Interreg North-West Europe
COTEMACO
European Regional Development Fund

Success Story

Developing a quality control system that assist chefs to (re)create a perfect dish

Maes / Combi Invest , BEL

Quality control system that assist chefs

Company description

Maes / Combi Invest is a Flemish SME that builds high-end kitchens for Michelin star chefs.

Motivation/Starting Point

A head chef of high cuisine expects of his sous-chef to prepare high-quality dishes, where the visual representation is just as important as the taste. Controlling every dish before the waiters serve them to the customers is not always possible for the head chef. Maes noticed the high demand for automatic quality control, and wants to offer a solution integrated in their luxury kitchens.

Analysis

Vision-based control of a finished dish is challenging. No two plates are identical, even with all the good will of the chef, due to the nature of the ingredients. It also gets harder to distinguish ingredients when many of them come together on a plate. Moreover, the error would only be recognized at the end of the process when it becomes difficult to correct the discrepancy. Monitoring the actions of the chef step-by-step while he or she is dressing the plate is a more convenient approach. The last placed ingredient is clearly visible. Plus, feedback can be provided to the chef quickly, allowing to correct the mistake before adding new ingredients to the dish. Mistakes can actively be avoided by guiding the chef, by means of digital work instructions. This reduces the need to start all over again. Specifically in serving plates, where errors cannot easily be corrected without creating a mess. The proposed proof of concept is a dish state monitor with a top-mounted camera and with instructions displayed on a screen.

Technical Realization

The concept consists of two phases: (1) training the state monitor and (2) applying the state monitor. First, the head chef demonstrates the expected steps under the camera construction. In the second phase, a chef can be guided step-by-step through his tasks, using the same set-up. On the graphical user interface, he can see an image of the requested state of the plate augmented with instructions on where to place the new ingredients. When making a mistake, the chef receives feedback on how to correct that action. If the newly added ingredients are placed correctly on the plate, the system will automatically display the instruction for the next step. He will also get notifications if anomalies (for example a piece of plastic) have found their way onto the plate. In addition, a thermal camera is also integrated, to control the temperature of the newly added ingredients.

The entire process is based on step-by-step template images, developed in the first phase, and the (visual) difference between two successive steps. The ingredient that needs to be added at the current step, is automatic derived as the difference between the templates of the current and previous step. Likewise the ingredient that has been added at the current step, is derived by contrasting the current camera stream with the image taken at the start of the step. The contour of the measured new ingredient is contrasted against the expected contour to evaluate differences in position and rotation. When the difference exceeds the allowed tolerance, the chef gets textual feedback about his error. If however all ingredients have been placed correctly, the system will automatically continue with the next step. Unexpected colors in the picture (for example blue plastic) will also trigger a warning. In addition, the temperature within the measured contour is contrasted against the reference temperature.

Besides visual feedback, the chef is also notified by the illumination of a green led that he can continue to the next step. A two-button control is added to allow the chef to manually force the system to continue to the next step. For instance, if the observed discrepancy is allowed

Result

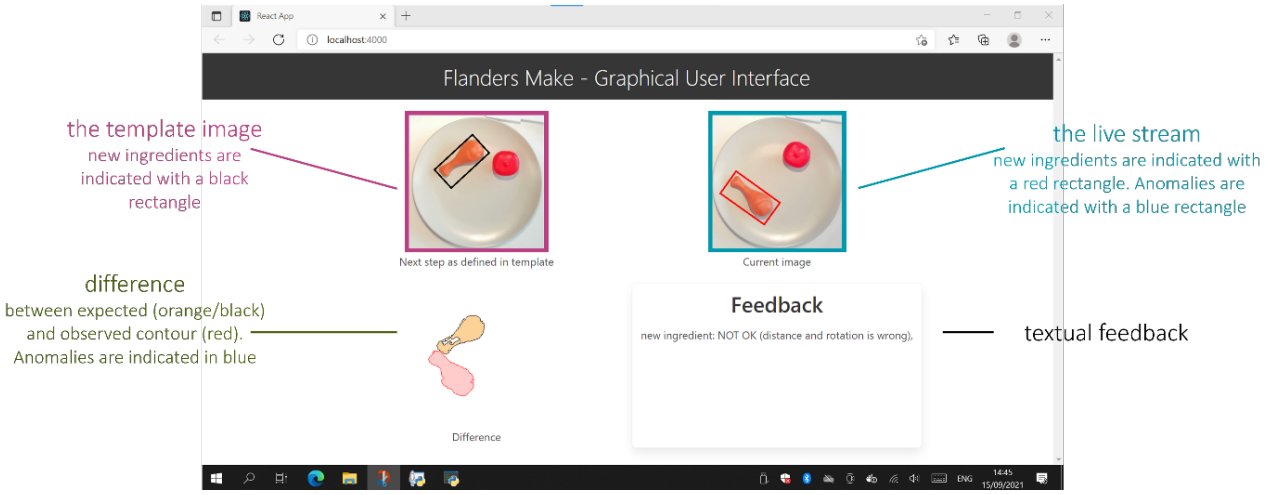
The proof of concept has been tested on a dummy set-up with plastic food. The system works as expected under the following constrains: (1) adding one new ingredient per step, or a few non-overlapping, non-touching ingredients, (2) clear color difference between new ingredient and underlying ingredients or plate, (3) non-reflective plates and (4) controlled light environment that doesn't cause shadows.

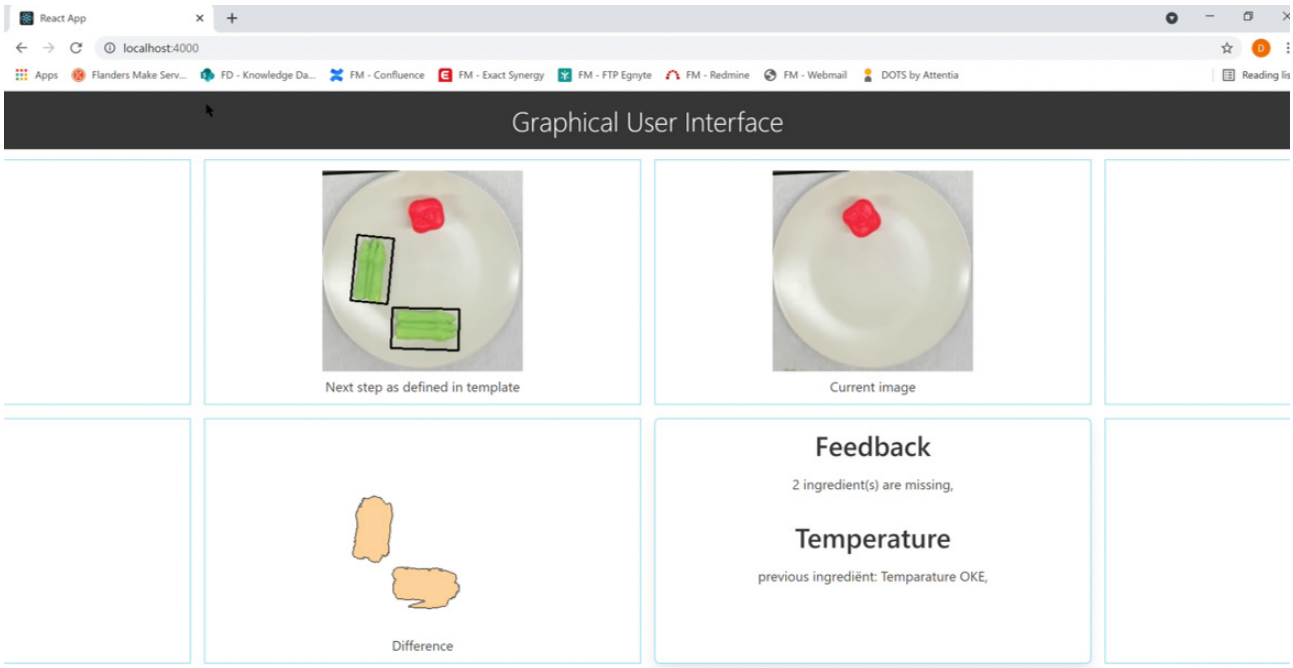
The temperature evaluation wasn't reliable and was removed from the final concept.

View from the employee perspective

The developed tool can assist the chef when adding the ingredients to the dish. Due to the instructions, it is especially beneficial to guide new and inexperience chefs. However, the step-by-step validation can be too slow for an experienced chef, as he has to wait for the vision analyses to confirm the quality of his last action.

Images


Flanders Make - Graphical User Interface
the template image
new ingredients are indicated with a black rectangle
Next step as defined in template
Current image
the live stream
new ingredients are indicated with a red rectangle. Anomalies are indicated with a blue rectangle
difference
between expected (orange/black) and observed contour (red). Anomalies are indicated in blue
Difference
Feedback
new ingredient: NOT OK (distance and rotation is wrong),
textual feedback


Graphical User Interface
Next step as defined in template
Current image
Difference
Feedback
2 ingredient(s) are missing,
Temperature
previous ingredient: Temparature OKE,

Interview

How could COTEMACO support you?

Restaurants lack sufficient skilled personnel for various reasons. The workings hours are less appealing and may conflict with work-life balance, the payment is on the lower side and the job is physically demanding. As a manufacturer of professional kitchens, we get in contact with a lot of chefs and stakeholders in that respect. The idea and the challenge was how we could implement technology to support speeding up the skills of people in decorating a plate with food. The aim was also to assess the heath of the food on the plate. We saw potential benefits for the restaurants as well as for schools.

What was implemented and what are the benefits?

Flanders Make developed a proof of concept to demonstrate the technology. It consisted of a mobile set up where a camera was looking down to the table (or plate) with a detached tablet for visualization. The system could easily learn the location of the different types of food on the plate by putting it manually on the plate and confirming its position on that plate. This step could be retaken as long as additional food was required on the plate. The system was programmed to validate the decoration of a new plate. In the decoration of a new plate, the tablet showed where exactly to put the food on the plate and validated the place and the quantity. If correct, the system processed to the next step.
The benefit was a system demonstrating that the programming and validation of food decoration on a plate was flexible and accurate by using technology. This could increase the learning curve of new personnel, decrease the number of errors of plates not having all necessary ingredients and improve the quality of the overall performance of the personnel.

Were your expectations fulfilled – technical implementation?

In the feasibility study, it became clear that the thermal inspection of the food was very challenging and needed further research. It was decided to leave this aspect out of the final Proof of Concept.
Some requirements, such as recognition of hair on the plate as a non-conformity, were not possible with the used camera's. In terms of ease of use, ease of programming of new plates and flexibility in switching between different plates, the Proof of Concept achieved its goals. The technical implementation showed potential to extend the developed solution with a database containing different recipes so no new programming was needed. Another extended feature is projection on the plate instead of projection on a tablet to facilitate the decoration of the food.

Were your expectations fulfilled – Support through COTEMACO?

The support from Flanders Make in this project was very good. We lack experience in working with research groups and learned that an innovation trajectory holds different steps. And we gained a lot of insights of the different possibilities for the future during the process. The Proof of Concept allowed us to verify with our market if there was an interest for our idea. Although there was and is an interest in using this technology, different hurdles are still to overcome: The COVID pandemic resulted in difficult months, even years for restaurants in terms of financial income. Restaurants are reluctant to invest in this type of technology at the moment. The most interesting parts such as detection of a hair on a plate, projection of the food in the plate and verification of the temperature of the food need additional work.

What is COTEMACO?

The project, which is an initiative of Interreg North-West Europe, aims to support around 60 SMEs in the automotive and food manufacturing industries with so-called „test environments“ and to encourage them to integrate collaborative robotic systems and digital technologies into their business. Accordingly, in addition to increasing production flexibility, the relocation of production abroad will be curbed and the number of jobs in manufacturing increased, which will generally lead to an improvement in the competitiveness of the companies involved.
In the project new technologies are implemented in application examples - the aim is to move from the prototype in the laboratory environment to the transfer to production, taking into account the legal situation and certifications.

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