Brief Technical Specification

of

Wide Area High Resolution Technologies (WAHT)

INSTRUMENTS RESEARCH AND DEVELOPMENT ESTABLISHMENT
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1. INTRODUCTION

Surveillance camera is most significant requirement from the services to carryout 24X7 surveillance. The key parameter of a surveillance camera is the Field of View (FOV), which dictates the range capability of the surveillance system. It is defined as the angular substance of the scene viewed by the camera. When the FOV of a camera is increased the resolution of the camera decreases and hence the range of the camera. A surveillance camera with wide FOV and high resolution is a state of art technology. It is a Herculean task to develop a surveillance camera with an ultra-wide FOV and sufficiently high resolution. These systems can cover the wide FOV and provides long detection, recognition and identification (DRI) ranges.

We are proposing an optical scanner-based wide-area surveillance imaging system operating in the MWIR spectral band. This system effectively covers a full wide field of view, providing comprehensive surveillance capabilities. An optical scanner can be integrated with a high resolution camera to cover wide area with long range performance capability. This high-resolution persistence surveillance camera, based on optical scanning technology, provides the performance of hundreds of thermal cameras in monitoring wide areas.

2. System Specification

The Wide Area High Resolution Technologies (WAHT) for Persistence Surveillance is a Thermal Imagers with an integrated scanner which provide wide field of view by stitching the numbers of frames. The WHAT system provide a panoramic view of the scene along with high resolution images of Selected Region of Interest (ROI).

Table:1

Parameters	**Value**
Detector type and format	1280x1024pixels, InSb
Pixel pitch	10µm
Spectral Band	3.6 µm - 4.9µm
F#	3.4
TI-FOV	4.0° x 3.3° ± 10%

System FOV	90° x 10.5° ± 10%
Refresh Rate	≤ 4 second
Video format	Digital (HD-SDI), HDMI
Range Target size :2.3mx6m (Visibility:>23km,ΔT ≥2°C)	Detection :18km Recognition :8km
Power	24 VDC
Weight	≤ 10 kg
Working Temperature Range	-20°C to + 55°C
Storage Temperature Range	-20°C to + 70°C

3. System Configuration:

The key component of the wide-area high-resolution persistence surveillance camera system is an optical scanner, which is optically coupled with a high-resolution MWIR base camera on a high-definition (1280x1024) infrared detector. Together, these components create a powerful surveillance camera capable of capturing detailed imagery over a wide area.

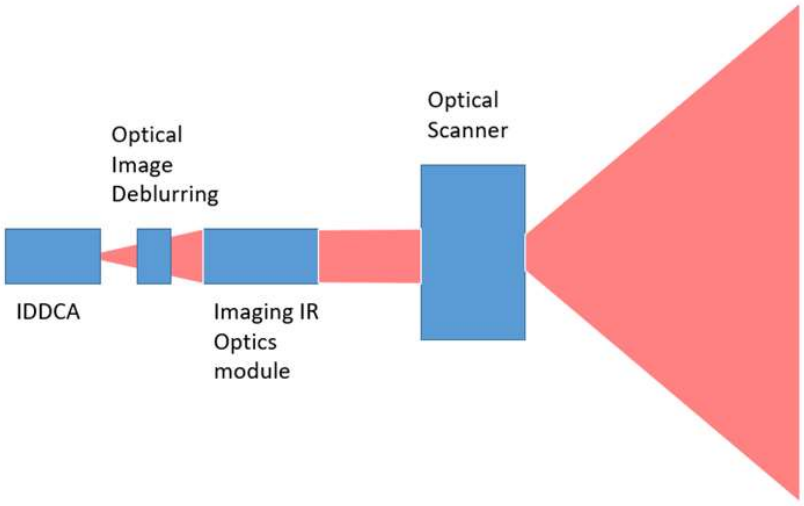

Figure 1. Block diagram of the wide area high resolution surveillance camera

As the high-speed scanning is performed, image blurring may occur, but this can be effectively corrected by incorporating an optical image de-blurring module within the base optics module. This module addresses any blurring issues, ensuring clear and sharp images despite the scanning motion.

To facilitate wide-area persistence surveillance, all the sub modules will be integrated within a shield console. This console will enable the generation of a panoramic view of the scene by combining the scanned video, which will be displayed on an interactive screen. This integrated setup ensures comprehensive surveillance coverage and provides an interactive display for effective monitoring and analysis.

4. Scope of Work

4.1 WAHT Modules

The wide-area high-resolution persistence surveillance camera consists of several fundamental modules which are required to be developed by the vendor.

a. Base optical module
b. De-blurring module
b. Optical scanner
c. Integrated Detector Dewar Assembly
d. Image acquisition Electronics with external trigger
e. Image processing electronics
f. Panorama generation and video display and Artificial Intelligence based automatic target detection.

4.2 Detector Module

The IR detector as per specification given be

Table:2

PARAMETER	VALUE
Detector type	InSb detector
Format & Pitch	1280 x 1024, 10µm pixel, F/# 3.4

Spectral Range	3.6 - 4.9 µm
NETD with 50% well-fill	<25mK
Operability	>99.5%
Maximum Frame Rate	90 Hz at full window
Integration Modes	ITR, IWR
Cool-downtime@23°C	7 minutes (Micro Cooler, Split Linear)
Ambient operating temperature	-40ºc to 71ºc
Residual Non-Uniformity	< 0.06% STD/DR at 20-80% well fill capacity
Module Total Power Consumption @ 23°C	Typical 15 W
Module MTBF	> 10,000 hours (GM @ 35°C)
Module Weight	<730 g

4.3 IR Optical Module

Specification of the Base optics Module:

The base optics module is a **Compact folded L shape single FOV Optics module** works in the MWIR spectral band. The specification of the optics module has been decided based on the range requirement and the field of view coverage.

1. Spectral Band : 3.6 to 4.9µm
2. Effective Focal Length (EFL): 180 mm
3. F# : 3.4
4. FOV (Single FOV) : 4.0° x 3.3° ± 10%
5. Integrated de blurring module: Rotating Parallel plate based or FSM based

4.4 Optical Scanner:

Optical Scanner Scan the field and stair the Line Of Sight (LOS) to create the field of view 90° x 10.6°. The optical scanner will rotate with a rotational speed of 15 rpm (approx.) to create the entire ultra wide FOV. Due to high speed rotation of LOS there will be an image de-blurring and image Rotation. There will be an active optical de-blurring mechanism to restore the sharpness of the image.

4.5 Imaging De-blurring:

The optical scanner, while scanning a wide field of view, rotates at high speed, leading to blurring in the acquired frames. To address this issue, image de-blurring techniques can be employed. Image de-blurring is a process that aims to eliminate blur or out-of-focus effects in an image caused by factors of motion blur. Its objective is to restore the sharpness and clarity of the original image. An optical de-blurring mechanism is required and will be integrated with the base optics module. During the image integration time the de-blurring mechanism will kept the LOS stationary.

4.6 Control and Display Unit.

Control and display unit is rugged display based control station integrated with Joystick of mouse rugged keyboard mounted on a panel for ease of using the system. The display should have 4k resolution. The control and display unit will be integrated in a suitable mechanical console.

4.7 Integrated GPS and DMC Module

GPS is a COTS item Elena, Part no: ELNNC4A

DMC is a COTS item from Navicom,India AHRS-M1 OEM .

These two module will be integrated inside the WAHT System

4.8 Mounting Platform

A pan and tilt unit i.e. A High Accuracy 12', 2-Axes Gimbal Mount (Part No.GM-12E-090090) from Newmark Systems with controller or equivalent platform to be used for mounting of WAHT system

5. Electrical Interface of the system

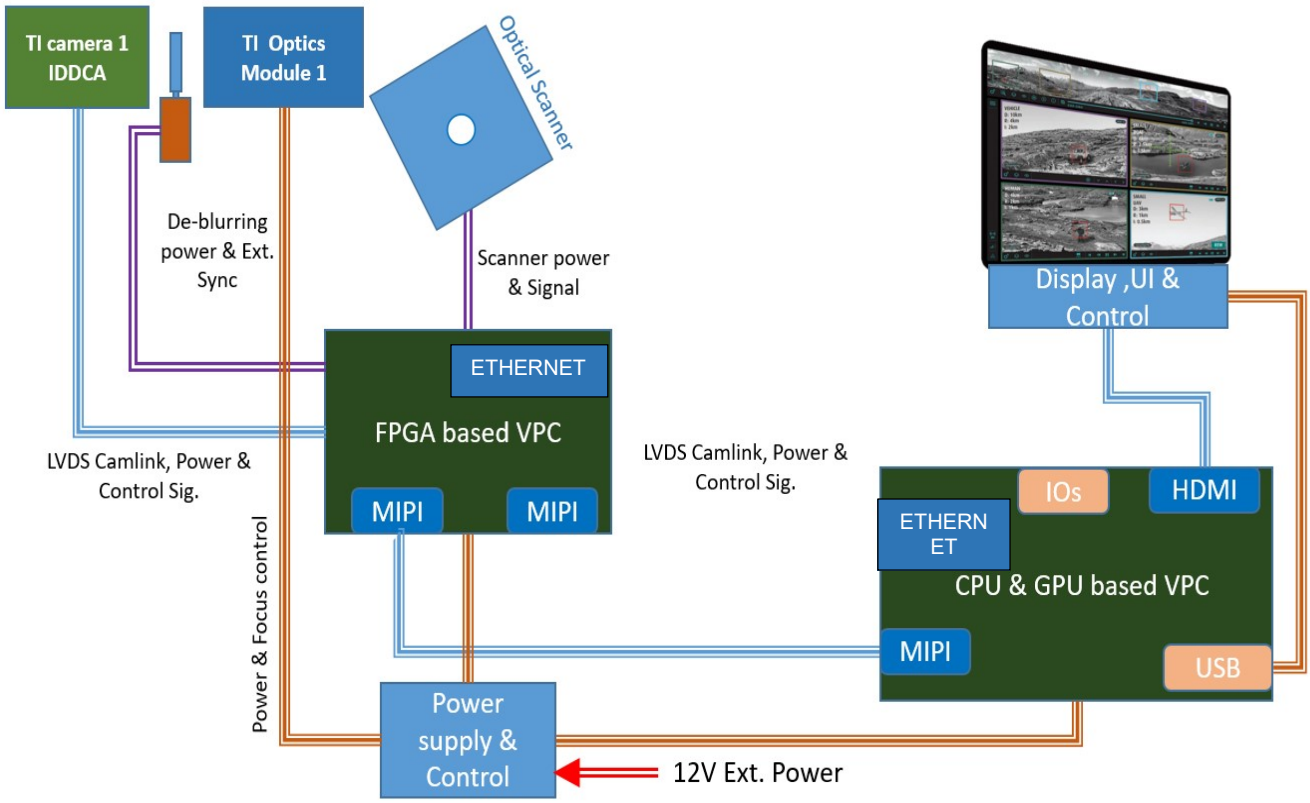

Figure 2. Electrical Interface Scheme of WAHT

6. Software Specification/ Requirement (To be developed by Vendor):

The list of software modules to be developed are as given below. These modules are to be developed on the control station and VPC and are to be delivered with the system. The control station will be a (HP Zbook Firefly 15.6 G8 or equivalent). It is to be provided as deliverable.

5.1 VHDL software

a. IDDCA interface with FPGA Card

b. Image Acquisition

c. Bad Pixel Replacement (BPR)

d. Non Uniformity correction (NUC)

e. Dynamic Range compression (DRC)

f. Automatic Gain Control (AGC).

g. Image processing Filters.

h. External triggering signal to start the frame acquisition

i. Frame labelling (address) with the number frames in a line and line number. (There are approximately 30 frames per line and 4line to generate the entire FOV of 90° x 10.5°)

j. Video output format MIPI and HD-SDI with each frame labeling as mention above (i).

5.2 GPGPU software Features

a. Interface with FPGA based VPC as mention above

b. Image acquisition from the FPGA based VPC

c. In transit storage of frames (150 approx.) as metadata

d. Generate panorama by stitching four lines and 30 frames in each line with a refresh rate of 4 second (it may reduce further based on the performance of the system)

e. Image Blending.

f. Automatic target detection/ Classification (Tank, Vehicles, Man)*

g. Target tracking and trace the path of the tracked vehicles.

- Subject to training data available with IRDE.

5.3 Command control software

a. Image representation of panoramic view.

b. User selected four Region of Interest (ROI) on the panoramic view and display of four High resolution image of selected ROI on the same display just below the panoramic view.

c. Generate an angular co-ordinate information by mouse clicking on the panoramic image and deliver through RS232/ RS 242.

d. Mouse/ Joystick for ROI selection

e. Video recording of 8 hours for forensic use.

f. Generation of target direction data (Az & El) for external cueing of other EO payload.

7. Work Responsibility

Table:3

S. No.	Activity/Module	Responsibility
1	Optics Design including Scanner	IRDE
2	Optics Fabrication	Vendor (As per IRDE Design)
3	Mechanical Design	IRDE
4	Mechanical Fabrication	Vendor (As per IRDE Design)
5	Opto-Mechanical Assembly	IRDE & Vendor jointly
6	Electronics Hardware Design	Vendor (As per IRDE specifications)
7	Electronics Hardware Fabrication	Vendor
8	Software Development (As per Para 6)	Vendor (Approval by IRDE)
9	Deblurring Module	Vendor
10	IR Detector	COTS (To be purchased by Vendor)
11	GPS & DMC	COTS (To be purchased by Vendor)
12	Pan & Tilt Unit	COTS (To be purchased by Vendor)
13	System Integration	IRDE & Vendor jointly
14	Documentation (As per Para 8)	Vendor
14	Performance Evaluation & Testing	IRDE & Vendor jointly

Note - The above list is indicative and any activity towards the Development and Delivery which is necessary but not part of the list above will be deemed to be in the scope of work.

7.1 Integration of the system at IRDE

1. Vendor will carry out the final integration of the system at IRDE under the supervision of IRDE scientist
2. Vendor will depute 04 nos. of engineer at IRDE upto 6 months for integration of system during the complete cycle of the development.

8. Milestone wise document and report generation

Vendor should prepare following documents and submit a copy of the same in both softcopy and hardcopy to the IRDE. These document should be handover to IRDE in the phase wise manner during the development of the system.

Table:4

Sr. No.	Document
1.	System Design documents
2.	User Manual
3.	Technical description manual
4.	System Acceptance Test Report as per ATP
5.	Manufacturer's Recommended List of Spares (MRLS)
6.	Illustrated Spare Parts List (ISPL)
7.	ESS /QUALIFICATION Test Reports
8.	Sub modules Acceptance Test Results (ATR) as per ATP
9.	Complete Wiring layout
10.	Electrical and mechanical ICD
11.	Mechanical documents: 1. Assembly procedure document

	2. Material inspection report, 3. Component & assembly level inspection report **4.** Mechanical drawings (Part Drawings, Sub-Assembly Drawings and Assembly Drawings in DWG format of Solid Works)
12.	Electronics Hardware documents: **1.** Design document with memory mapping details **2.** BOM **3.** Schematics, Circuit Diagrams, PCB layouts and connectors details **4.** Data sheets of all components **5.** Acceptance Test Report **6.** Signal Integrity & Thermal Analysis Report of Electronics Cards
13.	Software Documents **1.** Software Requirement Specifications (SRS) **2.** Interface Requirement Specifications (IRS) **3.** Software Design Documents (SDD) **4.** Device Driver Document **5.** Software Configuration Management (SCM) **6.** Software Version Description (SVD) **7.** Software Test Plan (STP) **8.** Software IV&V Report **9.** Acceptance Test Report (ATR)

The above list is indicative and any activity towards the Development and Delivery which is necessary but not part of the list above will be deemed to be in the scope of work.

9. Intellectual Property Rights

The rights of Intellectual Property, developed under the contract, will be property of IRDE (DRDO), Govt. of India. The development Partner will have to give complete technical know-how & design data to IRDE. **Development partner is also required to sign a Non-disclosure**

Agreement with DRDO during pre-bid. All technical design documents will be shared at the time of pre-bid meeting.

10. Realization Time

First unit to be realized in 20 months and 2nd unit to be delivered by 24 months after signing of contract

11. Deliverables

The work package envisages the following deliverables.

1. **WAHT** **02 sets (As mentioned in Table 5)**

Table:5

S. No.	Deliverables	Quantity
1.	WAHT with Harness	01 set
2.	Rugged Control and Display unit	01 set
3.	2 axis Pan and Tilt unit	01 set
4.	Mechanical Jigs for testing	As per requirement for optics testing and assembly.
5.	Documentation	As specified in Table 4
7.	Rugged controller for VHDL and GPU programming and upload (HP Zbook Firefly 15.6 G8 or equivalent)	01No

2. **Spares** **01 set (As mentioned in Table 6)**

Table:6

S. No.	Nomenclature of Item	Quantity
1.	Blackbird Detector (F# 3.4)	01 No
2.	Optical Scanner module	01 No

3.	Video Processing and other Electronics card	01 No
4.	Interface Electronics	01 No
5.	Rugged Control and Display unit	01 No
6.	System Assembly Tools	01 No
7.	Fasteners Used in System	01 No
8.	Electronics Unit Assembly Tools	01 No

3. NRE

Table:7

S.No	Deliverables	Quantity
1.	NRE Cost (Non Recurring Expenditure)	01 Job

Appendix A

Limited Environmental Test

1. Visual

All the developed units will undergo visual testing. The sight shall be checked visually and must be free from the following defects:

a. Missing, loose or damaged screws and other components.
b. Broken or chipped optical windows / lenses.
c. Dirt, dust, filming or fungus on optical surfaces.
d. Defective polishing and thin film coatings.
e. Faulty electrical connections/hardware.

2. Environmental Tests

2.1 Dry Heat (Storage):

Place the prototype unit inside the temperature chamber in switch off condition. Raise the temperature of the chamber to +70°C ± 3°C and maintain for 8 hrs. Switch off the chamber and allow the temperature to come down to room temperature and open the heat chamber. Switch on the system and Check all the function and controls of system.

2.2 Dry Heat (Operation):

Connect the prototype unit to 24 Volts power supply and place it inside the temperature chamber. Raise the temperature of the chamber to +55°C ± 3ºC and maintain for 8 hrs. Switch on the sight for last 1 Hrs. Switch off the chamber and allow the temperature to come down to room temperature and open the heat chamber. Check all the function and controls of system.

2.3 Low Temperature

Connect the prototype unit to 12 Volts power supply and place it inside the temperature chamber. Lower the temperature of chamber to -20°C ± 3ºC and maintain for 8 hrs. Switch ON the system

for last half an hour and system should display normal image. Switch off the chamber and allow the temperature to come down to room temperature and open the heat chamber. Check all the function and controls of the system.

2.4 Vibration Test:

Mount the system using a suitable fixture on the vibration machine and subject to the vibration test in following sequence keeping switch off condition.

a. 20- 30 Hz at 2g for 30 min.
b. 10- 40 Hz with amplitude of vibration displacement of 0.16 mm.
c. 40 – 120 Hz with and vibration accuracy of 1g for 10 min.

Power on system and check the function and controls of system.