

The Convergence Application Example of Non-destructive Inspection System

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비파괴 검사 시스템의 융합 적용 사례

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Abstract This development is for non-destructive machine using X-Ray source about detecting outline faults of below middle size products. The differentiation is product of research and development unspecialized small and medium-sized products using X-Ray light sources can check real time if the surface of an external fault of radiation dose reference, within the leakage. The speed control is possible by software solution. In addition, we're working on possibly block doors for worker safety and equipment at the same time that inner drive can be identified in the image. These principles, as a key enabler of the current inspection system such as the container is small to medium-sized parts - a long way from utilization level is possible. This research will give rise to major effects for other various non-destructive market industries except car-industry. The most important fact is that this developed non-destructive machine is controlled below 0.2 micro- μ Sv.

• **Key Words** : Non-destructive, Inspection system, Scanning system, Line detection, Convergence

요약 본 개발은 중간 크기 미만의 외형 결함을 검출함에 있어 X-Ray 광원을 사용하는 비파괴 장비이다. 본 연구개발물의 차별성은 X-Ray 광원을 이용 중 소형 생산제품들의 외부결함 유무를 실시간 검사할 수 있으며 표면 방사선 누설선량에 있으면서 검사 속도제어가 가능하다. 이를 소프트웨어로 해결하였다. 또한 작업 중 작업자 안전을 위해 도어 차단이 가능하고 동시에 장비 내부 구동 영상의 확인이 가능하다는 점이다. 이런 원리로 현재는 중 소형 부품에서부터 크게는 컨테이너와 같은 검사시스템의 기반 기술로 활용이 가능하다. 본 연구는 자동차 산업 외에 다른 다양한 비파괴 시장 산업에 큰 영향을 미칠 것이다. 마지막으로 개발된 비파괴 장비는 0.2 μ Sv 하에서 제어된다는 사실은 아주 중요한 사실이다.

• **주제어** : 비파괴, 검사 시스템, 스캐닝 시스템, 라인 검출, 융합

1. Introduction

As far as the X-Ray Scanning System of domestic technology is mostly dental X-Ray production and export in simple, such as medical, industrial, and

medical radiation generators, biased and radiation sensors and is dependent on imported key components entirely, and also areas of exports and domestic demand for industrial X-Ray market share is marginal,

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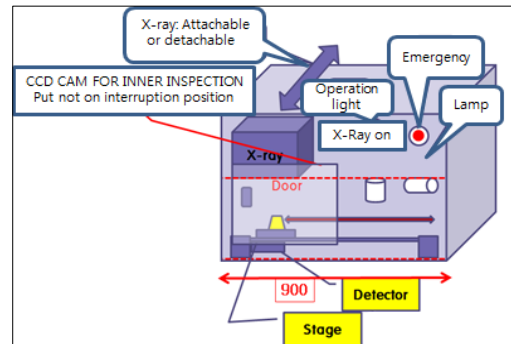
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and the already limited or expanded. On the other hand, the developed countries, including the United States, outside of technology since the 1980s, as the concentrate radiation device has fostered strategic industrial areas, global business centered on the world market and the world's third major company, GE(United States), Siemens (Germany), Philips (Netherlands) People's Republic of China, Southeast Asia. etc. to live relatively regulated gentle has been exported, and manufactured products to target the country's domestic rate is 50-60% to the level of radiation, such as generators, radiation sensors and is dependent on imports of core parts, almost(actual import dependence is more than 90%). In addition, in 2008, the radiation appliance world market size is about 500 billion(an average of more than 10 percent, and the property sheet). This study uses X-Ray and outside of small to medium-sized products with defects in oil and non-realtime the goal of making the Organization as a device to scan the surface of the water a nuclear radiation leakage does within the design criteria, user-adjustable conveyor speed range must be within the software, world's safety equipment must be able to block the door and engaging at the same time, it is possible to check via the video equipment to the internal drive. This study used a simple and economical for the line detection X-Ray¹⁾ system developed by small and medium sized enterprises, etc, designed for future expansion of the dissemination structure augmentation container scan, based on the technology development of large inspection and detection systems are available.

2. Development of the X-Ray scanning system

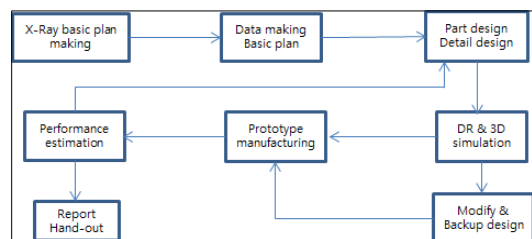
This line detector X-Ray equipment design and manufacture of machine appliances have the following aims. The first, a nuclear leak radiation does the surface of the machine framework law shielding design criteria must be made within. The second,

user-adjustable conveyor speed within the range must be implemented. The third, the nature of worker's safety product and equipment for engaging the door should be implemented to block. For this purpose, the system's configuration and structure are developed as follows. This line detector-X-Ray equipment system configuration²⁾ is expressed in Fig. 1.



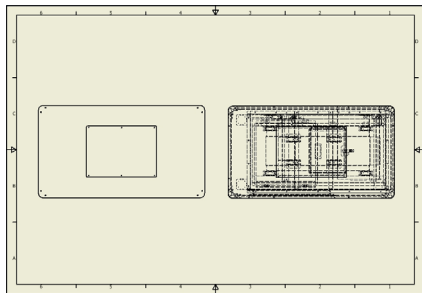
[Fig. 1] System configuration

1. Total area is outside of the shield design.
2. The electrical system is designed at the top(the side of X-Ray Tube).
3. Cable Hall is designed in the back of the top.
4. Attach the equipment operation and warning lights on the front
5. The detector should be designed so that it can easily be replaced.
6. The system is also capable of grounding.
7. Switch-type door sensor lock is capable of designing.
8. It should be possible to install expression wheel and foot.
9. In the case of emergency power shut-off function switch should be designed as AC 220.

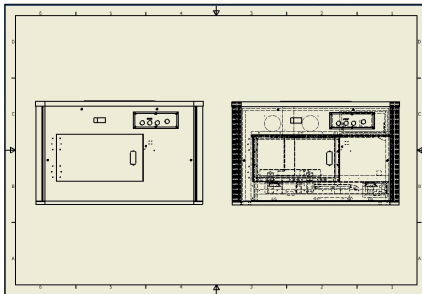


[Fig. 2] System development process

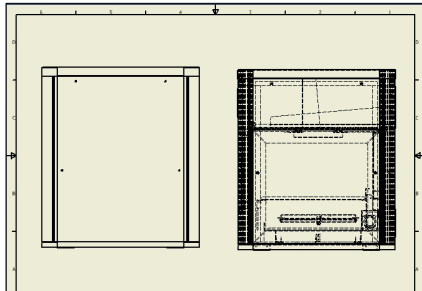
Fig. 2 of the system development process is designed to partially subsidize the Organization³⁻⁴⁾, 3-dimensional drawings and pictures below are of actual developed Fig. 3. Fig. 3 of picture is represented as a two-dimensional CAD and general appearance(top view(a), front view(b), side view(c)), picture-below, the actual production photos, and more.



(a) Top view of X-Ray Scanning System



(b) Front view of X-Ray Scanning System

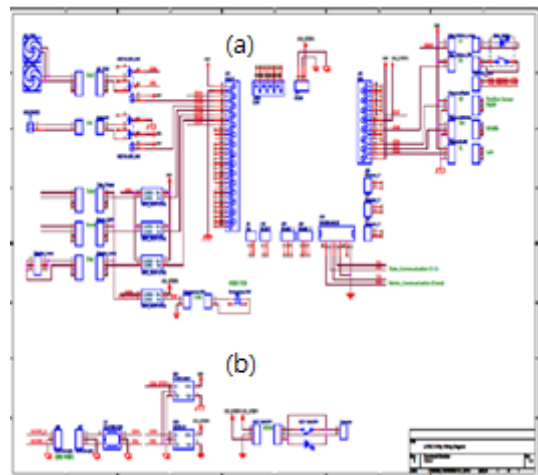


(c) Side view of X-Ray Scanning System



[Fig. 3] 2 Dimensional mechanical design and photo of X-ray system

This study is produced through the X-Ray machine the surface of the radiation leak at the Nuclear Safety Commission does and No. 21(regarding the approval and inspection of radiation equipment design criteria), you'll find "radiation device is formed outside the radiation doses of the cloth on the operation conditions up to all of the contacts above the surface radiation level is 10 micro sivert/hour should not be exceeded."There are currently set forth by this study, authorized by X-Ray Scanning System of Fig. 3 is all sides management of less than 0.2 μ Sv above all. Just a special method or technique for the shielding is not. In the form of a double sheet of lead plates to surround, a large part of this was due to the weight increase. However, the weight is impossible to move. This is a lot of leakage radiation into the underside of the initial case. So, lead plates fixed had been covered with. In addition, by way of an internal drive video line-scanning results with video, but on an as-needed basis, in real time, RS-232C cables can also be verified by an external monitor has been designed for.



[Fig. 4] Inside circuit design of X-ray system((a): whole circuit system, (b): emergency system circuit)

The above Fig. 4 drew a schematic on the inside circuit of the X-Ray Scanning System(Fig. 3). Line detector-X-Ray equipment system details that were developed by this study were designed by under 9

described earlier in Fig. 1 characteristics. This is designed to be medium to large X-Ray Scanning System and discrimination, especially as a distinct advantage among No. 4 and 5. Equipment of the system in front of the operation and the warning light attachments are worked for not to read your line scanning data or are get stopped immediately if there is a problem with the work of operating at peak efficiency(No. 4). In addition, the core element(detector) of the line detector designed to be easily replaced is the most important part in the development of this machine(No. 5). The detail specific design photos of above mentioned No. 4(a) and 5(b) in 9 ways are expressed under Fig. 5.

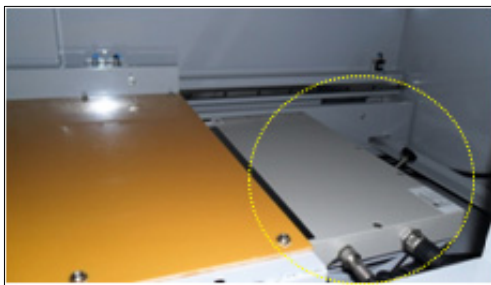
clearness. As shown in Fig. 6, this well appears to have advantages. X-Ray Scanning System developed by the participating companies to control the conveyor speed of motor control software control, by the way. This software is intended to protect the user during work switch-type door sensor lock is activated. Conveyors, screw conveyor, can describe in more detail the structure of the motor to turn a screw conveyor screw and moving along a simple structure. X-Ray Scanning System designed in this study is the largest of about 70 cm range from conveyor scanning speed 2.2 is a program to move in a matter of sec and depending on the speed of the user's intent is designed to be adjustable.

3. Some results through development

The example of experimental result is expressed in Fig. 6 through a line of detection system for X-Ray Scanning principle outside of small to medium sized products with defects in real-time to examine.



(a) Device operation and alarm button design on front side



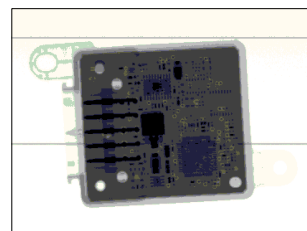
(b) Easily replaceable design of detector

[Fig. 5] Detail design illustrations of X-ray Scanning System

This prototype line director-type X-Ray Scanning System must have a function as follows. The electromagnetic noise is to eliminate the possibility of wiring and power happen clearance toward the rear of the top designed by unscrewing the screw conveyor, the motor's constant control, safety, mechanical robustness and without the video due to the result of



(a) Occupant sensor unit



(b) Scanning image of occupant sensor unit



(c)

(c) Air-lumber support pump



(d)

(d) Scanning image of air-lumber support pump



(e)

(e) Seat belt-PT



(f)

(f) Scanning image of seat belt-PT

[Fig. 6] Three applications scanning result of developed X-ray Scanning System

Fig. 6 is the scanning results of the driver or passenger seat occupant sensor unit under the chair, air-lumber support pump of car, and seat belt-PT of car seat depending on how the contents of the above products such as line sensors. This can be expressed part of a defect through a defect, flaw and multi porous of machine. The process can be recognized before you continue further, it is possible to use for reverse engineering. This product will be free from external defects. This experiment is a conveyor moves at a rate of 6 cm/min of video. In addition, this product is designed for Single Image X-Ray Scan possible. Structure design makes it possible to implement, and the X-Ray radiation shielding design of double shielding apparatus for surface radioactive leak is low natural radiation leakage levels by the nature of the

product, completely shielding, worker's safety equipment was designed to be engaging the door block. In addition, user's can schedule within the scope of the X-Ray conveyor speed for inspection was designed to be adjustable. This system ensures a fair-to-poor parts of the processes. This X-Ray Scanning System has a strong point that die casting machine parts(Fig. 6) for car, electronic circuits and soldering defects detection with two dimensional checking machine examines the degree of unattainable high(spacing test, multi porous-multi porous ceramics). In addition, with the quality at a reasonable price and competitive industrial X-Ray Scanning System, it is possible to enlarge the dissemination and use of easy operation, easy maintenance and cost-saving through easy one. Business area is expecting job creation with multiple sales is becoming possible accession bio X-Ray field sales and cheap brand Center of People's Republic of China, Southeast Asia and other regulations aimed at a gentle country exports. In addition, the compact, miniaturized X-Ray nondestructive X-Ray baggage examine market has been spread, quick and versatile material using local produce, as available for sale.

4. Conclusions

This study uses X-Ray outside of small to medium-sized products with defects and real-time scanning system developed by industry for research and development through the following conclusions.

1. This study is suggested that the organization of the production process control system of nuclear radiation leakage when the charge reaches the product at law shielding design criteria(10 μ Sv). X-Ray nondestructive inspection is possible as it is implemented within the product by adding differentiated and the production process was made possible the development of management programs. (This development is controlled less than 0.2 μ Sv management.)

2. Nondestructive scanning inspection system is available and certain conveyor speed can be controlled from within the scope of the development of a good inspection equipment. (This system is programed up to about 70 cm range from conveyor scanning speed 2.2 sec.)
3. For the safety of workers, this system is engaging door blocked compact X-Ray inspection equipment. By development of this machine, overseas export entry is enabled.
4. The developed this research structure design in the future enlargement through the container search and retrieval system is available on the technology of producing large inspection and development.

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