MILITARY INSTITUTE OF SCIENCE AND TECHNOLOGY

Department of Computer Science and Engineering
System Requirements Specifications(SRS)

UAV Based Integrated Observation System for Artillery Fire guidance

IDP group-09

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1. Preface:

The corps of artillery is known as the **GOD OF THE BATTLE**. It serves with the motto **We Fire First In The Battlefield**. The Corps of Artillery fires with exact precision and accuracy during battle. But practice in peace-time is the main prerequisite of the best outcome on the battlefield. In the context of BD Army, during practice,the present firing system and blind-shell detection system is not automated. We are still following the old system of finding the *blind-shell* using metal detectors with help of Corps Of Engineers which is a lengthy process,manually calculating the correct angle for firing using projectile motion formula and manually finding rate of accuracy. However, it takes a lot of time and humane effort to successfully terminate each firing cycle. To minimize the above mentioned problems for saving time and firing efficiently the concept of **UAV Based Fire Guidance and Observation system** is being introduced.

2. Introduction

2.1 Purpose

The purpose of our project is:

a. To introduce UAV based artillery guidance systems.

b. To evaluate & locate the pin-point location of every fired-shell including (burst and blind-shell) in real time.

c. Reduce the time and manpower taken to search for blind-shell.

d. To reduce the whole process time of 'Target Acquisition' and increase the precision.

e. To provide security monitoring of the impact area to minimize any unforeseen casualty.

f. To provide tracking aid to serve as eyes for any surveillance team in bombing place.

2.2   Intended Audience

The project will be made for the Artillery Corps of Bangladesh Army. Artillery fire conducting teams of the concerned unit or training institution will have the access to use it. Authorized officers from the unit or training institution will have access to the system.

2.3   Product Scope

This product is for the Artillery Corps of Bangladesh Army. Our main focus will be accuracy of result, reduction of the consumption of time and reduction of human fatigue in artillery firing practice and **increase the precision of target acquisition**. The scope of the product is totally based on a niche organization that is the military.

2.4   Objective

To digitize the artillery shell guidance system with a view to making the system more precise target acquisition,flexible, time saving and reducing degree of errors & human fatigue.

3.   Glossary

3.1   OpenCV

OpenCV (Open Source Computer Vision Library) is an open source computer vision and machine learning software library. OpenCV was built to provide a common infrastructure for computer vision applications and to accelerate the use of machine perception in the commercial products.

3.2   Thermographic Camera

A thermographic camera (also called an infrared camera or thermal imaging camera, thermal camera or thermal imager) is a device that creates an image using infrared(IR) radiation, similar to a common camera that forms an image using visible light. Instead of the 400–700 nanometre (nm) range of the visible light camera, infrared cameras are sensitive to wavelengths from about 1,000 nm (1 micrometer or μm) to about 14,000 nm (14 μm). The practice of capturing and analyzing the data they provide is called thermography.

3.3   FFMPEG

FFMPEG is a free and open-source software project consisting of a suite of libraries and programs for handling video, audio, and other multimedia files and streams. At its core is the command-line ffmpeg tool itself, designed for processing of video and audio files.

3.4 Wireless ad hoc network (**WANET**)

A wireless ad hoc network (WANET) or mobile ad hoc network (MANET) is a decentralized type of wireless network. The network is ad hoc because it does not rely on a pre-existing infrastructure, such as routers in wired networks or access points in wireless networks. Instead, each node participates in routing by forwarding data for other nodes, so the determination of which nodes forward data is made dynamically on the basis of network connectivity and the routing algorithm in use.

3.5 GPS

The Global Positioning System (GPS) has been developed in order to allow accurate determination of geographical locations by military and civil users. It is based on the use of satellites in Earth orbit that transmit information which allow them to measure the distance between the satellites and the user.

4. Requirement Discovery :

4.1   To detect the location where the fired shell got exploded

4.2   To detect the location where a blind shell got dropped after firing

4.3   To get the exact GPS location where the sell impacted

4.4   To send the GPS location to the firing team to balance the corrections and adjust other measurements for b etter & precise firing

4.5   To send the data in real time or within the time of another firing schedule

4.6   To make the overall system more accurate as this will impact on making precise firing with a very small percentage of error

5. User Requirement :

5.1   The overall system must be user-friendly and also easy to operate

5.2   The location detection must be done in real time and the data should be sent to the firing unit as soon as possible

5.3   The firing team should be informed about the deviation of impact

5.4   The safety and security of both the drone and it's pilot must be ensured

5.5   The result should be transmitted in a profound way also the deviation measures shortly

6. System Architecture :

Application Based Interface
Drone
Drone Control Module

Configurational Services

Drone Management
GPS Module Management

Application Services

Shell Detection
GPS Tracking
Altitude & Angle Calculation

Utility Services

Operating System
System Server

6.2 Tabular Description :

Operating System	There will be a small device that gets all the data from the drone and then it calculates the end result for us.
Drone	This will work as the UAV portion of the entire project and this will give the thermal images or videos that will be used for the entire processing for the shell localization.
Drone Control Module	This module is a part of the drone. In simple words the brain or the main remote control module is this one. We can set the drone at any suitable position and also many important data will be retrieved from this module.
GPS Module	For the GPS tracking and location there will be a GPS module attached to the drone that will be helpful for giving precise GPS location and reading that will be very important for the overall result.
System Server	This will be our main server that will communicate with the OS and as a result all the calculation and other integration stuff would be done here. This will help to keep the OS lightweight and also less costly. This will be the backbone of the entire integration of the process that brings the final outcome.

7.   System Requirements Specifications :

7.1   System Requirements

7.1.1 User-friendly System
- Easy to use and also easy to operate
- The module should be compact and mobile at the same time
- No complex functionalities or navigation

7.1.2 Shell Detection
- The data from the thermal camera of the drone will give us the initial working data
- Using Image Processing, Machine Learning the fired shell would be detected by the heat signature as it will be comparatively higher

7.1.3 **GPS Tracker**
- This module will always track the GPS of the drone
- Sending the server the exact GPS of the drone we can calculate the GPS of the shell after some complex calculation

7.1.4 **Shell Tracking With Angle & Altitude**
- By keeping the shell in the focal point of the drone's cam vision we have to calculate the angle between the object and the perpendicular of the ground
- Also the drone can easily send the server the altitude it is currently airing.

7.1.5 **Application Based Interface**
- This will show the overall result after the entire process has been finished
- All the necessary data will be shown here bravely and profoundly
- The user can easily get track of the deviation and other interested parameters
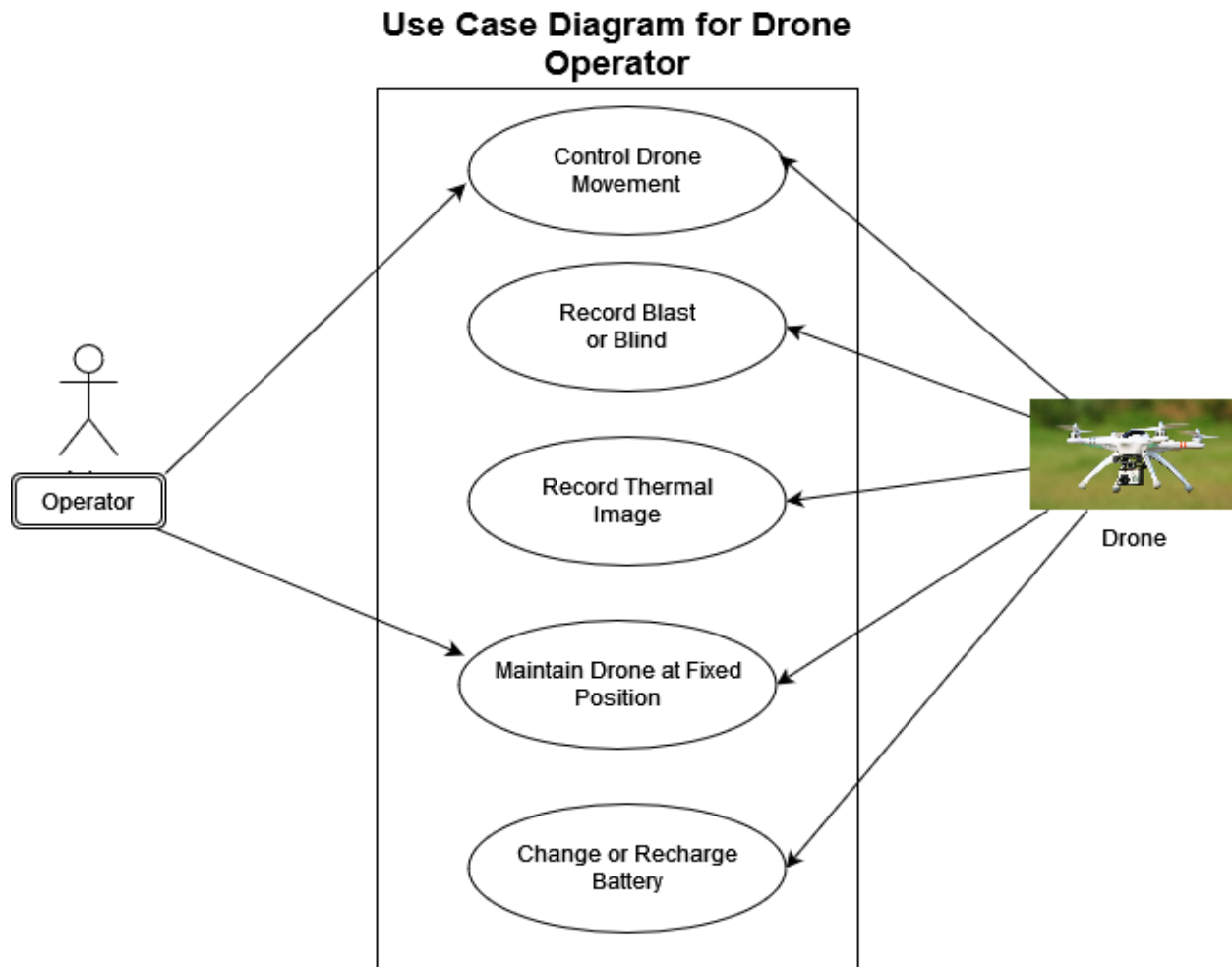
7.2 Requirements Classification

Serial no	System Requirements	Types Of Requirements Functional	Non-Functional
1	User Friendly System	✘	✔
2	GPS Tracker	✔	✘
3	Altitude & Angle Tracker	✔	✘
4	Shell Detector	✔	✘
5	Application Based Interface	✔	✘
6	Real Time Feedback	✘	✔

8.   System Model :

8.1   Context diagram :

8.2 Use Case Diagram:
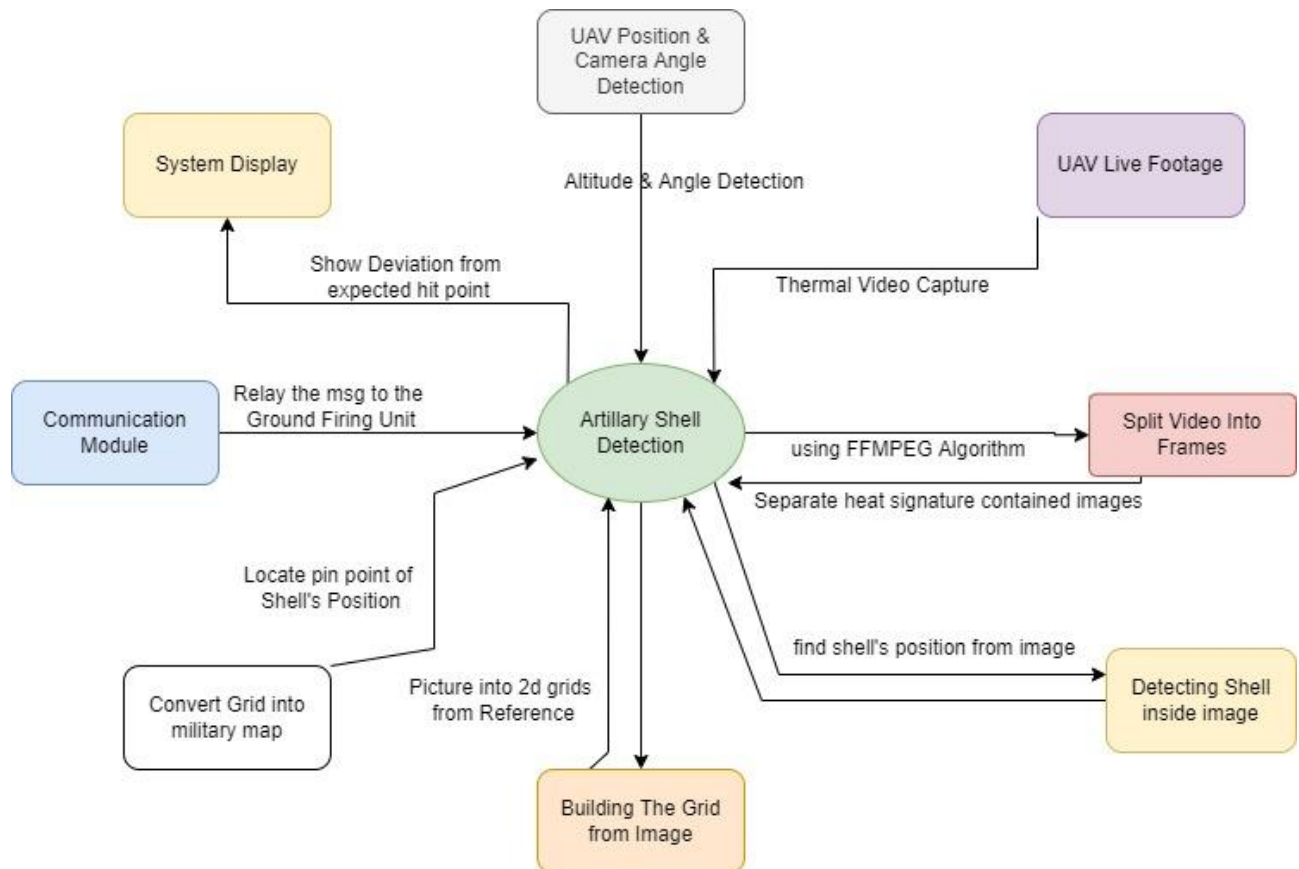
Use Case Diagram for Drone Operator

8.2.1

| Operator and Drone Interaction	
Actors	Operator who will control and maintain drone
Description	The authorized operator will maneuver the drone across the practice field and set it in the center for full area coverage. He/She will also be incharge of maintaining the drone.
Data	Live video footage and thermal video footage, drone location
Stimulus	The operator will maneuver the drone
Response	Confirmation that artillery firing records have been updated and information will be shown when asked for.
Comments	The operator must have stand by batteries for the drone. The drone must cover the entire practice area.

8.2.2

Use case Diagram for Observer
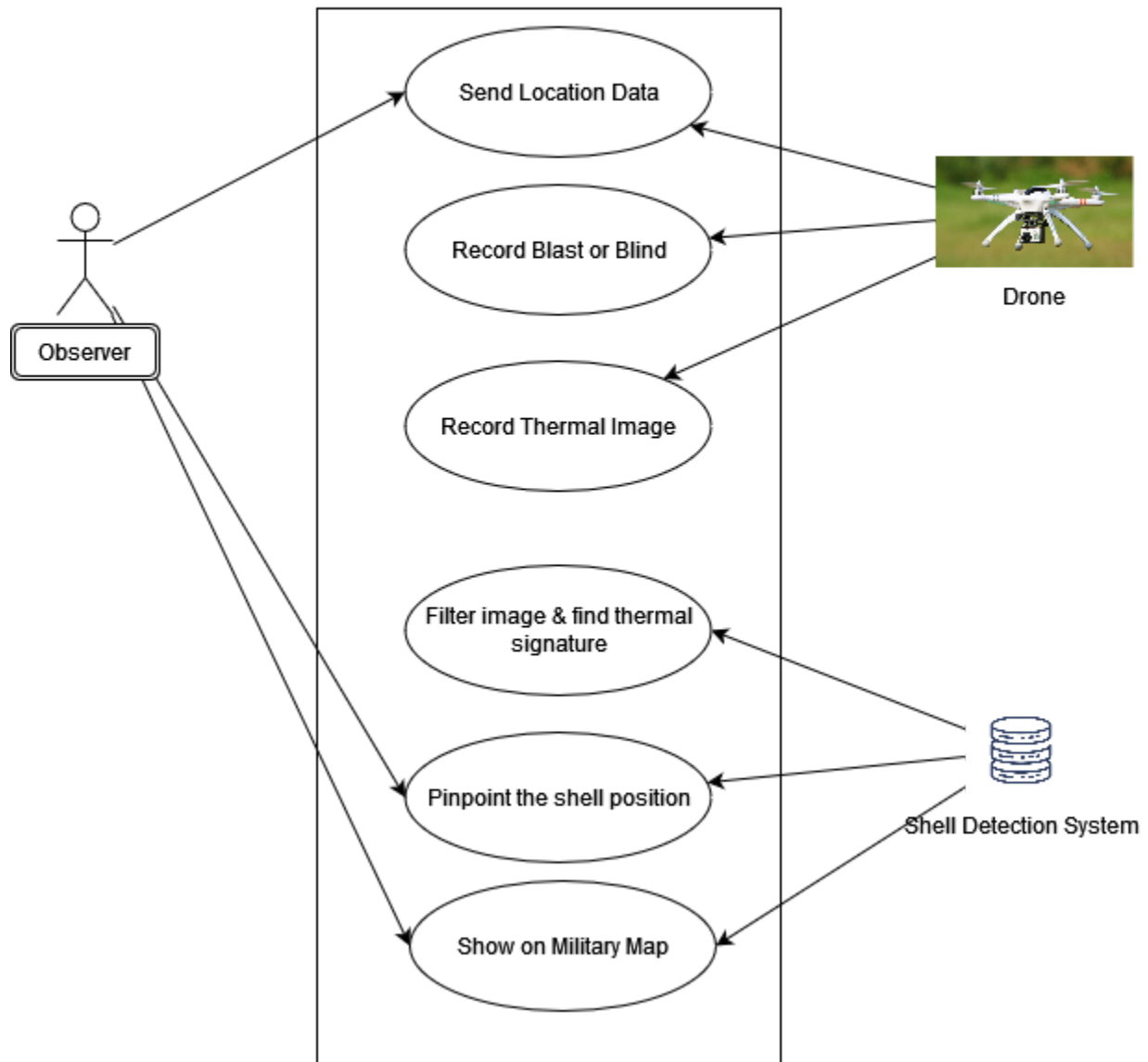
8.2.3 Tabular Description:

Observer and Drone Interaction	
Actors	The observer will get location data of the shell
Description	The drones will find the location of the shell using thermal imaging and send the data as location to the observer.
Data	Live video footage and thermal video footage, drone location
Stimulus	The observer will see the location on military map
Response	Confirmation that artillery firing records have been updated and information will be shown when asked for.
Comments	The image needs to be pinpoint accurate..

8.3 Activity Diagram

8.3.1 Activity Diagram of Device
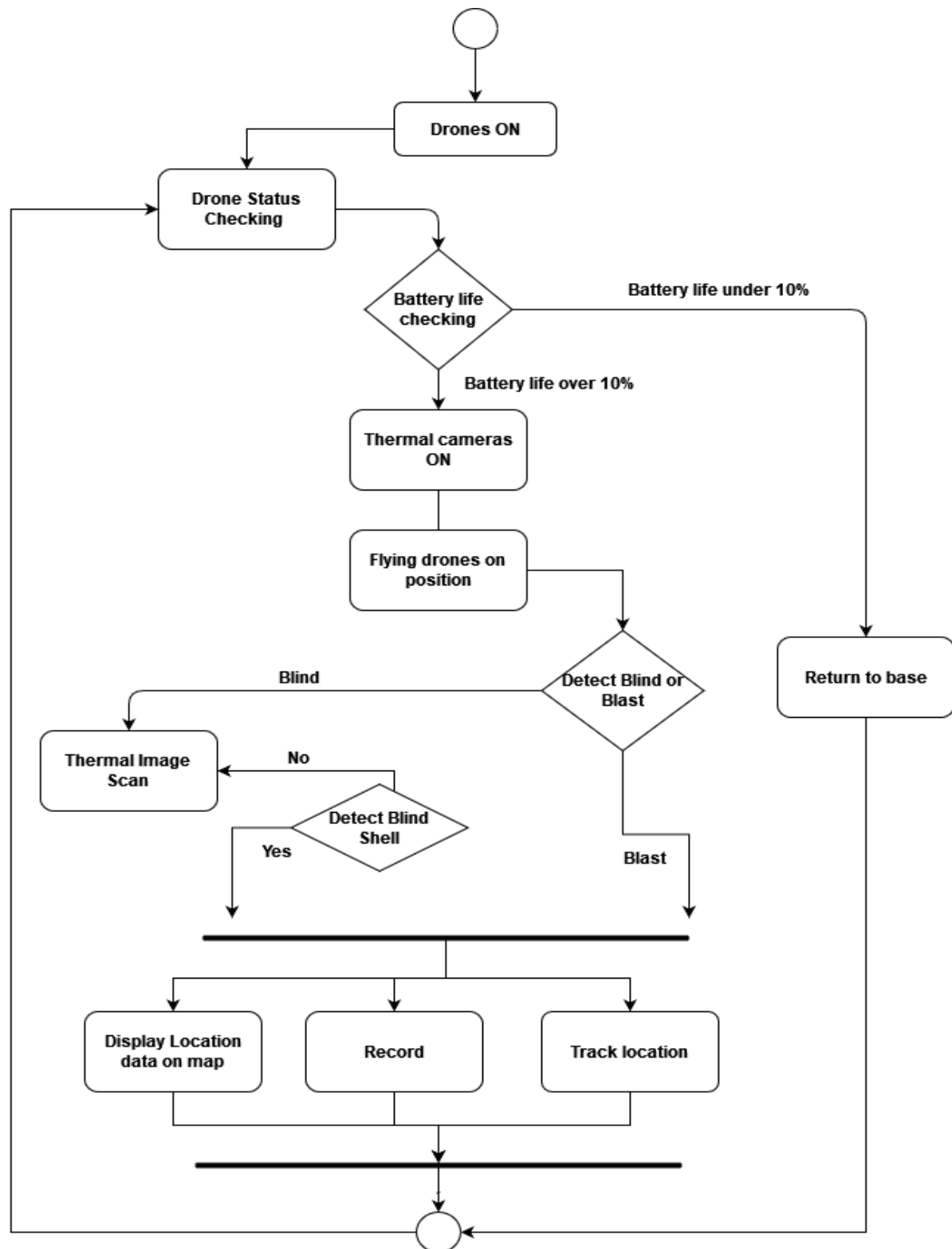
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