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Hand Recognition simulation in Military Ops

| Automation in Military Operations |

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Why Automation in Military

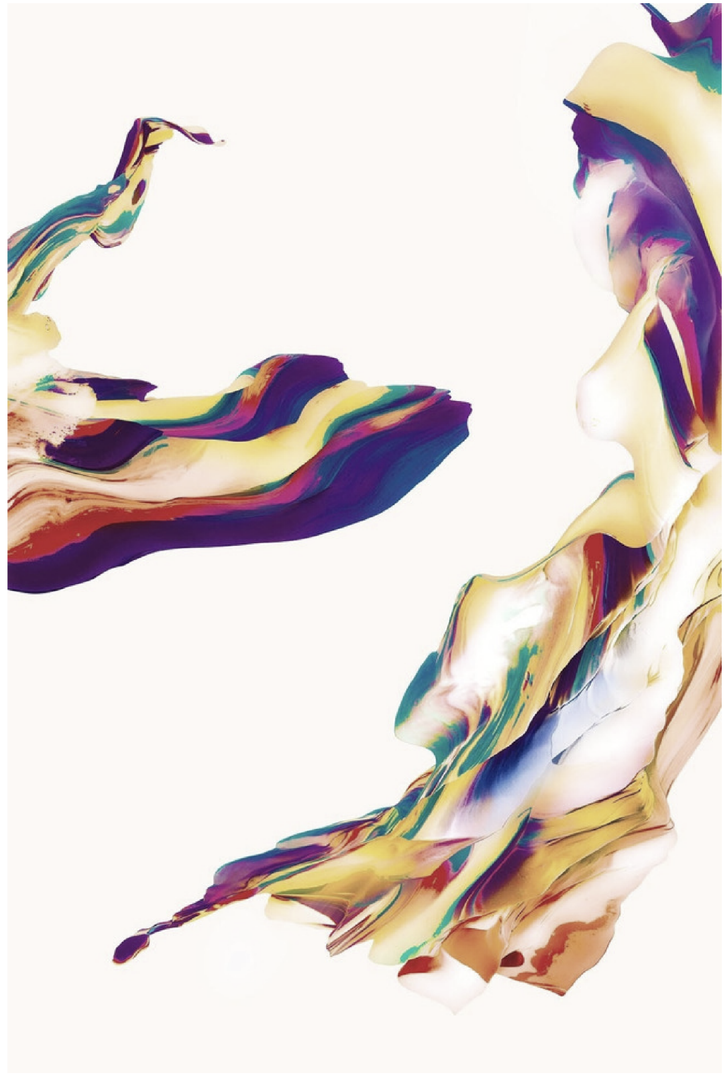
AI improves self-control, self-regulation, and self-actuation of combat systems due to its inherent computing and decision-making capabilities.

AI is deployed in almost every military application, and increased research and development funding from military research agencies to develop new and advanced applications of artificial intelligence which is projected to drive the increased adoption of AI-driven systems in the military sector.

In a military context, its purpose is to identify, classify, verify, and if needed, neutralise any perceived threat. In the interest of security, this may seem a reasonable application. However, a major concern with recognition is its accuracy.

Introduction

- **AI** is becoming more widespread and pervasive in all fields.
- It is difficult for **comrades-in-arms** to communicate via gestures in the **actual combat zone.** High-tech wearables can undoubtedly aid in the advancement of communication.
- **Gesture recognition** is an exciting area of study in **image recognition.**
- Using the concept of hand gesture recognition, in a **Wearable Headgear**, with the hand movements, these troops may communicate at a **longer distance** with the support of **AI comprehending and monitoring** their **movement in real time.**
- **Encryption** on the backend makes it **difficult** for hackers to crack their movement.
- We attempt to do this by integrating **OpenCV, Mediapipe, and CNN for classification**, with **audio interpretation** linked to the gesture.



Motivation

Artificial intelligence (AI) advancements show significant potential for enhancing strategic military decision, lowering human losses, and expanding troops' war capacity.

The Indian military may eventually utilise Intelligence equipment for night mode as part of the effort to boost its contributions to AI.

AI will play a role in defense technology in a variety of ways, with hand, facial, and voice recognition being some of the fundamental products of AI. Working on Hand Recognition contributes to the advancement of technology, headgears, and robotics.

Open CV, Haar Cascade Classifiers, CNN, and other techniques aid in getting the desired outcomes for the Ideation. Google Mediapipe assist in enhancing identification and accuracy.

Literature Review

Paper Name	Consortium	Author	Highlights of Paper
Hand gesture recognition using a neural network shape fitting technique	Elsevier	E. Stergiopoulou N. Papamarkos	Here method is based on a hand gesture fitting procedure via a Self-Growing and **Self-Organised Neural Gas (SGONG) network.** Region of the hand is detected by **applying a colour segmentation technique based on a skin colour**. Then, the SGONG network is applied on the hand area so as to approach its shape. Based on the output grid of neurons produced by the neural network, **palm morphologic characteristics are extracted.** Finally, the hand gesture recognition is accomplished through a **likelihood-based classification technique.**
Real-time Vernacular Sign Language Recognition using MediaPipe and Machine Learning	IJRPR	Arpita Haldera Akshit Tayade	The purpose is to demonstrate a methodology that simplified Sign Language Recognition using **MediaPipe's open- source framework** and machine learning algorithm. Multiple sign language **datasets such as American, Indian, Italian and Turkey are used.** With an average accuracy of **99%, the proposed model** is **efficient, precise and robust.** Real-time accurate detection using Support Vector Machine **(SVM)** algorithm without any wearable sensors makes use of this technology more comfortable and easy.
Blast Loading on the Head Under a Military Helmet: Effect of Face Shield and Mandible Protection1	Conference Paper	David R. Mott Theodore R. Young, Jr. Douglas A. Schwer	In order to assess the affect of **helmet system geometry on blast loading** on the head, a study was performed computing the under-helmet pressures due to a blast event for various combinations of the helmet shell and liner, mandible protection, and face shield for the Conformal Integrated Protective **Headgear System (CIPHER) prototype geometry.** These waves interacted with the head, the suspension geometry and other waves to generate a complex pressure field under the helmet. In some cases, waves trapped by the geometry produced an increased pressure when reduced pressure was expected.

Literature Review

Paper Name	Consortium	Author	Highlights of Paper
ASL Recognition with MediaPipe and Recurrent Neural Networks	Bacherlor-Thesis	Antonio Dom`enech L.	This research proves that, nowadays, there is not a need for complex and expensive hardware in order to recognise Sign Language, **only a modern mobile phone or a computer camera is required.** This is accomplished by using **Google's MediaPipe framework** developed in 2019 and recurrent neural networks **(RNN).** This paper proofs it is possible to recognise **four different gestures** (hello, no, sign and understand) with an **accuracy of 92%, in real time**, and with a mobile phone or computer camera.
Multiplatform System for Hand Gesture Recognition	IEEE	Tomas Bravenec Tomas Fryza	This paper focuses on **hand gestures and finger detection in still images and video sequences.** It contains a brief testing of different approaches to hand gesture detections as well as the realisation of the platform independent application. The combined dataset provided a high variety of hands in different environments, lighting and poses, and contained over **6000 images**. The additional processing helps to **recognize** whether the hand sent through the network was **left or right correctly in almost 95% of all cases.**
Thai Sign Language Recognition: an Application of Deep Neural Network	IEEE	Anusorn Chaikaew Kritsana Somkuan Thidalak Yuyen	Thai Sign Language (TSL) is the national sign language for Thai deaf people or hearing impaired in Thai- land. This approach can produce an accurate close to the traditional approach. We purpose a simple approach with a **MediaPipe framework** that helps to extract the hand landmark from video on the preprocessing step and use that landmark to build the model for recognition hand gestures with various **Recurrent neural networks (RNN).** The result showed that the model builds with **LSTM, BLSTM and GRU has an accuracy greater than 90 percent.**

Literature Review

Paper Name	Consortium	Author	Highlights of Paper
Smart Helmet 5.0 for Industrial Internet of Things Using Artificial Intelligence	NIH	Israel Campero-Jurado Sergio Márquez-Sánchez Juan Quintanar-Gómez Sara Rodríguez Juan M Corchado	This paper presents a smart helmet prototype that monitors the conditions in the workers' environment and performs a **near real-time evaluation of risks.** The data collected by **sensors** is sent to an AI-driven platform for analysis. The training dataset consisted of **11,755 samples and 12 different scenarios.** The use of a state-of-the-art models of supervised learning & Deep Convolutional Neural Network **(ConvNet/CNN)** is proposed for the detection of possible occupational risks. The data are processed to make them suitable for the **CNN** and the results are compared against a **Static Neural Network (NN), Naive Bayes Classifier (NB) and Support Vector Machine (SVM), where the CNN had an accuracy of 92.05% in cross-validation.**
Possibilities and Challenges for Artificial Intelligence in Military Applications	SDRA	Dr Peter Svenmarck Dr Linus Luotsinen Dr Mattias Nilsson Dr Johan Schubert	Recent developments in artificial intelligence (AI) have resulted in a breakthrough for many classical AI- applications, such as **computer vision, natural language processing, robotics, and data mining.** Despite the possibilities for AI in military applications, there are many challenges to consider. For instance, **1) High risks** means that military **AI-systems need to be transparent to gain decision maker trust** and to facilitate risk analysis 2) Military AI-systems need to be **robust and reliable;** AI-techniques may be **vulnerable to imperceptible manipulations of input data** even without any knowledge about the AI-technique that is used 3) Many AI- techniques are based on machine learning that requires **large amounts of training data**
Visual-Based Real-Time Detection Using Neural Networks and Micro-UAVs for Military Operations	Springer	Marco Calderón Wilbert G. Aguilar	This article presents a **vision-based detection system for a micro-UAV,** which has been implemented in parallel to an autonomous **GPS-based mission.** The research seeks to determine a value objective for **decision-making** within military reconnaissance operations. **YOLO-based algorithms** have been used in **real-time,** providing detection of people and vehicles while fulfilling an **automated navigation mission.** The project was implemented in the CICTE Military Applications Research Center, as **part of an automatic takeoff, navigation, detection, and landing system.**

The Cons

- It is well known that artificial intelligence has the ability to find patterns that can hardly be found in linear analysis models.
- Considering neural networks require a large amount of training data to create useful results, producing accurate results requires a large amount of memory.
- A difficulty with present risk analysis techniques is that techniques that are easy enough for regular project people to employ are too simplistic to capture the subtleties of identified risks.
- There is a high level of problems with portraying some signs and gestures which are similar
- The following are the most essential issues for military AI to address: Transparency, Vulnerabilities, and Learning despite insufficient training data
- In the future, the study may be expanded by incorporating whole body detection utilising Mediapipe's cutting-edge and best-in-class classification algorithms.

Research Gap

- *There is least research done on headgears having capabilities to work on gesture recognition for military using AI*
- *Less research done in advancements of mixed reality for Military*
- *More innovations are needed in the Memory utilisation using MediaPipe & OpenCV*
- *Neural Networks still have a lot of possibility for new things to come up advancement in algorithms to achieve 100% accuracy with less dataset given to train.*

Conclusions

Intelligence is progressively progressing to the position where this can be deployed in military purposes.

Military needs may range greatly in terms of risks, quality of data, government constraints, and so on, and some forms of transparency may not have been accessible.

GAN is yet another interesting methodology for learning with unlabelled and labeled dataset (semi-supervised learning). GAN could be combined with simulations to increase the realism of synthetic and real training data.

The AI and dataset employed in this work have a lot of room for improvement.

Furthermore, the databases for this research was also not established by a trained sign language interpreter.

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Thank You.