ISSN No:-2456-2165

Microcontroller based Injera Making Machine (KMACK Smart Mitad)

Assefa Sefu G. Egzabher*
Adama Science and Technology University
School of Electrical Engineering and Computing
Electrical Power and Control Engineering Program
Adama, Ethiopia

Kaleab Temesgen
Adama Science and Technology University
School of Electrical Engineering and Computing
Electrical Power and Control Engineering Program
Adama, Ethiopia

Chalie Yirsaw
Adama Science and Technology University
School of Electrical Engineering and Computing
Electrical Power and Control Engineering Program
Adama, Ethiopia

Manaye Kerebin
Adama Science and Technology University
School of Electrical Engineering and Computing
Electrical Power and Control Engineering Program
Adama, Ethiopia

Kibryisfaw Adem
Adama Science and Technology University
School of Electrical Engineering and Computing
Electrical Power and Control Engineering Program
Adama, Ethiopia

Abstract:- **In Ethiopia one of the most famous food is Injera but its baking process is not efficient and effective with energy, size, quality and other feature. In this research we have designed Automatic Injera baking Mitad model which incorporates heater temperature, batter level and polishing material sensors to measure various monitoring parameters on Injera making process like temperature of heater, level of batter and monitors status of polishing materials and also used three different stepper motors. There is also an arrangement for displaying the temperature of the heater, level of batter, level of polishing materials and number of Injera baked on the LCD display. In this research PIC16F877A has been used for analyzing the inputs from the sensors and monitoring the system (baking process) to give an Injera by controlling the different baking stages to the delivery of baked Injera in protous because PIC16F877A controller is simple and effective to control and design our system. This research has been implemented using arduino software and arduino driver For home based Injera baking process, and our proposed machine can improved Energy efficiency, Economical cost, quality of Injera and also simplify life of people from the previous one by incorporating automatic polishing process, baking process systems, baked the same quality of Injera effectively and equally then to the delivery of the Injera process there by making it useful in home as a very efficient and dedicated Injera baking machine.**

Keywords:- *KMACK : our proposed Injera machine name; LM35: Temperature Sensor; LCD: Liquid Crystal Display; LED: Light Emitting Diode; PIC16F877A: Microcontroller; ULN2003A: Motor Driver; EL2073: Non-inverting op-amp; 2N1741: NPN Transistor; LM044L: 20x4 LCD Display.*

I. INTRODUCTION

For centuries Ethiopia, and perhaps even for millennia, women made *Injera* through a labor-intensive process that required them to pour the batter onto a hot clay *Mitad* one piece at a time, piece after piece, letting it cook for a few minutes, removing it, and then beginning the process all over again.

Injera is made using either of Teff, Corn, Sorghum and Millet or a mixture of two or three of these and is used as the staple food by most Ethiopians. in urban areas weight of Inijera about 300 to 450 grams. And also baked using clay plate of diameter 40-60 Cm called Mitad using either of biomass, fire wood, cow dung, leaves, saw dust and electrical power as source of Energy. [3]

Injera is traditionally prepared manually. And the process by which it is prepared usually involves three distinct steps. First, the hot baking surface upon which it is prepared is optionally polished with a non-stick applicator, so as to prevent the baked Injera from sticking to the baking surface. Second, the batter is rapidly poured onto the flat baking surface, so that the baking surface is fully covered with a thin layer of batter in a short amount of time. Third, after the Injera has baked a sufficient amount of time, it is removed onto a cooling pan. Cooling the Injera makes somewhat it easier to handle without risk of a tear and also makes it easier for the diner to enjoy.

Mitad is usually made of either clay or cast iron. Stove, on the other hand, is a piece of equipment for providing heat for cooking, baking etc.[8] Making *Injera* one piece at a time or even in a factory with 400 individual wood-burning ovens isn't very efficient, and it's destroying the Ethiopian environment. Ethiopia was once nearly 50 percent forest; now it's just 3 percent. But innovation and technology has slowly begun to change that: Now you can make *Injera* in mass quantities using automated devices that require far less human labor than the traditional way.[8] An Important Need: an Effective Automatic Injera Baking Machine is essential today because this longstanding manual process, by which countless cooks have prepared Injera, merits respect, but, unfortunately, it makes the preparation of this delicacy a time-consuming and labor-intensive process.[8]

Today there are different Injera making like Electric Injera Mitad, *Mirt Stove*, Revolving Mitad, WASS Mitad Grill, Zelealem Injera Machine and also others but each of them are their own advantage and drawback to solve the problem our proposed system are design by integrating the existence system and adding external feature.[7],[8]

II. OVERVIEW OF THE WHOLE SYSTEM

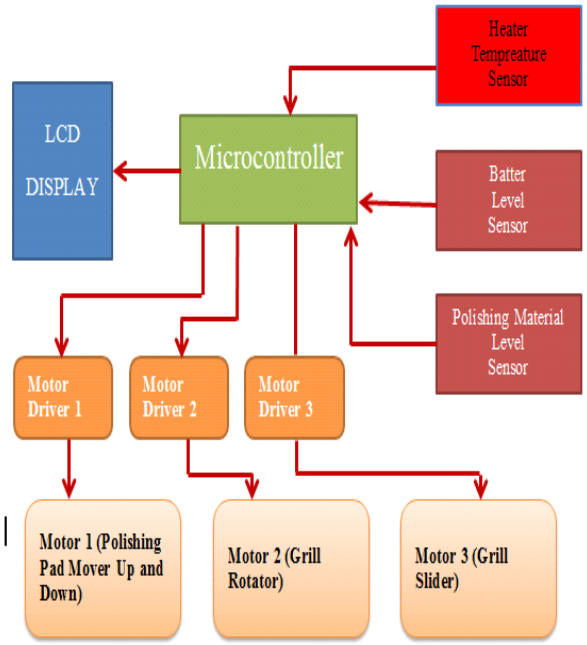

Fig.1:- Block diagram of our system

When the temperature exceed or falls below normal working range of values, when either level of batter or level of polishing materials falls below the preset level the microcontroller automatically send a signal to the user through LCD display then the baking process will be stopped by the user and after those preset conditions are reached the user start the machine and the baking process will proceed.

A. Overview of the Heater Temperature Monitoring System

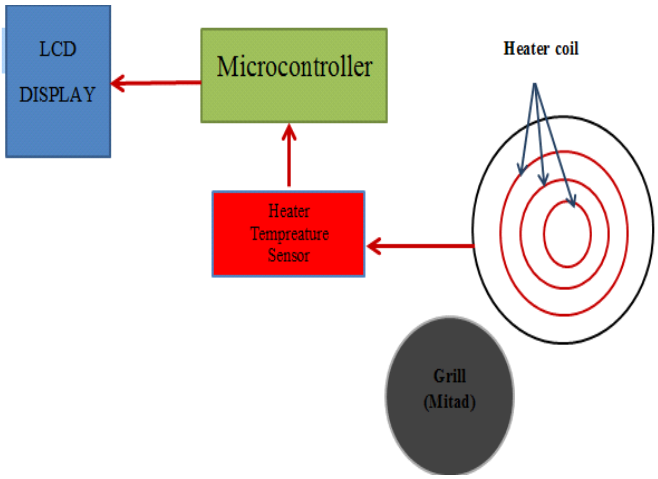

Fig.2:- Block diagram Heater Temperature Monitoring System

LM35 is used as heater temperature sensor. PIC16F877A Micro controller is used to convert analog signal from LM35 to its equivalent digital value by its analog input of the micro controller in - built ADC and then its equivalent degree Celsius value is calculated by the software. The calculated temperature value is displayed on the LCD.

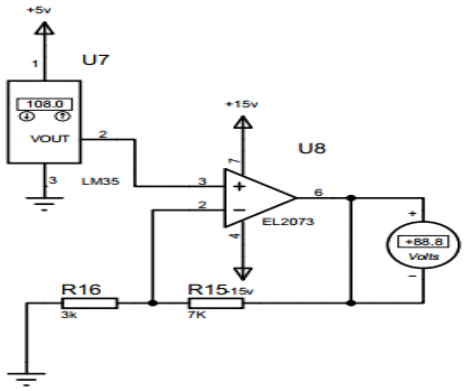

Fig.3:- LM35 connection with a non inverting amplifier

The voltage output for the non inverting amplifier

$$Vout = (1 + \frac{Rf}{Rin})Vin \quad (1)$$

$$Vout = (1 + \frac{7K}{3K})1.5V$$

$$Vout = 3.33333 * 1.5$$

$$Vout = 4.9998 \cong 5v$$

Calculation of Temperature Sensor:

V_{in}= (Temperature in degree Celsius) x 10 mv;

$$Vout = (1 + \frac{Rf}{Rin})Vin$$

X= (Vout/Vfullscale) x (2^10 - 1)

Example: For 29 ° C, Vin = 29 x 10 mv = 290 mv

$$Vout = (1 + \frac{Rf}{RIN})Vin$$

$$Vout = (1 + \frac{7K}{3K})0.29 = 0.9657$$

X= (0.9657v/5 v) x (2^10 – 1) = 197.58

In this research value of X has been divided by 204.6 and multiplied by 30 for matching internal ADC of PIC with LM35 temperature sensor. ADC is set to its default range 0 to 5 volt.

B. Overview of the Batter Level Monitoring System

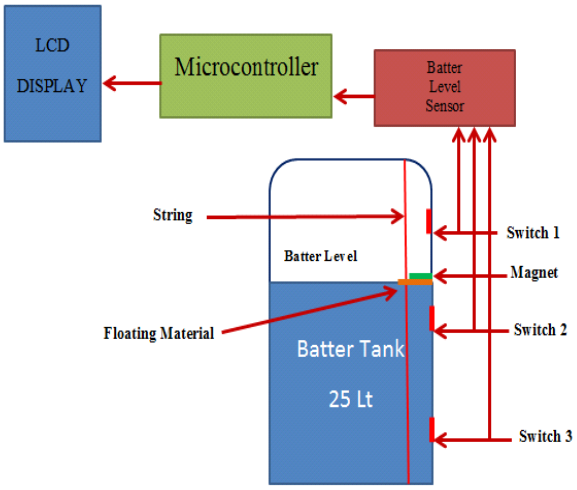

Fig.4:- Schematic diagram of Batter Level Monitoring System

The batter level monitoring system will control the batter level and keep the level between two predefined upper and lower positions.

Read switch-magnet arrangement is used as batter level sensor. Read switches are fixed on batter tank wall at desired positions, and magnet is fixed on a floating material sheet which floats in batter. The designing of sensor arrangement is shown above. When the floating material reaches predefined batter-levels the magnet and read switch come in contact and the read switch is activated and batter level is detected.

Whenever the level of batter falls below the preset level the microcontroller automatically send a data to the user and the user fills the batter tanker and the baking process will be stopped by the user when he receives the signal from the microcontroller. Then after the preset conditions are reached the user start the machine then the microcontroller starts the baking process automatically.

C. Overview of the Polishing material Level Monitoring System

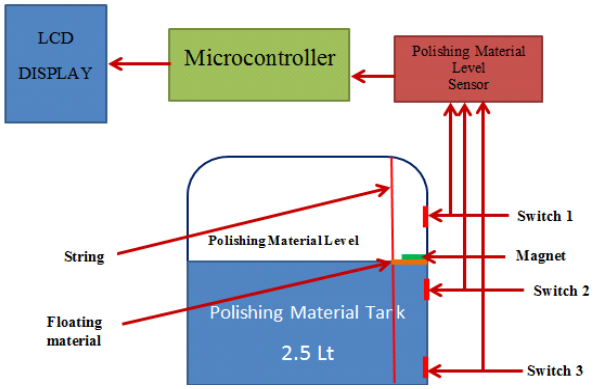

Fig.5:- Schematic diagram of polishing material Monitoring System

Its controller system is like Batter Level Monitoring System.

D. Grill Rotating Mechanism using Grill Rotator Motor

After the polishing pad mover starts to down the polishing pad from its original position to the grill the microcontroller automatically starts to rotate the grill in order to polish the grill with a Grill rotator motor.

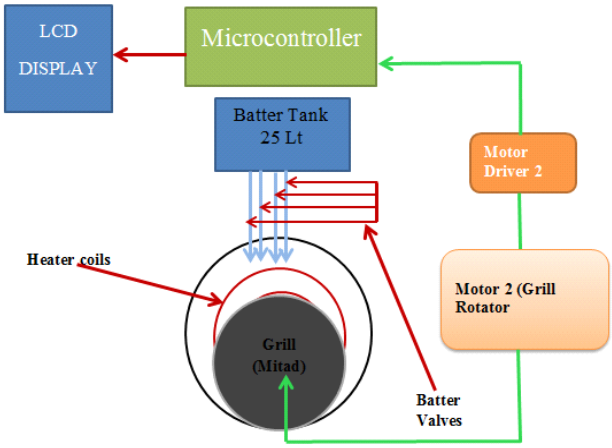

Fig.6:- Grill Rotating Mechanism using Grill Rotator Motor

We use same UN2003A driver which we used to the polishing pad mover motor to receive the signal to and from the motor and Microcontroller. When the grill rotator motor rotates one full cycle the polishing process has been done. After the polishing process finished the grill rotator motor stop rotation and waiting to the polishing pad mover motor rotates in the reverse direction to goes up the polishing pad to its original position.

Then after immediately the grill rotator motor rotates the grill and simultaneously the batter is poured on the grill through valves. The valves are positioned above the grill with its radius, so when the grill rotator motor rotates the grill, the grill is fully battered and baking process is started

now. The grill rotator stop rotation till the baking process is finished and the baked injera is delivered and the polishing pad mover starts to move down the polishing pad to the grill.

E. Injera Delivery Mechanism using Grill Slider Motor

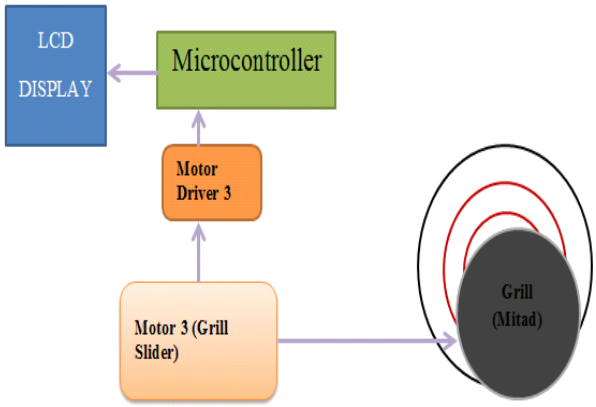

Fig.7. Injera Delivery Mechanism using Grill Slider Motor

After all, now it is time to get automatically baked injera. After all those above stages are Finished the grill slider motor slides the grill with the heater to the outside and delivers injera to the user. Stepper motor is also used as Grill slider motor.

When the grill slider motor drives the grill back to its position the microcontroller counts number of injera baked and it display on the LCD display. Then it goes back to the polishing phase and it repeats this cycle for the number of injera baked.

III. HARDWARE AND SOFTWARE IMPLEMENTATION

A. software implementation

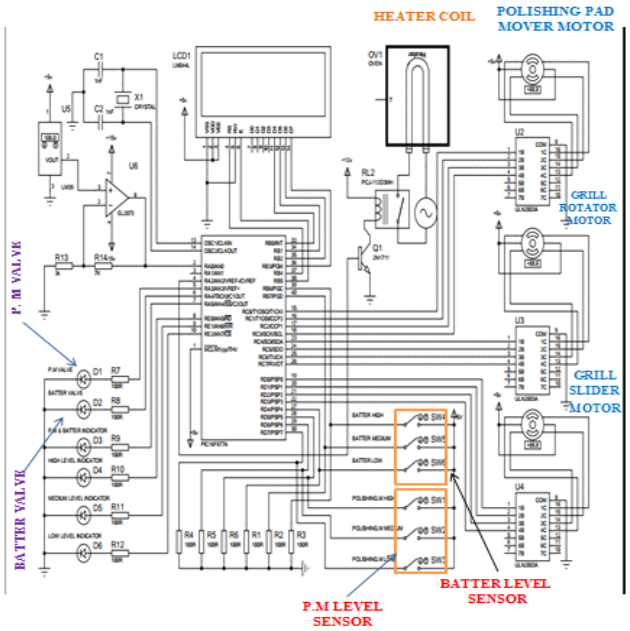

Fig.8:- Circuit of PIC 16F877A based Automated, Integrated and Digitized Injera making Machine

Above Figure shows the main circuit of PIC16F877A micro controller based Automated, Integrated and Digitized Injera making machine. The circuit mainly consists of the LM35 temperature ,level sensor ,stepper motor for baking process from polishing the grill to deliver the baked injera to the user, PIC16F877A micro controller, LCD, LED, Switches, Inverting input amplifier to amplify the voltage from the LM35 temperature sensor and give the amplified signal to the micro controller.

B. Hardware Implementation

This senior research has been implemented using arduino software and arduino driver due to we couldn't find the materials at the time when we are trying to design and implement the prototype of our proposed injera making machine called KMACK Machine.

Fig.9. Prototype of our Research Work at bread board

IV. CONCLUSION AND RECOMMENDATION

This Research which demonstrates an automated patient monitoring system has Making the baking process digitally controllable using microcontroller, Reduce electric power demand, energy consumption, electric network overloading, frequent power interruptions of electric injera Mitad, minimize the energy bill, thereby it would minimize individual energy bill per month, improves individual economy and have many multiplicative economic effects, It has low power consumption since the grill we proposed is made of cast iron rather than clay and the heating coil is induction coil rather than resistor coil. It is based on the principles of electromagnetic induction. In general efficiency labels and standards are a highly cost effective way to reduce future investments in expensive power plant construction, freeing capital for more economically advantageous investments in the energy sector, or basic health and educational services. We recommend that made PLC based is more efficient.

ACKNOWLEDGMENT

We are most thankful for the blessings obtained throughout this study. Our sincere thanks and appreciation are extended to our advisor Mr. Shimelis Demsie (MSc) for his support and continuous encouragement and advice they gave us. We are grateful also for our friends in campus for their support in completion of a task like this, we are sure we will overlook someone who had assisted us along the way which we didn't mention here, we would like to ask for your forgiveness.

REFERENCES

[1]. Embedded C Programming and Microchip PIC by Richard H. Barnett, Sarah Cox, Larry O'C,2003
[2]. "MicroprocessorArchitecture,Programi,and Applications with the 8085" by Ezana,N.and Van Buskirk, R.Electric Enjera Cooker (Mogogo) Efficiency
[3]. Research Report: Energy Research and Training Division Department of Energy Ministry of Energy, Mines and Water Resources P.O.Box5285 Asmara, Eritrea,October, 1996
[4]. PIC microcontroller programming in C by Milan Verle, February 20, 2013
[5]. Research Proposal and Implementation Plan"ENERGYEFFICIENT ELECTROMAGNETIC MITAD" By Dr.-Ing. Getahun Mekuria, General Manager Dellplatz Engineering Pvt. Ltd. Co. Addis Ababa, October 2009
[6]. Ramesh S. GaonkarBThe Dynamics of Electric Cookstove Adoption: Panel Data Evidence from Ethiopia. Yonas Alem, Sied Hassen, and Gunnar Köhlin (2013).
[7]. Wass Energy Efficient Temperature Controlled Injera Baking Machine
[8]. ZELFIWU Inc. Design forInjera Manufacturing System, Jun. 20, 2006