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Eye-gaze controlled desktop robotic arm for the rehabilitation of users with Severe Speech and Motor Impairment (SSMI)

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Our users are individuals with Severe Speech and Motor Impairment (SSMI). It is a condition caused by disorders like cerebral palsy. People with SSMI lack fine motor control which causes full or partial malfunctioning of body parts responsible for generating speech and limb movements. People with SSMI often use a technique called eye pointing to communicate with the outside world. One of their parents, caretakers, or teachers holds a printed board in front of them, and by analyzing their eye gaze manually, their intentions are interpreted. This technique is often error-prone and time-consuming and depends on a single caretaker. They find it difficult to physically operate devices such as a joystick, mouse, or trackball, or use speech recognition systems. They find it convenient to use Augmentative and Alternative Communication (AAC) devices to access computers.

During the habitat study, it was observed how our targeted users have been deprived of activities of creativity and art, due to a lack of appropriate hardware and devices. The requirement arose to design a product that will help them communicate and express themselves through art, along with helping them with their rehabilitation. Discussions done with parents, guardians, and teachers revealed that these activities are already being practiced by these individuals with SSMI but with a lot of help from an assistant. They wanted a system where these individuals can do such activities independently, not only to help develop their skills but also to place them at the same level as able-bodied individuals on the societal platform. The current devices that are being used are either very expensive, intrusive, or confusing to use for the users, making them unfavorable for this use case.

This project focused on making a device that will help individuals with SSMI perform activities of basic 2D visual art forms of block printing and line drawing with reduced human assistance. The project began with habitat study and research, followed by the design of the system and sub-systems, with prototyping as the last stage. Our final product consists of a robotic arm, that can be installed on a desktop, and performs activities of block printing and line drawing on a canvas/paper. The robotic arm is moved around using an AR-based GUI which is controlled by the SSMI users using eye-gaze. This system is safe, ergonomic, and affordable.