Smart Kitchen: Automated Cooker Technique Using IoT

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(Received Jan. 29, 2018; revised and accepted June 1, 2018)

Abstract

Catering companies around the world suffering from wasting food during cooking it because of a large number of meals preparing at the same time so that the Chef can forget them on the Cooker during preparing another one. The paper discusses the design, implementation, and evaluation of an embedded system using (IoT) technology for improving the control of cooking time of "Basmatio" restaurant in the city of Cairo, Egypt. This system allows the chef to choose between different timers for different meals and all timers can work in parallel which will save a lot of food losses and unnecessary employees, and this system will be an embedded system using avr-atmeg32.

Keywords: Automated Cooker; IoT; Smart Kitchen

1 Introduction

We are living in the Internet of Things (IoT) era. According to the prediction of the International Data Corporation [4], the global IoT market will grow from $655.8 billion in 2014 to 1.7$ trillion in 2020 with an annual growth rate of 16.9% [4, 6, 16].

The Internet of Things (IoT) plays a remarkable role in all aspects of our daily lives (See Figure 1). It covers many fields including healthcare, automobiles, entertainments, industrial appliances, sports, homes, etc. The pervasiveness of IoT eases some everyday activities, enriches the way people interact with the environment and surroundings, and augments our social interactions with other people and objects [**?**, 12, 21–23]. Developing applications for the IoT could be a challenging task due to several reasons:

1) The high complexity of distributed computing;
2) The lack of general guidelines or frameworks that handle low level communication and simplify high level implementation;
3) Multiple programming languages;
4) Various communication protocols.

It involves developers to manage the infrastructure and handle both software and hardware layers along with preserving all functional and non-functional software requirements [7, 8, 10, 11, 14, 15]. We proposed to design and construction of an embedded system in a kitchen cooker, its interfaced with an Atmega 32 microcontroller programmed in C language.

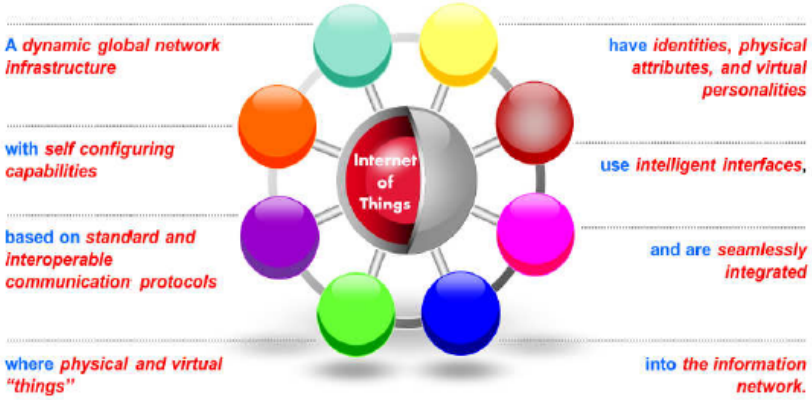

Figure 1: Internet of Things

1.1 Background to IoT

The IoT was envisioned in Mark Weisner's seminal paper on ubiquitous computing in 1991, "The computer of the 21st Century" [9]. However the term "The Internet of Things" wasn't used until 1999 by Kevin Ashton [20] who was working on networked Radio Frequency Identification (RFID) devices. Since then developments in communications and networking technology have fuelled an exponential growth in this area with IoT forecasted to soon become the largest global market sector [5].

Whilst there is concern over data security and intrusion into people's daily routines [18], these connected appliances offer many potentially helpful services, such as food management in the kitchen, remote heating control and health monitoring.

1.2 Role of IoT in Smart Kitchens

There is lot of promotion surrounding the IoT. The basic idea connects objects we use every day to the internet and each other allowing them to communicate in a novel way and make life easier. Many companies are making ventures into the field with internet connected kitchen appliances, clothing, home security systems. The implications of IoT in food industry more specifically making improvements in food safety are highly appreciable. The advancement in Wireless technology and cloud computing the IoT has the potential to make food more safer from the farm to the consumers dinner plate.

The smart kitchen is installed with all computing system to exhibit smart behavior based on sensors, actuators and interactive devices that are built in or embedded within the household articles such as dinning set, refrigerators, cooking range, coffee machine, oven, sink and so on. The integral components of the computing system will sense and model contextual information and apply it for providing smart services for a chosen application. Many other researchers who are recognized in literature on IoT applications such as [1–3, 17] studied the important of IoT application in our life.

2 Related Works

Numerous studies have attempted to explain and discuss smart kitchens with various approaches and methods. Shivaranjini S. Mogali [13] highlights the various aspects of IoT and its role in smart kitchen.

The different technologies such as RFID, WSN, Cloud Computing, Networking Technology and Nanotechnology that support the IoT, and their applications in various fields i.e Smart home, Smart City, Smart Grid, Smart Health and Smart Farming, and she found, and how IoT is significant because it could open new avenues of research and learning. Of course it raises serious concern about privacy, security and data owernership. The different applications of IoT in Kitchen ranks the highest when compared with other domains. Perhaps it may be due to the hi-fi living style and advancement of the applied technology in every walk of life. Ultimately the smooth functioning of the devices and the knowledge for their operation are essential to achieve the expected results. Otherwise the traditional cookware can only save us.

Shirsath *et al.* [17] aimed to design and construction of an SMS based Gas Leakage Alert System to reduce the risks in Kitchen if there is leakage in gas cylinder using Internet of Thing, and thereby leads to a faster response time in the events of a leakage condition. multiregional sensors has been designed, constructed and tested. The result obtained from the tests carried out shows that the system is capable of sending SMS alerts whenever there is gas concentration at the inputs of the gas sensors. For this they are using gas sensors, temperature sensors, weight sensors. Threshold values are set into the room, when it crosses that values it will send a notification to the user, about the leakage of a gas cylinder and leakage of a gas. Server can communicate with the user through android device. Through email and SMS server can sends a notification to the user which will display on the android devices. It can prevent the accident and hazards. It is a cost effective and time consuming solution.

Gaurav *et al.* [19] also focused on the gas leaking problem by designing a gas leaking monitoring system for kitchen and home safety. This system detects the leakage of the LPG and alerts the consumer about the leak by SMS and as an emergency measure the system will turnoff the power supply, while activating the alarm. The additional advantage of the system is that it continuously monitors the level of the LPG present in the cylinder using load sensor and if the gas level reaches below the threshold limit of gas around 2kg so that the user can replace the old cylinder with new in time and automatically books the cylinder using a GSM module .The device ensures safety and prevents suffocation and explosion due to gas leakage and software monitors all the functionality of software.

Lei *et al.* [24] developed an automatic checkout and healthy diet catering system based on lOT technique. By utilizing a new type dishware which embedded RFID tag, the system can mark the diet with IS014443A air protocol and bind it to the consumer. With the automatic checkout feature, it can save labor costs for the catering company and cut down the consumers' waiting time to improve the service quality. The system use a new type dishware which embedded RFID (Radio Frequency Identification) tags, via the uniqueness of the RFID tag's identification, so system can mark every dish the consumer select. When consumer checking out, the system can collect diet data by identify the RFID tags which embedded in dish ware. This system uses the advantage of cluster, providing catering enterprises SaaS (Software as a Service) service. Through the diet data mining, the system can draw the overall spending trend of consumers. On the one hand, the system can improve the efficiency of catering enterprises by the feature of automatic checkout. So the system can reduce the unsalable food to improve the catering enterprises profit.

3 Implementation

In the implementation process we walkthrough many steps, firstly we must specify the Hardware components of the system, and they are will be:

1) Input Unit:
   We have only one input in our device and it is the 4×4 Keypad (See Figure 2) and it's role is to make the user choose the meal which he wants to put on the stove that he already choose, and

to generate alarm sequence. The user press on the reset button to reset the stove and terminate the alarm sequence.

Figure 2: The 4×4 Keypad

2) Output Unit:
We used the LCD (LMO 016L 16×2 Alphanumeric; See Figure 3) as an output device because it makes the user simply see what he chooses and the changes in the system conditions easily, it is also easy to program and uses less DIOS from my micro controller

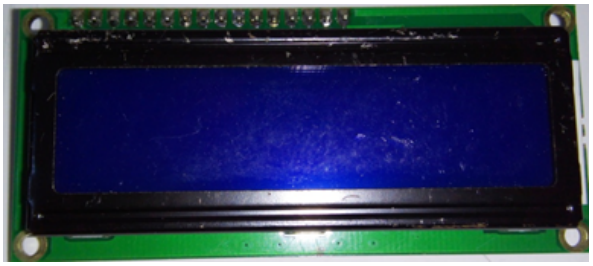

Figure 3: The LCD

3) Microcontroller Unit:
This unit is divided into two parts, hardware part and software part. The hardware is essentially the microcontroller. Microcontroller is a single chip containing a microprocessor, memory (RAM & ROM), input/output ports, timers and serial ports and it is designed for embedded control applications. We know that the main use of microcontroller is the control of a machine or system using a fixed program stored in the ROM and this program does not change over the lifetime of the system [14]. We used ATmega32 microcontroller. ATmega32 is an 8-bit high performance microcontroller of Atmel's Mega AVR family (See Figure 4). ATmega32 is based on enhanced RISC architecture with 131 powerful instructions. Most of the instructions execute in one machine cycle. ATmega32 can work on maximum frequency of 16MHZ. It contains 8-channel 10-bit A/D Converter and a JTAG interface for on-chip debugging. The device supports throughput of 16 MIPS at 16 MHz and operates between 4.5-5.5 volts.

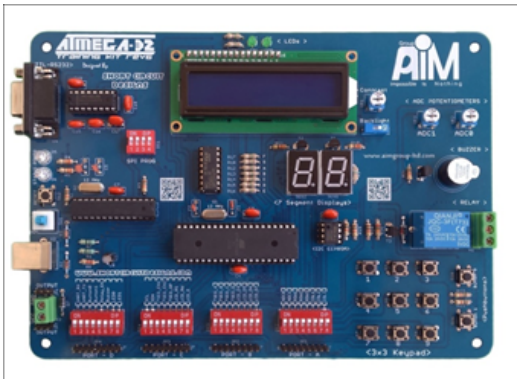

Figure 4: AVR - Atmega 32 Micro controller kit

4) Alarm Unit:
We also need buzzer and led as alarm indications for the user (See Figure 5).

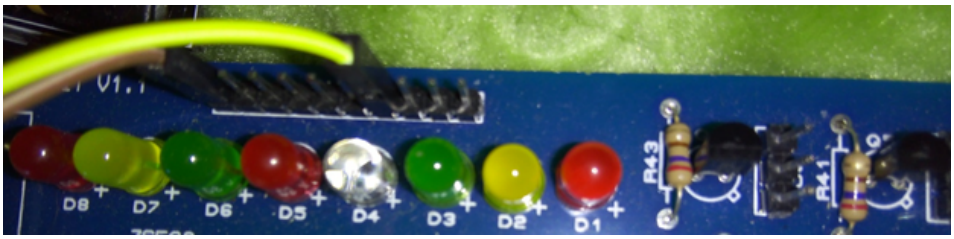

Figure 5: The Led Indicator

5) Burning Tool:
We used the USB asp as an AVR Burning Tool (See Figure 6).

Figure 6: USB ASP

6) Software Development:

The software needed to run the control process of this system was developed using C language in the microC PRO for AVR (See Figure 7). The program code was then written into the chip. Eclipse Neon 0.2 used to write code and burn it in the microcontroller.

We also need to specify Timers to calculate the time for the meals and give us indications when it's done, Choose the DIO-S to connect the hardware components (LCD - Keypad - Led - Buzzer), and create the drivers for the microcontroller peripherals (Timers - DIO - ISR "Interrupt") and the devices that I used (LCD - Keypad).

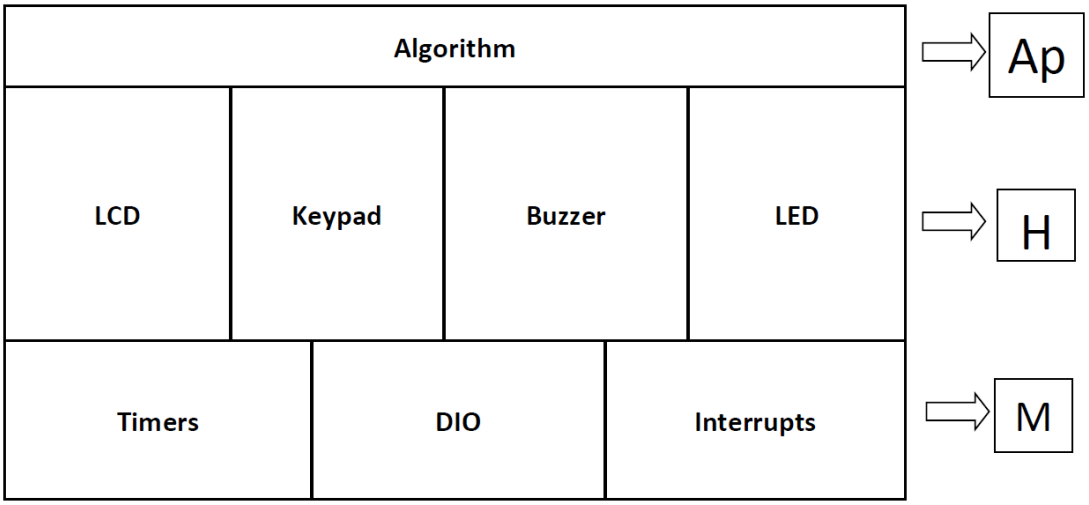

Figure 7: Static design

7) Construction:
The system was constructed in modules as designed and later put together on completion to simplify construction, testing and maintenance. After verifying that all the components are working as expected, we integrated them into a single system. The entire system circuit as shown in Figure 8 was laid out carefully to minimize error and to ease troubleshooting.

4 Results

At the first, the LCD will show the default screen which contains the cooker stoves numbers (See Figure 9).

And then check which button has the user pressed, if it was stove 1 the button waits until he choose the meal. And the same for the other stoves buttons. When the user chooses the meal it appears on the screen the name of the meal next to the stove he chooses (See Figure 10).

The global flag of the meal turns to 1 and when the code goes to the ISR it will check the flag of the meal when it finds the flag equals to 1, it starts the timer logic for this meal.

When the meal counter reaches the desired time, it starts the alarm sequence which is putting voltage on the pins which the buzzer and the led are connected to and they turned on (See Figure 11). And put (*) next to the meal name on the screen to work as indication that this meal has already finished.

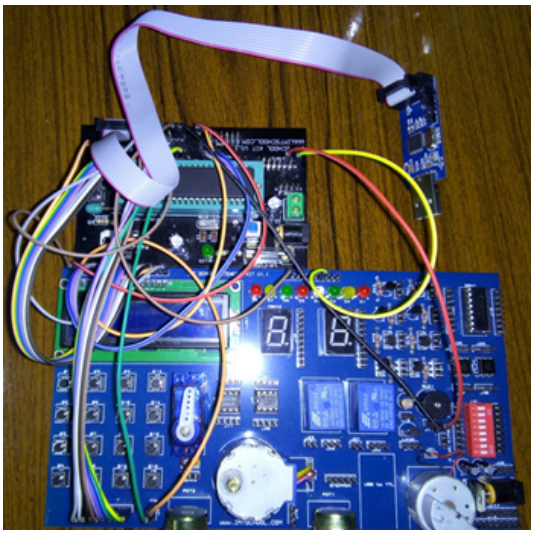

Figure 8: The system construction

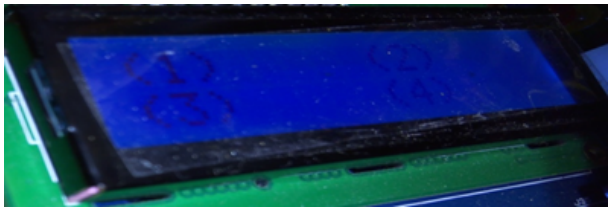

Figure 9: The default screen

Figure 10: The screen after choosing the meal

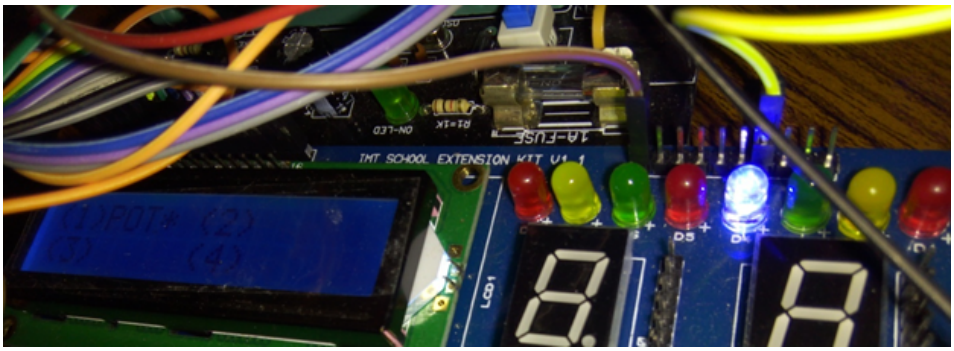

Figure 11: The screen and the led after reaching the desired time

If the user pressed on the reset button of the stove. It deletes the meals name, and the (*) from the LCD and remove the voltage from the pins which the buzzer and the led connected to terminates the alarm sequence for this stove, and return to the default screen (See Figure 12).

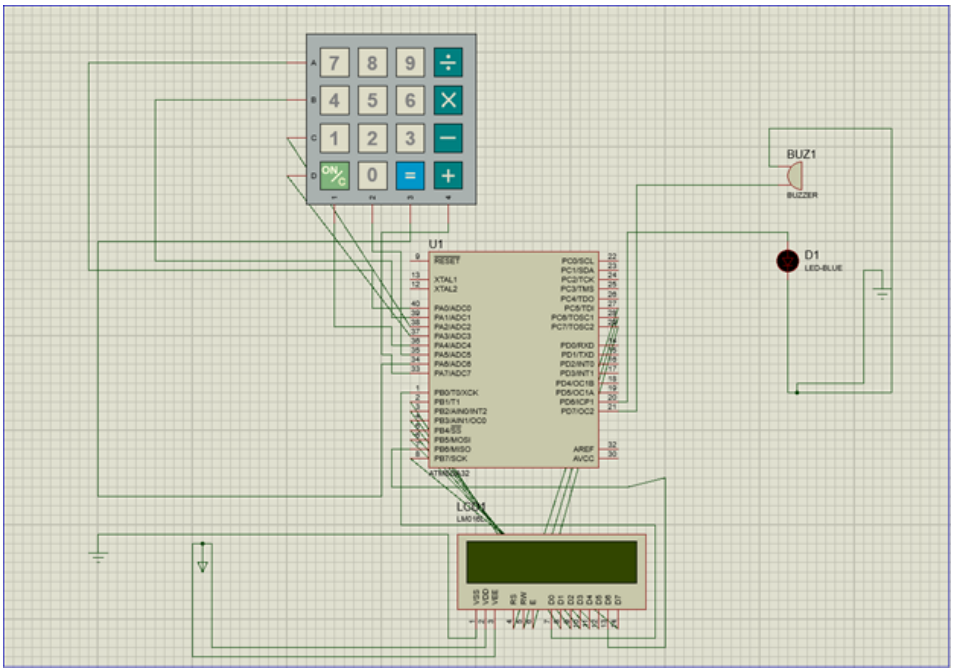

Figure 12: The system layout and the circuit diagram

5 Conclusions and Future Works

The IoT market is growing rapidly and as a consequence the attention has shifted from proposing single IoT elements and protocols towards application platforms in order to identify frameworks supporting the standard IoT suites of regulations and protocols. This study has covered a subset of commercially available frameworks and platforms for developing industrial and consumer based IoT applications. The developed IoT embedded system has partially solved the cooking problems in "Basmatio" restaurants by allowing the chef to choose between different timers for different meals and the all timers can work in parallel.

One of the modifications is to provide the system with heat sensor for safety if there is undesired fire from the stove. Make the configuration of the meal time generic product. Not for "Basmatio" only but for any restaurant. And Make a counter using 7 segment to count how many time as he cooked a certain meal, to know which meal is preferred by his clients and the average of each meal's ingredients consumption.

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Biography

Diaa Salama Abdul-Minaam was born on November 23, 1982 in KafrSakr, Sharkia, Egypt. He received the B.S from Faculty of Computers & Informatics, Zagazig University, Egypt in 2004 with grade very good with honor, and obtains master degree in information system from faculty of computers and information, menufia university, Egypt in 2009 specializing in Cryptography and network security. He obtained his Ph.D. degree in information system from faculty of computers and information, menufia university,Egypt . He is currently a Lecturer in Information systems department, Faculty of Computers and Information, Benha University, Egypt since 2011. He has worked on a number of research topics .Diaa has contributed more than 20+ technical papers in the areas of wireless networks, wireless network security, Information security and Internet applications, Cloud Computing, Mobile Cloud Computing in international journals, international conferences, local journals and local conferences. He majors in Cryptography, Network Security, IoT, Big Data, Cloud Computing. (Mobile: +20166104747; +201019511000 E-mail: ds_desert@yahoo.com)