ElectroCap Mid-Program Pitch Deck

Optimizing Smart Irrigation

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Team

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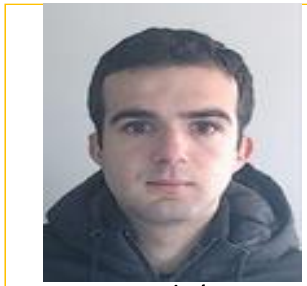

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Advisors and Mentors

Prof. Marcelino Santos

Scientific Co-advisor

Coordinator

Francisco Simplício

Problem definition

Our project aims to save water by optimizing the amount of water used in agriculture. Currently, farmers lack the information needed to calculate the precise amount and timing of irrigation for their crops. This results in either insufficient watering for the plants or the wasteful use of water.

Solution beneficiaries

Our project aims to develop a viable and scalable solution for large fields that are too expansive for conventional systems utilizing technologies like WiFi or Bluetooth communication. We also aim to create a fully autonomous and more efficient water management system. The primary beneficiaries will be medium and large-scale farmers seeking to conserve water and enhance their yields.

Technological solution

- Our solution aims to integrate soil and climate-based data to calculate whether to irrigate the plants or not. To achieve this, we will have a main node that receives data from peripheral nodes connected to the soil, measuring soil moisture. The main node collects climate data and uses it to estimate evapotranspiration. With these two parameters, we can make a more precise decision on whether to open the valve and irrigate the crops or not.
- The user will define the time of day for the soil to be evaluated and for a decision to be made. Using evapotranspiration, we can predict the water that will be lost from the soil, ensuring that the crops will not be under water stress until the next soil evaluation.
- We will maintain a database with crop and field parameters selected by the user. These parameters are used to estimate evapotranspiration more precisely.
- The valve's opening time will be calculated based on the current soil moisture, and crop water needs, which are also influenced by the soil type.

Competitors and previous work

Competitors

Competitors: There are numerous companies in the market offering smart irrigation systems. Some are solely focused on acquiring data to assist farmers in deciding when to irrigate, while others utilize sensors (such as soil sensors and/or climate sensors) to estimate Irrigation Water Need (IWN). Most systems establish thresholds for these parameters, determining when to initiate irrigation.

-**NOS Rega Inteligente, Earthscout:** A system that collects and provides users with data, assisting them in deciding when to irrigate. Users can remotely control valves and pumps.

-**Watersystems:** A system that uses climate data to estimate evapotranspiration and predict IWN.

-**IRRIOT, Spherag, Hydropoint:** Systems that acquire data with soil and climate sensors, controlling irrigation based on thresholds defined by the user.

Previous work

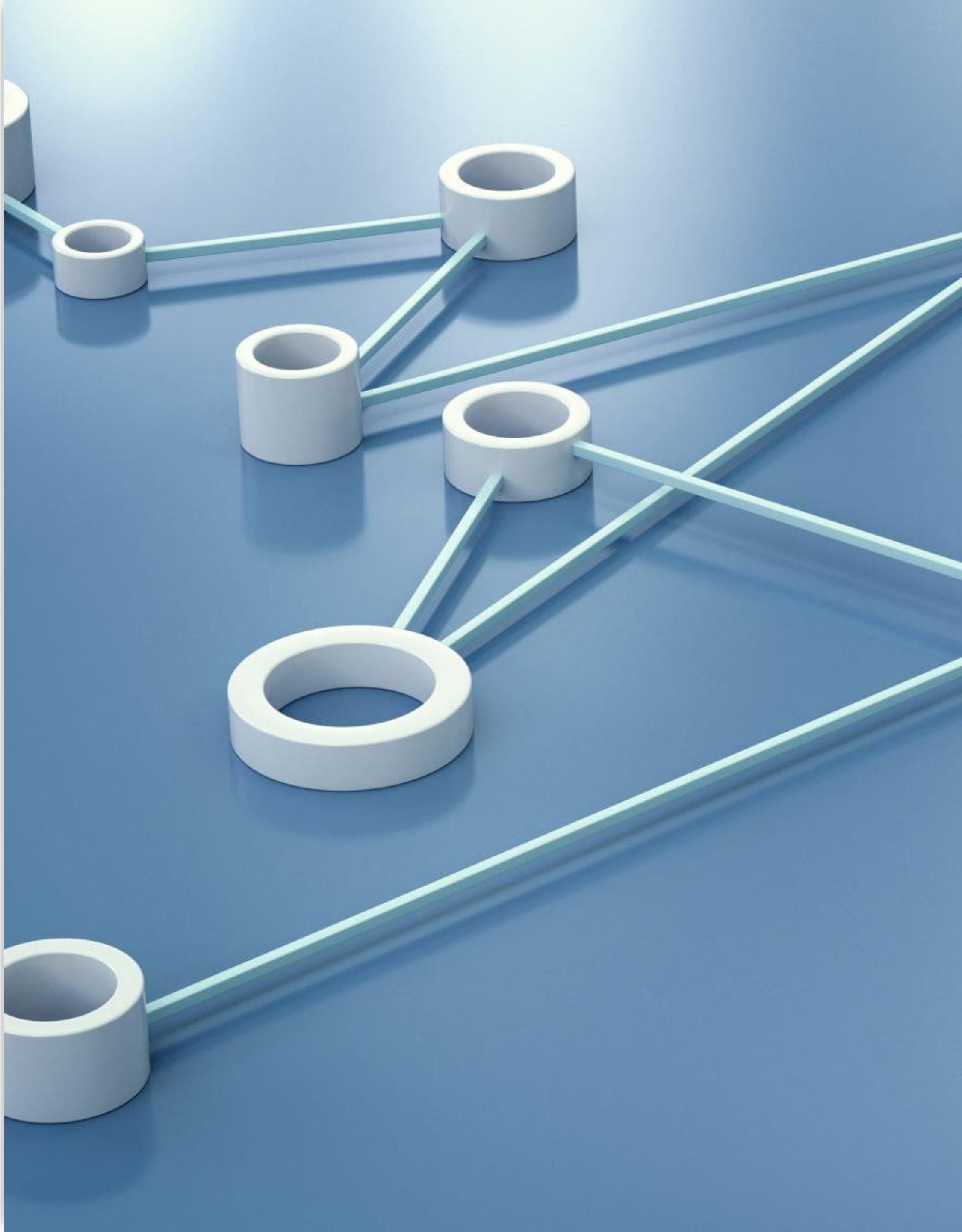
From research conducted by the group, we discovered that many universities and companies have developed solutions and systems to address this problem. They utilize technologies such as:

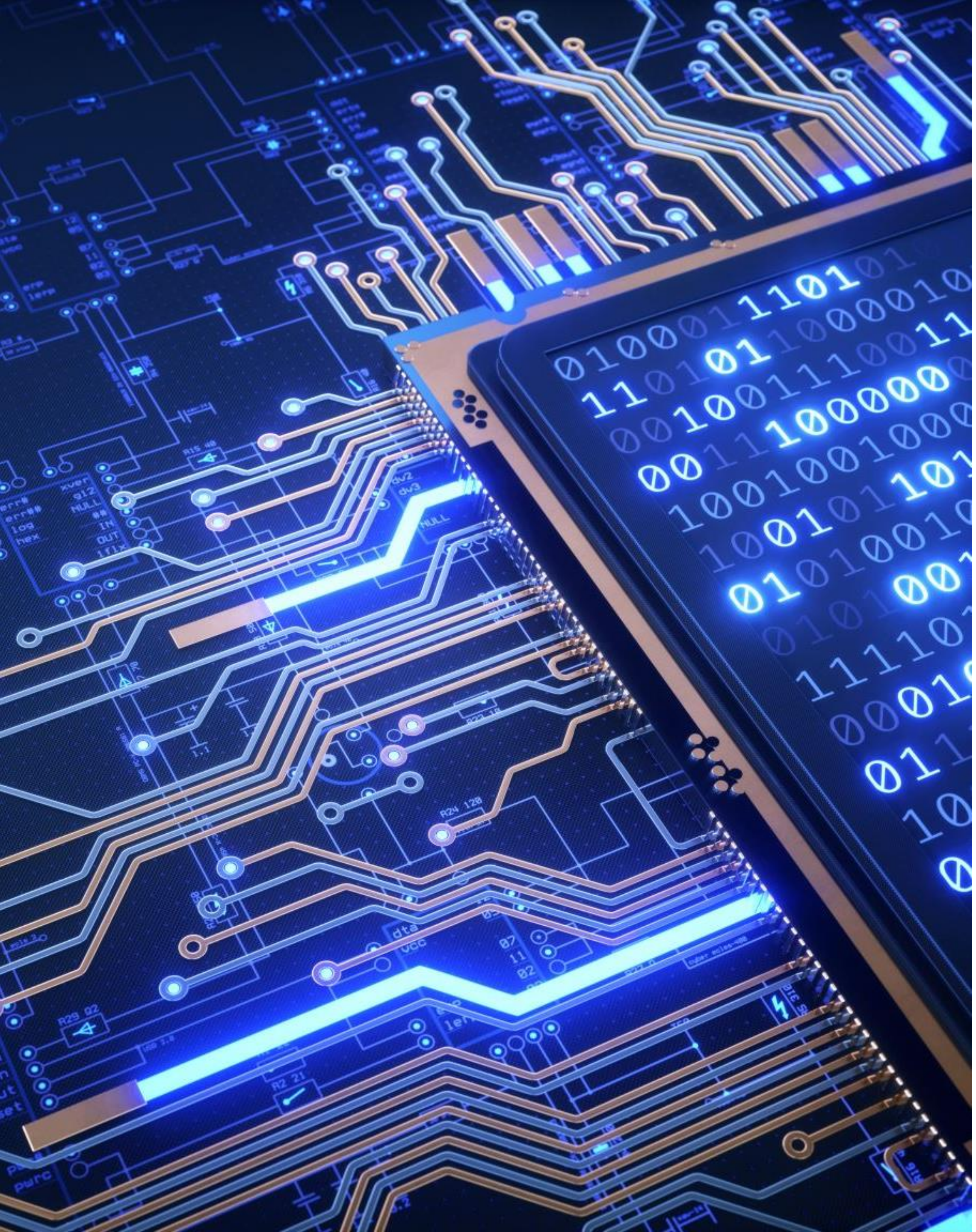
-Soil moisture sensors that schedule irrigation and activate irrigation systems based on soil moisture.

-Climate-based solutions that use climate data to estimate evapotranspiration, predicting soil water levels and scheduling irrigation accordingly.

Solution requirements

Our system must detect, during specific times of the day, whether our crops need water. The prototype must take into account the current presence of rain, evapotranspiration, soil moisture, and the time of day to generate the irrigation schedule. This schedule will be calculated based on the parameters defined by the crop's needs and the type of soil. If the calculations indicate that the crop requires irrigation, the valve will be opened.





Technical challenges

The group is confronted with the challenge of accurately and precisely determining when to define that the plant needs water and calculating the evapotranspiration level. This parameter will be computed based on the temperature and solar radiation levels, which will be estimated by a sensor conceptualized by the group; radiation sensors prove to be too expensive.

Partners

The biggest partner will be IST and its professors and students of Agronomy in Instituto Superior de Agronomia.

Testing and validation metrics

The metrics that will evaluate the success of the project include maintaining a fully autonomous and self-sufficient prototype, ensuring the health and proper care of the crop, and comparing the experimental evapotranspiration to a real one captured by a dedicated sensor available online.

Division of labor (1)

Filipe Cruz	André Carvalho	António Simões
Control and sensors	**Website and sensors**	**Control and communication**
Designing the system	Arduino Programming	Designing the system
Sensors and Valves management	Sensors and Valves management	Lora antenna communication
Designing the valve’s controllers	Website Management	Designing the valve’s controllers
Website Management and entries		

Division of labor (2)

Rodrigo Arriegas	João Galego	Gonçalo Amado
Energy and communication	**User interface**	**User interface**
Solar Panels	Web application	Web application
Energy sources for all the equipment	Crop and soil data base	Crop and soil data base
Lora Antenna communication		

Original Schedule

Week 2 - Design and product inventory;

Week 4 – Connection and calibration of the sensors;

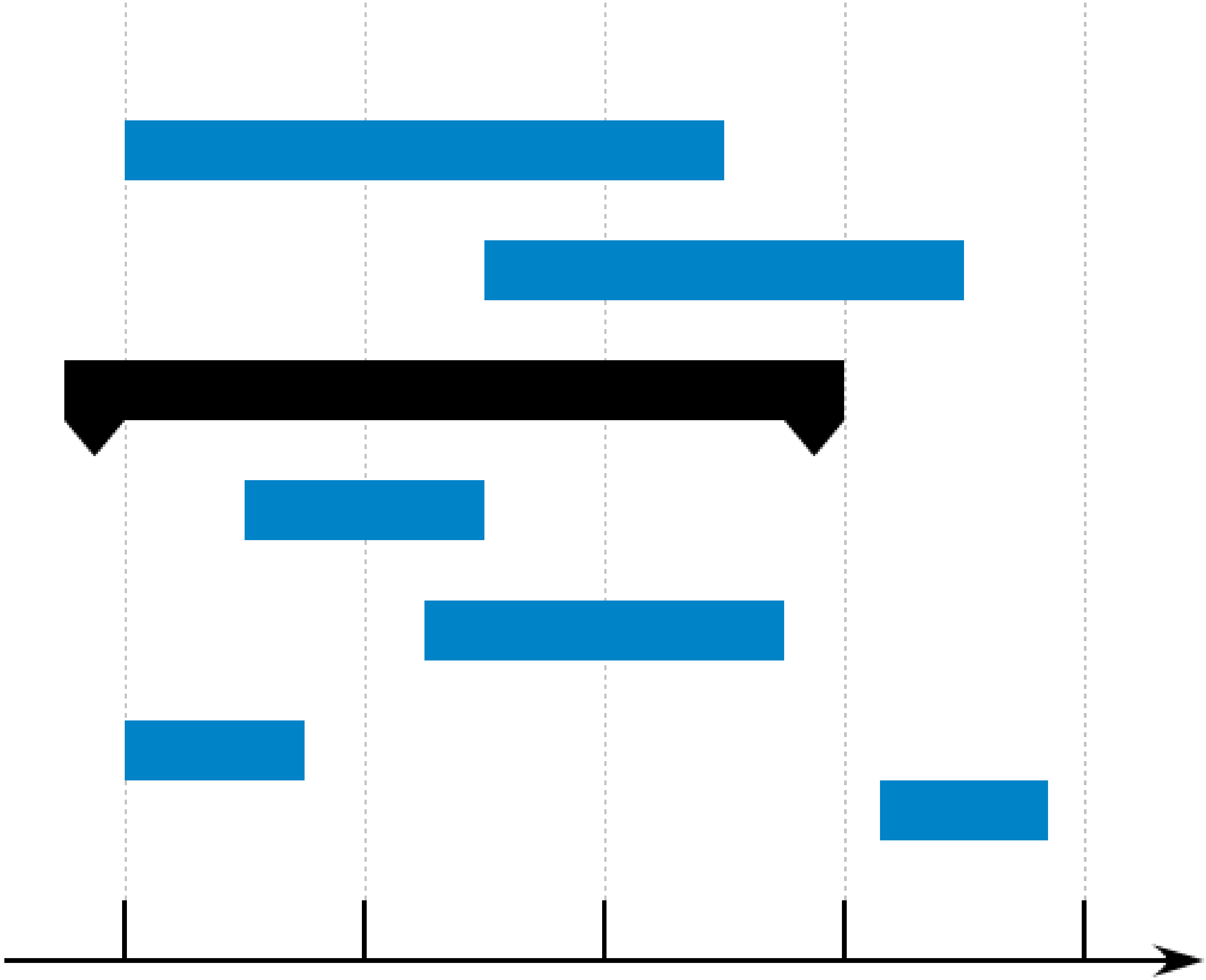
Week 6 – First tests to make the prototype self sufficient and decision support system; App with a functional data base.

Week 8- Fully functional peripheral node without connection to others. Decision support system and valve controller fully functional;

Week 10 – Test with a wireless implementation and communication with the main node; App using the data obtained from the main arduino.

Week 12 – Optimization and field testing;

Week 14 – The system fully works.



Mid-program status

Comparing to the first proposal of the project, the group changed the approach slightly witch made the prototype simpler in a physical sense.

The group abandoned the idea of gathering data to calculate evapotranspiration and will be using the API from IPMA to gather the data, which will reduce the cost and complexity of the system, since now only one sensor will be used. Even though through a phototransistor the radiation could be measured, when the group found out about the solution of using the IPMA API, it made more sense to use that data as it can be more viable given the window of time available.

In the first prototyping stage, the communication will be done through BLE and the project won’t include the autonomous energy system until the material is delivered.

Achieved results

During the first phase of the project, as mentioned earlier, the group changed the approach to a more inter-node communication approach instead of a self-gathering data method. This resulted in a bigger energy consumption, which didn’t become a problem because the main node will be connected to the grid and will send the information to the self-sufficient nodes.

Through research on our competitors, we found ways to make our prototype more efficient, removing complexity and costs from the solution.

The public website and blog have been set up, updated every week, refined and improved to make them more appealing and consise for potencial users to comprehend to the most minor details what the solution entails.

A Google Form has also been sent to various agriculture work groups and potencial users to understand their feelings about our solution and if it would be viable and useful for their crops. The responses have been very positive has most of them recognize the solution as viable and are interest in it.

Since the Arduinos have been delivered recently, the group has already started working on communication between two nodes through BLE to test synchronized data sending and data reception as well as developing a dashboard to display all the data.

Achieved results

With the Google Forms Data, we managed to pinpoint a few areas of our project that stand out from the other available solutions and where we can improve upon. We got answers from 32 farmers.

81% of our responses indicated that they don’t water their crops through a smart irrigation system. The reason why these farmers dont have one is due to the lack of offer and high prices. In a detailed question we posed, the farmers pointed out that what would make them consider a smart irrigation system would be one with low water waste, lower prices, viability, and watering based of the needs of the crop.

From the first proposal, our prototype will have these features, making it stand-out from the available solutions that these farmers don’t consider.

75% of our responses would consider our proposal or have interest, and they mention that the prototype lacks plant-specific features, such as water stress calculations. Another feature that has been pointed out is leakage detection, which the group is considering implementing.

The other 25% of our answers mention they wouldn’t consider our prototype because they don’t have enough area for it to make it worth it or have dedicated stations for data gathering.

Challenges faced by the team

Challenges Faced by the Team:

- Delay in receiving the base material to commence work.
- Absence of radiation sensor

Research to streamline future work processes:

Exploring alternative methods and technologies to mitigate the impact of delayed material delivery.

Development of code utilizing IPMA API:

Due to the absence of radiation and temperature sensors, we opted to develop code that integrates the IPMA (Instituto Português do Mar e da Atmosfera) API. This API offers data on evapotranspiration, replacing the need for physical sensors.

Deviations from original schedule

The lack of immediate access to the material delayed the progress a little bit, which made us realize that we should try other implementations while all the material hasn’t been delivered, such as BLE to substitute Lora and direct grid connection instead of Solar Panels.

Contribution of each team member (1)

Filipe Cruz	André Carvalho	João Galego
Website Designing	**Website Designing**	**Dashboard development**
IPMA API	Blog entries	
Blog entries		

Contribution of each team member (2)

Rodrigo Arriegas	António Simões	Gonçalo Amado
Redefining the prototype	**Redefining the prototype**	**Dashboard development**
Arduino communication	Website Development	
Google Forms conception	Arduino communication	

Corrected Schedule

Week 10: Arduinos communicating with each other.

Week 11: Two nodes sending information to each other and simulated sensors.

Week 12: Functional Dashboard and tests using the real sensor as well as working with data from the IPMA API.

Week 14: Communication via LORA antenna between nodes.

Week 15: Self-sufficient nodes and functional prototype.