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MIND DRIVEN TANK THE FUTURE OF WARFARE USING EEG AND NEUROSKY MINDLINK

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Abstract : Thought is fundamental human activity, which can be recognized by analyzing brain signals. The development of EEG-based brain-controlled tank, which can serve as powerful aids for physically disabled people. Since these cars will rely only on what the individual is thinking they will hence not require any physical movement on the part of the individual. It captures EEG (electroencephalogram) signals from the driver's brain using EEG head set which contains three electrodes. The instructions for the movement is programmed and stored using Arduino Uno and the connection between head set and Arduino is established using Bluetooth (HC05). The instructions from the brain is displayed on a Android App. The output from the Arduino is connected with driver motor (L298N). The project is focused on scope of BCI in the transportation filed and also for encouraging disabled people for driving. The human brain constantly generates electrical impulses. These electric currents are often referred to as brain waves. EEG (electroencephalography) is a bioelectrical measurement used in the biomedical field to study the human brain. Through this research, a sensor system will be developed that can detect brain waves non invasively and transmit signals wirelessly via a Bluetooth connection. The detected EEG signal will be displayed in graphical form using signal parameters. Brain Computer Interfaces (BCI) is a technology that allows taking action on a computer based on brain waves. Brain waves are recorded by electroencephalography so they can be processed by a computer. There have been many studies using BCI including analyzing brain waves in humans.

***Index Terms* - BCI, NEUROSKY MINDLINK, ARDUINO UNO, MOTOR DRIVER**

I. INTRODUCTION

In the ever-evolving landscape of warfare, technological advancements have always played a pivotal role in reshaping the strategies and tactics employed by military forces. This groundbreaking integration of the human mind and cutting edge technology promises to revolutionize the way wars are fought. Mind-driven tanks, equipped with neural interface systems, have the potential to create a new era of warfare characterized by unparalleled accuracy, enhanced decision making capabilities, and reduced human intervention on the front lines. This project aims to explore the multifaceted aspects of mind driven tanks, delving into the underlying technology, ethical considerations, strategic implications, and the broader societal impact of this futuristic concept.

The mind-driven tank represents the fusion of cutting-edge BCI technology with the raw power and versatility of armored vehicles. Unlike traditional tanks, which rely on human operators to control their movements and firepower, mind-driven tanks harness the power of neural interfaces to establish a direct link between man and machine. Furthermore, the mind-driven tank is equipped with an array of sensors and onboard systems that provide the operator with unprecedented situational awareness. From advanced threat detection algorithms to predictive analytics, these systems allow the operator to anticipate enemy movements and react accordingly, giving them a decisive edge in combat situations.

II. ALGORITHM

1. **Attention:** The Attention algorithm in a mind-driven tank utilizing a NeuroSky MindLink device serves to interpret the user's level of attention based on their brainwave patterns. Aplha related to Attention.

2. **Meditation**: The Meditation algorithm in a NeuroSky MindLink device serves to monitor and facilitate the user's meditation practice by providing real-time feedback on their mental state. Delta related to Meditation.

Table 1: Frequency ranges of EEG signal

Brainwave Type	Frequency range	Mental states and conditions
Delta	0.1Hz to3Hz	Deep, dreamless sleep, non-REM sleep, unconscious
Theta	4Hz to7Hz	Intuitive, creative, recall, fantasy, imaginary, dream
Alpha	8Hz to12Hz	Relaxed (but not drowsy) tranquil, conscious
Low Beta	12Hz to15Hz	Formerly SMR, relaxed yet focused, integrated
Midrange Beta	16Hz to20Hz	Thinking, aware of self & surroundings
High Beta	21Hz to30Hz	Alertness, agitation

III. METHODOLOGY

1. **BCI(Brain Computer interface):** A Brain-Computer Interface (BCI) is a technology that allows for direct communication between a human brain and a computer or machine, without requiring the use of traditional input devices such as keyboards or mice. In the case of a mindcontrolled tank, a BCI could be used to allow a human operator to control the tank using their thoughts. The process typically involves placing sensors on the scalp that can detect the electrical activity of the brain, known as electroencephalography (EEG).

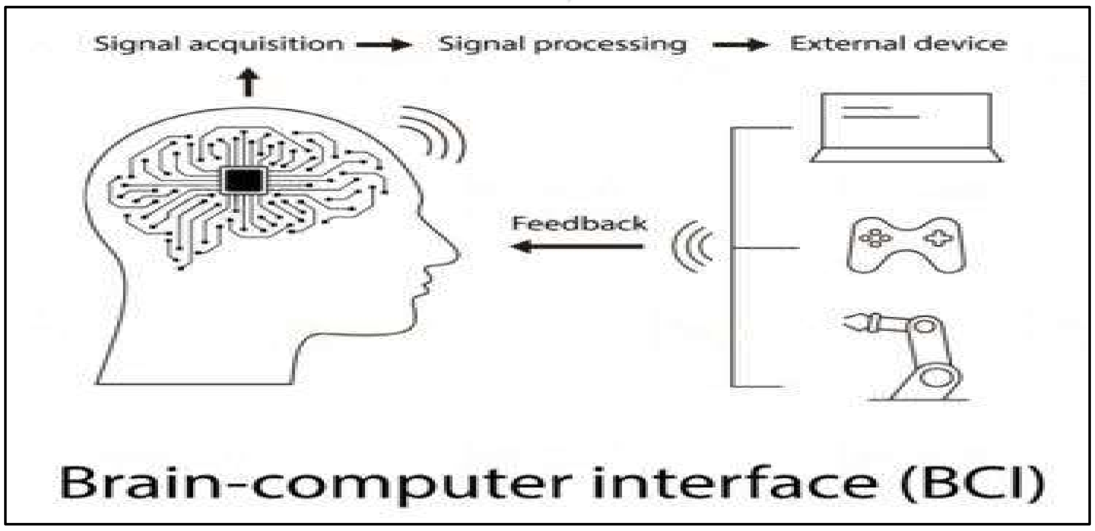
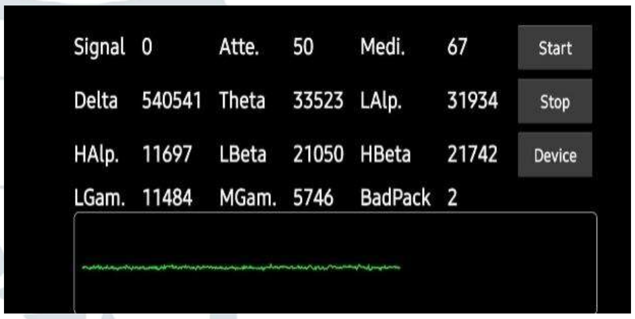
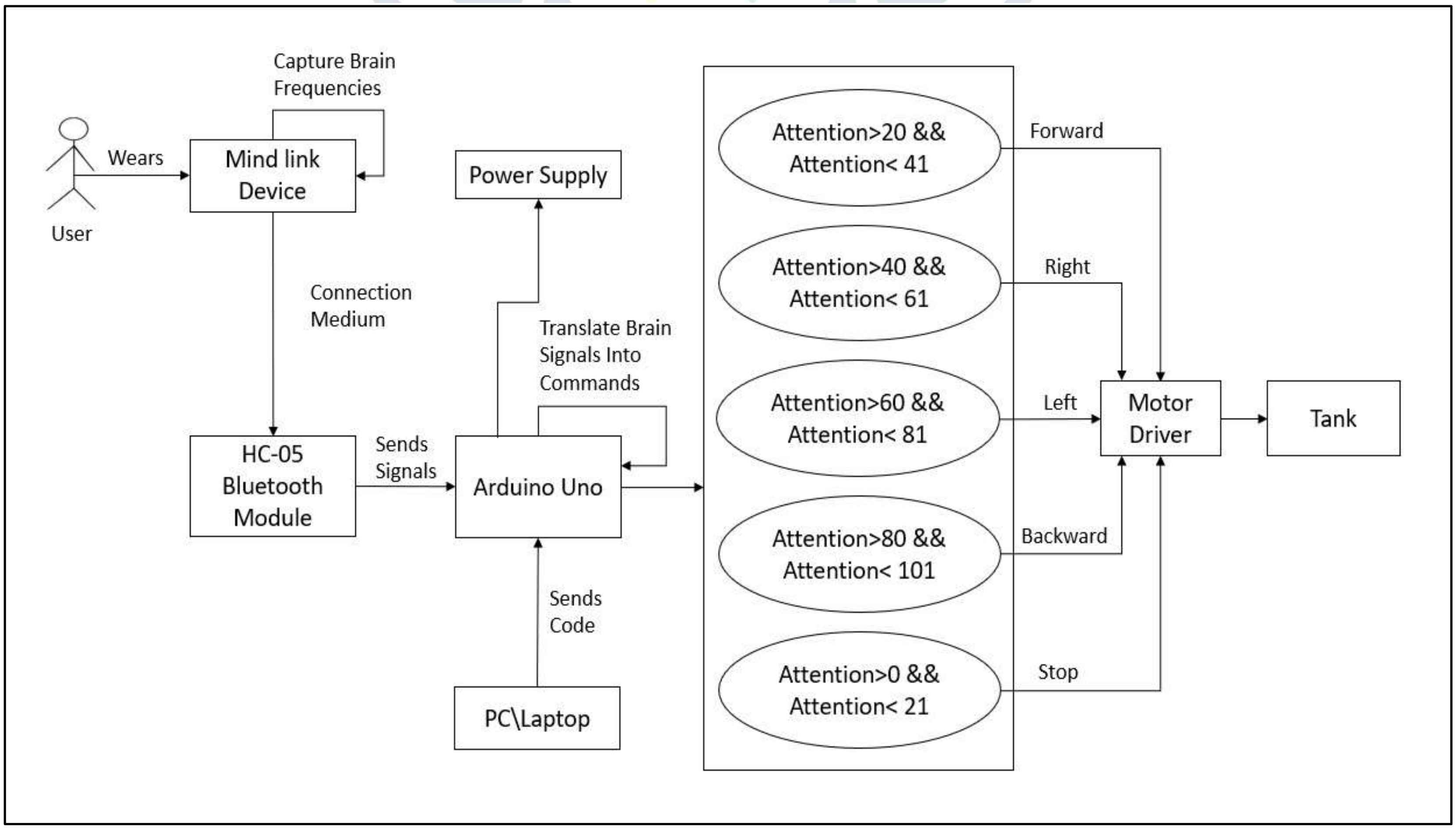


Fig: BCI working flow

2. **EEG(Electroencephalography):** The NeuroSky Mindlink device is a brain-computer interface (BCI) that uses electroencephalography (EEG) to detect brain activity. In the case of mind-controlled tanks, the Neurosky Mindlink device is used to detect the user's thoughts and translate them into commands for the tank. This allows for precise and intuitive control of the tank, as the user can simply think about the desired movement or action and the tank will respond accordingly. EEG Signal Processing: The processing and analysis of real time acquired EEG signals is performed in MATLAB (2016b) workspace. The proposed approach is developed and implemented using Core i3 processor with speed 2.40 GHz. At first acquired EEG responses are imported to MATLAB workspace. Distinct epochs of the acquired dataset locked to actions of interest are extracted to study the corresponding EEG-dynamics. The volunteer eye blink related signals attained by each of the 14-electrodes of emotive headset are extracted. It can be observed that eye blink related variations in EEG are maximum captured by first four frontal channels viz., AF3, AF4, F7 and F8. The similar instances have been observed in eye blink signals attained from other subjects. Thus, EEG captured at frontal channel AF3 has been utilized for further analysis and development of Arduino interfaced on-off control of LED. The extracted signals at frontal channels are scaled by subtracting the mean value of signal from original signal.



IV. ARCHITECTURE



1. **NeuroSky MindWave Interface:** The NeuroSky MindWave headset detects and interprets brainwave signals, providing data on the operator's mental state, focus, and emotional patterns. Brainwave data is processed in real-

time using advanced algorithms to extract meaningful information, such as the operator's intent and cognitive state.

2. **Control System Integration**: The processed data from the MindWave headset is integrated into the tank's control systems. Machine learning algorithms analyze the operator's brainwave patterns to predict intended movements or actions, allowing for intuitive control of the tank. Commands related to movement, targeting, and other functionalities are transmitted to the tank's subsystems.

3. **Bluetooth Module:** A Bluetooth module facilitates wireless communication between the MindWave headset and the tank's control unit. Real-time data transmission enables instant feedback, ensuring responsive control and feedback mechanisms. Bluetooth connectivity also allows for remote operation, enabling military personnel to control the tank from a safe distance.

4. **Tank Subsystems:** The tank's subsystems, including propulsion, weaponry, and sensors, are designed to respond seamlessly to the operator's neural commands. Propulsion systems adjust speed and direction based on the operator's intent, optimizing maneuverability. Sensor data, such as environmental conditions and enemy positions, is fed back to the operator through the MindWave headset, enhancing situational awareness.

V. RESULT AND DISCUSSION

Commands	**Attention**	**Meditation**
Forward	20-40	>50
Backward	80 - 100	>80
Left	40 - 60	>60
Right	60 - 80	>65

Table 1. Analyze frequency and set command

Command	User1	User2	User3	User4	User5	Total
Forward	8/10	7/10	6/10	8/10	7/10	80%
Backward	6/10	5/10	4/10	7/10	6/10	60%
left	7/10	8/10	8/10	9/10	7/10	82%
Right	5/10	7/10	8/10	6/10	6/10	70%
Total	65%	70%	75%	80%	68%	

Table 2. Real time testing data accuracy

The results from the NeuroSky MindLink device indicate varying success rates for executing commands based on attention and meditation levels. Across multiple trials, "Left" commands consistently achieved the highest success rate at 82%, followed by "Right" (70%), "Forward" (80%), and "Backward" (60%). Notably, attention levels generally fell within specified ranges for each command, except for "Backward," which consistently exceeded the upper limit (>80). Meanwhile, meditation levels remained consistently high across all commands, potentially influencing users' ability to focus and execute commands accurately. Despite fluctuations in success rates across trials, the overall effectiveness of the Mindlink device in executing commands remained moderate to high, suggesting promise for further refinement. Further analysis could explore factors contributing to variability in performance and potential enhancements to improve reliability.

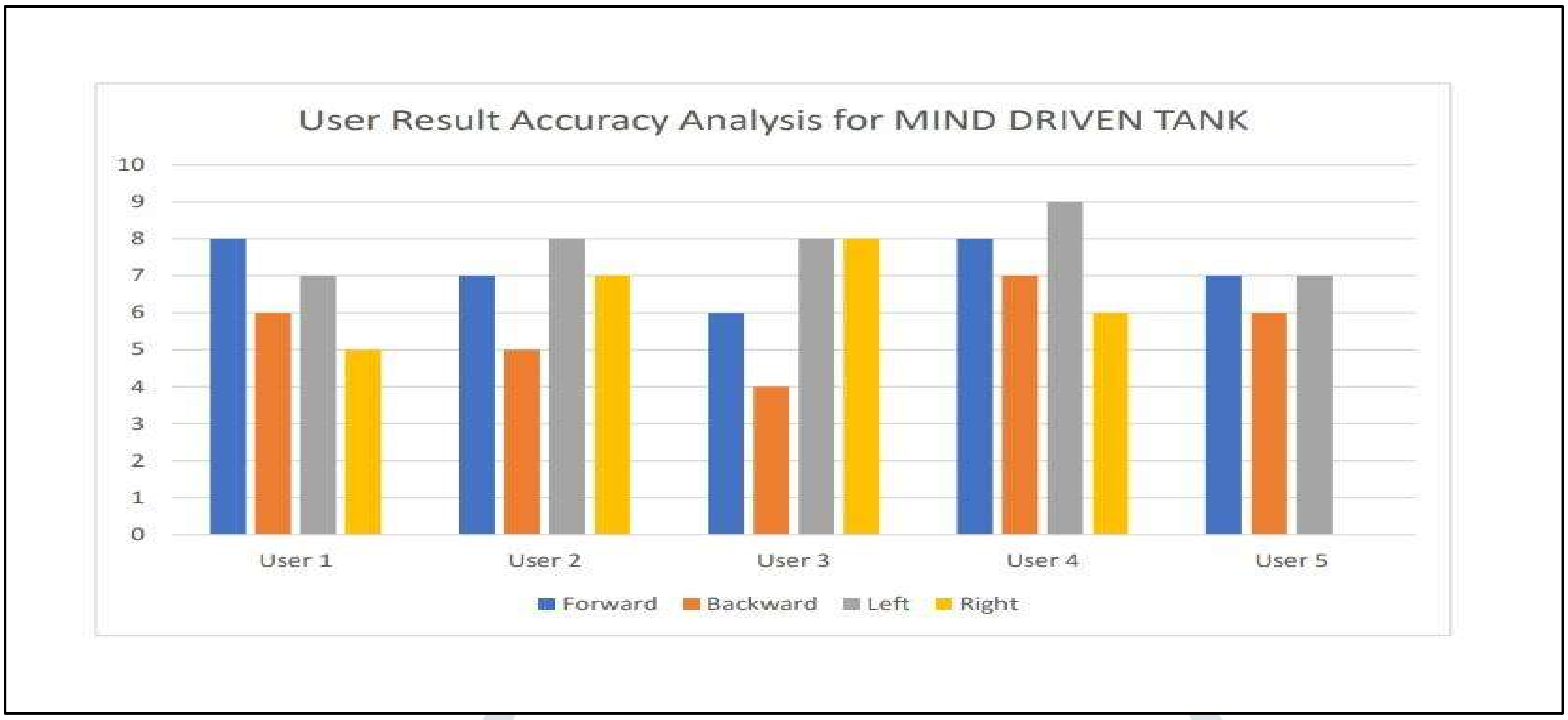


Fig: Real time result analysis

VI. CONCLUSION

In conclusion, the development of mind-driven tanks heralds a new era in warfare, where human cognition merges seamlessly with machine intelligence, reshaping the dynamics of military operations. As this technology continues to evolve, it is imperative for military institutions, researchers, and policymakers to collaborate, setting ethical standards and international regulations that uphold the principles of safety, security, and human dignity in the face of this transformative military innovation. The future of warfare has arrived, and the responsible integration of mind-driven tanks into military strategies will shape the landscape of global security in the years to come.

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