

MACHINE VISION IMAGE ACQUISITION SYSTEM

FIELD OF TECHNOLOGY

[0001] The present invention relates to the field of machine vision technology, and more particularly to an image acquisition system for industrial inspection, which features automatic cleaning and angle adjustment functions.

BACKGROUND

[0002] In industrial automation production lines, machine vision systems are widely used for product quality inspection, dimensional measurement, and positioning guidance. The core component, the industrial camera, must operate stably for extended periods in various environments, including those with heavy dust, to capture clear images.

[0003] Most existing industrial cameras are directly exposed during installation, making the lens highly susceptible to contamination by oil and dust, resulting in blurred imaging and requiring frequent manual cleaning, which affects production rhythm and the degree of automation. Although some solutions add protective covers, the observation window of the cover itself also accumulates dust and lacks effective automatic cleaning means. For example, some patents focus on physical collision protection (such as CN219101940U), but do not address the problem of dust accumulation and cleaning on the observation window. Manual cleaning is not only inefficient but also difficult to implement on enclosed or high-speed production lines.

[0004] Therefore, developing an image acquisition system that can automatically keep the observation window clean while providing flexible shooting angles is of great significance for enhancing the reliability of machine vision systems and reducing maintenance costs.

SUMMARY

[0005] The purpose of the present invention is to overcome the shortcomings of the prior art by providing a machine vision image acquisition system that integrates dust prevention, automatic dust removal, and multi-degree-of-freedom angle adjustment functions, ensuring continuous acquisition of high-quality images in harsh industrial environments.

[0006] To solve the above technical problems, the technical solution adopted by the present invention is: a machine vision image acquisition system comprising a base, a bracket, a rotary drive mechanism, a dust cover, a transparent glass plate, an automatic dust removal mechanism, an industrial camera, an angle adjustment mechanism, and a mounting plate.

[0007] The upper part of the base is connected to the bracket via the rotary drive mechanism, which drives horizontal rotation. The upper part of the bracket is connected to the mounting plate via the angle adjustment mechanism, which drives pitch rotation. The industrial camera and the dust cover enclosing it are mounted on the mounting plate, and a transparent glass plate is hermetically installed at the front end of the dust cover. An automatic dust removal mechanism is also provided on the mounting plate for wiping the outer surface of the transparent glass plate.

[0008] The automatic dust removal mechanism comprises a second motor, a lead screw, a threaded sleeve, a limit rod, an adapter frame, and a cleaning cotton wipe. The second motor drives the rotation of the lead screw, and the threaded sleeve, which cooperates with the lead screw, is restricted by the limit rod inserted into the sliding groove of the mounting plate, thereby driving the adapter frame and the cleaning cotton wipe installed by hook-and-loop fastener (or buckle) to reciprocate linearly, achieving wiping.

[0009] Preferably, the rotary drive mechanism comprises a first motor fixed to the base, which drives a first gear meshed with a second gear fixed to the support shaft of the bracket, thereby driving the bracket to rotate horizontally.

[0010] Preferably, the angle adjustment mechanism comprises a third motor fixed to the bracket, which drives a third gear meshed with a fourth gear fixed to the transmission shaft of the mounting plate, thereby driving the mounting plate and industrial camera to pitch.

[0011] Preferably, the front end of the dust cover is provided with a mounting groove for the embedded transparent glass plate, and sealed with sealant.

[0012] Preferably, an angle sensor may be provided at the transmission shaft for feedback control of the pitch angle.

[0013] Compared with the prior art, the beneficial effects of the present invention are: the invention isolates dust by sealing the dust cover, protecting the core of the camera. The innovative automatic dust removal mechanism can clean the observation window periodically or on demand, thoroughly solving the problem of dust accumulation on the protective cover affecting imaging, and achieves long-term stable operation without manual intervention. Through precise adjustment of two degrees of freedom—horizontal rotation and pitch—the industrial camera can quickly and accurately align with targets at different stations and heights, greatly improving system adaptability and inspection range. In the present invention, the dust removal mechanism adopts lead screw transmission for smooth movement and uniform wiping; the overall drive adopts gear transmission for good rigidity and precise positioning. All functional modules are integrated into a compact design, suitable for industrial sites with limited installation space. The cleaning assembly is detachable and replaceable, resulting in low maintenance costs. The system effectively reduces misdetection, downtime, and manual cleaning costs caused by unclear images, thereby improving overall production efficiency.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The present invention will be further described below in conjunction with the drawings.

[0015] FIG. 1 is a schematic perspective view of the overall structure of the present invention.

[0016] FIG. 2 is a schematic view of the internal structure of the dust cover in the present invention.

[0017] FIG. 3 is a schematic view of the structure of the angle adjustment mechanism in the present invention.

[0018] FIG. 4 is a schematic view of the structure of the automatic dust removal mechanism and mounting plate in the present invention.

[0019] FIG. 5 is a schematic view of the structure of the dust removal mechanism in the present invention.

[0020] In the drawings: 1, base; 2, bracket; 201, support shaft; 3, rotary drive mechanism; 301, first motor; 302, first gear; 303, second gear; 4, dust cover; 401, mounting groove; 5, transparent glass plate; 6, automatic dust removal mechanism; 601, second motor; 602, lead screw; 603, threaded sleeve; 604, limit rod; 605, adapter frame; 606, cleaning cotton wipe; 607, hook-and-loop fastener; 7, industrial camera; 701, camera lens; 8, angle adjustment mechanism; 801, third motor; 802, third gear; 803, fourth gear; 9, mounting plate; 901, transmission shaft; 902, limit sliding groove.

DESCRIPTION OF THE EMBODIMENTS

[0021] The present invention will be further described below in conjunction with the drawings and embodiments.

[0022] As shown in FIGS. 1 to 5, the machine vision image acquisition system of the present invention mainly comprises a base 1, bracket 2, and mounting plate 9 to form the main support frame, and integrates rotary, pitch, dust protection, cleaning, and image acquisition functions.

[0023] In this embodiment, the bracket 2 is rotatably connected to the base 1 via the support shaft 201 at its bottom. The rotary drive mechanism 3 consists of the first motor 301, first gear 302, and second gear 303. The first motor 301 is fixed to the base 1, and transmits power through the gear pair to the second gear 303 fixed to the support shaft 201, thereby driving the entire bracket 2 and all upper components to rotate in the horizontal plane for rapid adjustment of the shooting direction.

[0024] In this embodiment, the mounting plate 9 is rotatably connected to the bracket 2 via the transmission shaft 901 at its bottom. The angle adjustment mechanism 8 consists of the third motor 801, third gear 802, and fourth gear 803. The third motor 801 is fixed to the side wall of bracket 2, and drives the fourth gear 803 fixed to the transmission shaft 901 through a gear pair, thereby driving the mounting plate 9 to rotate precisely about the horizontal axis, enabling adjustment of the pitch shooting angle of the industrial camera 7.

[0025] In this embodiment, the industrial camera 7 is fixed to the mounting plate 9. A hemispherical dust cover 4 is fixed to the mounting plate 9, completely enclosing the camera. The front end of the dust cover 4 has a circular observation port with an annular mounting groove 401 at its edge, into which the transparent glass plate 5 is embedded and adhesively fixed with sealant, forming a reliable seal to prevent dust ingress.

[0026] In this embodiment, the second motor 601 is fixed to the lower surface of the mounting plate 9 and drives the horizontally arranged lead screw 602 to rotate. The threaded sleeve 603 is threaded onto the lead screw 602. To prevent the threaded sleeve 603 from rotating, its upper part is fixed to the limit rod 604, which is inserted into the elongated limit sliding groove 902 on the mounting plate 9. The side of the threaded sleeve 603 is connected to the L-shaped adapter frame 605, and the end of the adapter frame 605 is detachably fitted with the cleaning cotton wipe 606 via hook-and-loop fastener 607. The cleaning cotton wipe 606, under the action of a spring or its own elasticity, lightly contacts the outer surface of the transparent glass plate 5 with its working face.

[0027] When the control system triggers a cleaning command or the preset time cycle is reached, the second motor 601 starts, driving the lead screw 602 to rotate and forcing the threaded sleeve 603 to move the cleaning cotton wipe 606 in a reciprocating linear motion along the surface of the transparent glass plate 5 to effectively remove accumulated dust. The cleaning cotton wipe 606 can be easily removed and replaced when dirty. Cable routing grooves may be arranged on the bracket 2 for cable management.

[0028] Working principle: The system is installed above the inspection station. According to the position of the object to be inspected, the first motor 301 drives overall horizontal rotation, and the third motor 801 drives the camera pitch, enabling the industrial camera 7 to obtain the optimal shooting field of view. During continuous operation, dust gradually accumulates on the outer surface of the transparent glass plate 5. At this time, the automatic dust removal mechanism 6 is activated according to the preset program, driving the cleaning cotton wipe 606 to clean the observation window, ensuring imaging remains clear throughout the process without manual intervention.

[0029] The present invention deeply integrates active cleaning and multi-axis adjustment functions, significantly enhancing the practicality, stability, and image quality consistency of machine vision systems in complex industrial environments.