Design and Development of an Automatic Cooking Machine for Domestic Use

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***Abstract*—This paper explores the creation of an innovative cooking machine designed to simplify everyday cooking tasks in home kitchens. The system supports busy individuals by automating key cooking functions like stirring, heating and timing with minimal human effort. Built using embedded hardware and a microcontroller system, it features an easy to access web dashboard. Users can pick from a variety of preset recipes, tweak cooking parameters and follow the process in real time. Emphasis is placed on user safety, adaptability across cuisines and ease of expansion. A prototype was initially tested in real world scenarios showing promising results**

Keywords—Smart Automation, Home Automation, Smart Cooking System, Human Machine Interface, IoT system, Home appliance innovation

I. INTRODUCTION

Modern advancements in automation are steadily reshaping how we manage daily household chores, particularly in the kitchen. Cooking, a task that often requires time, attention, and effort, becomes challenging in fast-paced lifestyles. As people juggle work, studies, and family responsibilities, there’s a growing need for solutions that make preparing home-cooked meals less burdensome.

Smart cooking systems present a great opportunity to bridge this gap by offering tools that reduce hands-on involvement without compromising quality. The fusion of embedded systems, smart sensors, and internet-connected devices has opened the door to intelligent kitchen gadgets. However, most of today’s smart appliances tend to focus on specific tasks rather than providing a complete cooking solution.

This idea originated from first-hand experience managing academic and personal responsibilities where cooking time was often limited. It became clear that a more efficient, user- friendly system could greatly ease meal prep while allowing personal control over the process.

This paper presents the design and development of such a system—an automatic cooking machine created for regular households. The goal is to automate essential kitchen functions like timing, heat regulation, and ingredient mixing, while ensuring affordability, simplicity, and reliability. The following sections outline the design approach, implementation, and testing of the prototype.

II. LITERATURE SURVEY

Automatic cooking machines have evolved significantly, with microcontroller-based systems like those designed by Oyedeji et al. [1] and Kumar et al. [2], which automate cooking times and temperatures. These systems, especially when integrated with IoT, as seen in the works of Ramya et al.
[5] and Livinsa et al. [9], offer more flexibility by allowing remote control of cooking processes via smartphones. These innovations suggest a growing trend towards more user- friendly, connected cooking machines.
The role of robotics and AI in cooking automation is also expanding. Jang et al. [6] developed a cooking robot that processes raw food using instance segmentation, while Syamsudduha et al. [7] designed a smart cooking machine that adapts to different cooking conditions using AI. Both systems indicate the potential for more sophisticated, intelligent cooking technologies that go beyond simple automation.
Finally, advancements in embedded systems and machine learning are improving cooking machine performance. Zhang et al. [8] showcased the use of high-performance microcontrollers to enhance control in cooking machines, while AlNaibari et al. [10] introduced "Gustoso," an intelligent cooking robot that learns user preferences. These developments point to a future where cooking machines are not just automated but also adaptive and personalized to individual needs.

III. METHODOLOGY

The methodology adopted for this project involves a systematic approach for designing, developing and testing an automatic cooking machine. As this project is being developed it is now a semi-automatic cooking machine. The process begins with defining the functional requirements, followed by selecting suitable hardware components such as ESP32 microcontroller, DC motor, modified electric cooker, RTC module and Linear Actuator. Step by Step cooking is carried out using the Arduino IDE to implement cooking algorithms. A user interface is created as a web dashboard using IP address to start and end the process.

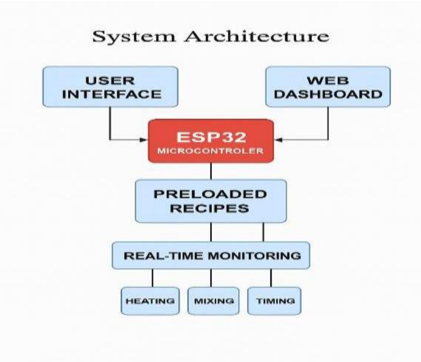

FIG 1. System Architecture

The ESP32 microcontroller uses a web dashboard which is connected through the IP address using WiFi. In the web dashboard the preloaded recipes are given from which we can choose a recipe and as this is a basic research model the dashboard provides buttons to start and stop an operation. The real time monitoring operations like heating, stirring is done automatically whereas timing is done manually.

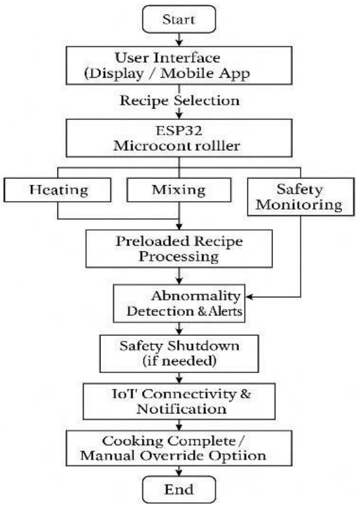

FIG 2. Work Flow of the Automatic Cooking Machine

The machine is started by connecting the DC adapter and the user interface is shown through the web dashboard with the WiFi. In the web dashboard we can select a recipe and the ESP32 microcontroller sets through the operation such as mixing, the heating process is set by default because of the electric cooker that is used in the project. The preloaded recipes are processed and in the web dashboard there are button like icons for starting and stopping an operation such as dropping the specific ingredient. For safety purposes the electric cooker will stop when something interrupts the operation in the middle. When the cooking is completed it can be taken out manually for serving.

IV. DESIGN OF THE MACHINE & PROCESS WORKFLOW

The initial hardware structure was designed using Autodesk Fusion360 where the 3D design was created. Initially there were many changes for the machine because of the complications and the affordability of the products to be purchased. This model was created to make the cooking process easy and affordable. The software Fusion360 enabled us to create a clear image of what we wanted to develop but this is a basic model for testing and research purposes.

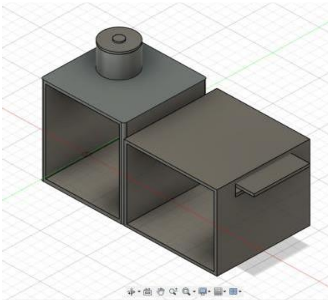

FIG 3. Initial 3D Model of the Machine

This initial model was also developed using Fusion360 but because of the complications in the design and the size was too big for a cooking appliance and also the cost was very high so the model had to be changed to a simpler model.

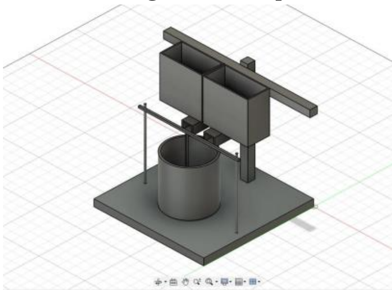

FIG 4. Final 3D Model of the Machine

The 3D model features a cooking chamber which is later fit into as electric cooker and the inside the chamber there is a stirring part fixed inside using a iron rod for balance. The hoppers are fit on the top of the cooking chamber with a iron material with opening on one side so the ingredients can fall into the cooking chamber.

The process is very simple for this model because this is a basic experimental model so the machine is turned on and WiFi is connected through the module in the ESP32 microcontroller. The web dashboard shows the preloaded recipes that are needed to be cooked so we can choose a recipe from that. In the web dashboard, there are icons which can be clicked for starting and stopping a process. The web dashboard was designed using CSS, HTML and Java. When the icons are clicked the operation is started and also ended when clicked again.

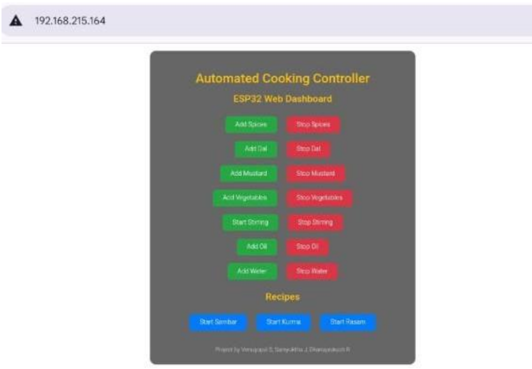

FIG 5 Web Dashboard with IP address

When the ingredients are put inside the containers in the machine, the button start should be clicked and then the heating process is started there is no need for temperature sensor because the electric cooker is already pre made for these conditions.

The containers are labelled as ingredients names so we can just click the button and the ingredient is dropped from the container with the linear actuators used in each container. The ingredient is dropped through the rod fixed from behind the container which has an opening in the front side of the cooking chamber.

The stirring process is started when the ingredient falls off by stirring continuously the cooking process can be done. There are two more containers fixed in the back of the cooking chamber and connected using a pump for pumping oil and water. The oil and water is pumped when needed it is based on what recipe is made.

V. RESULT AND CONCLUSION

Choosing the right microcontroller for this project is very necessary because the working of this machine is a bit complicated so to choose the exact right thing is very important. ESP32 microcontroller was chosen because of its affordability and its objectives.

The ESP32 based system demonstrated effective coordination between hardware components and software commands., enabling reliable execution of preloaded recipes. The web dashboard provided seamless control and real time monitoring to have remote access and observe the progress of the cooking process.

The 3D model further confirmed that all components could be housed compactly without compromising accessibility, safety, or heat dissipation. The ingredient dispensing unit delivered specified quantities, while the heating and mixing modules operated synchronously as instructed. The machine consistently produced well-cooked dishes across multiple trials, indicating stability and repeatability of the process.

FIG 6. Initial Prototype Model

Tests showed that the system handled cooking tasks effectively. It regulated heat accurately, avoided undercooking, and ensured even stirring. Sensor feedback ensured smooth operation and consistent food quality.

The ESP32 played a major role in maintaining performance, enabling real-time updates and remote control. Users were able to track progress and intervene if needed. In terms of results, the dishes turned out well in taste, texture, and appearance. Visual inspections confirmed consistent outcomes, with evenly cooked ingredients and proper coloration.

In conclusion, this project is a basic testing model which is used for testing and experimenting whereas the original product would be made with higher end products and with more technologies.

FIG 7. Finished Model

VI. FUTURE DEPLOYMENT

This paper only deploys the basic model prepared for testing purposes. So in the future by incorporating machine learning for customized cooking and real-time optimization according to user preferences will be the main emphasis of future automatic cooking machine deployments. Advanced sensor technologies will improve ingredient identification and recipe diversity, while cloud connectivity will allow remote control and monitoring through mobile applications. Operation and convenience will be further enhanced by voice control and connectivity with meal delivery services. These enhancements will put the system in a position to be used in commercial kitchens as well as smart households, providing a flexible, self-sufficient cooking option.

The system has room for exciting upgrades. Future versions could feature machine learning to adjust recipes automatically, improved sensors to detect ingredients, and compatibility with more cooking styles. Enhancements like voice control and smart home integration would also improve user experience. Future enhancements may include voice assistant integration, feedback sensors for precision control, and machine learning algorithms for adaptive cooking, thereby extending its capabilities and user-friendliness.

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