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Automatic Cooking Machine using Arduino

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ABSTRACT

This research article focuses on the reduction of human effort by involving conversion of action into machine instructions. Using the microcontroller, motors & sensors, automation is achieved to a major extent in the cooking process. The Arduino Uno microcontroller is used here to interface all the sensors & motors in all the steps of the cooking process. The machine instructions are verified using proteus software and then executed.

Key words : cooking process, automation, Arduino Uno.

1. INTRODUCTION

Automation is a recent technology development that improves the quality of living by automating the process at home or at work. They provide safe processes, does things that humans physically cannot do and also make humans more productive with reduction of cost. Increased demand for new products have left industries [1], [2] and agriculture [3] to incorporate automation strategies. This improves reliability, scalability and flexibility.

Automation in cooking refers to the use of robots that are meant for cooking. The idea behind this is to save time. Around 253 minutes per week is spent by a homemaker to cook food whereas the incorporation of automation helps us to reduce the time & focus on other meaningful activities. Also in manual cooking consistency is a lacking property. But automation in cooking helps to remove these consistency and food is prepared exactly at the same taste each and every time. Moreover these are safe and hygienic as well.

2. BACKGROUND

Many research works are carried out for automating the cooking process. Miyawaki et al [4] have used CCD camera to identify location of cooking utensils. Also two markers are used for identifying the state of the bowl. Yan W. Xi et al [5] have developed special machinery that uses a feeding mechanism to put the right ingredient to the cook. Modi et al [6] have analysed using sensors the quickness of cooking and mechanical strength using machine vision. Nakauchi et al [7] have developed a system that uses temperature sensor heat adjustment and also camera to visualize the recipe. S. S Lad et al [8] used a food mixing machine that is operated using a Arduino microcontroller that controls the process and the motor drives. Chandrasekar et al [9] have developed a chapathi making machine that works at lower pressure by using a pneumatic cylinder, control unit, solenoid valve, three phase AC motor and maker parts.

Pasumarti Giridhar et al [10] have developed an automatic mysore bonda making machine using solar energy. A 3D image based on insight control unit for vegetable making is developed by Kaviraj et al [11] that uses electrical devices like sensor & control boards to help mechanical device to operate with proper & accurate time interval during operation.

Using rotating conveyors, mixtures with screw extruder and electric power, Solanki et al [12] have developed a fast food making machine that moves the device in circular direction. Automatic dosa maker for Indian households was designed and developed by K. S. Shaji et al [13] wherein a removable hopper is placed to remove the items easily.

3. MATERIALS, METHODS & IMPLEMENTATION:

3.1 Mechanical Portion:

The mechanical portion, it consists of all hardware parts needed for construction of the cooking machine. It acts as a framework on which the logic is being implemented.

3.1.1 Steel Rod

It is used to stand the setup between the karahi holds. Figure 1 shows the pictorial view of the steel rod which is used as holder.

Figure 1: Steel rod used in the setup

3.1.2 Aluminium Sheet

The aluminium sheet serves for mixing and grinding the food. It is shown in the figure 2 below:

Figure. 2: Constructed aluminium plates.

3.1.3 Containers:

The containers for rice and vegetable are cut from bottom and a small opening is provided as shown in figure 3. The locking rod is connected to servo, when a trigger is applied to servo, it pulls the rod and opens the gate.

Figure. 3: Construction made inside the containers

3.2 Electronics Portion:

3.2.1 High Torque DC motor

We have used a high torque motor which has a speed of 45rpm. It is a 4- pole motor. It is used to rotate the mixing plates. High rpm is not used as high speed may throw food out of the vessel. Its operating voltage is between 9V to 15V.

3.2.2 Servo Motor

It is a dc powered motor as shown in figure 4. It has a rotation angle of 180^0, it can be programmed by microcontroller and its rotation angle can be controlled. It has a weight of 9 gram. It has three wires to it, one for source, one for ground and one for signal. It has an operating voltage of 4.8V.

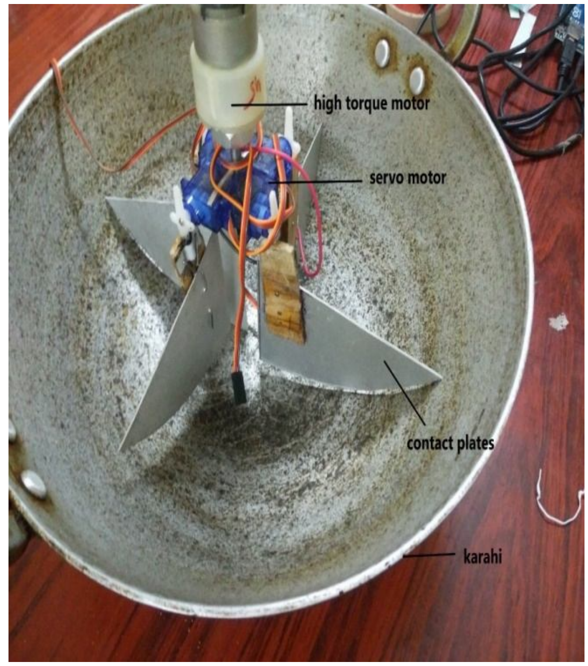

Figure 4: Setup with high torque motor & servo motor

3.2.3 DS18B201 Temperature sensor

The DS18B20 Digital Thermometer provides 9 to 12-bit (configurable) temperature readings which indicate the temperature of the device. The DS18B20 communicates over a 1-Wire bus that by definition requires only one data line (and ground) for communication with a central microprocessor. In addition, the DS18B20 can derive power directly from the data line (parasite power), eliminating the need for an external power supply. This sensor has been included in many applications such as thermostatic controls, industrial systems, consumer products, thermometers, thermally sensitive systems. Figure 5 shows the sensor fixed in setup.

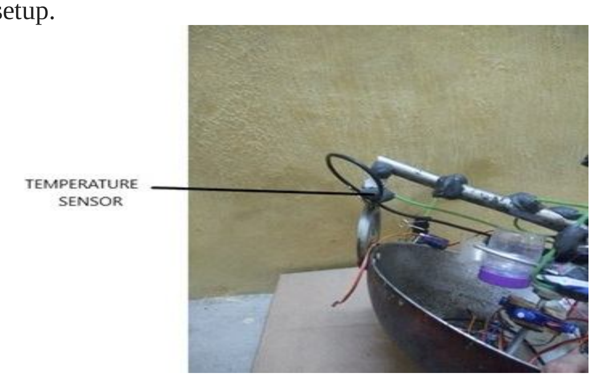

Figure. 5: Setup with temperature sensor DS18B201

3.2.4 Arduino Uno Microcontroller

The Arduino Uno microcontroller boards are equipped with sets of digital and Analog pins that are interfaced with various breadboards and other circuits. It has serial communication interfaces [14], USBs for loading programs from computers. In this research work Arduino Uno is used to control the various components connected to it. It automates and controls the process, motors and sensors. It takes the changes happening in the sensor output and triggers the motors attached with it. The sensor gives updates of temperature and accordingly the microcontroller triggers the motors. It also controls moving of parts, determines the delay and sets which motor should move first and which is next to follow it.

3.3 Methodology

Figure 6 shows the schematic view of the model. The temperature sensor is connected to the karahi. The containers are mounted at the top of the cooking vessel to drop the ingredients one by one. A separate motor is attached to heat regulator to put off the flame when the process is over.

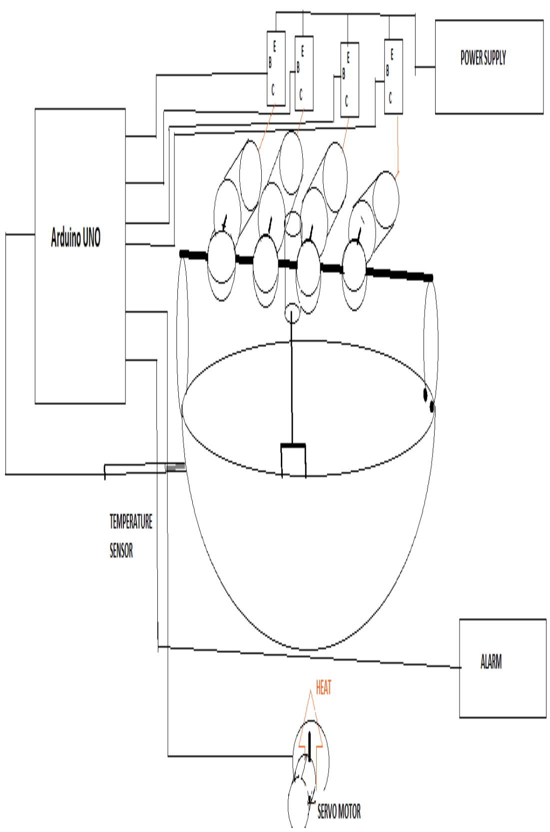

Figure. 6: Schematic view of the setup

The block diagram of the whole process is shown in figure 7. A switch is connected to the arduino to start the whole process. In the input pin of arduino, a temperature sensor is connected. It is connected to the karahi holder clip so that the cooking vessel has direct contact with the temperature sensor and can measure the temperature accurately. The output side has the motors attached. This motors are fixed with the container to rotate it.

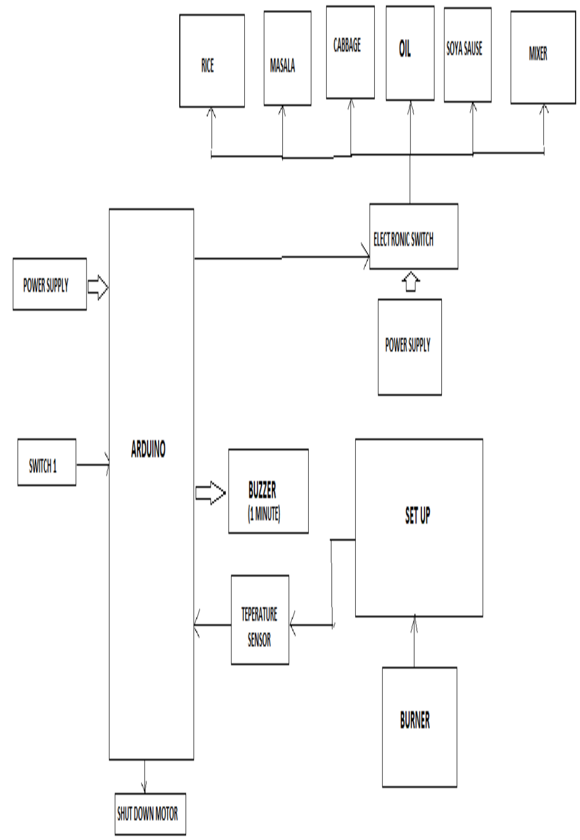

Figure. 7: Block Diagram of set up

The flowchart in figure 8 shows the sequence of operation. At first, the power supply to the system is set on. The controller makes a default positioning of the containers once the system is started. The default positioning is done to ensure all the containers of the system are in its position. All required ingredients are then added in the container and the switch is pressed on. The controller takes input from the temperature sensor whether vessel temperature is sufficient to start the process. It checks it by comparing the vessel temperature with the set point.

The system waits for the temperature to rise. Once temperature is greater than the set point, the controller triggers the oil. The servo connected to the oil servo rotates upside down and oil is introduced in the system. The servo waits till all the oil gets in the vessel and then the next process is continued. After waiting for 30 seconds, egg container is triggered. the servo rotates to drop the egg mixture. It waits for few seconds and triggers the masala container, the masala servo rotates and then the mixing operation is started. The mixing servo is triggered on and the operation continues for 30 seconds to 1 min.

Once scrambled egg process is over it goes for egg fried rice process. At first, vegetable container is triggered. The vegetable servo rotates to drop the vegetables. Then the mixer is triggered. The mixer starts rotating and the operation is carried on for 3 to 4 minutes and then the next step is started.

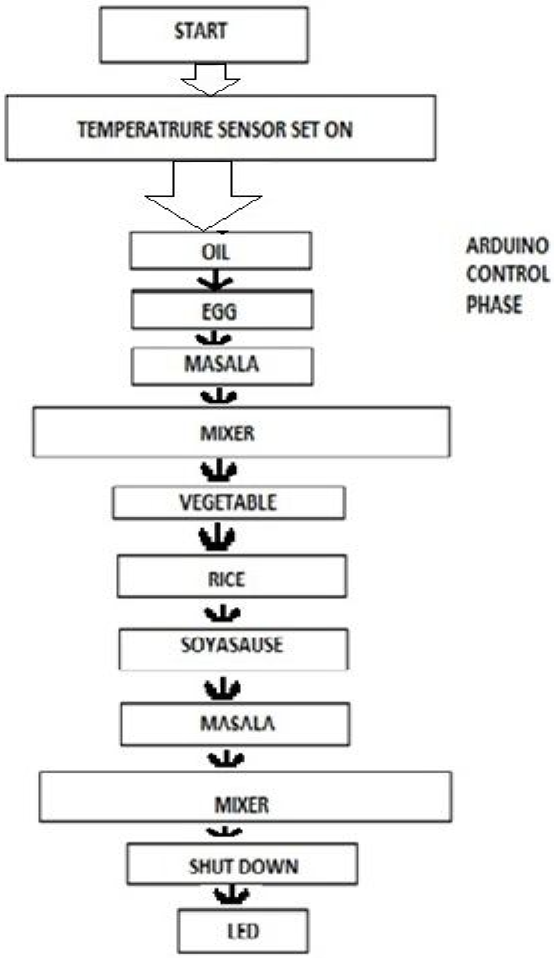

Figure. 8: Process flow diagram

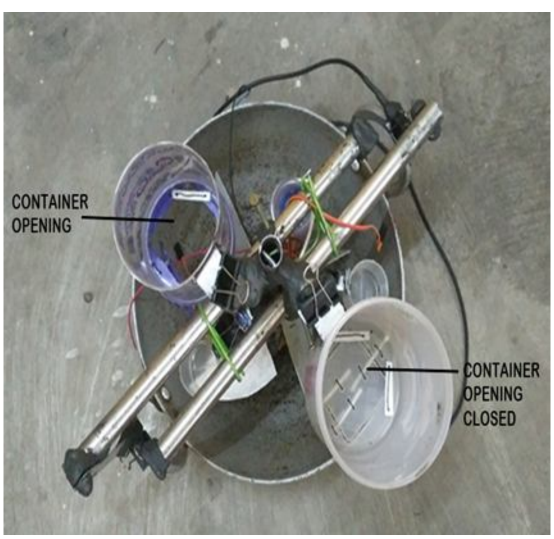

Figure. 9: Top view of the system.

After the vegetable frying process is completed, rice is poured. The rice container is now triggered and the servo rotates to drop the rice. The mixer is then set on and it mixes rice with the ingredients thoroughly. The mixing process is carried on for 2 minutes. Once rice is cooked then soya sauce container is triggered. The soya sauce servo rotates and pour it in the karahi. The servo is set to a delay of 30 sec and then masala container is triggered. The masala servo rotates and pour masala in the mixture. The mixing motor is triggered and is continued for more 2 minutes. Once the cooking operation is completed and ready to feed, the LED and the shutdown motor is set on. The shutdown motor put off the stove and LED indicate that the dish is ready. Figures 9, 10 and 11 represent the top view, front view and the view of the setup without containers.

Figure. 10: Front view of the system.

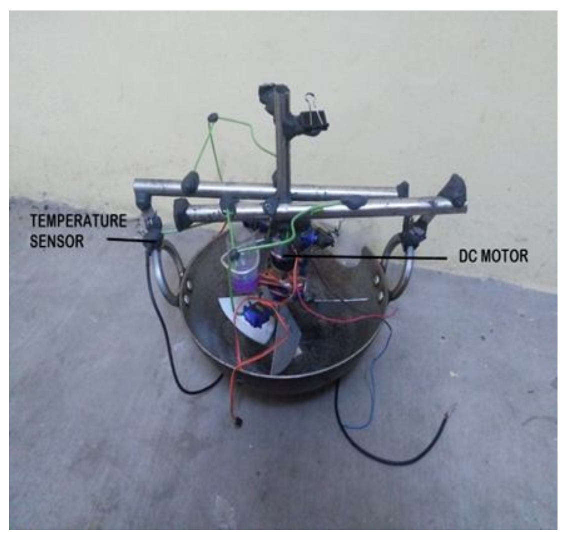

Figure. 11: View of the system without containers

4. RESULTS & DISCUSSION

Coding is run and verified using proteus 8 software whether it is working properly or not. The initial construction of the setup within the software is shown below in figure 12.

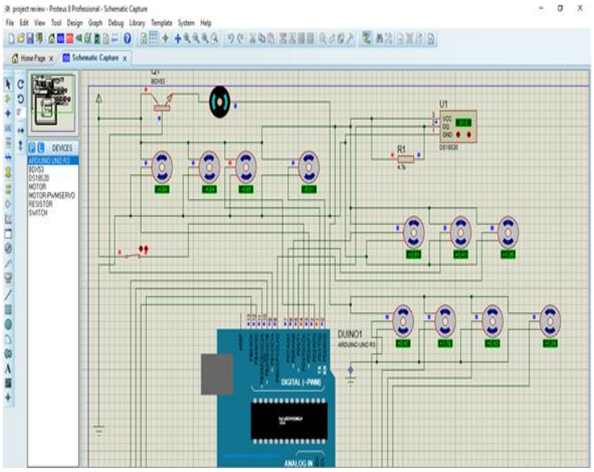

Figure. 12: Initial construction done in proteus software

Next the play button is pressed and the operation is started. Even if the operation is not started, it waits till the temperature reaches the set value. Following figure 13 shows the temperature below set point.

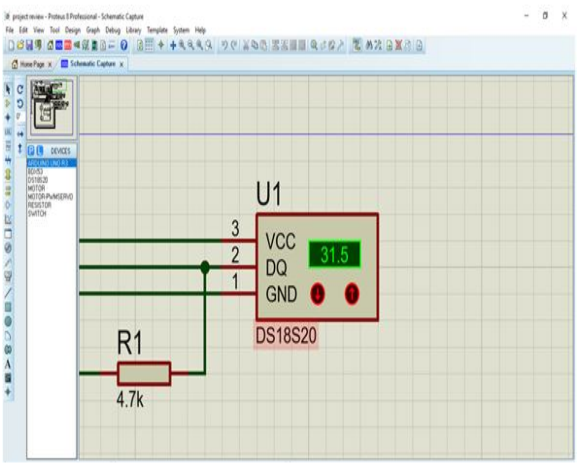

Figure. 13: Temperature is below set point.

Once the temperature is greater than set point, oil servo is triggered and the oil servo is introduced into the system. After 30 seconds, egg servo is set ON. Figure 14 shows that the temperature is above set point

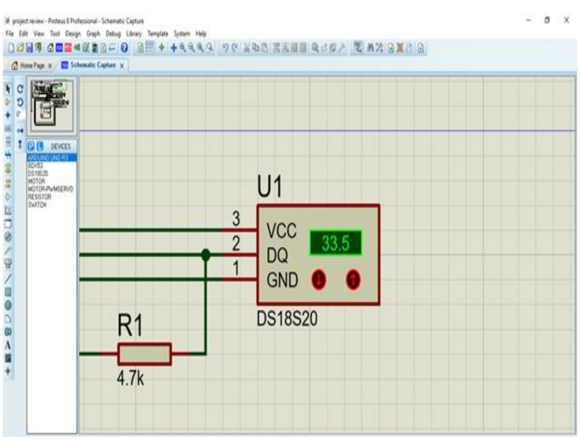

Figure. 14: Temperature is above set point

The operation continues for more than 30 seconds to 1 minute. Next the vegetable frying phase is started and vegetable motor is set ON, which is carried out for 3 to 4 minutes. This is followed by Masala servo motor ON, soya sauce motor ON and the mixing process is continued for more than 2 minutes. Next rice servo motor is set ON and mixer mixes the rice along with ingredients thoroughly for 2 minutes. The cooking operation is completed and it is ready to serve. The shut down motor is put OFF and the LED indicates the dish is ready.

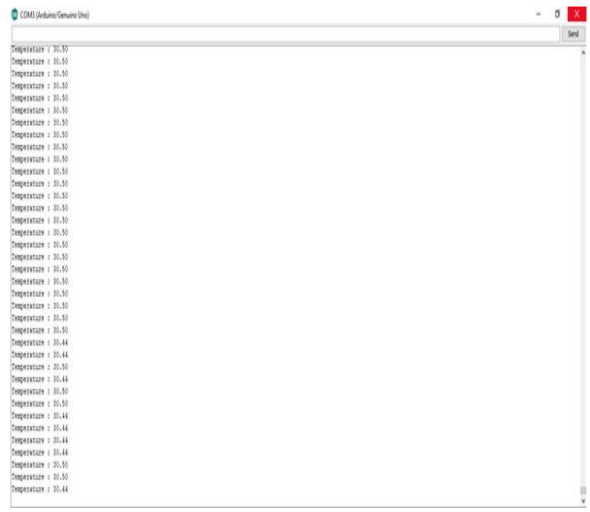

Figure. 15: Practical temperature value shown by sensor.

The temperature cut off is recorded approximately as 32^0C to start the process. In the above figure 15, the practical set point value is shown recorded by the temperature sensor.

5. CONCLUSION & FUTURE WORK

Automation is very helpful for our society. It helps to get precise result and accuracy as it is the main ingredient in industries. In this research work using Arduino Uno microcontroller, motors and sensors cooking is done.

There is lot of scope in future regarding this research work. This system is programmed for only one receipe. We can include more receipes by varying the delay, motor speed, run time, etc., by programming it. Also, high memory limit microcontroller can be used to manifest more functions. Low power motors can be replaced by high power motors so that they can take bulky ingredients to prepare more food than one person at a time.

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