

**DEVELOPMENT OF BIO-MIMETIC FORCE
ATTENTIVE ROBOT HEAD**

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Degree of Master of Science

Department of Electrical Engineering

University of Moratuwa

Sri Lanka

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Thesis submitted in partial fulfillment of the requirements for the degree of Master of
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Declaration

I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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A.G.N. Jayasekara

The above candidate has carried out research for the Masters under my supervision

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A.G.B.P. Jayasekara

Abstract

This research was focused on the development of force attentive robot head for external forces acting on the head and used same as research plat form for future researches.

An anthropomorphic robotic head has been designed and developed to comply with the biometrical data of adult human head. The developed robot head has 3 degree of freedoms in the neck section. It is capable of ascertaining natural human like neck movements into a greater extent. This design is capable of minimizing the displacements between the moving axes and facilitating for a compact modular design. Commonly available DC motors in the market can be used as actuators instead of custom-made actuators. Therefore, the design is cost effective while providing adequate performance. DC motor driven brass metal structure was integrated with force sensor and other electronic components.

A detailed design of mechanical structure, selection of DC motors and electrical design of control system was included in the thesis. In addition to design of force sensors signal conditioning and interfacing circuits were designed and assembled all the components to a single assembly so that size of the head designed is similar to size of human head.

Force attentive features of robot head were developed based on two main modes of force. First, robot head is capable to detect the direction of external force acting on head and as the result head will move away from the direction of force. Here, by analyzing force sensor reading at neck of the robot, controller will identify the direction of external force and control command will activate to axis motor so that head is away from the force. Robot head was tested with main 8 directions of forces and it was functioning successfully for each case. This is what exactly happening once human head collide with an obstacle. Instantly Head will move away from the external force.

Second force attentive feature is to respond for the magnitude variance of the external force acting on the head. Robot head was tested by varying the magnitude of external force acting on the head. For less force, head was moving away to small distance with slow speed whereas once force is increased it moved to larger distance with higher speed. This feature is also with human head. If something collides with head hardly, the respond of the head will be faster than same thing collide with head gently.

Apart from that, the robot head has been developed in such a way that it can be used as a research platform that can be used for further research purposes.

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