April 2023

Virtual Food Probe - ID-06008

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ID-06008 19 April 2023

Specification

Oven system and Method for operating the oven system

The invention relates to an oven system and a method for operating the oven system. An oven system comprises a heating unit, a camera unit, a detection unit, and a control unit.

A physical food probe is well-used in the kitchen appliance market. The user inserts the food probe in the target foodstuff in an oven before or during a heating process or a preheating process in order to generate information whether the temperature within the foodstuff reaches the expected value. However, the correct measurement of the temperature value by that probe is based on its correct placement. The user may obtain the wrong measured temperature value because of improper placement. It is also difficult to obtain the comprehensive temperature measurement of a large-sized foodstuff.

Therefore, it is desirable to provide an oven system which precisely notifies the status of the cooked foodstuff.

That problem is solved by an oven system as well as by a baking control method carried out by the oven system.

The inventive oven system comprises a heating unit, a camera unit, a detection unit, and a control unit. In the following embodiment, the detection unit can be a part of the control unit of the oven or of a smart device such as a smartphone, a tablet or the like.

The invention is discussed in detail by means of a sketch. Therein is shown by

Fig. 1 a general scheme of an oven system according to an embodiment of the invention,

Fig. 2 a schematic perspective view of the oven system, and

Fig. 3 a schematic flow chart of a control method according to an embodiment of the invention.

As shown in Fig. 1, an oven system 1 comprises an oven 2, a smart device 4 and a camera unit 6. The oven 1 comprises a control unit 8, a heating unit 10, a memory unit 12, a user interface 14, a light unit 16, a ventilation unit (fan 18), and the camera unit 6. The control unit 8 is electrically communicated with the heating unit 10, the memory unit 12, the user interface 14, the light unit 16, the fan 18, and the camera unit 6. The smart device 4, i.e., a smartphone in this system, communicates with the control unit 8 via a wireless connection. The oven's 2 memory unit 12 is configured to store a number of operation modes, a list of food data and its relevant parameters, and programs based on algorithms analyzing visual information. The user interface 14 is a panel enabling the user to input command instructions and to receive operational information. The control unit 8 is configured to execute the operation modes and the programs based on algorithms analyzing visual information.

As shown in Fig. 2, the oven 2 has a housing part 20 defining a cavity 22 by its walls 24 and door 26. The camera unit 6 is arranged on an inner surface 28 of a rear one of the walls 24 to capture an image of a cooking area 30. The camera unit 6

may have a movable lens (rotatable and tiltable) to capture different areas in the cavity 22 or images of the targeted area from different angles of view. The camera unit 6 may include a thermal camera module for capturing a heat source, i.e. the heating unit, and generating a thermal color image. Adding to this, the camera unit 6 may also include a system executing a software for virtual reality image sensing for object modelling and volume estimation. By using the algorithms of the software, the 2D images are converted into 3D images. Alternatively, the camera unit 6 may comprise a plurality of camera modules to achieve the same goal.

The ventilation unit, i.e. the fan 18, is embedded into the rear wall 24. The heating unit 10 is arranged on the bottom and top walls 24. The control unit 8 and the memory unit 12 are arranged to a space located within the oven 2 and separated from the cavity 22. The user interface 14 is arranged on a front wall 24. The light unit 16 is arranged on the top corner between a sidewall 24 and the rear wall 24, or alternatively, is integrated into the camera unit 6.

An oven operating application 40 is installed on the smart device 4 and the control unit 8 of the oven 2 to execute the operation modes as well as a program based on an algorithm analyzing visual information. The algorithm-based program is basically mathematical models run on the oven operating application 40 having functions similar to a numerical computing software tool for describing the relation between the volume of an object in virtual reality models and the real objects. One of the algorithms is responsible for creating a real and virtual world coordinate framework using the so-called checkerboard plane recognition method, to

calibrate parameters of the oven camera 6. Adding to this, one of the algorithms performs an image classification, other of the algorithms perform an object detection, yet another of the algorithms performs a semantic segment, i.e., a virtual coordinate segmentation of the detected object. These algorithms are implemented by using a neural network. The neural network runs algorithms, which formulates a mathematical model for the virtual coordinates assigned to the detected object. Based on the mathematical model generated, the volume and the surface area of the foodstuff within the cooking area are estimated.

Based on the determined food type of the foodstuff and the information generated related to the volume and surface area of the foodstuff kept within the cooking area 30, the oven operating application 40 performs a forming of recommended cooking modes with the corresponding estimated cooking period. The estimated cooking period required for cooking is based on the known food type of the target food, the food’s volume/dimensions and the given heating function with the corresponding heat transfer coefficient.

As shown in Fig. 2, a piece of meat, in the present embodiment i.e. one steak 50, is arranged within the oven 2, especially within the cooking area 30. When the oven's 2 power is triggered, the object detection from either the camera unit 6 or the smart device 4 is started. The control unit 8 of the oven 2 performs the determination of the object based on the measured image and the stored data of the food list. Alternatively, the smart device 4 performs the determination of the object based on the measured image and the stored data of the food list. Once determining the type

of food, its volume, and its surface area is done, the control unit 8 notifies information about the food type, the correspondingly recommended cooking modes, wherein the estimated cooking time, based on a heat transfer rate of the recommended cooking modes and the determined geometrical profile of the food, and the sub-preference modes are presented on the user interface 14. Then a user may select one of the recommended cooking modes.

When the user further selects one of the sub-reference modes, the cooking time is re-estimated based on the operational parameters, e.g., the heating temperature and the heating transfer rate obtained from the geometrical profile of the foodstuff and is presented on the user interface 14. For example, the food type is determined as beef and, therefore, one of the recommended cooking modes is beef roast. The user selects this mode and further chooses one of the sub-reference modes, e.g. medium-rare steak with steam low, 180°C (that may be preset data obtained from cooking experts). Accordingly, the cooking time is re-determined as 57 minutes based on the food's volume, the targeted result, i.e. medium-rare, the heat transfer coefficient of the heating function and the heat transfer coefficient of the foodstuff.

The user can choose the preferred one of the recommended cooking modes via either the control panel or the smart device 4. When the selected cooking mode starts, the cooking period is counted down. The cooking mode comprises at least one cooking phase. The cooking phase can be one of an expanding phase (e.g. in case of dough), a browning phase, or their combination. The captured image is assigned with the virtual coordinates for volume and surface area calculation.

Based on the expected result in each cooking phase, the algorithms comprising the mathematical models decide the estimated cooking duration for the target foodstuffs at each cooking phase. Therein the control unit also ensures that the heating unit of the oven gives out sufficient heat to the cooking area 30 (and the foodstuff within) at the optimum heat transfer rates, based on the food parameters tracked via the camera unit 6.

Fig. 3 shows a flow chart of operating a cooking process with monitoring the steak's 50 status. The cooking process comprises at least one cooking phase. After the oven 2 is powered on, the camera unit 6 captures an image of the foodstuff, here the steak 50, and delivers the image to the control unit 8. The control unit 8, e.g. of the smart device 4, executes the oven operating application 40 including the algorithm based on the neural network to determine the food type, its volume and the surface area, based on the virtual reality image. The captured image is assigned with a unique coordinate system which helps in taking decision regarding the size of foodstuff and the amount of heat transfer rate required for optimum cooking.

The smart device 4 running the application 40 determines recommended cooking modes with the corresponding estimating cooking time based on the food type and food size. The food type and the recommended cooking modes are presented on the user interface 14 of either the smart device 4 (its display) or of the oven 2 so that the user can choose.

When the user chooses one of the recommended cooking modes, wherein the operational parameter of the selected mode is

adjustable, the cooking time based on the sub mode-selection is re-estimated and presented on the user interface 14. The user input the commands on triggering the cooking process based on the selected recommended cooking mode.

The control unit 8 terminates the cooking process once the cooking period is over and performs controlling of user interface 14 for delivering notification in an audio manner or a visual manner.

Alternatively, the determining mechanism can be based on any algorithms as known to the skilled person, e.g. a Kalman Filter.

The invention provides a control method of adjusting the relevant cooking parameters, particularly parameters relevant to time, of the presetting cooking mode based on the image measurement. Therein the presetting cooking mode is based on the determination of the food type, and correspondingly provided with the presetting temperature of the oven and the relevant parameters, e.g., hot air, 180°C. These parameters are associated with the food type.

Claims

1. Oven system (1) comprising an oven (2), a camera unit (6) and a control unit (8) adjusted for providing virtual food probe based on visual information, wherein the control unit (8) is further adjusted to
   - capture by the camera unit (8), an image of an cooking area (30) of the oven (2) wherein foodstuff may be placed,
   - process and analyze the capture image,
   - determine the type of foodstuff, and the geometrical profile of the foodstuff,
   - form recommended cooking modes based on the type of the foodstuff and the food size determined by the geometrical profile, especially wherein the recommended cooking modes include the corresponding cooking function, heating temperature, relevant parameters of the food and an estimated operating duration based on the operating conditions, the type of the foodstuff and its relevant condition, wherein the relevant parameters of the food include the food size and a maximum interval of the food to be heated,
   - present the recommended cooking modes with relevant parameters for selection by a user,
   - upon selection of one of the recommended cooking modes start the cooking process; and
   - terminate the cooking process once the cooking period is over.

2. Method for operating an oven system (1), especially the oven system (1) of claim 1, the oven system (1)

comprising an oven (2), a camera unit (6) and a control unit (8), the method comprising the steps of

- after switching on the oven (2) capturing, by the camera unit (6), an image of a cooking area (30) of the oven (2) wherein foodstuff is placed,
- processing and analyzing, by the control unit (8), the captured image,
- determining the type of foodstuff and an geometrical profile of the foodstuff,
- forming recommended cooking modes based on the foodstuff type and foodstuff size determined by the geometrical profile, especially wherein the recommended cooking modes include the corresponding cooking function, heating temperature, relevant parameters of the food and an estimated operating duration based on the operating conditions, the type of the foodstuff and its relevant condition, wherein the relevant parameters of the food include the food size and a maximum interval of the food to be heated,
- presenting the recommended cooking modes with relevant parameters to a user,
- upon selection by the user of one of the recommended cooking modes,
- starting the cooking process, and
- terminating the cooking process once the cooking period is over.

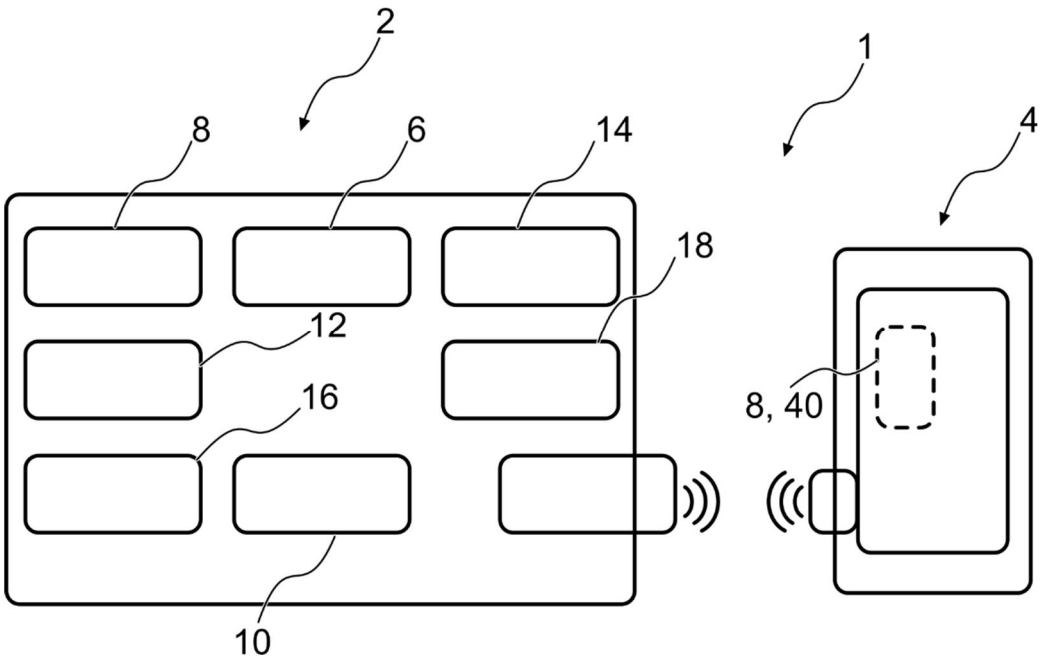

Fig. 1

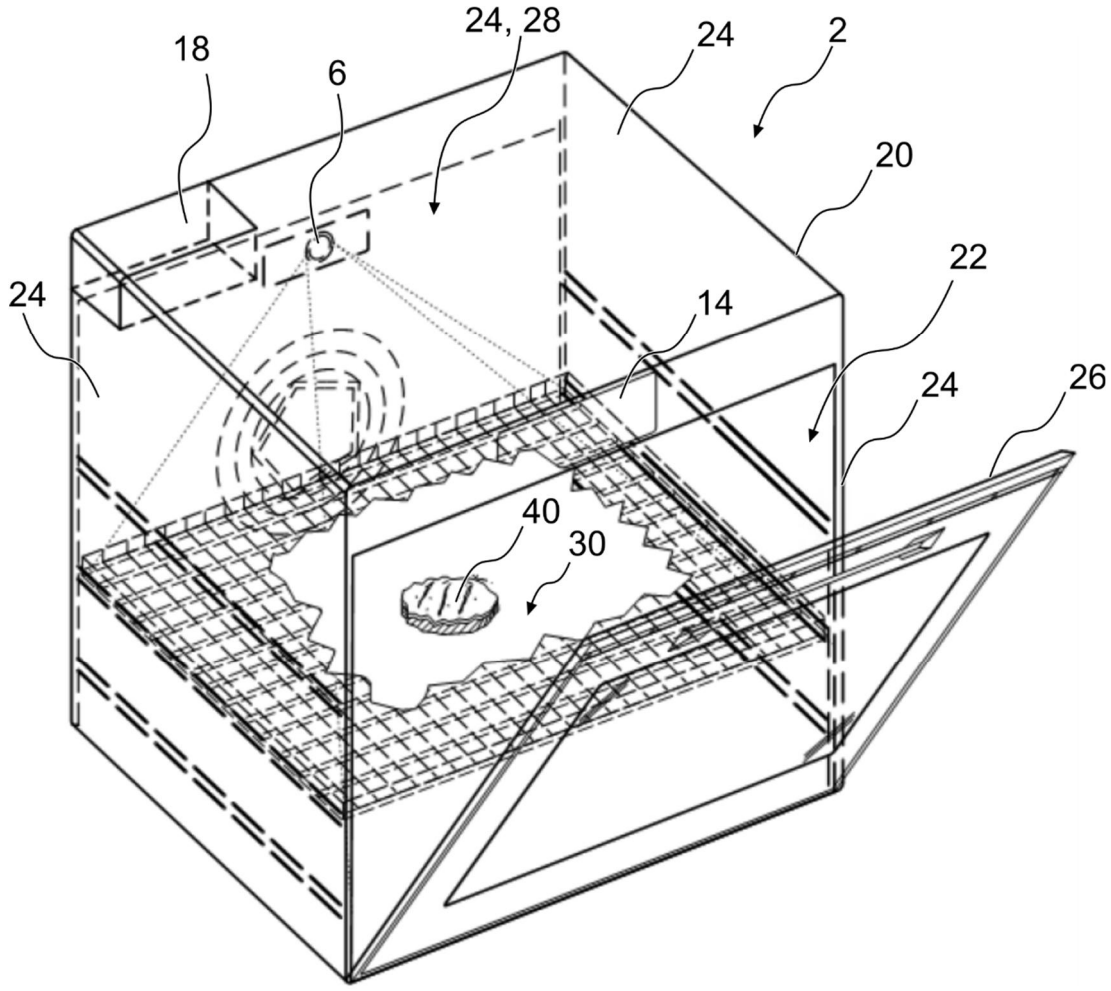

Fig. 2

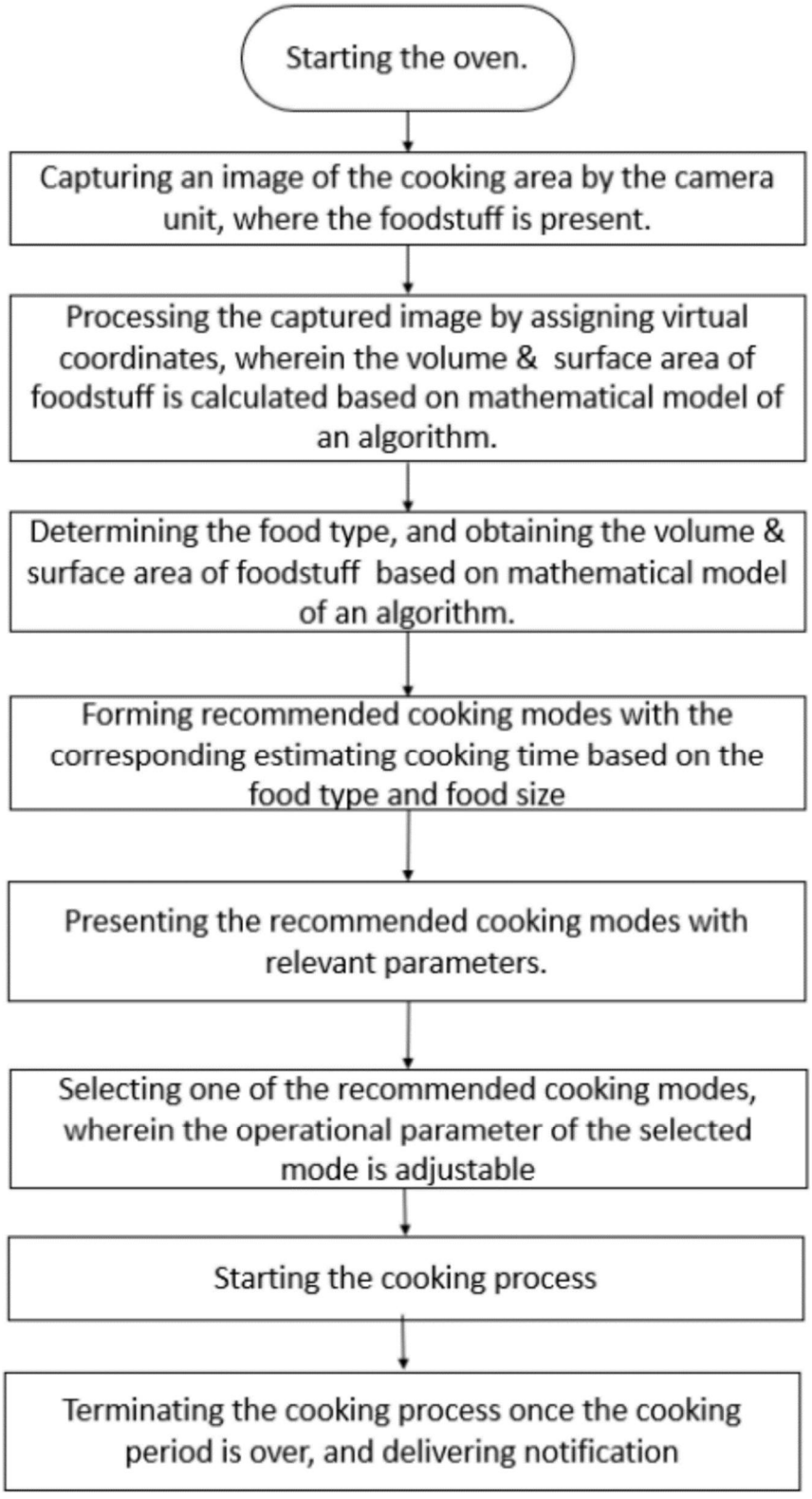
Starting the oven.
Capturing an image of the cooking area by the camera unit, where the foodstuff is present.
Processing the captured image by assigning virtual coordinates, wherein the volume & surface area of foodstuff is calculated based on mathematical model of an algorithm.
Determining the food type, and obtaining the volume & surface area of foodstuff based on mathematical model of an algorithm.
Forming recommended cooking modes with the corresponding estimating cooking time based on the food type and food size
Presenting the recommended cooking modes with relevant parameters.
Selecting one of the recommended cooking modes, wherein the operational parameter of the selected mode is adjustable
Starting the cooking process
Terminating the cooking process once the cooking period is over, and delivering notification

Fig. 3