Enhanced Safety in Cooking: Microcontroller-based Single-Burner Electric Cooker with Buzzer

Akingbade Luisa.O

Lecturer, Department of Computer Enginering

The Federal Polytechnic, Ilaro.

Ogun state.

Abstract

Safety while cooking with an electric cooker means taking proper precaution and safety measures while making use of the burner. Cooking is fun but staying safe is a priority. Generally, there are hazards with electric cookers, many of which are as a result of electrical malfunctions. Electric cookers do not require gas, it is odorless and the cook-tops are often flat surfaces, making it easy for users to leave items sitting on them and forget about it, thereby creating a major fire hazard. In other to solve this problem efficiently, a system comprising of a push button keypad, buzzer, and automatic timer is connected to an 8 bit microcontroller ATmega328P. The microcontroller continuously monitors the keypad and if somebody enters a password it will check the entered password with the password stored in the memory and if they match then the microcontroller will switch on the corresponding device, otherwise it triggers the buzzer to create awareness when it is been wrongly accessed. Moreso, the sensitivity of the design is based on the fact that it will not allow any unauthorized person to gain access to the operation of the device. This system design is of low cost, durable, and reliable. After the completion of the design, the users can password, time and as well secure its cooker burner due to high sensitivity of the Microcontroller. Also, this design will be of benefit to individual, restaurants, hotels and other organizations

Keywords : Electric cooker, single burner, microcontroller, safety, password access

I. INTRODUCTION

According to (Richard V., 2001) An Electric cooker is an electric powered cooking device for heating and cooking of food. There will be knobs to determine the temperature of the stoves. Unlike gas stoves that are powered by gas, it is powered by electricity. Usually they have a plate which the pot can be placed for cooking. Timer hardware is a crucial component of most embedded systems. In some cases, a timer measures elapsed time. In others, we want to count or time external events. The timer can be used when talking about the hardware.

Microcontroller based secured electric single burner with buzzer is used in places where we need more security. The system comprises of a push button keypad connected to the 8bit microcontroller ATmega328P. This is one of the popular Microcontrollers. It has only 20 pins and there are 15 input/output lines. (Vincent S., 2008). In other to achieve the aim of the design, the construction was done with a Programmable Integrated Circuit which was programmed in other to allow only authorized persons to access the electric cooker by inputting password into the device. The microcontroller continuously monitors the keypad and if somebody enters a password it will check the entered password with the password stored in the memory and if they match then the microcontroller will switch on the corresponding device. If wrong password was inputted the device will reject it and trigger the buzzer to create an alert (Griffith E., 2006).

II. BACKGROUND INFORMATION OF THE STUDY

In this present age of digital technology, the concept of a digital revolution carries the ramifications of paradigm shift from traditional to new ways of doing thing in real time this has given rise to revolutionary trends that has orchestrated industrialization in the world today, and consequently improved the socio-economic, political and technological base of many countries and the world in general. Also, the recent technological advancement in management information systems and sharing of information across nations and amongst the international community has also reshaped our society to a great extent, this has no doubt been made possible by the efforts of various technologies advancements in micro-electronics, devices, machines and micro-controller-based systems with most at times computer interface which has yielded an information technology

society where a successful and dynamic relationship between engineering and societal needs. (Jacob Millan, 2006).

The world converted into a global village such that we are not only able to use the products of engineering, but also have been challenged to study about existing technologies with a view to creating our own idea with a view to solving contemporary problems.
This paper is aimed at enhancing security in cooking environments through a "microcontroller-based electric cooker single burner with buzzer". The system will allow access to the person who knows the password to switch on the burner and it will not allow access to unauthorized people.

This of course is an indispensable concept in industrial electronics. More so, The value of security to man is applicable to the facilities used by him. Most electric cookers in industrial settings are fortified with automation.

III. LITERATURE REVIEW

The first microcontroller was a 4 bits Intel 4004 released in 1971 with the Intel 8008 and other more capable microprocessors becoming available over the next several years. However, both processors required external chips to implement a working system raising at a total system cost and making it possible to economically computerize appliances. It combined read only memory, read/write memory, processor and lock on one chip and was targeted at an embedded systems. Most microcontrollers at this time had two variants; one had an erasable EPROM program memory with a transparent quartz window in the lid of the package to allow it to be erased by exposure to ultraviolent light while the other was a PROM variants which was only programmed once; sometimes this was signified with the designation OTP, standing for ' one time programmable' microcontroller. (Gray B. 2001).

In the late years the functionality of a digital/combination secured system is implemented in the software design as an access control that restricts unauthorized person to have access to various devices, such as computers, locks and cell phones (Smith S. 2003).

(Jacob M. 1999) emphasizes on digital computer code lock and it was said to have been designed as a security measure in an automobile. It can however be implemented for locking electronic

devices such as television set, computer system and other electrical appliances. The system consists of a hardware module and an application program for microcontroller units.

A programmable digits code lock system is a high security code lock system that can be used to lock electronic device such as television set, computer system, and other electrical appliances. In this design, the digital code lock was used as a security measure in an electric cooker. This system is a combination of hardware and software and at its best. In this design, a device is locked using a 4 digit code to lock up the device by allowing the gas valve to be in off state whenever any wrong code is entered and allows the users to start it only when a proper four digits code are entered in the correct sequences.(Martin. P. B. 2009).

Coded lock are also called magnetic locks, an electronic lock is a locking devices which operates by means of electric current. Electric locks are sometimes standing alone with an electronic control assembly mounted directly to the lock. Most often electric locks are connected to an access control system. The advantages of an electric lock connected to an access control system including the keypad control where keys can be added and removed without re-keying the lock cylinder; fine access control where time and place are factored and transaction logging where activity is recorded. Electric locks use magnets, solenoids, or motors to activate the lock by either supplying or removing power. (Mehta T.K. 2003).

A. Microcontrollers

(Gary Brone, 2001) The first microprocessor was the 4 bit Intel 4004 released in 1971, with the Intel 8008 and other more capable microprocessors becoming available over the next several years. However, both processors required external chips to implement a working system raising total system cost, and making it impossible to economically computerize appliances. The Smith Sonian institution says T I engineers Gary Brone and Michael Cochran succeeded in creating the first microcontroller in 1971. The result of their work was the TMS 1000, which became commercially available in 1974. It combined read-only memory, read/write memory, processor and clock on one chip and was targeted at embedded system.

(Rak, J. 2000) Partly in response to the existence of the single chip TMS 1000, Intel developed a computer system on a chip optimized for control applications, the Intel 8048, with commercial parts first shipping in 1977. It combined RAM and ROM on the same chip. This chip would find

its way into over one billion P.C keyboards, and other numerous applications. At that time Intel's president, Luke J. Valenter, stated that the microcontroller was one of the most successful in the company's history, and expanded the division' s budget over 25%. Most microcontrollers at this time had two variants. One had an erasable EPROM program memory, with a transparent quartz window in the lid of the package to allow it to be erased by exposure to ultraviolet light. The other was a PROM variant which was only programmed once; sometimes this was signified with the designation OTP, standing for 'one time programmable'.

The PROM was actually exactly the same type of memory as the EPROM, but because there was no way to expose it to ultraviolet light, it could not be erased. The erasable version required ceramic packages with quartz windows making them significantly more expensive than the OTP versions, which could be made in lower cost opaque plastic packages. For the erasable variant, quartz was required instead of less expensive glass, for its transparency to ultraviolet- glass is largely opaque to UV but the main cost differentiator was the ceramic package itself.

B. Buzzer

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers and confirmation of user input such as a mouse click or keystroke. (Definition of a Buzzer by the Free Dictionary).

C. History of Buzzer

The first electric buzzer was invented in 1831 by Joseph Henry. They were mainly used in early doorbells until they were phased put in early 1930's in favor of musical chimes which had a softer tone.

Piezoelectric buzzers, or Piezo buzzers as they are sometimes called, were invented by Japanese manufacturers and fitted into a wide array of products during the 1970s to 1980s, this advancement mainly came about because of cooperative efforts by Japanese manufacturing companies. In 1951 they established the Barium Titanate Application Research Committee, which allowed the companies to be "competitively cooperative" and bring about several piezoelectric innovations and inventions.

D. Types of Buzzers

i. Electromechanical

Early devices were based on an electromechanical system to an electric bell without the metal gong. Similarly, a relay may be connected to interrupt its own actuating current, causing the contacts to buzz. Often these units were anchored to a wall or ceiling to use it as a sounding board. The word “buzzer” comes from the rasping noise that electromechanical buzzes made.

ii. Piezoelectric Disk Beeper

A piezoelectric element may be driven by an oscillating electronic circuit or other audio signal source, driven with piezoelectric audio amplifier. Sounds commonly used to indicate that a button has been pressed are click, a ring and beep

IV. METHODOLOGY

The design and construction of an Electric cooker with single burner, buzzer, password access and automatic switch was done following electrical rules and regulations which required programming of PIC in other for only authorized users have access to the burner cooker and automatically switched off when the set time elapsed.

A. Design Analysis

In this project, the microcontroller is programmed to activate output that powers mains appliances when the correct code has been entered on the keyboard. The code consists four digits which range from 0 to 9.

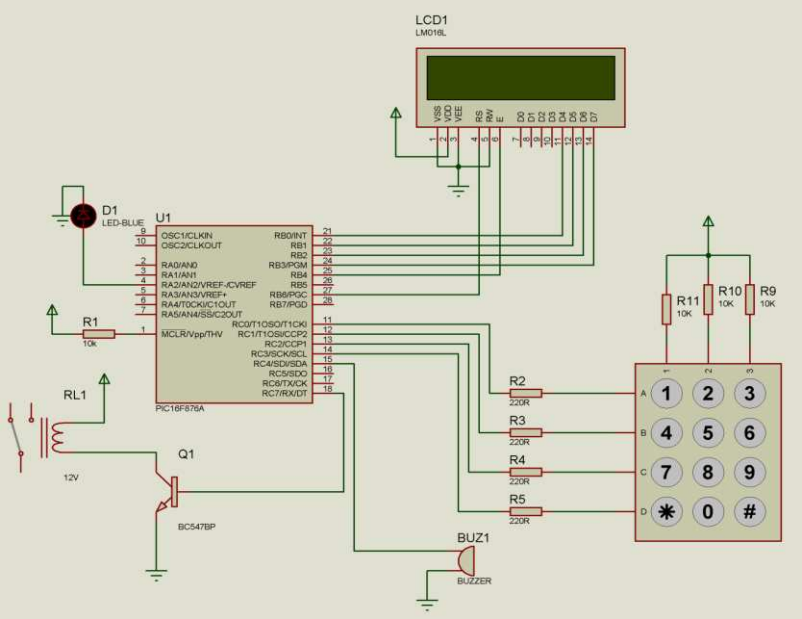

Figure 1: Circuit Diagram for the constructed project

B. Selection of Materials

i. PIC Microcontrollers

PIC is a family of microcontrollers made by Microchip Technology. The original one was the PIC1650 developed by General Instruments. This device was called PIC for "Programmable Intelligent Computer" although it is now associated with "Programmable Interface Controller." Microchip does not use PIC as an acronym. Instead they prefer the brand name PICmicro. Popular wisdom relates that PIC is a registered brand in Germany and Microchip is unable to use it internationally.

The original PIC was built to be used with General Instruments' CP1600 processor, which had poor I/O performance. The PIC was designed to take over the I/O tasks for the CPU, thus improving performance. In 1985, the PIC was upgraded with EPROM to produce a programmable controller. Today, a huge variety of PICs are available with many different on-board peripherals and program memories ranging from a few hundred words to 32K.

PICs use an instruction set that varies in length from about 35 instructions for the low-end PICs to more than 70 for the high-end devices. The *accumulator*, which is known as the *work register* in PIC documentation, is part of many instructions since the PIC contains no other internal registers

accessible to the programmer. The PICs are programmable in their native Assembly Language, which is straightforward and not difficult to learn. In addition, C language and BASIC compilers have been developed for the PIC. Open-source Pascal, JAL, and Forth compilers are also available for PIC programming.

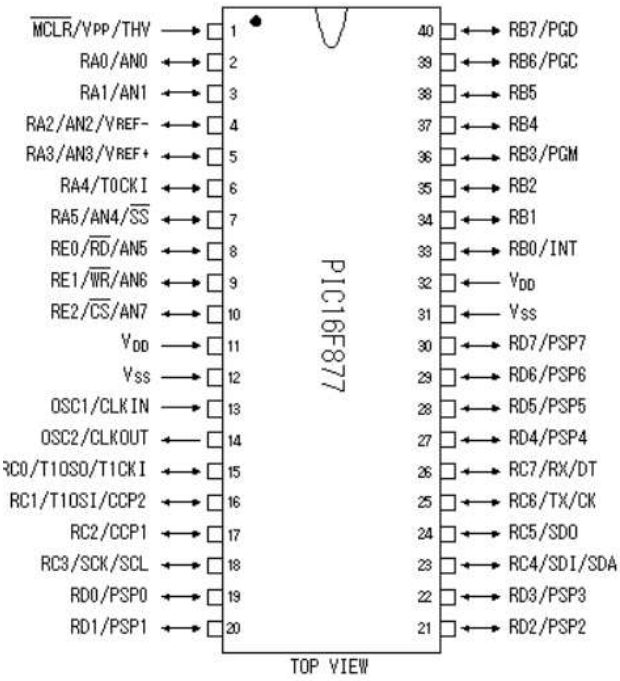

Figure 2: Diagram of PIC microcontroller and the pin outs.

PIC microcontrollers use TTL logic, and therefore expect a well-regulated 5V power supply. The supply may however range from 3.5V to 5.5V. These microcontrollers require very small amount of current. Indeed, these devices have been labelled as nano-watt technology devices. The logical

Levels are also same, a signal from 0 to about 2V is considered as logical '0' and a signal from 3.5V to 4.5V is considered as logical '1'. In order to communicate with devices using higher logical voltages, consider level conversion

ii. A liquid-crystal display (LCD)

Liquid is a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals. Liquid crystals do not emit light directly, instead using a backlight or reflector to produce images in colour or monochrome. LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images with low information

content, which can be displayed or hidden, such as preset words, digits, and 7-segmentdisplays, as in a digital clock. They use the same basic technology, except that arbitrary images are made up of a large number of small pixels, while other displays have larger elements.

LCDs are used in a wide range of applications including computer monitors, televisions, instrum ent panels, aircraft cockpit displays, and indoor and outdoor signage. Small LCD screens are common in portable consumer devices such as digital cameras, watches, calculators, and mobile telephones, including smartphones. LCD screens are also used on consumer electronics products such as DVD players, video game devices and clocks. LCD screens have replaced heavy, bulky cathode ray tube (CRT) displays in nearly all applications.

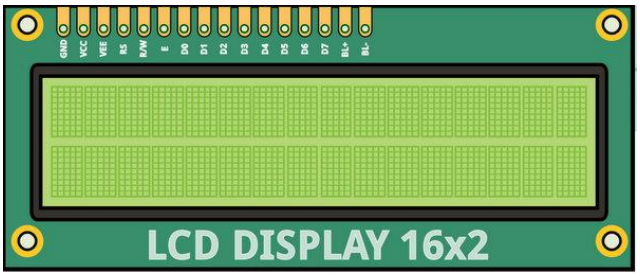

Figure 3: Liquid Crystal Display

iii. Transformer

A transformer is an electrical device that transfers electrical energy between two or more circuits through electromagnetic induction. A varying current in one coil of the transformer produces a varying magnetic field, which in turn induces a voltage in a second coil. Power can be transferred between the two coils through the magnetic field, without a metallic connection between the two circuits. The alternating current through the winding produces a continually changing flux or alternating flux that surrounds the winding. If any other winding is brought nearer to the previous one, obviously some portion of this flux will link with the second. As this flux is continually changing in its amplitude and direction, there must be a change in flux linkage in the second winding or coil. According to Faraday's law of electromagnetic induction, there must be an EMF induced in the second. If the circuit of the later winding is closed, there must be an current flowing through it. This is the simplest form of electrical power transformer and this is the most basic of working principle of transformer.

Figure 4: Transformer

iv. Rectifier

A rectifier is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), which flows in only one direction. The process is known as rectification, since it "straightens" the direction of current. Physically, rectifiers take a number of forms, including vacuum tube diodes, mercury-arc valves, copper and selenium oxide rectifiers, semiconductor diodes, silicon-controlled rectifiers and other silicon-based semiconductor switches.

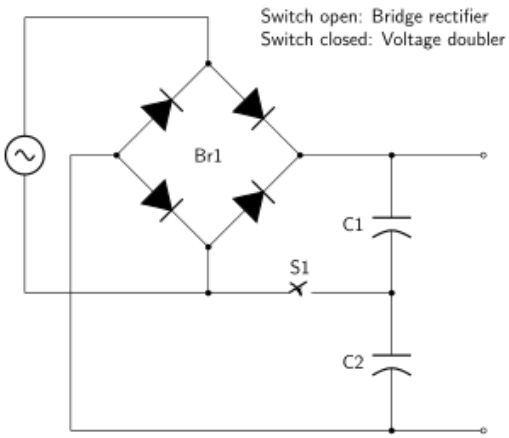

Figure 5: Rectifier

v. Capacitor

A capacitor is a passive two-terminal electrical component that stores electrical energy in an electric field. The effect of a capacitor is known as capacitance. While capacitance exists between any two electrical conductors of a circuit in sufficiently close proximity, a capacitor is specifically

designed to provide and enhance this effect for a variety of practical applications by consideration of size, shape, and positioning of closely spaced conductors, and the intervening dielectric material. A capacitor was therefore historically first known as an electric condenser.

The physical form and construction of practical capacitors vary widely and many capacitor types are in common use. Most capacitors contain at least two electrical conductors often in the form of metallic plates or surfaces separated by a dielectric medium. A conductor may be a foil, thin film, sintered bead of metal, or an electrolyte. The nonconducting dielectric acts to increase the capacitor's charge capacity. Materials commonly used as dielectrics include glass, ceramic, plastic film, paper, mica, and oxide layers. Capacitors are widely used as parts of electrical circuits in many common electrical devices. Unlike a resistor, an ideal capacitor does not dissipate energy.

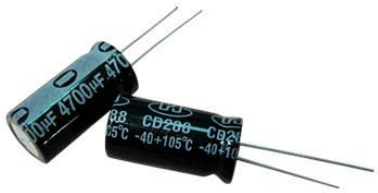

Figure 6: Capacitor

C. Construction Procedure

In designing this project, microcontroller PIC 16F676A is programmed to activate the relay switch which was connected to the electric cooker. This code consists of ten digits in the range of 0 to 9. The LCD screen serves as the output device that displays the operation of the system. The codes to be entered shows on the screen of the display. The code to power the gas is 2580, when this code is entered into the circuit, the time can be set to the desired range either minutes or seconds. In order to set the time the user will press 8 on the key pad after the correct password has being entered, the * key is used for increasing the time of operation of the burner while 1 can be pressed to reduce the time of operation of the burner. In other to pause the burner operation the user can press 5 on the keypad, this will pause the operation of the burner for some time.

V. RESULT AND DISCUSSION

A. Performance Test

Testing of the construction of automatic timer with one burner, cooker password access and automatic switch was done after the completion of the project, the program section of the construction was tested by inputting four digit number which has already being programmed on the microcontroller, the password which was 2580 when inputted into the programming section of the construction, it was accepted by the construction. If wrong access was made, the solenoid value will not open, so the gas will not follow through.

The diagram below shows how the password was inputted into the programming section.

Figure 7: Time set for the burner to operate

Figure 8: 2580 Code inputted into the control circuit.

B. ***Presentation of Result***

After the construction and the testing of was done, the result indicates that the codes being programmed, the result indicates that the codes was correct and match the construction.

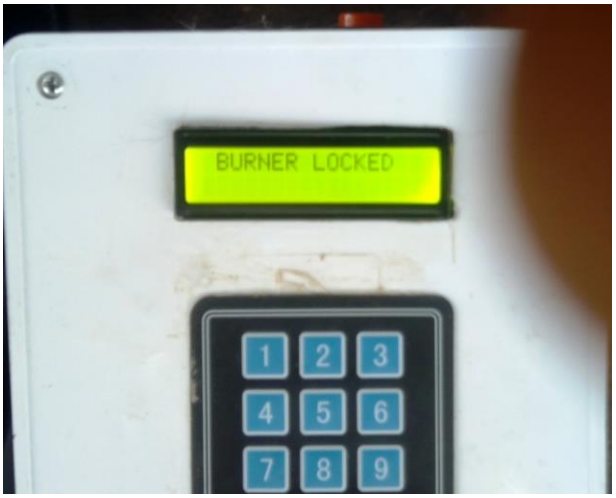

Figure 9: Code locked immediately after time inputted lapsed

Figure 10: Code inputted and accepted

C. ***Discussion of Results***

Construction of an automatic timer with one burner, cooker password access and automatic switch was achieved from all stages. The power stage which was a 9v was able to power all the circuit, the construction was programmed through a microcontroller, the controller was programmed in other to control the electric cooker, when the password was inpute into the system it accepted the

password which was 2580. The timer was set to various ranges of time in other to determine if the timing of the device was correct. It was set to 30mins and after the time lapses the cooker was looked. Until another time was input to the system.

VI. CONCLUSION AND RECOMMENDATION

A. *Conclusion*

The construction of Electric cooker with single burner, buzzer, password access and automatic switch was constructed considering some factors such as economic application, design economy, availability of components and research materials, efficiency, compatibility and portability and also durability. The design has enlighten me more on how programming of circuit can be made related to the circuit itself. The constructed project has assisted me in relating theoretical knowledge taught in school to practical knowledge.

B. *Recommendations.*

For the purpose of the future research, this project work can be improved upon. The following areas were highlighted for this purpose.

1. The construction showed be improved upon in other to allow it operate on other means such as cylinder gas.
2. A higher scale programmable controller system such as Adriano can be used so that other minimizes stress that one can undergo when soldering.
3. Moreover, it is recommended that individuals should be enlightened on new areas of technology that are yet to be addressed in order to bring solution to the various problems faced by man in his day to day activities.

REFERENCES

Aldridge J. (2001). 'A textbook on Appliance timer coding' coding of controller system :Fairfield, China, p. 4-10.

Bosch BSH. and Siemens H. (2008). 'operator control for domestic appliances and method for operating a display unit', Fifth International Conference on Technology: New Generations, Shangai, China, p. 25-33.

Gray Brone and Micheal Cochran (2001). 'A textbook on History of Electrical Device': Library of Engineering and Technology, England. P. 65-80.

Griffith, E. (2010). "Burner Accounts 101": How to Get Extra Numbers for Your Smartphone". PC Magazine. P. 112-115

Jacob Millman (2006). "A textbook on Microelectronics": Mcgraw-hillbook company New York. P. 56-60.

Mehta T.K. (2003). "A textbook on Principle of electronics", 5th edition,: Macmillan India ltd, India. P. 33-37.

Martin V.K. (2009). "A textbook on Principles Of Electronics": S.Chand & company ltd. Beijing, China. P. 117-205.

Rak, J (2000). "Safety device for electric cooking Stove, Berkeley Med. C Issues". Proceedings of 3rd International Conference on computer science. United Kingdom. P. 47-52.

Richard Vereker (2001). "Timer with resettable alarm and automatic turn – off; auto – alarm selector", PC Magazine. P. 34-40.

Robert Boylestad (2012). "Real clock and calendar operation", (Eighth edition): Prince-hall. Hongkong, Japan.

Smith S. (2003). "Digital time and calendar Device Operation": Havard University, England. P. 56.

Vincent Sellecchia (2008). "Stove knob timer device, intelligent timer system with alarm system". Journals of Technology, vol.4, no. 5, p. 67-72.