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Design of Robotic Hand and Wireless Glove to Tele-operate

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Abstract
Electronics and electronic devices have taken over our lives. Today, we are surrounded with such devices. They have become an integral part of our everyday schedule and are making our lives easier. Similarly, Robots are deployed to replace humans in industries to make the work faster and efficient. There robots are capable of accomplishing tasks which could otherwise be hazardous for humans. But there are certain jobs (for instance, handling harmful chemicals) where preprogrammed robot can't accomplish a job [2], and human intervention is required. To solve this issue, we have developed an electro-mechanical device that can mimic one's hand gestures with certain degree of accuracy. The device will allow user to perform any operation from a distance using robotic arm at the location and operating it through specially designed glove from a distance. The robotic hand will replicate user's hand movements in real time. The flow diagram in Figure 1 shows the procedure of controlling the remote hand using the hand gesture glove.

Figure 1: Block diagram showing the process.

An operator will wear a glove comprising of electronic circuitry as shown in Figure 2. A flex sensor is used for the glove, it is based on change in electrical resistance on bend and can be used to effectively measure the flexion movement of the user's fingers [4]. Flex sensor are placed on each fingers of the glove to measure the finger movement of the user. This will then be processed using the algorithm on the Arduino board. After processing the data, it is communicated to the robotic hand using nRF24L01^{+} controller [3]. The robotic unit shown in Figure 3 upon receiving the data, will process the data on the Arduino board and instruction to the servo motors to function accordingly, thus robotic fingers will mimic user's actions. The robotic hand comprises of a under actuated 15-DOF manipulator. Having each finger of 3-DOF which is tendon driven using servo motors and all parts are 3-D printed as shown in Figure 3. The nRF24L01+ controller is used for communication and has dedicated Arduino board. nRF24L01+ controller is used due to ultra-low power consumption [5].

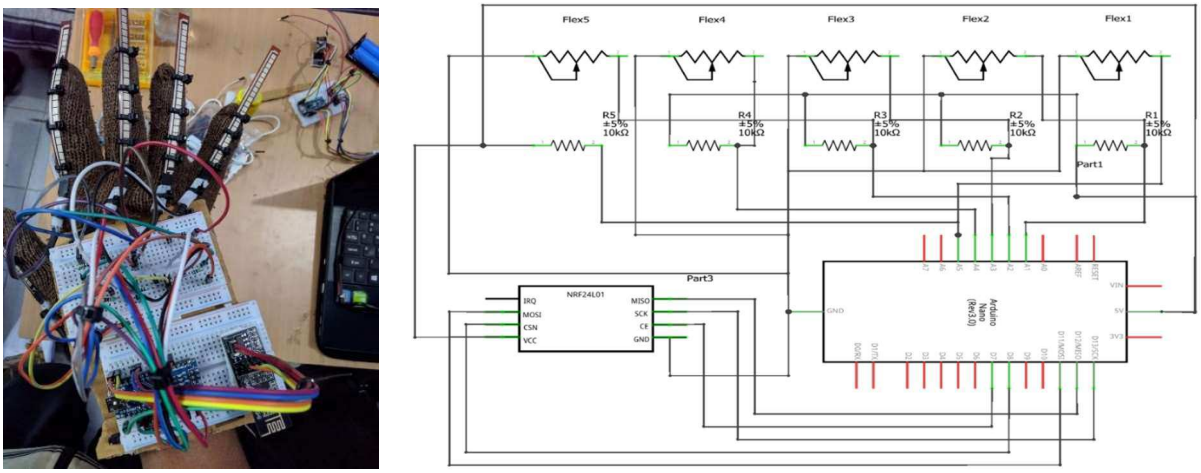

Figure 2: Controller Glove, actual image (left) and schema diagram (right).
The glove has Arduino Nano board, NR24L01+ Transceiver and Adapter, 10k Resistances, 4.5" Flex sensors connected together through wire.
Left: actual glove with all the components connected, to be worn by the user.
Right: Schema Diagram showing connections of various components.

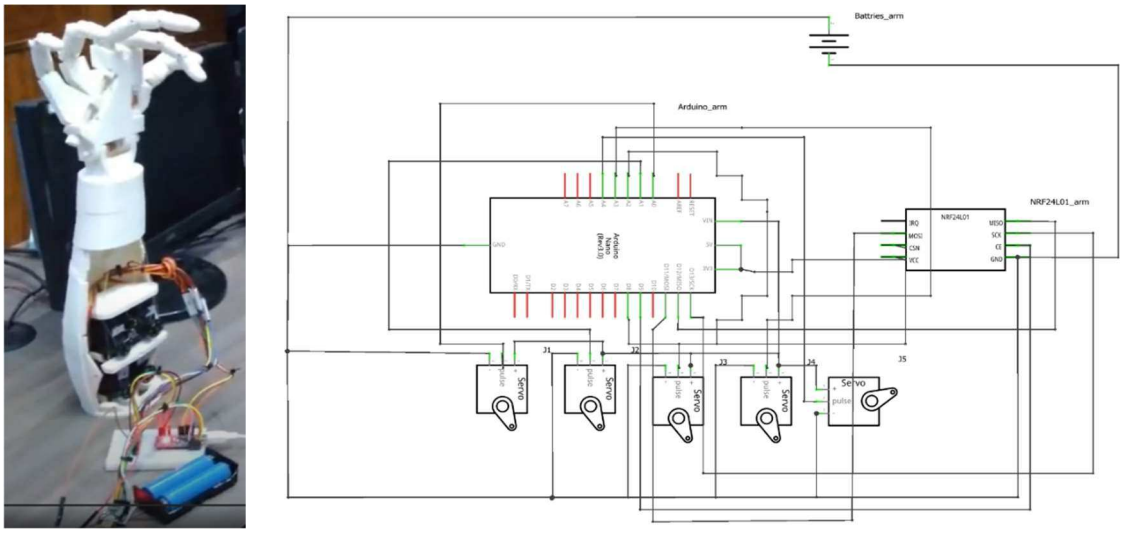

Figure 3: Robotic Hand, actual image (left) and schema diagram (right).
The robotic arm has Arduino Nano board, NR24L01+ transceiver and adapter, MG996R Servo motors, 18650 3.7V batteries
Left: 3D printed exoskeleton. The electronics visible outside can be shifted inside the exoskeleton.
Right: Schema diagram showing all the components connected.

Application of such devices includes handling harmful and hazardous substances where human control without involving a human life is required. The controller can stand at a distance while controlling the robot using his hand and thus accomplishing the task. The applications don't stop here and can be extended to bomb disposal and handling radioactive substances [1].

References

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