



# Movement Sensed Automatic Door Opening System for Buses on Emergency Doors

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## Article Info

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## ABSTRACT

*The major purpose of the project is to employ all of today's technology to develop a solution for risks in buses that will avoid human fatalities and injuries. As traffic congestion and transportation complexity increase, buses with existing accident response system techniques are unable to satisfy current demands, forcing the introduction of foolproof mechanisms on buses. In this project, we'll automate the door by monitoring temperature, gas pressure, and abnormally quick vibrations. During a fire, lives were lost due to the failure to open the car doors. There are systems in place to recognize and control car fires, but they are meant to detect the fire, inform the drivers, and extinguish it using fire extinguishers. Temperature sensors, smoke sensors, Piezoelectric sensors, and MEMS sensors were utilized to detect the fire in this study work's system, and various motors are used to open the door.*

**KEYWORDS:**Sensors, Temperature, Gas, Vibrations, Position, Automobiles, DC Motors, and buses.

## 1. INTRODUCTION

The current risk rate for bus travel is quite high; as a result, the country's top priority is public transportation, as well as the Department Of Transportation, is actively working with state and local transportation companies, and industry groups, to set standards, guidelines, and programmed that will protect future generations. To reduce the risk rate, cutting-edge technology is being used to design a single safety mechanism for the bus. In current buses with single-control pneumatic doors controlled by the driver, there is no mechanism to open doors in the event of a switching failure or a catastrophic scenario, and emergency doors must be opened manually. Thanks to better technology and sensible viewpoints on safety issues, a solution was designed to

eliminate the barriers to attaining safe mode in buses by integrating two-way switch control of pneumatic or emergency doors. Once a vibrating sensor detects the effect on the bus body in the case of an accident, the escape door will immediately open. In the event of a fire, the smoke alarm detects it and activates the emergency and main bus doors. An alert message is transmitted to the rescue squad whenever the escape doors are opened, and the car's built-in GPS sends the bus's current location for rescue missions and the archiving of event reports made on the spot. In recent years, gas and motor-driven vehicle doors have been used to open and close. To keep the passengers and belongings secure during the voyage, 0 T robotics must be used to open and close the doors. Automated bus doors are used on

air-conditioned buses to maintain the temperature and conserve energy on the air-conditioning equipment. Based on how they are utilized, the following types of bus doors are often available.

## 2.LITERATURE REVIEW:

Fire avoidance, fire reduction, and fire suppression are three ways of dealing with fire threats in automobiles that have been studied previously [3]. The Tamilnadu Government oversees the Chennai Motor Vehicles Rules. Fires are divided into four categories: class A, B, C, or D. For a Class A fire, water is the extinguisher. A fire caused by oil is classified as just a ' B fire, but a fire caused by electricity is classified as just a Category C fire. Automobile fires are classified as class B, controlled Substance, or both, and are put out by injecting the right number of emissions into the fire source. Automobile fires are caused by a variety of circumstances, the most prevalent of which are gasoline leaks or electrical system failure [4]. The Road Transport Workers Act was passed by the Tamilnadu government. It takes at least 5 min for a fire inside the engine to spread to a passenger compartment. The fire from the vehicle's rear end enters its passenger compartment in 2 minutes, and the fire department arrives in 10 minutes [5]. The author demonstrated in [6] Mechanical Vibration, Nem Chand, and Bros by Grover, GK that if a fire hazard developed in an automobile, it took on average 12 minutes to cause significant damage. Every day, more than 2,000 autos are destroyed due to fires. Every year, a few of thousand-stock-inventory stocks in the United Kingdom catch fire. Fuzzy control systems and an Arduino Uno microcontroller system are used to solve this challenge [7]. Orient Longman Publications, Bombay, published RS Gupta's Handbook of Fire Technology. Robert et al. created a system that detects and mitigates fire damage in automobiles using an Arduino and fuzzy logic technology. They used sensors such as fire detection, a temperature probe, and a flame sensor in their research [8]. Highway Engineering is published and distributed by Gurcharan Singh and Jagdish Singh. Only heat detection has traditionally been implemented to determine fires in autos [9]. 'Kinematics of Machines,' Henry Xavier R. Chand, S.chand and company Ltd. On the other hand, fire sensors, such as gas, fire, flame, or heat sensors, are being used to identify a fire risk [10]. Mahboob Basha's Handbook of Transport Engineering,

Anuradha Publishing. Barera Sarwar et al just use an adaptive neuro-fuzzy fuzzified interface system (ANFIS) to build a fire detection control process and decrease false alarms by merging two essential technologies: fuzzy logic & artificial neural networks (Ann).

Standard fire detection systems, according to their research, cause false alarms, and the city fire department is required to respond to a false complaint every minute, spending £37 million per year [11]. The transport research wing of India's Department of Road Transport and Highways studies road accidents. Between 2003 and 2007, fire services in the United States responded to an average of 287,000 car fire incidents per year. Fires cost the lives of 480 individuals each year, injure 1525 others, and inflict \$1.3 billion in property damage [12]. S-C A automobile can catch fire for a variety of reasons. Excessive engine and battery wear, leaking fluids, a dead battery, a faulty fuel tank, or high exhaust temperatures just are a few of the reasons. Accidents between vehicles increase the probability of a fire. [13] Environmental and safety performance management is part of Washington's Safe Driver program.

## 3.SCOPE OF THE PROJECT

The safety system allows the specified solution to reduce the danger rating to zero.

1. Action in the event of a collision or a fire
2. Smoke detection provides a strong warning to passengers.
- 3..Spontaneously reporting an accident or occurrence to the rescue crew.

## 4.HARDWARE REQUIREMENTS

### a. PiezoelectricSensor:

A piezoelectric sensor is commonly used for the measurement of acceleration and pressure, which are two physical qualities. The principle of piezoelectricity is the same in both pressure sensor and acceleration sensor, but the application of force that is supplied to the detecting device changes dramatically. To calculate the force applied to the piezoelectric element, a thin membrane is placed on a large base of the pressure sensor. The piezoelectric material gets stressed and starts to create electrical voltages whenever the applied stress is applied to the thin membrane. The voltage generated is proportional to the magnitude of applied pressure. In the case of accelerometers, seismic mass is coupled to the

crystal element to transmit force applied to piezoelectric materials. When this force is applied, seismic mass loads the piezoelectric material thereby generating the electrical voltages, Based on Newton's second law of motion. The applied force is measured using the electrical voltages created by the piezoelectric material. An acceleration correcting element is used in combination with a pressure sensor since these sensors may pick up undesirable vibrations that can lead to erroneous results.

#### **b. Gas sensors:**

Gas sensors are available in several configurations, depending on the sensitivity level, gas type, physical aspects, and other factors. Gas is ionized and then absorbed by the detecting element when it encountered this sensor. This adsorption results in a voltage differential on the component, which is conveyed to the processing system through output pins as current. The gas sensor modules consist of a metal exoskeleton with a sensing unit within. Voltage is fed to this sensor device through connecting leads. Because of this current, known as heating current, gases that come near the detecting element get ionized and absorbed by the sensing element. The impedance of the sensing material is changed, leading to changes in the flow leaving it.

#### **c. MEMS Sensor**

Micro-electro-mechanical systems (MEMS) is an acronym for micro-electro-mechanical systems. These are a group of devices, and their characterization can be determined by their small size and design method. These detectors can be designed using components that are 1 to 100 micrometers in size. These devices can range in size from simple constructions to complex electromechanical systems with several moving elements controlled by micro-electronics. Pneumatic micro-actuators, micro-structures, micro-electronics, or segments and sub are commonly found in these sensors.

#### **d. IR Sensor**

The IR Sensor module has a pair of infra-red transmitter and receiver tubes, the infrared emitting tube emits a certain frequency, the infrared emitting tube encounters an object tracking orientation (reflecting surface), infrared reflected the tight end tube having received, after a switch circuit processing, the green light lights up, whereas the transmit power will extract transmitted data (a low-level signal), through potentiometer knob. The

good range of the sensor can be modified by the potentiometer, with minimum interference, easy to assemble, and easy to use properties, and can be widely used for robot obstacle avoidance, automobile assembly line counting, and black-and-white line tracking, among other things.

### **5.SAFETY MEASURES**

1. Several methods that were in place for a long time to safeguard the public's life are used to provide bus transportation. The hazard rate of bus transportation may rise because of the boarding procedure and the existence of a vehicle.
2. The below are among the most common bus transit steps:
3. Smoking is banned on the bus.
4. Fireworks and flammable substances are not permitted.
5. Animals are not permitted on the bus.
6. Glass bottles are not allowed on the bus.
7. It is not permissible to bring alcoholic drinks on a bus.
8. No weapon, explosive device, harmful drug, or chemical may be transported on a bus.

### **6.THE OBJECTIVE OF THE STUDY**

1. The purpose of the project is to develop a complete safety system.
2. An efficient accident-response system
3. The time it takes to respond to crashes and fire hazards is short.
4. Incident reporting and archiving
5. The design model facilitates bus monitoring and includes an accident reaction system and alarm.

### **7.EXISTINGSYSTEM:**

The following are the elements of a digital door opener. The Door Regulation Unit, its Gate Frame Circuitry, as well as the Remote Control make up the doorway control system.

For RF signaling, the Remote Control includes a LINX Technologies TXM-418-RM / RXM4 18-Rh4 received signals. This TX/RX pair operates at 418MHz using a SAW architecture, resulting in a frequency source having incredibly low-temperature variance. To increase security and ensure that only those who are allowed can use the remote control, a fingerprint reader is employed. The chip used was the VeridicomFPS110. Figure 1 shows

an example of this chip. A 300-by-300 grid of plates of a capacitor (90,000 capacitance) is spaced with a 50-pm gap beneath the top layer of this silicon wafer. A varied capacitance is recorded by the sensor for each alteration in the length between the ridges and valleys of a finger and the capacitor plate. The capacitance is converted into an 8-bit decimal signal by an on-chip A/D converter, which is subsequently read by the system. When the fingerprint sensor is initially used, it recognizes the user's thumb and records it as a signal on the chip. Every time the client uses a television remote, her fingerprint is scanned, and the controller is enabled if the corresponding identity is detected. Most fingerprint sensors convert digital impulses into a fingerprint. This approach differs from others in that it does not require fingerprints to be photographed. A D/A converter converts digital data from an A/D conversion to analog signals. The Automatic Door Opener uses a 14bit 135MSPS D/A conversion from Nationwide Semiconductor. Finally, biometrics are looked into in the following way: As previously said, the fingerprint is read, and the inductance is transformed into digital information row by column on the chip. A digital-to-analog converter converts the capacitance of each row from electrical pulses to analog signals. The sensor data is then compared to a database of previously stored fingerprints which has been transformed into analog data. If all of the impulses correspond, the authentication is complete, and a signal is delivered to activate a television remote if the identity is authentic. A PIC 16C64A microcontroller distinguishes the Access and CLOSE commands. Any one of the remote control's two buttons delivers information to the controller, which is then decoded. As a radio signal transmission, the encrypted information will be relayed to the door framing receiver. This strategy is depicted as a schematic in Figure 2. To gain access, a keypad safety mechanism mounted on the wall could also be used. By tapping the ENTER key, you can enter your security code. A green LED illuminates whenever the Entry button is pressed, indicating that a message is received. The door will open if the proper security code is entered. To close the door, you'll need another security code. If the wrong code is entered, a red LED illuminates, indicating that access has indeed been refused. If a passcode is entered incorrectly, the CANCEL key can be used to undo the entry. The encoded signal from the control is received by the

parking door's LINX-418-RM complementing reception for the far transmitter. The received signal is decoded using a Holter HT-694 decoder. A 12VDC power source is activated by the deciphered signal, which then triggers the electric deadbolt. The Automated Door Opener's deadbolt is the Locknuts Electric Deadbolt. Whenever the electricity is turned off, the lock expands back into the door. Domestic 110 VAC is used to power this lock, which is then transformed and converted to 12VDC. A timed relay delays the signal, ensuring that the door is unbolted before it has been opened. The antique handle is utilized to close or draw the door.

## 8. PROPOSED SYSTEM

A subsystem is a system that is designed to do one or a few specific tasks in a limited amount of time. It's most often seen as part of a larger gadget that includes both physical-mechanical components. An entire computer, including a desktop pc (PC), on the other hand, is meant to be adaptable and suit a wide range of end-user demands. Many modern devices are controlled by embedded systems. One or more fundamental processing cores, usually microcontrollers or embedded processors, control embedded systems (DSP). However, the most important aspect is that it is tailored to a certain task, which may need the use of very powerful processors. And although they need a mainframe and specific regional and national networks to link airports and radar stations, flight control, for example, maybe called embedded. (Each radar is likely to include one or more embedded devices.) Because it is committed to a particular purpose, design engineers may develop the embedded system to lower the product's size and cost whilst increasing its dependability and performance. Embedded systems are occasionally mass-produced to take benefit of economies of scale. Physically embedded systems include anything from small portable gadgets like wristwatches and MP3 players to huge, permanent structures like traffic lights, process control, and nuclear power plant control mechanisms. When a single microcontroller chip is used, the complexity is low; but, when several units, accessories, and networks are fitted in a big chassis or enclosure, the complexity skyrockets. "Embedded system" is a difficult concept to define in general since most systems are extensible or configurable in some way. Handheld computers, for example, share

some of the same operating systems and microprocessors as embedded systems, and they also allow again for the loading of extra programmers and peripheral connections. Furthermore, even systems that do not encourage programmability as a core feature must allow for generic software changes. Even though the system is "built to accomplish one or a few dedicated tasks," it's reasonable to call it "embedded," since big application systems will have subcomponents ranging from "purpose" to "engrained."

### 9. BLOCK DIAGRAM

The block diagram shows the power source, Arduino boards, Motor Driver, CD Reader for the Exit Door Sign, and different sensors including MEMS sensor, Piezo sensor, Temperature probe, and Gas sensor. This design also includes a notification display LCD at the front of the bus driver. The data will be displayed on the LCD whether any of the sensors are engaged, and the Exit Door will immediately open.

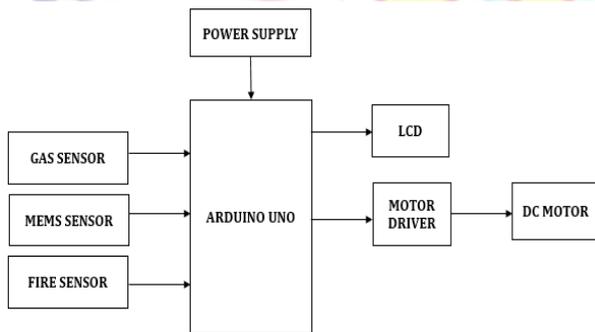


Fig: Block Diagram

### 10. RESULTS AND DISCUSSIONS

The Result obtained from the experimental setup comprised of Arduino board, Motor Driven Module, CD Reader, Power supply Board, Voltage Regulator, LCD Display along with Piezo Sensor, MQ2 Gas Sensor, MEMS Position Sensor, IR Flame Sensor.

The LCD unit is positioned at the viewing point of the driver Such that the performed operation should be pointed out. The Arduino board is the major unit in this entire experimental work which thereby receives the deflections that appeared to the sensors, analyzes the situation, and passes commands to the motor Driven module. The motor-driven module operates the CD Driver which is used as a Motor-Driven Door in this Experiment. The above-listed parts are assembled as shown in the below figure

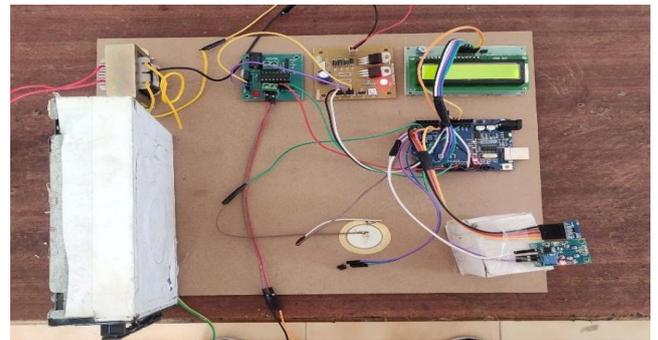


Fig:2. Hardware setup for Emergency Door Opening in Bus



Fig:3. Gas detected notification to driver



Fig:4. Fire detected notification to Driver

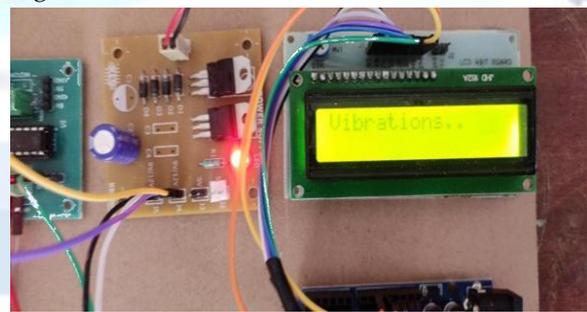


Fig:5. Vibrations detected notification to Driver

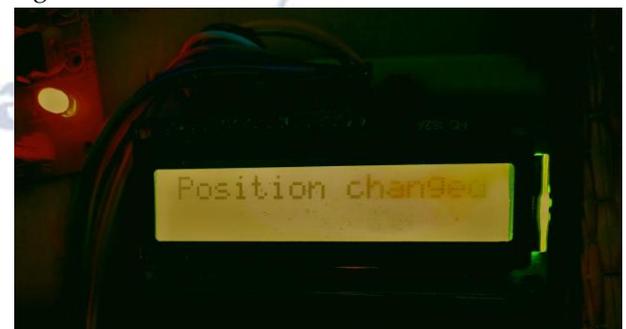
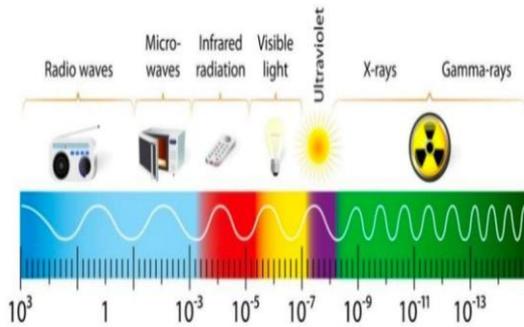


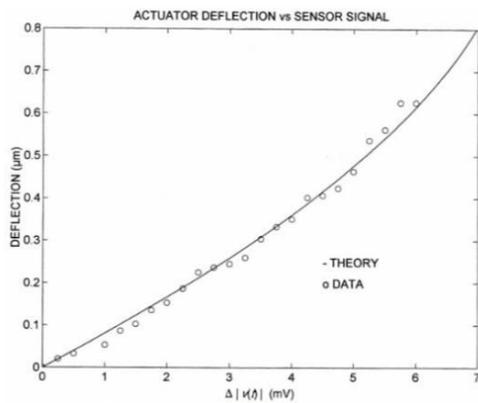
Fig:6. Position changed detected notification

### Graphical values of IR heat sensor



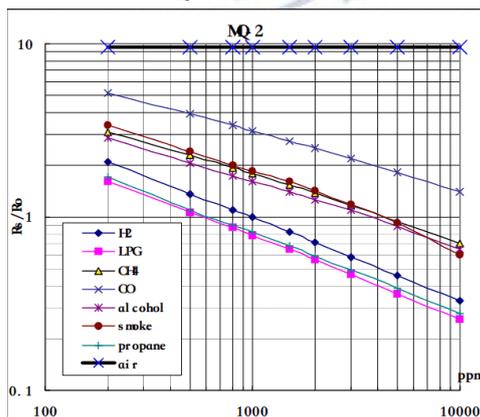
Graphical representation of IR sensor shows that it both emits light and detects motion to perceive an item. Almost all items emit some type of thermal radiation in the Infrared range. Some of the Waves, light, and rays are shown in the above Graphical figure with their respective values. Different waves had their different range of radiation such as Light rays had a range of 10<sup>th</sup> power of -5 to 10<sup>th</sup> power of -7 as tested.

### Graphical values of MEMS Position sensor



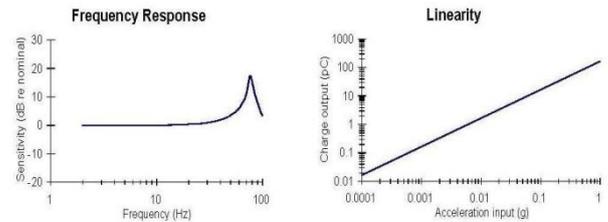
Graphical representation of Mems Position sensor is plotted between Actuator Deflection and Sensor signal based on the Data evolved. The Deflection values are plotted on Y-axis and the Sensor signal values are plotted on X-axis in the graph. When the Deflection angle range exceeds the settled angle the Arduino actuates the Module.

### Graphical values of MQ2 Gas Sensor:



Graphical representation of MQ2 Gas sensor shows the typical Characteristics for several gases. Ro indicates the sensor resistance at 1000ppm of H2 in the clean air. Rs indicates the sensor resistance at various concentrations of gases. Gases such as H2 gas, LPG gas, CH4 gas, Co gas, Alcohol, Smoke, Propane Gas, and Air pollution are referred to with their certain values of ppm for the formation of the graph.

### Graphical Values of Piezo Sensor



Graphical representation of Piezo sensor is plotted on two topics whereas Frequency response and Linearity. Frequency Response is plotted between Sensitivity Vs Frequency, the sensitivity is plotted as the y-axis, and Frequency is plotted as the x-axis. The sensitivity range is taken from -20 to 30 nominal values and the Frequency range is taken from 1 to 100. Linearity is plotted between given Acceleration input(g) Vs Charge output(pO), the acceleration input is plotters as x-axis, and charge generated is plotted as y-axis. Charge generated value starts above the 0.01 electrical volts.

### 11. CONCLUSION

The Movement Sensed Automatic Door Opening System for Buses on Emergency Doors test bench was fabricated and tested for its performance. The ideology of this Project is entirely based on the Automatic Emergency Door Opening system in the event of Gas leakages, sudden vibrations caused by collision effect, Temperature raise caused by fire accidents, and position changes occurring in the tilt condition of the bus. Sensors such as MQ2 Gas sensor, Piezoelectric sensor, Temperature sensor, and MEMS Position sensor are used for a variety of applications. When any of the changes are sensed such as a Gas leak, sudden impact, Temperature rise, or tilt condition the Arduino UNO board which is Programmed as commands, since the changes, activates the power module and displays the notification on the LCD. The power module board supplies the output voltage to perform the Door opening operation.

