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A Development Of The Exhibition Or Performance Tree Shape Robot Having A Growth Reproduction Function

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***Abstract*— The tree shape robot is mainly applied at the exhibition or performance. In order to take the eyes of the spectator, the moving function, reproducing the fast growth process of tree, is important function of the tree shape robot. This paper proposed the mechanism to reproduce growth process of tree shape robot which is used at the exhibition or performance. Proposed mechanism for growth process of tree shape robot consists of a steel structure, spring, coil spring, pulley and wire actuated by power cylinder. Using this mechanism, we manufacture the exhibition or performance tree shape robot with a growth reproduction function and demonstrate capability of the manufactured prototype.**

***Keywords*— tree shape robot, growth reproduction**

I. INTRODUCTION

Nowadays, based on the development of the robot technology and the growth of the robot industry, various functional robots were developed. Also, recent robot application field was enlarged to individual service robot such as guide service robot, housework service robot and performance robot and special service robot such as medical surgery robot, rescue robot, security robot and education service robot. Among these robot, Performance robot have been developed player robot with human shape to show performance, marionette performance robot, stage background robot and device robot. In particular, the tree shape robot which is able to provide stage background as well as performance and can be usedas exhibition and promotional purposes is still in the early stages of development and as shown Fig. 1, robot of flower and plant shape was developed as the initial robot model.

Flower shape robot firstly developed by Nourbakhsh[1]. The developed robot move six flower leaves as variation of light and mainly used education robot. Park[2,3] proposed a mechanism using tendon in order to operating of flower robot. Kim[4] developed moving flower robot to be possible moving, group dancing performance, blooming by using developed stem action mechanism, RFID tag, LED as shown Fig. 2

But, development the history of development of the plant shape robot such as tree robot or flower robot is limited to the last and developed case of the plant shape robot is rare. Furthermore, level of development is working-model system that interacts with the surrounding environment in the plants and trees shape such as the flower, stem and leaf shape. Therefore, development of the exhibition or performance tree shape robot having a realistic growth reproduction function can not be found yet.

Fig. 1. Flower robots

Fig. 2. Mobile flower robots

This paper proposes growth process reproduction mechanism of the tree shape robot which realistic growth reproduction is possible so that it can apply at exhibition or performance. Using proposed mechanism for growth process of tree shape robot and personify function, we manufacture the exhibition or performance tree shape robot with a growth reproduction function and demonstrate capability of the manufactured prototype.

The remainder of the paper is organized as follows: Section (2) presents the growth process reproduction mechanism of the tree shape robot. Section (3) describes working mechanism for the personify function of the tree shape robot. Section (4) describes manufacture process of the tree shape robot. Finally, Section (5) concludes this work.

II. GROWTH PROCESS REPRODUCTION MECHANISM OF THE TREE SHAPE ROBOT

Growth process reproduction mechanism of the tree shape robot usually can be represented in increasing the branch length and unfolding the leaf branch. In this paper, we reproduce branch length growth using power-cylinder in order to represent in increasing length and represent unfolding branch using coil spring. Generally, power-cylinder is possible maximum of 2 times the length increasing of the power cylinder length because piston of power cylinder inside is extruded to the outside by the rotation of the motor. But, in order to represent more dynamic growth process of branch, greater than the increase length is required. Hence, as shown Fig. 3, we propose the mechanism which maximum of 3 times length increase of a power-cylinder length is possible. Proposed mechanism for growth process of tree shape robot represents branch part and consists of a steel structure, spring, coil spring, pulley and wire actuated by power cylinder. Part 2 and part 3 are overlapped inside part 1. If length increase occurs by driving the power cylinder, part 2 connected to the power cylinder move and the wires are release. Then, spring compressed by the wire tension is elastic restoration and push up part 3, so that branch length is increased again. The other hand, unfolding branch mechanism installs coil spring at rotating shaft. Leaf branch part fold in state which it is entering part 1 inside but branch length increase mechanism is operated and leaf branch part is projected to the part1 outside so that leaf branch part is unfolded by coil spring as shown Fig. 4.

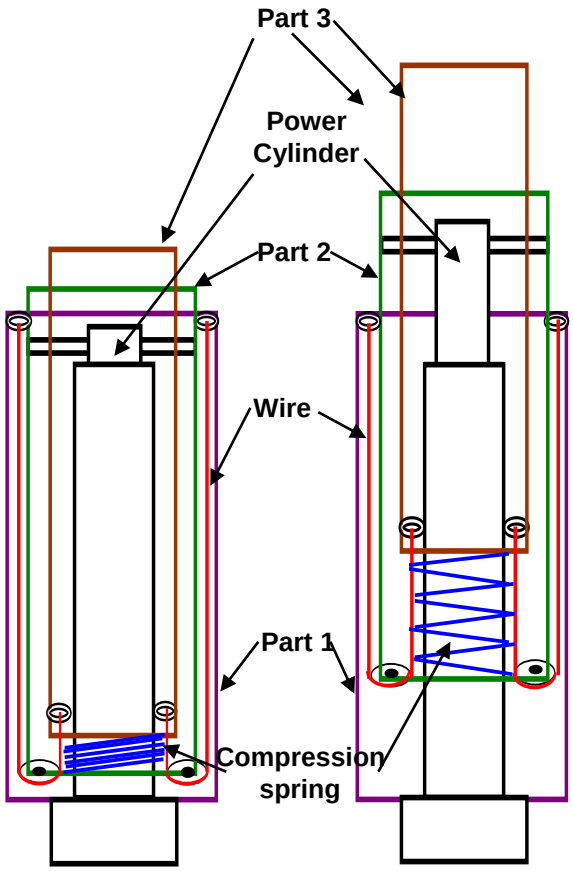

Fig. 3. Length increment mechanism

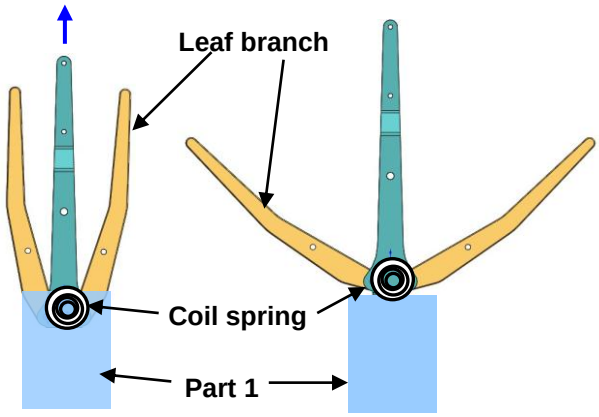

Fig. 4. Unfolding mechanism

III. WORKING MECHANISM FOR THE PERSONIFY FUNCTION OF THE TREE SHAPE ROBOT

For a realistic representation of tree shape robot, in addition to growth process reproduction function, personify function, available for interaction are added. This personify function was implemented by applying facial expression mechanism and speech recognition to the tree shape robot. Applied facial expression mechanism and speech recognition refer the reference literature and were implemented. Therefore, this paper simply explains about facial expression mechanism and speech recognition algorithm. Detail explain about facial expression mechanisms describe in references [5-8] and Detail explain about speech recognition algorithm describe in references [9-11].

To personify of the tree shape robot, firstly, at the base of the tree symbolizes a human face to the facial expressions of emotion makes possible. Mechanism

for the facial expressions describe in Fig. 5. In this figure, eye mechanism was to allow each up and down, left and right two-way rotation to represent movement of the pupils and two eyebrows, two eyelids and lower lip was to allow each up and down one-way rotation. Hence, mechanism for the facial expressions has total 9 degree of freedom and 9 piece actuators is equipped. Really manufactured configuration describe in Fig. 6.

Secondly, to personify of the tree shape robot, we take speech recognition function. This speech recognition process recognizes the language of the people and converts the language to be recognized to the sentence and grasp the meaning. After such process, finally, the results output the reply to be saved at the data base in the voice. As such the speech recognition function is HRI(human robot interaction) function which the conversation is possible with the human. The speech question which corresponds to the input of system is input in the waveform through the microphone, then speech recognition engine extract the speech signal using noise filtering and the extracted speech signal is recognized as a language. This speech recognition process as shown Fig. 7 describe that robot automatically recognized speech inputted from outside and do suitable to the meaning reply through this process. However, the speech recognition function employed in this paper is available only for the Korean language. The speech recognition engine is used voice EZ^{TM} software developed by voiceware company. The speech recognition distance is the maximum 4m and has recognition rate 98%. Also, compared silence environment, recognition errors within the range of 1-3 % occur in 70~75dB Pink, White Noise environment, Musical Noise 65~70dB environment.

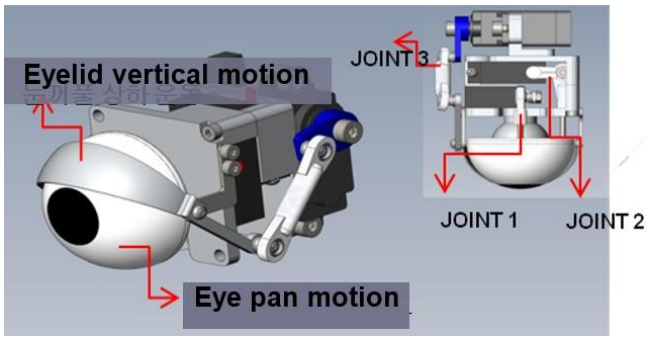

Fig. 5. Mechanism of moving eye and eyelid

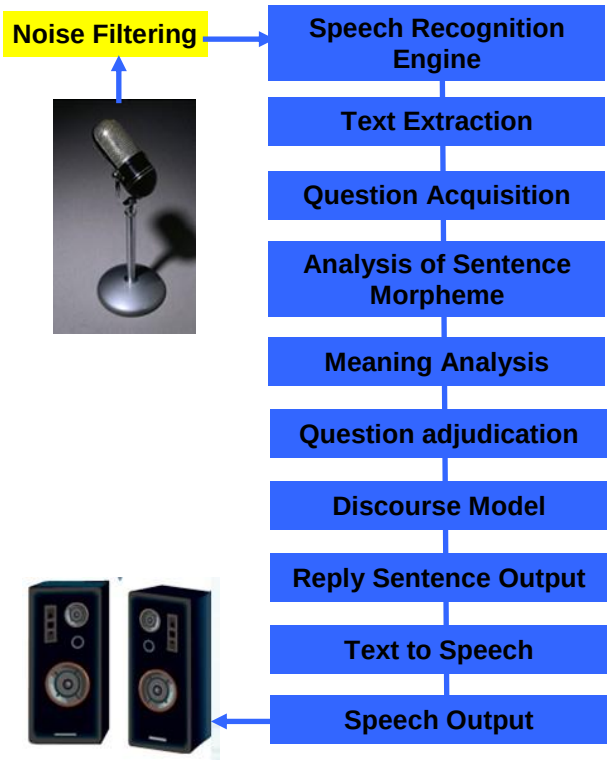

Fig. 7. Speech recognition process

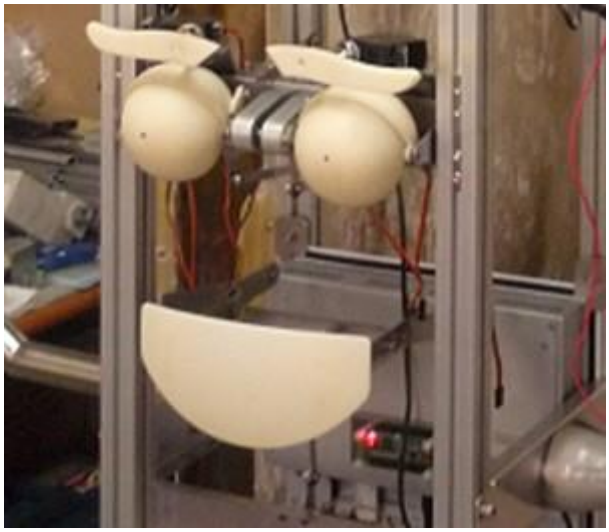

Fig. 6. Structure of moving face

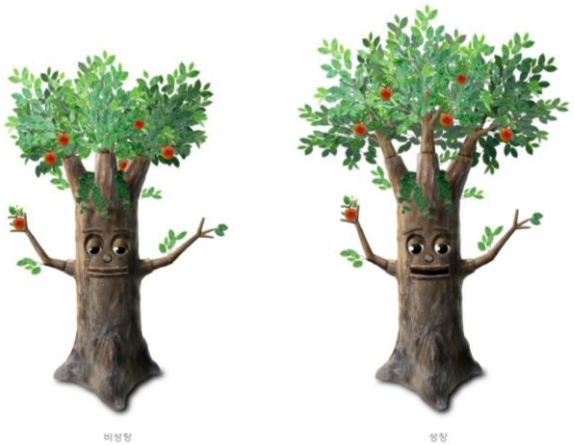

Fig. 8. Design concept of the tree shape robot

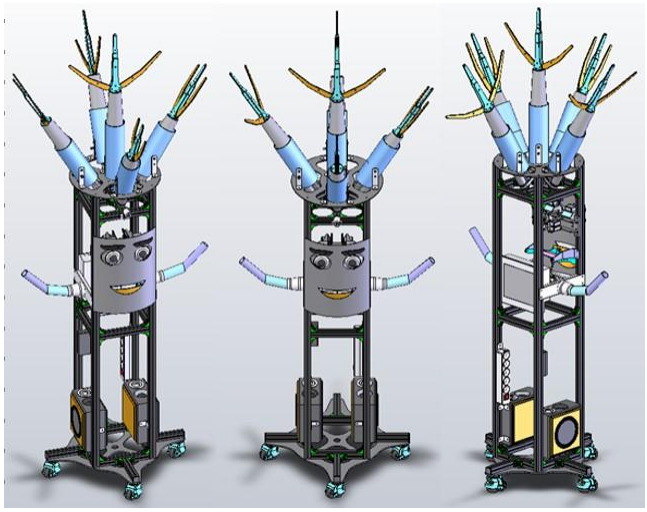

Fig. 9. Frame structure of the tree shape robot

Fig. 10. Frame structure of practice model

IV. MANUFACTURE OF THE TREE SHAPE ROBOT

Applying above developed mechanism, we manufacture the tree shape robot. Design concept of the tree shape robot show Fig. 8. The structure of tree shape robot is applied the facial expression mechanism at the base of the tree and the growth

Fig. 11. Growth mechanism of practice model

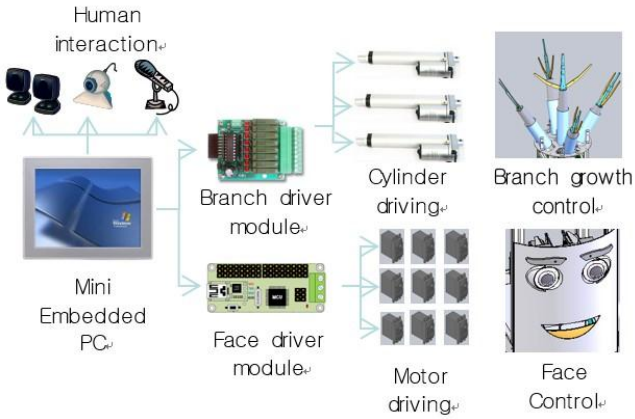

Fig. 12. Control process

process reproduction mechanism at the branch and leaves part. Also, microphone for speech recognition function install at a nose part which long Extruded in face part, so the voice input is rather easy. The basic frame structure of tree shape robot designed to manufacture show in Fig. 9. Based on this frame structure, manufactured practice tree robot frame

Fig. 13. The tree shape robot

show Fig. 10. In addition, detail expression of the growth process reproduction mechanism of manufactured practice branch part show in Fig. 11.

As shown Fig. 12, if the external input which the robot can recognize such as vision, voice is passed to mini embedded PC, PC control command drive power-cylinder installed at the growth branch and face action actuator through branch driver module and face driver module, and motion can be occurred. The control of tree shape robot is implemented by above process. The manufactured entire tree shape robot show in Fig. 13.

V. CONCLUSION

This paper presents mechanism of the tree shape robot which more realistic growth reproduction is possible to use at exhibition or performance of tree shape robot. Applying proposed mechanism and personify expression function such as facial expression mechanism, speech recognition function, we manufacture realistic tree shape robot. When robot is emplaced exhibition or theme parks, the Manufacture tree shape robot can attract the attention of visitors due to such realistic technology and can play a supporting actor role as well as Stage background of performances. These facts mean that it has pioneered the new application of robot. In the future, applying moving base platform and simultaneous control technology of multiple tree shape robots, application filed will be expanded.

REFERENCES

[1] I. Nourbakhsh, E. Hamner, T. Lauwers, C. DiSalvo, and D. Bernstein, “TeRK: A Flexible Tool for Science and Technology Education.” Proceedings of AAAI Spring Symposium on Robots and Robot Venues: Resources for AI Education. pp.43~48, 2007.

[2] H. K. Park, S. M. Jung, J. H. Choi, S. H. Park, C. H. Yoon, J. O. Park, “A Study on the Moving Mechanism for Flower Robot,” International Conference on Control, Automation and Systems 2007, pp. 2514~2518, 2007.

[3] Hyunku Park, Jongho Choi, Semi Jeong, Jongoh Park, and Sukho Park, “Advanced Stem Mechanism for Flower Robot,” 39th International Symposium on Robotics 2008, pp. 642~647, 2007.

[4] Woo-young Kim, Il-hyeon Song, Kyung-whan Kim, Suk-Ho Park and Jong-Oh Park, “Group Dancing Mobile Flower Robots with Moving Mechanism, Mobility and Localization Functions,” 41st International Symposium on Robotics 2010, pp. 1032~1037, 2010.

[5] Dinesh P. Mital, Goh Wee Leng, “A voice-activated robot with artificial intelligence,” Robotics and Autonomous Systems, Vol. 4, pp. 339~344, 1989.

[6] Naoto Iwahashi, “Language acquisition through a human–robot interface by combining speech, visual, and behavioral information,” Information Sciences, Vol.156, pp. 109~121, 2003.

[7] Hans-Joachim Böhme, Torsten Wilhelm, Jürgen Key, Carsten Schauer, Christof Schröter, Horst-Michael Groß, Torsten Hempel, “An approach to multi-modal human–machine interaction for intelligent service robots,” Robotics and Autonomous Systems, Vol. 44, pp. 83~96, 2003.

[8] Kazuhiro Nakadai, Daisuke Matsuura, Hiroshi G. Okuno and Hiroshi Tsujino, “Improvement of recognition of simultaneous speech signals using AV integration and scattering theory for humanoid robots,” Speech Communication, Vol. 44, pp. 97~ 112, 2004.

[9] Cynthia Breazeal, Chin-Shyurng Fahn, Kai-Jay Lu, Chih-Cheng Chang, “Emotion and sociable humanoid robots,” International Journal of Human-Computer Studies, Vol. 59, pp. 119~155, 2003.

[10] Kenzo Kurihara, Daisuke Sugiyama, Shigeru Matsumoto, Nobuyuki Nishiuchi, Kazuaki Masuda, “Facial emotion and gesture reproduction method for substitute robot of remote person,” Computers & Industrial Engineering, Vol. 56, pp. 631~647, 2009.

[11] Chyi-Yeu Lin, Li-Chieh Cheng, Chang-Kuo Tseng, Hung-Yan Gu, Kuo-Liang Chung, Chin-Shyurng Fahn, Kai-Jay Lu, Chih-Cheng Chang, “A face robot for autonomous simplified musical notation reading and singing,” Robotics and Autonomous Systems, Vol. 59, pp. 943~953, 2011