Pressure Cooker Whistle Notification Using Arduino Based Wireless Sensor Networks

Adarsh JK¹, Kishore R², Arul R³

¹,²,³School of Electrical Engineering, VIT Chennai, Tamilnadu, India.

*Corresponding Author: arulphd@yahoo.co.in

Abstract. In this paper, a new safety method is proposed to reduce the pressure cooker risks, accidents due to the carelessness of the user. The main aim of the paper is to introduce a gadget that can be used to keep track of the whistle count and notify the user in real-time about the whistle count through their mobile phones. This way the user can keep track of the whistle count and can turn off the pressure cooker when their desired whistle count is reached. Sound sensors are used to detect the sound wave of the pressure cooker whistle. The whistle count is recorded using an Arduino and the notification is sent to the user’s mobile via the Blynk application. Blynk is being the open-source platform for a modular graphical user interface to control experimental tools based on Arduino, it extends Arduino’s capabilities allowing instrument makers to easily create a custom user interface program that runs on a connected computer. This device can be used in an indoor environment.

Keywords: Arduino, Sensors, Data collection, Cooking pressure, Indoor environment

1. Introduction

In the course of scientific research, many laboratories around the world are faced with the need to develop their own specially designed experimental systems. Indeed, it is an intrinsic feature of scientific research in which new and unknown phenomena require new experimental configurations [1, 2]. While some tools are too complex to develop in-house and require professional help and industrial tools, many are simple enough to be created with the limited technical skills available on production teams [3]. In recent years, science has discovered an open-source electronic platform "Arduino" for monitoring and controlling experimental equipment. Arduino consists of a microcontroller on a small printed circuit board (PCB) with connectors that allow you to easily connect external devices to digital and analog inputs and outputs (I/O) [4]. The success of this particular hardware suite is based on a dedicated integrated development environment (IDE) that runs on a personal computer (PC) running Windows, Mac OS X, or Linux. This is designed for non-experts and makes integration a lot easier. Different stages of editing, compiling and downloading the software on the microcontroller. The Arduino can be connected to a separate printed circuit or breadboard equipped with interface circuits to adapt the signals to the various components of the experimental system for control and monitoring functions [5]. As an open-source project, the Arduino ecosystem offers a significantly cheaper alternative to other hardware
control solutions such as LabVIEW (National Instruments, Austin, TX, USA) [6]. Arduino boards start at around $10.

Printed electronics are ideal for making this job easier. On the one hand, they are inherently economical as they can usually be made using an additive process that does not require high temperatures or vacuum systems [7, 8]. Ultimately, printed electronics enable the compatibility of sensors and electronic systems with the high-performance, low-cost manufacturing required for IoT applications and offer additional features such as flexible substrates and large areas [9]. Blood pressure measurement is a general and active research area. Typically, sensors rely on induced contact pressure rather than ambient pressure. Although related, the required sensitivity coupled with the lack of physical contact prevents the two mechanisms from being used interchangeably [10]. The applications for tactile pressure sensors and ambient pressure sensors are also different and it is important to distinguish them. However, those who use this product face serious problems such as: For example: knowing how much gas will remain in the bottle during its useful life because the packaging is opaque; and be careful if the gas escapes, which could endanger the safety of the user [11]. A sudden interruption of the contents of the bottle could therefore disrupt food preparation and lead to unexpected expenses for the family budget, as the loss could cause serious damage to those who use the bottle [12].

One of the most common kitchen utensils is the pressure cooker. It makes cooking much easier than using heavy pans, which are difficult to use. Although various fundamental changes have been made to the pressure cooker design and people are now more used to cooking in pressure cookers, the brainpower of pressure cookers has always been slowed down. Due to the increased pressure at work, people today forget to realize that the pressure cooker whistle is important and sometimes they tend to overcook or undercooked their meals. The aim is to fill this gap by presenting a gadget that allows users to keep track of the number of whistles and inform the user about the whistle count in real-time on their mobile phones. Not only tracking the count but also the user could also turn off the stove when the desired number of counts is reached. The product is easy to use and could be easily fixed by the user. This device does not take up too much space and is light in weight.

2. Literature Review
The examinations concerned set out in this segment present the definition that identifies with the Arduino-based pressure cooker whistle recognition.

Farmanesh et al. [13] have introduced an enhancement of delivering interaction of poultry side-effects with clump cooker model observed by electronic nose. An electronic nose framework was planned and constructed dependent on metal oxide semiconductor sensors to screen the gases radiated from the clump cooker model. Likewise, GC-MS was utilized to distinguish the radiated segments. To enhance the delivery interaction, a reaction surface procedure was performed on temperature, cooking time, and instigator speed factors. Results showed that the temperature of 140 °C (inward pressing factor comparable to about 3.2 bar), the cooking season of 45 min and the instigator speed of 20 rpm enhanced the interaction of clump cooking to augment the level of protein and limit the level of fat, dampness content, energy utilization and outflow of toxins.

Andrews et al. [14] have executed a completely printed carbon nanotube slight film semiconductor (CNT-TFT) for detecting natural pressing factor over a pressing factor range stretching out from 0 to 42 PSIg. The transconductance of the CNT-TFT was discovered to be directly related to the ecological pressing factor at an affectability of 48.1 pS/PSI. Furthermore, show the ability to remotely communicating the information estimated by the pressing factor sensor utilizing a straightforward Bluetooth module. Utilizing the Bluetooth framework, noticed the sensor's reaction over the long run as the pressing factor was powerfully changed.

Susa et al. [15] have introduced a programmed room humidifier and dehumidifier regulator utilizing Arduino Uno. This limits scents that can encompass shape and build-up to free your place of the "smelly" or "spoiling" smell, it additionally declines dust and the danger of framing moulds on your apparel,
furniture, and different clothes, and in the long run lessens irritation of your skin and respiratory framework, causing it simpler to inhale and to feel great comfortable. The regulator utilized in this examination is Arduino Uno.

Svosve et al. [16] have introduced an electric cooking oven through programmed control and reaction frameworks. Right off the bat, a miniature regulator decides if there is anything on the warming plate and if there isn’t anything, it consequently turns off the plate by methods for a little voltage-order hand-off switch leveled out of the miniature regulator. The second capacity of this plan forestalls the consumption of food during the cooking cycle that includes bubbling. In the wake of recognizing the consuming temperature, the miniature regulator is additionally ready to identify when the food is going to consume by deciding when the water runs out.

Rahayu et al. [17] have introduced an early admonition of spilling LPG gas through short message administration (SMS) and amplifier apparatus utilizing Arduino Uno. The method of working from these apparatuses when the MQ-6 sensor recognizes LPG gas over 100 ppm, the sensor will send information to the microcontroller on Arduino Uno for giving a reaction as a ringer as an alert, the amplifier as gives notice the sound of threat and send data as SMS to the mortgage holder.

3. Proposed Methodology

The sound sensor input consists of sound waves as a frequency and sends them to the microcontroller via one of the pins. The microcontroller then processes the received signal and searches for the frequency range of the tone. If the input tone is in the specified frequency range, the microcontroller sends a HIGH voltage to the LED and the LED indicator lights up, and at the same time, the counter variable is updated. The microcontroller connected to the WIFI chip via serial communication sends information about the number of counts. The WIFI chip, recognized by a mobile phone connected to the same WIFI network, receives a message and sends a notification to the device via software.

3.1. Components Used

- ARDUINO UNO
- ESP8266 NODEMCU
- Sound Sensor
- Push Button
- Resistor
- LED
- Copper clad board

3.2. Components Description

3.2.1. ARDUINO UNO

Arduino is an open-source electronics development platform with a simple and easily accessible user interface. Arduino is widely used by thousands of students, teachers & hobbyists to develop electronic projects because of its flexible and inexpensive nature. Professionals were able to develop interactive prototypes in a short time and also able to make updates easily. Arduino is a modular platform and users can add different modules like sensors, motors, etc to achieve required functions. Arduino codes are written, compiled, debugged in the Arduino Integrated Development Environment (IDE). Arduino IDE is used to code various types of Arduino boards. The Arduino programming language is almost similar to C programming Language with various libraries available for different uses. Once the sketch is written, compiled, and debugged in the Arduino IDE, it is uploaded to the Arduino board for execution.

Salient features of Arduino board:

- The Arduino board operates at 5V.
- The number of digital input/output pins are 14 & number of analog pins are 6
- Powered by ATMega328 Microcontroller
- The USB port acts as a power supply to the board and also transfers data to and from the PC.
• The Arduino board uses a ceramic crystal oscillator which operates at a frequency of 16MHz.

Features of ATMEGA328P microcontroller:
• The operating voltage is 5V
• 32KB of flash memory to store codes
• SRAM 2KB
• EEPROM 1KB

This is the microcontroller that is intended to use as the brain of the project that has a clock speed of 16MHz has 14 digital pins out of which:
• Pin 8 is connected to the sensor itself
• Pin 6, 5 are connected to NodeMCU for communication between the devices.
• Pin 13 is connected to a LED/buzzer to indicate the whistle
• Pin 3 is connected to the push button to turn off the led/buzzer connected to pin 13

The Arduino UNO is coded using Arduino IDE,

3.2.2. NodeMCU ESP8266
NodeMCU is an open-source developer board that is mainly focused to ease the integration of IoT into miniscale projects. It is LUA based chip developed around ESP8266 Wi-Fi chip. The ESP8266 is designed and produced by Espressif Systems. NodeMCU is widely used for developing IoT-based hardware. The NodeMCU contains key components like CPU, RAM, Wi-Fi, SDK built-in thus it makes an ideal choice for IoT proposed scheme.
Features of NodeMCU:
• Operating voltage 3.3V.
• Clock speed 80MHZ.
• Flash memory 4MB, RAM 64KB
• 11 digital pins and 1 analog pin
• Built-in Wi-Fi 802.11b/g/n

3.2.3. Sound Sensor
The sound sensor Module is a Single channel signal output Sensor. The output is effective to the low-level sound signal with good fidelity. It can be used to detect sound. It converts sound energy into electrical energy. The sound sensor consists of a diaphragm, magnet, coil, and some wires, when the sound hits the diaphragm, it vibrates the diaphragm and thus the coil attached to it. The relative motion of coil and magnet converts the energy into electrical energy, but the voltage produced is very little and thus can’t be used practically, therefore we have to amplify it. The LM393 IC is a double, differential comparator. It is used to calculate the voltages at two dissimilar terminals and contrasts the dissimilarity in voltage quantity.
• Uses Electret condenser microphone
• Has a Signal output Indication LED.
• Can detect the intensity of the sound environment

3.2.4. Push Button
It is used as an interface to turn off the LED.

3.2.5. Resistor
It is used so that while pressing the push-button circuit doesn’t get short.

3.2.6. LED
Acts as an indicator to know if the whistle sound is detected

3.2.7. Copper Clad Board
This is used to draw and make PCB.

In figure 1, the overall proposed workflow diagram has been illustrated.

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**Figure 1.** System Flowchart
4. Circuit diagram and Working of the Proposed System

Arduino Uno has an ATmega328P microcontroller that calculates the data for the proposed method. From the datasheet of the microcontroller, it can be concluded that the clock speed of the ATmega328P is 16 MHz (i.e. it performs 16 million cycles per second). The clock frequency of the NodeMCU microcontroller is 80 MHz. The NodeMCU is coded with SSID, password, and Blynk Auth token in the IDE. The program includes 2 additional pre-processor directives namely FreqMeasure.h and SoftwareSerial.h. FreqMeasure is a specialized library that calculates the time taken for each cycle of an input frequency.

FreqMeasure.h contains functions such as:

- FreqMeasure.begin(): this function starts the beginning of frequency measurement and is included in the setup function.
- FreqMeasure.available(): this function returns number of measurements (if any) or 0 if false.
- FreqMeasure.read(): contains the number of CPU clock cycles that elapsed during a cycle.
- FreqMeasure.countToFrequency(): converts unsigned long numbers to frequency.

The default Arduino hardware supports transferring and receiving data only on pins 0(Rx) and 1(Tx). The native serial support takes place with UART, which is a hardware component of the Arduino board. The SoftwareSerial library is developed and used to overcome the above limitation and allows users to use other digital pins of the Arduino for serial communication. SoftwareSerial port makes it possible for the ports to transmit data up to the speed of 115200 bps.

The circuitry is shown in Figure 2 (a) and a simple schematic is provided in Figure 2 (b) for clarification. It consists of a sound sensor, Arduino UNO, NodeMCU, battery, and other passive components.
Figure 2. Schematic Representation of hardware components
Figure 3 shows the PCB design for the circuitry. The sound sensor converts sound energy into electrical energy. The sound sensor consists of a membrane, a magnet, a coil, and some wires. When sound hits the membrane, it vibrates the membrane and with it the coil attached to it. The relative movement of the coil and the magnet converts the energy into electrical energy, but the voltage generated is very small, so it can be put to practical use, so we need to amplify it. The LM393 IC is a double differential comparator. It is used to calculate the voltages on two different terminals and to compare the inequality in the voltage amplitude. The output is then sent to the Arduino via the output pin, read by the Arduino from pin 8, and coded to respond to the signal. The Arduino saves this value in a variable. The Arduino is coded to collect data from at least 100 cycles and then check to see if the average of the data is at that particular frequency. If the average is in the frequency range, the Arduino will execute the command given in the condition. Since Arduino is not Wi-Fi compatible, NodeMCU can be used to connect to Wi-Fi and send messages to the mobile phone. To do this, communication should be established between the Arduino and the NodeMCU. Communication between two microcontrollers is widespread because not all operations can be performed with just one microcontroller. Here, Arduino and NodeMCU are connected for serial communication. Serial communication is a process in which data transfer occurs by transferring the data bit by bit on the bus. One stands for HIGH voltage and zero for LOW voltage. All Arduino boards and ESPs have at least one serial interface, which is also known as a UART. It communicates via (RX) and (TX) pins, the serial communication on the TX / RX pins uses TTL levels (transistor-transistor logic). To establish serial communication between two devices, the TX pin of one microcontroller must be connected to the Rx pin of the other microcontroller. Data sent from one device should be received on another device and vice versa.

Figure 4. Serial communication setup between the devices
Figure 4 illustrates the communication setup between the Arduino and the NodeMCU. Here 6 is connected to D6, 5 is connected to D5. Using the software serial programming library, we use 5,6 as Rx, Tx pin, and similarly, in NodeMCU D6, D5 is used as Rx and Tx pin. Once communication is established, Arduino and NODEMCU can exchange data sequentially. If the average data from the sound sensor is in the specified frequency range, it sends information about the number of counts to NodeMCU. NodeMCU receives this, information, it receives the number of whistle count, therefore the NODEMCU is coded to print this information as a statement, and information to BLYNK's server. The BLYNK app then sends a notification to the mobile phone.

5. Results and discussion
The sound level that was recorded while experimenting was in the neighbourhood of 80 dB when the pressure cooker whistled. Figure 5 shows the frequency value.

![Figure 5. Recorded peak decibel values.](image1)

The gadget detects the pressure cooker whistle which falls in the frequency range and sends the notification directly to the user’s smartphone and also the whistle count is updated in real-time via WiFi.
The notification and the updated whistle count is displayed in the user’s smartphone which is shown in figure 6.

6. Future Enhancements
   • The proposed model can be easily modified to detect and control the following safety features.
   • The proposed model with a smoke and LPG sensor which detects any leak of the gas and sends a notification to mobile phone.
   • To set the time at which the system will turn off the cooker and informs the user through notification.

7. Conclusion
In the conventional pressure cooker model, safety valves are used to minimize accidents because of pressure build-up. Although it helps in reducing the number of accidents, it is still not quite enough to avoid accidents. And if the users miss the counts it leads to wastage of foods and sometimes leads to accidents. In order to overcome these, a new method was proposed and inspected in real-time. The test result proved that the proposed system reacts quickly and efficiently.

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