Development of wire-driven two-finger robot system

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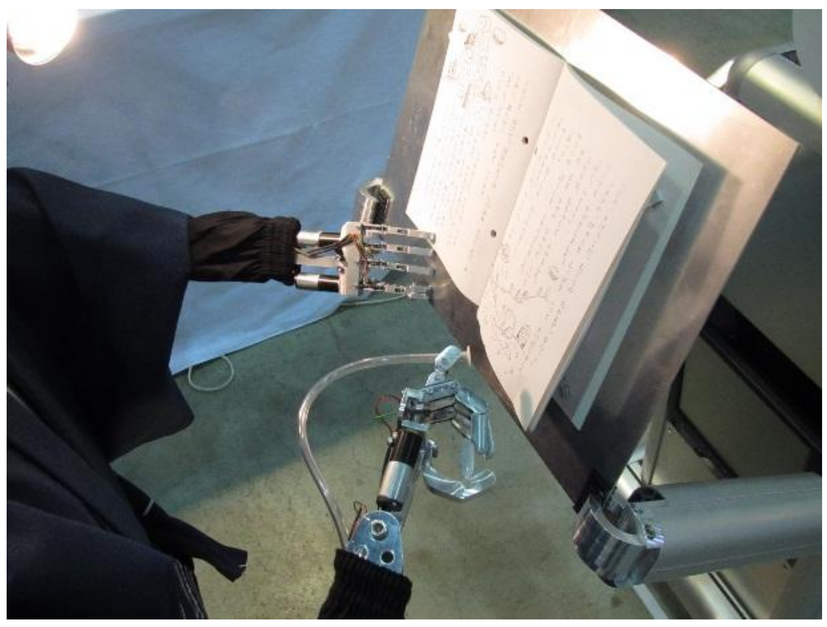
Introduction

We propose a wire-driven robotic hand system for the operation of tablet computers.
It has two fingers, each of which has a wire-driven region and a touch pen at the fingertip for operating touch-sensitive panels of tablet computers.
The system consists of three wire-driven actuators (pulse motors), and it is controlled using a personal computer.

System structure of Ninomiya-kun's hand

The robotic system Ninomiya-kun is equipped with a mechanical hand in order to turn the pages of a book. This hand system is driven by a gear, and it has a mechanism of a suction pump for extracting the contents of a page. Further, a page whose contents are extracted by one hand is turned over, and the page turned over is held with the other hand.



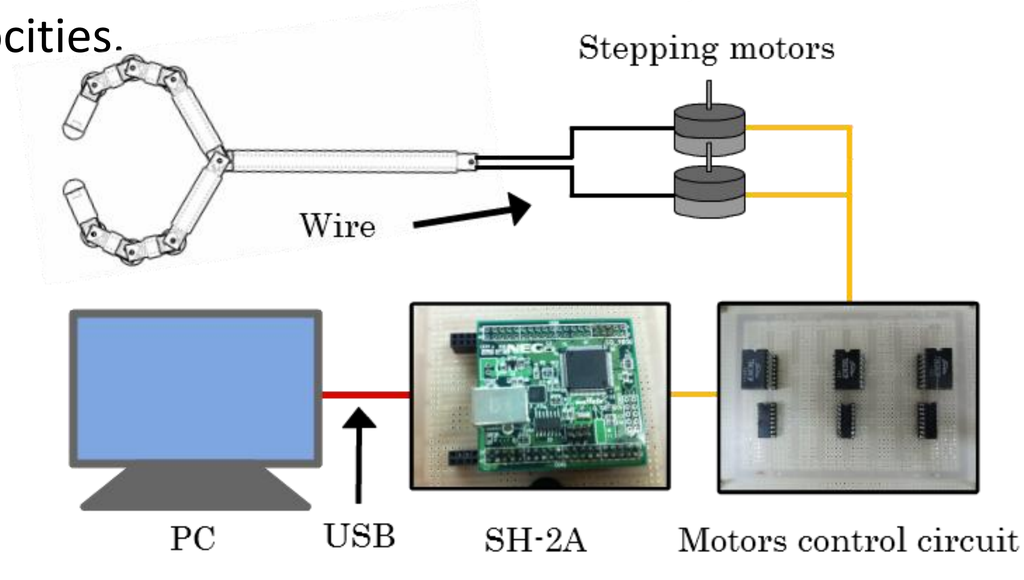
Issue of Ninomiya-kun's hand

The following issues are encountered.
1. Unexpected behavior due to transient response.
2. Book damage due to metallic hand operation.
3. In turning a page by the suction pump, we looked like a unique behavior.

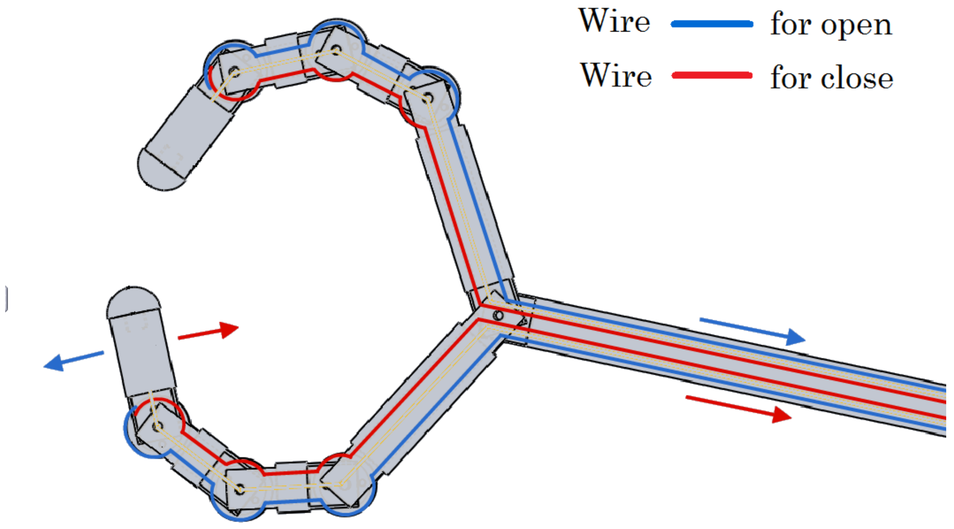
Solving these problems will enable us to realize flexible behavior of the robotic hand system.

Proposed hand system

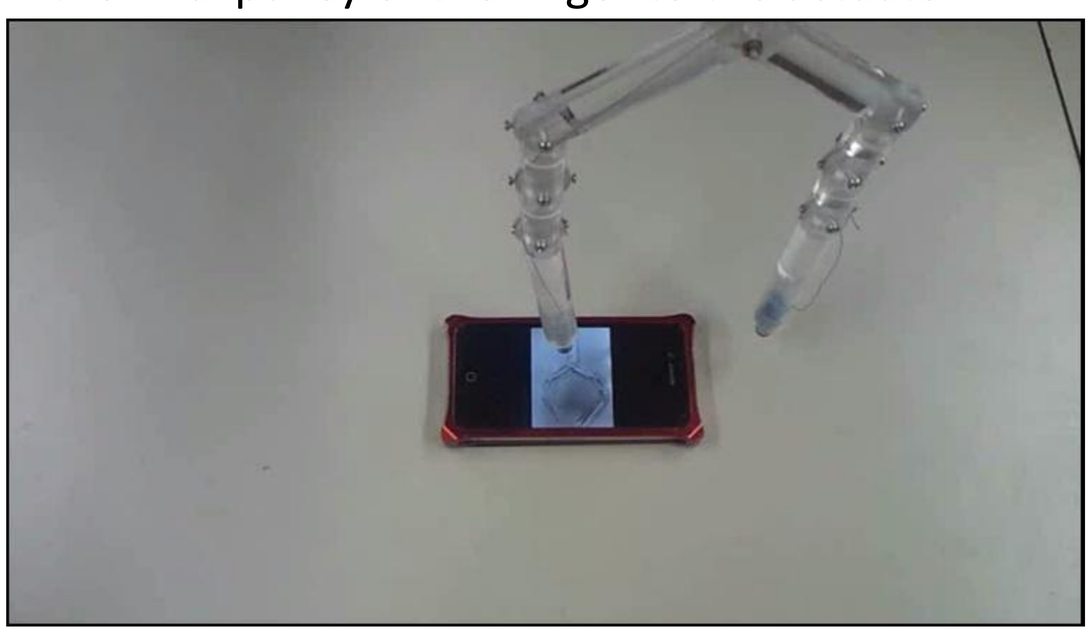
The two fingers of the robotic hand are operated by two wires through actuators. Because its performance is highly dependent on the geometry of the structure, we can easily modify it in order to adapt it to various tasks.
The ability to vary the minimal and maximal wire length is crucial because these parameters play an important role in the robot workspace, accuracy, and maximal velocities.



We used a readily available plastic material in order to minimize the weight of the system. Wires were used for operating the fingertips to realize flexible behavior of the robotic hand system. Moreover, such a setup can prevent the positioning error due to gear's backlash. Springs were used for opening and closing the fingers.



The developed wire-driven two-fingered robotic system consists of a two-fingered hand, a built-in microcomputer, and a personal computer. The two-fingered hand has three diarthrodial joints driven by a pulse motor whose rotational speed is defined by the number of the pulses fed by the controlling microcomputer. One extremity of the wire is attached to a fixed point of a fingertip, and from this point, the wire goes alternately to pulleys that are attached to the diarthrodial joints and the finger links. The wire goes from the final pulley of the finger to the actuator.



Conclusion

We proposed a wire-driven robotic hand system for the operation of a tablet computer, and we realized a test model made from a plastic material. To evaluate the behavior of the driven parts and the system usability for tablet computers, we devised a strategy based on the light-weight body. This strategy was implemented experimentally using the test model of the two-fingered robotic hand system, and satisfactory results were obtained. Further development of the system is required in order to ensure flexible motion of the fingers. In addition, enhanced behavior of system can be realized by solving the identified problems.