FUSE

Intelligent Sensor Fusion Guidance

AI-Assisted Guidance and Documentation System for Crashed Vehicle Handling

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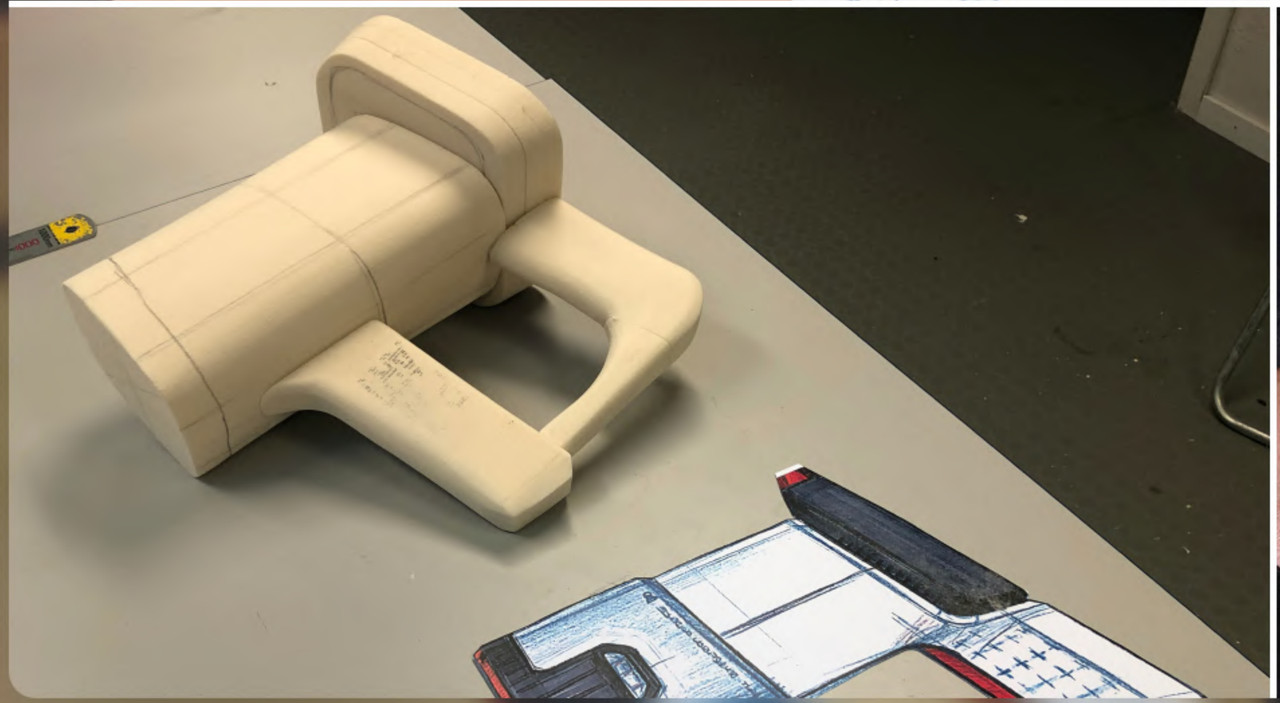
FOUNDRY CLARITY




FUSE
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1 Introduction

Challenge

As a response to the zero emission targets set for 2050, the number of electric & alternative fuel vehicles are increasing drastically. While those vehicles are not more likely to burn compared to the combustion engine vehicles, there are numerous accidents where batteries ignite, the firefighters couldn't handle it properly due to lack of experience with new cars and on-site real-time information. It becomes even harder as there are not widely accepted procedures. Extrication has also become very hard due to the structural changes in the new vehicles. First responders and firefighters need to adapt themselves, thus they need guidance and help from the industry to be able to respond to this change properly. Inspired by electrification, FUSE aims to provide guidance for all types of the vehicles.

-The firefighters are concerned and need clear directions in how to respond to the EV accidents.

1 Introduction

What It Does

FUSE is an AI-assisted handheld device and a system designed for firefighters to be used for car accidents. FUSE has a set of sensors and cameras together with flashlights and a laser c ross generator. It's not only packed with sensors but a powerful AI which has the access to a database of 3D models and rescue information of the vehicles together with the real-world knowledge. It compares 3D data of vehicles with real-world scans and generates recommendations in augmented reality form.

The closest archetype of this concept is the handheld infrared cameras used by firefighters for measuring the surface temperature, however it can't be compared with this concept as the main purpose is completely different.

Essentially, the concept is reforming the rescue sheets into a real-time interactive guide. This is a unique solution which uses the capabilities of radar & lidar sensors with a regular & an infrared camera with a smart brain. The AI combines all these real-world data that is scanned with the information in its database. (3d models of the vehicles, rescue sheet information manufacturers obligated to provide & real-world knowledge). There are AIs used in a similar way such as AI used in autonomous vehicles or for face recognition systems. This system barrows this approach and applies it to an emerging area that needs a new and up-to-date solution. It also uses the battery management system available in the vehicles to access important data.

1 Introduction

How It Works

With the help of a set of sensors and cameras, FUSE creates a 3D scan of the incident and compares it with the 3D models of the vehicles to generate real-time recommendations in augmented reality (AR) form.

There are 4 main features of the handheld device:

- Connection to the vehicle's battery management system (BMS) and the minimum set of data (MSD)
- 3D scan
- Thermal imaging
- Laser cross projecting

While the first 3 are used by the AI to create the recommendations and make calculations, the laser is used to project important location information. For instance, when an EV is on fire, one of the most recommended ways to extinguish it is by flooding the battery with water by puncturing it from a precise location. The AI would know and show the operator where to aim, thus they can help other firefighters by projecting it onto the real-world position.

The command center has a web version of the interface so every information collected and shown can also be accessed by them.

1 Introduction

Pain Points

There are some new problems to solve when it comes to vehicle accidents, especially the accidents involving electric and alternative fuel vehicles. Some of the main pain points this concept aims to address are shown below:

1. Access to the Vehicle and Structural Info

It is crucial for the first responders to know the location of the airbags, intersection points, battery, high voltage cables, reinforced panels, etc. for any response including extrication as well as how to discharge the system. However, these are only available as written documents and that is not always the best way to reach the information in the time of an emergency response.

2. Information Transfer to the Firefighters

The firefighters are informed about the incident via e-Call and MSD (for the location and transmission system of the vehicle) following with e-mails for rescue sheets. *(They might also have the printed version)* Detailed information about the vehicles are not easy to access.

3. Correct Estimation of the Battery Status

Currently, the firefighters need to observe all the indications about the battery such as physical deformation, leakage, fire, smoke generation; hissing or cracking sounds, thermal status etc. which are easy to miss and not the strongest indicators. Any wrong assessment can have fatal consequences. Currently, assessing the condition of the battery correctly is a big challenge for the firefighters.

4. Directing the Water to a Precise Location

When there's a fire or a thermal runaway in the battery, the water needs to be directed to specific locations such as the air channels. In order to access these areas, the battery might need to be punctured from the best location possible, puncturing a wrong area can also cause a short circuit or even initiate a thermal runaway. If this carried out incorrectly, it could lead to fatal consequences.

Measurements

2 Handheld Device

Placement

The unique form factor of FUSE allows it to be placed in different positions. While it can be placed straight, it can also be placed inclined at a 50° angle to allow for easy discussions during the incident, or sideways. There's also a bumper part in the front that absorbs impacts to protect the more sensitive sensor area.

DETAILED DESCRIPTION SECTION

2 Handheld Device

Securing

The user of this tool is a firefighter (commander) in a role that is in direct contact with the command center, thus they need their hands to be free for answering the calls and many things they do at an accident scene.

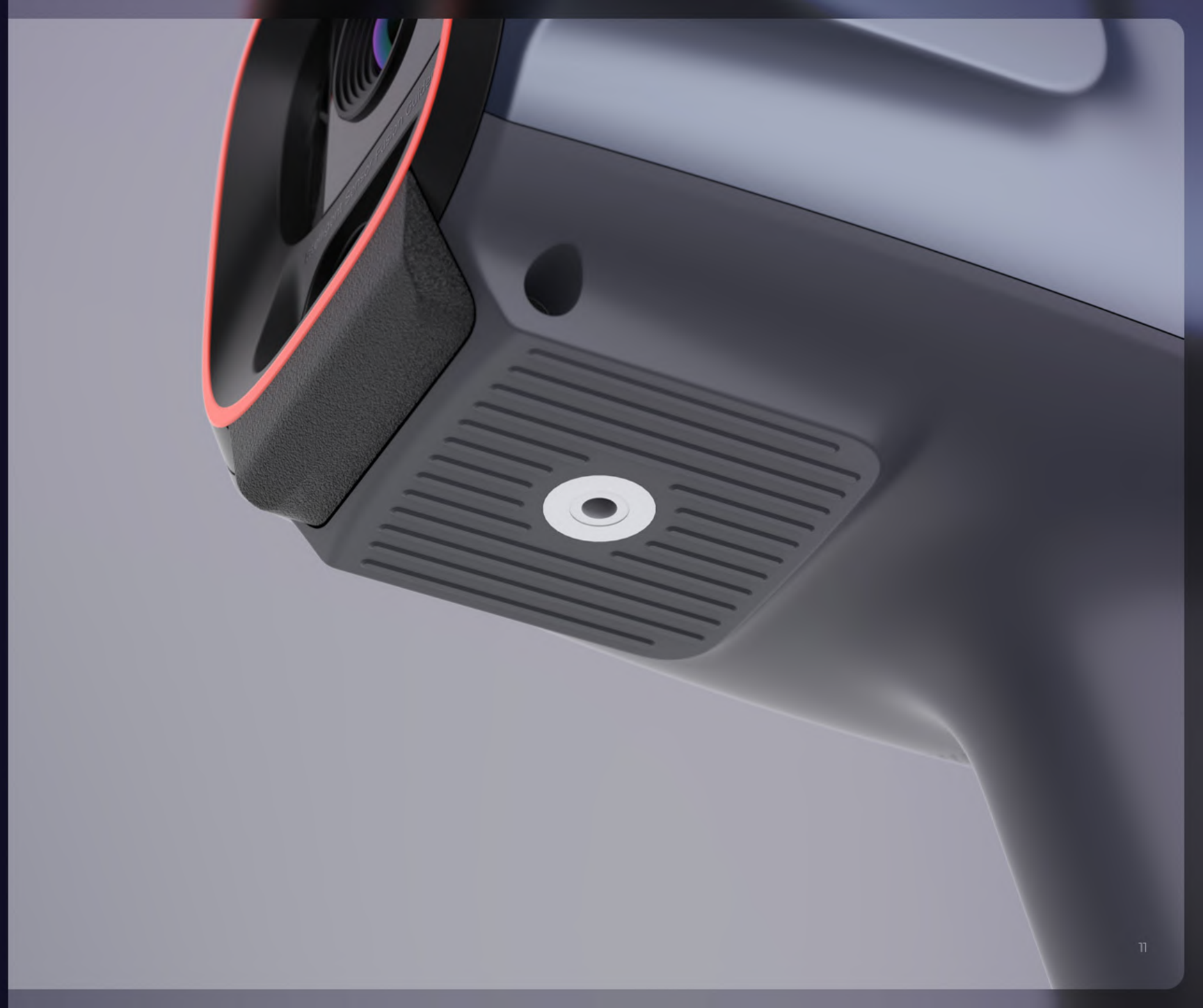
To secure the device easily, FUSE has stainless steel hooks placed inside the body tightly, allowing for a secure connection for a strap to be locked.

DETAILED DESCRIPTION SECTION

2 Handheld Device

Tripod Connection Area

FUSE can be mounted to a tripod to observe an ongoing situation easier as it could take some time to be able to respond to some incidents that take longer.



DETAILED DESCRIPTION SECTION

2 Handheld Device

Battery

For a secure battery connection, there's a locking mechanism underneath and the wide opening allows for easy and quick access to this latch. Considering the centre of gravity and use cases, the device is designed to rest at both angles of this battery unit.

As the main interaction points have a distinctive colour, this part is also defined by the bright accent colour.

- The battery can be removed after releasing the latch.

DETAILED DESCRIPTION SECTION

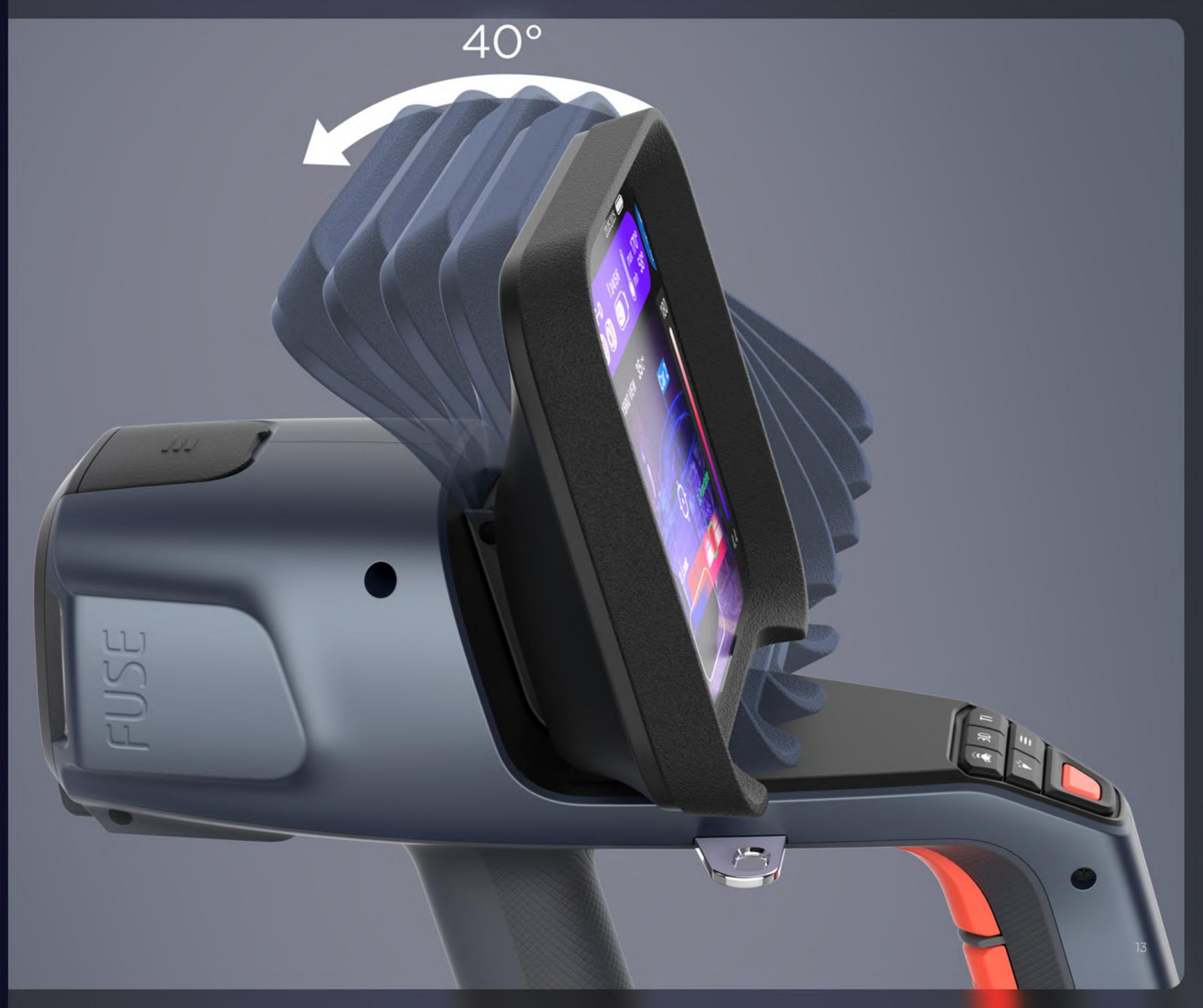
2 Handheld Device

Screen

The screen of FUSE is designed with a matte display, and it can be tilted up to 40° for various applications and better ergonomics. When tilted at a certain angle, it locks in and stays on that angle till the user changes it again. That can also be handy to prevent having glares at the screen on a sunny day.

The display was designed indent with a frame of soft material that absorbs impacts and protects the display from taking damage easily.

Since the main purpose of the interface is to give guidance, it requires much information to be displayed. The moderately large screen is designed in an optimum size to offer great visibility while displaying this information and keep the device compact.



DETAILED DESCRIPTION SECTION

2 Handheld Device

Keypad

The keypad is designed as a single piece from rubber material to provide a waterproof solution with affordable manufacturing costs and low maintenance. However, the icons on the buttons have transparent material and the central selection button has an opaque orange overmolded part. The transparent icons are backlit, and they are highlighted with a stronger light when active.

FUSE is designed with physical buttons for seamless interaction in harsh use cases and variable weather conditions, and it is designed perfectly aligned with the digital interface.

DETAILED DESCRIPTION SECTION

DETAILED DESCRIPTION SECTION

2 Handheld Device

Front Sensor Area

The components are carefully selected from the reference applications in different products since this is a new type of device. FUSE uses available and accessible components in the market. In the front, FUSE has a set of sensors and cameras together with flashlights and a laser cross generator.

The more sensitive area is designed indent to prevent possible damage. Despite using various surface finishes and a highlighted print of the accent colour on the edge of the black front area, that is a one-piece part holding all the sensors and cameras. Connecting with this part on top, there's a rubber cover for the USB-C and display connection ports to provide fast data transfer. On the bottom, there's a rubber bumper.

-The connection ports can be accessed by lifting the rubber cover.

3 Interface

Experience How It Works!

start prototype

1. Critical Vehicle Info

Temperature Bar

3. Real-time AR View

2. Tasks Panel

3 Interface

Functions: WiFi Connection

Connection to Vehicles

FUSE uses WiFi connection to the vehicles to pull the initial data (MSD and BMS) from the vehicles.

It can either be activated for searching the nearby vehicles by using the dedicated “Quick Connect” button on the keypad or by moving left in the “Critical Vehicle Info” panel.

1.0 Connect Screen

Press the middle orange button to connect to the vehicle nearby.

1.1 Connection Establishing

While connecting, a label is generated specific for each vehicle. Build name and plate number are also displayed.

1.2 Connected to “Car 1”

When connected, critical information is displayed on the top bar, and related tasks are shown on the left column.

3 Interface

Functions: 3D Scanning

3D

3D Scanning - Sensor Fusion

FUSE uses a method called **sensor fusion** that combines Radar and LiDAR sensors which have a different sensitivity to solid objects and gaseous materials like smoke for more accurate scans in the harsh environments.

3D scanning function can be activated by pressing the “3D” button on the keypad.

2.1 Start 3D Scan

Toggle 3D scanning function with the designated “3D” button on the keypad.

2.2 Calculate 3D Scan

After the sensors and cameras capture enough frames or the user turns off the scanning the 3D model is created.

3 Interface

Functions: Thermal Imaging

When used, it adds to the AI's calculations and helps with the recommendations it makes.

TI

Thermal Imaging

When switched to this function, the AR view window is overlayed with the thermal view. Snapshots can be taken by using the top trigger.

Thermal imaging function can be activated and deactivated by pressing the "TI" button on the keypad.

2.1 Start TI

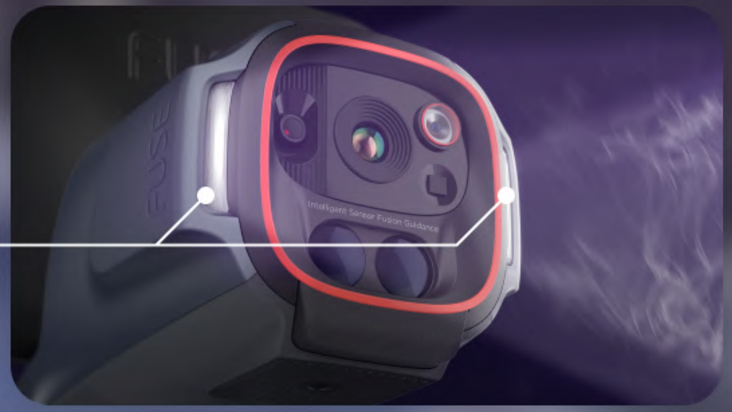
Toggle TI function with the designated "TI" button on the keypad.

2.2 Calculate TI

The thermal Imaging can either work in the background, seen on the main window, or turned off during the incident.

3 Interface

Functions: Flashlight & Menu



Flashlight

When the scanning function is enabled, lights are automatically turned on to enhance the quality of the capture, however, the user can manage the lights by using the dedicated button on the keypad.

To adjust the intensity, the user can move between 3 levels by pressing the same button.

Menu

By pressing to “Menu” button, the user can access the settings and other functions.

3 Interface

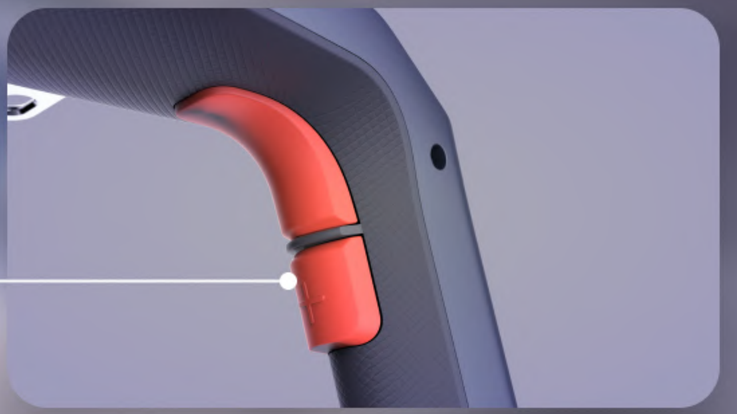
Functions: Laser Cross Marking

This function is essential when aligning the real world with the digital input. For instance, it can be used in a scenario where the firefighters need to puncture a battery and the FUSE system recommends the best place to do it on the interface. So, the user can project it on the vehicle itself.

When the user directs the handheld device to the recommended area and pulls the lower trigger, the stabilizer on the laser cross generator helps with the precision of the alignment.

Laser Cross Marking

It can be projected by pulling the bottom trigger.



DETAILED DESCRIPTION SECTION

3 Interface

AI & AI Assisted AR Overlays

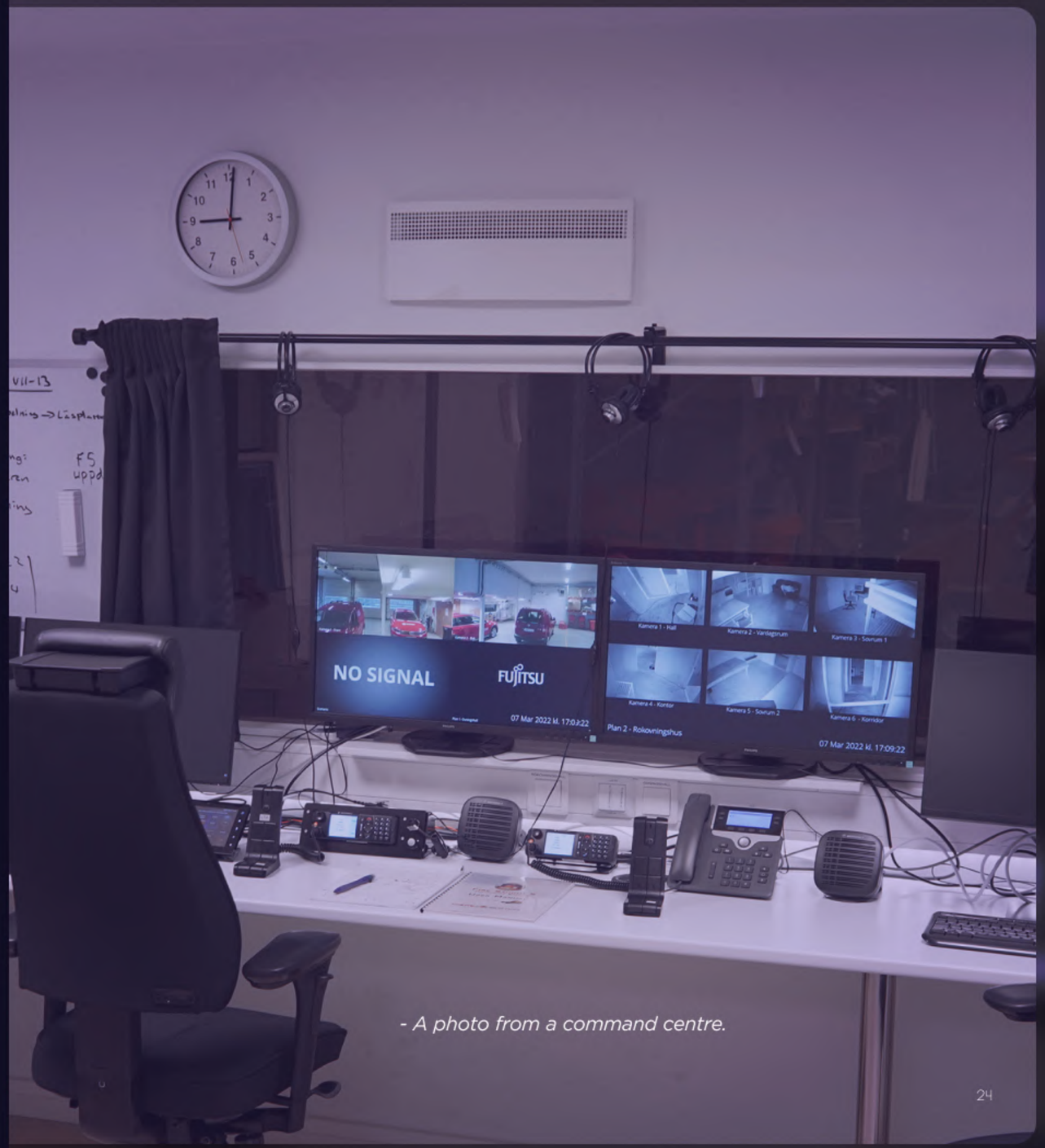
When using a thermal camera, the user can only measure and see the surface temperature. In the image on the right, there's the thermal view of the illustrated battery module of a vehicle. FUSE creates this **3D visualization digitally** by using the "Critical Vehicle Info" that it retrieved from the BMS (Battery Management System) and places it on the scanned and matched 3D data of the vehicle in the AR view window. This way, the user can see the thermal image of the battery through the screen as if it is being measured from the surface of the vehicle.

Using the real-world knowledge and the 3D models of the vehicles, FUSE compares them with the scan data, then analyses them. This way, the AI could see the unmatching areas, deformations, possible areas where the tension is built, possible damages to the internal components that are important for the response, etc.

Some tasks are also visible in the AR view if their location is vital when responding. When those tasks are selected and the laser marking is used during that time, the system helps with the adjustment of the projected laser marking for better accuracy.

4 Documentation & Education

FUSE is connected to the fire command vehicle via WiFi, thus, all the data retrieved and displayed on the screen and available on the site for the firefighters could reach the command center. This would allow for it to be recorded to a server to study and learn from different incidents. That could either be used to train the firefighters but also it could be used to improve the AI. Apart from educational purposes, recording incidents as soon as they occur is also a crucial part of a proper incident investigation.



- A photo from a command centre.


FUSE