Intelligent Cooking Providing Automatic Time and Temperature Setting using Image Processing with Wide Range of Recipes for Microwave Ovens

S.R. Patil, Raveena Chavan, Anjali Shinde, T. Jecintha Joy, Nirmala Wakale

Abstract- In this, accurate automatic cooking is done using Image Processing. Automatic cooking means time and temperature will be set automatically at fly time. It involves comparing images of cooked food and food currently being cooked. No need to decide the preset timing. This software can be used in microwaves and ovens. Component detection algorithms and Image processing algorithms will be used. Input and output will be images like photographs or frames of video. Images will be treated as 2D signals and signal processing techniques will be applied. Both hardware and software components will be used. Feedback from oven can be taken into a webcam and videos will be converted into frames of images at runtime. Here we are certain about the exact image which will be our input. This is the main advantage over fuzzy logic where in we get approximate input rather than an exact input. It is effective in time and speed. It is efficient and user friendly. We will have a wide number of recipes in our database.

Index Terms- Automatic Time and Temperature Setting, Image Processing, Intelligent Cooking, Microwave Ovens.

I. INTRODUCTION

In brief, the project proposes the idea of accurate automatic cooking using image processing. By comparing the images of cooked food and the food currently being cooked, it can be decided whether additional heating/cooling is required or not. Microwave ovens can make ideal use of this technique for automatic time and temperature setting. There is no need to decide a preset timing for cooking food since it can be decided at run time. Temperature and humidity changes

require change in standard timings to cook a particular recipe. This can be handled using image processing. Component detection algorithms and additional image processing algorithms will be used to compare the images and to deal with the video feedback.

In the broadest sense, image processing is any form of information processing for which both the input and output are images, such as photographs or frames of video. Most image processing techniques involve treating the image as a two-dimensional signal and applying standard signal processing techniques to it.

We will implement the project using hardware and software components.

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The feedback from the oven or microwave will be taken using webcam. This video will then be converted into images at flytime.

Advanced image processing algorithms will be used to compare original image stored in the database and the one obtained while cooking.The software will also control the hardware (fan/heater) at the output which in turn will be used to control Microwave Ovens.

II. RELATED WORK

Multi-Technology Oven cook food better and faster. Automatic pre-heating can be done. A thermoscan shows which areas of food are at proper temperature. Waste heat is used to heat water for washing dishes.

In Speedcook Oven, bright halogen light delivers oven-quality food up to eight times faster than a conventional oven. A sensor recognizes pre-packaged foods and enables fast cooking.

A few decades ago, image processing was done largely in the analog domain, chiefly by optical devices. These optical methods are still essential to applications such as holography because they are inherently parallel; however, due to the significant increase in computer speed, these techniques are increasingly being replaced by digital image processing methods. Digital image processing techniques are generally more versatile, reliable, and accurate; they have the additional benefit of being easier to implement than their analog counterparts. Specialized hardware is still used for digital image processing: Computer Architectures based on pipelining have been the most commercially successful. There are also many massively-parallel architectures that have been developed for the purpose. Today, hardware solutions are commonly used in video processing systems. However, commercial image processing tasks are more commonly done by software running on conventional personal computers.

III. LITERATURE SURVEY

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A. Multi-Technology Oven:

- Cook food better and faster.
- Automatic pre-heating.
- A thermoscan shows which areas of food are at proper temperature.
- Waste heat is used to heat water for washing dishes.

***B. Speedcook Oven*:**

- Bright halogen light delivers oven-quality food up to eight times faster than a conventional oven.
- A sensor recognizes pre-packaged foods and enables fast cooking.

C. PAST REFERENCES:-

[1] TOWARDS VIRTUALLY COOKING CHINESE FOOD.

Chinese food is delicious but cooking Chinese food is a very complex process which involves in combing ingredients at the right time and temperature. In this paper, we present a multimedia technology for virtually cooking Chinese food. We focus on a popular Chinese food, shredded potato. We propose to use the theory from mechanics of materials to model shredded potato in its cooking process. The shredded potato is initially simplified with changed deformable beams by adjusting model parameters during the cooking process when shredded potato gets 'soft' deformations. We use superposition principle to cope with the multi-load problem when potato shreds pile up and contact with each other. We describe the modeling techniques and implementation issues in detail. We show the result from the proposed modelling technique by comparing it with the real image [1].

[2] A REAL-TIME HAND GESTURE RECOGNITION SYSTEM FOR DAILY INFORMATION RETRIEVAL FROM INTERNET.

In this paper, we use PCA method to recognize faces as also hand gestures, and then a number of hand gestures and system controls are acquired and stored into this system. Results from a set of experiments indicate that the proposed system in a family environment with small-scale of face recognition show good performance as also good result inhand gesture recognition [2].

[3]AIRTOUCH: INTERACTINGWITH COMPUTER SYSTEMS AT A DISTANCE.

We present AirTouch, a new vision-based interaction system. AirTouch uses computer vision techniques to extend commonly used interaction metaphors, such as multitouch screens, yet removes any need to physically touch the display. The user interacts with a virtual plane that rests in between the user and the display. On this plane, hands and fingers are tracked and gestures are recognized in a manner similar to a multitouch surface. Many of the other vision and gesture-based human-computer interaction systems presented in the literature have been limited by requirements that users do not leave the frame or do not perform gestures accidentally, as well as by cost or specialized equipment. AirTouch does not suffer from these drawbacks[3].

[4] HUMAN TRACKING IN VIDEO SURVEILLANCE.

To overcome this human flaw in the area of monitoring, the concept of making monitoring automatic came into existence. Since, video surveillance has came in the market, researches have been taking place in order to make to more easy, accurate, fast and intelligent. The goal of visual surveillance is not only to put cameras in place of human eyes, but also to accomplish the entire surveillance task as automatically as possible. In one statement we can say that video surveillance is nothing but taking the video, identifying unwanted entities, tracking their actions, understanding their actions and raising an alarm. In this paper, we will be study the phases of the video surveillance system. [4].

[5] AN ALGORITHM FOR WATERMARKING MOBILE PHONE COLOUR IMAGES USING BCH CODE.

This paper proposes a scheme for embedding phone numbers into color images captured by a mobile phone camera. Firstly, the phone number digits are transformed using BCD encoder and the generated binary vector is appended by the phone number checksum represented in binary format. Then, this binary vector is coded by BCH code before inserting it in the DCT blocks of the image. The coded watermark information are embedded into a predefined low frequency coefficient in the DCT domain. The robustness of the scheme is assessed by using "Stirmark" software package. The new algorithm survived JPEG compression and 3x3 2D filtering [5].

[6] AUTHENTICATION SCHEMES FOR SESSION PASSWORDS USING COLOR AND GRAY-SCALE IMAGES.

The most common method used for authentication is Textual passwords. But textual passwords are vulnerable to eves dropping, dictionary attacks, social engineering and shoulder surfing. Graphical passwords are introduced as alternative techniques to textual pass-words. To address this problem, text can be combined with images or colors to generate session passwords for authentication. Session passwords can be used only once and every time a new password is gen-erated. In this paper, we proposed a scheme related to the grayscale images which will be advantageous as compared to many of the well known formats. In this paper, two new authentication schemes are proposed. These schemes authenticate the user by session passwords which are used only once. Once the session is terminated, the session password is no longer useful. For every login process, users input different pass-words. The proposed authentication schemes use text and colors for generating session passwords [6].

[7] WEB IMAGE AND VIDEO MINING TOWARDS UNIVERSAL AND ROBUST AGE ESTIMATOR.

In this paper, we present an automatic web image and video mining framework with the ultimate goal of building a universal human age estimator based on facial information, which is applicable to all ethnic groups and various image qualities. On one hand, a large (391 k) yet noisy human aging image database is collected from Flickr and Google Image using a set of human age-related text queries.

Multiple human face detectors based on distinctive techniques are adopted for noise-prune face detection. For each image, the detected faces with high detection confidences constitute a bag of face instances.We further remove the outliers via principal component analysis (PCA), which results in a condensed image database with about 175 k face instances. The derived human age estimator is extensively evaluated on three benchmark human aging databases, and without taking any images from these benchmark databases as training samples, comparable age estimation accuracies with the state-of-the-art results are achieved [7].

[8] THRESHOLDING (IMAGE PROCESSING).

Thresholding is the simplest method of image segmentation. From a grayscale image, thresholding can be used to create binary images (Shapiro, et al.2001:83). During the thresholding process, individual pixels in an image are marked as "object" pixels if their value isgreater than some threshold value (assuming an object to be brighter than the background) and as "background" pixels otherwise. This convention is known as threshold above. Variants include threshold below, which is opposite of threshold above; threshold inside, where a pixel is labeled "object" if its value is between two thresholds; and threshold outside, which is the opposite of threshold inside (Shapiro, et al.2001:83). Typically, an object pixel is given a value of "1" while a background pixel is given a value of "0." Finally, a binary image is created by coloring each pixel white or black, depending on a pixel's labels [8].

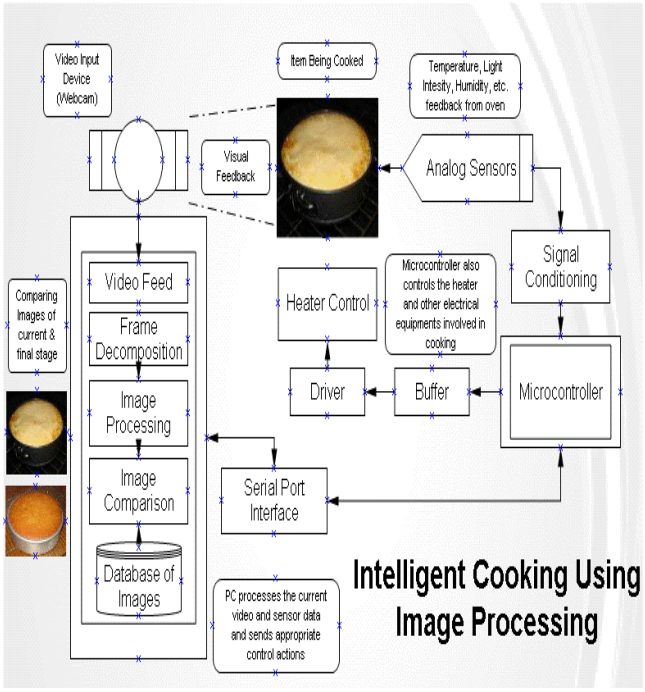
[9]QUALITY EVALUATION OF HYDROTHERMAL TREATED QUICKER COOKING SCENTED RICE BY QUANTIFICATION OF QUICKNESS OF COOKING TIME AND MECHANICAL STRENGTH USING MACHINE VISION.

Rice (Oryza sativa L.) together with wheat and maize is one of the most important cereal crops of the world. Hydrothermal treatment is used to be given to the scented rice to produce quicker cooking rice. The quickness in terms of time for cooking for scented cooked rice is then evaluated on the basis of fissures so produced in the form of rings using microscope. In this paper we are proposing a machine vision system and a novel technique for quality evaluation of Hydrothermal treated quicker cooking scented rice by quantification of quickness of cooking time and mechanical strength evaluation based on image processing techniques [9].

[10]DETECTION OF PROFESSIONAL TECHNIQUES IN COOKING BY IMAGE PROCESSING.

Generally, professional cooks directly teach cooking techniques to apprentices; however, in recent years, it is getting more difficult to deploy this traditional teaching method because the number of both professional cooks and students has been decreasing. Although a recently proposed method that uses archived videos, can be replacement of the traditional one, it is not easy to understand the cooking techniques with only watching the video. Obviously, professional techniques are usually ambiguous and accumulated by their continual daily work. Therefore, this paper proposes a new system that uses thermographic images for detecting ambiguous techniques from the Chinese cooking videos, and it discovers what the differences are between professional and unprofessional cooking from the videos [10].

IV. SYSTEM ARCHITECTURE



V. IMPLEMENTATION DETAILS

The various algorithms used in the project are:

Blurring:- In image terms blurring means that each pixel in the source image gets spread over and mixed into surrounding pixels. Blurring an image reduces the sharpening effect, this makes the detection more accurate.

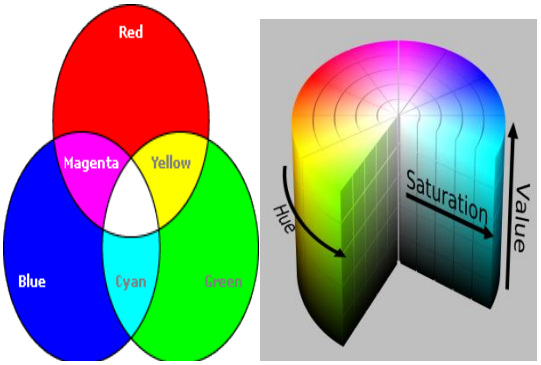
Grayscaling:- We convert an RGB image(24 bit) into a grayscale image(8 bit) which is further required for thresholding.

Steps are as follows:

1. Separate Red(R),Green(G) and Blue(B)
   B=RGB AND 0XFF
   G=RGB>>8 AND 0XFF
   R=RGB>>16 AND 0XFF
2. Grayscale(GS)=(R+G+B)/3

Segmentation:- Here we are using model based segmentation. It is basically cropping and not segmentation. Camera will take the input in the form of a video which will be segmented in the form of distinct images.

RGB to HSV Conversion:- *The RGB color* model is an additive color model in which red, green, and blue color is added together in various ways to reproduce a broad array of colors . *HSV* is a color model and HSV stands for Hue Saturation Value. Hue tells the angle, Saturation tells the amount of color, Value tells the brightness of color.



Thresholding:-Thresholding is the simplest method of image segmentation. From a grayscale image, thresholding can be used to create binary images i.e. image with only black or white colors. It is usually used for feature extraction where required features of image are converted to white and everything else to black (or vice-versa). The grayscale image GS(8 bit) is converted into threshold image TH(1 bit). We are taking TH=128 which is exactly half of 255(color pixel has value from 0 to 255) to avoid excess/less brightness/darkness.

Steps are as follows:

If (GS < TH)

{ pixel = 0; // pure black}

else

{ pixel = 0xFFFFFF; // pure white}

Note: The if-else conditions can be interchanged depending on our requirements.

Comparison of Images:-Comparison of uncooked food image(in oven/microwave) with the cooked food image in the database will be done using euclidian distance formula i.e. difference of h1 - h2 (hue of source image minus hue of current image). We are making use of template matching algorithm for comparison of images.

Images related to blurring, grayscaling and thresholding:

VI. SYSTEM REQUIREMENTS

A system can be characterized by its functional and non-functional requirements. Functional requirements describe the functionality of a system while non-functional requirements describe attributes like reliability, maintainability and security, etc.

The system's functional requirements are as follows:

1*) Hardware Interface:-*

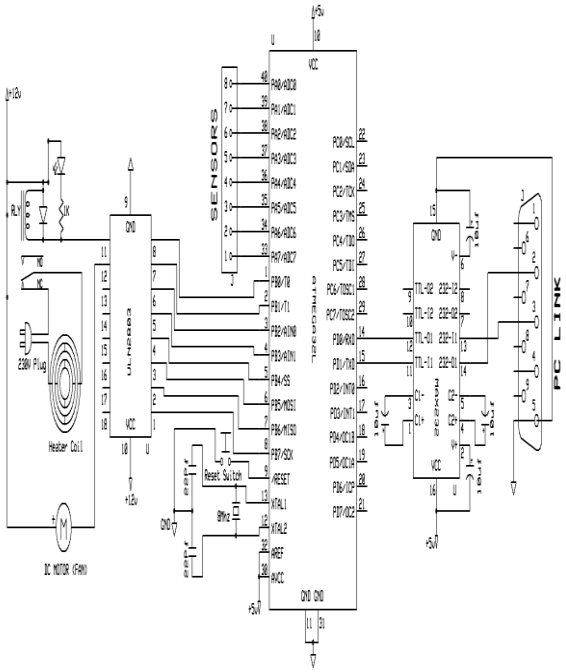
(a) Webcam :- It will be mounted inside the oven at the top. Webcam captures the images of the food being processed and compares it with the images in the database. Camera will capture the video feed after equal intervals of time (5 sec/10 sec) and then our software will convert this video feed into frames of images. At the load event of GUI filesystem checks whether the drivers for webcam are installed, if they are installed then it automatically gets started.

(b) Controller :- It will control the Fan and Heater.

(c) Analog Sensors:- Sense the light intensity, texture, temperature, color, etc.

(d) MAX 232 :- It is in direct interaction with RxTx, JNI.

(e) User PC/Laptop.



2. *Software Interfaces :-*

JAVA NETBEANS IDE is in interface with JAVA SERIALISATION.

The system's non-functional requirements are as follows:

Performance Requirement:-

1)Availability:-Our software will be available for a wide range of recipes of food items present in our database.

2) Speed:- The speed of our system depends upon the processor and the webcam we are using. For e.g. if the processor is i5, then speed will be higher. But if the processor is core 2duo, then speed will be lower. If camera used is specialized, a good live feed of the processed food will be taken as input which will be faster and reliable.

Software Quality Attributes:-

1) Reliability:- The food should be properly cooked. It should not be undercooked or overcooked.

This is applicable for one food item/recipe at a time.

2) Availability:- The software developed by us will be available all time to the users once it is installed. This tool can be easily available at the relevant cost in the market.

3)Portability:- This tool is portable because it can be installed on any OS of Windows. This tool enable us to reuse the existing code instead of creating new code when transferring software from one environment to another. When the same OS version is installed on two compatible computers, it is also possible to transfer one or more files between them.

4)Performance:- In software engineering, performance testing is testing that is performed to determine how fast the software performs under a particular workload. The performance of our tool can be defined by determining the load on the tool. This system can have only one user at a time which secures a high performance. This tool will immediately respond to the request of the user. Thus, this tool will perform faster.

5)Security:- We are providing the authentication for securing the software and the database.

6)User Friendliness:- This tool is user friendly. As a user there are no complicated steps to use this tool. User has to select the recipe or images of the cooked food via GUI.

7)Robustness :-The title of the software is intelligent cooking which means the software has been already instructed how to work and function. Minimum human intervention will be required.

VII.SYSTEM TESTING AND IMPLEMENTATION PLAN

The purpose of testing is that it provides a way to check the functionality of components, sub assemblies, assemblies and/or a finished product.

For successful implementation of our software, it is necessary that the camera should grab a correct image and the grabbed image should further be compared with a correct image stored in the database.

1.Requirement Specification:-

It includes complete specification of the system (with appropriate assumptions). A document detailing the same should be written and a presentation on that must be made. Attempt should be made to survey more on the system and to check latest updates regarding system currently used for detection.

2.Technology familiarization:-

It includes understanding of the algorithms and technology needed to implement the project. The technology defined should be such that we are able to apply it practically to the project rather than just a theoretical perspective.

3. High-level and detailed Design:-

Listing down all the possible scenarios and then coming up with flowcharts or pseudo code to handle the scenario. The scenarios should map to the requirement specification (i.e. for each requirement specified, a corresponding scenario should be there).

4.Implementation of the system:-

Implementation of the desktop application and establishing connection with camera, heater, fan and other necessary hardware. During this milestone period, it would be a good idea for the team (or one person from the team) to start working on a test plan for the entire system. This test-plan can be updated as and when new scenarios come to mind.

5. Unit Testing:-

The system should be thoroughly tested by running for all the scenarios. Another one week should be there to handle any issues found during testing of the system.

6. Inter-task Testing:-

The system should be thoroughly tested to check the interactions between different modules of the system are properly working or not. Another 2 weeks should be there to handle any issues found during testing of the system. After that, the final demonstration can be arranged.

7. Final Review:-

Issues found during the previous milestone are fixed and the system is ready for the final review. During the final review of the project, it should be checked that all the requirements specified during milestone are fulfilled (or appropriate reasons given for not fulfilling the same).

SYSTEM IMPLEMENTATION PLAN:

ID	Task Name	Duration	Start	Finish	Predecessors	Resource Names
1	Topic Finalization	16 days	Mon 10/06/13	Sat 29/06/13		Internet
2	Study of IEEE paper	6 days	Mon 01/07/13	Mon 08/07/13	1	Internet
3	Synopsis submission	5 days	Tue 09/07/13	Mon 15/07/13	2	IEEE paper
4	Defining problem definition	5 days	Tue 16/07/13	Mon 22/07/13	3	IEEE paper
5	Discussion of references	3 days	Tue 23/07/13	Thu 25/07/13	4	IEEE paper
6	Literature survey	11 days	Fri 26/07/13	Fri 09/08/13	4	IEEE paper
7	Presentation1 preparation	6 days	Mon 12/08/13	Mon 19/08/13	4	
8	Discussion of all reviews	6 days	Tue 20/08/13	Tue 27/08/13		
9	Feasibility study	5 days	Wed 28/08/13	Tue 03/09/13		SAHANE(DAA)
10	Satisfiablity study	7 days	Wed 04/09/13	Thu 12/09/13		SAHANE(DAA)
11	SRS- Introduction	2 days	Tue 20/08/13	Wed 21/08/13	4	
12	SRS- System features	2 days	Tue 20/08/13	Wed 21/08/13	4	
13	SRS- External interface	1 day	Tue 20/08/13	Tue 20/08/13	4	
14	SRS- Non-functional req	1 day	Tue 20/08/13	Tue 20/08/13	4	
15	SRS- Analysis models	3 days	Tue 20/08/13	Thu 22/08/13	4	
16	SRS- System plan	2 days	Tue 20/08/13	Wed 21/08/13	4	
17	Mathematical Modeling	7 days	Mon 02/09/13	Tue 10/09/13	4	
18	Architectural diagram	3 days	Wed 11/09/13	Fri 13/09/13	4	
19	UML Diagrams	10 days	Tue 23/07/13	Mon 05/08/13	4	BOOCH(OOMD)
20	Design of test cases	6 days	Tue 23/07/13	Tue 30/07/13	4	
21	Assignments of project	6 days	Tue 23/07/13	Tue 30/07/13	4	
22	Reference Term-work Assessment Sheet 1 Work	9 days	Wed 25/09/13	Mon 07/10/13		
23	Report Preparation	11 days	Wed 18/09/13	Wed 02/10/13		SRS

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VIII. CONCLUSION

We have proposed a novel approach to introduce traditional image processing model into cooking food. We mainly focus on the color, temperature and texture of the food. We are using image processing as a better option than fuzzy logic, as fuzzy logic is based on partial truth i.e. approximate value. The proposed method can be extended to many other food items.

Better cameras can be used so that we get the exact and correct grabbing of the input image.

We can use the cameras with better resolution and the cameras that will require minimum consumption of electricity.

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