Design and Implementation of Automatic Pasta Cooking Machine

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***Abstract*-** Mention the abstract for the article. An abstract is a brief summary of a research article, thesis, review, conference proceeding or any in-depth analysis of a particular subject or discipline, and is often used to help the reader quickly ascertain the paper's purpose. When used, an abstract always appears at the beginning of a manuscript, acting as the point-of-entry for any given scientific paper or patent application.

***Index Terms*-** About four key words or phrases in alphabetical order, separated by commas. Keywords are used to retrieve documents in an information system such as an online journal or a search engine. (Mention 4-5 keywords)

I. INTRODUCTION

Food is an essential part of life, and is considered an indispensable element. Every day, humans need to eat in order to stay energetic, stay on track in life, maintain good thinking, and work efficiently. Unfortunately, due to busy schedules and lack of time for cooking, some people don't know how to cook, while others may be too lazy. All of these reasons and more are enough to prevent people from cooking their own food, leading them to consume low-quality food or food with poor nutritional value, such as fast food.

One solution to this problem is to rely on machines or tools that can cook by themselves or help people prepare their food. A paper titled "Panavi: Recipe medium with a sensors-embedded pan for domestic users to master culinary arts" seeks to help domestic and beginner users improve their cooking skills in their kitchens. This is done by supporting their cooking experience by managing temperature and pan movement properly [1]. The system is based on two sensors-embedded frying pan, "J-type thermocouple sensor and acceleration sensor", providing projected images and vibration-wirelessly connected with a computer system that shows text messages with sounds to do that.

Z. Mary Livinsa et al. proposed an implementation of an automatic cooking machine which is designed to be used for domestic cooking [2]. It is a fully automated machine based on Arduino Mega and the Internet of Things (IoT). Objects are pushed or rotated precisely by using servo motors. It uses a relay switch to open and close the system electromechanically. Oil is pumped into the pan slowly through the valve pipe, and the menu selection can be done with a web app/Android app using IoT.

A machine that can help disabled people prepare their food easily is proposed in [3]. It is a Wi-Fi controlled automatic food maker machine based on mechanical and electrical parts, with a program uploaded to the Arduino 2560 board. It is mainly designed for preparing breakfast meals, but can also make heavier foods. The food maker is connected to a remote user. The remote user can send required messages to the Arduino with the support of the internet. Another food machine with WiFi ability is the one presented by [4]. A machine that cooks Chinese dished is proposed by [5], it uses three mechanisms to prepare stir-frying Chinese food.

Arduino as a friendly microcontroller board is used in most of the cooking machines, such as a rice cooker proposed by [6]. Another machine that uses Programmable Logic Controllers (PLC) and specialized in making soup is the one suggested by [7], where it uses the PLC to control the whole operation.

This paper is an extension of a work that studies the design and simulation of a cooking pasta machine [8]. This paper describes the realization of an automatic pasta cooking machine, which utilizes the Arduino Mega platform. The machine is designed to be user-friendly, particularly for the elderly and those with disabilities. It is a straightforward and efficient device that does not require any

special applications, such as Wi-Fi, and consistently delivers high-quality food without wastage or errors. The user can easily customize the recipe through the machine's LCD interface, selecting cooking settings based on ingredient availability and personal preferences. The machine then performs the necessary cooking operations, including heating, adding water and oil, seasoning, ingredient addition, and mixing, until the dish is fully cooked.

II. System Development

This section covers the main block diagram of the system, the system structure and finally the system operation.

A. System Description

The system has rotating platform with eight containers, four with screw feeder and four with a sliding bottom, mounted on top of it. There is one screw feeder motor and one sliding bottom motor. The platform is rotated to align the proper screw feeder/container to the motor. The overall system is shown in Figure 1.

Figure 1: The general structure of the system with all elements and taken from different views.

The basic block diagram of the proposed system is shown in Figure 2. It can be seen that all components are either directly or indirectly connected to the Arduino. It is a very important element and can be considered as a core of the system.
An L293D H –bridge is used to drive DC motors (moto1, motor3 and motor4). Motor2 is driven by another motor shield, TA4829, since it needs a higher current than that provided by the L293D H –bridge. DC motors and their attachments, encoders and photo interrupters, are used for adding and mixing the ingredients such as pepper, turmeric, and potato in the pot. This can be done by rotating the platform 'which is mounted on three wheels' through motors 1 and 3. Sliding in and out the bottoms of the container to dispense the ingredients is controlled by motor 2.

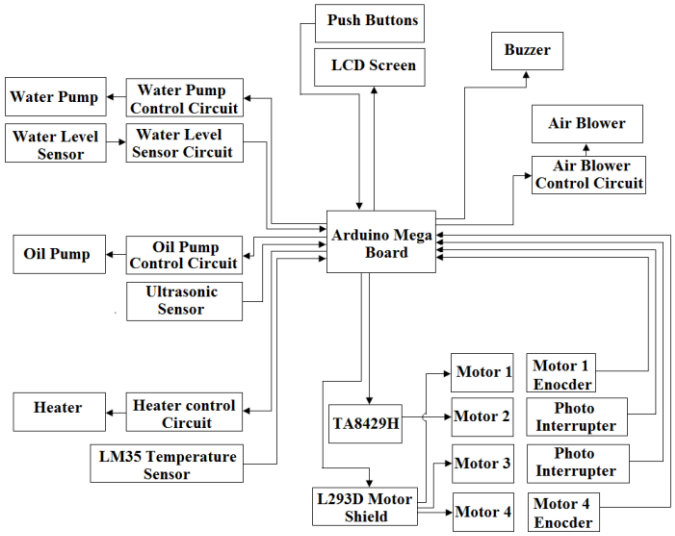

Figure 2: General block diagram of the system

Motor4 is responsible for opening and closing the pot cover as well as the mixing operation. The amount of oil is measured by observing the oil level in the oil reservoir before and during the cooking by using an ultrasonic sensor in the reservoir. While, the amount of water used in the cooking pot is measured by a sensor in the pot. It is consists of 33 probes; in which one is ground and 32 probes are fixed inside the pot at equal distances. The water level will connect electricity to the submerged probes, which the Arduino uses as a level indicator. The Arduino operates the oil and water pumps through an interface circuit. LM35 temperature sensor is used to measure the temperature of the pot. The required heat to perform the cooking process is provided by heater. Push buttons are used to select the cooking settings and to allow the user to interface with the LCD. The system has an air blower as a protection element. It is used to blow the steam coming out of the pot away from the electronic parts to prevent any damage. A buzzer notifies the user when the cooking is done. The system structure is shown in Figure 2.

B. System operation

Firstly, the system should be initialized before starting. The cooking procedure is summarized in the flow chart shown in figure 2. This can be done by filling the oil and water tanks with oil and water respectively, putting each ingredient in its specific place, pitting the pot on the heater and switching it ON.

A user can choose the cooking settings using the push buttons after turning the machine ON and a "WELCOME" message in the LCD is displayed as showing in figure 3.

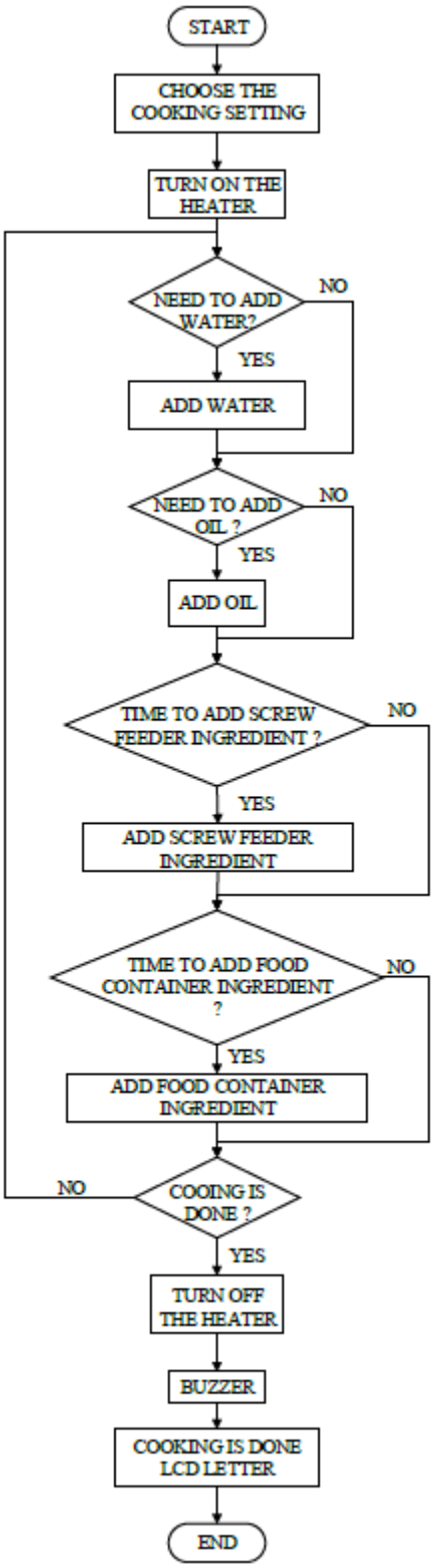

Figure 2: System operation flow chart.

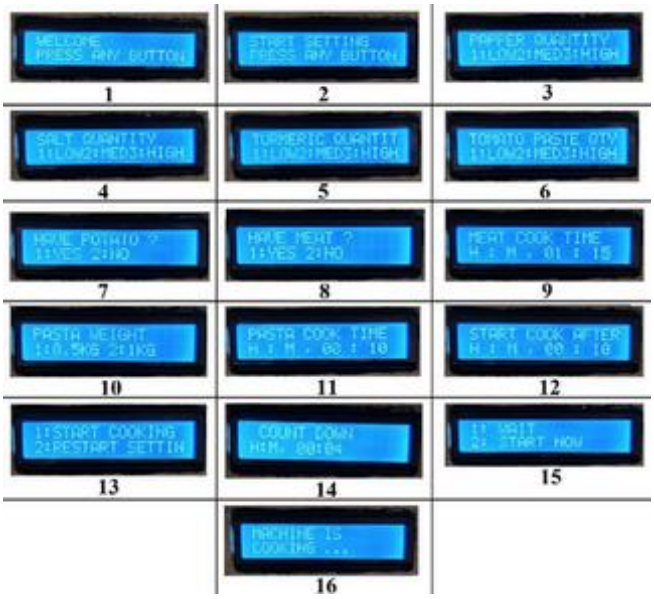

Figure 3: WELCOME message and cooking settings.

To add water/oil to the cooking pot, the Arduino will turn ON the water/oil pump which will start pumping it from the water/oil tank to the pot. at the same time the Arduino will start monitoring the water/oil level in their tanks using the HC – SR04 ultrasonic sensors. The Arduino will turn OFF the pump when the water/oil level in the tank drops to the desired level. This operation is repeated whenever the water/oil is needed to be added in the pot.

Whenever one of the ingredients in the screw feeders (powdered material and pasta) or one of the solid materials that are in the food containers is needed to be added to the pot, motors (1, 3 and 4) are used to add the ingredients through the use of screw feeders as shown in figure 4.

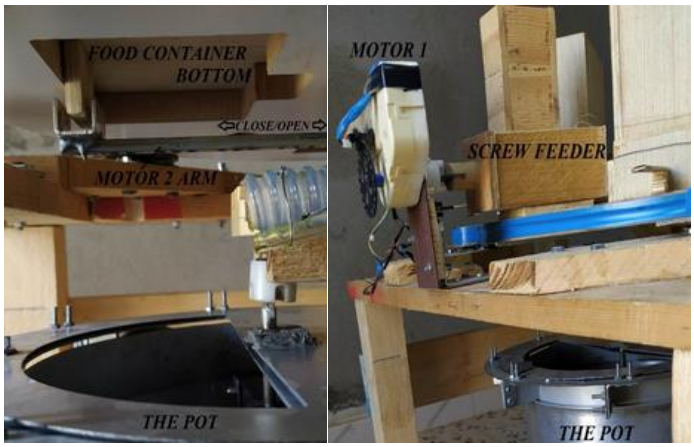

Figure 4: (left) Rotating the screw feeder, (right) opening and closing the feed container.

The system will start mixing the ingredients by using a mixer installed inside the cooking pot as shown in figure 5. The rotation direction "CCW or CW" is controlled by using motor 4.

Figure 5: Mixer and the pot cover.

Water level sensor, shown in figure 6, uses 32 signal probes and a common power probe insulated which are embedded inside the cooking pot. The copper wires are used as probes and they can determine the water level in the pot. This can be done by defining how many signal probes are connected to the power probe through the water medium.

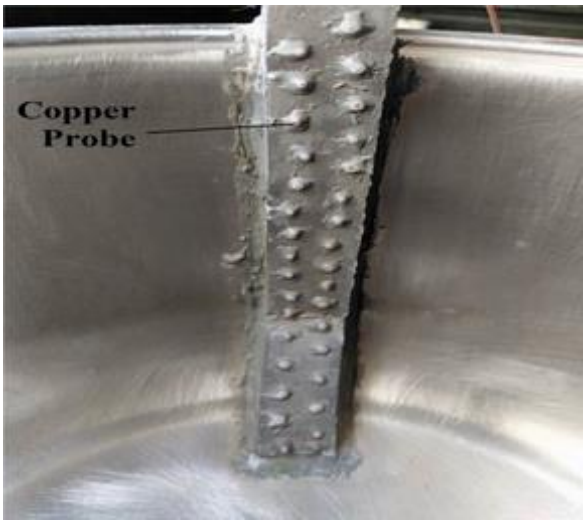

Figure 6: Water level sensor probes.

The relationship between the signal probes and required water volume to be added "ml" as well as the logic representation of the operation tine of the water pump is illustrated in figure 7.

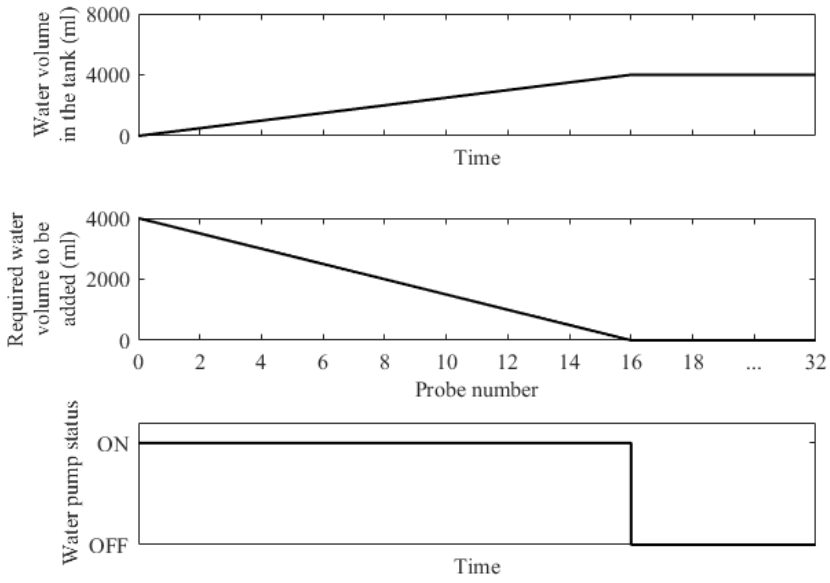

Figure 7: (a) desired water level in the pot, (b) the relationship between the required water volume to be added and the signal probes and (c) logic representation of the water pump operation time.

After finishing executing the cooking procedure the Arduino will turn the buzzer ON to notify the user and the sentence "COOKING IS DONE ENJOY" will be shown on the LCD display, see figure 8.

Figure 8: Finishing message shown by LCD.

III. RESULTS

Now it is the time to articulate the research work with ideas gathered in above steps by adopting any of below suitable approaches:
The taste and quality of the pasta that can be done by this machine depends on the availability of the ingredients, quality grade of some ingredients and the quantity needed of them. This can be chosen by a user through the push buttons during the cooking setting up step. The pasta that is shown in figure 9 is cooked by the machine using the following settings:
Pepper quantity: Low, salt quantity: Medium, turmeric quantity: Low, tomato pasta quantity: Low, have potato?: Yes, have meat?: Yes, meat cooking time 01:15, pasta weight: 0.5 Kg, pasta working time: 00:10, start cooking after 00:10.

Figure 9: The pasta cooked by the machine.

IV. Conclusion

This work, prototype, is the main step towards implementation of the proposed system. It is a good chance for entering in eco – friendly world. This machine is not complicated and can be easily accessed by general people. It is full automation machine and can be used in different places such as houses, restaurants, hotels, job places etc. using this machine helps us to avoid having fast foods and other unhealthy and bad quality foods. Finally, this machine can be used to prepare other meals such as soup.
This machine can also be considered as a good starting point for designing other cooking machines such as the rice machine. The communication technology can be provided to the system by using GSM shield. It allows the user to be informed about the cooking operation steps and the problems that might be faced during the cooking operation

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