Journal of Engineering and Fundamentals
Vol.3(1), pp. 1-8, July, 2016
Available online at <http://www.tjef.net>
ISSN: 2149-0325
<http://dx.doi.org/10.17530/jef.16.01.3.1>

Fully Automatic Soup Machine

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Article history

Received:
05.02.2016

Received in revised form:
04.04.2016

Accepted:
05.04.2016

Key words:

PLC, SCADA, Material
science, Pneumatic,
Mechanisms

Fully automatic soup machine project is made for meeting hunger needs of people in emergency situations without any request from anyone. Compared to systems that only cup soup, there is a system which suitable for Turkish society, meet bowl of soup and bread needs, at the same time self cleaning, report the lack of materials to system over web or mail with system to be installed. The system is controlled from PLC over and have visual support with a operator panel. Also, it transfers necessary information to central system with GSM mode and fiber lines. The system is characterized in that self cleaning. It is thought to take place near the municipality and police stations buildings, in parks and schools to serve the people. PLC programming is designed with twin cat. System software is designed in codesys ST language. Mechanical materials used is selected in accordance with food. Fingerprint application which prevent multiple use in the same day is developed. Mechanical design is prepared with Solid Works. Also remote monitoring module is developed. This module is designed two kinds. First designed is a cloud application. Remote access is designed making IP routing with cloud application in Beckhoff PLC system. On the other system is designed to access codesys software via modem forwarding on port. The movement of mechanical equipment is designed on servo motor and pneumatic. Two servo motors and rotary pneumatic activators are used. Servo motors is designed for bread units and rotary activators for soup preparation mechanism.

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1. Introduction

Kocakahya [1] made a study regarding the determination of food frequency and the budget allocated to food minimum-wage families in Department of Family Economics and Nutrition in Gazi University. A person need sufficient income for adequate and balanced diet and maintaining a healthy way of life. For this, especially minimum-wage families's income level is very important. The low level of income of families consequently failure to meet fully food requirements cause increasing healthy problems in under developed and developing countries. A study is considered to determine the budget allocated to food of minimum-wage families and their foods which consumed generally. So, study is made for detecting views about the budget allocated to food of minimum-wage families and foods which consumed generally.

Yılmaz [2] made thesis on food safety systems and control methods applied in Turkey. In this study, food safety becomes more important in recent years due to changes in food production technologies and rapidly changing life conditions. Implementation of food safety systems is a legal requirement. Besides, food safety threats prevention of hazards occurring without progress, so it provides reaching safe foods for consumers, decline in cost and customer happiness. Turkey is a candidate country to the European Union runs studies about developing control systems providing efficient and sufficient food inspection to accomplish food safety in adaptation period. It is necessary to harmonize available national food control systems with more efficient approach accepted internationally. In this period, food industrial, consumer, related organizations and establishments should be on cooperation to provide safe food consumers and to protect consumer health. In this study, it is purpose to examine food safety systems and application conditions in food industrial applied in

Turkey, current state of the control systems and perspective with European Union adaptation policy.

Kahraman [3] studied at determining process control systems and quality assurance in the manufacturing sector. Sol [4] explained analysis methods and process control concepts at study of analytical and interpretative statistically analysis programme for process control. Afşar [5] made a study at process control training set design and application, pressure temperature PID control, flow control, level control. Birgit Vogel-Heuser, Daniel Schütz [6] made a study at PLC programing with model-driven engineering of manufacturing automation software in article. In the project, codesys is selected for software language. Becerikli [7] made a study at increasing the solid and liquid weighing accuracy and dosing. In this study, it is provided to accomplish a combination of different engineering process using electric, mechanical and software.

2. Full Automatic Soup Machine

We will examine here the machine in parts. Full automatic soup machine consists of six main parts:

- A. Preparation Unit
- B. Baking and Holding Unit
- C. Bowl Preparation and Presentation Unit
- D. Bread Presentation Unit
- E. Control - Command Unit
- F. Auxiliary Systems Unit

Figure 1: Machine Overview

A. Preparation Unit

This unit comprises the mechanism that allows the storage of powder feedstock of up to capacity and provides volumetric automatic charge to baking unit. Reservoir

Figure. 2: Soup Preparation Unit

B. Baking and Holding Unit

This unit consists of doubled walled and 1 liter vessel, a stirring wire a driving mechanism and auxiliary systems. All parts coming into contact with feedstock will be produced from materials that meet the appropriate standards in food production. Final product will be obtained by adjusting powder feedstock added to baking vessel with water to be mixed in suitable proportions, holding stirred in temperature and time determined by control-command system. Level will be controlled and followed by non-contact level meter, vessel

capacity is 15 liter. All parts coming into contact with feedstock will be produced from materials that meet the appropriate standards in food production. Powder feedstock in reservoir is charged to system automatically by the drum which rotating around its own axis, incorporating the substance in desired volume when it comes to coincide with the tank end, discharging inside feedstock to baking vessel from its opening. Reservoir fullness will be controlled by non-contact level meter. As it is shown in **Figure 2** there is also a water-chemical charging line connected to the solenoid valve for spot cleaning (CIP) on the reservoir. It is designed to provide the cleaning and rinsing processes suitable with water and chemical in the line with the instructions given by the control-unit.

temperature will be controlled and followed by thermostat and temperature sensor connected to the resistance, stirring speed and activity will be controlled and followed by a frequency controlled electric motor driving. As it is shown in **Figure 3** there is a water-chemical charging line for spot cleaning (CIP) on the vessel. It is designed to provide the cleaning and rinsing processes suitable with water and chemical in line with the instructions given by the control-command unit.

Figure 3: Baking and Holding Unit

C. Bowl Preparation and Presentation Unit

As it is shown in **Figure 4** this unit consists of two electrically controlled valves, a volumetric reservoir among the valves,

bowl filling nozzle at valves end, a bowl magazine, a pneumatically driven bowl receiving unit and a pneumatically driven 180 degree rotating bowl unit. All parts coming into contact with bowl will be produced from materials that meet the appropriate standards in food production.

The product which is ready in vessel will be discharged from first valve to volumetric filling reservoir, then filling is accomplished to bowl ready for use via nozzle channel by opening the valve at the end of the reservoir. In parallel with this operation, via pneumatically driven mechanisms the bowl will be taken from magazine and released to the transfer unit, then centered to filling mechanism. After filling is completed, it will warn that product is ready by removing intermediate cover with customer. Taking bowl and discharging reservoir will be followed by related sensors then cover will be closed and system will be returned to the zero point. Pneumatically driven equipments movements will be followed by sensors suitable today's technology simultaneously, it will be verified that taking bowl and centering to the zero point is come true seamlessly with photocells which reflected from the object as a second control. After the presentation of the reservoir turned off before, it will be checked that any foreign object remains inside with sensors technologies then cover will be closed. To avoid exposure to users from failure will occur in electric electronic, the power of the capping driving device will be restrained by pressure regulator and when it is required, the loss of all propulsion will be provided by putting the 'emergency stop' button on the reservoir. Spot cleaning (CIP) process of volumetric filling reservoir and related valves will be done with vessel discussed in the previous issue.

Figure 4: Bowl Preparation and Presentation Unit

D. Bread Presentation Unit

This unit consists of a bread drum, a cutting mechanism and a transmission channel. Products in this unit as packaged will become, even so all parts of machine was designed from materials that meet the appropriate standards in food production. As it is shown in **Figure 5** after the package, produced in accordance with rotary knife cut into single strand was charged to drum, rotary knife cut drum accomplished cutting process by turning a lap with product presentation, also would have provided necessary action for the next cutting operation when sending a single product to channel. It will be controlled that cutted product is sent to channel and the new one is settled for cut process by photocell technologies.

Figure 5: Bread Presentation Unit

E. Control – Command Unit

As it is shown **Figure 6** this unit is equipped with non-contact distance sensors, photocells which reflected from the object, pressure gauges, motor driving, control cards, user screen, pneumatic drive sensors, pneumatic drive control unit, fingerprint reader or facial recognition system, GPRS communication module, plc system, touch

Primarily the system makes control material. If there is a lack of material, the system will not work. As it is shown in **Figure 7** in the absence of material system will make informed by mail or message with GSM module. If the materials are available, cleaning unit will make control. If cleaning the boiler, the system will begin to purchase materials. Cooking and holding phase will be made after purchase materials. The finished

screen operator panel vb. that provide to control functioning accurately of processes mentioned above. Belonging to high protection class and compliance with the food norms will be considered in all factors.

In control unit, industrial panel will be done with pc. ARM Cortex™-A8, 1 GHz processor is selected for system. IO units will be controlled by connecting to the computer with ethercat protocol. Program of system will be prepared in twin cat language. Material deficiencies in the system can be monitored remotely.

Figure 6: Control Unit Industrial PC

soup material will be poured into the bowl when the request is made with fingers and the system will give users bowl with rotary mechanism. With the arrival of the soup bowl, bread unit will operate and bread pieces will leave into the system. The system will return to deal with the release of bread. Turning to head over if soup is ready finished, the system will flush itself and begin making soup again.

Figure 7: PLC Flow Diagram

F. Auxiliary Systems Unit

Auxiliary systems consists of compressed air generation and transmission, water regulation and distribution, cleaning chemical dosing section. Compressed air generation for pneumatically driven elements will be provided with compressor accordance with the food norms and transmission elements and system operating status will be followed by pressure sensor. Water regulation and distribution is designed to achieved water supply accurately. Cleaning chemical dosing will be provided by transmitting the desired amount of chemical

to water line during the spot cleaning (CIP) processes as it is shown in **Figure 8**.

All systems will be manufactured with chassis and shell that accordance with food production norms and required cover mechanism will be produced for adding bowls from outside. System is designed to give 200 products and bread in one charging then it is necessary to add disposable bowl, powder feedstock, bread and spoon. 1 bread unit capacity is 100, 200 is completed by placing the pieces apart. On the other hand, the sustainability of the system of hygiene for

at least a week out of the CIP system is considered to be a condition of making general cleaning, it is planned to clear cleaning cycle time required with swab analysis will be performed subsequent to the manufacture of prototypes.

Figure 8: Auxiliary Systems

3. Conclusion

With project to be held, a design in the field of mechatronics using electrical, electronic, using a combination of electrical, electronic and computer sciences. It will be held in the social dimension with a machine made design. This machine is intended for use primarily in the social sphere. In previous studies , it is made with ready soup cups but that the serving bowl, making traditional tarhana soup , designed as a social project and fingerprint free running at the same time having self-cleaning and bread unit there is no design. Continuity is ensured by alerts in the project. Continuous operation of the machine will be provided by inspecting material need.

4. References

- [1] Kocakahya, A, Asgari ücretli ailelerin gıdaya ayırdıkları bütçelerin ve gıdaları tüketim sıklıklarının belirlenmesi [Low income families in order to detect their budget for nutrition and the most food they consume] , Gazi University, 2007
- [2] Yılmaz, S, Türkiye’de uygulanan gıda güvenlik sistemleri ve kontrol yöntemleri [Food safety systems and control methods applied in Turkey] , Uludağ University, 2010
- [3] Kahraman, F, İmalat sektöründe kalite güvencesi ve proses kontrol sistemlerinin belirlenmesi [Quality assurance in the manufacturing sector and the determination of process control systems] , Çukurova University , 1994
- [4] Sol,B,” Proses kontrol için çözümleyici ve yorumlayıcı istatistiksel analiz programı [Analytical and interpretative statistical analysis program for process control]”, Marmara University, 2007
- [5] Afşar,E, Proses kontrol eğitim seti ve tasarımı [Process control training set and design], Kocaeli University, 2014
- [6] Birgit Vogel-Heuser, Daniel Schütz , Timo Frank, Christoph Legat, Journal, 5 May 2014
- [7] Becerikli, F, PLC ve SCADA sistemlerinde katı ve sıvıların tartım hassasiyetinin artırılması ve dozajlanması [Improving the accuracy of weighing and dosing of solids and liquids in PLC and SCADA systems] , Fırat University , 2013
- [8] Toraganlı, M, Türkiye’de gıda mevzuatı ve kontrolü [Food legislation and control in Turkey] , Hacettepe University , 1979
- [9] Yılmaz, İ, PID kontrolör ile servopnömatik konum kontrolü [Pneumatic servo position control with PID controller] , Marmara University , 2008
- [10] Kılıç, M, PLC ve SCADA sistemlerinin bir MDF presi dış saha besleme hattına uygulanması [Application of PLC and SCADA systems to the outfield feeder line of a MDF press] , Kocaeli University , 2010
- [11] Turan, Ö, Gıda güvencesi değerlendirmesinde kullanılan yöntemler

- [The methods used in the food security evaluation] , Uludağ University , 2012
- [12] Kılıçaslan, E, Pnömatik sistem elemanları [Pneumatic system components] , Marmara University , 1988
- [13] Güneş, H, Bir pnömatik motor kontrol sisteminin teorik ve deneysel analizi [Theoretical and experimental analysis of a pneumatic engine control system] , Gazi University, 2012
- [14] Sağır, T, Pnömatik motor tasarımı ve prototipinin imalatı [Designing of a pneumatic engine and production of a prototype] , Gazi University , 2006
- [15] Atalı, G, Döner tablalı mekatronik sistemler için tek hatlı çift yönlü haberleşme protokolü tasarımı [Single line half duplex communication protocol design for turntable mechatronics systems] , Sakarya University , 2015
- [16] Ergür, S, Endüstriyel robot rollarıyla 3D modelleme amaçlı benzetim ortamı tasarımı [Simulation environment design for 3D modeling purpose with industrial robot arm], Eskişehir Osmangazi University , 2015
- [17] Hancı, O, Servo motorlar ve örnek bir uygulama tasarımı [Servo motors and a sample application design] , Marmara University , 2007
- [18] Kuzer, K, Ac servo motorlar ve sürücü devreleri [AC servo motors and drive circuits], Yıldız Teknik University , 2006
- [19] Çalışkan, Ö, Çok sayıda servomotor, sensör ve elektro pnömatik eleman içeren tekstüre-büküm makinası otomasyonu [texturing - twisting machine automation including many servomotor, sensors and electro elements] , İstanbul Teknik University , 2007
- [20] Kanat, Ş, Gıda üretim sistemlerinin iş sağlığı ve güvenliği açısından incelenmesi ve önleyici tedbirlere yönelik risk analizlerinin yapılması [Food production systems investigation in terms of occupational health and safety and risk analysis done for preventive measures] , İstanbul Aydın University , 2015
- [21] Erünlü, G, Sabit mıknaatıslı senkron motorların servo uygulamalarında PID kontrolör parametrelerinin otomatik ayarlanması [Auto tuning of PID controller parameters for permanent magnet synchronous motor servo applications] , İstanbul Teknik University , 2014
- [22] Hurma, H, PID kontrolör ve plc uygulaması [PID controller and PLC applications], İstanbul Teknik University , 1998
- [23] Demir, K, PLC ile control edilen endüstriyel bir sistemin cep telefonu ile uzaktan kontrolü [The industrial system is controlled by a PLC with a remote control mobile phone], Gazi University , 2010
- [24] Başkara, H, Bir PLC kontrollü vana işleme hattının tasarımı ve imalatı [Design and manufacture of a PLC-controlled valve processing line] , Gazi University , 2014