

# A BIDIRECTIONAL SAFETY-ENHANCED IOT STOVE WITH AI AGE VERIFICATION

## Abstract

The newest technologies now heavily rely on smart embedded systems, with IoT-based smart embedded systems being the most popular subfield of study. In our research, we suggest an Internet of Things-based smart gas. When using a stove, any mishap could happen. Because of this, we are developing a two-way safety-enabled gas with a kid lock mechanism and a gas leak detection feature that opens the door or window. The smart gas will make an effort to maintain safety and use live video streaming to determine age. Our major concern is making sure a kid can't turn the burner on. Additionally, the gas may guarantee safety through a gas detection alert. Automatic gas booking system, whenever the load cell has less. The hardware implementation consists of an Arduino Uno and a Gas Detection Module with a buzzer. For system execution, we also use a Machine Learning object detection method (Haar Cascade) and a deep learning architecture (CNN). Because our gas is IoT-based, it ensures safety remotely as well as manually, attempting to prevent unintended occurrences. By executing this project, we are assisting individuals in saving time by enabling automatic gas booking. It can give security personnel by detecting gas leaks.

**Keywords:** Arduino Uno, Convolutional Neural Networks, IoT

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## I. INTRODUCTION

One of the crucial expanding fields that can revolutionize the way people live their diurnal lives is the internet and bed systems. The thing of bedded bias is to produce a one-of-a-kind computing system. An embedded system generally performs a single operation. still, these internet-connected bedded biases can communicate with other network biases. likewise, these technologies give inflexibility and options for perfecting the home terrain. People can ever operate and cover widgets using IoT( Internet of Effects) functionalities. In this study, we introduce a smart bedded device, an IoT- grounded smart cookstove. Real-time age identification for child locks and safety from unintentional gas leaks are two ways that the stove will safeguard us. The perception of Bangladesh is the subject of our research. Both a manual and an electric stove will be used. In our effort, we're introducing a smart IoT-based system that will serve as a representation of the idea behind our smart stove. We are using an Arduino Uno microprocessor for the system. The Arduino Uno is connected to other relevant sensors, modules, and equipment. The Arduino Uno is a tiny, inexpensive computer the size of a credit card that connects to a PC or TV and uses a standard gamepad and mouse. It is a competent little gadget that enables explorers of all ages. It can perform all of the tasks that a typical user would expect a personal computer to perform, including playing high-definition video games, accessing the web, and generating spreadsheets and Word documents. Furthermore, the Arduino Uno has been used in a wide variety of digital maker projects, including music machines, weather stations, and parent detectors. We suggested the child lock in our system because of the safety precautions. In the interest of safety and responsibility, we have included an age detection medium to prohibit children under the age of 12 from operating the cookstove. We collaborated using the OpenCV library using a laptop and camera, applying Python with advanced algorithms and trained datasets for software development. Python's strength is that it supports both procedure-oriented and object-oriented programming, combining remarkable computing power with simple syntax. Python allows us to construct complicated features tailored to unique demands by leveraging dynamic information kinds and composing. This connection offers a safe and efficient cookstove experience while pushing innovation to exceed expectations. In the age detection technique, two algorithms are used. The Haar Cascade Classifier Algorithm is one. Haar Cascade is a machine-learning object detection system that can recognize things in a photograph or video. The HAAR-like features utilized in the system are a typical face database where the Caffe model file holds the information of the trained neural network (trained model) and the proto txt file defines the layers in the neural network, each layer's inputs, outputs, and functions. We have collected trained datasets for age detection that have been trained using a machine learning classifier. A fascinating use of artificial intelligence (AI) is machine learning, which gives systems the ability to learn and develop over time by gaining knowledge from experience without making explicit adjustments. Convolutional Neural Networks (CNNs), a potent classification algorithm skilled at tasks like image recognition and pattern analysis, are an example of a famous deep learning approach in this subject. Our ability to solve complex problems and build intelligent systems capable of constant evolution thanks to the seamless integration of machine learning and deep learning has the potential to lead to groundbreaking developments in a wide range of industries, from healthcare and finance to autonomous vehicles and natural language processing, enriching our lives and accelerating innovation. CNNs (Convolutional Neural Networks) are a subclass of deep neural networks that specialize in deep learning. Each convolutional layer in a CNN measures the yield of the previous layer to produce a more robust and lower yield. [3] The convolutional neural

network (CNN) uses down sampling and learned convolutional components to carry out AI tasks on images. Since CNNs learn based on clusters of pixels rather than taking into account each pixel independently, they are better suited to tasks involving images than perceptron-based systems. Another safety feature of the system at work is the ability to detect unintentional gas leaks. To detect gas and smoke, we are employing a module. We are integrating Python scripts with the Arduino Uno device to perform the detection. Since our system is Internet of Things (IoT) based, both features (age and gas leakage detection) will connect to the IoT server, which will provide the required values and results. The Industrial Internet or the Internet of Everything is another name for the Internet of Things (IoT). Another innovation worldview envisions a global network of devices and tools capable of interfacing with one another. IoT is seen as one of the most important areas for future innovation and is receiving a lot of attention from a variety of businesses.

Although numerous studies linking age detection and gas leakage detection individually have been conducted in the past, we have presented a combined technique of both for safety measurements. Our smart stove has two-way safety features enabled, such as a child lock mechanism. about the stove. The other advantage of our smart gas is that it will sound an alarm if anything happens accidentally. a gas leak. The users will be interested in our proposed smart stove because it is IoT-based. able to keep an eye on the gas from a distance and stop any unintended events. Additionally, our technique has become well-known in Bangladesh. The IoT-based design of the smart stove's technology allows users to keep an eye on it from a distance to protect their safety. We can add a GSM module to our system so that customers may monitor the gas as well as receive email or SMS alerts when something happens.

## II. PROBLEM STATEMENT

To create a system that continuously checks for gas leaks and notifies the user when one occurs to prevent serious mishaps. If a gas leak occurs and the level exceeds the threshold, the relevant procedures are taken, such as opening windows and turning on exhaust fans. The feature of sending the user an SMS for cylinder reservations is included in addition to the leakage detection feature. When the weight of the cylinder falls below a certain threshold, the system sends an SMS. The system also keeps an eye on the stove level concerning the vessels set concerning weight and uses gas sensors to identify any type of food spoilage and take appropriate action.

- 1. Solution:** Gas sensors, a load cell unit, and a relay module make up the proposed system's components for autonomous gas control. If a user forgets to switch off the gas, the system does it for them. Using the weight that the load cell unit measures, automatically replace gas. Gas sensors can identify gas leaks and alert the user via IoT communication. Additionally, by spotting extra flame in the gas, the device may identify gas waste.

Industrial stoves of today come equipped with a variety of functions, such as temperature sensors, temperature controllers, blower fans, and other controls. Comparatively, over the past century or so, the family Adding an automatic ignition to the stove has only marginally increased its complexity, but few other features. Gas leakage is a big hazard, and it is not prevented by the burners now on the market. The topic of

whether a home burner can contain some intricate elements is raised. allocated for burners used in industry. To keep up with the generally increasing complexity and incorporation of microcontrollers in most household and technological products, the complexity of household stoves can be significantly expanded. It is only appropriate that we include elements to stop the flow of gas in the absence of a flame given the growing scarcity of gas and fossil fuel. Another safety feature of this is that it prevents the buildup of a gas-air mixture that could explode in a small space.

- The current technology does not support automated bookings.
- There are no safeguards for children in the current system.
- Every cylinder booking is done manually under the current method.

Gas sensors, a load cell unit, and a relay module make up the proposed system's components for autonomous gas control. If a user forgets to switch off the gas, the system does it for them. Automatic gas refueling using a load cell unit to measure weight. Gas sensors can identify gas leaks and alert the user via IoT communication. The technology also finds gas waste by spotting unneeded flames in gas stoves.

- It improves the child's safety measures.
- Automatic reservation.
- Less manual labor is required for gas reservations;
- User-friendly.

The requirements can be divided into two main groups: hardware requirements and software requirements. The first one outlines the bare minimum hardware requirements for the machine that must be used to run the project. The latter lists the crucial applications required to create and manage the project. By offering the proper platform to construct the system, system requirement specifications are obtained. The elaborative conditions are what the system must achieve. It also gives the system a clear idea of what to accomplish and how to achieve it without placing any restrictions on it. The specification specifies the implementation framework or plan and places limitations on externally observable characters. A software system's description is contained in a software requirements specification (SRS). It is based on a specification of business requirements. The software requirements specification outlines both functional and non-functional needs. It may also include several use cases that illustrate the ideal user interactions that the product must enable. In a project driven by the market, the marketing and development divisions may take on these tasks. Software requirements specifications create the groundwork for an agreement between clients and vendors or contractors for how the software product should operate. The purpose of the software requirements definition is to reduce later redesign by conducting a rigorous assessment of needs before the more precise system design stages. It should also give a reasonable foundation for predicting product costs, risks, and timelines. Used Software requirements specifications, when used correctly, can aid in the prevention of software project failure. The software requirements specification document includes sufficient and essential requirements for the Project creation. To derive the requirements, the developer must have clear and concise instructions. thorough understanding of the items under development. This is accomplished through careful planning and execution. Throughout the software development process, there is constant communication between the project team and the

customer. The development procedure. The use of a CPU is included in the hardware requirement specification (HRS). RAM and storage space might vary greatly depending on user behavior. These hardware requirements are based on typical deployments and may increase or decrease depending on the number of active users. Furthermore, peak file-sharing activity might raise RAM requirements. The recommendation is based on the default file size of 50 MB, which can be changed using the System Console. Changing this number may result in different memory needs.

## 2. Objectives

- A mechanism for automatically booking gas.
- Detecting gas leaks.
- Child supervision in the kitchen.
- Control and monitoring of room devices if a sensor detects a fire or gas.
- Notification to the home's owner.

## 3. Expected Results

- We enabled two-way safety features in our smart stove, such as a child lock system
- We also added a feature that will sound an alarm if there is an accidental gas leak.
- We also added a system that automatically books the gas cylinder when the weight sensor detects a lower value.

## III.METHODOLOGY

In intelligent applications including access control, human-computer interface, enforcement, marketing intelligence, and visual surveillance, age estimation from a single facial photograph is an important problem. The main goal of this project is to create an algorithm that accurately predicts a person's age. Haar cascade is one of the most used methods. This project includes a model that can regulate the ignition and, with the aid of the Haar Cascade, forecast the age of a person. The various male and female photos that were both positive and negative were used to train the classifier. Various facial traits are taken out. A deep Convolution neural network was employed. It is effective. efficiently while having little data. The design uses the caffeine deep literacy frame for the age approximation challenge. Caffe offers extendable law and suggestive armature. The suggested system for automatic gas control consists of gas sensors, a load cell unit, and a relay module. The mechanism automatically shuts off the gas if the user forgets to do so. Automatic gas replenishment using the load cell unit's weight measurement. Gas sensors can identify gas leaks and alert the user via IoT communication. By spotting extra flame in the gas gas, the system may also spot gas waste.

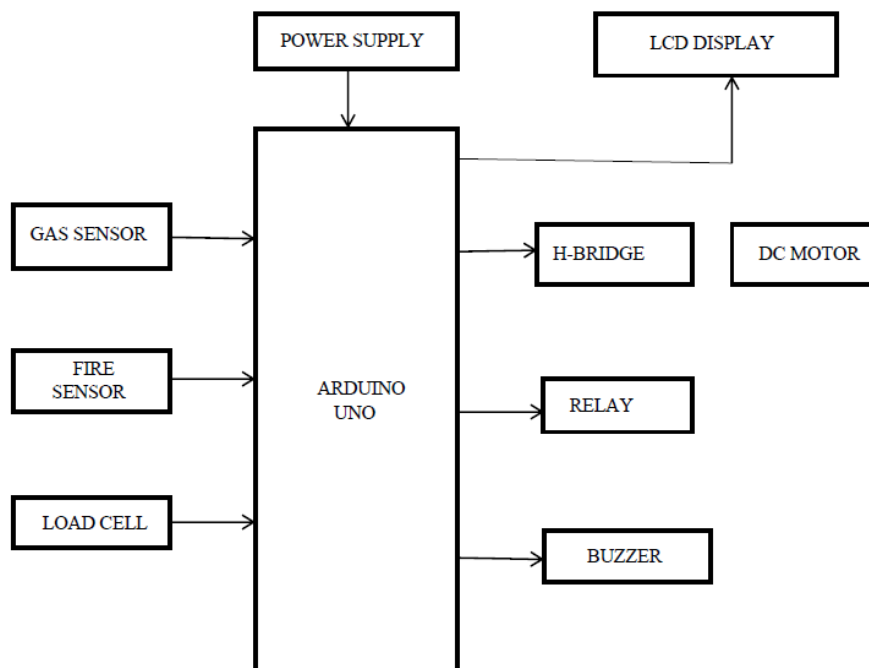
- 1. Overall Methodological Approach:** In this study, a gadget is created using an Arduino microcontroller, a lap camera, and other embedded system project equipment. The appliance, which will provide the safety measures, will be mounted to the gas.

Additionally, because the gas is Internet of Things (IoT) based, users of internet-enabled smart devices like smartphones, tablets, and PCs can monitor it from anywhere.

- 2. Software for System Execution:** Python 3.8 is used in the software that works with the Arduino Uno and the Internet of Things server. Additionally, we use Thing Speak for remote access and to monitor the entire system, including the stove. Using a local area network, we have built a private channel for our research. "Gas Detection" and "Age Detection" are two fields on the channel. We interfaced the Python programs with the copied API key (write) that was provided. So that we may remotely monitor the system.

#### IV. SYSTEM ANALYSIS

The proposed model's fundamental construction and operation. The detection of gas leakage is the suggested model's key feature. If there is a gas leak in an LPG cylinder, it will be found using a sensor connected to an Arduino board. We notify the user of the leak by sending an SMS when gas is detected. A buzzer will activate in response, creating a warning, and an LCD will display a leakage message. A relay attached to it will turn off the mains, cutting off power to the house and preventing any potential fire threats. Natural language processing machine learning algorithms now take too long to finish their learning process. The methodology tends to be unsuccessful for real-time applications that are becoming more and more necessary, such as sentiment analysis, language translation, text summarization, voice transcription, and topic extraction. Additionally, present systems are unsuitable for real-time requirements because they operate in an offline batch mode. To improve learning performance, newer machine learning algorithms are being developed that make better use of sampling and distributed methods. In my thesis, I pinpoint untapped market niches where machine learning is not being used to its full potential. I'll offer system-level recommendations and assessments that could boost functionality, accuracy, and relevance.



**Figure 1:** Block diagram of System Design

- 1. Arduino:** A microcontroller board called Arduino/ GenuinoUno is grounded on the ATmega328P. It has a 16 MHz quartz demitasse, 6 analog inputs, 14 digital input/ affair legs( of which 6 can be used as PWM laborers), a USB connection, a power jack, an ICSP title, and a reset button. It has everything necessary to simply use a USB string to connect to a computer or an AC to DC motor to power the microcontroller. A battery or a DC appendage is needed to begin. You do not need to worry when tinkering with yours. However, you can replace the chip for many bones. In the worst case, If a commodity goes wrong. Then begin formerly more. The Italian word "uno" (which translates to "one") was chosen to signify the ArduinoSoftware (IDE) 1.0 release. The Uno board with the Arduino Software (IDE) version 1.0 served as the foundation for later generations of Arduino. The Uno board, the first in a line of USB Arduino boards, serves as the platform's benchmark.
- 2. Power:** It can be powered by a USB connection or an external power source with the Arduino/Genuino Uno board's various power options. Based on availability, the board makes an intelligent choice for the power supply. You have the option of using a battery or an AC-to-DC adapter (wall wart) for external (non-USB) power. A 2.1mm center-positive plug, which fits into the board's power connector, is required to use an AC-to-DC adapter. The GND and VIN pin headers on the POWER connection can be used to connect battery leads. The voltage range for the external power supply must be taken into account. A supply voltage between 6 and 20 volts can be used to power the board. However, you must pay attention to the 5V pin's voltage. The 5V pin may give less than the anticipated five volts if the voltage supplied is less than seven volts, which could cause instability in the board's functionality. On the other side, a voltage supply that is higher than 12V may cause the voltage regulator to overheat and perhaps harm the board.

It is advised to operate the board within a recommended voltage range of 7 to 12 volts to guarantee optimum performance and safety. This range establishes a balance between supplying the board with enough power and averting any problems brought on by an insufficient or high-voltage supply. You may increase the Arduino/Genuino Uno board's efficiency and dependability, enabling the smooth and successful operation of your projects, by carefully regulating the power settings and following the advised voltage range.

- 3. Memory:** The boot loader takes up 0.5 KB of the ATmega328's 32 KB of memory. Additionally, it features 1 KB of EEPROM (which can be read and written using the EEPROM library) and 2 KB of SRAM.
- 4. Relay:** An electrically controlled switch is a relay. A magnetic field produced by current passing through the relay's coil draws a lever and modifies the switch contacts. Relays feature two switch positions and are double throw (changeover) switches since the coil current can be either on or off. The switch connections on a relay are typically marked COM (POLE), NC, and NO.
- 5. LCD Display:** The extraordinary electronically regulated optical gadget known as a liquid-crystal display (LCD) uses liquid crystals to modify light and produce images. In contrast to light-emitting displays, liquid crystal displays use a backlight or reflector to produce pictures that can be either color or monochrome. There are many different kinds

of LCDs, from those that can show random visuals, similar to computer screens, to set images with little information, including text, numbers, and the seven-segment displays seen in digital clocks. Despite their variations, LCDs all share the same core technology and rely on liquid crystals to produce their optical effects. The difference can be seen in the size of their components; while some displays use larger components, others, like random pictures, are made up of innumerable tiny pixels. The adaptable LCD technology is widely used in a variety of industries, making it an essential part of many gadgets and displays. It can be found delivering clear and bright graphics on computer monitors, television screens, aviation cockpit displays, and instrument panels. LCD panels are no longer just used in large-scale applications; they are now used in a variety of portable consumer goods, such as digital cameras, watches, calculators, and mobile phones, including the increasingly popular smartphones. LCD panels are used in consumer electronics goods like DVD players, gaming consoles, and clocks as well as replacing the once large and heavy cathode ray tube (CRT) displays in a variety of fields. LCDs serve a wide range of purposes, from tiny digital watches to massive, big-screen television sets, revolutionizing the way we perceive and interact with visuals in the modern world. LCDs come in a wide variety of screen sizes. The fact that LCD panels are resistant to image burn-in, which happens when a static image remains on the screen for an extended period and causes persistent ghosting or discoloration, is one of their key advantages. LCDs do not have this problem, in contrast to previous display technologies that utilize phosphors. It's important to remember that image persistence can still happen with LCDs. This phenomenon involves transient residual images, often known as "image retention," where a hazy remnant of previously seen content could linger for a brief amount of time after the image changes.

## V. HIGH-LEVEL DESIGN

- 1. System Architecture:** The detection of gas leakage is the suggested model's key feature. If there is a gas leak in an LPG cylinder, an Arduino board-interfaced sensor will be used to find it. We notify the user of the leakage by sending an SMS when gas is detected. A buzzer will activate in response, creating a warning, and an LCD will display a leakage message. A relay attached to it will turn off the mains, cutting off power to the house and preventing any potential fire threats. Making an automatic reservation for a cylinder refill is another feature of the model. In the automatic gas refill booking system, we use a load cell sensor to continuously check the amount of gas in the LPG cylinder. The user will receive a notification through SMS that the gas level has reached the minimal level and request confirmation before scheduling an LPG cylinder refill when the gas level falls below the predetermined level or threshold level. If the user confirms the booking, an SMS to schedule a refill will be automatically sent to the gas agency. The confirmation SMS will be issued the following day if the user rejects the replenishment. Up until the refill booking has been completed, the cycle had a gas agency registration.
- 2. DB Design:** A data flow diagram (DFD) is a graphic representation of how data moves through the system as a whole. A DFD can be used to visualize how data will move through the system. An internal procedure or subroutine can be used to transfer data from an external source, an internal source, and either an external destination or an internal destination itself. A data flow diagram is a creative and intuitive approach to show how information and data are processed and moved inside a system. These data flow diagrams



are primarily used to describe the system architecture and how data flow in a particular order will change the behavior of the system and how it affects the system as a whole. The DFDs of previous systems of the same kind can be compared to the new DFDs to gain a comparison, which will aid in the implementation of a very efficient system. The common users will benefit from having a visual representation of how the system works when given data as an input so they can visualize how the system transforms the data into useful information or outputs and how each input ultimately affects how the system functions.

## VI. IMPLEMENTATION

- 1. Methodology & Techniques:** Picture processing is the process of enhancing photographs produced from camera sources and photographs captured during daily life. The image is processed depending on the analysis, a wide range of methods and calculations. Digitally created images require meticulous thought, and research. There are two main processes in the processing of images, then easy steps. The development of a picture aims to produce more high-quality images that can be used by other programs referred to as picture enhancements. The alternative method is the most frequently used technique for data extraction from a picture. It is known as the separation of images into specific components segmentation. It is crucial to know where the information in the images is located information. To facilitate finding, the information that the image carries must be modified. Different kinds of procedures are necessary for, just like the removal of the problem. In a facial recognition technique: A lot of information is stored in the articulations that the faces have. There is a correlation between a huge number of ideas whenever the individual gets close to the other person. The development of ideas aids in determining some boundaries. Age assessment is a complex subject when different age groups are assigned to different years. It is challenging to put together the photographs because people of different ages have different facial features. Several techniques are used to determine the age and gender of various faces. Features are extracted from the neural network by the convolution network. The image is transformed into one of the age groups in light of the ready models. The highlights are dealt with in further detail and sent to the preparatory frameworks. Convolutional neural networks (ConvNets or CNNs) are one of the main types of neural networks used to recognize and classify images. CNN's image classification system uses an input image to analyze and categorize it. Technically, each input image will be passed through a series of convolution layers with filters (Kernels), Pooling, and fully connected layers (FC), and the Activation function to categorize an object in deep learning CNN models for training and testing. The best models for image classification, segmentation, object detection, and many other image-processing tasks are convolutional neural networks.
- 2. Algorithms Employed:** The project report's content is primarily broken down into four sections that give clear explanations of what happens at each stage of the implementation process.

In this ground-breaking methodology, we adopt a hands-on and incremental manner to construct our very own model, the sequential CNN model, layer by layer. This model, created primarily for wireless spectrum monitoring applications, has three convolutional layers and two pooling layers. This model stands out because it can learn

on its own without the use of manually created expert features using time domain in-phase and quadrature data. We have opened up a new world of possibilities by putting forth a novel end-to-end learning approach, which does away with the necessity for time-consuming manual feature engineering. The key to this approach is the integration of sequential convolutional recurrent neural networks, which balances the parallel processing capabilities of convolutional neural networks with the intrinsic temporal sensitivity of recurrent neural networks. Our clever method uses convolutional layers with pooling, which have a unique understanding, as a dynamic front-end feature distillation and dimensionality reduction technique. As a result, the model gains the ability to fully exploit wireless spectrum monitoring applications, enabling automatic learning from complicated time-domain data that is seamless and efficient. We can pave the road for better and more effective wireless spectrum monitoring thanks to the use of cutting-edge technologies and the skill it took to build our model piece by piece. Our model, which combines the best elements of convolutional layers, pooling, and recurrent neural networks, is a monument to human ingenuity and can revolutionize the way we approach and resolve challenging data-driven problems.