PROJECT REPORT

Design and Simulation of Circuits and Embedded Systems

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Project Title: Induction Stove

Content

1. Introduction

This project is carried out in the second module of Internship. The second module is embedded module. So the project carried out in this project is based on embedded systems. Initially a case study was conducted on two embedded products :

1) Complex embedded system: Induction Stove and

2) Simple embedded system: Automatic Fan

Among these two one is selected as project and implementation is carried out.The complex embedded system that is induction stove is selected as the project topic and the further implementation and test phases are carried out.

1.1. Description

Basic working idea of induction stove:

The Induction Stove\cooktop consists of a surface(usually made of glass), under which there is a coiled metal induction element. A magnetic field is created as electricity flows into the coils. Within this field the cook wares are placed, these ferromagnetic cookware functions as the second conductor, and a current is produced onto it. This generates the Eddy currents within the cookware, which has its own magnetic field. This in turn opposes the induction element's currents. Energy produced by the opposing magnetic fields is released in the form of heat within the cookware (or vessel), due to this the contents in the cookware also gets heated. When the the power button of induction stove is switched ON, it should just blink untill a vessel is placed on it , Once the vessel is placed it should display the options like: Fry, Water, Milk, Pan etc. Once the user chooses the option it should show the heat reading. For some option there is fix heat reading and for some the user can increase or decrease it. The temperature is also measured and displayed to user. There is also an option for timer settings.

Fig 1. Induction Stove

2. Requirements

2.1 High Level Requirements

* Shall take input from the user based on Cooking Options.

* Shall Detected Vessel(whether placed on stove or not).

* Shall Producing enough amount of heat to cook.

* Shall take the Input from user

* Shall have a cooling circuit.

2.2 Low Level Requirements

* Shall display the user option on Led/lcd Display.

* Shall provide heat changing option.

* Shall provide time changing option.

* Shall provide Temperature changing option.

2.3 SWOT Analysis

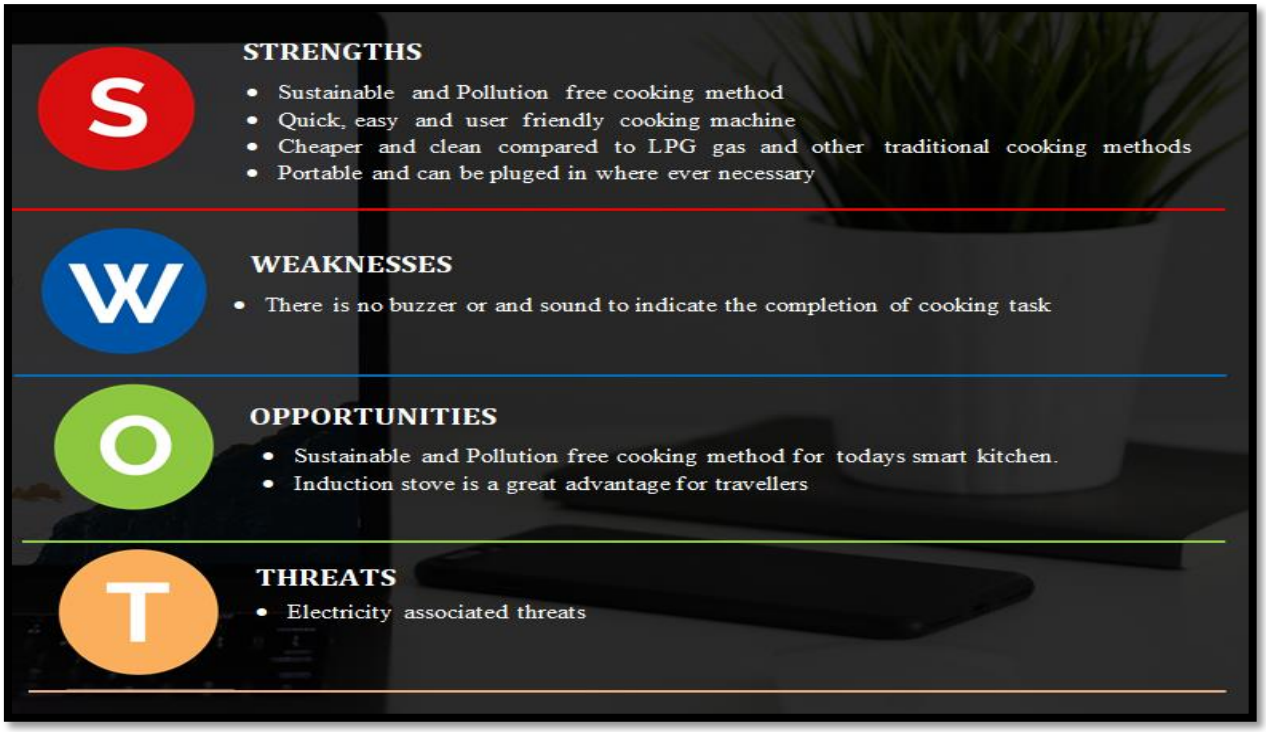


Fig 2. SWOT Analysis

2.4 . 4W's and 1H

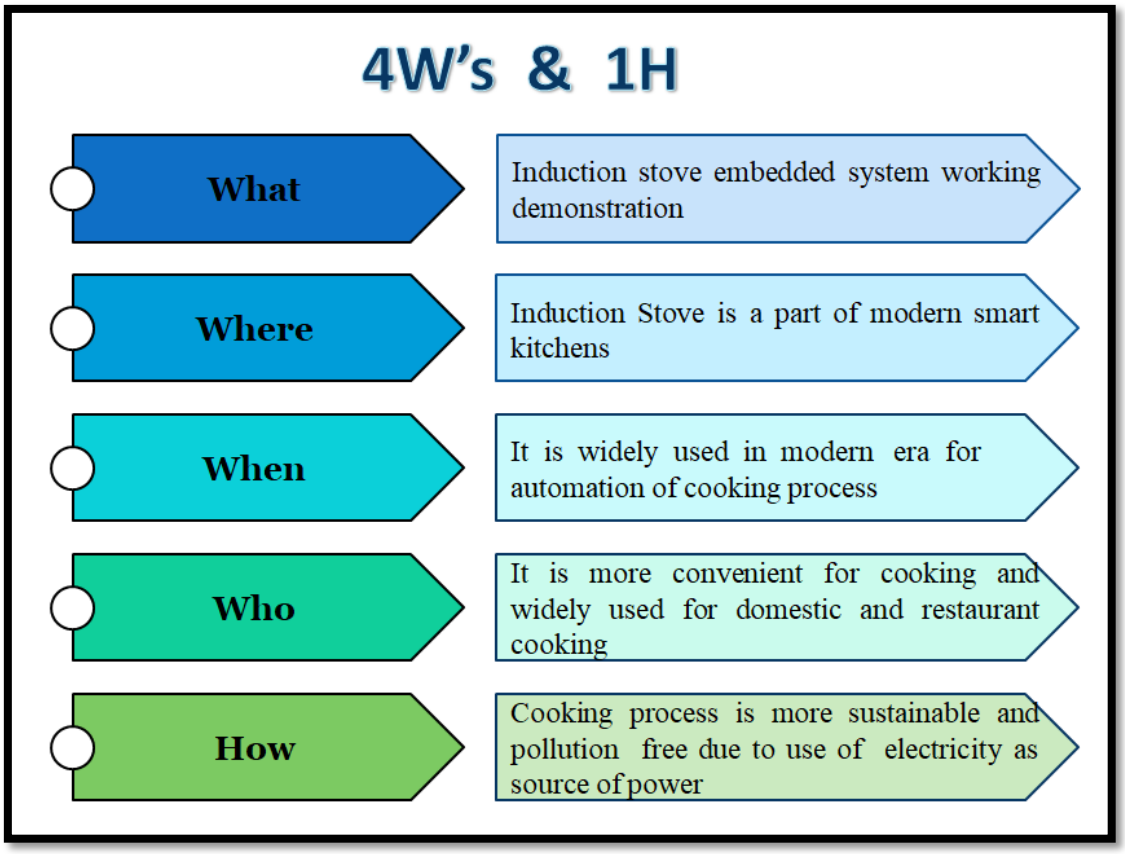


Fig 3. 4W and 1H

3. Architecture

3.1. V Model

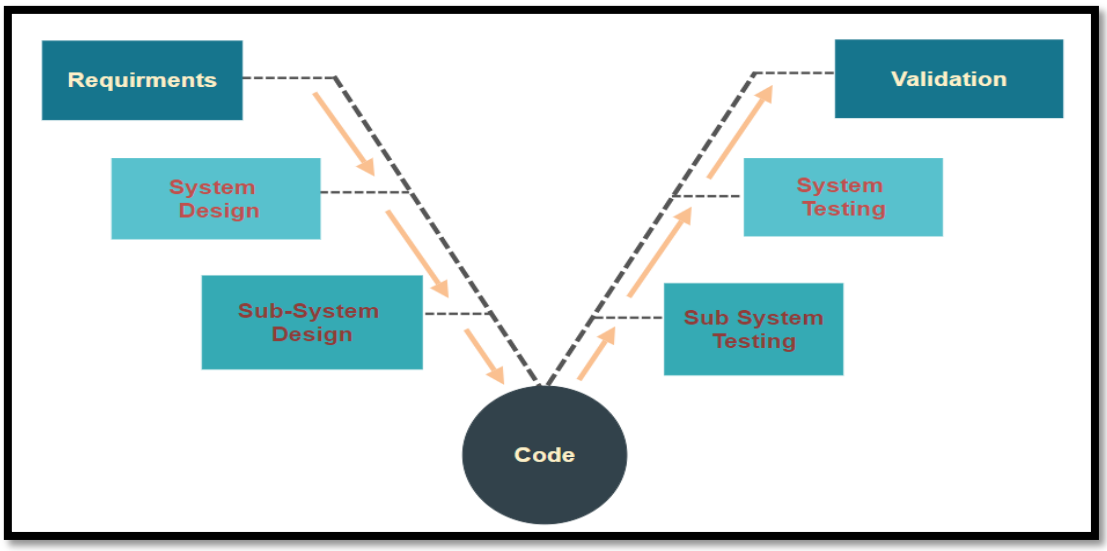


Fig 4. V Model

Requirements:

The primary step in any project/case study is to collect the user and market Requirements, which are used to build the objectives of the project

System Design:

This phase consists of block diagram, Flow chart, Behavioral diagram etc of the whole system. Here the entire Induction stove is designed.

Sub System Design:

In this phase each subsystems are designed and built

example: In this case study, Temperature sensor sub system, heat generation sub system, etc are designed and built

white box testing is also carried out in this stage.

Code:

During this phase code for different functionality is written and executed for the required application.

Sub System Testing:

Each of the subsystem is tested and the conclusion is drawn to check whether the subsystem is capable of working or not. Black Box test is carried out in this phase.

System Testing:

In this phase, all the susbsystems and codes are collaborated or integrated and test is carried out. If all the tests are passed then the system is sent for validation.

Validation:

The main objectives of the product (Induction Stove) are validated, that is all the high level and low level requirements are tested, if the product passes all these tests then it is ready for the market, else it is sent back for re examining

3.2. Block Diagram of embedded system in a Induction Stove(cook)

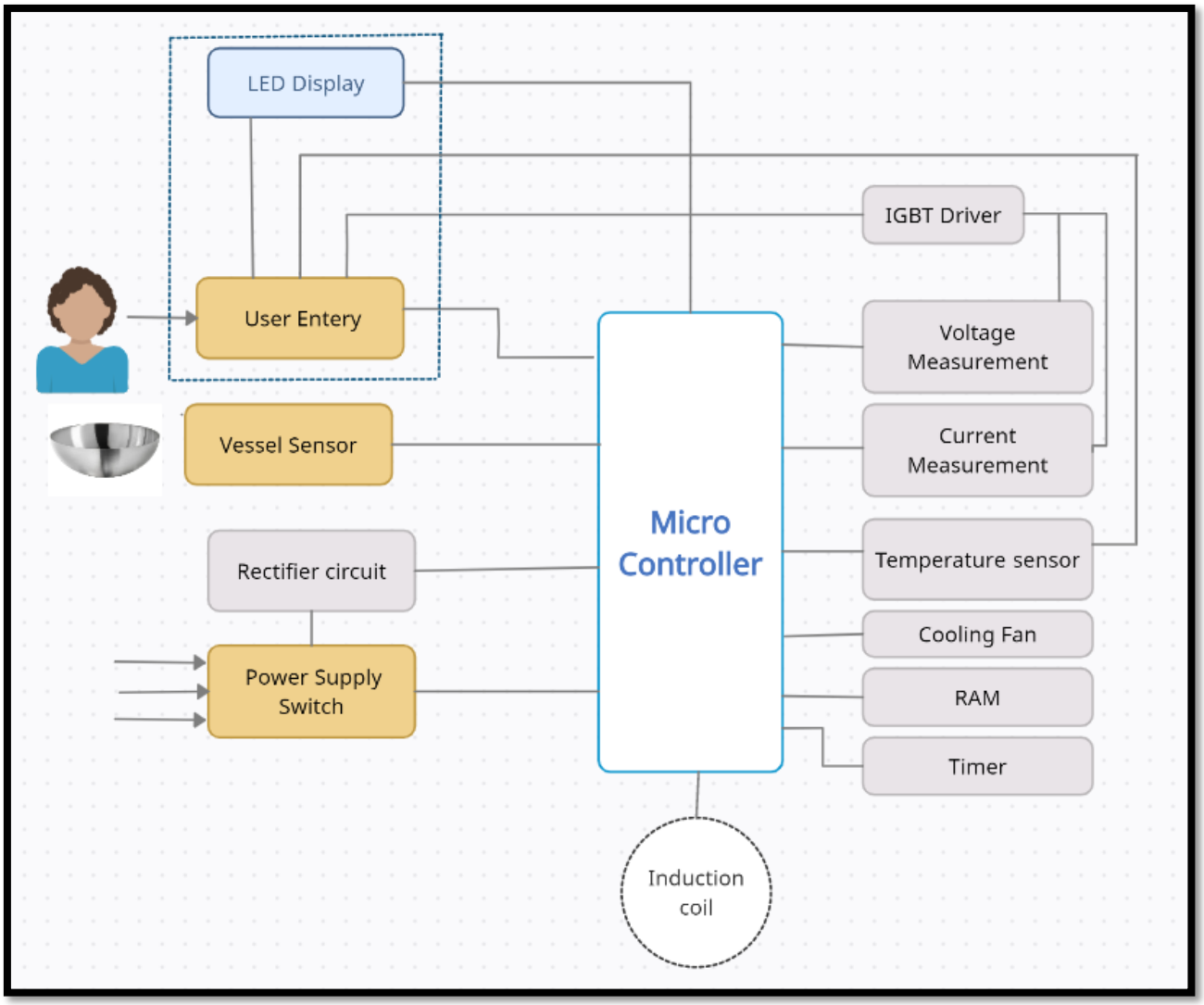


Fig 5. Block diagram

3.3. Sensors and Actuators used

Microcontroller :This is the heart of the system. Here it is the basic controlling block the system.

Power Supply switch : Used to get the input power in order to the run machine.

Rectifier circuit : Used for current conversion that is from AC to DC and Automatic voltage Regulator for limiting the possible radiation hazards

User entry block : It is used to take the input from the user with the help of touch sensor. example: commercially available induction stove\cook have the options like: pan, curry, milk, water, idly, tea etc. There are also some options to set the required time and to increase or decrease heat

LED Display : This is used to display the option selected by the user, the temperature or the timing.

Vessel Sensor : This is used to detect whether the vessel is placed on cooktop and the cookwares used are Induction friendly or not

Voltage and current measurement : This is done to check the level of input current and voltage in order to protect the device and for power control.

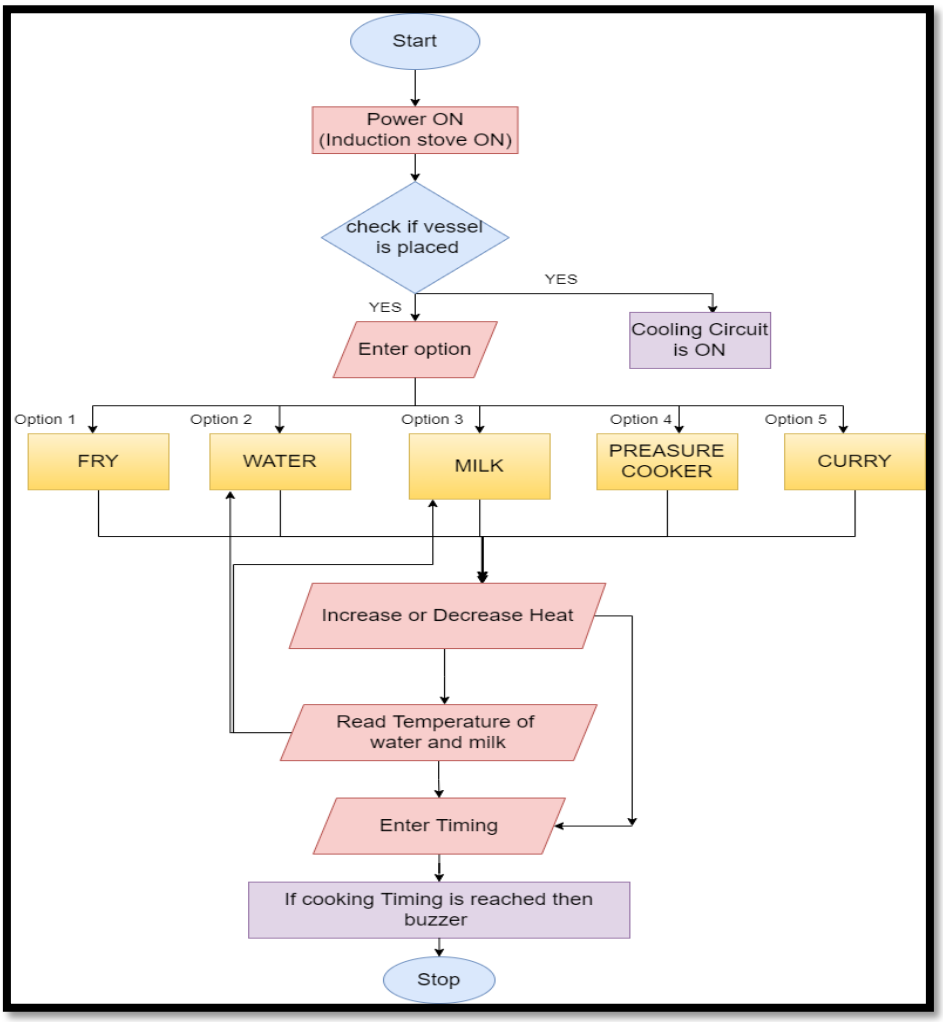
Temperature Sensor : Used to measure and set the temperature as per the option given by the user.

Cooling fan circuit : To reduce the heat that is produced while the machine is ON and to cool the devices placed inside.

Timer: Timers are used to set the timing as per the user's option.

Induction Coil : Use to produce the required heat

3.4. **Flow Chart**



Sensors and Actuators assumptions made

- . Microcontroller :This is the heart of the system. Here it is the basic controlling block the system. Ardunio is used as controller
- Power Supply switch : Used to get the input power in order to the run machine.
- User entry block : It is used to take the input from the user with the help of touch sensor. example: commercially available induction stove\cook have the options like: pan, curry, milk, water, idly, tea etc.There are also some options to set the required time and to increase or decrease heat. here push buttons or switchs are use to take user input insed of touch screen.
- LCD Display : This is used to display the option selected by the user, the temperature or the timing.
- Vessel Sensor : This is used to detect whether the vessel is placed on cooktop and the cookwares used are Induction friendly or not. A push button is used as vessel and an led is used to indicate that vessel is placed.
- Voltage and current measurement : This is done to check the level of input current and voltage in order to protect the device
- Temperature Sensor : Used to measure and set the temperature of water and milk. Here thermistor is used to measure temperature.
- Cooling fan circuit : To reduce the heat that is produced while the machine is ON and to cool the devices placed inside.In this project DC motor is used to indicate fan.
- Timer: Time input is given by user . This time is compared with inbuilt timer and if the entered time is matched then buzzer is ON.
- Induction Coil : Use to produce the required heat. Here Inductor is used as induction coil

4. Implementation:

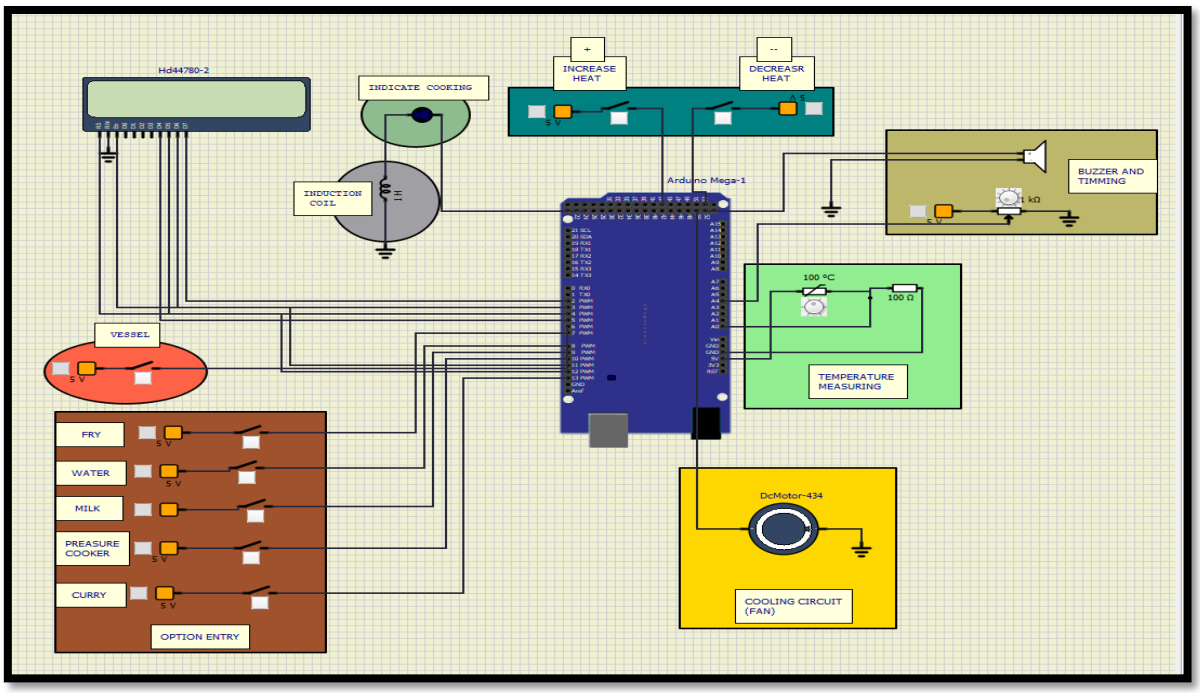


Fig 7. Implementation done in SimulIDE

5. Results

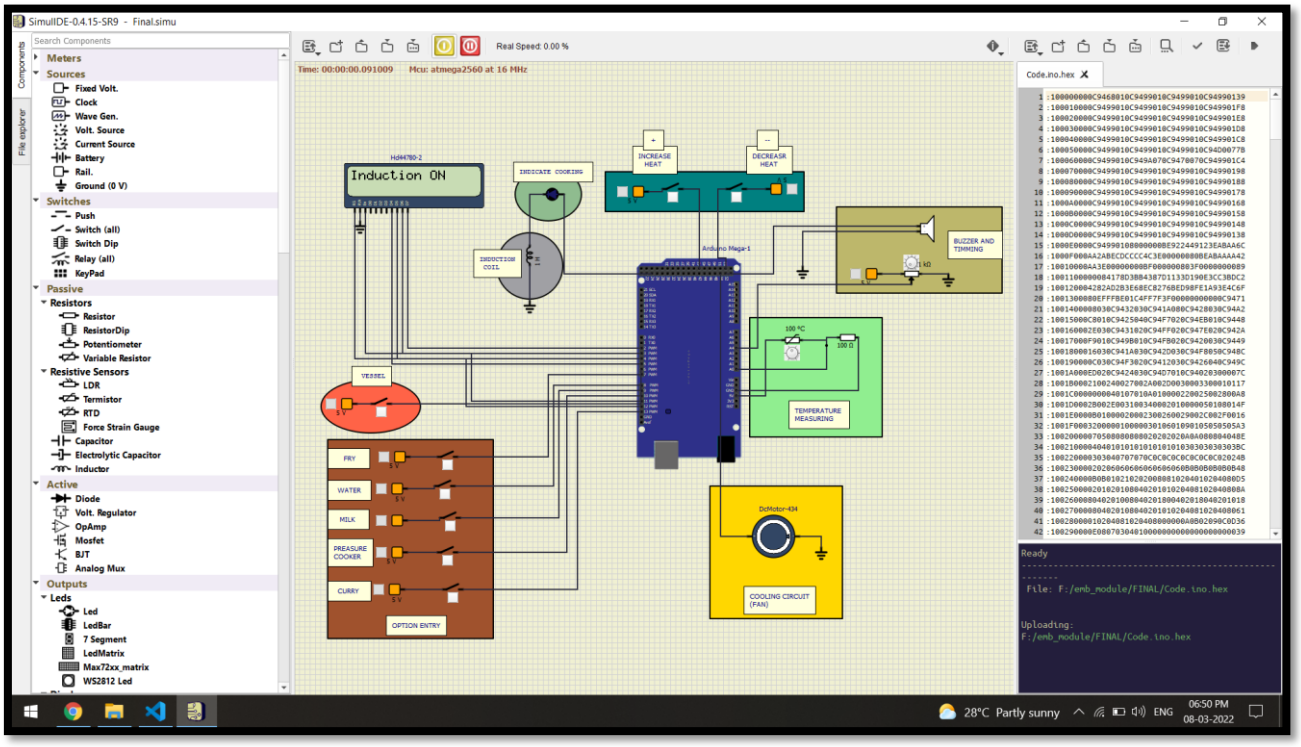


Fig 7. Induction ON : Display when power is switched ON

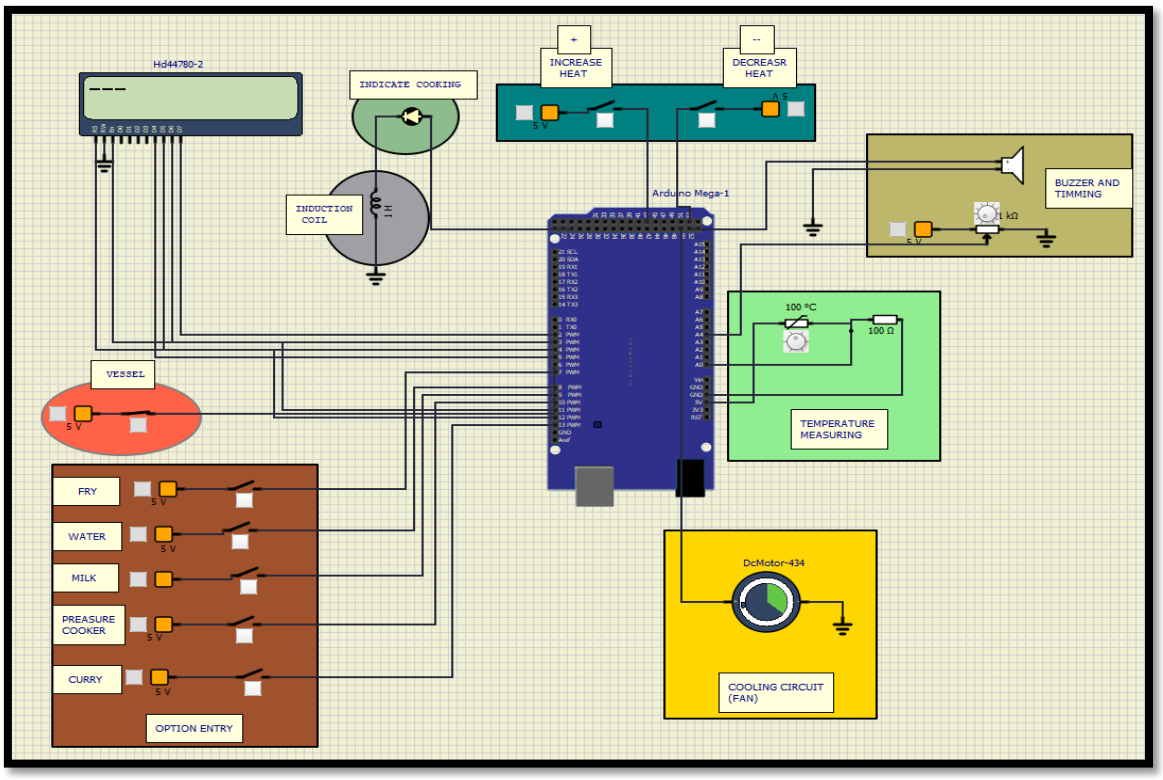


Fig 8. Result : LED ON

Image showing the result i.e when vessel is placed LED IS on and current is passed to Induction coil.

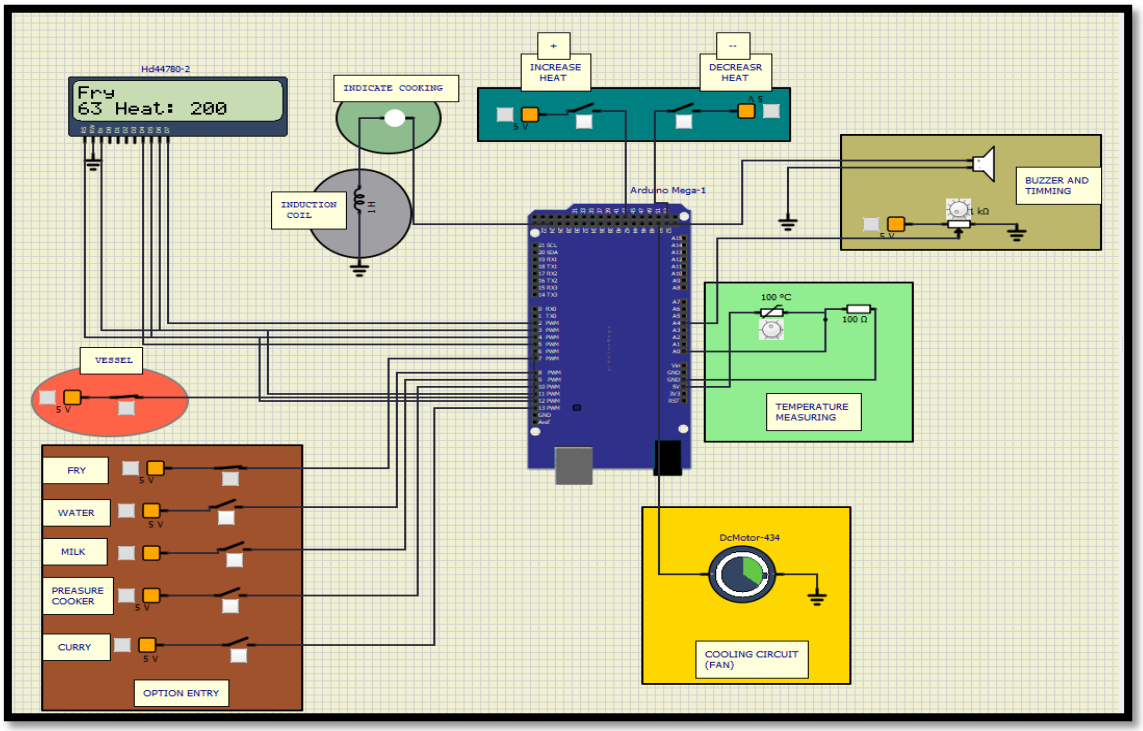


Fig 8. Result

This image shows the start of cooking process. Fry is the user entry given. The cooling circuit is also ON.

6. Test plan and Output

6.1 High level Test plan

Test ID	Description	i/p	Expected o/p	Actual o/p	Status
1	Power on	Run SimulIDE	Induction ON	Induction ON	pass
2	Detecting Vessel	Push button (vessel)	LED ON	LED ON	Pass
3	Cooling Circuit	Vessel Push Button ON	Rotation of DC motor	Rotation of DC motor	Pass
4	Take User entry	• FRY • WATER • MILK • PREASURE COOKER • CURRY	Display respective option	Displayed respective option	Pass
5	Display Heat And Timing	User entry	Display timing and heat	Displayed timing and heat	pass

6.2 Low level Test plan

Test ID	Description	Expected i/p	Expected o/p	Actual o/p	Status
1	Read temperature of milk and water	temperature	Temperature display	Temperature display	Passed
2	Time calculating	User entry time	Buzzer	buzzer	Passed
3	Exact LED Display when input is changed	Changes made	Changes display on LCD	Changes displayed on LCD	passed

Conclusion:

The conclusion drawn from this project is that , the complex embedded system that is induction stove is modeled and demonstrated with help of SimulIDE platform. The results are verified with requirements and the test cases are checked. Hence we can conclude that induction stove project is completed as per the set target.