

Image Processing: An Advanced and Secure Tool used in the Field of Modern Military Applications

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Abstract: In this paper, we are discussing about the uses of the (DIP) or Digital Image Processing technique in the Military applications. Nowadays, DIP is heavily used everywhere, not only in military applications it also helps the satellite communication industry, security, and biomedical applications. DIP takes an key role in military application. DIP is used for enhancing a particular image, target detection, and tracking aid in identifying potential problems, monitoring activities, etc. Military forces heavily used the DIP algorithm to automatically choose and classify and recognize targets in images and video. Dip technique algorithms are used for Target tracking and guidance systems in missile defense and guided munitions. Some recent technologies like camouflage and stealth are used the DIP technique for better moderation. By analyzing the picture of the environment and optimizing its appearance to process an image which gives to enhance the different condition military assets survivability.

Keywords: Unmanned, ground-based, recognition, algorithms, photogrammetric, Object detection

I. INTRODUCTION

When a digital computer wants to process something through some algorithmically image they used this technique called as DIP or Digital image processing. Analog Image Processing is not advanced more than it. To avoid the distortion problems and noise, Dip is widely used for processing an image. It materializes and analyzes the image which is coming through a satellite and aerial targets by the image. It is used for auto recognition of a target, in surveillance purposes and in data reconnaissance which is collected from different sources in unmanned aerial vehicles, satellites, and ground-based sensors. DIP is influenced by three parts-

1. The Development of Computers
2. The Development of Mathematics
3. The demand for a wide range of applications in the military, environment, industry, medical science, agriculture, etc.

It acts for enhancing image quality, reducing noise, and gain the image resolution. In military operations, images taken can be promoted. It includes noise reduction, contrast improvement, edge sharpness, and brightness adjusting in different levels from where it gathers more documentation about an image. Data from various kinds of origins like visible light, infrared, and radar imagery. By implementing data from different sensors, Military operators can achieve an obvious view of the Battlefield or Military camp.

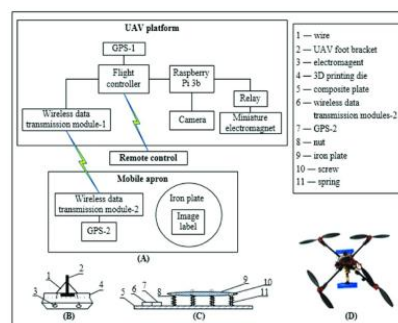


Fig1: The schematic diagram of the unmanned aerial vehicle (UAV) platform: (A) system overall hardware structure diagram

AR or augmented reality systems are heavily utilized by the DIP which might be delivered to the soldiers with enhanced situational sensitivity on the battlefield. There are some important notes which generally pertains the sensorial information and are subject to maintain proper regulations and the security systems. The particular data of these applications might be depended on the country, military sector, and technological advancements available at that time.

DIP or Digital image processing has acted in nature effectively from many years.

Its history in the military can be investigated through the early improvement of computers and digital technology. Since World War two, image processing was used for aerial reconnaissance and interpretation of a photo. Analog Image processing is like photogrammetric and image enhancements were used to essence workable mentality from aerial photographs. This Early Development was held in the middle of 1940 to 1950.

Computers and algorithms give the advance role to conduct the Elevation of DIP. In 1960 digital computers were launched to be applied for enhancing the image and restore the data in the military applications. To examine the Corona related program, Satellite imaging system broadly used for capturing an image from the space. DIP is acted as an eventual preface in surveillance and to aim the systems from cold war related. Corrupted algorithms in our image processing were conducted to find out and determine objects of interest like enemy vehicles and aircraft. Target Recognition algorithms were improved to recognize appointed targets based on their visual features. Military application is used for terrain analysis, change detection, and mapping of enemy positions by remote sensing. From 1990 -2000 this Technology was formed. Data Acquisition or remote sensing technology involves to detect Earth's surface data for advanced ourselves. DIP is used for analyzing the data which is taken from various types of remote sensing platforms. For spreading real-time awareness everywhere, automation, Object Detection, Tracing type algorithms are heavily used. Machine learning is a technique where classification and recognition of an image and target are applied. Due to security concern, Many image process able data are classified military safety. For that reason, people got some knowledge from the latest development.

Some Military applications in DIP is used are;

Tracking and Detection of a target: Digital Image Processing is used to track and identify track targets by satellite imagery. It was used to find military vehicles, aircraft, ships, etc. This technique has an advanced algorithm that can automatically analyze a lot of data and highlight potential threats.

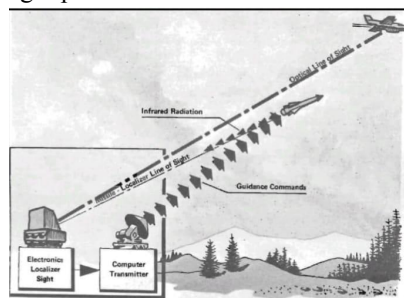


Fig2: Target detection acquisition and tracking method

Reconnaissance and Surveillance: Military drones have high-resolution cameras which take images and videos for security purposes. DIP plays the key role to analyze these visuals and extracting important information and giving real-time image to the military staff. It also helps to find enemy positions and monitor activities.

Image Enhancement: Nowadays captured images and videos may suffer from bad lighting conditions, noise, or distortion, this time DIP algorithms are mainly used to improve the visibility and standard of the contents. This technique also has the capability to recognize more valuable information from images.

Geospatial Intelligence: Geospatial Intelligence environs the analysis of images coming through satellite and aerial photographs to take data about Earth's surface and earth terrains and infrastructure or from threats. DIP is mainly used in this scenario to interpret these images and helps to create accurate maps and geospatial databases.

Automatic Target Relocation (ATR): In the ATR system DIP technique is used. From DIP techniques it can automatically detect and recognize targets. By analyzing the image's shape, texture, and color these systems to understand and differentiate between various type of objects including vehicles.

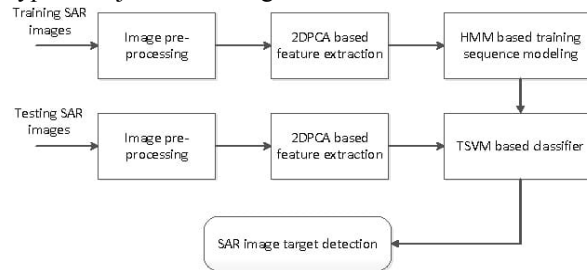


Fig3: Flowchart of Automatic target relocation

Biometric Analysis: DIP is heavily used in biometric Analysis also. In this domain, it is mainly used for the biometric analysis of defense objects such as recognition a face, fingerprint identification, iris detection, etc. This technique can help to identify individuals which is very important for security purposes. This image processing technique is also utilized in AR systems which are delivered to soldiers with enhanced situational sensitivity on the battlefield. It is important to note that the military applications generally pertain to sensorial information and subjected the proper regulations and security protocols. The particular data of these applications may depend on the country, military sector, and technological advancements available at that time.

II. LITERATURE SURVEY

In paper 1; Virtual Reality Goes to War: A Brief Review of the Future of Military Behavioral Healthcare.

On 07 May 2011, this paper was published by Albert Rizzo, Thomas D. Parsons, Belinda Lange, Patrick Kenny, John G. Buckwalter, Barbara Rothbaum, JoAnn Difede, John Frazier, Brad Newman, Josh Williams & Greg Reger. They said in their paper that Numerous reports indicate that the incidence of posttraumatic stress disorder (PTSD) in returning OEF/OIF military personnel is creating a significant healthcare challenge. These findings have served to motivate research on how to better develop and disseminate evidence-based treatments for PTSD. Virtual Reality delivered exposure therapy for PTSD has been previously used with reports of positive outcomes. The summarized projects in these areas have been developed at the University of Southern California Institute for Creative Technologies, a U.S. Army University Affiliated Research Center, and this paper will detail efforts to use virtual reality to deliver exposure therapy, assess PTSD and cognitive function and provide stress resilience training prior to deployment.

In paper 2; Emerging Military Applications of Free Space Optical Communication Technology: A Detailed Review

On 28-30 October 2021 this paper was published by Suresh Kumar and Nishant Sharma. They said in their paper Free Space Optical Communication (FSOC) technology, designed to operate through free space as a medium is rapidly emerging as a reliable, fast & secure alternative for broadband communication. It is being researched & investigated for applications and technical utilities in both civil & military domain systems owing to its immense benefits including high security, better data rates & fast installations, no requirement of licensed spectrum, best costs & simplicity of design as compared to contemporary Radio Frequency (RF) systems. FSOC networks once established are difficult to detect & intercept in view of the small divergence of the laser beams.

In paper 3; Military Applications of Augmented Reality.

On 01 January 2011, this paper was published by Mark A. Livingston, Lawrence J. Rosenblum, Dennis G. Brown, Gregory S. Schmidt, Simon J. Julier, Yohan Baillot, J. Edward Swan II, Zhuming Ai & Paul Maassel. They said in their paper that military benefits and requirements have led to a series of research efforts in augmented reality (AR) and related systems for the military over the past few decades, beginning with the earliest specific application of AR. While by no means a complete list, we note some themes from the various projects and discuss ongoing research at the Naval Research Laboratory. Two of the most important thrusts within these applications are the user interface and human factors.

In paper 4; The military applications of remote sensing by infrared.

In January 1975 this paper was published by R.D. Hudson; J.W. Hudson. They summarized in their paper that Remote sensing is the process of acquiring information from the environment by the use of a sensor that is not in physical contact with the object under study. The military services are experienced practitioners of this old, but newly glamorous, art. Their accomplishments in the infrared, that region lying between visible light on the one hand and microwaves on the other, are both impressive and of increasing importance. Our purpose is to provide an overview of these accomplishments. Early military experience with remote sensing by infrared is described and an applications matrix is developed in order to provide a perspective from which the reader can view the full panorama of military applications. Specific applications are discussed. These include strategic systems for early warning of intercontinental ballistic missile launches, methods for the detection of atmospheric contaminants, such as poison gas, under field conditions, aids for the precision delivery of weaponry (including passive, active, and laser designator guidance techniques), and sensor systems for reconnaissance and surveillance. Wherever possible, details of sensor performance are given.

III. CONCLUSION

Digital image processing has acted in an effective role in military applications. Here are some important future scopes of Dip in military application:-

We can see clear pictures or videos of potential targets through surveillance cameras, drones, satellites, or other sensors by Dip algorithms. From this technique, we can be detecting threats like weapons, some huge explosives, or other skeptical actions through visual data. Digital image processing can be used to improve countermeasures versus threats like anti-camouflage activities, and image enhancement for a clear view of the Battlefield.

We can detect surveillance video footage or impound devices. Forensics are recognizing suspects, and detecting evidence from crime scenes. Digital image processing can help in unmanned ground vehicles, unmanned aerial vehicles, and other robotic systems, developing military strengths and decreasing human engagement in dangerous or risky situations.

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