Logbook

2024-5

NOTES

DATE: 2025/01/14

Schedule

- **January 15-17:-**
- Pick a science fair topic based on personal interest. Then research about it to know background, relevance, and application in real life. This would be step 1, as you plan project beginnings into project direction and defined scope of the experiment. This topic would also match the criteria of the Science Fair.
- **January 18-20:-**
- Order all supplies and equipment needed to perform the experiment. Work on understanding how the whole machine concept works individually for each element. Write a clear problem statement defining the research question and formulate null, positive, and negative hypotheses to be proved during the experiment.
- **January 21-23:-**
- Find and list all external independent, dependent, and controlled variables involved in the experiment. Collect-and-Source all those links to references. Make a diagram or flowchart that visualizes how these supplies and components will come together and function on one another to set an evident template for the experimental setup.

DATE: 2025/01/14

January 24-26:

- Collect components and parts of a full project. Test each item separately to ensure that it meets acceptance criteria before running a realistic experiment. Record extensive notes on issues and changes made throughout the period, which can include modifying of parts or troubleshooting until its proper operation.
- **January 27-29:**
- Finalize robot assembly and testing configuration. Proceed with the experiments and trial-tests on it for any failures in the system. Describe the procedure of testing the robot, focusing on any surprises during the test. Change the procedure for better accuracy and reliability in results if necessary.
- **January 30-February 1.**
- Robotic Data Collection by clean and arranged form of all result data. Revised any required documentation and changes taken by feedback from testing. Ensure repeatability and verification.

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February 2-4:

- Final tests and results are to be concluded. One focus is to attempt to improve the data and robot performance. The second is to revise the experiments using insights gained from this analysis for the reliability and reproducibility of results. Any changes would be documented, especially if improvements in efficiency or accuracy have potentially been gained.

February 5-7:

- Write the conclusion based on results and the testing procedure. Major findings are summarized and their implications discussed. To present the problem, hypothesis, procedure, data table, and results informatively, the trifold presentation needs editing. The trifold has to look pretty.
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February 8-10:

- Set up the trifold by adding creative fire designs along the borders and print all the necessary materials. Analyze and, if needed, edit results in terms of correctness and relevance. Afterwards, draw from this research to enhance the experiment while overcoming any limitations encountered during testing and improving it based on recommendations and insights. Document possibilities of further improvenment of the experiment.

DATE: 2025/01/14

February 11-13:

- Trifold preparation and layout planning. All the while, it should have a project theme and look attractive. Use colored paper; graphics; and charts to flavor up the board. Be sure all sections are present and arranged clearly and organized.

February 14-16:

- Print all the project sections: the hypothesis; the problem; the question; the procedure; the data table; the results; and the conclusion. Arrange the printed items neatly and paste them on the trifold paper. Finishing touches can be labeling, decoration, or adjustment to refine the overall presentation and to achieve visual balance.

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DATE: 2025/01/15

Notes:-

The various project ideas considered included line-following cars, delivery drones, smoke detectors, and smart dustbins, after which I settled on the fire-fighting robot. I had originally shown interest in smoke detectors because these alerted people to fire. Their limitation, however, was clear to me after I thought a bit more: they beep, but they do not actively try to stop the fire! This led me to consider something that could both detect and do something about the fire.

Hence, I thought of a robot that would fight fire. A robot that detects fire, moves toward the fire, and sprays water to extinguish it. Unlike smoke detectors that only alert people, this robot makes an effort to respond to the fire. Though not necessarily for larger fires, this could assist in confined spaces like homes or offices. This may be just an interest for now, but it is a move toward enhancing the fire safety regulation with automation.

DATE: 2025/01/16

Work done:-

I have a project for the science fair working on the design of a fire-fighting robot that detects and extinguishes the fire as opposed to smoke detectors, which only beep to alert human beings. It has a system working on the principle of the motherboard Arduino, which acts as the "brain" of the system and works to process all the information and control the actions of the robot.

The robot consists of a flame sensor continuously checking for any signs of fire. On the detection of flames, the flame sensor transmits data to the Arduino system for processing. After processing the signal received from the flame sensor, the Arduino sends command signals to the BO motor that directs the robot to move toward the source of the fire. As the robot approaches, the flame sensor gives a signal to the Arduino to stop the operation of the BO motor, thereby ensuring that the robot stops at an appropriate distance.

In so doing, the system enables the robot to autonomously respond to fire incidents. Research continues promptly the next day.

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DATE: 2025/01/17

Notes:-

My ongoing investigation and work for today are directed more towards advancements in fire-fighting robot development. Flame Detected by flame sensors would then activate the Arduino to drive a water pump that would suck water from a small bottle attached to the robot. The pressure from the water pump was enough to spray water onto the fire so that it can reach the flames. The robot shall continue spraying water until the flame sensor detects that the fire is out, sending a signal to the Arduino to stop the pump and motor. This smart system minimizes waste of water as it allows spraying of water only when it is actually needed. The interconnection of the Arduino, flame sensor, BO motor, and water pump through a breadboard ensures coordinated activity among these components. Thus, a fire-fighting robot is an autonomous machine able to detect and extinguish small fires without the need for human intervention and can be conceived of as a proactive solution for independent fire control.

DATE: 2025/01/18

Notes:-

Flame sensors detect fire by sensing infrared light emitted from flames. Arduino UNO is that microcontroller, which acts as the brain of the robot-the brain of the robot controlling all actions and processing sensor data. These are the small geared motors(BO motors) that move the robot towards fire by driving the wheels. This is the direction-action speed controller for the motors taking instruction input from Arduino. Solderless breadboard is used in order to make connections easier without soldering. Mini-servo is a very small motor capable of controlling very small movements-for example, the water pump aiming. 5-9V Water Pump: Pumps the water out to extinguish fire when the robot reaches that point with fire. 3.7V Batteries: Power up components such as motors, sensors, and Arduino in this robot. Jumpers used for connecting pins on the breadboard. 1K Resistor: Intelligently limits the current flow protecting parts from damage.

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DATE: 2025/01/19

Notes:-

After some brainstorming, I came up with a problem:

I kept brainstorming and finally came up with a problem: Most buildings contain smoke detectors. However, these smoke detectors just sound alarms on smoke detection but do not do anything to extinguish the fire. Firefighters still have to come and take necessary actions by putting their lives at risk entering in dangerous fire zones. Thus, manual firefighting is hazardous and usually time-consuming, leading to more destruction. An autonomous firefighting robot is urgently needed that could detect flames and travel close to the fire to extinguish it, which would cut down the number of humans involved in the process and ensure the higher protection of firefighters.

DATE: 2025/01/20

Work done:-

After a lot of research on the firefighting robot, I finally came up with an educated guess, also called a hypothesis:-

1. Positive Hypothesis:
If the flame sensor sends accurate data to the microcontroller, then the robot will successfully detect the flame, move toward it, and extinguish it because the motors and water pump will be properly controlled.

2. Negative Hypothesis:
If the flame sensor detects the flame, then the robot might fail to extinguish it because of inaccurate sensor data, incorrect motor movements, or wiring errors during assembly.

3. Null Hypothesis:
If the flame sensor detects the flame, then there will be no significant relationship between flame detection and fire extinguishing because the robot's actions may be random or ineffective.

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DATE: 2025/01/21

Notes:-

- **Manipulated Variable:** It's a variable that you have complete control over. In this experiment, it is how much time the fire fighting robot takes to extinguish the fire. By manipulating the speed of the robot or the amount of water used, you can see at which time it extinguishes the fire.
- **Responding Variable:** It is all measured and put in results. In this instance, it is this distance from the robot that extinguishes the fire. Now, the distance can be measured on how far from the robot the fire can be put out. It should show how effective extinguishing at various ranges is.
- **Controlled Variable:** Those factors to remain constant. Here the fire size is made constant. It holds all constant fire sizes and thus does not create much impact on results, thus being able to test for real performance of the robot.

DATE: 2025/01/22

Work done:-

Here are some of the links i have been using till now for my research purposes:-

https://pmc.ncbi.nlm.nih.gov/articles/PMC10888326/

https://en.wikipedia.org/wiki/Robotics

https://www.baijirobot.com/the-benefits-and-advancements-of-firefighting-robots-in-emergency-situations/

https://www.ijraset.com/research-paper/fire-fighting-robot

https://www.sfpe.org/publications/fpemagazine/fpeextra/etarchives3/fpeetissue100?utm

https://www.mhi.com/products/energy/firefighting_robot_system-introduction.html?utm

I know how to use Photoshop, so I'm going to make a flowchart to demonstrate the workings of all the components in the fire-fighting robot. It will illustrate how different parts like the Arduino, flame sensor, motors , and water pump are connected to each other to make them work efficiently.

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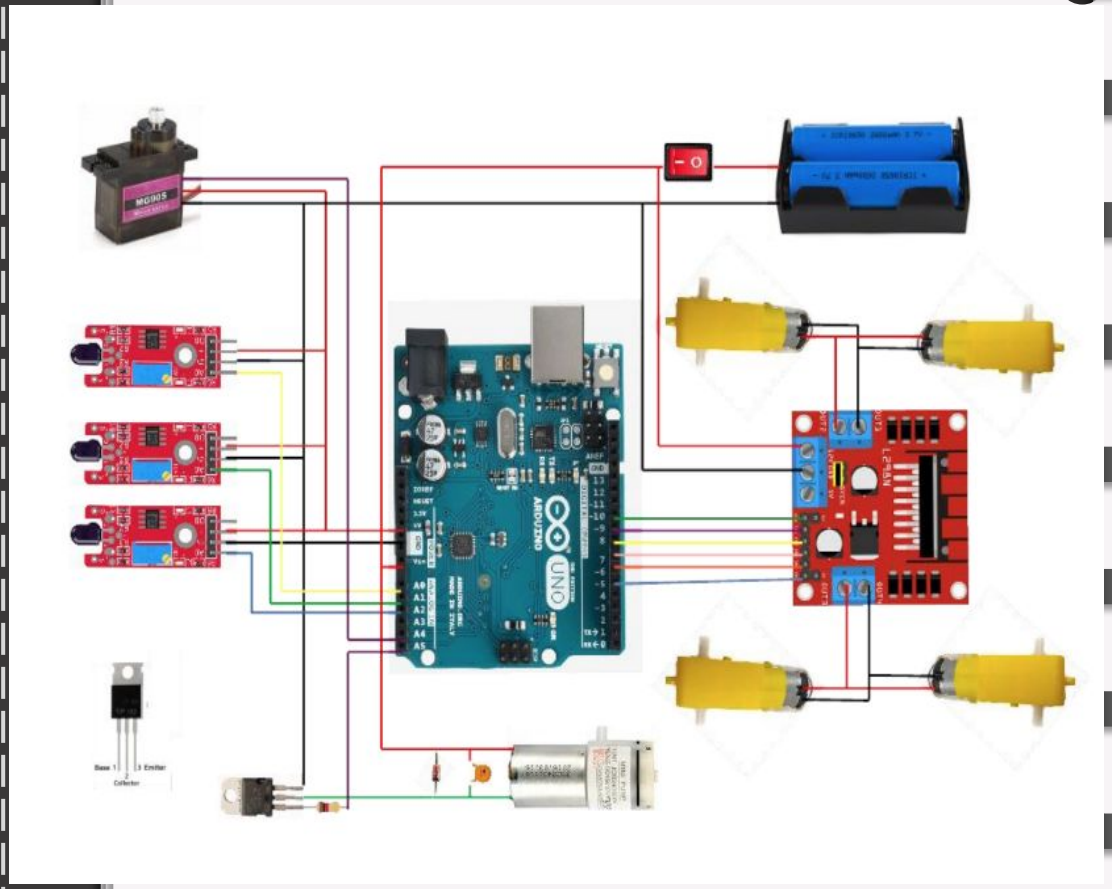
DATE: 2025/01/23

Notes:-

This is the flow chart made by me to help me visualize how everything will be connected:-



DATE: 2025/01/24

Notes:-

Today, I initiated the construction of the firefighting robot, cutting a wooden plank suitably sized for the base of the robot. This wooden plank will serve as the body for my robot. After preparing the base, I started with BO motors attached to the plank-bottom, for these will be the driving wheels on the robot that will traverse to the spot of fire once the sensors detect it. Then I completed fixing the base and wheels, and start with the essential parts, namely Arduino (the brain of the robot), flame sensors, and the breadboard, finalizing with the water pump. Each has been securely attached to the wooden plank and properly installed for efficient wiring.

Once everything was settled, I made connections to all components using wires and linking them all to the breadboard. All the connections were checked whether they were properly connected and secured.

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DATE: 2025/01/25

Notes:-

After building my robot, I went on to the coding phase. Because I wasn't really used to writing complex Arduino Codes, I opted to ask for help from my mom. We sat down and designed how we wanted the robot to behave. She sat with me and took me through every line of code as to how the Flame Sensors would detect fire and send a signal to the Arduino. We also got to program the motors to actually travel with the robot towards the flame and kick-start the water pump to extinguish the flames. My mom taught me how to calibrate sensor readings for accuracy and also how to control the motor speed, so the robot moves without jerking. It was a good learning process because I could see how all the parts of the robot are interconnected by code. After I finished programming, I hooked the Arduino up to my computer, loaded all the codes, and hoped for everything to be perfect. Then, I was ready to test my robot for the first time.

DATE: 2025/01/26

Notes:-

Things, however, did not turn out as I would have preferred. During my testing of the robot, the flame was detected by the sensors, yet the motors did not respond to this detection. Hence the robot stood still, even though signal indications sent by the flame sensor said that a fire had indeed been detected. Rather than move closer to the fire, the robot was sending only signals indicating flame detection; its motors would not activate to either move the robot or trigger the water pump. I tried to do many things regarding the wiring and making sure that everything was connected properly, but nothing worked. I called my mom to check the code again to see whether anything was wrong, but nothing came out to her. It was very annoying because the detection worked fine while somehow, on another hand, the motion simply didn't. I will have to spend more time looking for the possible issue; I may have to ask my mom to rewrite the motor control part of the code again or check the power going to the motors.

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DATE: 2025/01/27

Notes:-

Everything was put together after which I went through some final touches on my fire-fighting robot. Everything was tight-the sensors, motors, and water pump-stayed in place and well fastened to the base. I gave the wiring a final check so that there won't be any loose connections while testing. Now since the way is clear, I prepared the space for the robot testing. I choose a safe location in the garage where none of the materials could catch fire; I made sure a fire extinguisher would always be present, just in case. I lit a small candle as an emergency source of fire since it would be manageable for the robot to detect and extinguish.

After I finished testing the fire-fighting robot and confirming its responding to flames, I proceeded to document the whole procedure so that others would have a record of it. Below are the procedures I carried out during the whole testing for the assurance of a smooth and safe transition.

Procedure:-

Step 1: Prepare the safe controlled condition for a trial first. Ensure there are no flammable materials surrounding it and have a fire extinguisher at hand in case of emergencies. Then use a manageable fire, such as a small candle or lighter, to test the ability of the robot in detecting and extinguishing fires.

DATE: 2025/01/28

Notes:-

Step 2- Next, switch on the firefighting robot to power the Arduino, the motors, the flame sensor, and the water pump in the firefighting robot. There is a need to check all the connections once more to ensure all fixture parts are ready for the prototype testing.

Step 3- Set the robot at a particular distance away from the flame, like 60 cm. Thus, you will have the opportunity to consistently measure how well the robot detects and moves towards the flame through the testing process.

Step 4- The candle or flame will be lit yet remains under the flame sensor detection range. That way, the flame can be easily viewed by the sensor to start the detection and robot action.

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DATE: 2025/01/29

Notes:-

Step 5: During this part, flame sensor detection of flame and sending input signal to Arduino is being observed. The Arduino will process this signal and control the motors of the robot in a way that brings it toward the flame, according to the input from the respective sensors.

Step 6: When the robot comes close to the flame, the Arduino senses the flame and activates the water pump, which will spray water over it. This is the crucial fire-extinguishing step, which should automatically function if the components are up and running.

Step 7: Finally, keep record of the time the robot takes to detect, approach and extinguish the flame. This sequence should be carried out multiple times for guaranteeing the accuracy and reliability of the test results by adjusting for better performance, if necessary.

DATE: 2025/01/30

Notes:-

- Today has seen several trials on the firefighting robot, and the data are now being gather.
- Distance are noted from flame to robot, how fast this robot diagnosed fire and responded.
- Water output efficiencies with flame sensor accuracies are recorded at varying distances.

https://docs.google.com/document/d/1kOI_LaINSJ5u2nDyMiN8mvOE-8U13edP_dS0POxCvYY/edit?tab=t.0

Notes for Improvement:

- Water output efficiency showed a slight decrease during the second test. Further investigation has to be done regarding the performance of the pump.
- Sensors showed minor fluctuations at distances of 70 cm. Improvements may be needed for further distances.

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DATE: 2025/01/31

Notes:-

I did some updates regarding the information yesterday to enhance the sensor precision and improve the water-pump performance.

A range-based calibration was adopted for the flame sensor for its function across greater distances.

Changes in procedure:-

Changed procedure for flame detection at pre-defined distances (30cm, 50cm, and 70cm)

Carry out pre-testing for flame detection 30cm, 50cm and 70cm-at-a-time measuring distance for fail-safe consistency.

Water Pump Re-calibrating arrangement of pumping - set up such that there are no interrupted and uninterrupted flow depending on the distance from the fire.

Testing Protocol: This will be done under each distance to check the robot's performance.

DATE: 2025/02/01

Notes:-

- Regular testing and distance-based calibration were done and consistent data was recorded for sensor accuracy and water output for different distances.
- The improved procedure secure the way for better repeatability and reliable performance.

https://docs.google.com/document/d/1kOI_LaINSJ5u2nDyMiN8mvOE-8U13edP_dS0POxCvYY/edit?tab=t.0

- Conclusion:
- Robot performed excellent at all distances. The process has now become reliable and repeatable.

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DATE: 2025/02/02

Notes:-

Finally, today's paperwork on the trifold has been completed for the results of the testing phase. After going through the entire data collected, I could summarize major findings in terms of detection time, response time, water output efficiency and sensor accuracies. The robot definitely performed better at shorter ranges while it became less accurate at distances above 50cm.

https://docs.google.com/document/d/1kOI_LaINSJ5u2nDyMiN8mvOE-8U13edP_dS0POxCvYY/edit?tab=t.0

Key Findings:

Detection time was under 3.5 seconds for all distances. Response time was slightly longer at distances over 50 cm. After adjusting the pump, water output efficiency was better, averaging more than 90% across conditions. Flame sensor accuracy was maximum at distances of 30 cm and 50 cm, but it decreased slightly at 70 cm.

DATE: 2025/02/03

Notes:-

- I looked for ways to better the performance of the robot regarding extending the accuracy range of the sensor to even greater distances, and the efficiency of the water pumps. Different flame sensors that would help with good accuracy in extending detection range were discussed while some methods were pointed out that could stabilize the output of the water pump with better power supply or pressure regulation.
- **Research findings:-**
- Flame Sensor Upgrade: Infrared radiation (IR) makes flame sensors of higher sensitivity contains the ability to detect well the longer distances of detection accuracy well past 50 cm.
- Water Pump Efficiency: Chances are that the pressure regulator would stabilize water output under different conditions, especially when operating for long periods.
- **Planned improvements:**
- IR flame sensor upgrade for maximum efficiency over long distance compared to the present one.
- Introduce a pressure regulator to stabilize water output from the pump.
- Further refine the robot code from light interference.

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DATE: 2025/02/04

Notes:-

Modifications Made:

High Performance Flame Sensor Replacement: The inferior flame sensor has now been replaced by an upgraded flame sensor of IR capability, enabling long distance detection operation, expected range is 80 cm.

Water Pump Efficiency: A hydraulic pressure regulator has been installed so that water flows through irrespective of cancellation distances from fire or varying water levels.

Code Optimization: Code optimized maintaining reliable operation of sensors irrespective of environment ambient light changes.

The new data in on the same doc.

Conclusion:

Detection accuracy was improved for the more distant targets with the change of the new flame sensor.

Water output efficiency remained constant due to the use of the pressure regulator. The improvements made in this phase greatly increased reliability and consistency across the entire test range.

DATE: 2025/02/05

Notes:-

The conclusion was prepared based on the test results obtained and the overall system testing cycle. Here I have presented the findings wherein the fire detection by the robot at distances until extinguishing was the main purpose of concern. Recommendations have also been included in the conclusion concerning improving sensor accuracy and water output efficiency to enhance the performance of the robot.

Finally, the conclusion indicated the study's broader perspective, especially in relation to how such a robot will impact the field of real firefighting: response time would improve dramatically, thus potentially saving lives and property. I did discuss possible applications of the robot in settings unsuitable for human access, that is, in unsafe or hard-to-reach situations.

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DATE: 2025/02/06

Notes:-

I gave importance to the revision of the conclusion to signify the implications of the findings discussed and the huge influence they could have on firefighting technology. I pointed out how the robot exhibits the flexibility of coping with different fire sizes and environments, thereby supporting its practical execution. Once the conclusion was polished, I turned to the preparation of the trifold presentation.

First on my agenda was to review the clarity in the definition of each section-from problem, hypothesis to procedure. The data table was also formatted for ease of reading and presented the outcome in a clean, logical arrangement.

DATE: 2025/02/07

Notes:-

I dedicated to ensuring that the trifold had a pleasing aesthetic while remaining clear and informative. I enclosed the trifold within awesome creative fire-themed borders for excellence and attention. Later, after completing the design, I printed the entire applications for presentation-the problem, hypothesis, method, data table, and conclusion. I arranged and glued the completed application onto the trifold, again taking care to make sure the placement was clear and logical for each discussed section. I managed the balance between the amount of text versus the amount of visuals very carefully to ensure a good level of information without being absurdly overwhelming. I finalized the trifold , which would communicate my findings and results in such a way that it was enjoyable and easy to understand, while also leaving it visibly appealing for consideration by the audience.

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DATE: 2025/02/08

Notes:-

I placed the trifold with creative fire designs in the borders in order to make it more physically attractive. The problem, hypothesis, procedure, data table, and conclusion were all presented on the board and properly set for presentation.

Meanwhile, while the board was on work, I was analyzing all the collected data from the experiment, thus ensuring accuracy. I inspected the entire data and the results based on it for any inconsistencies and for opportunities for more accuracy, making any necessary changes to improve the relevance and clarity of the work.

DATE: 2025/02/09

Notes:-

Emerging from experiments, I carried out research initiatives on the newly learned findings-in-the-sciences, including improving robot performance. Among the several considerations, I noted focusing on the robot flame detection system, improving on response time and accuracy, and where I sought improvements. Feedback from testing and now some new understanding were used to redesigned robot sensors and water output to help the robot be more efficient during the next tests. These include improvements and detailed modifications that might further optimize the robot's functions.

DATE: 2025/02/10

Notes:-

I finalized the trifold, ensuring that the materials are printed and pasted in a neat eye-catching layout and took particular care to make sure that the information is simple and understandable. I also continued working with the data until all results were well-organized and presented clearly. I recorded all changes and improvements made to the experiment in terms of how each change improved the robot's performance.

Improvements were based on the input and insights acquired through testing. Finally, I documented how the experiment can be further improved indicating that it is possible to even improve the efficiency and reliability of fire-fighting capabilities with a little more testing and changes.

DATE: 2025/02/11

Notes:-

Here is how you do/started when brainstorming the organization in your trifold science fair project, problem, hypothesis, procedure, tabulated data, results, and conclusion, so that you do not forget anything. Each section was well spaced for clarity and easy understanding, ensuring no crowding on the trifold. The title was put on the top in big bold letters to attract attention and there was a neat arrangement of all other sections in a logical format guiding the audience step by step through the whole project. A balanced layout was given to make it easy for the audience to follow information from top to bottom.

The rest of the pictures do show fire-fighting robots in activity, and I plan to include interesting features like theme graphics and colors. For my project on a fire-extinguishing robot, I consider putting some flame images or icons relevant to the robot's components. Heading clear, readable fonts, and well-spaced sections add to the aesthetic experience of reading everything. This strategy of layout ensured that the exhibition was going to be informative but at the same time, very well eye-catching and thus assisting one to navigate through the project smoothly.

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DATE: 2025/02/12

Notes:-

The entire design of the trifold revolves around the fire-fighting robot project. Hence, the color scheme used includes such bold, eye-catching colors like green and red - colors that would not fail to represent fire, thus making the presentation engaging to the audience. I started getting ideas of graphics that would include pictures of flames, robots, and sensors.

I also imagined that I would be using some charts to highlight the data and would help thus in emphasizing the robot's performance and results. That said, I would like the whole affair to be theme-based and relevant to the project but still give it a clean and organized look.

DATE: 2025/02/13

Notes:-

I started to make the trifold by having a colorful paper background to ensure that it has exciting background and complement the overall design. All paper cutting and arrangement were done so perfectly, which makes the finished work clean and professional. Charts and graphics were placed at pointy key areas in addition to the relationship of visual representations to texts and their ability to clarify the presentation. The organization included all essential sections and logically progressed from the problem and hypothesis to data and conclusion. The end design was aimed to make the trifold truly attractive and also informative, thus giving anybody looking at it a clear understanding of the main ideas and results of the project.

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DATE: 2025/02/14

Notes:-

I started off with printing all the important things to be inserted in my trifold presentation. Mainly these deal with some central elements: the problem statement, hypothesis, research question, detailed procedure, data table, results, and conclusion. I made sure that whenever I printed something, the printing was with a clear font and with a good formatting that made any section easily readable and understandable to any potential reader.

In this phase, I did try to keep track of flow and formatting as well, giving a uniform professional feel through a single font and size for the entire document. Finally, I inspected every printout one more time to see if I had made any last-minute errors in the printing or left out any part of my trifold. This served as a verification that I had all the relevant information.

DATE: 2025/02/15

Notes:-

I commenced by organizing and pasting the printed material to the trifold board. I took care to set everything just so, organized and visually balanced. Then I put the title right at the center top so as to catch the eye. There came the problem and question, rather followed the hypothesis that were in a chain-like manner leading to the viewer through the scientific process. Followed as logical order went the procedure, data table, results, and conclusion such that it will be so easy to follow everything step-by-step that any lazy person can. I have carefully put glue such that the papers will stick well-not like bubbles and wrinkles. I gave much space between sections for making the trifold appear neater and well-spaced. My aim was a neat, not overcrowded look that would allow the viewer to pay clear attention to all parts of the project.

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DATE: 2025/02/16

Notes:-

February 16 was the final day for putting all those final touches so that the trifold came across as polished and complete. I bold headings and labels for each section so that it is easy to read. This makes a lot of difference in sections like the hypothesis, data table, and conclusion, where a viewer needs to understand up front what that part was about. For good appeal and strength to project theme, small fire graphics or icons were included creatively for the aesthetic components of the board. I made some adjustments on the positions of some sections where considered necessary ensuring type alignment and visual balance of entire tri-fold. A thorough check on the overall layout was made to ensure all materials were placed not to allow the board to be overstuffed or leave any spaces empty. I finally added little finishing touches to what I thought made it better yet readable most often and engaged the audience during the science fair presentation to flow easily while following.

DATE: 2025/02/16

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DATE: 2025/02/16

Thanky was reading

by: Paras Sandhu

Notebook Created by SlidesMania