MILITARY INSTITUTE OF SCIENCE AND TECHNOLOGY

Department of Computer Science and Engineering

Project Proposal of IDP

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1. **Group No: 09** **Date: 30.11.2021**
2. **Section: A** **Session: 2018-19**
3. **Program:** B. Sc in Computer Science and Engineering
4. **Tentative Title**: UAV with Integrated Observation System For Artillery Fire Guidance

5. Background and Present State of the Problem

There are some manual computation methods to estimate the projectile ballistic trajectory and subsequent impact point. Manually, it is not possible to aim at the target from the mortar firing end. So a team of observation post officers (OPs) are deployed ahead of the guns to an estimated impact point from where they could see the target. When The shell bursts they estimate the approximate impact point, calculate its position from a map and pass the target data to the gun firing positions to correct gun alignment and When the shell does not burst they send a blind report. Based on that, another shell is fired with the same adjustments in order to diffuse the blind shell. For obvious reasons, the deployment had to be on either own side of the border or at a safe distance and also if the range of mortar shells increases it becomes more difficult to see the target by a ground OP. Thus, the present system is fully manual which takes much time and there is a large degree of error which is also quite inefficient.

6. **Objectives with Specific Aims and Possible Outcome**:

- To provide a fully automated system to detect fired shells.
- To provide security monitoring of the impact area or region and provide tracking aid to serve as eyes for any surveillance team in bombing place.
- To be integrated with the GPS and GR system.
- To reduce the whole processing time of target Acquisition and increase the Precision
- To significantly reduce the degree of error of determining the exact hit point
- To evaluate & locate the pin-point of every fired mortar shell including (burst and blind shell) in real time

7. **Outline of Methodology/Experimental Design**:

Setting Up The Drone:

At first the drone [1] needs to be set up and as the firing is going to be done in a specific region the drone would be given the location of the observing point and it will automatically fly to that location. This part of the work can be done by the app of the drone.

Secondly, it has to be fixed on a suitable spot. The spot must be selected as the thermal camera [2] can have a good view of the entire map that is known as the field of target for the firing. This auto stabilization is also done by the drone's internal mechanism and can be altered by the app itself.

Capturing The Shell:

Video Capture :

As we are using a thermal sensor or thermal camera we will be getting a thermal view of the entire region, And from that inspiration as the shell is shot with tremendous power the heat would easily be detectable by the thermal camera. Now this entire process will be video footage that will be processed in real time.

Mainly as the thermal signature of the fired shell is higher than the rest of the environment we can easily get a good shot on the descending fired shell.

Splitting The Video Into Frames :

Now by the help of FFMPEG [3] we can easily split a video into many frames and as the shell will explode or be a blind one our main focus would be on the last couple of seconds for the shell to hit the ground.

Detecting The Shell :

As the shell is heated and thus the heat signature will be distinguishable and tending to the red spectrum. By the OpenCV [4] module we can easily render a new image that has only the matched color range that will be given as the input [5]. Here we will be working on the specific photo that will be processed from the video. Mainly this targeted picture will be used to do the further proceedings.

Calculating The Shell's Position:

Calculating The Altitude & GPS Of The Drone :

From the app we can easily know the altitude and the GPS of the drone. This is an internal feature of the drone provided by the manufacturer. Mainly the drone should be in a static point in the air so that the location can be processed precisely.

Calculating The Angle Between The Shell & The Drone :

When the shell will be getting closer to the ground or in other words if the shell is in the field of view of the drone then that would be tracked and by comparing to the internal compass and the camera deviation we will bring out the angle of alteration for the camera to get the angle of the tracked shell.

Building The Grid :

After the final processed image we can easily divide the entire picture into smaller 2d grids and as the drone has a reference point we can easily point out where the shell has fallen.

Calculating The Shell :

As per the elevation and the angle of interest we can easily bring the distance of the two from the horizontal plane field so after doing some mathematics we can get the GPS of the Shell as the drone's GPS will be a referenced one.

Converting To Military Map :

Now lastly we have to convert the GPS system to the Military System of representing the longitude and altitude. This conversion will require some good understanding of mathematics.

Getting Another Close Look :

As there is a small time gap in between two firings the drone can easily go to a lower altitude and get a more clearer picture and thus the error can be removed greatly. This will also make the result more accurate and if the data can be stored then the bomb diffuser team would be highly beneficial as this will bring up the location of the blind shell more precisely.

8. **Please select the covered domain of your project**

Theoretical CS and Algorithms	✔ Information Security
Networking	✔ Computer Vision
✔ Database and Data Mining	Pattern Recognition
Cloud Computing and Big Data	✔ Internet of Things (IoT)
AI and Robotics	Human Computer Interactions (HCI)
	Deep Learning & CNN

9. **References**:

[1] DJI Mavic 2 Enterprise Advanced by DJI
[https://www.dji.com/mavic-2-enterprise-advanced]

[2] Thermal Cameras Listup by DronesGlobe

[https://www.dronesglobe.com/guide/thermal-drones/]

[3] Split video into frames using FFMPEG by Artificial Images

[https://www.youtube.com/watch?v=ck11jOVYlIw]

[4] OpenCV by Python

[https://pypi.org/project/opencv-python/]

[5] OpenCV and Python Color Detection

[https://www.pyimagesearch.com/2014/08/04/opencv-python-color-detection/]

10. **Cost Estimate**:

Ser No	Items	Cost (USD)
1	Mavic 2 Enterprise Advanced	7000 $
2	Field works	60 $
3	Conveyance / Data Collection	120 $
5	Power Bank	200 $
6	Communication Module	250 $
4	Typing, Drafting, Binding and Paper etc.	20 $
Total Amount		7650 $

11. Signature of the group members:

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Signature of the Course Teachers