ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijareeie.com

Vol. 7, Issue 3, March 2018

An Advanced Cartesian Robot for Adhesive Dispensing

M. Hemalatha[1], R.Deepika[2], B. Hemasri[3], U.Balasaraswathi[4], T. Persia[5], D. Baskar[6]

Former Assistant Professor, Dept. of EEE, Hindusthan College of Engineering & Technology, Tamilnadu, India[1]

UG Graduates, Dept. of ECE, Hindusthan College of Engineering & Technology, Tamilnadu, India[2-5]

Assistant Professor, Dept. of ECE, Hindusthan College of Engineering & Technology, Tamilnadu, India[6]

ABSTRACT: The project is about designing a pneumatic system that dispenses the adhesive on the surface of the wrist watch cases for fixing the mineral glass (MG).Presently, this process is being carried out with the help of CAM machines and Cartesian Robot in which the position for fixing the cases is not exactly known. Also the speed cannot be adjusted and the watch cases get scratched due to friction caused by manual handling. The productivity is low in this process since only one case can be placed in the plate fixed in the motor. This is now replaced with newly designed robot and a pneumatic system which is used for the purpose of automatic picking and placing of MG. In this robot, the position can be known exactly and speed can be varied according to the case profiles. By this process, it is possible to rotate the designer case unlike the present methods for applying adhesive. So the productivity can be increased with an increase in speed and various watch case profiles can be generated. This also increases the accuracy of the process. In addition to this, adhesive can be applied even at the corner which increases the pull-off force hence increasing the water leakage resistance.

KEYWORDS: Dispenser, Servo motors, Adhesive, Motion Controller, CAM Machine.

I.INTRODUCTION

In wrist watch case there are three joints which are to be a leak proof. One of these joint is between glass and watch case.In this joint we need to apply the adhesive. As the wrist watch comes in various shapes and sizes and the area where the adhesive to be applied is narrow, so the quantity of adhesive required at that point is critical. This joint is on the visible area of the watch, the adhesive used here must be in a precise manner. In our system, watch case also moves where the adhesive is applied even at the side surfaces, hence the area where the adhesive applied is increased. The pull-up force is high because of increased surface area of adhesive and hence it is leakage resistant. The adhesive which we use will not dry at normal conditions. Hence we use Ultra Violet rays to dry the adhesive.

The project has been developed for fixing the dial cases in the wrist watches, where automatic picking and placing of MG is done based on the instruction given to the controller. Watch is rated to withstand the pressure at a depth of 100meters in water. The joint is critical because it prevents the entry of water into watch. The joint is sealed using two methods which is using a Teflon gasket and the other is by using the Adhesive.

The specially designed machine works similar to the Cartesian robot. It can be supplied with any combination of axis such as X, Y, Z or rotated in 360 degree. The X axis is meant for the movement of adhesive, Y axis for rotation of the locator (wrist cases) and Z axis for adjusting the height. The three axes X, Y, Z are controlled by three servo motors which are driven with help of controller. The outputs of the three motors are connected to a relay respectively in the controller. The controller can have only negative inputs but the output of the motors is in positive. So in order to have a link between them they are inter connected by the relays.

II.LITERATURE SURVEY

Han Ding (1957) proposed that the influence of gas compressibility in time-pressure dispensing can be alleviated by using a predictive model based on power-law to estimate the amount dispensed. Based on the simple and effective model, a run by run supervisory control scheme is delivered to compensate the variation resulting from gas volume

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change in the syringe. **B.L.Davies (1990)** used a technique relevant to sealants. Generally these are not regarded as critical in having high joint integrity except in a few specific applications. High pressure gases must be retained using gasket sealants in order to ensure that the automation is relevant to small batch production. **A.Razban (1991)** made a analyze on the rheological behavior of the adhesives for representing different types of adhesive flow under a variety of conditions. The material properties provides an initial approximation of the flow rate which can be applied to similar adhesives with known rheological data and nozzle flow rate.**Daniel Xiangbiao Chen (2000)** presents the advanced model for time pressure fluid dispensing process to overcome the two most critical performance (flow rate of fluid and shape of fluid dispensed) which are difficult to represent. These drawbacks are rectified and experiments have been performed.**Yi-Ping Hong (2003)** proposed that computational dynamics can be used to calculate flows in the time-pressure dispenser. The analysis of different factors can be used to know the information about the wall shear stress and the pressure drop caused by a sudden contraction.**X.B.Chen (2006)** used fluid dispensing process in electronics packaging manufacturing where adhesive delivered in a precise manner for bonding, sealing. By power law equation behavior of liquid is characterized based on fundamental flow in screw channels and tubes model developed to represent flow rate in rotary screw.**Cong-ping Chen (2007)** proposed that automatic dispensing has been widely used in the development of surface mount technology where four kinds of dispensing methods are employed. Among that time-pressure dispensing is widely used due to its simple operation, ease of maintenance and flexibility.**William Andrew (2008)** explained principal types of adhesive bonding as structural and nonstructural. Structural are large stresses up to their yield point and having a greater shear strength. Nonstructural is lightweight materials in place. It is called as “holding adhesive”, ex: pressure sensitive tapes. **O.S.Sezgin (2009)** used prototype system to know about adhesive beads and its shape(geometric model of bead) using laser light. Relationship between model and shape of a line of light on image material are investigated. According to their prototype system bead parameters and height of camera are analyzed.

III.SCOPE OF THE RESEARCH

The existing system consists of a servomotor mounted with the syringe (filled with 3055 adhesive) for fitting the watch cases. It is also known as a CAM machine. This machine uses mechanic logic in which speed is held constant but the pressure can be varied. Here the watch case is rotated and the syringe is held constant for the purpose of adhesive dispension. Here Cartesian robot is not employed and instead the servo motor is used to rotate the watch cases. A disc shaped metallic structure or plate is placed on the motor surface and when the motor is ON, the disc rotates along with the motor over which the watch cases are placed according to the shapes we require. The servo motor is used only for the purpose of dispensing adhesive. Since the pneumatic system is not employed for the purpose of sucking the Mineral Glass, the Mineral Glass must be handled manually and hence there are possibilities for scratches to occur on the surface of the manufacturing glass which results in damage of many cases and it will affect the productivity. Hence to improve the productivity a new avenue has to be developed to overcome the drawbacks.

The main problem in using the CAM machine is no accuracy can be identified in the machine. Since no position is known it will become difficult for the user to identify it manually and the process will also be time consuming. The second problem is that since manual method is used, the machine requires a mechanical touch in the case and there occurs scratches on the watch case. Also here the speed is constant and only the pressure can be varied. These drawbacks affect the entire output which lowers the productivity and hence automatically the efficiency will be reduced.

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IV.PROPOSED METHODOLOGY

The following is the Block Diagram of the proposed system which consists of the hardware components.

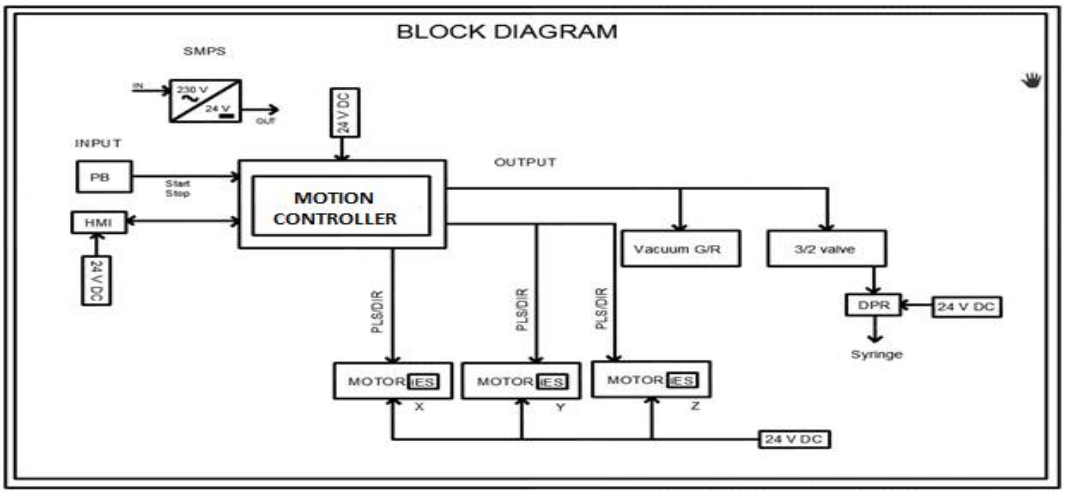

Fig.1 Block Diagram of the Proposed Pneumatic System

Once the controller is ON, the relay is ON and its output switches in the vacuum generator switches OFF after a time delay. The HMI has four modes namely with adhesive, without adhesive, with MG and without MG. once the button is pressed, the system checks whether the MG is ON and will move from home position to MG pick position. If the MG is ON, it automatically moves to MG pick position and the vacuum output is ON. Meanwhile there will be a wait for eg. 3 sec which will be more than enough to pick the MG. Now the vacuum sensor will be ON and it will move to the locator center. Else it will move to the Home position. Once it moves to the locator center, it will check for adhesive (ON or OFF). Once the adhesive output is ON the profile will be drawn and then the adhesive will be OFF. Then the process will be continued as above. Atlast the vacuum will be OFF and it will move to Home position.
There is a mode called auto continue cycle in which the cycle will be automated by fixing two important parameters namely number of cycles and time delay. For an example if the number of cycles are fixed to 10 cycles and time delay to 2 sec, the process continues to run automatically to the set values until it is stopped manually. The video of proposedsystem can be referred using the link:https://www.youtube.com/watch?v=b7xr7emR_J0&feature=youtu.be.

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V. EXPERIMENT RESULTS

In the fig 2, it shows the different kinds of locators with respect to different shapes such as circular, square and rectangular cases.

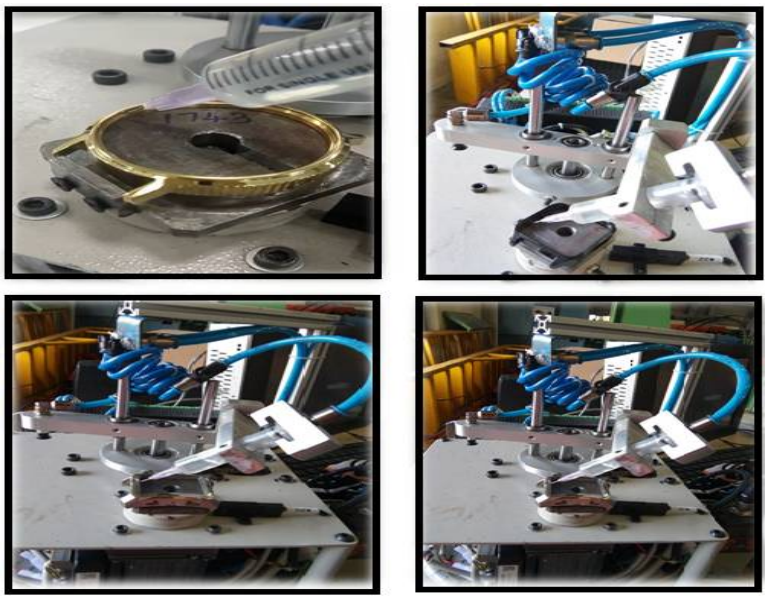

Fig.2 Different types of watch cases i) Circular case ii) square case iii) Rectangular case

In the fig 3, it shows the designed machine for adhesive dispensing on the watch cases for fixing the dial cases

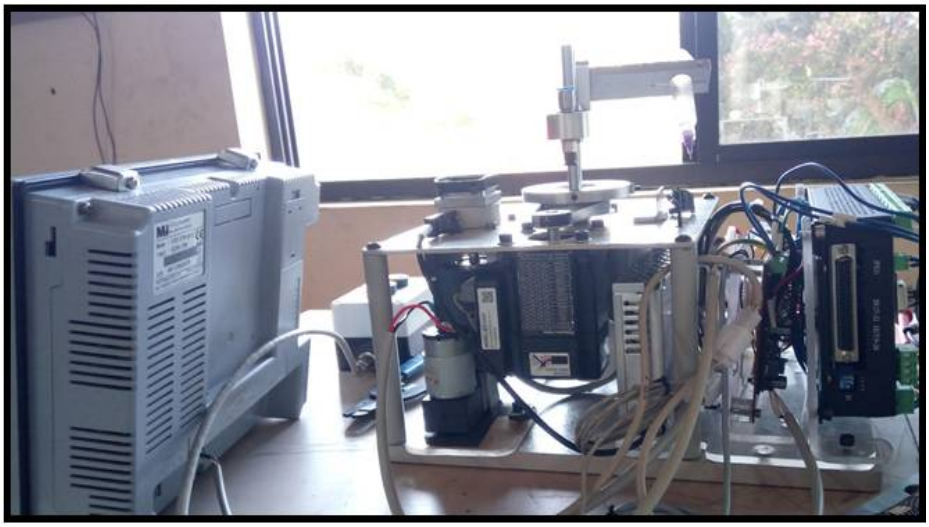

Fig. 3 Specially designed machine for adhesive dispensing on watch cases for fixing the dial cases

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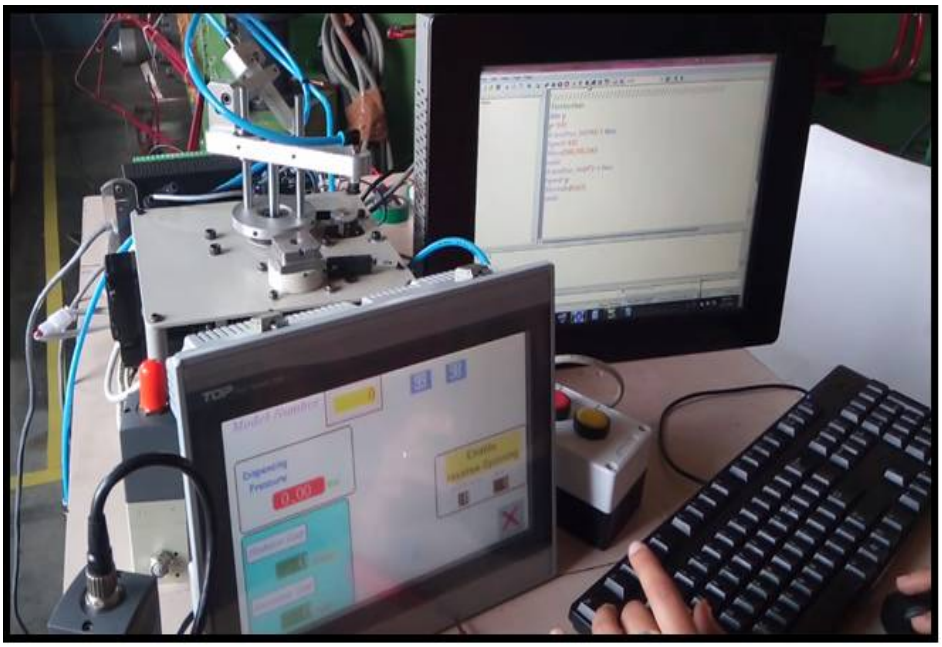

Fig.4.3 Automation with HMI and codes for the axes movement

Adhesive dispensing can be a perfect choice as it is comparatively easier to implement, smaller and cost effective, with the deployment of our robot.

VI.CONCLUSION

Adhesive dispensing serves as an important technique in the manufacturing of wrist watches. The existing method employing CAM machine and servo motor has a lot of drawbacks such as the shape and position of watch case is unknown, etc. Moreover many profiles cannot be drawn using this method. Also the speed is constant and pressure cannot be varied. In order to overcome these drawbacks, our newly proposed system with 3 axis (X, Y, and Z axis) controller is used. Thenewly designed robot and a pneumatic system which is used for the purpose of automatic picking and placing of MG.Unlike along with normal shapes (circle and square) other special profiles can also be drawn. The speed and pressure can also be varied unlike the existing method. This enhances the productivity, time factor, accuracy and speed of manufacturing. Thus the efficiency is also increased.

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