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Home Automation System

Proposal Document

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Contents

1)Background

In today's era of advanced technology and gadgets, human life should be more intelligent, uncomplicated, convenient, and effortless. This necessitates the integration of automated technologies into daily human routines to streamline and minimize daily tasks and responsibilities. Home security is one of the most important factors to consider. Because its impact directly affects the residents. Therefore people have found various technological solutions to curb its adverse effects. There are different kinds of matters in the home nowadays like Unsecured Access Points, Outdated or Ineffective Locks, Unmonitored Alarm Systems, Poorly Maintained Security Cameras, electrical shocks, gas leaks, Inadequate Fencing and Gates etc.. Traditional safety methods lead to delayed responses and potential failures so Nowadays people have changed to use modern safety methods instead of traditional safety methods.

Nowadays fire incidents have become a significant threat to human life and property. According to Fire Protection Association 1.3 million fires in 20233,500 civilian deaths, 15,200 injuries, and approximately \$21.9 billion in property damage. Traditional safety methods lead to delayed responses and potential failures so Nowadays people have changed to use modern safety methods instead of traditional safety methods. At present, there is a remarkable increase in the number of home-based fires. Moreover, due to the increase of electrical devices like Lithium-ion batteries, charging stations, Energy storage systems and home designs and materials, the rate of fire incidents have increased.

This project aims to address the gap by developing an automated fire-detecting extinguisher system and a smoke-detecting system. Residents can quickly know about the risk of fire by lightning a light in this system. Because of that, the residents can be informed very soon and reduce the dangers caused by fire. Our main aim is to detect fire and extinguish the fire using a water suppression system. From this project, we aim to make homes safer and smarter by using fire sensors and smoke sensors.

Nowadays homeowners can manage the climate, lighting, and entertainment systems remotely by using voice-controlling devices (Alexa, Google Home), automated light control systems, Climate Control systems, Energy Management systems, Automated Window Treatments and Appliance Control systems.

Although the above-mentioned home automatic systems are currently widely available in the world , no automatic fire safety system has been found in relation to fire safety. There for we have decided to design an automatic fire detecting system ,fire extinguishing system and smoke-detecting system to increase the home safety. So we have prepared all the necessary processes for that.

2) Problem and motivation

2.1) Problem

Safety and security in the house are major concerns that, as of now, most home owners have conventional fire detection systems that normally raise an alarm to alert the occupants in the presence of fire or smoke but do not result in a quick response to quench the fire. This can lead to significant property damage and expose lives to extreme danger. Moreover, traditional house security systems do not have advanced automation capability to bring greater control and convenience. Specific problems which we are going to solve are:

1. Late Response to Fire Outbreaks: The existing systems majorly focus on detection, and virtually no action is taken concerning extinguishing the fire hence spreading further, entailing massive damages.

2. slow response

Manual intervention needed: Most of the fire detection systems need to be operated manually, delaying thus response to the fire.

Integration Limited: Fire detection and extinguishing take time in some systems. Therefore, the fire may not be controlled.

3. Complexity and Installation

Professional Installation Needed: Traditional systems are always installed by a professional. It consumes a much time and expensive.

Complex Configuration: These systems are pretty tough to set up and run due to complexity.

2.2) Motivation

As stated above, these problems can be alleviated by an integrated home automation system in the following ways, which promise the following benefits to society:

1. Improved Safety: The instant response of the autonomous fire extinguisher system at the time of fire or smoke detection may reduce the spread of fire and loss to property along with personal injuries to a considerable extent. Therefore, such safety from fire is life-saving and cost-effective.

2. Cost Effectiveness

Inexpensive components: Arduino and associated sensors and modules are pretty cheap compared with conventional fire detection systems. This affordability will enable many

deployments of fire safety measures in most homes and small businesses which otherwise would not be able to afford them.

4.Low maintenance costs: The simplicity of the Arduino-based system, by extension, reduces the maintenance requirements and consequently the costs involved, thus making this a long-term, sustainable solution for fire safety.

5. Reduced Emergency Response Times: With detection capabilities being linked with how an automatic system reacts to fires, triggering immediate action most probably would be likelier and, in doing so, toward eliminating the emergency service intervention, overall emergency response times would be cut.

6. Enhancing technological development: The designing and implementation of cutting-edge automation systems bring in a culture of innovation and the adoption of smart technologies. This would not only enhance the safety and security of each home but also set up society toward its evolution into smart cities and interlinked systems. We shall strive to breathe new life into living environments that are much more secure, much safer with full home automation, and technologically more advanced—for humanity. We are close.

3)Aim and Objectives

3.1)Aim

The main aim of this project is designing of an affordable, reliable security home automation system using Arduino which is based on safety and fire protection. There are Three Stages of this Project. They are Fire detecting system, fire-extinguishing system and smoke-detecting system. Moreover, homeowners will have a fire-alarm warning system that is connected to the automated system and can even detect any form of house-fire. This system also offers automatic focused water suppression to take care of any type of fire. It can also save human lives and home properties by facilitating in reducing chances of home fires. This system informs very quickly when there is a fire or smoke so homeowners can take the proper measures at the right time, so they can reduce their property damage. We are making a user-friendly product that can be easily installed in modern homes. we create this reliable fire extinguishing system to be used by every average homeowner very easily by using a 12v & 7.4v Battery,5v Relay module, Mini water pump, pipe, Jumper wires, flame sensor module, smoke sensor module, Buzzer, Sun board sheet, Breadboard

3.2)Objectives

1.   System design and integration

Design a circuit that use the all components like Arduino board, 12v &7.4v Battery, 5v Relay module, Mini water pump pipe Jumper wires flame sensor module , smoke sensor module, Buzzer

Conduct some tests to certify that all electrical components are protected from water.

2.   Fire Detection Mechanism

This system detects fire using Arduino and a fire Sensor. It must detect fire and respond within 5 seconds. Also, the false alarm warning percentage should be under 1%.

Conduct testing with different kinds of fire sources

3.   Development of an extinguishing System

Create an automated suppression system using a relay module and mini water pump which activates in 3 seconds after fire detection. Conduct the experiments to identify the best water spray pattern
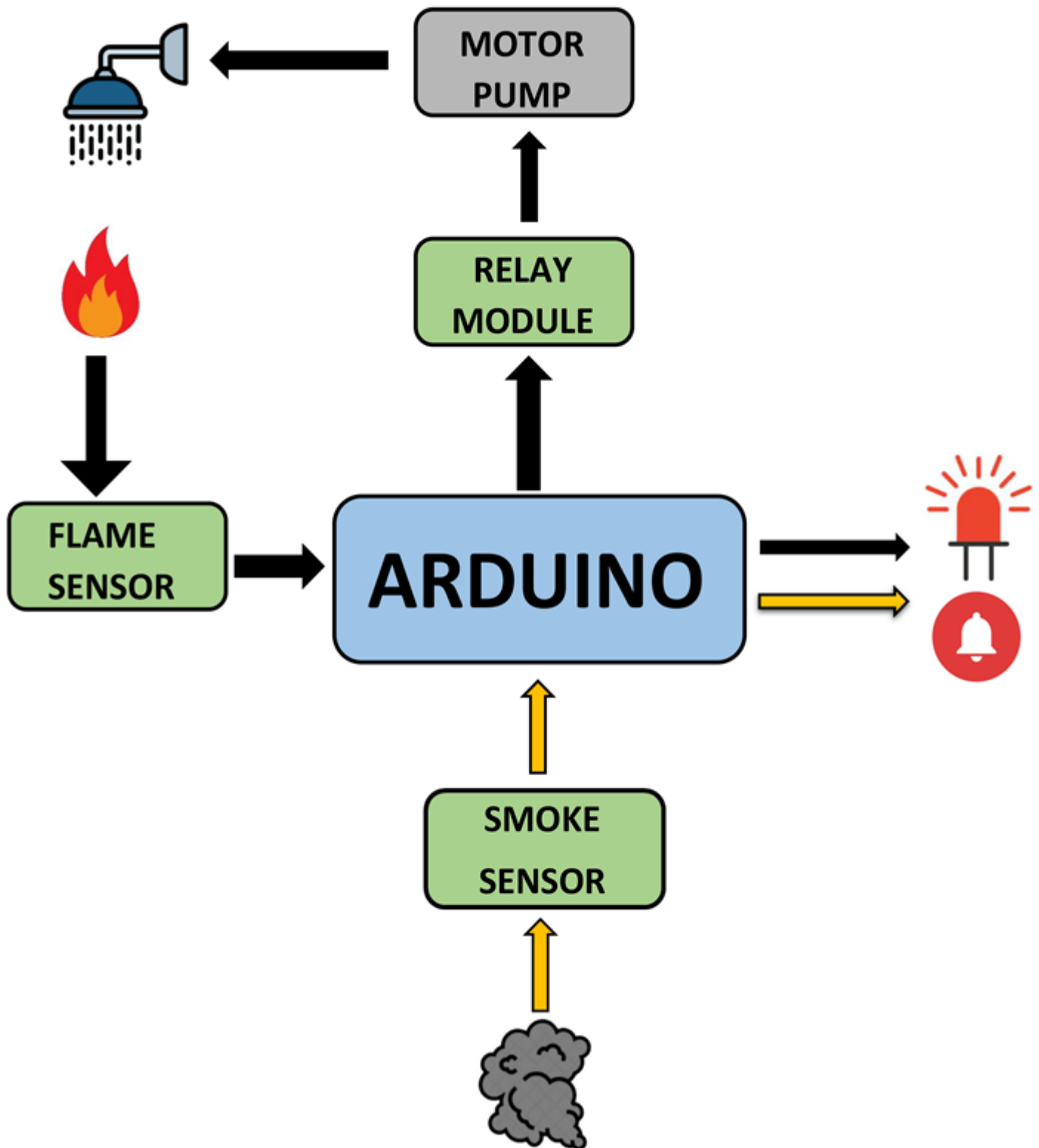
4.   System Testing and Calibration

Conduct a few test runs under different kinds of temperatures to check the reliability rate close to 95%.

5.   Automated smoke detecting system

Create a smoke detection system with an alarm signal and a light system

4)System Diagram

5)Methodology

5.1)System overview

Fire extinguisher system

a)   Detection of fire
     After the fire sensor detects a fire, it sends an analog signal to the Arduino.

b)   Activation Decision:
     After the arrival of the analog signal from the fire sensor, it decides whether it must activate the extinguisher or not

c)   Relay Activation:
     The Arduino sends another signal to the relay to close the circuit. It uses an electromagnet to operate a switch mechanically.

d)   Solenoid Valve Opening:
     The closed relay allows current to flow to the solenoid valve, opening it.

e)   Extinguishing Agent Release**:**
     The open solenoid valve releases the extinguishing agent to extinguish the fire

Smoke detection system

a)   Smoke Detection
     when the smoke sensor detects smoke, it sends signals(Analog value) to the Arduino

b)   Activation Decision:

     Arduino reads the analog value from the sensor and then this analog value is converted into meaningful smoke level measurement.

     Compare the smoke level with the predetermined threshold

c)   Alarm activation

     if the smoke level is above the predefined threshold level, the Alarm will be 'on'

     if the smoke level is below the predefined threshold level, the Alarm will be 'off'

d) Display smoke level on LCD

    Convert raw sensor inputs into readable formats and send to LCD display

5.2)Hardware Requirements

Breadboard

A breadboard is a solderless construction base for developing an electronic circuit and wiring for projects using microcontroller boards like Arduino. As common as it seems, it may be daunting when first getting started with using one.

FLAME SENSOR

The flame sensor detects flames by measuring infrared (IR) radiation emitted by hot bodies using an IR photodiode. When the detected IR radiation exceeds a set threshold, the sensor's output changes. When combined with an Arduino, this sensor provides an effective solution for fire detection and response, enhancing safety and automation systems. flame detectors are not all the same. Many brands and models are out in the market, and while all of them do basically the same thing, they each operate and perform a bit differently in response to particular hazards.

This can be divided into four categories. If they are, Ultraviolet (UV) Flame Detectors, Infrared (IR) Flame Detectors, Multi-Spectrum Infrared (MSIR) Flame Detector , Visual Flame Imaging Flame Detectors

MQ-5 GAS SENSOR

The MQ-5 gas sensor has been specially developed to detect flammable gases, hydrogen gas (H2), LPG, CH4 (methane), carbon monoxide CO, and alcohol. This sensor is appropriate for secure staffing solutions in both homes and industries due to its high sensitivity, fast response time, and adjustable sensitivity through a potentiometer. Sensors of this kind perform very well when set to detect gases like butane, propane, and liquefied natural gas. Because it has a low cost and is highly versatile, it can be applied to many gas leakage detection tasks.The MQ-5 gas sensor employs **MOS technology** in the mechanism of detecting different gases. It uses tin dioxide SnO_2 as the sensing material, changing its resistance in response to being exposed to methane, propane, and butane gases

Buzzer

12V mini warning buzzer with a piezoelectric sounder. Ideal for warning that indicators are operating but can be used for numerous other applications. Surface mounted via single screw hole and connection is via 6.3mm male/female terminals with polarity markings. Interior use only. The 12V mini buzzer utilized together with a smoke detector project generates its sound utilizing either piezoelectric or electromagnetic technology. In piezoelectric buzzers, the vibration of a crystal or ceramic disc is utilized to produce the sound. In electromagnetic buzzers, an

electromagnet and diaphragm have been used to produce the sound. With 12V DC powering and driven by an Arduino through a relay or transistor that manages high current, the buzzer is used. It takes an input from the smoke sensor, amplifies the signal, and triggers the buzzer to produce a warning in case of smoke detection. The setup offers high volume and clear warnings, adjustable sound intensity, and simple integration with Arduino, therefore acting as the best device for smoke detection systems.

IDUINO 1602 16x2 LCD Module Shield

The IDUINO 1602 16x2 LCD Module Shield is basically an implementation of a display utility for smoke detectors. It has a high-contrast 16x2 character LCD with a yellow-green backlight and supports connection to an Arduino via the IIC/I2C interface only using two data lines, hence easy to connect and communicate with. This technology is thus able to show important information like sensor data and the condition of the system, which much increases the usefulness and ease of implementation of the whole project.

Jumper wires

Jumper wires are important for projects with an Arduino due to the clear, yet at the same time, flexible way they provide connections among components. With male or female connectors in various colors and lengths, they make connecting to a breadboard or directly to the Arduino easy without soldering. These wires ensure that your work is clean and compact for easy prototyping or any other experiments on various setups.

5.4) Software Requirement

Arduino IDE

Arduino Integrated Development Environment is a free, open-source user-friendly software application used for writing, compiling, and uploading code to the Arduino microcontroller board. It runs on Windows, macOS, and Linux machines using the C and C++ programming languages. Important features include a modern code editor; integrated libraries and board management; serial monitor and plotter; debugging tools; cloud integration; extensibility with plugins; command-line interface; and robust management of the sketchbook. Supported by a huge community, this IDE is good for hobbyists and students, and professionals working in any project ranging from a simple prototype to large applications.

5.5)Tools and Technologies

ARDUINO - Arduino is a platform that enables students, teachers, hobbyists & professionals all over the world to build projects & applications that run on tiny computers. It consists of user-friendly hardware & software that help in designing interactive projects everywhere from home, school, classroom or even at the professional level. The user can input/output sensors, buttons or motors/ led lights through the microcontroller on board by using Arduino programming language code and IDE. The work on Wiring started 2003 in the Interaction Design Institute of Ivrea to facilitate the student's work with electronics using Arduino. This was further enriched to an entire set of IoT, wearables, 3-D printing and embedded systems applications. With a worldwide community of makers: students, hobbyists, artists and professionals with experience there comes a great knowledge base for both newbies and experts to develop sophisticated electronic solutions.

ARDUINO'S TECHNOLOGY

Ardino is not just a prototyping platform but an open-source project that allows people to create interactive projects with the use of electronic machinery and software that are user-friendly. It provides programmable microcontroller boards for processing the input that it gets from the sensors, buttons, online data, etc., and the results are then used for different purposes like motor control and LED thundering. Key components:

1. **Arduino Boards**: They are special circuit boards, which can be programmed, they are of different complexity such as 8-bit and 32-bit ones.

2. **Arudiuo IDE**: The programming environment that is a very needed software that is the reason why there are programmers such as the authors of the programs using the simple programming language that is used by both beginners and experts in a perfect way.

3. **Open Source Resources**: These are hardware designs and software libraries which are available publicly and which a global community constructs and innovates.

4. **Versatility**: Not just hobby projects but IoT, robotics, or industrial prototyping too are the areas where it is used.As a whole, the Ardino is a force of technological change and improvement through its efficient performance while its development is being the dedicated goal of people around the world.

6)Evaluation method

The evaluation of the fire extinguishing system should analyse the different factors and components implanted in the system to enhance productivity and efficiency. The evaluation process ensures the system is up to its standards and user- friendly

6.1)Functional evaluation

Accuracy and Reliability

Sensor accuracy :   measure the ideal sensors used to monitor temperature, and smoke detection
Comparing sensor readings with manual measurements several times can
ensure the accuracy of the system.

reliability: Test the system under various conditions to ensure consistent performance, detect
failures and record it

Data transmission and Storage

Connectivity**:** Evaluate and ensure data is transmitted without significant delays or losses

Data integrity: verify that the data is collected in an accurate manner and stored in the   database
Check for any corruption or loss

6.2) User-centric Reliability

Installation and maintenance

User-friendliness: Evaluate the simplicity, user-friendliness and ease of installing the system
Ensure the installation is easy and simple

6.3) performance

Effectiveness**:** Analyse how well the system will detect and extinguish the fire, and alarms
activation in a short period

Safety features**:** This fire extinguishing system is automated. So, it can work automatically, and
no one has to operate the system from outside, thus reducing any potential
risks. Implant an automatic water pump to improve the efficiency of the fire-
extinguishing process

6.4) feedback from users

Collect feedback from the users who used the system frequently .

Objective:- feedbacks /Reviews from users should be positive .

Gather recommendations from the users to refine the quality of the product

Send out feedback forms to evaluate the user- experience of the product

6.5)Budget

Item	Price
Arduino Uno	RS.2850
5V Relay module	RS.240
Micro DC water pump	RS.250
Buzzer	RS.100
IR flame sensor	RS.200
Jumper wires	RS.250
9V battery	RS.200
MQ-5 smoke sensor	RS.500
Total	RS.4600