

FIREFIGHTING ROBOT USING ARDUINO TECHNOLOGY

22CDL21 DESIGN THINKING

A REPORT

Submitted by

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DEPARTMENT OF COMPUTER SCIENCE AND DESIGN



KONGU ENGINEERING COLLEGE

(Autonomous)

PERUNDURAI ERODE – 638 060

JUNE 2024

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BONAFIDE CERTIFICATE

This is to certify that the report entitled FIREFIGHTING ROBOT USING ARDUINO TECHNOLOGY is the Bonafide record of work done by KARTHIKEYAN K (23CDR067), MEHARUNSHIYA S (23CDR089), MIRUTHULA B (23CDR090), MOHAMED ABYAZ M (23CDR093), MONIKA T (23CDR101), MUTHAMIL S (23CDR104), for the course 22CDL21 – Design thinking during the year 2023-2024.

COURSE INCHARGE

HEAD OF THE DEPARTMENT

(Signature with seal)

Date:

Submitted for the end semester viva voce examination held on _____

EXAMINER-I

EXAMINER-II

DEPARTMENT OF COMPUTER SCIENCE AND DESIGN

KONGU ENGINEERING COLLEGE

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JUNE 2024

DECLARATION

We affirm that the Report titled **FIREFIGHTING ROBOT USING ARDUINO TECHNOLOGY** being submitted for the course 22CDL21 - Design thinking during the year 2023-2024. It is the original work carried out by us and not formed the part of any other report submitted in earlier occasion by any other candidate.

Date:

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I certify that the declaration made by the above candidates is true to the best of my knowledge.

Name and Signature of the Faculty

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CHAPTER 1

ABSTRACT

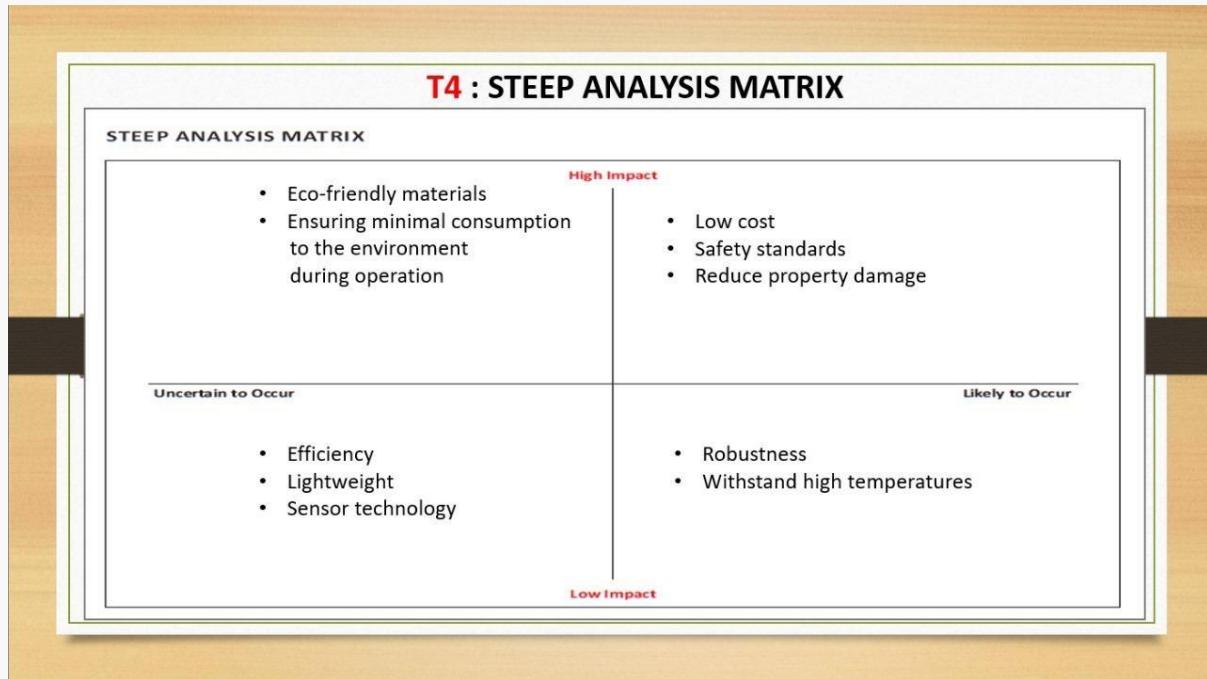
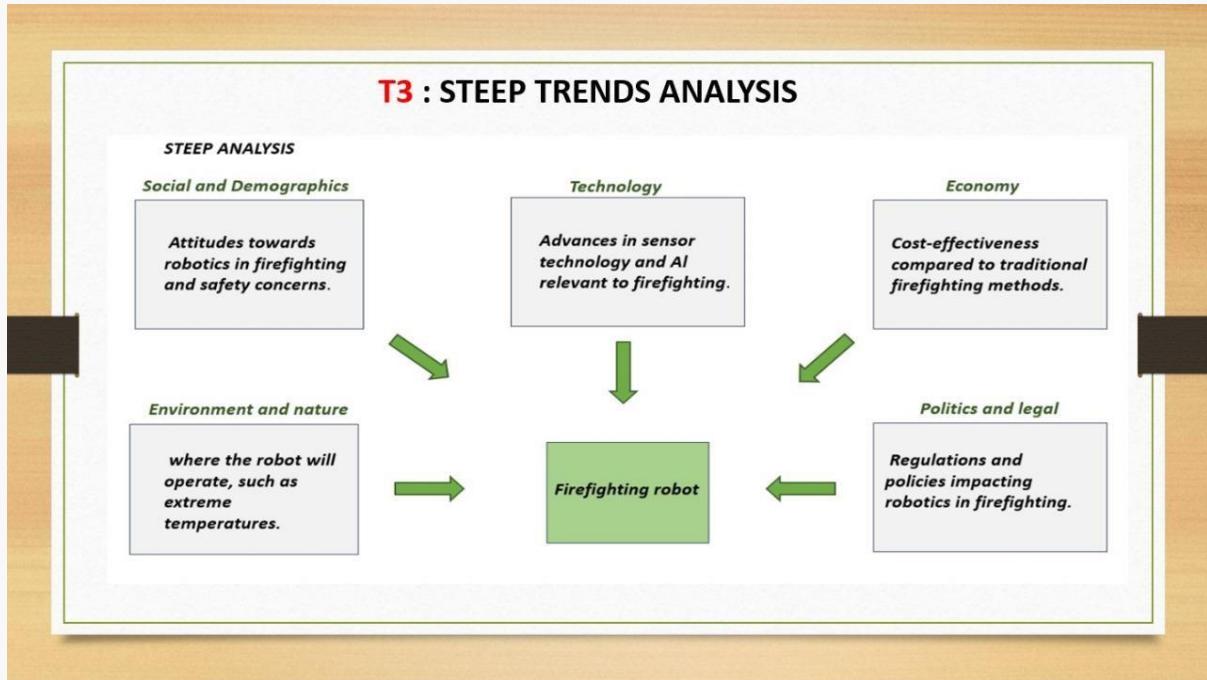
A fire-fighting robot is an advanced autonomous or semi-autonomous machine designed to detect and extinguish fires in hazardous environments, reducing the risk to human firefighters. Equipped with a variety of sensors such as thermal cameras, gas detectors, and infrared sensors, these robots can navigate through smoke-filled and structurally compromised areas to locate the source of a fire. They often incorporate water or foam dispensers and can be remotely controlled or programmed to operate independently. The primary objective of these robots is to perform reconnaissance, deliver fire suppression materials, and support rescue operations in environments too dangerous for human intervention. The deployment of fire-fighting robots has revolutionized fire management in industrial settings, urban areas, and even in forest fires. These robots enhance the efficiency and safety of firefighting operations by providing real-time data and imagery to command centers, allowing for better decision-making and resource allocation. Innovations in robotics, such as enhanced mobility through tracks or legs, robust communication systems, and integration with drones for aerial surveillance, have further expanded their capabilities. As technology continues to evolve, fire-fighting robots are expected to become more versatile, reliable, and essential in the ongoing effort to protect lives and property from the devastating effects of fires. In addition to their core firefighting functions, these robots often come with modular designs that allow for customization based on specific needs and scenarios.

CHAPTER 2

TEMPLATES

T1 : PMA 1 – DESIGN BRIEF	
DESIGN BRIEF	
Project Description	The Fire-Fighting Robot is an autonomous system designed to detect, and extinguish fires to enhance safety and response efficiency.
Intent Scope	It includes the detection, assessment, and suppression of fires in various environments, such as industrial sites, etc.,.
Exploration Questions	How can the robot navigate and operate autonomously in diverse and complex environments?
Target Users	Fire Departments and Emergency Response Teams , Large Commercial Buildings , Forest Management Agencies , Industrial Facilities.
Research Plan	Developing , testing advanced sensor , AI technologies for fire detection and suppression, while ensuring robust navigation and communication capabilities .
Expected Outcomes	To enhance fire detection, assessment, and suppression capabilities, thereby improving the safety and efficiency of firefighting operations.
Success Metrics	Its accuracy in fire detection, efficiency in suppression, reliability in operation under hazardous conditions.
Project Planning	It involves phases such as conceptual design, prototyping, testing in controlled environments , etc.,.

T2 : SCOPES (Firefighting robot)		
	SCOPES	DEFINITIONS
S	SITUATION AND/OR PROBLEM	The Challenge is to develop an Arduino firefighting robot to detect and extinguish fire
C	CONSTRAINTS	Limited budget , Size , Safety regulations
O	OBJECTIVES AND OUTCOMES	To create a reliable and efficient firefighting robot
P	PEOPLE	Fire fighters and emergency response , requires tools for combating fires
E	ESTIMATES	Arduino microcontroller , Sensor , Motor , Chassis
S	SCOPE	Scope to explore different sensor configuration and fire suppression methods
	FIREFIGHTING ROBOT	How might we create a firefighting robot to enhance human safety



T5 : STEEP ANALYSIS PRIORITIZATION

STEEP ANALYSIS PRIORITIZATION

Discuss 2 key trends from the High Impact - Likely to Occur quadrant:

1. Cost-effectiveness of different types of fire extinguishers, including initial purchase price, maintenance costs, and refill expenses.
2. As well as the economic impact of fire incidents on businesses and communities.

Discuss 2 trends from the High Impact - Uncertain to Occur quadrant

1. Consideration of the environmental impact of extinguishing agents, such as their toxicity, ozone depletion potential.
2. It also contributes to greenhouse gas emissions, as well as the ecological consequences of fire incidents.

T6 : STRATEGIC PRIORITIES MATRIX

STRATEGIC PRIORITIES MATRIX

	URGENT	LESS URGENT
IMPORTANT	Autonomous navigation in hazardous environment fire detection and suppression emergency communication	Robot design for durability extended operation battery life
LESS IMPORTANT	Cosmetic design , Primary mission of fire fighting and life prevention	User friendly interface routine maintenance protocols

1 Do First
High Urgency
High Priority

Important Task

2 Delay
High Priority
but Not so Urgent

Schedule to complete

3 Delegate
High Urgency but not High Priority

Can be done by someone else

4 Don't Do
Low Priority
Low Urgency

Distraction

T7 : SYTHESIS (Sense Making)

SYNTHESIS: MAKING SENSE OF STEEP ANALYSIS AND STRATEGIC PRIORITIES	
Assessment Questions <p>What relationships among the trends do you perceive? How are they related? Why are these relationships important?</p> <p>What opportunities and/or challenges need immediate attention going forward for your design challenge? And why?</p> <p>What would it take to create positive change on this issue relating to your design challenge?</p> <p>Who else would be interested in this issue? Why should they care? What conversations would you have with them?</p>	Synthesis: Sense Making <ul style="list-style-type: none"> • Versatile firefighting robots with enhanced mobility • Data exchange between firefighting robots, human responders, and command centres. <ul style="list-style-type: none"> • Improving the user interface and interaction modality • Developing cost-effective firefighting particularly for underfunded organizations. <ul style="list-style-type: none"> • Engage Stakeholders • Effectiveness and feasibility <ul style="list-style-type: none"> • Effectiveness and feasibility • Government Agencies and Research institution • Industry Partners

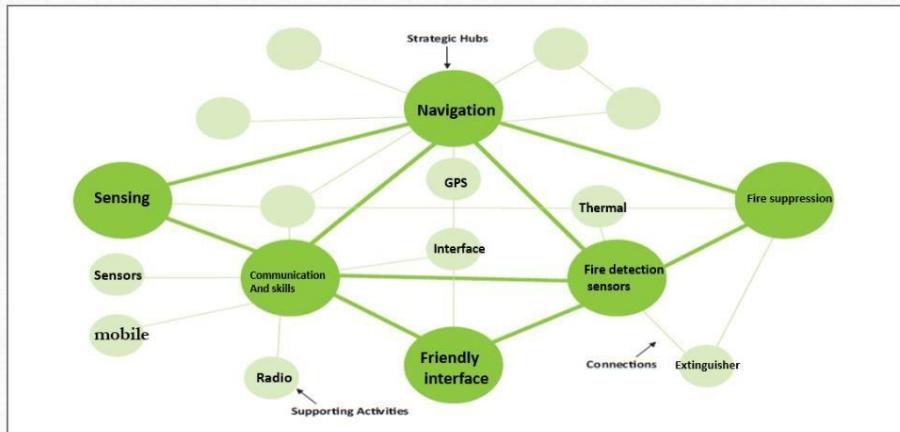
T8: ACTIVITY SYSTEM MAPPING

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graph TD
    A[Objectives or Mission statement] --> B[Strategy #1]
    A --> C[Strategy #2]
    B --> D["The current generation of fire extinguishers faces several challenges"]
    B --> E["Effectiveness in combating fires and ensuring optimal fire safety."]
    C --> F["Accessing hard-to-reach areas, detecting fires early"]
    C --> G["Operate in diverse environments, including urban areas, forests, and industrial facilities."]
  
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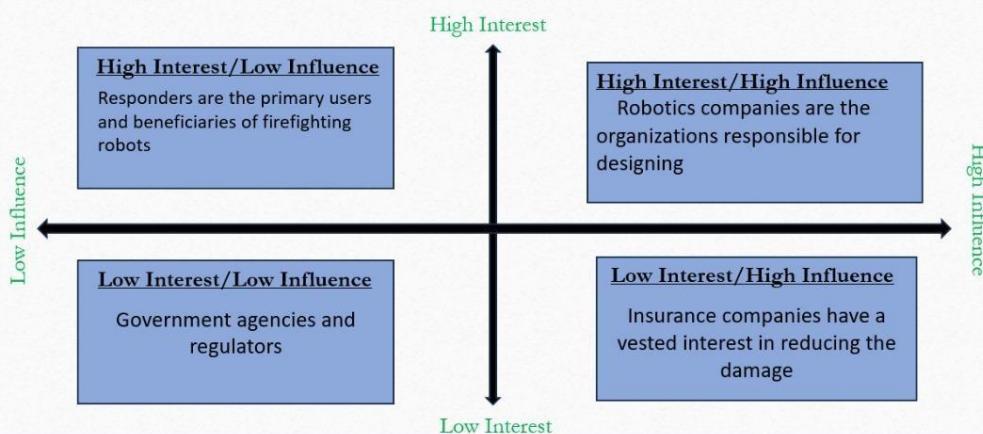
The diagram illustrates the Activity System Mapping process. At the top level is the **Objectives or Mission statement**. This leads down to two main **Strategy** boxes: **Strategy #1** and **Strategy #2**. **Strategy #1** is associated with the challenge: "The current generation of fire extinguishers faces several challenges" and the goal: "Effectiveness in combating fires and ensuring optimal fire safety.". **Strategy #2** is associated with the challenge: "Accessing hard-to-reach areas, detecting fires early" and the goal: "Operate in diverse environments, including urban areas, forests, and industrial facilities."

T9 : KEY COMPONENTS OF ACTIVITY SYSTEM



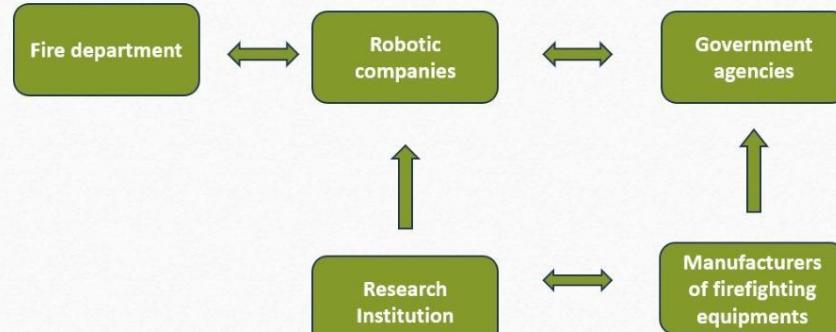
T10: STAKEHOLDERS MAPPING MATRIX

- Identify your relevant Key Stakeholders



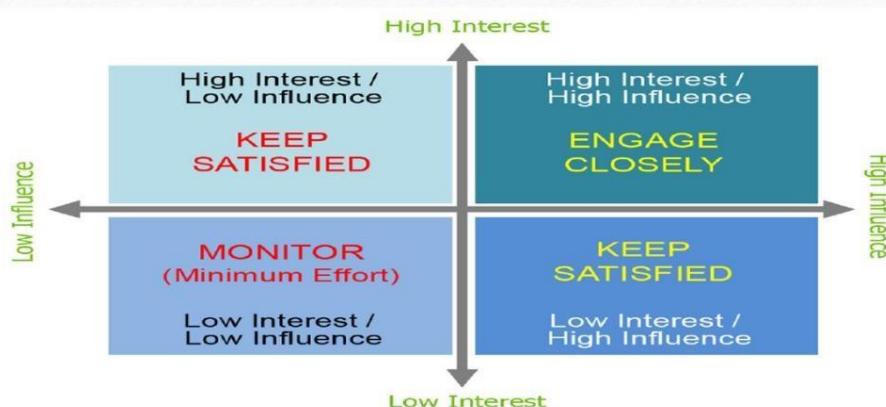
T11: STAHEHOLDER LINKS & RELATIONSHIP MAPPING

- Define the links and relationships between stakeholders.



T12: STAKEHOLDER PRIORITY MAPPING MATRIX

- Develop engagement strategies



T13: STAHEHOLDER ANALYSIS & ENGAGEMENT STRATEGY

Key Stakeholders	Relationships	Stakeholder's Interest(s) in the Design Challenge	Impact Assessment	Strategies to Gain Support or Reduce Obstacles
Fire departement	Fire officer	Involvement	Saving people	Bravery
Robotic companies	Manufacturer	Quality	Analysis	Innovation
Government agencies	Integration	Alignment	Evaluation	Alignment
Manufacturers of firefighting equipments	Collaboration	Investment	Outcomes	Empowerment

A. CHALLENGE OR PROBLEM DEFINITION (contd....)

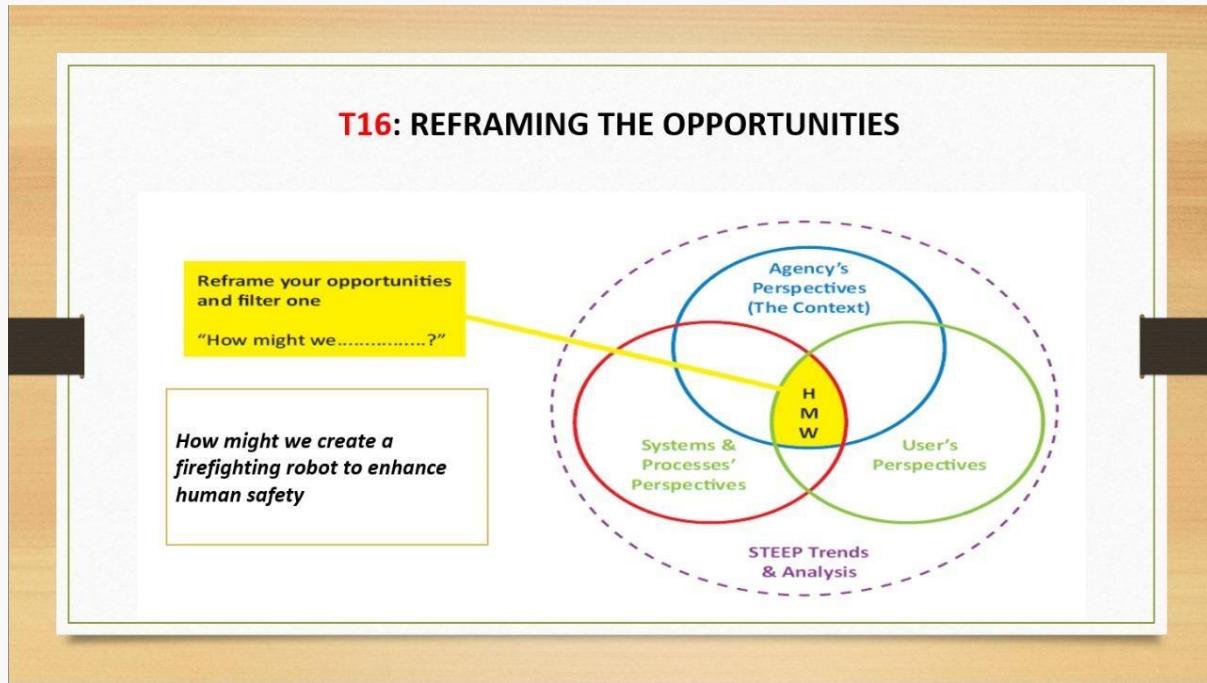
Goals and objectives of the Design Challenge	To enhance the human safety and reduce property damage
Target users of this Design Challenge	People and firefighter
Other key stakeholders	Fire department , Robotic companies , Government agencies
Previous efforts to solve this Design Challenge	At earlier fire accident occurs fire services will come and put off the fires
Current activity system and process	Firefighting robot based on autonomous Arduino technology

T14: PROJECT BRIEF AND OPPORTUNITY FRAMING		
A. CHALLENGE OR PROBLEM DEFINITION		
Project Sponsor	Organization Name	KEC
	Address and Contact	Perundurai
	Contact Person(s)	Team 8
Project Title	Fire fighting robot	
Design Challenge	A robot designed to detect extinguish fires using Arduino technology.	
Design Challenge Context and Background Info	What are the issues and opportunities that inspired this Design Challenge	
	Arduino board have limited computational power compared to more advanced micro controllers or processor	
	Why does this Design Challenge matter to the organization	

10

T15: PROJECT BRIEF AND REFRAMING PROJECT CHALLENGES	
B. OPPORTUNITY FRAMING	
Real issues behind this Design Challenge	The current generation of fire extinguishers faces several challenges that hinder their effectiveness in combating fires and ensuring optimal fire safety.
Inspirations from others in solving this Design Challenge	To save the people from hazardous risks without any fear
Teams contributions	User research, design and development , Education, Testing and iteration
Success criteria	Fire suppression effectiveness , Autonomy and adaptability , safety
"HOW MIGHT WE" Opportunity/possibility statement	How might we create a firefighting robot to enhance human safety

18

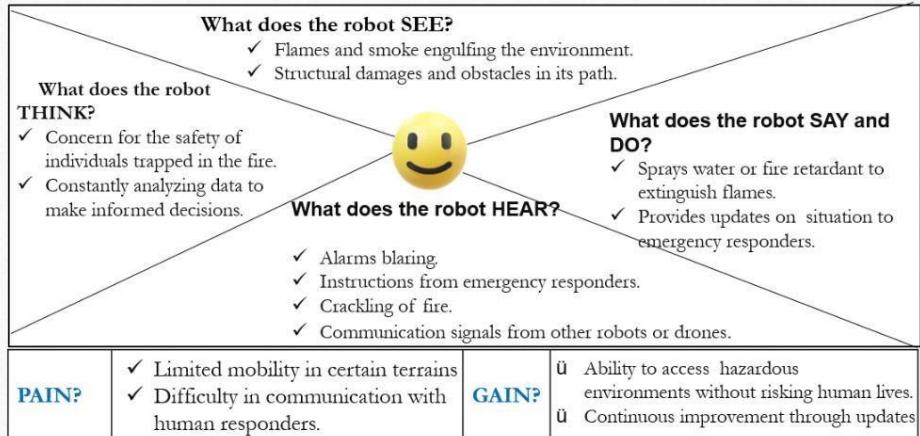


T17 : POEMS Framework

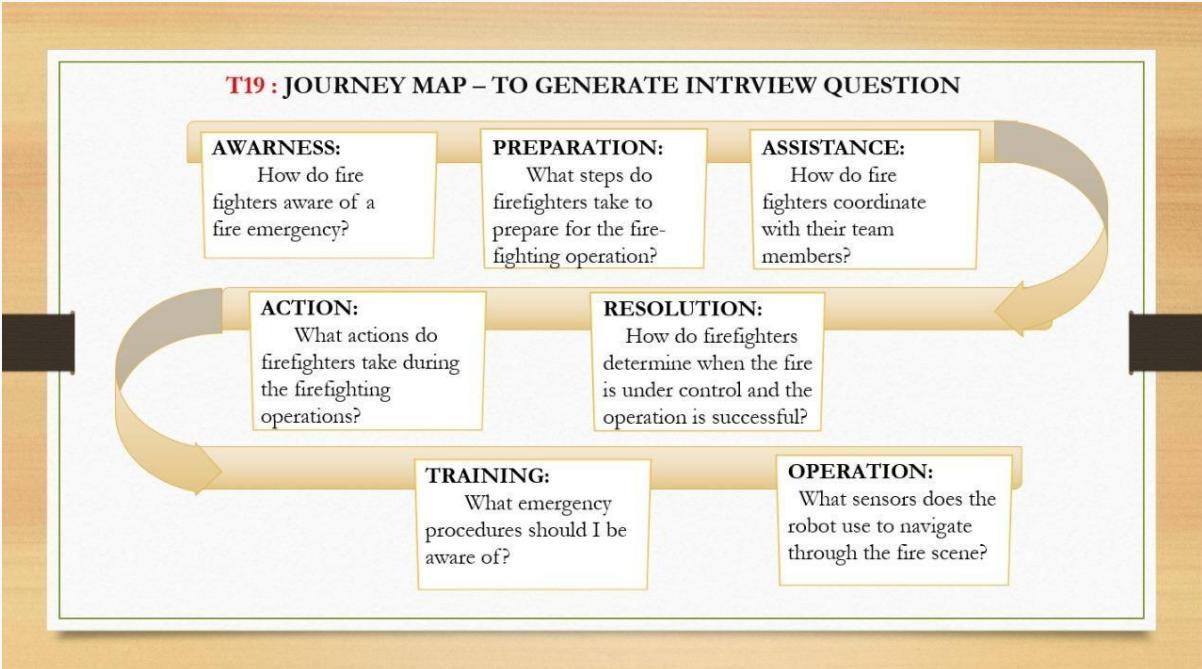
POEMS FRAMEWORK TEMPLATE

Location:	Date/Time/Period:
Report By:	
POEMS FRAMEWORK	Field Visit and Onsite Observation
P -People	Fire fighters , Civilians , Emergency responders
O - Objects	Fire hydrants/equipment , Emergency exit signs ,Smoke detectors
E - Environment	Residential buildings , Public spaces , Natural environment , Industrial sites
M – Messages and Medias	Emergency alerts & notification , Fire safety education ,Text/Call alert
S - Services	Inspection , Maintenance , Testing , Inventory management

T18 : EMPATHY MAP – To Generate Interview Question



T19 : JOURNEY MAP – TO GENERATE INTRVIEW QUESTION



T20 : Combined Empathy Map & Journey Map – To Generate Questions

EMPATHY MAP & USER JOURNEY TO GENERATE INTERVIEW QUESTIONS

DOING	SEEING	HEARING / SAYING	FEELING/ THINKING	FRUSTRATION	NEEDS / WANTS
How do the tasks and responsibilities of firefighters during a fire emergency align with the capabilities and functions of the fire-fighting robot?	What visual cues and sensory information does the robot gather to support firefighters in their decision-making and actions?	How does the robot integrate auditory feedback and communication to enhance coordination and situational awareness among responders?	What emotions and stressors do both firefighters and the robot experience during a fire emergency, and how do they influence their interactions and performance?	What are the common sources of frustration for both firefighters and the robot, and how can these be addressed to improve overall effectiveness and efficiency?	What are the essential needs and objectives that drive the design and functionality of the fire-fighting robot, and how well does it fulfill these requirements in real-world scenarios?

T21 : User Interview Notes

USER INTERVIEW NOTES

Interviewer Name	Miruthula B Muthamil S	Mohamed Abyaz M
Note Taker & Observer	Monika T Meharunshiya S	Karthikeyan K
Interviewee Name	Mr. Nageswaram	
Interviewee contact details	04294 223 101	
Date/Time of Interview	April 21 , 2024 / 10:00 AM to 12:00PM	
Interview Location	Fire service station , Perundurai	

T22: POST INTERVIEW DISCUSSION : ABOUT THE INTERVIEWER

INTERVIEWER'S GOALS /MOTIVATION	INTERVIEWER'S ASPIRATION :
Continuously improves skill by ongoing trainings / pride in being a trusted member of the fire department	Firefighters aspire to educate the public on fire safety measures, advocating for prevention strategies and promoting awareness to reduce the occurrence of fires
INTERVIEWER'S CURRENT EXPERIENCE :	INTERVIEWER'S CHALLENGES AND PAIN :
Extinguishing a fire And rescuing people – 18 Years Experience in fire department	Finding time for rest and relaxation is essential to prevent burnout And physical demanding work leads to injuries
INTERVIEWER'S CHALLENGES :	USER INSIGHTS AND NEEDS :
It is challenging to maintain a healthy balance between his personal and professional life	Adaptive and responsive design And Understanding firefighting scenarios

T23 : POST INTERVIEW DISCUSSION : ABOUT THE PROCESS

WHAT WENT WELL WITH THE INTERVIEW ?

They explain well the firefighting scenario with clear incident happened.
They show a demonstration on extinguishing a fire with the equipment they used.

WHAT DID NOT GO WELL WITH THE INTERVIEW ?

They did not give clear solution about our project.
(FIRE FIGHTING ROBOT USING ARDUINO UNO)

WHAT CAN WE DO BETTER FOR NEXT INTERVIEW ?

We expecting a clear solution/explanation relating to our project.

T24 : Post Interview De-brief Presentation

Summary profile of interviewer :		OVERVIEW OF INTERVIEW : All went well with the interview & we gain knowledgeable points from the fire man
GOALS / MOTIVATION: Advance within the fire department to leadership Roles / pride in being a trusted member of the fire department	ASPIRATION: Firefighters aspire to educate the public on fire safety measures, advocating for prevention strategies	
GOALS MOTIVATION: The primary goal and motivation for firefighters is to save lives & driven by a sense of duty and compassion to rescue individuals from danger	CHALLENGES AND MOTIVATION: Firefighters face inherent risks of injury and death while performing their duties, including exposure to flames, smoke inhalation , etc.,	
MOST MEMORABLE THINGS ABOUT THE INTERVIEW: ➤ They show demonstration ➤ Usage of equipment	USER INSIGHTS AND DEEP NEEDS : Adaptive and responsive design , fire minimizing technique , optimizing emergency response efforts	

T25 : SAM FRAMEWORK FOR INSISGHT MINING/ NEED FINDING :

SOCIAL CONTEXT:	A firefighting robot serves as a crucial tool for enhancing public safety and emergency response efforts
ACTION/ BEHAVIOR :	To assist in firefighting and emergency response efforts include fire suppression, ventilation etc.,
MOTIVATION	Beliefs , Values and Emotions surrounding the development and use , important to consider the perspectives of various stakeholders

T26 : SPICE FRAMEWORK FOR UNDERSTANDING AND UNCOVERING DEEP USER NEED

S

Trust: The robot needs to build trust among firefighters and other emergency responders so they can rely on its assistance during dangerous situations

P

Robustness: The robot needs to withstand high temperatures, flames, smoke, and other hazards present in fire environments

Mobility: It should have the ability to navigate rough terrain and climb stairs within a burning structure

I

Contribution to safety: The robot should be designed to contribute to the safety of both firefighters and civilians by assisting in extinguishing fires and rescuing trapped individuals

C

Remote operation: There should be a reliable communication link between the robot and its operators, allowing for remote control and monitoring of its activities, especially in hazardous or inaccessible areas

E

Confidence: The robot should instill confidence in both firefighters and civilians, assuring them that it is capable of effectively assisting in firefighting efforts and enhancing overall safety

T27 : SAMPLE NEED STATEMENTS

- "There is a pressing need for firefighting robots capable of navigating hazardous environments to assist firefighters in extinguishing fires and minimizing human risk."
- "In situations where access is limited or dangerous for human responders, there is a critical need for firefighting robots equipped with advanced sensors and extinguishing capabilities to swiftly contain and extinguish fires."
- "The demand for autonomous firefighting robots is growing due to the need for rapid response and enhanced safety measures in high-risk environments such as chemical plants, nuclear facilities, and urban settings."
- "The safety of firefighters is paramount, and there is an increasing need for robotic solutions that can operate in extreme heat and toxic environments to supplement human efforts in fire suppression and rescue operations."
- "As populations continue to expand into wildfire-prone areas, there is a growing need for robotic systems capable of early detection, rapid response, and strategic fire suppression to protect lives and property."

T28 : DOCUMENTING INSIGHTS AND NEEDS

INSIGHT : Understand the specific challenges faced by firefighters during fire emergencies, such as limited visibility, intense heat, and dangerous environments.

Learn about firefighters' preferences and requirements for controlling and interacting with the robot during emergency situations.

Insert narrative of the user insight, needs, quotes here.

Need : Implementing a "FIRE FIGHTING " robot that provide safety measures for fire fighters and makes the work easier than the humans do.

Robots can assist in locating and rescuing individuals trapped in fire-affected areas, improving response times and outcomes

Quotes 1:
" ROBOTS never DIE , they fight against fire FOREVER "

Quotes 2:
" ROBOTS can't think like a men , but they can work better than a men"

T29: PERSONA CANVAS

PERSONA CANVAS	Persona Name: Nageshwaram	
Demographic profile: Age: 45 years Gender: Male Home: Perundurai Family: wife, mother and 1 daughter and 1 son. Education Background: B.com	Goals: To protect people from disaster and to help the needs. To become financially strong	Deep Need Statement: To improve a safety measures for fire fighters and to mitigate fire easily and quick with a help of firefighting bots
Hobbies/Likes/Dislikes: Spending time with family and teaching firefighting skills	Motivation/Aspiration: To become a firefighting officer and to set a safety classes for people.	Diversity of Needs:  Training & Education Technology & Equipment
Social & Family Lifestyle: Extended family	Challenges/Pain Points: Put humans lives in danger situation and risks their lives to safe guard people	
	Behavior: Good and Respectable	

T30 : SCAMPER WORKSHEET

S	SUBSTITUTE	Substitute the regular water pump with high pressure water pump for better fire extinguishing
C	COMBINE	Combine the fire sensor with smoke detector for early fire detection
A	ADAPT	Adapt the robot's chassis to fit through narrow spaces in buildings
M	MODIFY	Modify the sensor sensitivity threshold for accurate fire detection
P	PUT TO OTHER USES	Put to another use the robot for inspecting and maintaining fire safety equipment
E	ELIMINATE	Eliminate any redundant sensors or components
R	REVERSE	Rearrange the placement of the water pump and fire sensors for optimal functionality

T31 : RECONNECTING PERSONAS

RECONNECTING WITH OUR PERSONAS

BEHAVIORS	ASPIRATIONS	MOTIVATIONS	CHALLENGES	PAIN POINTS
<ul style="list-style-type: none"> Team work and collaboration Composure Continuous training Physical Fitness Community engagement 	<ul style="list-style-type: none"> Saving Lives and Property Career Advancement Specialized Skills Positive Community Impact 	<ul style="list-style-type: none"> Public Service Risk Reduction Minimized Property Damage Precision and Speed 	<ul style="list-style-type: none"> Physical and Mental Stress Work-Life Balance Exposure to Danger Resource limitations 	<ul style="list-style-type: none"> Emotional Trauma Health Risks Administrative burden Public misunderstanding
USER INSIGHTS				
<ul style="list-style-type: none"> Adaptive and responsive design Public acceptance Firefighting practices Durability Customization 				
DEEP USER NEEDS				
<ul style="list-style-type: none"> Safety and reliable Advanced equipment Adaptability Continuous training Recognition 				
CONSTRAINTS &/OR DESIGN CRITERIA				
<ul style="list-style-type: none"> Heat-resistant Water-resistant Autonomous Durable Real-time communication Efficient and Compact Safe and Versatile 				

T32 : STORYBOARD CANVAS

STORY BOARD CANVAS

Title: FIREFIGHTING ROBOT

 THE ROBOT ARRIVING THE HAZARDOUS PLACE	 FIRE IN BUILDING WITH INITIAL STAGE	 ROBOT DETECTING THE FIRE AND SMOKE IN BUILDING
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STORY BOARD CANVAS

Title: FIREFIGHTING ROBOT

 ROBOT EXTINGUISHING FIRE IN LARGE SCALE	 FIRE SUPPRESSED IN BUILDING WITH LESS DAMAGE	 THUS FIREFIGHTING IS VERY USEFUL IN SUPPRESSING FIRE AT INITIAL STAGE AND REDUCES LESS DAMAGE TO PEOPLE
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T33 : STORYBOARD CANVAS FOR YOUR PERSONA'S

BEGINNING		MIDDLE		END
The Persona	The Setting	The Problems	The Solutions	The Resolutions
<ul style="list-style-type: none"> Nageswaram Head of the fire department in Perundurai Deep need Continuous training Scenario based training Preventive wellness 	<ul style="list-style-type: none"> Responding to a multi-story building fire with heavy smoke Responding to a Potential victims trapped inside 	<ul style="list-style-type: none"> Low visibility due to smoke Multiple obstacles and hazards High risk to personal and team safety. 	<ul style="list-style-type: none"> Deploy a fire-fighting robot equipped with thermal sensors Real-time data Autonomous navigation to enter the building first 	<ul style="list-style-type: none"> The robot navigates through smoke, providing real-time feedback It locates the fire source and suppresses it Identifies trapped victims, aiding in their rescue Ensures John's team operates safely and efficiently, leading to mission success

T34 : CONCEPT SYNTHESIS (11 BOX TOOL)

CONCEPT SYNTHESIS

DESIGN CHALLENGE	Need for an efficient firefighting solution in scenario where human intervention might be dangerous		SOLUTION CONCEPT	A robot designed to detect and extinguish fire using IOT Technology
PERSONA:	<p>Nageshwaram 57 years old Fire service Officer</p> 	<p>Boopathi Raj 45 years old KEC staff</p> 		VALUE PROPOSITIONS TO ORGANIZATIONS/AGENCY:
DEEP NEEDS:	To improve a safety measures for fire fighters and to mitigate fire easily and quick with a help of firefighting bot	VALUE PROPOSITIONS TO TARGET USERS:		<ul style="list-style-type: none"> Firefighting robots enhance firefighter safety by operating in hazardous environments and improve operational efficiency through rapid, precise fire suppression They also reduce extensive property damage
GAINS:	Ability to access hazardous environments without risking human lives	USER NEED (PROBLEM) SOLVERS:		
PAINS:	Limited mobility in certain terrains Difficulty in communication with human responders	GAIN CREATORS:	Our team mates	PAIN RELIEVERS:

T35 : STRATEGIC REQUIREMENT TEMPLATE

STRATEGIC REQUIREMENT TEMPLATE

Strategic Requirements		The Big Idea concept(Main Solution to be delivered)		
Key Solution Components of the Big Idea		Authentic Learning Program	Student Support Program	Community Partnership
Capabilities Required to Deliver this solution component		Sensor Integration , Adaptability	Education , Safety training, Continuous Learning and Updates	Collaborative Planning, Public Relations and Communication
Current Organizational Assets and capabilities to be Leveraged		Financial techniques , Assest of fire fighters	Knowledge on sensors and Arduino software	Users financial status, Fire department ,Emergency services and NGOs
Development Strategy to develop this capability(if needed)		Needs assessment , Error finding, Continuous improvement	Feedback and iteration, Maintenance and updates	Identify and Engage Key stakeholders ,Innovation Development
Requirements and cost to develop(high/med/low)		Low – The guidance and understanding of bot	Medium – Instructor training and students workshops	High – Academic partnership and fire departments
External Sources of Expertise (potential Partnership)		Departments of Education ,National fire protection association	Grants and Funding, Industry Association	Robotics manufacturers, Automotive companies

T36 : EVOLVING THE PROCESS FOR DELIVERY

EVOLVING THE PROCESS FOR DELIVERY

Key Solution Component	Workflow/Process Needed to implement the Solution					
NAVIGATION SYSTEM	Objective setting	Sensor selection	Mapping and location	Path planning and Navigation	Testing and Validation	
FIRE DETECTION AND SUPPRESSION SYSTEM	Requirement gathering	Fire sensor selection	Fire classification	Suppression system	Safety and compliance	
ROBOT DESIGN	Identify user cases	Concept Development	Prototype development	Mobility testing and efficiency	System testing	
USER INTERFACE	User requirement gathering	Stakeholder analysis	User acceptance testing	Updates and improvement	Feedback from users	

T37 : IMPACT EVALUATION INDICATORS (VIABILITY ANALYSIS)

IMPACT EVALUATION INDICATORS

Criteria	Indicators and measurement	Stakeholders
Social Value Creation	Enhancing safety , Efficiency Effectiveness in firefighting and quick emergency response	Firefighters , emergency responders , educational institutions and industry experts.
Stakeholder Satisfaction	Establish clear indicators and assess the success of user needs	Firefighters and users
Solution Sustainability	Scalability , adaptability , cost efficiency and Environment sustainability	Long term viability , impact on various stakeholders with safety and health and long term maintenance
Solution Scalability	Development flexibility , adaptability to different fire types , Remote operation ,training and maintenance	Expanding the deployment , capabilities and impact of these robots to broader contexts.

T38 : CHANGE MANAGEMENT PLAN(REVIEW TOOL)

WHAT IS OUR CHANGE MANAGEMENT PLAN?

Vision(Reasons) for change	Staff Engagement	Communicative vision for change	Implementation Plan	Empower people for change	Create Quick Wins
To revolutionize firefighting operations through the integration of advanced robotics technology, enhancing firefighter safety, operational efficiency, and effectiveness in mitigating fire emergencies.	Create a plan for engaging stakeholders throughout the change process and conducting focus groups, Feedback through surveys, and providing opportunities for stakeholders to ask questions and concerns.	Determine the most effective communication channels for reaching each stakeholder group. This may include town hall meetings, email updates, social media posts, newsletters, and one-on-one meetings.	Develop prototypes or proof-of-concept models to demonstrate key features and gather feedback from stakeholders. Gather feedback from end-users and stakeholders to identify opportunities.	Development of firefighting robots providing necessary resources continuous support. This empowerment ensures that stakeholders are motivated and committed to contributing to the project's success.	To create quick wins for developing a firefighting robot involves efficiently introducing and executing initiatives yield immediate positive results, boosting morale, building momentum of project lifecycle.

T39 : M-A-R-S FRAMEWORK

M-A-R-S FRAMEWORK

Use the MARS framework to understand the people's behavior in the face of the change and innovation Motivation It is about the Why/the Will to change		Ability	Role	Systems
		It is about the Tools and Skills	It is about defining Roles / ToRs	It is about the Support system(Resources)
Engage team in conversation to connect and to empathize Listen to welcome the truth and to gain trust	Think	Ability to support the user	It is about developing safety measure robot	Focus on practical usability and effectiveness
	Feel	Ease of use in critical situation	Ability to support the user	Usability and accessibility
	Do	Participate in field testing	Extinguish fire	Manage risk and resolves conflicts

T40 : IDENTIFYING QUICK WIN

IDENTIFYING QUICK WIN

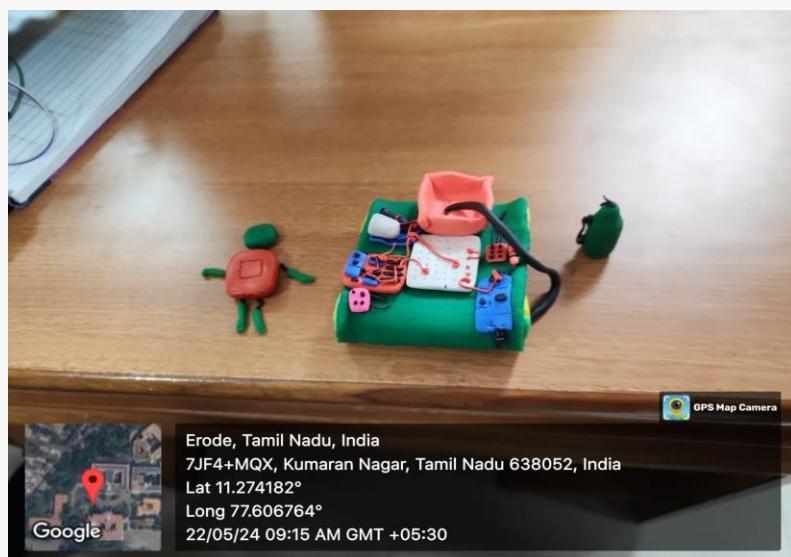
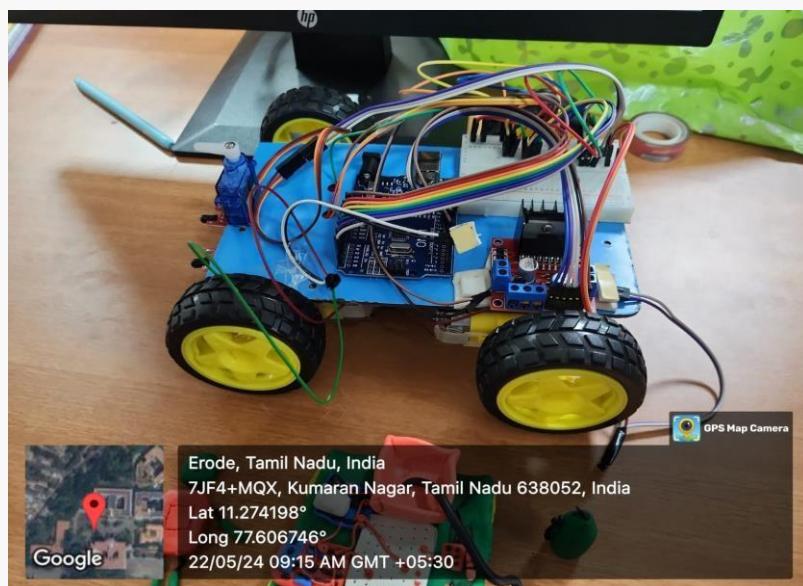
What is this Quick Win(1) about?	The Quick Attack Program aims to rapidly deploy specialized firefighting robots optimized for efficient fire suppression, enhancing firefighter safety and minimizing property damage
What are the success indicator(s)? How would it (these) be measured?	Response Time Reduction, Property Damage Mitigation It is measured by taking survey (or) feedback form
What are the resources/staff trainings needed?	Training for accessing the firefighting robot is needed
Who will lead this Quick Win implementation?	Project members , Technical Lead
What are the key steps needed to implement this Quick Win? What is the timeline till completion?	Assessment and Planning ,Testing, Training and Skill Development , Integration and Deployment , Evaluation , Feedback and Iteration
When will be the status or progress update?	Assessment and Planning: 2 months , Integration and Testing: 2-3 months, Evaluation: Ongoing with periodic reviews, Feedback and Iteration: Ongoing throughout the implementation process.
When will this be completed?	2 weeks
How would the success be communicated?	Assistant Professor (CSD) – Mr. P. Gowsikraja

T41 : ACTION PLANNING TO ADVANCE THE DESIGN CHALLENGE PROJECT

ACTION PLANNING TO ADVANCE THE DESIGN CHALLENGE PROJECT

Idea	Objectives	Responsibility	Implementation	Resources	Completion
Firefighting bot	Safety measures and user efficient	Real time usage	Review and approve the project	Sensors, servo motor	Planning and designing
Fire detection system	Affordable and efficient	Detection of fire and extinguishing	Regular maintenance	Flame sensor and smoke sensor	Deployment of fire
Fire suppression	Sustainability	User support	Updation in safety measures	Trainers and experties	Integration

CHAPTER 3

PROTOTYPE
(PHOTO OF MODULE / CLAY MODULE)

CHAPTER 4

FIELD VISIT



CHAPTER 5

SUMMARY

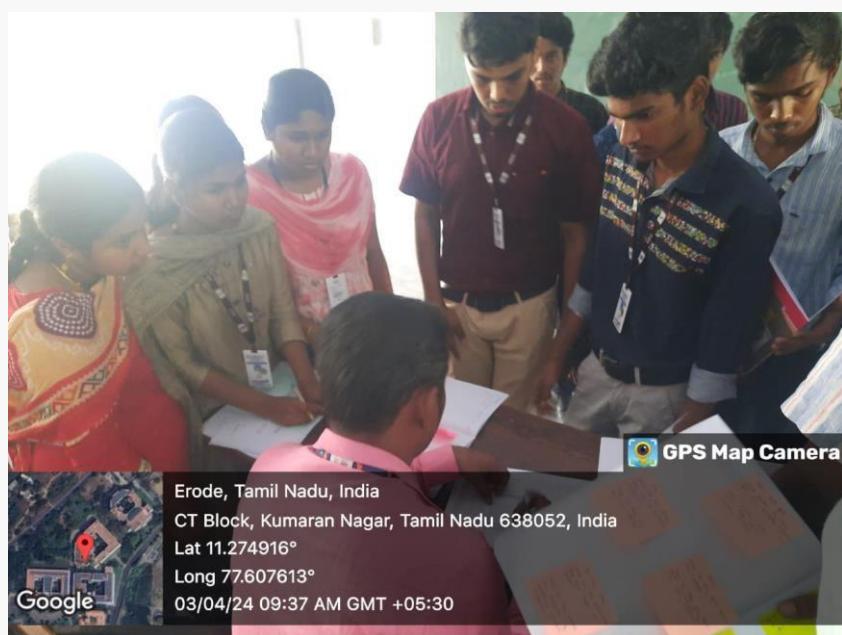
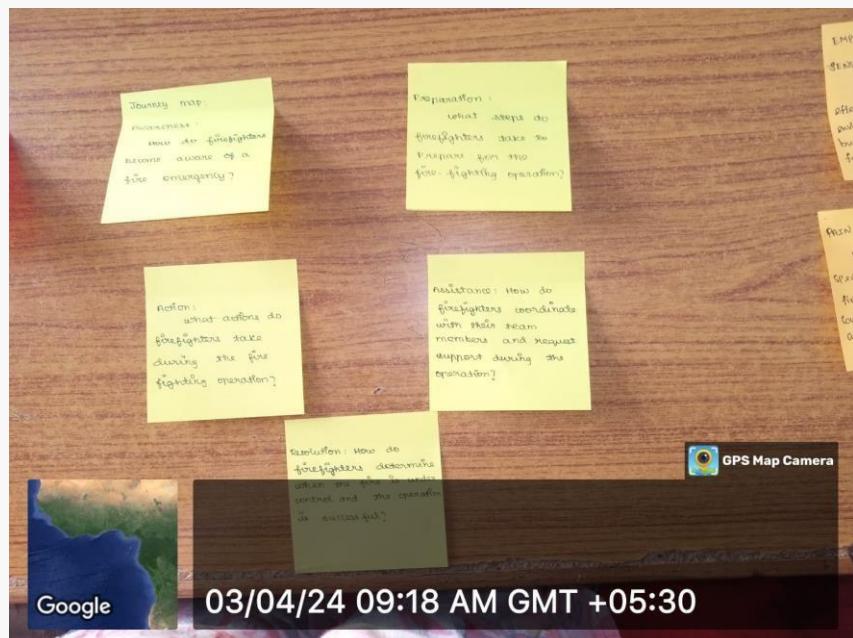
A fire-fighting robot is an advanced machine designed to autonomously or semi-autonomously detect and extinguish fires, reducing risks to human firefighters. Equipped with sensors like IR and gas detectors, these robots can navigate hazardous environments, locate fire sources, and deploy water or foam for suppression. Their primary goal is to perform reconnaissance, support rescue operations, and provide real-time data to command centers for better decision-making. These robots enhance firefighting efficiency and safety in various settings, from industrial to urban and forest environments. Innovations such as AI for autonomous navigation, modular designs for customization, and rugged materials for durability have expanded their capabilities. Integration with smart city infrastructure and ongoing advancements in swarm robotics are further improving their effectiveness, making fire-fighting robots essential tools in modern fire safety and disaster management.

CHAPTER 6

ACTIVITY PHOTOS

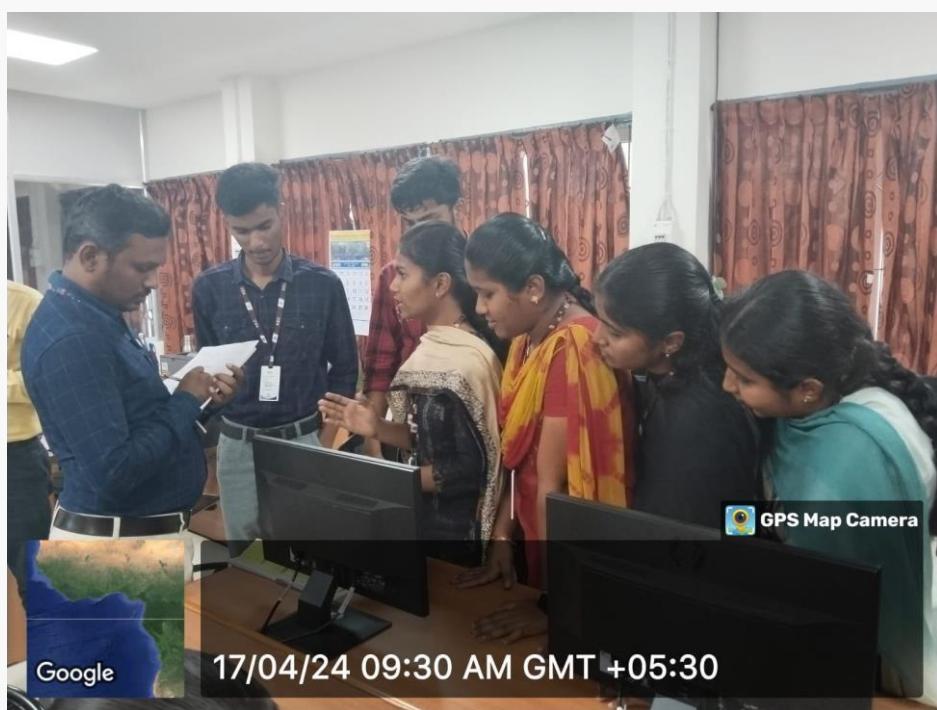
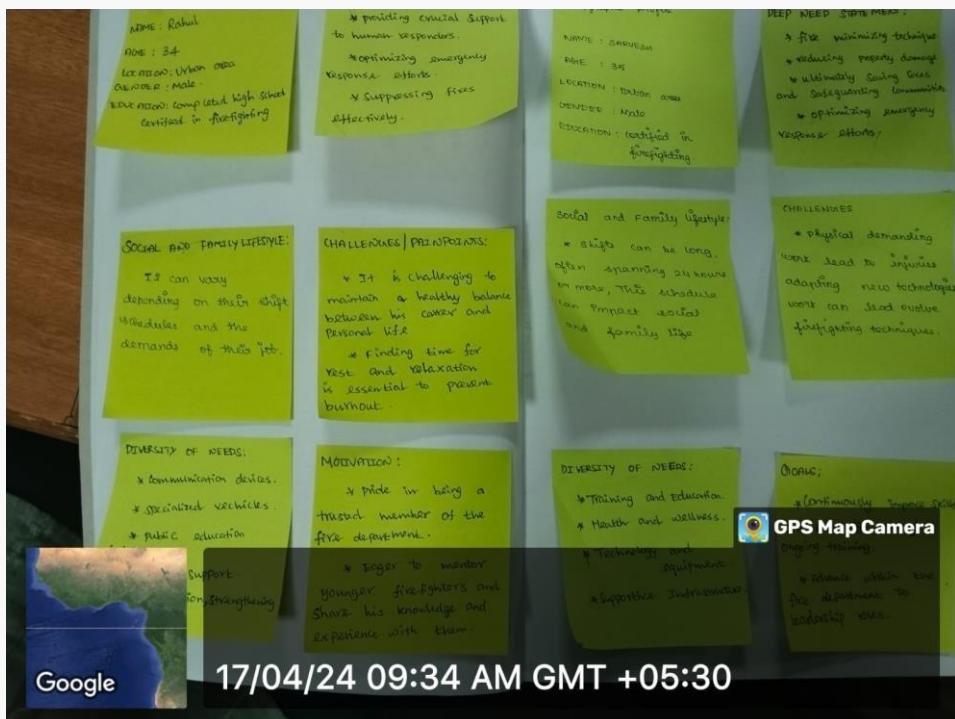
Activity : 1

Activity Name : Journey map and Empathy map



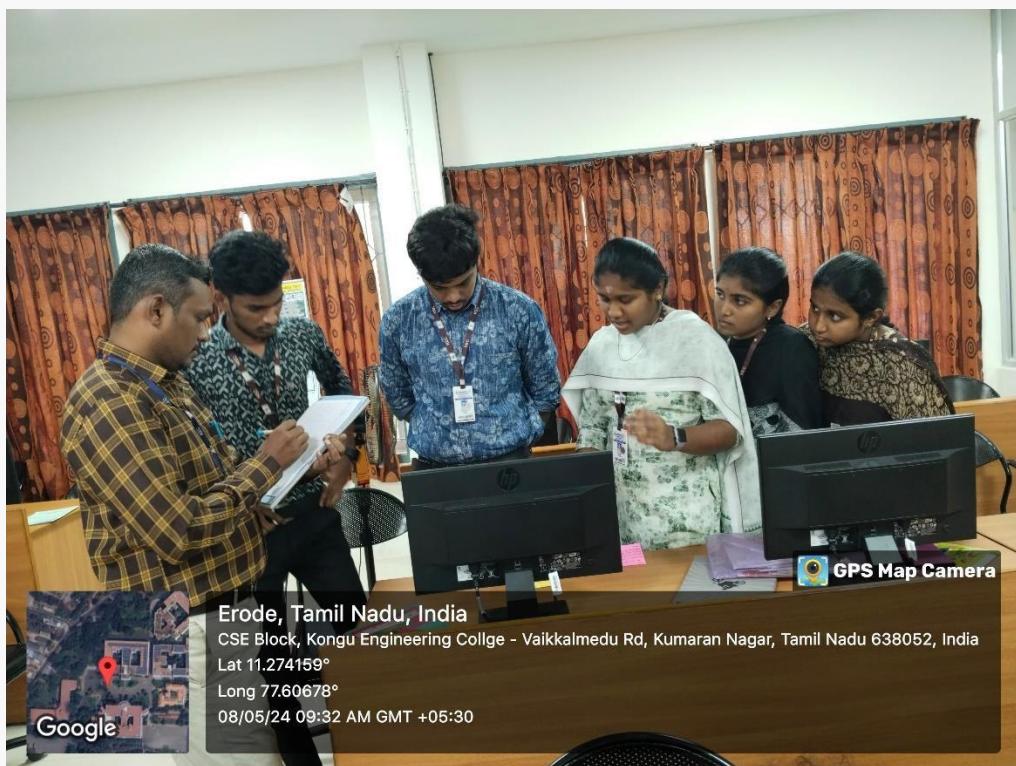
Activity : 2

Activity Name : User Persona Developing



Activity : 3

Activity Name : User Insights and User Needs



Activity : 4

Activity Name : Clay Module



Activity : 5

Activity Name : Create Low Fidelity Prototype



Acitivity : 6

Acitivity Name : Create Medium Fidelity Prototype

