PLANT DIAGNOSTICS VIA A GRADIENT TRANSPIRATION SENSOR FOR SMART-FARMING (PLACARE)

A Data Management Plan created using DMPonline.be

Creator: Batist Geldhof

Affiliation: KU Leuven (KUL)

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Project abstract:

In recent years, precision-based solutions and automation are revolutionizing crop production systems towards smart farming. Especially horticulture is rapidly transitioning towards high-level control of environmental conditions to optimize yield margins and sustainability. These systems are based on climate and fertigation control, but mostly do not take into account specific plant processes. Physiological processes such as transpiration are the first to change in response to deviating environmental stimuli. In this project, we propose a sensor to monitor transpiration in real-time and in relation to the microclimate at the leaf level. So far, no device is fully tailored to measure changes in the leaf boundary layer. Our wearable sensor will monitor changes in humidity at the leaf surface, not hampering plant growth, nor interfering with leaf transpiration itself. Therefore, it will be small, flexible, translucent and porous while retaining a high surface-to-volume ratio to ensure high sensitivity. We will deploy high-end fabrication techniques (e.g., two-photon polymerization) to design a humidity gradient sensor with optimized components (material, geometrical substrate design, interdigitated electrodes, sensing layer). An array of these sensors will be validated to allow for spatial and dynamic humidity sensing and boundary layer characterization directly on plants (and detect stress responses). Our sensor represents an innovative tool for smart farming.

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DPIA

DPIA

Have you performed a DPIA for the personal data processing activities for this project?

Question not answered.

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GDPR

GDPR

Have you registered personal data processing activities for this project?

- No

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Application DMP

Questionnaire

Describe the datatypes (surveys, sequences, manuscripts, objects …) the research will collect and/or generate and /or (re)use. (use up to 700 characters)

Sensor development is based on 2D and 3D designs (DeScribeKLayout) and CFD and electrical and material simulations (ComSol). We will devise protocols for resin, IDE and sensing layer composition. Materials will be characterized by optical microscopy, SEM, AFM, XPS, EDX and EIS, producing imaging data and quantitative spectra. Data on sensor characterization and time-series data will be described in journal and conference peer-reviewed publications. Patents on material design and processes will cover novel technologies and applications. Process description (steps/parameters), data related to material/device characterization and images will be stored in digital form (.doc, .csv, .tiff, .jpeg).

Specify in which way the following provisions are in place in order to preserve the data during and at least 5 years after the end of the research? Motivate your answer. (use up to 700 characters)

Digital data will be stored on the KU Leuven central servers, maintained by the ICT services, and in shared Onedrive folders. Physical data (sensor prototypes) will be stored at the KU Leuven Cleanroom facilities. At the end of the project (or after publication), data will be added to a digital repository. The PI (Prof. Taurino) will be responsible for the data after the end of the project.

What’s the reason why you wish to deviate from the principle of preservation of data and of the minimum preservation term of 5 years? (max. 700 characters)

Not all physical material will be stored for 5 years due to space restrictions. Intermediate materials used for the production of sensors might have to be removed before this term.

Are there issues concerning research data indicated in the ethics questionnaire of this application form? Which specific security measures do those data require? (use up to 700 characters)

NA

Which other issues related to the data management are relevant to mention? (use up to 700 characters)

NA

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FWO DMP (Flemish Standard DMP)

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1. Research Data Summary

List and describe all datasets or research materials that you plan to generate/collect or reuse during your research project. For each dataset or data type (observational, experimental etc.), provide a short name & description (sufficient for yourself to know what data it is about), indicate whether the data are newly generated/collected or reused, digital or physical, also indicate the type of the data (the kind of content), its technical format (file extension), and an estimate of the upper limit of the volume of the data.

				Only for digital data	Only for digital data	Only for digital data	Only for physical data
Dataset Name	Description	New or reused	Digital or Physical	Digital Data Type	Digital Data format	Digital data volume (MB/GB/TB)	Physical volume
		Please choose from the following options: • Generate new data • Reuse existing data	*Please choose from the following options:* • Digital • Physical	*Please choose from the following options:* • Observational • Experimental • Compiled/aggregated data • Simulation data • Software • Other • NA	*Please choose from the following options:* • .por, .xml, .tab, .csv,.pdf, .txt, .rtf, .dwg, .gml, … • NA	*Please choose from the following options:* • <100MB • <1GB • <100GB • <1TB • <5TB • <10TB • <50TB • >50TB • NA	
exp_microscopy	Evaluation masks and sensors. Used for visualization and characterization of physical data (Leica).	New data	Digital	Experimental	.tiff .jpg .png	< 100 GB	
exp_SEM	Evaluation sensors. Used for 3D visualization and characterization of physical data (thickness, ...).	New data	Digital	Experimental	.tiff	< 100 GB	
exp_profilometry	Evaluation sensors. Used for 3D characterization of physical data (Dektak, Sensofar).	New data	Digital	Experimental	.csv .jpg	< 1 GB	
exp_mechanical	Stress/strain, bending, wettability, transparency, adhesion sensors.	New data	Digital	Experimental	.csv	< 1 GB	

exp_electrochemical	Electrochemical characteristics sensors (voltammetry, amperommetry, EEC)	New data	Digital	Experimental	.csv .opju	< 1 GB	
exp_flow	Flow effects sensors (LCi)	New data	Digital	Experimental	.csv	< 1 GB	
exp_thermalIR	Latent heat measurements via thermal imaging (FLIR, Optris).	New data	Digital	Experimental	.tiff .csv	< 100 GB	
exp_sensorOutput	Evaluation sensor performance (T & RH measurements)	New data	Digital	Experimental	.csv	< 1 GB	
comp_recipes	Process flows cleanroom	New + reused data	Digital	Compiled	.doc	< 1 GB	
comp_masks	Lithography mask files	New data	Digital	Compiled	.gds	< 1 GB	
comp_PCB	PCB design files	New data	Digital	Compiled	.kicad_pcb or similar	< 1 GB	
SW_analysis	Data analysis scripts (time-series, parameter estimation, ...)	New data	Digital	Software	.R .py	< 1 GB	
SW_code	Microcontroller programming	New data	Digital	Software	.ino or similar	< 1 GB	
sim_fluidics	Flow modeling of leaves and sensors (T and RH) (COMSOL, ANSYS)	New data	Digital	Simulation	.mph or similar .png .avi	< 100 GB	
sim_electrical	Electrical circuit and heat generation sensor	New data	Digital	Simulation	.mph or similar	< 100 GB	
sim_solid	Material physics (adhesion, stress)	New data	Digital	Simulation	.mph or similar .png .avi	< 100 GB	
phys_mask	Photolithographic masks	New data	Physical				1 mask box
phys_wafer	Silicon and glass wafers	New data	Physical				1 box in cleanroom
phys_substrates	Unfinished sensor components (substrates, material test)	New data	Physical				1 box in cleanroom (see previous)
phys_sensors	Sensor prototypes	New data	Physical				1 box in cleanroom (see previous)
phys_plant	Plant material and seeds	Reused data	Physical				Seeds stored in dedicated storage. Plants grown in growth chambers

If you reuse existing data, please specify the source, preferably by using a persistent identifier (e.g. DOI, Handle, URL etc.) per dataset or data type:

- Process flows are partially based on existing processes in the MNS research group
- Seeds for plant trials will be provided by the co-PI. This material has been used during my PhD and is stored in dedicated boxes in a cooling room.
- Transpiration data might be compared with data from experiments conducted during my PhD.

Are there any ethical issues concerning the creation and/or use of the data (e.g. experiments on humans or animals, dual use)? Describe these issues in the comment section. Please refer to specific datasets or data types when appropriate.

- No

Will you process personal data? If so, briefly describe the kind of personal data you will use in the comment section. Please refer to specific datasets or data types when appropriate.

- No

Does your work have potential for commercial valorization (e.g. tech transfer, for example spin-offs, commercial exploitation, …)? If so, please comment per dataset or data type where appropriate.

- Yes

phys_sensors: The sensor technology will have application potential in horticultural settings. The underlying principles will provide insights that could be used in future technology (sensing principle, gradient sensing, adhesion to plant surfaces, ...). This will be assessed when needed.

Do existing 3rd party agreements restrict exploitation or dissemination of the data you (re)use (e.g. Material/Data transfer agreements/ research collaboration agreements)? If so, please explain in the comment section to what data they relate and what restrictions are in place.

- No

Are there any other legal issues, such as intellectual property rights and ownership, to be managed related to the data you (re)use? If so, please explain in the comment section to what data they relate and which restrictions will be asserted.

- Yes

If patentable, we will have to start up the IP trajectory for the technology.

2. Documentation and Metadata

Clearly describe what approach will be followed to capture the accompanying information necessary to keep data understandable and usable, for yourself and others, now and in the future (e.g., in terms of documentation levels and types required, procedures used, Electronic Lab Notebooks, README.txt files, Codebook.tsv etc. where this information is recorded).

Folders will contain README.txt files describing their content. Excel files will get a separate tab describing headers. Program scripts will be commented as far as possible.

Will a metadata standard be used to make it easier to find and reuse the data? If so, please specify (where appropriate per dataset or data type) which metadata standard will be used. If not, please specify (where appropriate per dataset or data type) which metadata will be created to make the data easier to find and reuse.

- No

No specific standard is available. Code and projects will be integrated using repositories (e.g. Github).

3. Data storage & back-up during the research project

Where will the data be stored?

Data will be stored locally, in shared OneDrive folders (via KU Leuven license), and on KULeuven servers if necessary.

How will the data be backed up?

Digital data will be backed up weekly in KU Leuven Onedrive folders. Non-digital data are mostly sensor materials and cannot be backed up. The recipes for their production will be standardized for maximal reproducibility and saved digitally.

Is there currently sufficient storage & backup capacity during the project? If yes, specify concisely.
If no or insufficient storage or backup capacities are available, then explain how this will be taken care of.

- Yes

For now, the expected data volume is <= 1 TB. This volume falls within the range of available storage space in the KU Leuven Onedrive folder. Backup capacity on the KULeuven servers can be expanded.

How will you ensure that the data are securely stored and not accessed or modified by unauthorized persons?

Digital data are protected through two-factor authentication.
Physical data are stored in labs with badge access.

What are the expected costs for data storage and backup during the research project? How will these costs be covered?

Onedrive folders are free of charge through the KU Leuven license. In case shared network folders will be used, the expected costs are starting around € 104 - 251 / TB / year, depending on the storage type (shared, large storage, ...) . This cost can be covered through my FWO benchfee if necessary.

4. Data preservation after the end of the research project

Which data will be retained for at least five years (or longer, in agreement with other retention policies that are applicable) after the end of the project? In case some data cannot be preserved, clearly state the reasons for this (e.g. legal or contractual restrictions, storage/budget issues, institutional policies...).

Important data will be stored for <= 10 years. Design protocols and simulation parameters will be retained to ensure reproducibility. Experimental data and code used for publications can be stored in repositories. Physical data (e.g. sensor prototypes) will be discarded as they can be reproduced using above protocols and storage space is limited.

Where will these data be archived (stored and curated for the long-term)?

Digital data will be stored in repositories whenever published (e.g. the KU Leuven RDR or Zenodo). Data not ready for publication or subject to IP rights (if applicable) will be archived in large storage volume of the KU Leuven servers.

What are the expected costs for data preservation during the expected retention period? How will these costs be covered?

Storing data in RDR is free of charge for 50 GB/year. This volume can be upgraded. Zenodo offers a free of charge storage of 50 Gb/dataset, allowing for multiple datasets to be stored. In case data are stored on the KU Leuven large volume servers a cost of € 104,42/TB/year can be expected. These costs will be covered by the lab PI.

5. Data sharing and reuse

Will the data (or part of the data) be made available for reuse after/during the project? In the comment section please explain per dataset or data type which data will be made available.

- Yes, in an Open Access repository
- Yes, in a restricted access repository (after approval, institutional access only, …)
- No (closed access)

Experimental data used in publications can be made available (e.g. humidity sensor measurements and simulation data). Data not fit for publication (e.g. patent pending), will not be made available until after discussion with the LRD office. Access can be granted to regulate availability.

If access is restricted, please specify who will be able to access the data and under what conditions.

Access is open after publication or available for collaborators under request (see next).

Are there any factors that restrict or prevent the sharing of (some of) the data (e.g. as defined in an agreement with a 3rd party, legal restrictions)? Please explain in the comment section per dataset or data type where appropriate.

- Yes, Intellectual Property Rights

Some of the technologies developed during the project might be suitable for patenting (recipes, protocols, sensing technology). These are mostly methodological and physical data types. These data might be closed or embargoed until publication.

Where will the data be made available? If already known, please provide a repository per dataset or data type.

For now, data will be mostly archived in the KU Leuven RDR or Zenodo. Other repositories, such as GitHub, can be explored for software code (python, c++, ...).

When will the data be made available?

Upon publication of research results (or patent).

Which data usage licenses are you going to provide? If none, please explain why.

For example: CC-BY-NC-SA or CC-BY-ND, depending on the data used. Certain data are possibly not adaptable (depending on their context, visualization could be adapted).
Source code can be licensed under MIT license for general code or similar (e.g. sensor read-out).
This will depend on the expected output of the project (patentable technology or not).

Do you intend to add a PID/DOI/accession number to your dataset(s)? If already available, you have the option to provide it in the comment section.

- Yes

What are the expected costs for data sharing? How will these costs be covered?

For now, data sharing is expected to be free of charge.

6. Responsibilities

Who will manage data documentation and metadata during the research project?

Batist Geldhof

Who will manage data storage and backup during the research project?

Batist Geldhof

Who will manage data preservation and sharing?

Irene Taurino

Who will update and implement this DMP?

Batist Geldhof