Overload Prevention Algorithm for the Crane Safety

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1. Introduction

Crane, as an industrial equipment which is able to transport and salvage heavy object at industrial site, is manufactured into very several types in accordance with its purpose and used often in building, civil engineering and construction. Particularly, despite its simplicity of maintenance tool of package compared to other transportation methods, it can handle relatively more weight[1].

Crane work requires sensitive control of equipments spontaneously by worker, it requires an expert skill and even for expert worker, there are still cases of rollover. Particularly in construction site, it is an inevitable reality that impracticality is continued by setting of excessive work range and enforcement of work even during bad weather for reduction of cost and construction period[2, 3]. Therefore, there is a need to cognize an overload in working environment and need of safety device which can prevent such circumstance, particularly invention of algorithm which can control this systematically. For this, this study develops centrally the algorithm, which is essential module of safety system to restrict the motion of equipment as warning the overweight status that can damage crane to worker to make this algorithm to be able being installed to existing controller and meet the demand of client in operation environment of crane[4].

2. Overload prevention algorithm design and development

The crane overload prevention device of this thesis is a safety system to warn overload status which may damage crane to operator and to restrict the motion of equipment. Here, it senses the load of objects with 10% error of accuracy through mechanical calculation of received signs from sensor by PLVC controller. When sensing the overload, it warns operator and limits the motion of equipment. Such system can be applicable to all straight type cranes and it also provides a display which can be used to check the status.It is classified generally into sensor module and electrical control module for application. First, sensor module provides a function to gauge the danger status of overturn of crane through sensor. With various signal of sensor, it applies the work and limit moment by calculation.

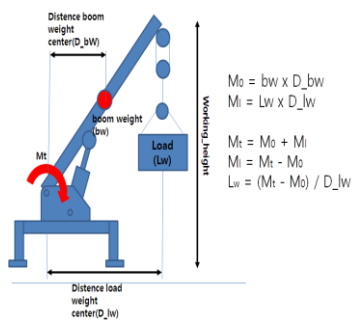

Figure 1. Work and Limit Moment

Then, in case of boom in motion, the moment calculation algorithm is like following. Then, the work range control algorithm by overall safety factor and electrical control module aspect is like following.

Increase moment between Leng_1 and Leng_1-1
(Bm_1-1 – Bm_1)/leng_2
total moment between leng_1 and Leng_1+Leng_2
B0 = Bm_1+((Bm_2 – Bm_1)/leng_2) x Boom stroke_1
increase moment between leng_1+Leng2 and Leng_1+Leng_2+Leng_3
(Bm_3 – Bm_2)/leng_3
Total moment between leng_1+Leng2 and Leng_1+Leng_2+Leng_3

B0 = Bm_1+((Bm_2 – Bm_1)/leng_2) x leng_2 + ((Bm_3 – Bm_2)/leng_3) x Boom stroke_2
increase moment between ang_1 and ang_2
(Bm_2 – Bm_1)/leng_2
total moment between leng_1 and Leng_1+Leng_2
B0 = Bm_1+((Bm_2 – Bm_1)/leng_2) x Boom stroke_1
increase moment between leng_1+Leng2 and Leng_1+Leng_2+Leng_3
(Bm_3 – Bm_2)/leng_3
Total moment between leng_1+Leng2 and Leng_1+Leng_2+Leng_3
B0 = Bm_1+((Bm_2 – Bm_1)/leng_2) x leng_2 + ((Bm_3 – Bm_2)/leng_3) x Boom stroke_2

It predicts the swing angle of boom in accordance with out-trigger status of each zone in illustration above, and it substitute each angle with whole number. Based on such overload prevention algorithm, installation of safety system is possible, and electrical control system using PLC can be materialized also. Moreover, it enables the addition of Extension module type along with increase of input and output amount and the integrated control of several number of PLVC, display equipment, wireless transmitter using CAN-BUS, RS232 communication method in order to make the extension and application easier after development.

3. System application

A development tool used in this thesis is OpenPcs Tool, the programming tool of PLVC, and Terminal Tool, the SETTING tool of PLVC.

With use of such tool, it pursues the availability of extension and common system that can be applied to any system. In addition, by using Terminal which is measurement examination tool for maintainability aspect, it enables the identification of all input and output.

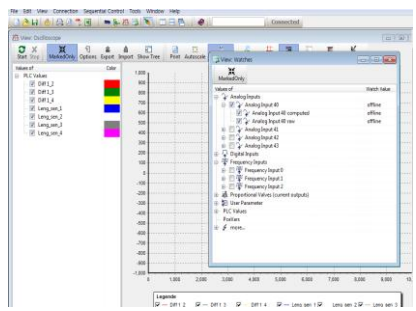

Figure 2. Applied to System

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4. Conclusion

This thesis developed an overload prevention algorithm which can be installed in existing controller, warn operator about overload status which can damage crane, and to restrict the motion of equipment to meet the demand of client in crane operation environment. Meaning to say, it suggested an algorithm to warn the harmful overload status of crane to operator and to limit the movement of equipment.

5. References

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