

# Sensing the quality

A MULTI-SENSOR SYSTEM FOR MONITORING THE QUALITY OF WAFERS HAS BEEN DEVELOPED WITHIN THE SCOPE OF AN EU PROJECT



++ figure 1



++ figure 1  
 SENBAK prototype – EU project:  
 COOP-CT-2004-513073

During and after the production of dry baked goods such as biscuits, crackers, crisp bread, rusks, ice cream cones, etc., it is necessary to monitor certain product parameters in defined intervals. This way, it is ensured that the products comply with the desired quality. Modification of baking time or oven temperature can result in quality deterioration in terms of color or moisture content. This has a negative impact on the sensory properties. Furthermore, a metering error during production might lead to weight deviations which may result in non-acceptance of the product by the consumer (short weight). From an economical point of view, it is important for the company to control e.g. the weight of the product as well as the physical dimensions. A batch of overweight products might have a deviating quality be-

cause baking time and/or baking temperature are not adjusted to the higher product volume.

Therefore, the most important quality parameters for dry baked goods are color, weight, moisture content and physical dimensions.

The EU project had the objective to develop a modular designed sensor-based inspection system. SENBAK can be used for monitoring the quality parameters of dry baked goods.

The project was a cooperation project sponsored by the European Commission within the scope of the 6th framework program. The 2-year craft project (1 Feb 2005 – 31 Jan 2007) included a total of seven project partners, five were SMEs (three end users and two system engineering companies) and two research institutes. ▶



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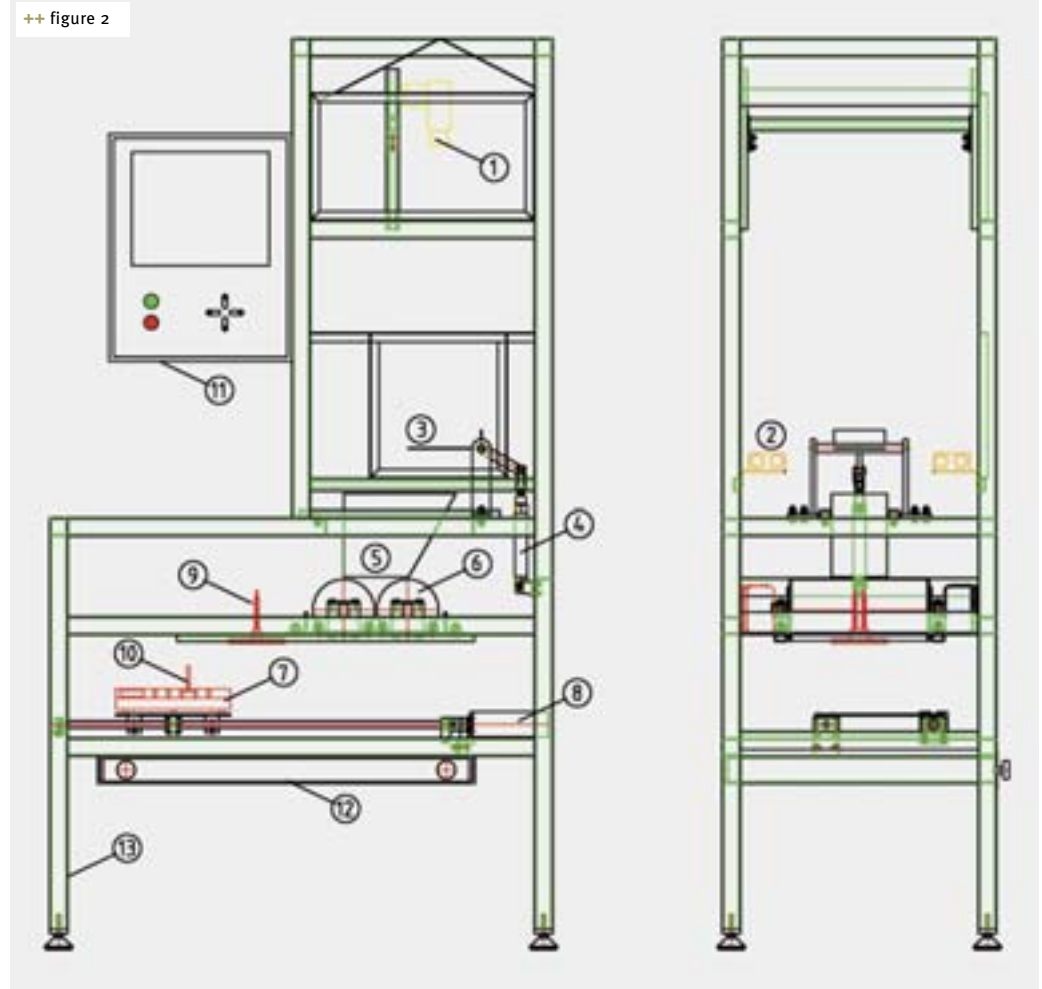
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++ figure 2  
Technical drawing of SENBAK prototype

**Legend:**

- 1. Camera system
- 2. Light
- 3. Product tray
- 4. Sampling system
- 5. Funnel
- 6. Grinding system
- 7. Scale
- 8. Scale moving system
- 9. IR-Heater
- 10. Brush
- 11. Interface – control cabinet
- 12. Drawer for crumbs
- 13. Frame (stainless steel)



The main objectives for this project were defined as follows:

- + Improvement of quality control during production
- + Increase in productivity and processing efficiency
- + Improvement of competitiveness
- + Improvement of customer satisfaction by higher and more standardized product quality
- + Improvement and simplification of

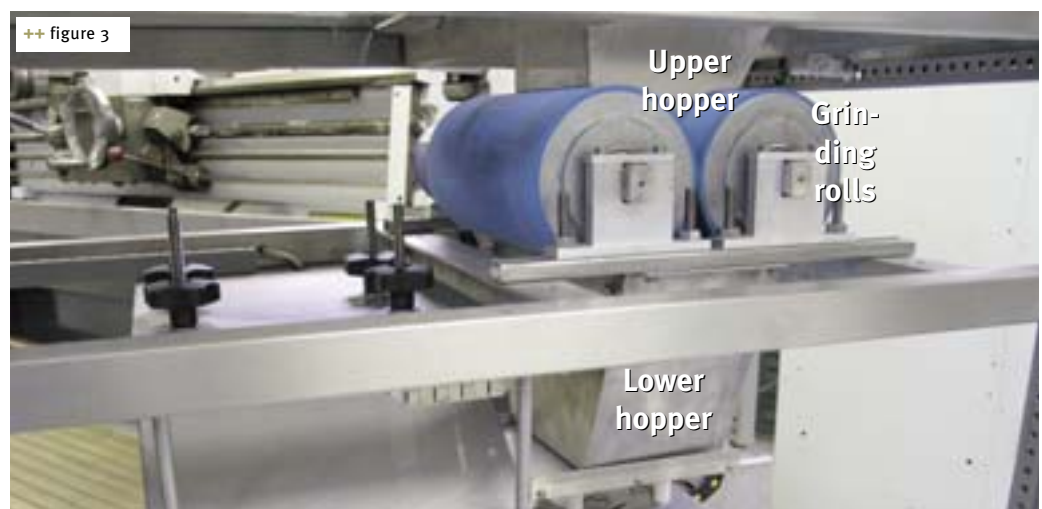
working conditions for employees

- + Less raw materials' consumption and product savings due to reduced waste
- + Time savings during measurement of four quality parameters
- + Quick adaptation of the process by real-time analysis

**Research assignment**

Conditions for end users and sensor modules  
The research assignment included amongst

++ figure 3  
Part of the prototype roller system with feeding hoppers and scale





others the analysis and specification of products, product parameters, processing methods as well as conditions for and requirements requested from the individual end users. Separate sensor modules were tested following these principles. The selection of the individual modules and the development of the entire SENBAK system were governed by criteria such as precision of analyses, user-friendly operation, software compatibility and low investment costs.

The SENBAK prototype, finally realized, uses specific technologies to determine the following quality parameters of a dry baked good:

- + Color and size of the products – determination by image analysis
- + Moisture content – IR drying and weight difference analysis
- + Weight – determination by weighing

### SENBAK – Development of a multi-sensor system for the supervision of durable baked goods

Co-operative Research Project funded by the European Commission under the 6th Framework Programme (FP 6); Project no.: COOP-CT-2004-513073, Scientific Officer: F. Trabada-Crende



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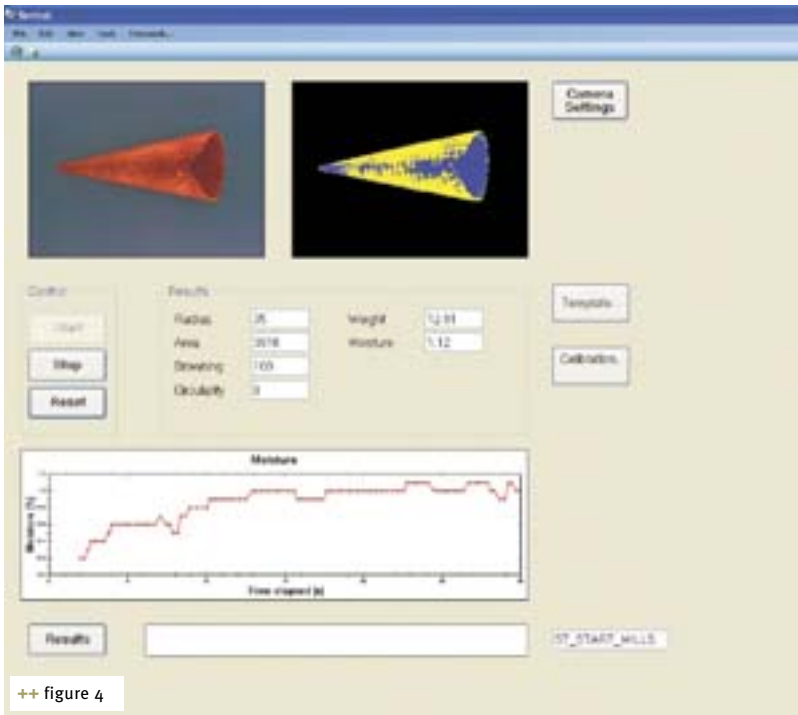
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++ figure 4

++ figure 4  
Computer display

++ figure 5  
Color measurement of round wafers

For high flexibility in terms of user requirements, commercially available sensor modules were chosen and combined and integrated into a mobile system.

**Prototype design**

The prototype design of the quality assurance system SENBAK was amongst others dependent on the individual modules selected. Observations made during work pack 2 – testing on individual sensor modules – resulted in

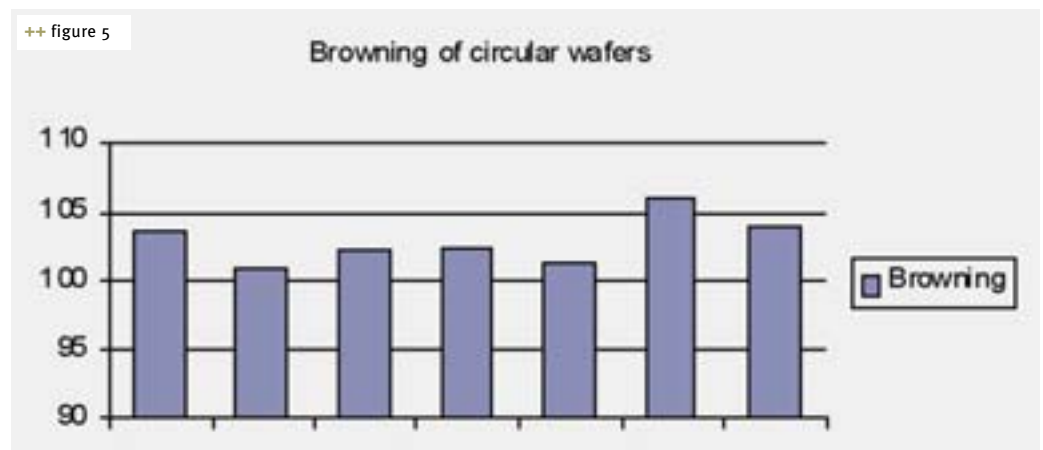
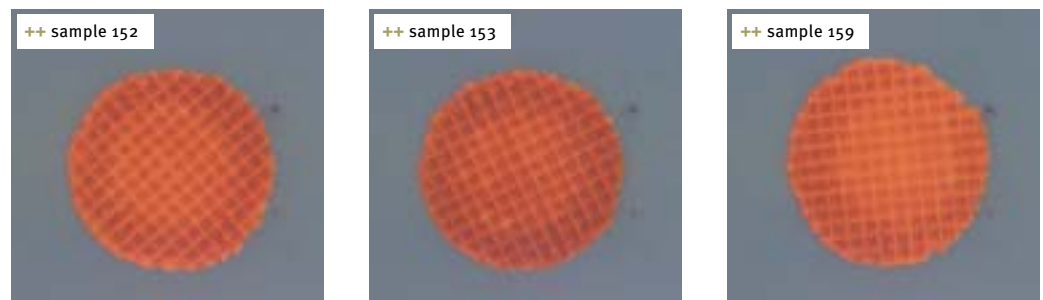
the finding that for the determination of certain individual parameters the product must be available as whole while for the determination of the moisture content, the product must be ground in order to yield precise results. The scales in the SENBAK system have a double function – weight determination and determination of moisture content. Therefore, special hardware and software were developed for the prototype to ensure fully automatic measurements. A controlled mechanism transports the sample from one module to the next. A roller system prepares the sample for the determination of moisture content via IR radiation.

**SENBAK prototype**

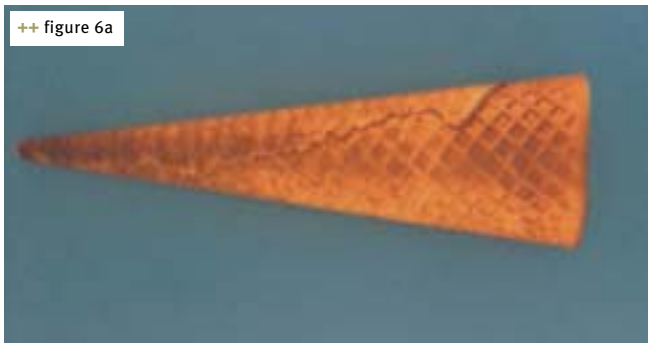
The SENBAK prototype is a mobile, fully automatic system for the determination of relevant quality parameters such as:

- + product color
- + product dimensions
- + product weight
- + product moisture content

of dry baked goods directly at the line. The SENBAK system was designed to suit the end user requirements. It features a number of production technology and measurement techniques properties: cost efficient, easy to operate, resistant, automatic, quick and precise. The user interface and the display of the data are user-friendly. The total measuring time for one sample is about 90 seconds.



++ figure 5



**User interface**

The user interface (monitor display) offers the option to start and end the measurement with the start and stop key. Furthermore, all relevant quality parameters are displayed:

- + Color
- + Dimension
- + Weight
- + Moisture content

The course of the moisture content measurement via differential weight analysis can be monitored during the measurement on the display. Added to this, product pictures and data can be stored.

**Evaluation of results/ display**

The bar diagram (figure 5) is a distilled version of a measurement series for the determination of color difference of individual wafers. The wafers were measured randomly.

It can be seen that due to the sample's color, sample 159 (light color) has the highest value while sample 153 (dark color) has the lowest value. This shows that even the smallest color deviation, barely visible with the naked eye, can be determined by image analysis. Data and product pictures are stored for control purposes or evaluation.

**Product evaluation**

The values determined with SENBAK prototype are to a large extent reproducible for products such as round wafers or wafer plates. The measurements, referred to here, are within the defined tolerance range (parameters: color, dimension, weight and moisture content).

**Testing conditions**

Overall test time: 90 seconds

The product dimensions are also determined via image analysis. Figure 6 shows two ice cream cones of different sizes. The cone on the left has a standard size; the right cone

is size XXL. The SENBAK prototype recognizes such quality relevant differences and transmits the data to the user.

However, as the prototype is only in its testing phase, it must be stated that the determination of the moisture content is reproducible only to a limited extent. Here, further optimization is required. Nevertheless, the SENBAK prototype is an instrument for the determination of the quality of dry baked goods which requires significantly less time than comparable traditional measuring devices. The unit has the potential for further development for application on an industrial level.

**Benefits at a glance**

- + Multi-sensor function in one unit
- + Measuring time for the determination of 4 quality parameters: 90 seconds
- + Immediate results allow quick reaction and action
- + Time saving operation
- + Product savings
- + Easy to operate, no expert skills required
- + Low investment costs compared to other analysis methods and systems
- + SENBAK can be used as an off-line system
- + Data processing with standard Microsoft software +++

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