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SMART STOVE

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Abstract

The "SMART STOVE", is an idea which will help in optimizing the consumption of the LPG. It will be able to maintain the proper flame intensity while cooking and help in maintaining the temperature of ingredients which is best suitable for cooking. Thus due to efficient consumption of LPG gas, the smart stove helps in reducing the expenditure on the gas fuel. Also the system can be made compatible with existing design with minor changes. The Smart stove ensures food palatability, is user friendly and simplifies the cooking process.

The present day products used for cooking are microwave-oven, induction cooktop etc. The above products are semi or fully automated. But according to the survey from Highly Professional Chefs, the food which is cooked in the above products is not as effectively cooked as the one cooked in Stove. Also due to busy schedule in today's life people cannot be always present in front of stove while cooking, so this idea will relieve human efforts by automating the cooking process.

Key Words: Load cell, sensors and microcontroller, flame mechanism, electronic components.

1. INTRODUCTION

Cooking is the activity carried out in each and every house. With the evolution, cooking has advanced and developed from a simple process of heating food to a variety of techniques used now days. A normal person spends 2-3 hours per day on cooking. With increasing work load it has become important to save time on mundane activities like that of cooking. An automated system would provide a person to multi task without worrying about the food being burnt. Most of the households use LPG stoves in their home for cooking. Though there are induction cook tops and microwaves which run on electricity but still majority of the households use LPG stoves in their kitchen for cooking. LPG is a fossil fuel which would be depleted if not used judiciously, and cooking is a highly inefficient process where there is maximum wastage of the fuel. The loss is mainly due to cooking of food for longer time than required, or due to burning of food. Also Government policies have restricted the number of cylinders available to a household per year. This has made common man to reduce his fuel consumption, which is possible only by optimizing the cooking process. This can be done by developing a feedback system that will regulate the flame intensity & control the fuel flow, depending on the parameters such as temperature, weight, time & viscosity.

2. ELECTRONIC COMPONENTS

Cooking is a very complex process and is dependent on many parameters. To develop a feedback control system, it is necessary to sense all the above mentioned parameters and send information to control system in the form of voltage signal which will regulate or stop the flow of fuel.

2.1 Temperature sensor

Temperature sensor is used to determine the temperature of the cooking food. The sensor will sense the temperature and send the information to the microcontroller where the microcontroller will check whether the temperature for a particular foodstuff is attained or not and likewise it will regulate the flame intensity. The temperature sensor which can be used is Fig 2.1 as it is having a wide range of temperature.

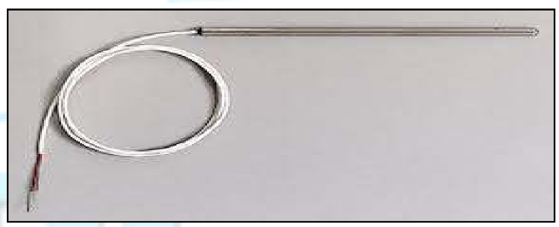

Fig 2.1 PT100 Temperature sensor

2.2 Weight sensor(Load cell)

A load cell converts force or weight into an electrical signal, which can then be sent to a remote computer or recorder to monitor load, pressure, strain and more.

Fig 2.2 Load cell

2.3 Timer circuit

A timer measures elapsed time (counting processor clock ticks). In others, we want to count or time external events. Fig2.3 shown will measure the time elapsed for a particular foodstuff during cooking. As soon as the time elapsed is zero it will send information to the microcontroller and microcontroller will activate the buzzer so as to give signal to the user that the food is cooked.

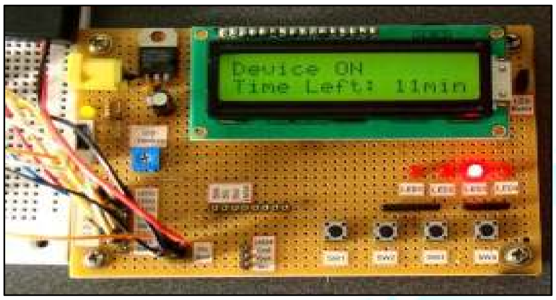

Fig 2.3 Timer circuit

2.4 Microcontroller

A microcontroller is a small computer on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals. We used Arduino mega since it is easy to program.

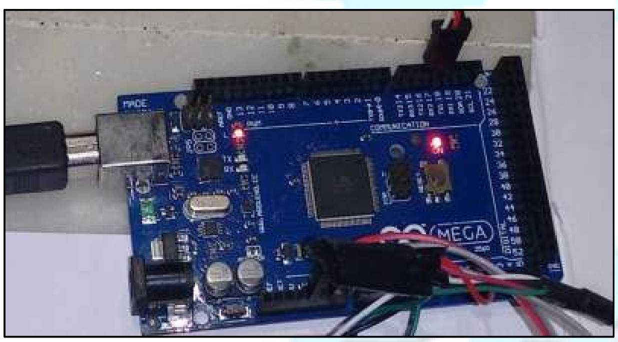

Fig 2.4 Arduino Microcontroller Board

3. EXPERIMENTAL STUDY

Experiments for various foodstuffs were performed and depending on that data empirical relation for each type was established. Fig 3.1 shows the relation for the time taken to cook rice. The experiment was performed for different weight samples and we reached to a conclusion that cooking food

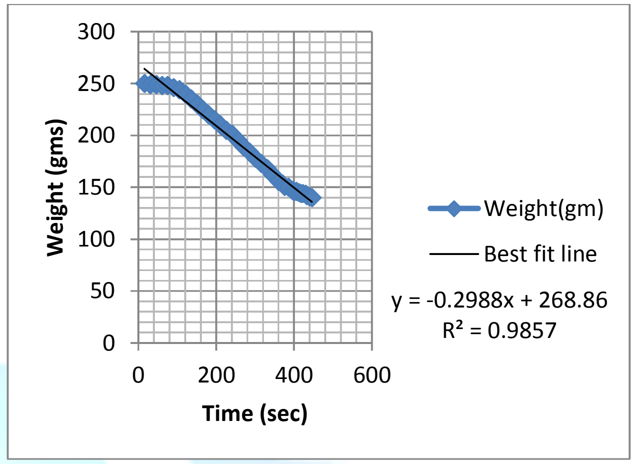

Fig 3.1 Weight v/s Time graph for cooking of rice

Contains two types of moistures viz. bound moisture and unbound moisture. Bound moisture is the moisture contained in the foodstuff or gets absorbed by it during cooking & unbound moisture is the one contained in the vessel. As the time ascends there is a rapid change in the weight of system till the unbound moisture is present. Once this moisture is evaporated completely the bound moisture starts evaporating where the change in weight is very negligible. This is the point where the food comes in direct contact with the vessel and starts burning. To sense this critical point we will be using a load cell that will in response switch off the flame.

Further, we conducted experiments to find the relation between the outer surface temperature of the vessel and the inside food temperature. Following are some results that were found.

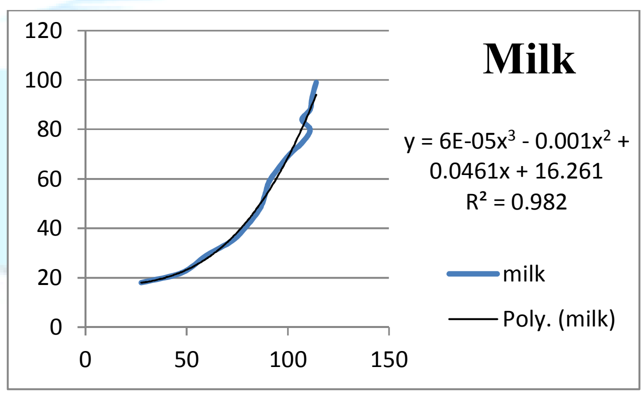

Fig 3.2 Inside temp (milk) v/s Outer surface temp of vessel

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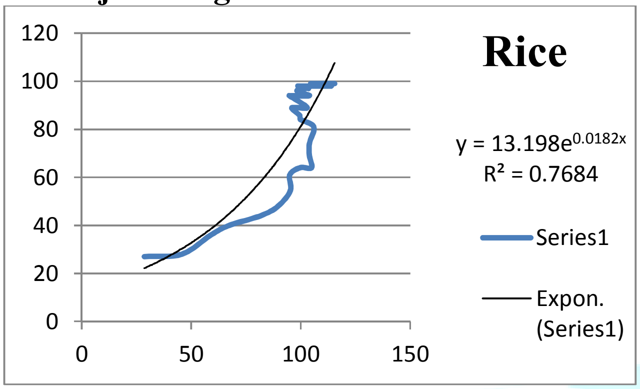

Fig 3.3 Inside temp (rice) v/s Outer surface temp of vessel

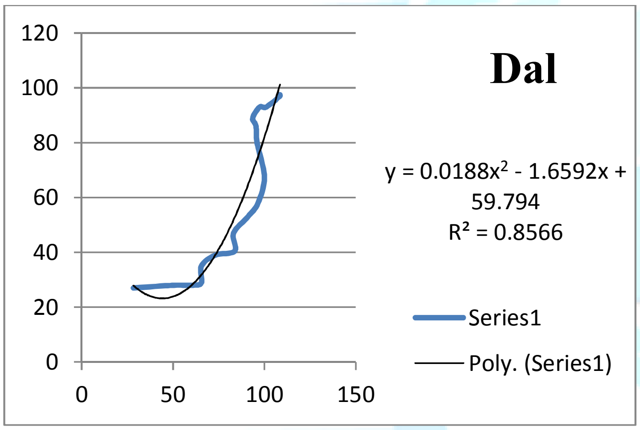

Fig 3.4 Inside temp (dal) v/s Outer surface temp of vessel

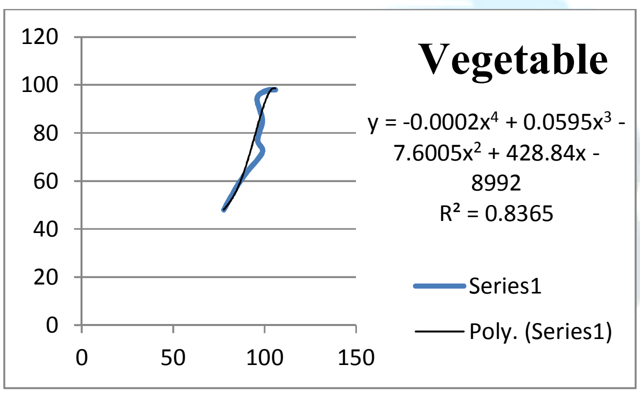

Fig 3.5 Inside temp (Vegetable) v/s Outer surface temp of vessel

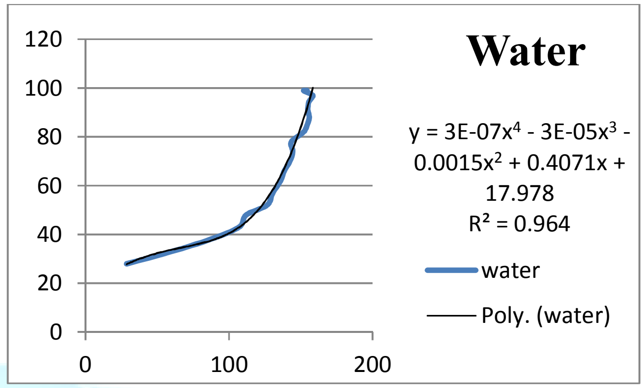

Fig 3.6 Inside temp (Water) v/s Outer surface temp of vessel

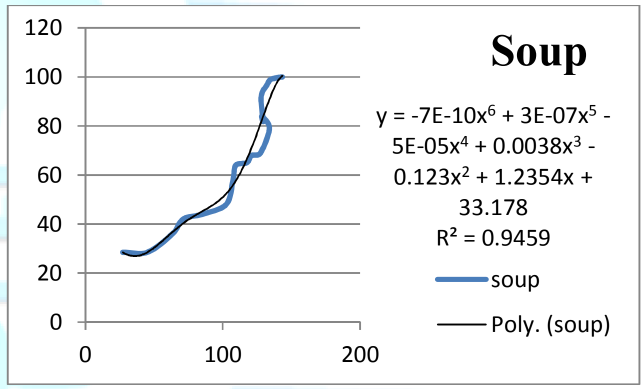

Fig 3.7 Inside temp (Soup) v/s Outer surface temp of vessel

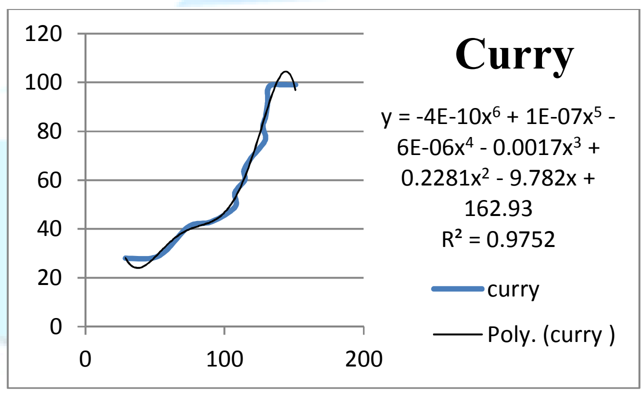

Fig 3.8 Inside temp (Curry) v/s Outer surface temp of vessel

From the graphs shown we were able to find empirical relation between the inside food temperature and outer surface temperature of vessel for milk (fig 3.2), rice (fig 3.3), dal (fig 3.4), vegetable (fig 3.5), water (fig 3.6), soup (fig 3.7), curry (fig 3.8).

The whole idea to find the relation was to prevent the food from any foreign contact as people in general would not like to have any electronic stuff hindering the cooking process so we used these relations as an input source to our temperature sensor which will be intact with the outer surface of the vessel. Likewise experiments were performed to find out the time taken for proper cooking of the food. Table 3.1 shows the time taken for cooking of various food items.

Table 3.1 Cooking time chart for different food

Food item	Cooking time
Leafy vegetables	10-15 minutes
Cauliflower	15-20 minutes
Tur dal	20-25 minutes
Moong dal	20-30 minutes
Potatoes	15-20 minutes
Sprouts	10-15minutes
Beans	15-20 minutes
Rice	20-25 minutes

4. METHODOLOGY

The inputs from the temperature, time and load cell sensors are fed to the micro-controller which compares them with the standard measurements taken from experimental analysis. The micro-controller performs decision making and control operations and provides output signal to the motor which controls the flow of fuel to the stove.

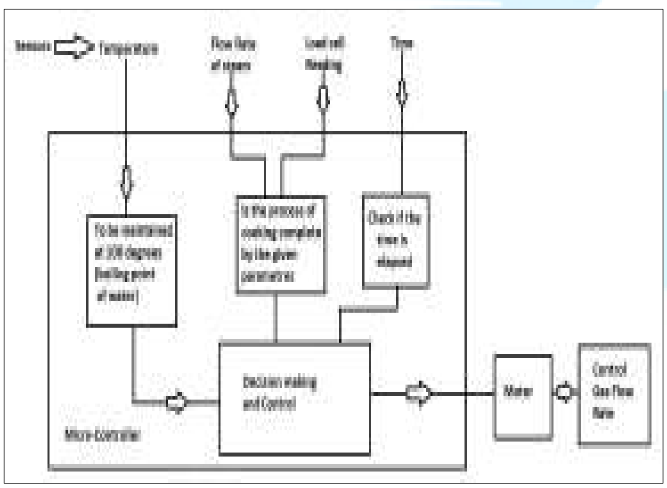

Fig 4.1 Flowchart of the working system

5. DESIGNING OF SYSTEM

The design of the system is done taking into consideration various factors. Fig 5.1 shows the flame control knob.

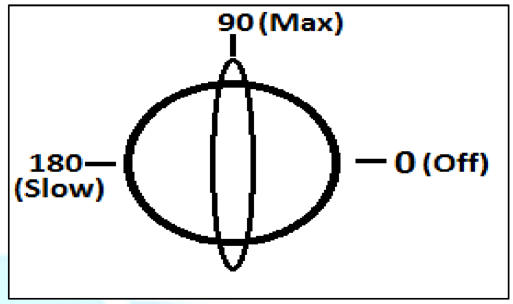

Fig 5.1 Flame control knob

The maximum rotation of the knob is 180^0. At 0^0 there is no flame i.e. the knob is at off position. To ignite the flame knob is rotated in anticlockwise direction. At 90^0 the intensity of the flame is maximum and at 180^0 it is minimum. So to control the knob according to our requirements we used a servo motor and a pair of gears. Fig 5.2 shows the flame control mechanism

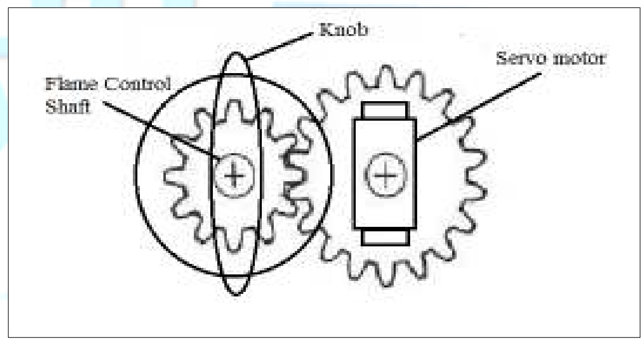

Fig 5.2 Flame control mechanism

The servo is mounted on the front panel of the stove. It is programmed only for 90^0 revolutions to give an 180^0 revolution to the knob by using a 1:2 gear reduction ratio so as to benefit the programmer to avoid extreme positions and obtain a better program. Further we designed a setup for load cell to measure the weight of the cooked food. Fig 5.3 shows the load cell setup.

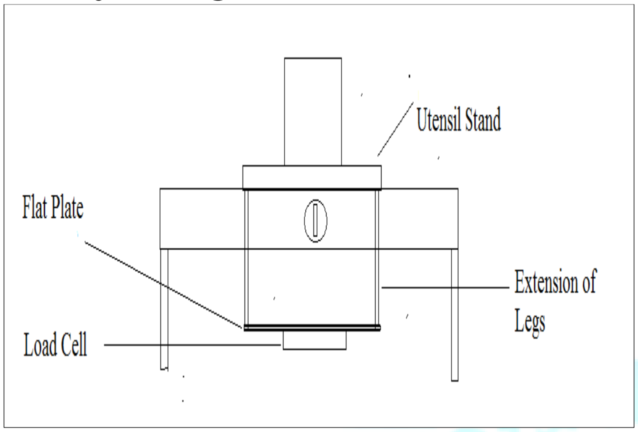

Fig 5.3 Load cell setup

The load cell is placed below the burner of the stove. The weight of the cooking food along with utensil is transferred through the utensil stand mounted on the extension legs connected to a flat plate at bottom and finally mounted on the load cell connected to a microcontroller. So as the weight varies the load cell sends the information to the microcontroller which activates the buzzer alarm and switches off the flame after sometime if not attended.

6. CONCLUSION

We can see that the *Smart Stove* not only saves the fuel but also provides comfort to the user while cooking. With the help of smart stove the cooking process is optimized. Also the smart stove is affordable for a common man since no high end high-tech equipment's are used.

Acknowledgment
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