Automated surveillance robots for high altitude regions like Siachen

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Abstract: The Siachen glacier is one of the worst battlefields and there are conflicts over its sovereignty. The soldiers have to survive in -40 to 10 degrees causing frostbite. During last 32 years the nation has lost more than 900 soldiers. Thus, automated robots for the purpose of surveillance can be implemented with temperature sensing and remote controlling functionalities along with alert systems for detecting suspicious activities and related actions.

IndexTerms **- Automated, Surveillance, Sensor, Wireless, Temperature, Remote control.**

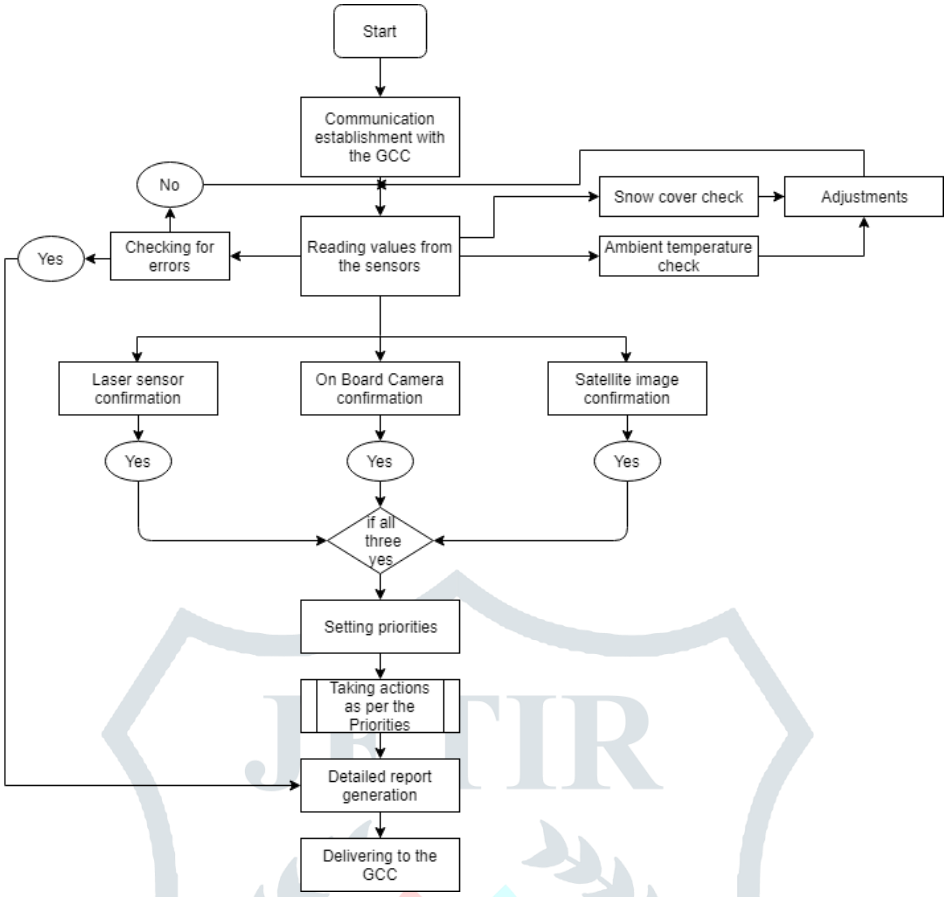
I. INTRODUCTION

The use of automated system involves minimum human assistance in the system operations decreasing human efforts and overhead. The soldiers are health and wealth of any nation. The Siachen region is known for its worst environmental conditions. The soldiers posted have to survive in those conditions with high probabilities of health related issues. The Government of India is spending five crores daily for safety and food supply to the soldiers in the Siachen region. Thus the surveillance system incorporating remote controlling facilities along with additional functionalities like temperature sensing, controlling, measurements on detection of suspicious activities can be implemented in such regions to ensure maximal safety of the soldiers. The proposed system consists of Pyramidal Mechanical assembly enclosing the required hardware assembly, protecting it from the environmental conditions. Multiple sensor modules working in Master-Slave fashion are mounted for collecting the data required from the surrounding. These sensor modules include Ultrasonic sensors, Laser sensors for obstacle detection, camera modules for obstacle recognition and temperature sensors for surrounding temperature sensing purpose. It also involves wireless communication module for establishing and maintaining the communication between robot and ground communication center.

II. MOTIVATION

The main objective behind this project is to risk money instead of precious human lives. Surveillance can be informally dined as "a close watch kept over something or someone with the purpose of detecting the occurrence of some relevant events". The person or thing to be watched should be understood to include humans, animals, areas, places, parts of aerospace, etc. Automated surveillance typically concerns itself with detection and recognition of relevant events. A system of CCTV cameras, microphones or smoke detectors can be used to detect interesting events or to analyze patterns of behavior. However event recognition is only one aspect of surveillance. Other aspects can be assigning the priorities and taking corresponding actions. Our Project will ensure the safety of the solders as "Military Power is the strength of the nation".

III. SYSTEM OVERVIEW



IV. SYSTEM IMPLEMENTATION

Multiple laser sensors and camera module are mounted along with encoder and driver assembly. It involves operations in the following sequence:

i. Establishing Communication: It is the first step which involves establishing communication between Ground Communication Center and Surveillance Robot. It involves:

a. Opening connection: Establishing the connection between robot and ground communication center.

b. Maintaining connection: Marinating the link between robot and ground communication center.

c. Repairing connection: Repairing the link between robot and ground communication center in case of failure.

ii. Reading sensor values: Temperature sensors for maintaining temperature, ultrasonic and laser sensor for obstacle detection are used.

iii. Error correction: Error correction involves verifying sensor reading, detecting the presence of errors and necessary corrective measures.

iv. Priority Assignments: According to the weights assigned to the activities in the database the priorities are assigned to the activities in the surrounding environments at run time at the time of occurrence.

v. Actions: Based on the priorities the corresponding measures are taken and the necessary actions are performed.

vi. Report Generation: Detailed analyzed report of the activity-action is generated and is sent to the Ground Communication Center for required processing.

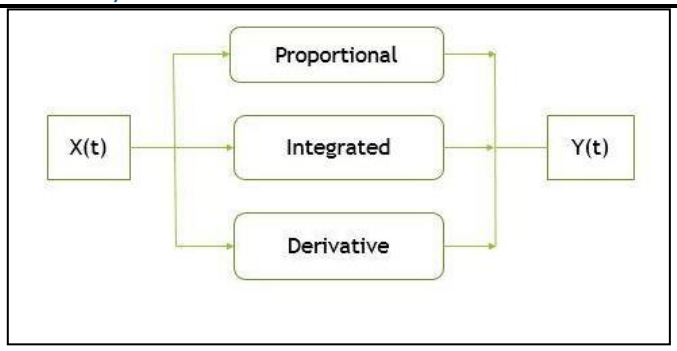
A. Techniques and equations

3.1 Priority Assignment to the actions

The weights are assigned to each of the task depending upon the priorities .Preemptive algorithm is used in order to decide priorities at the run time based on the weights assigned to each priorities. Corresponding actions are performed if necessary depending on the priority as per listed in the databases. The detailed report for the actions is generated and will be sent to the Ground Communication Center for further set of action if necessary.

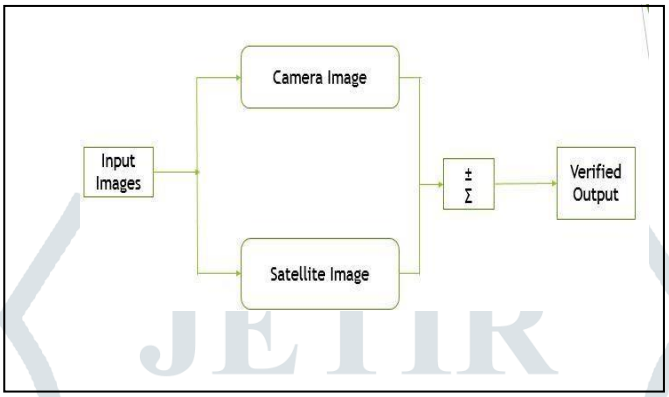
3.2 Temperature Sensing and Controlling

Thermocouples and RTD temperature sensors are used in order to detect normal as well as abnormal temperature conditions in the surrounding environment. Proportional Integral Derivative (PID) control for electric heaters is used in order to regulate and maintain the constant temperature inside the entire assembly.



3.3 Image Processing

Image processing is used for detection of suspicious activities. Satellite images are used along with the sensor and camera images for the detection of activities to make the system more efficient and reliable.



B. Error Checking

Error detection codes are employed in the system to overcome the errors in snow cover detection, avalanche detection and temperature detection along with the verification from satellite images for the activity detection. Forward error correction codes can be applied for error correction by comparisons.

C. Some Common Mistakes

1. Differentiating between regular and suspicious activities.
2. Assigning priorities during run time, may lead to wrong priority assignment.
3. All the possibilities of activities must be taken into consideration, out of the database scenarios/activities must be handled properly.
4. Lousy communication can cause missing / loss of data.

D. Figures and Tables

a. Test Cases:

TCA: Test Case Suit A refers to all the test cases related to Communication.
TCB: Test Case Suit B refers to all the test cases related to Sensor reading and inputs.
TCC: Test Case Suit C refers to all the test cases related to Verification, validation and error corrections.

Test Case_ID	Test Case	Test Case_ID	Test Case
TCA 1	Establishing communication with the on Ground Communication Center (bunkers).	TCB 4	Constantly checking for the ambient temperature and making adjustments in the Temperature Control System.
TCA 2	Reading values from the sensors.	TCB 5	Crosschecking and validating the outputs of TCB 3, TCB 4, TCB 5.
TCB 1	Confirmation of an obstacle through Laser Sensors and detecting whether the obstacle is Living or Non-living.	TCC 1	Setting priorities as per the results of case 6.
TCB 2	Confirmation of the Living obstacle through On Board Cameras.	TCC 2	Constantly checking for any errors and reporting if any malfunctions occur.
TCB 3	Confirmation of the Living obstacle through Satellite images. Constantly checking for the snow cover and performing physical movements accordingly.	TCC 3	Confirmation of the Living obstacle through Satellite images. Constantly checking for the snow cover and performing physical movements accordingly.

b. Performance Analysis of Robot

Sr. No.	Parameters	Value	Sr. No.	Parameters	Value
1	Temperature Sensor	Normal Temperature / Abnormal Temperature	3	Laser Sensor	Obstacle detected/ Not Detected
2	Ultrasonic sensor	Obstacle detected/ Not Detected			

V. APPLICATIONS

a. Military robots for high temperature regions.
b. Surveillance robots for high temperature region.

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