

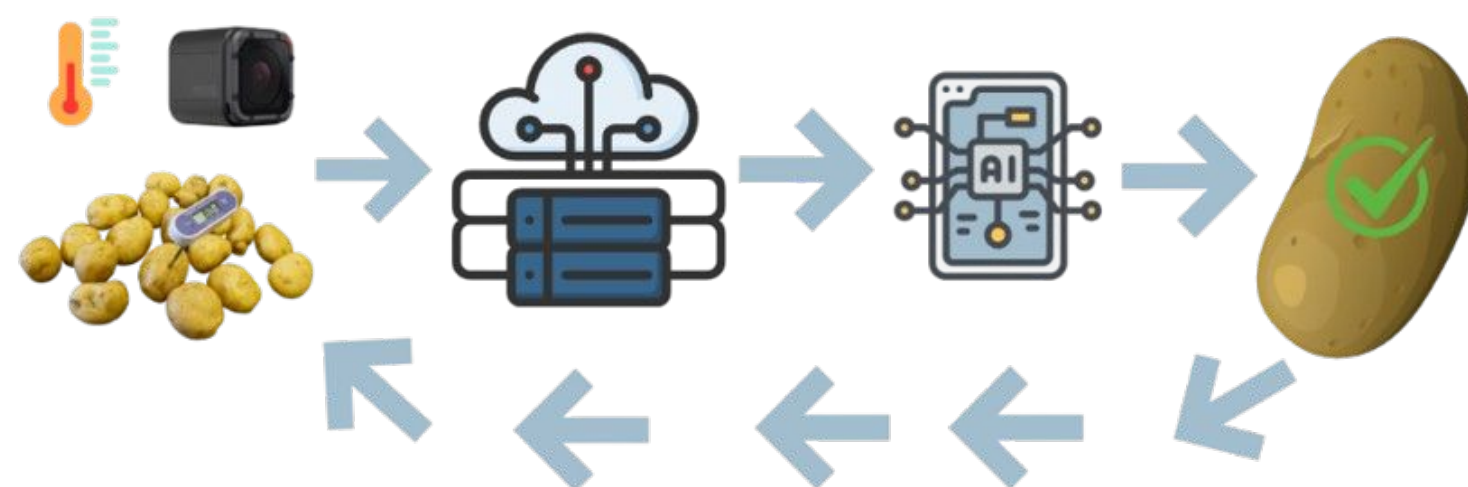
Namir Sabuwala, Aleksandar Jovanovic, Ohm Pandya, Gabe Garcia, Drake Zinn

Project Basis

In semiconductor fabrication, wafers are often processed and only evaluated after the run using destructive or offline testing. If something goes wrong, it's already too late and the wafer, along with the money, is lost. Industry is investing heavily in ways to monitor processes in real time so parameters can be adjusted on the fly.

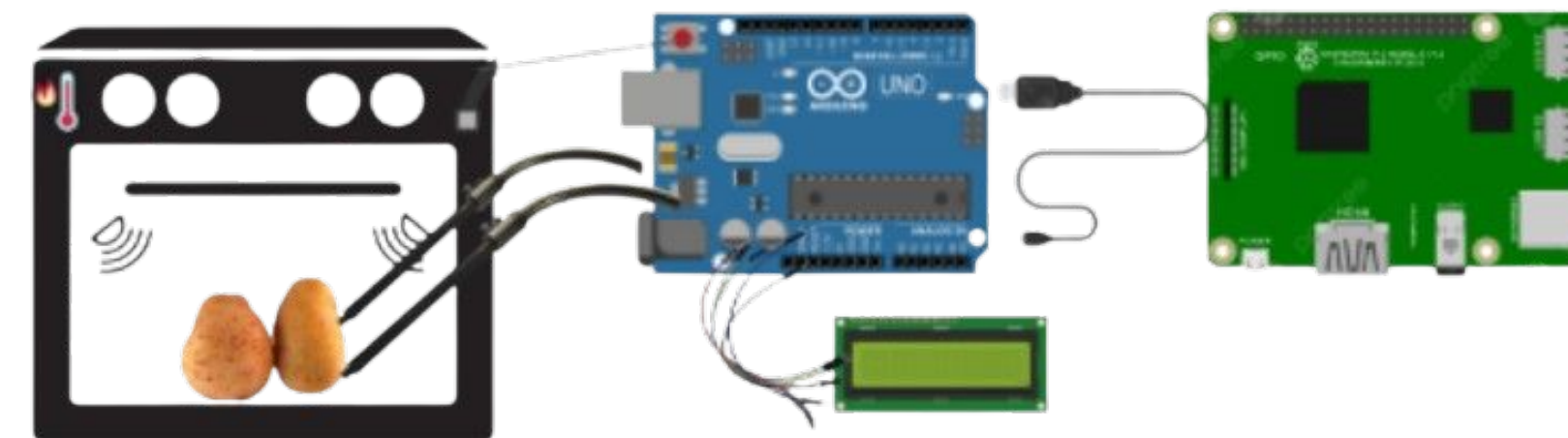
Project Scope

Cooking a potato is used as an analogy to build a closed loop system. The potato is monitored using internal and external temperature sensors, and a machine learning (ML) model uses this real time data to control the heating elements inside a custom oven based on how fast and how long the potato needs to cook. Instead of following a fixed cooking profile, the system adapts the process over time depending on the potato's size and density, which affect how it absorbs heat. Once trained, the process becomes automatic, where a user can place a potato in the oven and have it cooked properly, with the same approach transferable to different setups like ovens and air fryers.

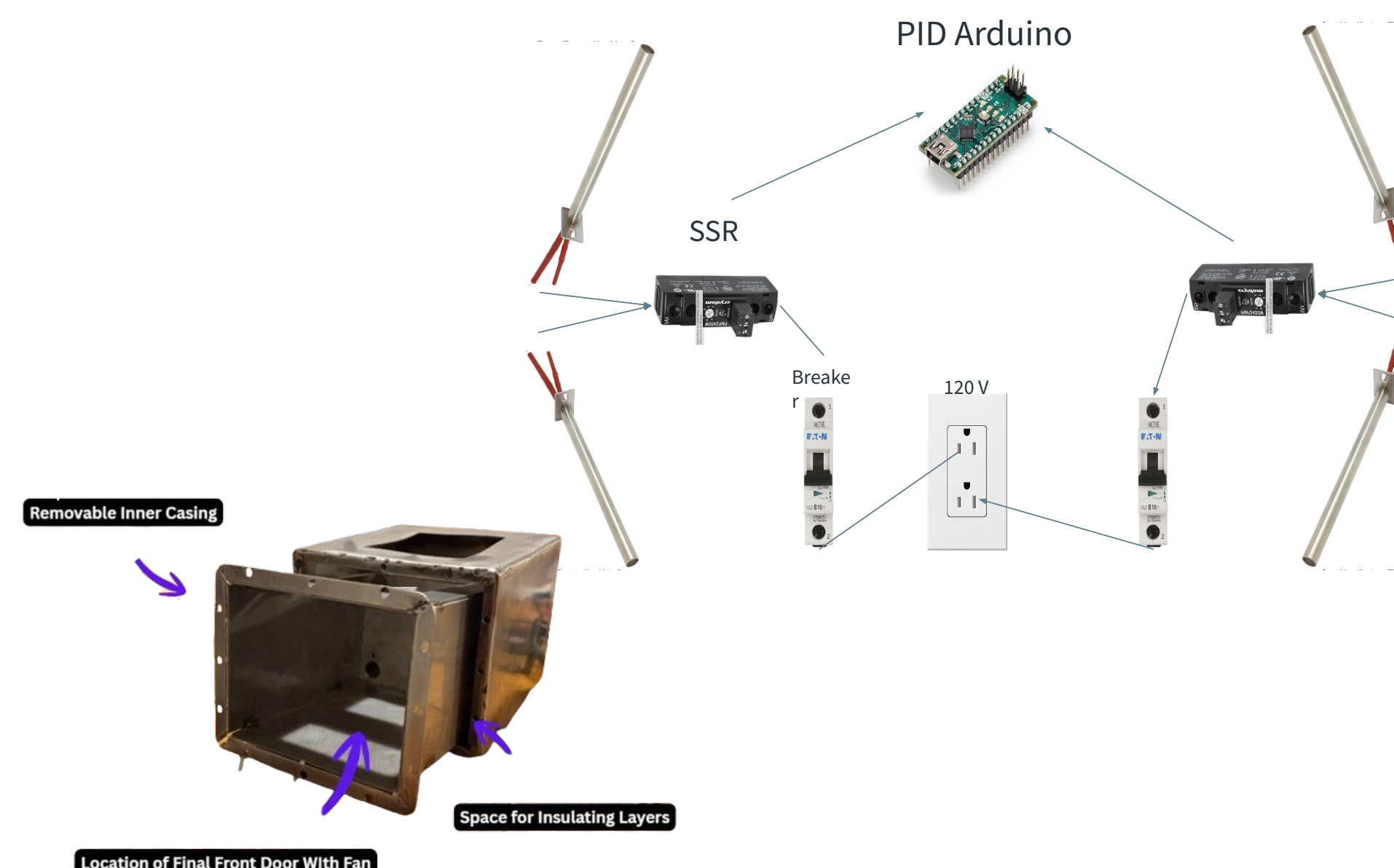


Process Flow and Model

Data is collected from the potato using internal and external temperature sensors and is initially processed by an Arduino. It is then transmitted to a Raspberry Pi, where a ML model analyzes the data to determine how the cooking process should be adjusted. The system updates the conditions in real time, and the results are reflected in subsequent temperature readings, creating a continuous feedback loop throughout the cooking process.

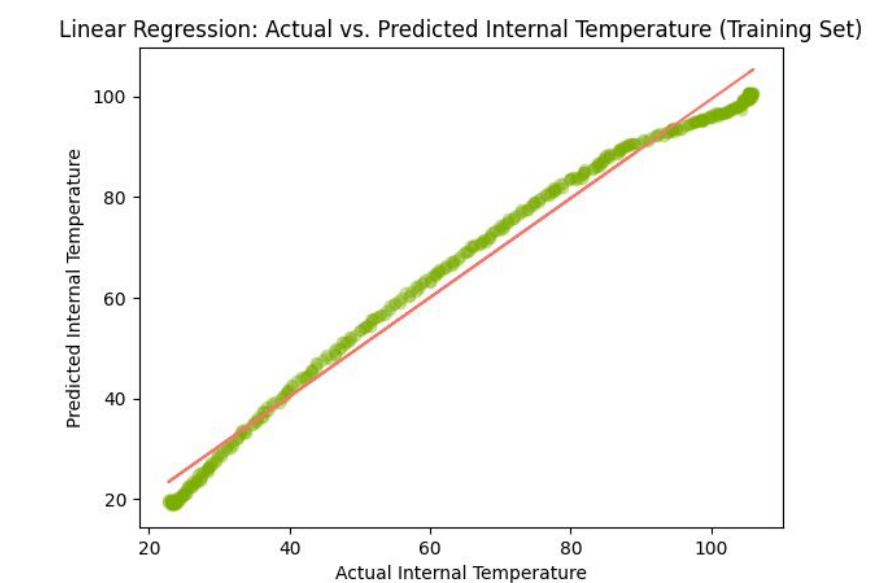


Oven Testbed



Machine Learning

The code loads temperature data from a CSV file, separates it into input features and a target value, and splits the data into training and testing sets. It then trains a linear regression model to predict temperature, and evaluates performance using metrics like mean squared error and R^2 . After training, the model is used to make predictions on new data, allowing comparison between predicted and actual values to assess accuracy and guide improvements.



Conclusion

By introducing the ML system to the variable cooking process it allowed for successful real-time correction and, in turn, an improved overall process

Future steps

The process of real time monitoring is not limited to just semiconductors. By changing the input sensors, you can adapt this process to almost anything. Greenhouses with humidity and temperature sensors would be a great use of this technology, as would any other industrial process.