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Design and Fabrication of Automated Fire Fighting Robot

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Abstract: ***Flames can cause critical harm and death toll, and it is pivotal to have powerful measures to control and douse them. The utilization of robots for firefighting activities has become progressively famous, provided their capacity to work in risky and testing conditions. In this paper, we present a point-by-point concentrate on the plan, improvement, and execution of a putting out fire robot. The putting out fires robot Is intended to explore through jumbled and temperamental conditions and furnished with sensors and cameras to identify and screen the fire. It is additionally equipped for conveying and sending firefighting gear, for example, quenchers and water hoses. The plan includes choosing the suitable sensors, actuators, and power sources to accomplish the ideal usefulness. The robot's motion framework is intended to empower it to travel through lopsided territory and flotsam and jetsam, and it has a controller arm to get and work firefighting gear. The execution includes building the actual equipment and fostering the product that controls its activities. The equipment might be created utilizing a blend of off-the-rack parts and specially constructed parts. The product is intended to empower the robot to work independently in a putting out fires situation, utilizing Al calculations to identify and group various sorts of flames and select proper reactions in view of the seriousness of the circumstance. The robot is additionally intended to speak with human administrators, empowering them to screen the robot's activities and settle on choices in view of the data given by the sensors***

Keywords: Robotics, Autonomous, Sensor, Imaging technologies, Control system, Emergency response

I. INTRODUCTION

Fire mishaps are a difficult issue around the world, and they frequently bring about huge harm to property and death toll. In this way, it is urgent to foster successful putting out fires techniques to limit the harm brought about by flames. Conventional putting out fires' techniques depend vigorously on human mediation, which can be risky and tedious. As of late, mechanical technology has arisen as a promising answer for putting out fires, and the improvement of putting out fires robots has turned into a significant exploration subject.

Tawfiqur Rakib, M. A. Rashid Sarkar proposed a firefighting robot model which consists of a base platform made up of 'Kerosene wood', LM35 sensor for temperature detection, flame sensors to detect the fire and a water container of 1 litre capacity which is made up of a strong cardboard that makes it water resistant. The robot has two wheels for its movement. [1]

Saravanan P.Soni Ishawarya proposed a model which uses Atmega2560 micro-controller and in which the robot is divided into three basic units according to their functions which are as locomotive unit, fire detecting unit and extinguishing unit.Each unit performs their task in order to achieve the desired output of extinguishing fire. The locomotive unit is used for the movement of the robot and to avoid the obstacles with the help of four IR and four ultrasonic sensors. The fire detecting unit is used to detect fire using LDR and temperature sensor. The extinguishing unit is used to extinguish the fire using water container and BLDC motor. The robot also has a bluetooth module that is connected with the smartphones in order to navigate it in the proper direction. [2]

S. Jakthi Priyanka,R. Sangeetha proposed an android controlled fire-fighting robot which uses Arduino UNO R3. The robot consists of gas sensor for fire detection, gear motor and motor drive for the movement of robot, a bluetooth module to connect the robot with the android device and to control the robot with the smartphone as well.

Water pump and sprinkler is also used in this. To instruct the Arduino UNO an open-source software which is Arduino IDE is required to code and to implement that code in Arduino UNO. [3]

Nagesh MS, Deepika TV, Stafford Michahial, Dr M Shiva Kumar proposed a fire extinguishing robot which employs DTMF (Dual Tone Multi Frequency Tones) technology for the navigation of the robot and uses a flame sensor for fire detection that is capable of sensing flame of the wavelength range 760 to 1100 nm and sensitivity varies from 10cm to 1.5feet. [4]

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Sushrut Khajuria, Rakesh Johar, Varenyam Sharma,Abhideep Bhatti proposed an arduino based fire fighter robot which consists of RF based remote operation to operate the robot and water pump. The robot is controlled by the user within a range of 7 metres. It also consists of a wireless camera which helps user to move the robot in the required direction.[5]

II. METHODOLOGY

The putting out fires robot is intended to be equipped for exploring through obstructions and moving in tight spaces, giving continuous data about the fire, and performing different firefighting errands like showering water or stifling specialists. The robot is outfitted with cutting edge sensors like temperature sensors, gas sensors, and smoke alarms to distinguish the area and seriousness of the fire. The robot is controlled remotely utilizing a remote correspondence framework and is furnished with a water or froth tank for quenching the fire

1) *Characterize Prerequisites:* Decide the useful necessities of the robot, like its versatility, sensors, correspondence framework, and control framework, in view of the putting out fire's situation.
2) *Reasonable Plan:* Foster a calculated plan of the robot that incorporates the significant parts, like the undercarriage, sensors, and actuators, and their game plan.
3) *Point By Point Configuration:* Refine the reasonable plan and make itemized plans of every part, including their aspects, materials, and assembling processes.
4) *Prototype Development:* Fabricate an actual model of the robot utilizing the point-by-point plans, and test its usefulness and execution in a controlled climate.
5) *System Integration:* Coordinate the equipment parts, like the engines, sensors, microcontrollers, and correspondence modules, and foster the product for the control framework.
6) *Testing and Approval:* Test the robot's exhibition in various situations, like snag aversion and fire location and concealment, and approve its usefulness and unwavering quality.
7) *Field Organization:* Convey the robot in a true fire situation and assess its exhibition, and make any important acclimations to work on its presentation. The strategy might change relying upon the putting out fire's situation and the ideal robot abilities. For instance, a robot intended for indoor firefighting might have unexpected prerequisites in comparison to a robot intended for open air firefighting. The decision of equipment parts, programming calculations, and testing techniques will rely upon the application and execution objectives of the robot. the block outline of Fire Fighting Robot the practical blocks are demonstrated and the activity or order bearing are shown obviously. The singular blocks and circuit of every one is made sense of in the following areas. The accompanying stream graph gives the full practical thought of the entire task.

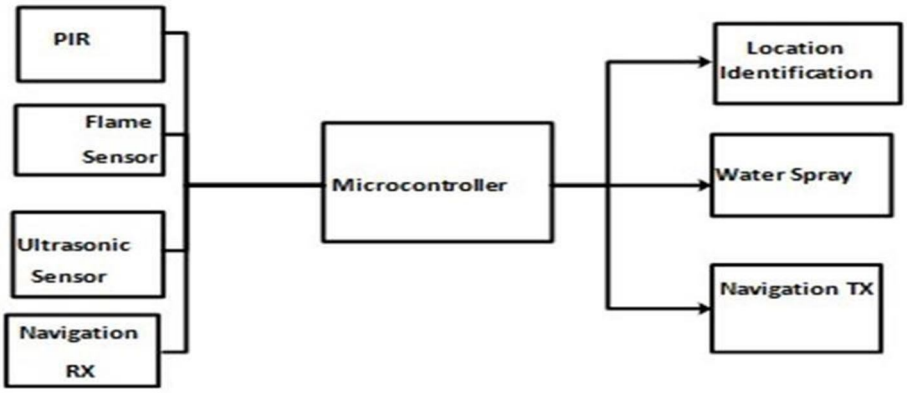


Figure2.1: Block diagram of proposed System

A. *Hardware Description and Prototype*

The equipment part is the primary segment of the improvement of a framework or Robot. Various sorts of sensors like fire sensors for identifying fire, PIR sensors for discovery of human and Ultrasonic sensors for estimating the distance among article and Robot has utilized. Four stuff engine, L293D engine driver, utilized for controlling rate and bearing of the engine. Furthermore, a DC sub siphon likewise utilized for showering water at the pipe. The carried-out model has portrayed in Figure 2. The portrayal of various equipment has cried:

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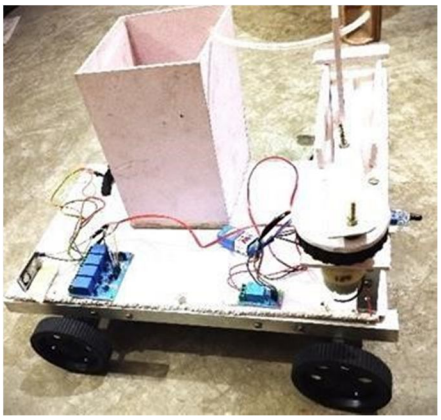


Figure 2.2: Implemented prototype of firefighting robot

1) *Gear Engines:* In this proposed model utilized four stuff engines. Require voltage for dc gear engine is 12v. The principal benefits of stuff engines are that it can convey more weight. The speed of the stuff engine is high. The speed of stuff engines fundamentally relies upon force. Assuming that force is low, speed will be high; assuming force expands, speed will likewise slowly diminish. It is more like an unbalanced connection among speed and force of the engine.
2) *Ultrasonic Sensor:* In this undertaking utilized one ultrasonic sensor which can recognize snag so Robot can undoubtedly stay away from the hindrance in its way. The ultrasonic sensor estimates the distance among Robots and articles; it sends data to ESP-32 so that engine speed and bearing change.
3) *Flame Sensors:* In this proposed model involved four fire sensors toward every path of the Robot. So that at whatever point fire identifies any side of the Robot, Robot can play out its activity at any moment vitally. The fire sensor identifies fire and sends data to ESP-32 so the Robot plays out its activity and shower water. Fire sensors recognize the frequency of the fire, which is tiny.
4) *Water Siphon:* The water siphon is an indispensable piece of this Robot as it will siphon water or cleanser to stifle the fire contingent upon the class of fire that happens. For this Robot utilized a 12V water siphon, it splashes water at whatever point it recognizes fire by any of the fire sensors. At the point when Robot identifies a fire, it pivots the water siphon to the fire area and showers water to sooth it.
5) *PIR Sensor:* The PIR sensor is one sort of IR sensor. It recognizes infrared radiation. It can recognize infrared radiation produces from the human body; it can distinguish human presence, so thus, the PIR sensor utilized in this task for identifying human presence who is trapped in chimneys

B. *Logic Table For H-Bridge Circuit*

Table 1: Logic table for H-Bridge Circuit

Input A	Input B	Motor Action
0	1	Forward
1	0	Reverse
0	0	Idle
1	1	Idle

Two arrangement of H-Bridge is utilized for the movement of robot and one is utilized for detecting the fire for example turns the sensor and fixes the heading of the fire.
We are utilizing D.C engine of type long-lasting magnet one the inversion is done exclusively through course adjustment of current move through the armature.

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The speed control is accomplished by the procedure beat width balance (PWM). The obligation cycle is changed in equipment and furthermore through the miniature regulator programming. Here we are dealing with programming method.

Ex-or rationale door is utilized to really look at the info information in the event that it is same one it produces coherent one result and semiconductor drive the

Strobe pin of LM311 and for divergent info the strobe pin is dynamic high and perform typical activity. For exchanging Darlington semiconductors NPN and PNP Comparative trademark semiconductors are utilized. (TIP 122 and TIP 127)

The model can be tried in a controlled climate to assess its exhibition and to recognize any plan or functional issues that should be tended to prior to conveying the robot in the field.

III. SYSTEM DESIGN AND IMPLEMENTATION

1) *Versatility Framework:* The portability framework incorporates the body, wheels or tracks, engines, and batteries. The robot ought to have the option to travel through unpleasant territory and over impediments to arrive at the fire.
2) *Sensor Framework:* The detecting framework incorporates sensors like temperature sensors, gas sensors, and optical sensors (e.g., cameras) to distinguish the fire, recognize the fire's area and size, and identify obstructions.

a) Operation

When it goes closer the temperature sensor gives the result that is more noteworthy than the set worth promptly robot pauses and stifle the fire. After smother the fire the caution goes on till the reset gave to the regulator.

The robot is furnished with Nickel cadmium re chargeable battery; through the terminal it tends to be charged utilizing a 7.5V/500mA battery charger

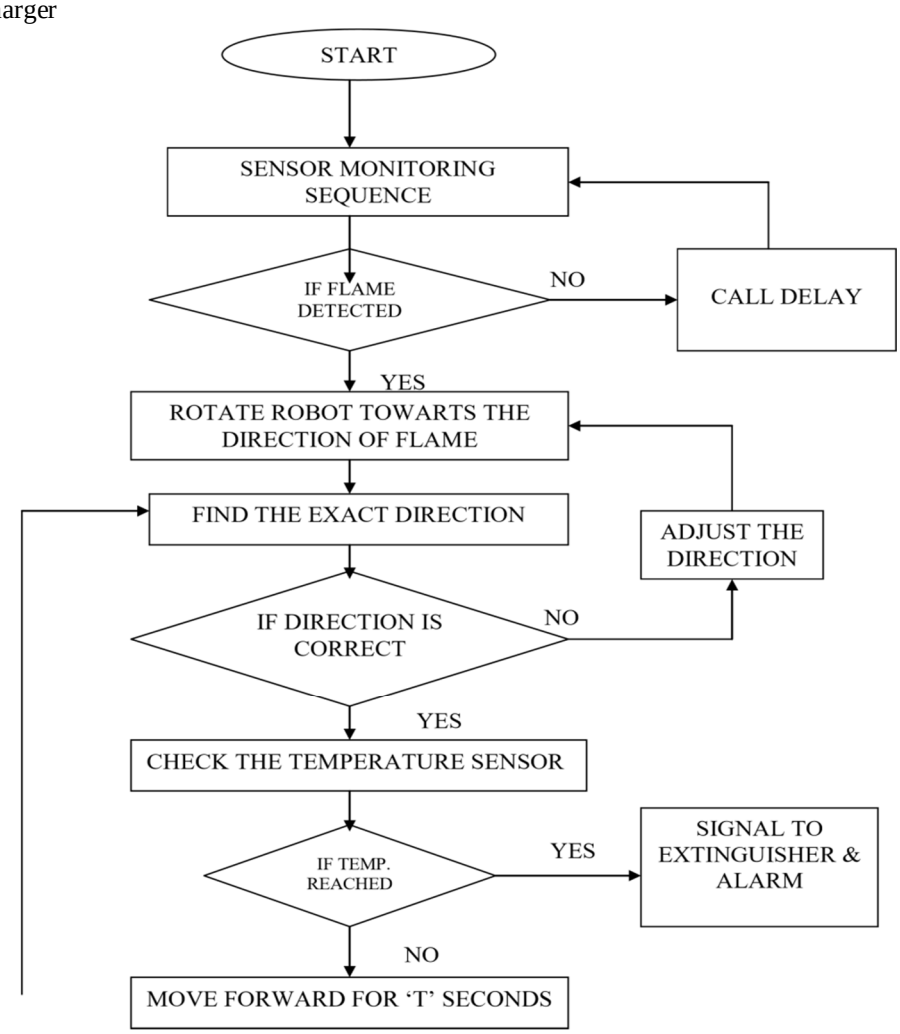


Figure 3.1 Functional flow

3) *Temperature Circuit:* The temperature circuit on a putting out fires robot commonly incorporates a temperature sensor, a sign melding circuit, and a microcontroller or a solitary board PC (SBC) for information handling and control. The temperature sensor can be a thermocouple, an opposition temperature indicator (RTD), a thermistor, or an infrared (IR) sensor, contingent upon the application prerequisites. The temperature sensor is put close to the fire or a way off from the fire, contingent upon the ideal estimation exactness and security contemplations. The above fig.3.2 shows the temperature detecting part comprises of Promotion 590 which is a metal bundle transducer (likewise accessible in SOIC and level pack) and a voltage-dropping resister. The voltage drop across the resister gives the corresponding voltage as far as temperature increment or abatement. The result current from the promotion 590 is autonomous of the resister associated in series, since it is consistent current drive unit relative to the temperature raise. The result is straightforwardly associated with the ADC divert present in the miniature regulator through a series security resister of 10

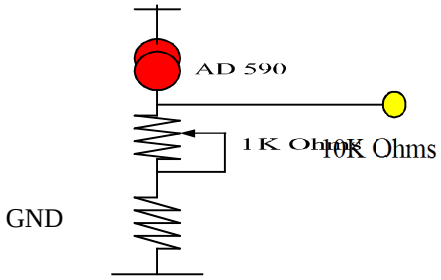


Figure 3.2 Temperature detecting Circuit ohms.

The sensor yields acclimated to detect the fire by fluctuating the series resister and change of voltage is accomplished to meet the necessary variety which we can recognize the fire and ordinary light beams.

4) *Control framework:* The control framework incorporates a microcontroller or a solitary board PC (e.g., Raspberry Pi) that processes the sensor information, decides, and conveys control messages to the engines and the sprayer.
5) *Fire Concealment Framework:* The fire concealment framework incorporates a water tank, a siphon, and a sprayer to stifle the fire. The execution of a putting out fire's robot includes the determination and mix of these parts into a utilitarian robot. The versatility framework ought to be intended to give the robot the essential speed and mobility to explore through the fire site. The detecting framework ought to be delicate and exact to the point of distinguishing the fire and hindrances continuously. The correspondence framework ought to be dependable and get to guarantee continuous information transmission between the robot and the controller station. The control framework ought to be intended to handle the sensor information and settle on choices in view of the fire circumstance. The fire concealment framework ought to be intended to stifle the fire successfully. The execution of the putting out fire's robot will rely upon the necessities of the putting out fires' situation and the plan objectives of the robot. The robot's equipment and programming parts ought to be upgraded to accomplish superior execution, unwavering quality, and security in the putting out fire's activity.

IV. RESULT AND DISCUSSION

The consequences of a putting out fires robot research project are commonly introduced as quantitative and subjective information, which can be examined and talked about to reach determinations about the robot's presentation and viability. Here are a few vital parts of results and conversation for a putting out fires robot:

1) *Quantitative Outcomes:* Quantitative outcomes might incorporate estimations of the robot's speed, scope of movement, firefighting abilities, and other execution measurements. These outcomes might be introduced in tables, diagrams, or outlines, and can be dissected measurably to assess the meaning of any distinctions between various test conditions or robot arrangements.
2) *Subjective Outcomes:* Subjective outcomes might remember perceptions of the robot's way of behaving and execution for various situations. These perceptions might be kept in field notes, photos, or recordings, and can be utilized to recognize qualities and shortcomings in the robot's plan and activity.
3) *Conversation of Discoveries:* The conversation segment of a putting out fires robot research paper commonly gives a definite examination of the outcomes, reaching determinations about the robot's presentation and viability considering the information gathered.

This might incorporate a conversation of the robot's capacity to explore through trash and deterrents, its capacity to stifle various sorts of flames, and its dependability in high temperature conditions.

a) Time Needed for Sooth Fire Depends on the Distance between Fire Source and Robot

Robots can effectively find the location of the fire automatically and sooth it. The operator can control and monitor the FF robot by an android device. First, it must connect via Wi-Fi, and ESP-32 already has this system. Figure 5 shows the amount of time required for sooth fire mainly depends on the distance between the Robot and the location of the fire.

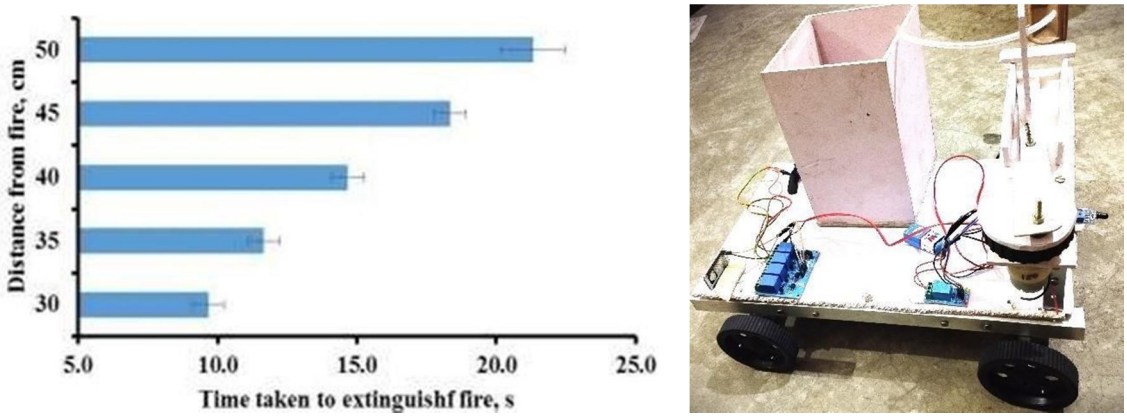


Figure 4.1 Time taken on fire

Correlation with Existing Frameworks: The conversation segment may likewise incorporate an examination of the putting out fire's robot to existing frameworks, like human firemen or customary firefighting gear. This correlation might feature the benefits and constraints of the robot, and can assist with illuminating choices about the organization and utilization of the robot in certifiable putting out fire's situations.

b) Ability To Detect Human Body Which Is Stuck In The Fireplace

In the client terminal of the Adafruit IO, every one of the information will be shown. The terminal will show which time fire has happened and when the human was distinguished (Figure 8). It very well may be gotten to through the web, from anyplace for remote checking. From here, it can comprehend Robot recognize people or not. At the point when people recognized, it can see the message "Human presence

Future Headings: At last, the conversation area might give suggestions to future innovative work of putting out fire's robots. This might incorporate ideas for working on the robot's plan, trying techniques, or functional conventions, as well as distinguishing possible applications for the robot in other crisis reaction settings.

By and large, the outcomes and conversation segment of a putting out fires robot research paper ought to give an extensive investigation of the robot's presentation and viability, and ought to feature its true capacity for further developing putting out fires abilities and decreasing dangers to human fireman

V. CONCLUSION

All in all, the improvement of putting out fire's robots can possibly upset the way we approach firefighting and crisis reaction. These robots offer the upsides of expanded security for human firemen, upgraded portability and route capacities in troublesome territory, and improved firefighting execution using progressed sensors, imaging advances, and computerized reasoning calculations.

The innovative work of putting out fires robots includes many interdisciplinary fields, including mechanical designing, electrical designing, software engineering, and materials science. To effectively plan and carry out these robots, specialists should cautiously think about elements like the robot's equipment and programming parts, control frameworks, warm administration, and firefighting capacities. While critical headway has been made in the improvement of putting out fire's robots, there are yet many difficulties to be survived.

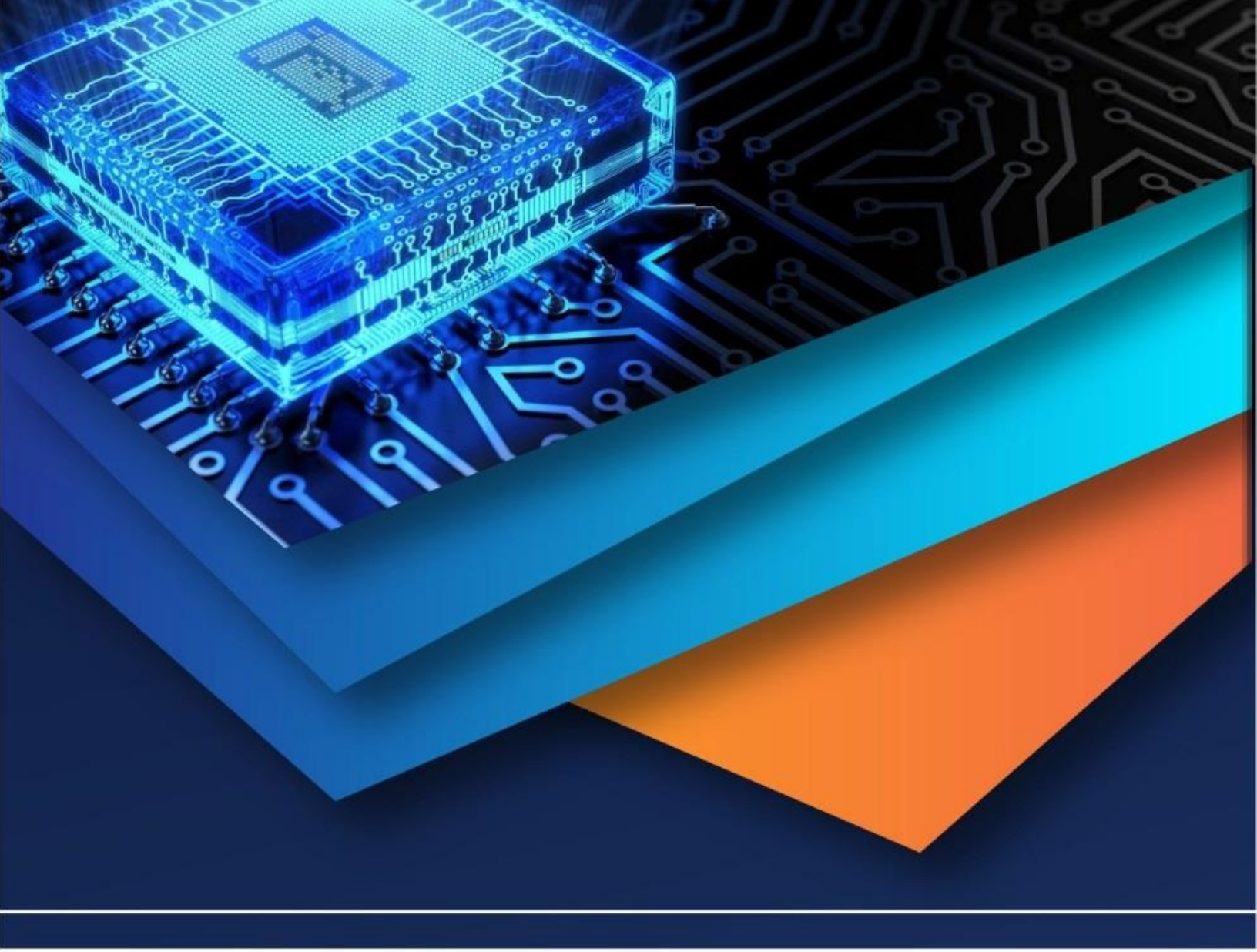
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These incorporate guaranteeing the unwavering quality and toughness of the robots in cruel conditions, working on their route and versatility capacities, and growing further developed firefighting innovations that can quench a more extensive scope of flames.
Generally speaking, the advancement of putting out fires robots addresses an intriguing and promising area of examination, with the possibility to fundamentally further develop crisis reaction abilities and save lives. Proceeded with interest in this space is fundamental to guaranteeing that these robots can be sent in true situations, and to propelling the field of advanced mechanics and mechanization even more comprehensively

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