

Consortium Members

Nº	Role	Short Name	Legal Name	Country	PIC
1	COO	UDC	Universidade da Coruña	ES	999629718
2	BEN	BCMaterials	FUNDACION BCMATERIALS - BASQUE CENTRE FOR MATERIALS, APPLICATIONS AND NANOSTRUCTURES	ES	928273511
3	BEN (IO)	INL	Laboratorio Iberico Internacional de Nanotecnología	PT	988145985
4	BEN	BIOMA	ASOCIACION CENTRO DE INVESTIGACION COOPERATIVA EN BIOMATERIALES- CIC biomaGUNE	ES	998347572
5	BEN (IO)	ICGEB	INTERNATIONAL CENTRE FOR GENETIC ENGINEERING AND BIOTECHNOLOGY	IT	999470444
6	BEN	GSEMI	GRAPHENEA SEMICONDUCTOR SL	ES	910983940
7	BEN	VTT	TEKNOLOGIAN TUTKIMUSKESKUS VTT OY	FI	932760440

Introduction

1.1. FLUFET WEBSITE

To ensure FLUFET outreach to society, the project designed a website utilizing the project's brand identity and existing visuals, to provide all relevant information about the project, the partners, public reports, news and the evolution of FLUFET through its lifecycle.

The URL is https://flufet.eu/, the website is managed by TripleVdoble and it is powered by the WordPress Content Management System. On the one hand, this allows TripleVdoble to manage the website, leaving the consortium to worry about sending and updating content and information, and on the other hand, once the project is completed, the WordPress service, which is common and intuitive to use, will allow the consortium to update information for communication and dissemination tasks.

The website structure and content include:

a) FLUFET - front page: The front page gives a general sense of the project, the mission and objectives, explanation about graphene-based FET, advantages and goals.

b) Consortium: Shows the partners involved in the project, with a small summary of the institutions and their websites to extend info.

c) Goals: shows in a short way the objectives of the project.

d) Activities: description of events organized within the framework of the project and related news, like press releases and public communication.

e) Results: all research publications generated by the Project, papers, patents, posters, etc.

f) Contact: It is a contact form that allows to send an email to the project account "proxecto.flufet@udc.gal" managed by the University of A Coruña.

g) Networks: There are two links to the project's social networks on X (formerly Twitter) and LinkedIn, together with contact.

h) The webpage includes acknowledgment and reference to the European Union and disclaimer excluding European Commission from any responsibility.

The screenshots of the current version of the website are displayed next:

Figure 1. Front page of the FLUFET website, explaining the meaning of FLUFET acronym and mission of the project.

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One Health

"One Health" is a global initiative that advocates collaboration between human, animal and environmental health professionals to address health challenges affecting all these sectors in an interconnected manner.

It aims to understand and prevent zoonotic diseases and promote a holistic approach to global health.

Graphene-based field

Graphene-based field effect transistors are devices that allow detection of molecules of interest (proteins, nucleic acids, viruses, etc.) and are based on changes in the conductivity of graphene sheets by interaction with these substances or with other chemical species generated from them.

In other words, when the state-of-the-art graphene-based sensor locates a virus or part of a virus, it will give us a specific signal that we can study.

FLUFET's advantages

FLUFET provides exciting opportunities for health and pandemic experts and managers, policy makers and regulatory and standardization bodies, livestock producers and their associations, precision livestock solution providers, investors and researchers in the multiple disciplines involved in the consortium.

Figure 2. Second part of the front page with the background of the project.

Consortium

The project requires an interdisciplinary consortium that includes partners from computational biophysics, graphene technology, nanotechnology, sensing, microfluidics, virology, surface engineering and sensor design and electronics.

Discover Consortium

CICA

CIC biomaGUNE
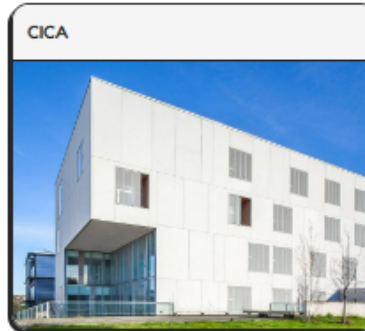
Goals

The goal of FLUFET is to create and evaluate a proof-of-concept prototype for a rapid, fully automated detection device designed for continuous surveillance of a wide range of viruses on animal farms.

The project focuses on the use of graphene field effect transistors, recognized as highly sensitive analytical platforms, combined with microfluidics and particular cell receptors.

With its adaptive detection approach, the device is able to identify unknown and unexpected viruses, rapidly triggering an alarm to alert and prevent against possible risks of spread.

Cookies

HTTPS:// TRIPLEVDOUBLE

Figure 3. Third part of the front page showing the consortium, goals and the acknowledgment of the European Union.

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1.2. PROJECT LOGO

The project Logo was designed with two concepts together, the mobility of a virus and the ability to alarm that the **FLUFET** sensor will have, whose acronym can be understood as FLU (representing the virus) and FET (signifying the acronym of field effect transistor, the transducer component of the sensor).
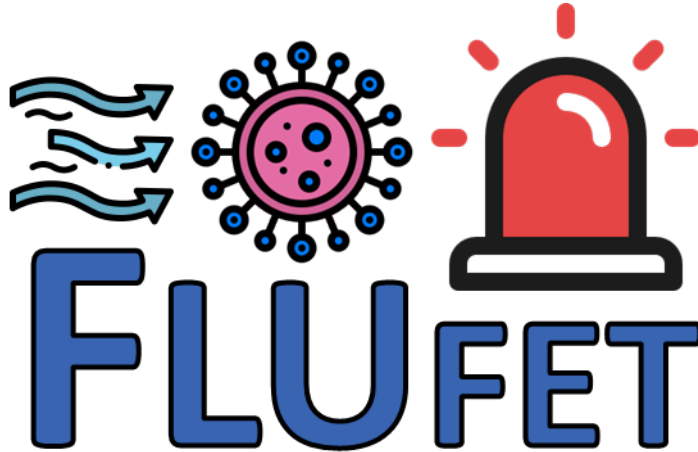

Figure 4. Logo FLUFET – It combines the FLU (Virus) and the sensor part, the FET (Field Effect Transistor).

1.3. SOCIAL MEDIA

FLUFET project, will use social media to raise awareness about the project progress. The main aims are to:

a) maximize the dissemination and communication of the project and the FLUFET sensor utility.

b) ensure that project results are widely distributed to all potential stakeholders.

c) share progress, technology, and project results to ensure broad awareness among a diverse spectrum of external stakeholders, with emphasis on the agricultural sector and policymakers.

It is crucial to ensure the proper alignment between **FLUFET**'s social media objectives and the project's main dissemination goals. As a European project, it is crucial to explain to society how science and technology can be applied to solve society's problems, and even more so in this case, where the project focuses on the detection of viruses and possible zoonoses.

The main social networks considered relevant to the project are going to be:

Twitter:	FLUFET (@flufet_EIC) / X (twitter.com)
LinkedIn:	LinkedIn: FLUFET

FLUFET will have presence through LinkedIn (Figure 5) to strengthen the impact of the project and to reach the widest possible audience, especially commercial partners related to exploitation.

Figure 5. FLUFET Profile in LinkedIn

And will have Twitter (Figure 6) to communicate rapid and short messages relevant to the project to a more general audience, taking strategic and targeted measures for promoting the action itself and its results.

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Figure 6. FLUFET - Twitter profile.

The messages will frequently include a link towards the website, where full-fledged posts on the topics may be found.