Application of the Industrial Automation Standards and Methodologies for Reliable and Continuous European Food Traceability System

Received 23rd March; accepted 31st March.

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Abstract:

Recent traceability requirements create necessity of organization of the food production process in the completely new way. This way of production organization is typical rather for large industry, than for traditional way of work at the rural areas. This fact generates tensions as well as resistance of the farmers, especially farmers working in traditional way.

This paper presents new ideas of industrial application of automation standards and methodologies for reliable, robust and user-friendly food traceability system. Due to the high level of automation and application of industrial IT solutions together with multimodal data transmission, presented traceability system can be implemented in traditional food production farms and operated intuitively by personnel without specialized training. As a result application of presented system will significantly reduce tensions and resistance connected with implementation of new technologies in traditional food production farms.

Keywords: *food traceability, transportation monitoring, telemetry.*

1. Introduction

Nowadays food producers on the European Market need to fulfil very diversified requirements. These requirements are connected with quality control systems such as ISO 22000 incl. HACCP, ISO 9001/9002 and ISO 14000 [1]. Moreover, producers have to strictly follow different European Directives. It should be indicated that there are at least 17 different directives, including Directive 64/433/EEC (Fresh meat), Directive 71/118/EEC (Poultry meat), Directive 92/46/EEC (Milk and milk products) or Directive 93/43/EEC (Hygiene of foodstuffs). Moreover, producers have to also fulfil local law and standards, e.g. in Poland milk must fulfil requirements of PN-93/A-86034/03 standard.

As a result food production for many European enterprises seems to be more legal and dministrative than technological problem [1]. Moreover, this problem is very important especially for SMEs – companies up to 100 employees as well as for farmers producing food in the traditional way. For example administrative and legal problems were reported as the most painful problem for „BIALUTY" Company, leading producer and exporter of potatoes from Mazovia region.

As a result development of the technical solutions supporting proper application of quality standards and directives seems to be one of the most important task for engineers and quality assurance specialists [2]. These solutions are necessary to ensure competitiveness of small and medium enterprises. Moreover in the EU new member states and candidate countries, which are recently introducing EU directives and quality standards, development of specialized IT systems for this purpose may create possibility of avoiding bad practices together with cost reduction. It should be indicated, that costs of implementation of IT solutions supporting quality management and traceability systems for SMEs may be partially covered by structural funds.

2. Integrated production monitoring and traceability system

The most important idea from the point of view of system development is connected with the fact, that all quality systems and legal requirements are based on the similar data from the process of food production [1]. As a result IT system integrating data from production process and generating reports accordingly to the needs, can cover requirements of all quality systems (HACCP, ISO 9001 etc.) as well as may generate reports connected with directive's requirements. It should be indicated, that such automated production monitoring and traceability systems are widely used in large industry, especially between car and electronic equipment producers.
An example of the structure of production monitoring and traceability systems for food production SME is presented in figure 1.

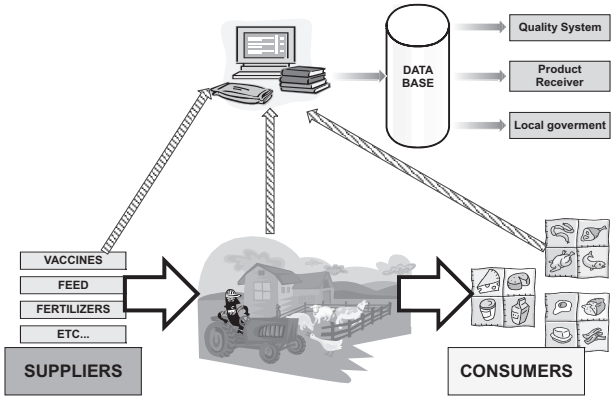

Fig. 1. General diagram of the structure of food production monitoring and traceability system in SME.

Presented system has to integrate:

- data on input of the process, such as data about feed, fertilizers or vaccines. These data may be determined by scanned bar codes of containers with raw materials.
- data from the food production process, including process parameters as well as unexpected or extra-

ordinary events. This part of system is typical for production monitoring systems well developed in other areas of industry.
- data on the output of the process such as numbers and content of containers together with data of the recipients of the food.

On the other hand it should be indicated, that food production monitoring and traceability system must be extremely reliable, due to the fact, that it contains very sensitive data. Malfunction or collapse of such system would lead to significant economical losses for the company, due to problems with fulfilling of the legal requirements for the production.

Moreover monitoring system has to be user-friendly, because users at the rural areas have very limited IT background. This feature of the system may be provided by automatization of the system, including application of the bar-code scanners or RFIDs. Moreover, automatic system operation would reduce labour-consume and cut running costs of the SME.

Third problem connected with practical application of the food production monitoring and traceability system is connected with the fact, that such system has to be very flexible, to fulfill different legal requirements and requirements of different quality systems. Moreover these requirements may be modified during the time of system operation. As a result it is necessary to ensure of the possibility of system remote servicing – to enable updates due to the changes of user needs or legal requirements.

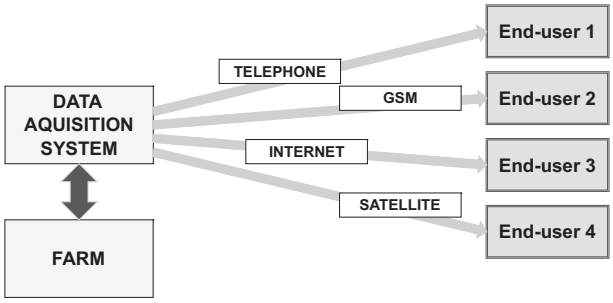

Fig. 2. Simplified flow of the information in the proposed system.

In figure 2 the simplified flow of the information in the proposed system is presented. Generally food production in the company is distributed on the large area. As a result so data transmission is the most important (and the most sensitive) part of food production monitoring and traceability system. To provide satisfactionary level of reliability and to reduce running costs of system operation, combined modes of data transmission have to be applied. These modes have to cover the low power radio, GSM/GPRS, Internet and satellite data transmission.

3. Data transmission modes: possibilities and threats

Each mode of data transmission has it own advantages and disadvantages. These features of data transmission methods have to be considered by both users and constructors of food production monitoring and traceability system to guarantee its optimal use.

Low Power Radio transmission is based on the well-known and reliable technologies. It is cheap, everyone can use it, there are no running costs, and transmitters are cheaper each year, user-friendly and malfunction resistant. Well known is also flexibility of the LPR transmission systems where different configurations are possible, as well as easy integration with sensor and measuring equipment. A disadvantage could be only small range of radio transmission, which is operating up to few hundred meters [3].

Service called GPRS (General Packet Radio Transmission) is a break through solution in data transmission via GSM network. The most important feature is charging not for the time of handled connection but the amount of transferred data. Next new feature is possibility of connection “one to many” instead “peer to peer“, which was only available in traditional systems. Next advantage comparing to traditional CSD (Circuit Switched Data) mode used in e.g. telephone modem connection, is avoiding a need of proceeding a long and complicated procedure for data channel establishing [4].

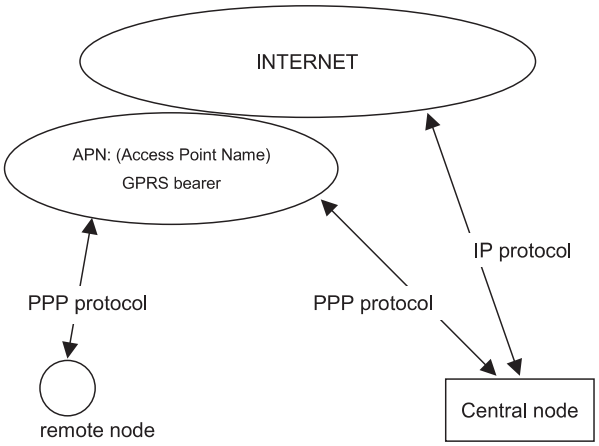

Fig. 3. Schematic block diagram the GPRS data transmission from the remote to the cental node [4].

The above-mentioned features create new possibilities for utilization of GPRS transmission in monitoring systems where data is transmitted relatively rarely, in small amounts. Schematic block diagram the GPRS data transmission from the remote to the cental node is presented in figure 3. As it is presented, data transmission via GPRS utilizes similar technology to transmission via Internet. With GPRS, the information is split into separate but related "packets" before being transmitted and reassembled at the receiving end. Packet switching means that GPRS radio resources are used only when users are actually sending or receiving data. Rather than dedicating a radio channel to a mobile data user for a fixed period of time, the available radio resource can be concurrently shared between several users. The other advantages of GPRS data are: flexibility, not limited by distance, which is long opportunity for development of pan-European systems, low price-transmission on 20 km costs the same as transmission on 1000 km, reliability when reaching GSM operator is possible. It should be men-

tioned as an disadvantage that some rural and not urbanized areas are not covered by GSM network.

Satellite communication is based on the few satellites placed on the circumeaerth orbits. Round-the clock communication between any two points on the Earth (beyond the polar area) provide three stationary satellites, located on angular distance 120° at the altitude 35 800 km. Normal transmission in case of the movable vehicles is working on the 12/12/14 GHz band [5]. Surely the advantage of the satellite data transmission is its reliability, because it is the most advanced technology in data transmission science. Figure 4 presents range of the currently working satellites. It is clearly shown that the satellite IOR covers all Europe. Europe is also partially covered by AOR-W satellite. The possible problem of such kind of applications could be only the high price of the modules as well as price for the continuous transmission.

Transmission via Internet is cheap, fast and reliable from every place on the earth. It is also very easy to use for each final user because of that aggregated data can be presented on every WWW browser anywhere on the world. Main disadvantage of this way of data transmission ais necessity of the specialized infrastructure. However this disadvantage is constantly reduced due to wide application of cable-less networks such as WiFi (according to IEEE 802.11 standards) networks.

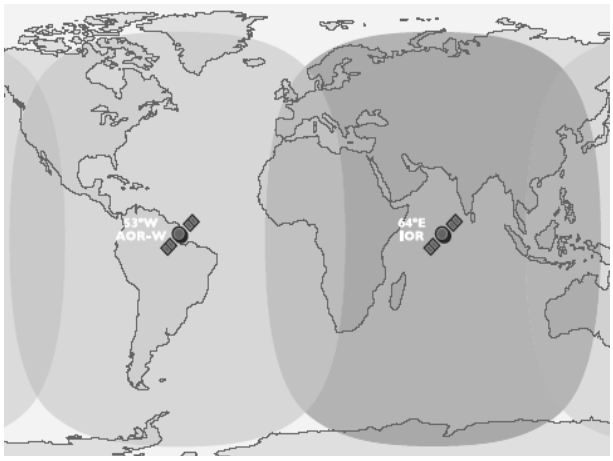

Fig. 4. INMARSAT satellite data transmission system coverage [6].

4. Conclusion

Food production for many European enterprises starts to be more legal and administrative than technological problem. This problem is very important especially for SMEs. As a result the development of the technical solutions, supporting proper application of quality standards and traceability directives, seems to be one of the most important tasks to ensure competitiveness of small and medium enterprises in the EU and on the global market.

All quality systems and legal requirements are based on the similar data from the process of food production. As a result IT system integrating data from production process can generate reports and cover requirements of all quality systems (HACCP, ISO 9001 etc.) as well as it may generate reports connected with directive's requirements.

Data transmission is the most important (and the most sensitive) part of food production monitoring and traceability system. To ensure its reliability and cost-effectiveness, different (and combined) modes of data transmission should be carefully considered.

ACKNOWLEDGMENTS

This work was partially supported by the Polish Ministry of Science and Higher Education and by German Ministry of Science and Education.

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