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SCADA AUTOMATION OF BREWERIES

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ABSTRACT

The objective of this research is to design low cost SCADA automation system applicable to small and medium industries where frequent monitoring of the data is profitable in introducing efficiency, quality and low production cost to fulfill the domestic demand, export and to provide job opportunities.

Survey through visit of breweries, was made to record the state of the art, bottlenecks in technology and need for automation.

Keywords: *SCADA, PLC, RTU, SENSORS and Breweries.*

INTRODUCTION

Considering the population of India, present and future, there is a growing demand for all kinds of drinks made from tomato, mango, apple, orange, carrot, grape, pineapple in the conventional categories and other new produce with medicinal properties such as Jamun, Amla and Sea Buckthorn (berry) etc.

India is now ready for export of new kind of beverages not available in the international markets without creating local shortage. India has agricultural resources to become a producer of a large range of beverages and enter into international market as a leading exporter. Brewery industries have potential to become leading exporters if they are modernized through automation to produce quality and quantity of beverages at a friendly cost.

Beer is one of the world's oldest beverages dating back to the 6th millennium B.C. Today the popularity of the beverage continues with more than 133 billion lifters sold worldwide each year. The simple process of fermenting a mixture of water, barley and hops has become a $295 billion industry, and almost every country in the world has a stake in making brew as it is a potentially lucrative business. Baltika has recently upgraded its Breweries which is the largest beer producer in Russia with a 41 percent market share and a production capacity of 50 million hectoliters per year.

Paired with the Wonder ware System Platform, a comprehensive industrial software platform for SCADA, HMI and MES applications, Wonder ware Equipment Operations Module provides comprehensive data management. Though early brew houses were fairly primitive and used a variety of methods for making beer, the beer manufacturing process has not changed much since the Industrial Revolution introduced modern methods and tools. Technology from Invensys has made it easier for Baltika and other breweries to more effectively track the production process to manage raw material processing and deliver to market a high quality product. Beer has low alcohol content made from various types of grain. Barley predominates, but wheat, maize, and other grains are also used. The production steps include: 1. Malt production and handling, 2. Wort productions, 3. Beer production

BEER MANUFACTURING PROCESS

Before Malt Extract Production begins, the barley is tested for extract content, extract color, protein content, water content, diastolic powder and grain size. Barley is tipped and conveyed to Silos. Before entering the mills the grain passes through a cleaner and destine. Grain is crushed in a roller mill to produce grist. Grist is mixed with water and heated. For the best extraction, the mash is held for fixed times, known as rests at a series of

specified temperatures. The malt owns enzymes help to convert insoluble starches and proteins to soluble sugars, which dissolve in water to form wort. After extraction, the wort is separated from husks and residues known as "spent grains". Separation is carried out by a natural process using the husks as a filter.

OBJECTIVE OF AUTOMATION

The reduction of 8 to 10 percent in energy usage during the manufacturing process can be achieved to lower its overall operating costs

About 7 percent reduction in steam consumption during the beer manufacturing process can be achieved

The cost of packaging can be also lowered by 2 percent

SCADA automation is an interdisciplinary area of research that includes telecommunication, electronics software, computers and process control. A SCADA system is an automation process system that is used to gather data through sensors and measuring instruments located at remote sites and transmit data to server at a central site. The collected data is viewed on one or more SCADA host computers located at the central or master site. SCADA has two aspects

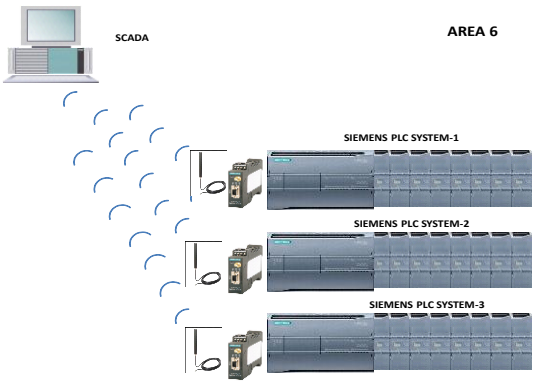

Figure1: Indicates the general layout of SCADA System

AUTOMATION OF BREWERY

Brewery is one of the fast growing businesses in India and highest source of govt. revenue. India has agricultural resources for this product to become a high class revenue producer of a large range and enter into international market as a leading exporter and to do this it would of course need SCADA Automation for:

1. Quality production 2. Fulfillment of the export targets

3. Competitive Industry can introduce new non-competitive drinks made from Rice, Barley, Amla and other crops which grow in abundance and available cheaply. Also some may have *medicinal property.*

STUDY OF BEER

Aditya Goel & Ravi Shankar Mishra [1] have developed an "*integrated wireless SCADA system*" for monitoring & accessing parameters such as temperature, pressure, humidity on real time basis. For this they have used the infrastructure of the existing mobile network, which is based on GPRS technique. Supervisory Control and Data Acquisition (SCADA) is a field of constant development and research they have concluded.

Swati Jayade [2] describes the design, development and analysis of low cost and low power SCADA system for sugar industries in Vidarbha region of Maharashtra. In fact, most of the sugar factories in the Vidarbha region of Maharashtra are 20-25 years old and still using manual settings of process control parameters. Hence, the quality of the end product, i.e. sugar, is not satisfactory and hence profit margin is low. PLC based SCADA is too costly as most of the sugar industries are running in loss and about to be closed. Mahalik [3] reviews aspects of systems, standards and interfaces for the modern food industry. It presents processing and packaging principles, methods, techniques, standards, interfaces, and state-of-the-art technology. The paper covers recent advances in smart packaging materials, the examples of nanotechnology in packaging, material handling systems, application of robotics, non-destructive inspection methods, packaging execution systems (PES), distributed control and automation systems,

traceability, and finally OMAC (Open Modular Architecture Controls) guidelines on software standards and interfaces.

COMPONENTS OF SCADA

Sensor network

A sensor network (SN) is a wireless network of many smart devices, called *Nodes*, which are spatially distributed. The primary component of the node is the *Sensor,* essential for monitoring real-world variables such as temperature, humidity, presence, sound, intensity, vibration, pressure, motion, and pollutants, among others, at different locations of the food plant or store.

Moin Shaikh [4] explores the changing roles of traditional distributed control systems (DCS) and programmable logic controllers (PLC) used to automate cement manufacturing processes. The two technologies initially served two different control requirements. However, improvements in microprocessor-based controllers created conditions for two technologies to merge. The shift toward commercial, off-the-shelf automation technology, software-based control verses hard control and use of non-proprietary networks has created a new class of systems called hybrid Process automation systems…

PLC

PLCs eliminated the need to physically rewire the relay systems as it can now be done by modifying the software. Hence software in the PLC became the brain of the manufacturing process.

PLCs are programmed in ladder logic, which strongly resembles a schematic diagram of relay logic. Modern PLCs can be programmed in a variety of ways, from ladder logic, to more traditional structured programming language C and function blocks that a process control engineer can easily understand, because his view of the plant is in the form of groups, routes, and individual objects such as motors, PID, and diverters.

WOLVERHAMPTON AND DUDLEY'S BREWERY ESTABLISHED IN 1890 IN WOLVERHAMPTON

The technology has changed but the beers and the brewers' yeast remain the same. W&DB has replaced virtually all their manual control of production. The extensive automation for data monitoring and supervisory control system fully utilizes Wonderware's In Touch SCADA and engineering expertise from *Wonder ware UK's Enterprise Support Group [5].*

Quality beverage production

M. Urbano Cuadrado [6] has presented a system for the overall management of the information related to analytical processes and quality control in wineries. It enables the integration of semi-automated and automated analytical processes. It has been developed in Java using the database management system Oracle 9i and can be executed both as a stand-alone program and through a standard Internet browser.

Michael A etel [7] have documented and evaluated the recent trend toward consolidation in the global wine industry. Their main conclusions are as follows. First, the structure of the wine industry is not consistent around the world. This industry provides a vivid example of an industry whose structure varies depending on differences in institutional context and historical patterns of development around the globe. Second, the structure is changing, but not at the same pace in different regions of the world. This seems to be the case because of rigidity in the institutional context in the Old World. Thus, we see that contextual rigidities can serve as a constraint on the changing scope of geographic competition even when powerful economic forces are pushing for global consolidation. Third, consolidations are taking place for economic efficiency reasons, and

perhaps, for some reasons that are not consistent with shareholder value maximization.

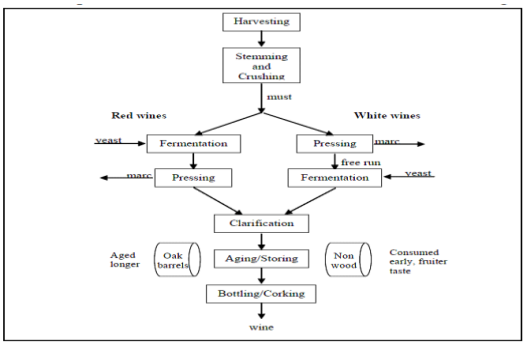

Fig 2: Simplified schematic presentation of the

wine making process

Grape wine

Wine is made from fruits like grapes, berries etc by drying them and later fermenting them. When the grapes ferment the sugar in the grapes convert to alcohol they are available in various colours and textures depending upon the elements present in them. For example, the wine exhibits a reddish colour when the seeds and the skin of the grapes are present during the fermentation process. When it is fermented without any quantity of non-juicy parts they turn pinkish.

The three main categories in wine are fortified wine, sparkling wine or table wine. It is known as a fortified wine when a little brandy is added to enrich the alcoholic content. It is termed as still or sparkling depending upon the CO2 quantity. Table wine is available in a very natural form and is not like the other wine.

Grapes are usually the best ingredients used in the preparation of wine. There is an equal proportion of sugar and acid in them, which cannot be found in any other fruit. High temperature heat is required to dry away the grapes. You must have a thorough knowledge regarding the exact harvesting season. If the harvesting is delayed you may not be able to produce a good quality wine because the level of sugar increases and the acidic extent gets too low.

At the initial stage of processing, the grapes are crushed using a large cylindrical container that separates the juicy part of the grapes in the large bags that are attached. They are then fermented by heating the juicy part. In the process of heating the yeast that is present helps converting the sugar into alcohol and carbon dioxide. Sometimes this solution requires fermentation for the second time due to malic acid present. When the malic acid breaks downs into lactic acid and carbon dioxide, it adds a new buttery flavour to the wine.

The next step carried out is to settle all the particles like yeast cells, or any other material flowing on the top layer. It is then filtered and all the sediments are gathered on the filter. Winery aging is the process where the wine is tightly packed in containers not allowing the air to enter in them for nearly several months and sometimes years. The wine is then transferred in small bottles and sold.

Bottling is done in such a way that it becomes easy to identify the various types of wine. Also colour bottles reduce the chances of damage, oxidation and many other risks.

After buying a wine product it is important to store it in a right place. Usually damp and cool places like underground cellars are more appropriate. There are some underlying principles regarding the storage of wine. Wine should be kept away from external sources like light, vibration and strong odours, which are obviously the barriers to the formation of a good quality wine.

Wine is one of the functional fermented foods and has many health benefits. These include *anti-ageing* effects in red grape skins, improvement of lung function from antioxidants in white wine, reduction in coronary heart disease, development of healthier blood vessels in elderly people, reduction in ulcer-causing bacteria, destruction of cancer cells by protein present in red grape skins, prevention of stroke by keeping the arteries clean by polyphones in red grape skins, decreasing ovarian cancer risk in women and making the

bones stronger. Many wines are made from fruits having medicinal value and such wines have many additional benefits. The exact composition of a herbal product is influenced by the method of extraction. A hot water extract is generally rich in polar components because water is a polar solvent. Oil on the other hand is a non-polar solvent and it absorbs non-polar compounds. Alcohol lies somewhere in between the polar and non-polar compounds.

AMLA WINE

Effect of nutritional and environmental factors on alcohol production S K Soni etel [8]The Amla wine production was standardized by taking *50g Amla berries* in different sets of *250 ml Erlenmeyer* flasks and adding *125 ml boiling watering each. Cane sugar* was added to adjust the TSS at 20% and maintaining the *p*Hat 4.5 with citric acid. The effect of nutritional factors was studied by supple-menting the production medium separately, with various nitrogen sources (0.5% w/v) including ammoniumsulphate, urea, diammonium hydrogen phosphate, malt extract, yeast extract, soya bean meal, corn steep liquor, peptone, metal salts (0.1% w/v) including magnesium sulphate, calcium chloride, sodium chloride, potassium chloride, zinc sulphate, potassium dehydrogenate ortho-phosphate, amino acids (0.01% w/v) including alanine, phenyl alanine, tyrosine, tryptophan, ornithine, threonine, aspartic acid, proline, serine, valine, arginine, leucine, lysine, glutamic acid, glycine, methionine, histamine, cystine and vitamins (0.01% w/v) including thiamine, riboflavin, nicotinic acid, pantothenate, biotin, niacin, pyridoxine, folic acid and-complex. The effect of *temperature* was studied by incubating the Amla based production media, after inoculation, at different temperatures including 25, 30, 35, 40 and 45oC. The effect of TSS was studied by adjusting the solid content in the production media at 10, 15, 20, 25, 30 and 35% with cane sugar.

Wine production with repeated fed-batch fermentation

This was studied by taking *1kgof Amla berries* and dispensing in *2.5 l of boiling water* and adjusting the initial TSS of the production medium at 20%. The batch was repeatedly fed twice with sugar syrup (70% TSS) after the TSS of the medium reached 10% after 3 and 6 days of fermentation, respectively, to readjust the TSS to 20% at each of the two stages.

It is concluded that Amla berries can be used as a valuable ingredient for the production of *herbal wine* with all the important properties of wine having medicinal characteristics of Amla fruits.

All the useful natural components of Amla, Indian gooseberry, *Emblicaofficinalis* Gaertn., with therapeutic value, can be easily extracted in water after dispensing the berries in hot water. Ameliorating the extract with the sugar made it a good medium for the growth of *Saccharomyces cerevisiaein* and fermenting the sugar into ethanol to make wine. *The wine was found similar to any other wine in terms of its composition, taste and aroma.*

DISCUSSIONS

This paper discusses techniques of automation applied to breweries. Survey shows that in most cases in India and abroad modernization of breweries through automation has been sought to introduce economic and efficient production to make this industry most competitive in the world market. Russian brewery supplies a large percentage of their product to the world and since after their automation a few years ago they have been able to generate profits due to improving quantity, target delivery resulting in higher sales. Automation has not only been introduced in production but also in marketing and stock taking in the warehouses.

UK has also introduced automation recently and literature review in the earlier section indicates their progress. It is hard for the Indian breweries to enter the international market with various

types of hard drink because of popularity and the existing brand names such as Scotch whisky, Vodka, Guinness Beer and other popular brands of beer, wine etc... However, Indian industry has to choose the unbeaten path of the product-ideas. Though manpower is cheaper in India yet automation process not only produces quality at lower cost but introduces efficiency and production targets which are necessary to fulfill the demand when generated.

CONCLUSIONS

This paper focuses some novel raw materials for wine which not only gives a new taste but also keeps the consumer in good health by providing antioxidant in the wine or beer, and high source of vitamin C and curative effects in some ailment. In this category of new raw material for wine, one of the most desirable is Amla (Indian goose berry), which is full of health benefits. This does not only grow in a large quantity in India but remains unutilized. Jamun for brewing wine is another raw material in the above category which has the health benefits of controlling the diabetes.

The SCADA automation recommended here is based on the latest technique and system and sub system like PLC, RTU etc... Future research can be carried on the process of wine production from Amla, Jamun and Mahua.

REFERENCES

i. Aditya Goel & Ravi Shankar Mishra, Remote Data Acquisition Using Wireless SCADA System, *International Journal of Engineering (IJE) Volume (3): Issue (1) 58*

ii. Swati Jayade, *International Journal of Computing and Corporate Research IJCCR India* Design, development and analysis of low cost, low Power SCADA system for sugar industry based on\ Atmel can networking MCU 89c51cc03: a case Study.

iii. Nitaigour P. Mahalik, Processing and packaging automation systems: a review in Sens. & *Instrument Food Qual. (2009.) 3: 12–25 DOI 10.1007/s11694-009-9076-2*

iv. Moin Sheikh, **(**Company: Siemens Energy & Auto-mation, Inc.) Cementing the relationship between DCS and PLC: *A review of emerging trends in plant control systems, 978-1-4244-3698-9/09/$25.00©2009IEEE*

v. Wonderware's In Touch SCADA and engineering expertise from Wonder ware UK's Enterprise Support Group.

vi. M. Urbano Cuadrado An Information System for Quality in Wineries (The Open Information Systems Journals, 2008, 2, 17-23.

vii. Michael Aetel the Changing Structure Of The Global Wine Industry (International Business & Economics Research Journal Volume2

viii. SK Soni1*, Namita Bansal1 and Raman Soni2 Standardization of conditions for fermentation and matu ration of wine from Amla (*Emblicaofficinalis* Gaertn.) Natural Product Radiance, Vol. 8(4), 2009, pp.436-444