KSCST SYNOPSIS

1) **Project Reference Number**
   46S_BE_4704

2) **Title of the project**
   EXOSKELETON ARM.

3) **Name of the College & Department**
   Vemana Institute of Technology, Information Science and Engineering Department.

4) **Name of the Students & Guide**
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5) **Keywords**
   EMG sensor module, Arduino UNO, PAM (pneumatic air muscles), Solenoid switches, Pneumatic cylinders.

6) **Introduction/background**

The Exoskeleton is a robotic arm designed to assist with muscle movement, providing a novel approach to physical therapy for various conditions. It is particularly beneficial for individuals with arm injuries, Myopathy, and Cerebral Palsy, who experience muscle weakness or loss of movement in specific muscle groups. The device can also aid those with abnormal movement, tremors, or loss of coordination in their upper limbs, offering support and enhancing their motor abilities. Exoskeletons have the potential to revolutionize rehabilitation by providing targeted assistance and enabling patients to regain strength and control in their affected limbs. In addition to medical applications, exoskeletons find significant use in the military, particularly among infantry personnel. Military exoskeletons are computer-controlled devices that enhance soldiers' mobility, endurance, and load-carrying capacity by reducing strain on their lower back and legs. By counteracting overstress, these exoskeletons can help soldiers perform physically demanding tasks more efficiently and minimize the risk of injuries. The use of exoskeleton technology in the military is expected to enhance the effectiveness and safety of soldiers during combat operations and logistical tasks. Exoskeletons offer a potential solution for reducing the physical burden on soldiers, increasing their operational capabilities, and improving overall mission success. Continued research and development in exoskeleton technology have the potential to bring about transformative changes in both medical and military fields, benefiting individuals with mobility issues and enhancing military operations.

7) Objectives

- The device aims to amplify human muscle movement at the elbow joint for load manipulation, assisting individuals with muscular problems in daily activities.
- Health professionals can monitor and record patients' progress using the device.
- The exoskeleton arm should be modular and resizable, allowing multiple users to benefit from the same device.
- Soldiers in the army could gain enhanced strength, mobility, and versatility through the proposed exoskeleton arm.
- The exoskeleton's design has the potential to reduce the risk of injury for soldiers engaged in physically demanding tasks.

8) Methodology

Coming to the working of the Exoskeleton arm, an EMG sensor module reads input from the user's biological arm and passes it to the Arduino board. After processing the signal, the system generates a response through the exoskeleton frame to assist the user. The output will be the flexing and expanding of the PAMs and pneumatic cylinders simultaneously. The proposed system has two phases: Signal generation and Signal response. The user produces an electrical signal through the motor nerve which runs down the bicep through the nervous system. The response generator system then receives the input signal. It consists of input signal processing and response mechanism. The input signal is processed and rectified by the EMG sensor module, It is then fed into inputs of the Arduino board. The output of the Arduino board is read in terms of ON and OFF signals which can be monitored on the serial plotter and serial monitor of the Arduino IDE, the ON/OFF signals are then fed to the solenoid Valve which controls the flow of pressurized air from the air tank. The output response is updated through the PAMs and pneumatic cylinders onto the exoskeleton frame.

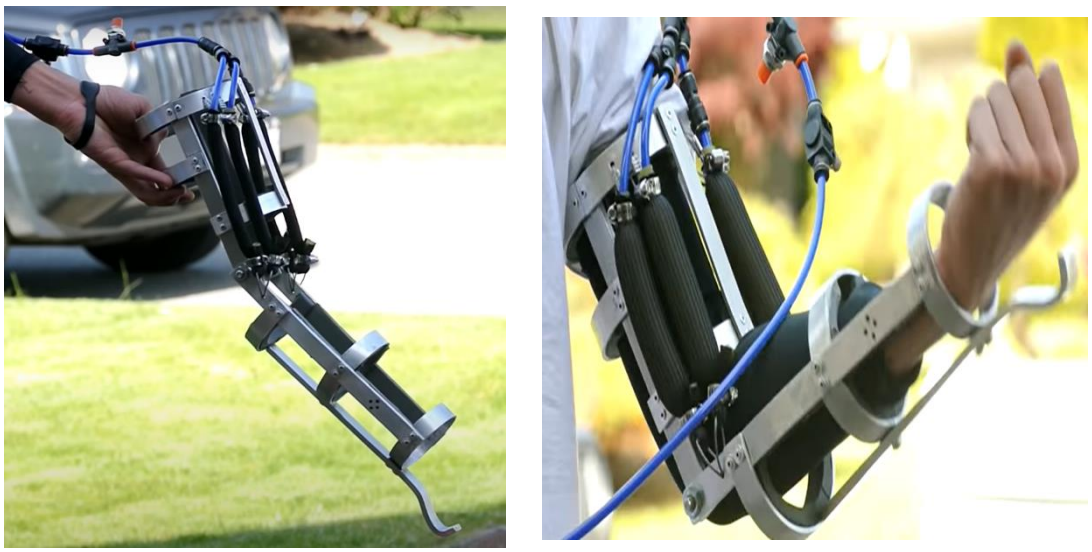

Fig 1: 3D view of Exoskeleton arm

9) Results and Conclusions

- The Exoskeleton arm was able to amplify the movement generated by the human muscles relative to the elbow joint while manipulating loads.
- The device should be able to help people with muscular problems perform daily routine activities. The device should help health professionals monitor and record the patient's progress.
- As the device is modular and resizable multiple people can use the same device.
- The exoskeleton arm should provide soldiers in the army with enhanced strength, mobility, and versatility in various military applications while potentially reducing the risk of injury for soldiers performing physically demanding tasks.
- The Exoskeleton arm was tested successfully under manual and automatic operational modes.

10) Scope for Future Work

- In the future many enhancements can be made to the Exoskeleton arm, we can implement Artificial intelligence and machine learning algorithms to produce linear angle prediction, these algorithms can be used to predict the flexion of the arm with better precision and controlled air flow.
- The weightlifting capacity can be improved by increasing the air pressure capacity.
- The mobility of the arm's joints can be improved by using synthetic or flexible plastic instead of using mechanical joints.
- More sensors can be incorporated for accurate results and improved automation.
- Design this product on the IoT (Internet of Things).
- Use a Raspberry pi model 2 instead of an Arduino board to apply complex AI/ML codes and connection over the internet for remote observation of the patient's progress.