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A New Glass-Ceramics for Tile-Glaze Application using PID Controller

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Abstract: Glazes can be defined as a stable glassy coatings applied to ceramic earthenware and formerly obtained by cooling oxides or minerals applied and melted on the surfaces of ceramic objects. The large increase in demand for tiles with improved and advanced properties, such as high resistance to abrasion, higher hardness, lower closed porosity and improved chemical resistance is observed. Glazes ceramics need to improvement in the mechanical and chemical properties of glazed. The pick and place station is equipped with a three-axis module. test piece housings placed on the vacuum are detected module picks up a test piece insert from the slide and places it on the test piece housing. Overall, glazes ceramics are compared with automatically and manually of the speed and the position control. The handling modules of automatic transfer are a new generation of high speed and precision then these color results from absorption and thickness than manual is also included.
Keywords: Glaze-Ceramic, Crystallization, Pick and Place Robot, PLC Control.

1.0 Introduction

Nowadays, it would be hard to imagine the consequences of a word without ceramic a world without bricks, tiles, pottery and the refractories necessary to withstand the high temperatures in the melting of metals and the melting of glass as also the most efficient and economic solution used to obtain high quality [1]. The ceramic made the birth of glass possible, since, with the aid of ceramic crucibles that were sufficiently refractory to withstand attack, impure glass was produced as early as 1200^{O}C. It is an interesting theory that although a glaze is merely a coating of glass on the ceramic, the development of glazes may have preceded the invention of glass in its own right [2]. Glaze objects were made in various parts of the word long before the development of any scientific knowledge of chemistry and consequently the processes involved must have been simple and the raw materials easily obtain [3]. At last previously, human operators are provided with a work piece to chemical properties of glazed by them self. Some disadvantages are repeatability, quality control, waste reduction and decreased productivity. However the concept only became truly practical with the addition of the pick & place module , whose flexibility allowed it to drive almost any sort of task. It module have been implemented in many fields of human life.

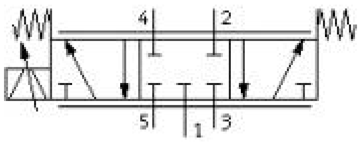


Figure 1; A pneumatic servo valve

Figure 2; Photo of high performance pneumatic servo valve

The results that were achieved were often of a very high quality but were achieved by empirical methods rather than by an application of scientific knowledge or theory. The work piece is transported to the pneumatic separator on the station and detected by a second diffuse sensor. This leads to precisely controlled actions that permit a tight control of the process or machine. Human-Machine Interfaces (HMI) are usually employed to communicate to programmable logic controller (PLC). The pick & place module picks up a work piece insert from the slide and places it on the work piece housing. The complete work piece (housing and insert) is released by the separator and transported to the end of the process. The purpose of this paper is to discuss on how to achieve the best control performance compared with automatically and manually of speed and position control. In section 2, the discussion focuses on the conceptual design of a pick and place control. In section 3, experimental results separated by human and machine control. Overall, the paper is concluded in Section 4.

2.0 Mathematical model

We describe detailed mathematical modeling of pneumatic for pick and place machine. The System consists of high-speed, electronic drives, pneumatic actuators, and position transducers. The pneumatic system used in our research is a double-acting no-rod cylinder. PID controllers are so far the most common in industrial process. [5]. They have several important functions, provide feedback, have the ability to eliminate steady state offsets through integral action and can anticipate the future through derivative action [3]. In practice, PID controllers are used at the lowest level and multivariable controllers provide set points. [4]. The behavior of a PID algorithm can be described as

$$u(t) = K_p \left(e(t) + \frac{1}{T_i} \int_0^1 e(t)dt + T_d \frac{de(t)}{dt} \right) \quad (1)$$

Where K_p is the proportional action, T_i is the integral time and T_d is the derivative time. The PID controllers are parameterized by the following transfer function.

$$\frac{X(s)}{R(s)} = \frac{C(s)G(s)}{1+C(s)G(s)} \quad (2)$$

The closed loop third order is given as

$$G(s) = \frac{5432.58}{s^3 + 179.65s^2 + 8069.07s} \quad (3)$$

Transfer function of equation (2) using equation (3) yields

$$\frac{K_p(1+T_{ds}+\frac{1}{T_{is}})\frac{K}{s(1+T_{P1s})(1+T_{p2s})}}{1+K_p(1+T_{ds}+\frac{1}{T_{is}})\frac{K}{s(1+T_{p1s})(1+T_{p2s})}} \quad (4)$$

The PID controller was designed by following standard procedure of PID controller design, which consists of control and plant as shown in Fig 3.

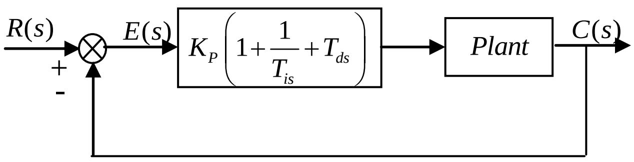


Figure 3; PID Control Scheme

The result acquired under the condition of PID controller are given as $K_p = 0.694$ $K_i = 1.84$ and $K_d = 1.64$. The process modeling tool is selected to customize the structure of the identified model based on the knowledge of the third order system. The simulink model of the PID control system can be shown in Fig 4.

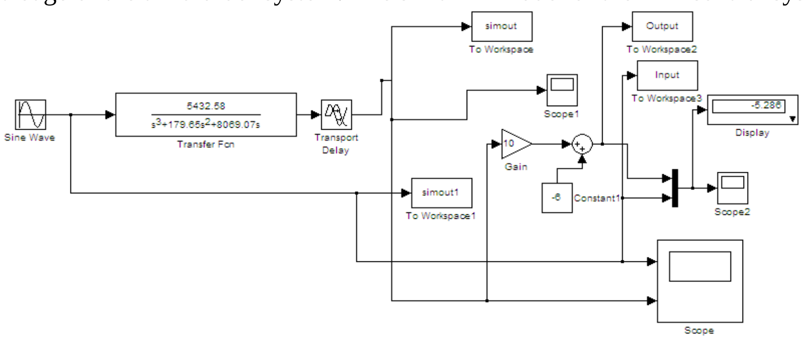


Figure 4; Simulink model of the PID controller

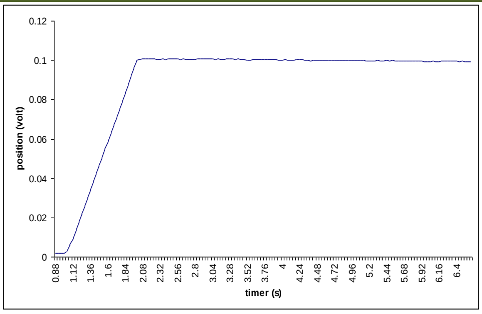


Figure 5; Unit position responses experiment with PID control

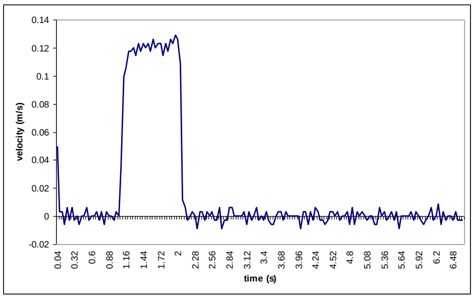


Figure 6; Unit velocity responses experiment with PID control

3.0 Conceptual design

The conceptual gives some view of what this system develop for and it consist several element to be considered. In designing and implementation of the pick and place system using controlled ceramic materials, it use close loop process control to control the pick and place robot movement by giving the absolute valve in the command language. The hardware used in automated system is call automation equipment. An automated used in this process control performs the following functions:

3.1 Control design

Function of this device is to ensure that a process variable is maintained at specific limits. If a disturbance causes the to deviate from the end point, the controller must call for a corrective action. The control section is the brain of the automated system, which compare the end point or timer to a sent signal from the measuring device. A PLC was made use in sequential working of the working model of the pick and place assembly. In this project there are a number of applications where a partial sequence of operations repeats itself. Automation of these operations can be effectively carried out using low-cost automation techniques, which employs fluid power system. Until recently, the sequence control of fluid power has been performed by electromechanical means. The employ relays, counters, switches etc. This hardwired systems tend to be expensive and pose serious limitation if found necessary to change the machine sequence. The ladder logic diagram is converted into a PLC ladder diagram by using the conventions of PLC ladder diagram construction. The components used are of two basic types in this program: contacts and coils.

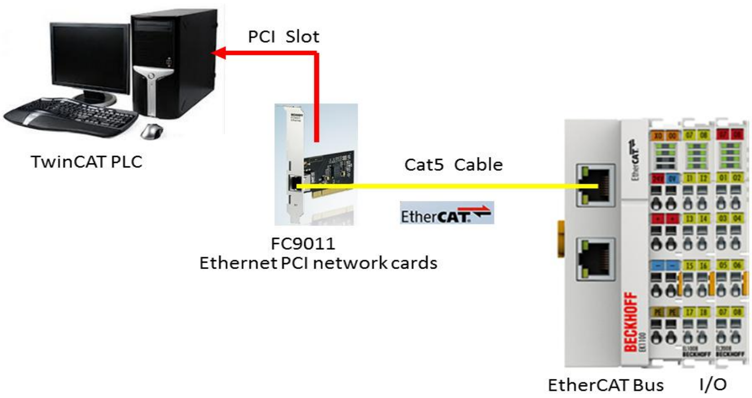


Figure 7; Beckhoff PLC control

Contacts are used to represent input switches, relay contacts and similar elements. Coils are used to represent loads such as solenoids, relays, timers, counters etc . The programmer inputs the ladder diagram rung into the PLC memory with the CRT displaying the results for verification. This figure shows the system, which is used to control the working model consisting of a CPU, power contracts, TwinCAT etc.

3.2. Hardware design

Function of this device is to execute the pick and place operation. In this section, the pick and place robot will be used to do all the sequence to pick and object and place it at another place as we instruct in command language of the system. The motions of a pick and place arm can be achieved with the use of pneumatic. Following are the essential components of a robot.

1) Sensor, which is an essential limit, is a transducer of some kind whose input is physical phenomena and the output are electronic signal.
2) Actuators, which act as the muscle of the system, produce the motion. The power supply of actuator is electrical with pneumatic.
3) Communication is unit transmitting information and receiving instruction from protocol TwinCAT operator.
4) Controller, which integrate the activity of the several microprocessor.
5) End effectors is a vacuum device at the end of the manipulator arm.
6) Manipulator is a mechanism consisting of several segment or arms.
7) The energy storage devices, such as battery or AC power supply.

The work done by pneumatic actuators can be linear or rotary. Linear movements is obtained by piston cylinders, reciprocating rotary motion with an angle up to 270 degrees by vane or rack and pinion type actuators and continuous rotation by air motors. cylinders operated by solenoid controlled valves with limit switches and sensors to indicate when a motion is completed.

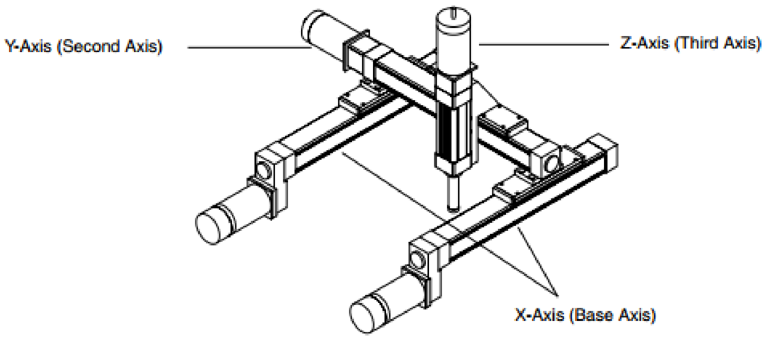


Figure 8; Hardware design

Thus, the clockwise rotation of the unit might result from the piston in a cylinder being extended and the counter-clockwise direction by its retraction. Likewise, the upward movement of the arm might result from the piston in a linear cylinder being extended and downward motion by it retracting, the extension of the arm by another cylinder extending and its return motion by retraction. The gripper can be opened or closed by the piston in a linear cylinder that is extending or retracting with a basic mechanism.

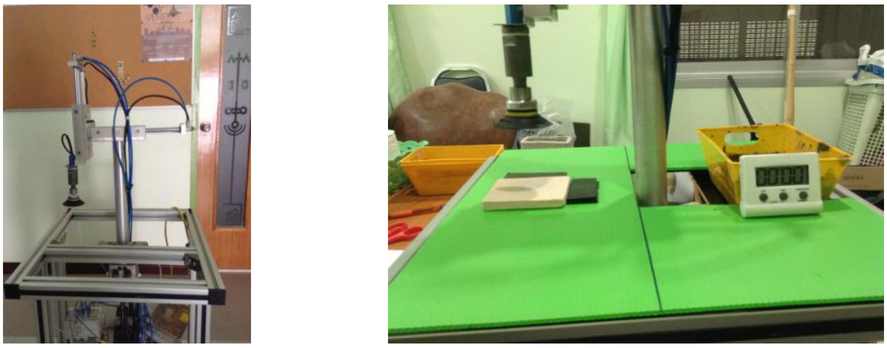
Number of axes of motion

It is important to understand the operating environment of the motion system and the cost effective quantity and placement of motion components. It is equally important when ordering to understand the orientation of systems as specified by the actuator division.

The x, or base axis. The axis which provides the base for all other axes of motion is referred to as the x-axis in all system type considerations. Regardless of whether the base axis rests on a horizontal or on a vertical surface, the most heavily loaded axis shall be called the x-axis.

The second axis. When placed on a base axis and traveling in the same plane, the second axis is referred to as the y-axis. When placed on a base axis and traveling in the plane perpendicular to the base axis plane, the second axis becomes the z-axis, as in system. The second axis may be mounted upright, inverted on its side.

The third axis, is referred to as the z-axis when travelling perpendicular to the plane of the base x-axis and second y-axis.

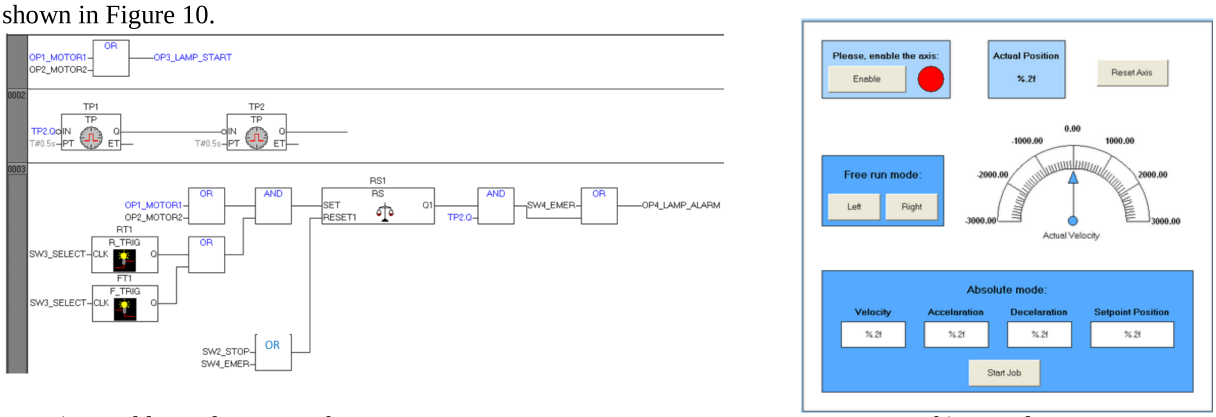


a) hardware b) suction and discharge

Figure 9; pick and place movement

3.3 Software Development

For performing pick and place operation smoothly, planning must be made before creating suitable program. First, all possible route for movement of robot and major movement probability of robot arm and gripper for lifting, gripping and release must be determined. Then, the program being made using the short subroutine that perform the task quickly and smoothly. Several program subroutine being made as for strategy purpose which each program subroutine will perform different technique or method for pick and place operation. Lastly, all the strategy subroutines are combining in main program which being install in PLC. The aim for this project is to make the arm robot to move upward and downward using sensor at left and right gripper. The planning of the behavior is starts by configuring the size of object that need to be picked up using sensor at the gripper. Then, the sensor at the main structure indicates the movement of arm robot in term of height. After that, object will be picked and be held before arm robot being raised upward until certain height as indicated by the sensor at the main structure. Finally, the arm robot will place the object back in it position after being held few seconds and arm robot will be back to its initial position. The flowchart of main program is shown in Figure 10.



a) Ladder and Function box b) Visualization

Figure 10; Software Development

4.0 Experimental set up and results

Controlling cylinders is one of the most important aspects of pneumatics. Experiments were conducted to implement and check the accuracy and effectiveness of the proposed controller with position and speed observers. Two sets of experiments were conducted. The first set utilized the manual, and compare with the second set utilized the observed automatic. By the way, for the control of the motion trajectory of the end-effector using the PID controller. However, for the results, only one degree of freedom is used, which is a double acting pneumatic cylinder (Festo SLT-20-150-A-CC-B). Two four-way proportional spool valves (Festo MPYE-5-M5-010-B) are used for controlling charging and discharging process of both chambers of the cylinder. A linear potentiometer (Modori LP-150F) with a travel length of 150 mm is used to measure the position and speed. The communication between the computer and the experimental setup is established through the digital input and analog output channels of an A/D card (Beckhoff PLC). The pick and place station is

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equipped with a three-axis module. test piece housings placed on the vacuum are detected module picks up a test piece insert from the slide and places it on the test piece housing. Overall, glazes ceramics are compared with automatically and manually of speed and position control, can be shown in Figs 11-12.

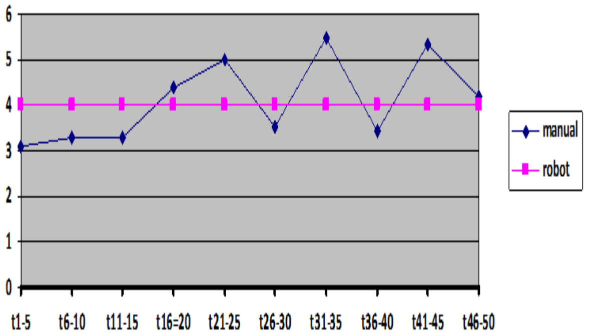


Figure 11;. Dip for test at first time

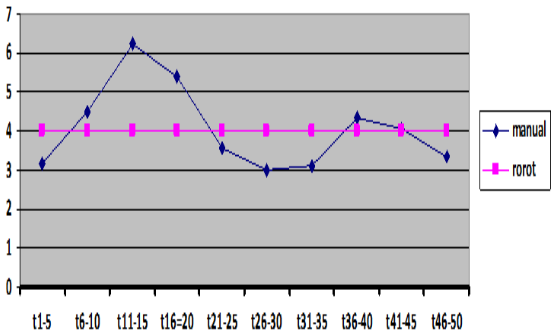
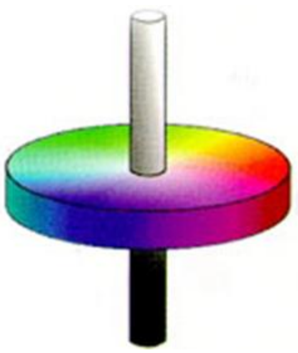


Figure 12;. Dip for test at second time



L = Bright 0 – 100
0 = Darkneess
100 = Brightness
a = Red or Green
+a = Red
-a = Green
b = Yellow or Blue
+b = Yellow
-b = Blue

Figure 13;. Hunter (L,a,b

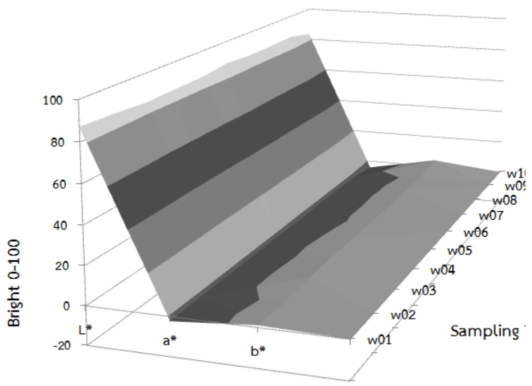


Figure 14;. color intensity for manual

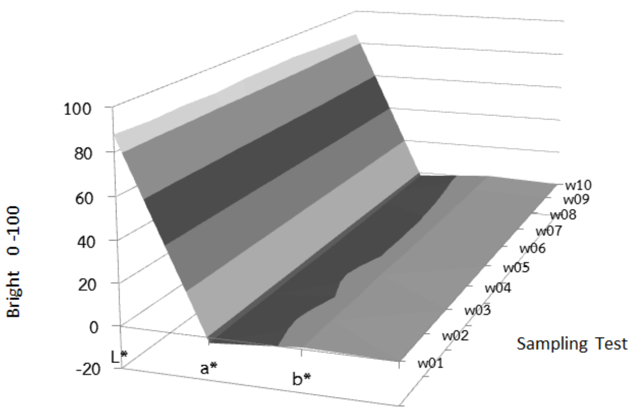


Figure 15;. color intensity for automatic

5.0 Conclusions

This paper documented the design, manually and automatically experimental evaluation and simulation of the position and velocity servo control of a pneumatic pick and place machine. Fig 13, it was found 50 test piece the proposed automatic control is better by compared with the manual. At the same time, the scheme has been tested on various process in color intensity between manually and automatically in Fig 14-15. The L is lightness, A is green color, and B is blue color are still same line. Overall, a pick and place robot control via automatic was found a good position and velocity than manual. This shows that the system can be accurately controlled using PID controller observers and hence it results in a good system. The system is very important to eliminate human errors and to get more precise work. It can also save the cost in long term and help to solve problems.

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