THE AUTOMATION OF THE PRODUCTION LINES

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Abstract: *The overall objective of the project is to develop an intelligent system for monitoring the components of the production line in real time and to help the operator to assemble the equipment by indicating their number and order in the production flow. The development of monitoring systems is a very important topic both domestically and internationally.*

Simultaneously with the emergence and specialization of monitoring systems, the barriers between human operators and the control system, between the world of computers and programmable automata, between technology and the automation system were removed. In this paper I want to describe a topic of great interest due to the tendency of companies to gain control over the resources they use in order to reduce the costs generated by the excessive consumption of components and the incorrect assembly of equipment. Due to the employees' lack of focus or fatigue, various errors can occur in the production flow, leading to a significant loss in terms of time, profitability and quality.

Keywords: *electric, components, systems, automation, equipment, production flow*

1. INTRODUCTION

The electronic products industry is characterized by a fast pace and maximum competitiveness, being essential the ability to combine high standards of quality and constant precision with high productivity, low production costs and fast process times. Offering immense flexibility in a wide range of manufacturing processes, automated solutions make it relatively easy to obtain this synthesis.[1]

Lean manufacturing is today one of the most successful strategies for improving the competitiveness of organizations. Lean is based on the philosophy, concepts and tools of the Toyota Production System (TPS), but it all started in 1913 with Henry Ford and the streamlined assembly line of the famous T model.[2]

A recent study by the National Institute of Standards and Technology - Manufacturing Extension Partnership in the United States concluded that a correct implementation of Lean Manufacturing techniques and methods can generate important benefits: • Reducing unfinished production by up to 90% • Reducing process cycles by up to at 95% • Increase productivity by 10-40% • Increase quality by 25-75% Lean is an integrated approach to using human, material and financial resources to produce exactly what is required, when required and in the required quantity, using the minimum of materials, equipment, work and space.

A first list of classic wastes was sent to us by the Japanese, the 7 "muda" (muda = wasted), which we are now trying to enlarge. The seven classic wastes, identified by the initiators of the Lean methodology are: overproduction, stocks, defects, over processing, transportation, waiting, movement, people.

In the manufacturing process, on the production lines, the lack of an overview of the ongoing stages and processes can lead to significant losses. Moving components, structural elements, raw materials are constantly changing in the manufacturing process. Human error is a real factor that must be taken into account. The quantity of scrap, or returned product is inversely proportional to the quality level of the production system and production supervision.[3]

2. THE NOVELTY OF THE PROJECT

The novelty of this project is characterized by:

• the implementation of the system on a model consisting of boxes of independently monitored components;

• the introduction of RFID mode for traceability of electronic equipment;

• a much lower cost than in the case of current systems.

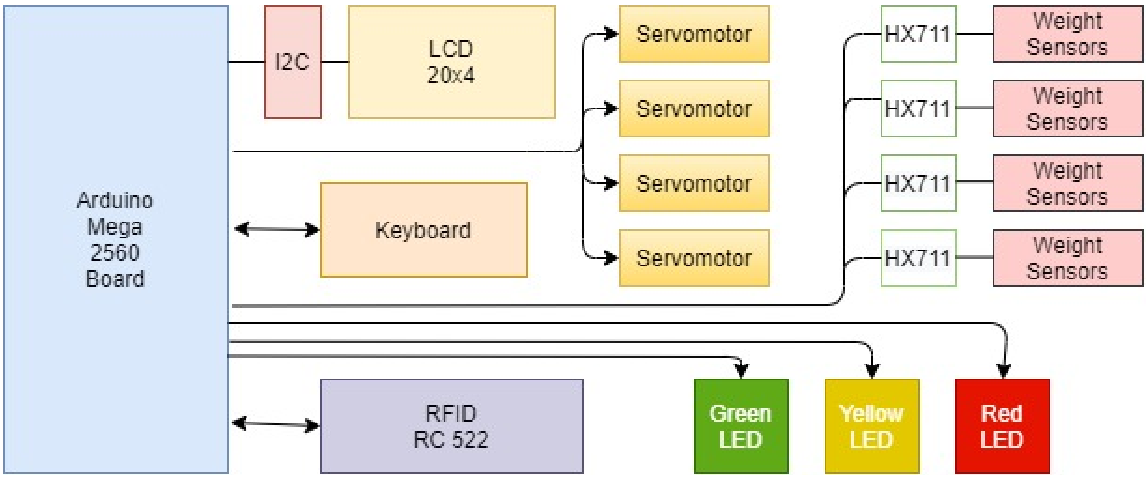

FIG. 1 Electronic circuit diagram

Traceability means in the very strict sense of the word, the ability to review the path taken by a product on manufacturing processes and technological flow based on the "traces" left behind. Traceability is a solution for consumer protection, but it is also a control tool and delimitation of liability. If a product or a larger quantity of electronic products has failed, the manufacturer through a traceability system has the ability to verify whether the reason is a general one related to the whole batch or a batch. Or it is a well-defined specific situation and the cause of this incident must be investigated at the distributor: the way of storage and handling, the way and circumstances of presentation, exposure, etc.

The objective of traceability is to obtain total control over the products by individual and group identification (batch or batch) in order to be able to intervene if after the manufacture a defect or inconvenience of the product is found.

Through a traceability system related to the product or goods we receive answers to the following questions:

1. when? where? from what? how much was produced? by whom? who worked and at what stage of production on that product?

2. when? where ?, what quantity? by whom was it stored? how long did that product stay in the warehouse?

3. when? where? by whom? what? What quantity was delivered?

For the practical achievement of traceability, a common language is needed to ensure continuity and unity on the distribution chain, beyond the limits set by the information systems specific to each company. All traceability items must be identified by either labeling or marking. Each item must have a unique, global identifier. Then follows the step of aligning the basic information, in which each factor must obtain the unique global identifier.[4]

In the traceability information recording stage, it is determined how to allocate, apply and capture the identifiers of the items included in the traceability process and how to select, collect, share and store traceability information during the physical flow. This is the stage in which the identifiers are effectively allocated and applied, as the physical flow of processes is achieved, and the information contained in them is captured.

3. SENSORS

The recent development of electronics and integrated circuits offers new possibilities for many practical applications and leads to new discoveries in the field of sensors. The sensor can be generally defined as a sensitive device that detects a certain phenomenon. The sensor is a device that detects a phenomenon. The term sensor is widely used and is associated with that electronic component that allows the measurement of a physical quantity. In fact, the sensor senses a certain phenomenon, receives and responds to a physical stimulus. It is the device at the input of the measuring system.

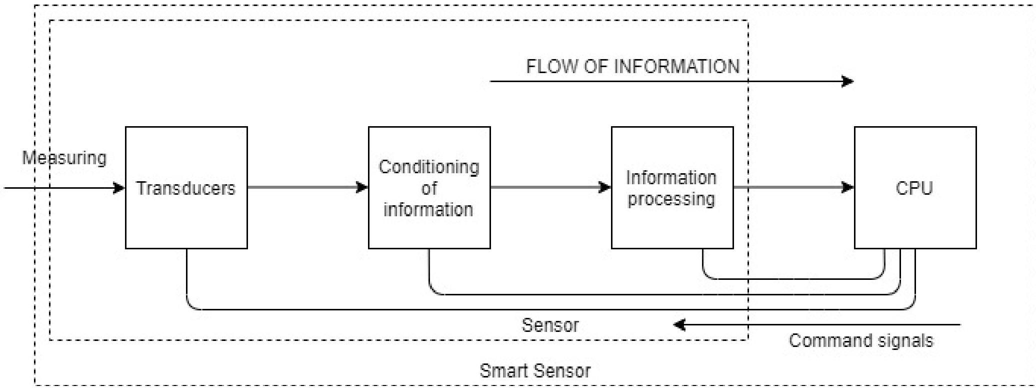

FIG. 2 Structures of sensory systems

The most requested and important sensory function is the visual one, which ensures the preponderant amount of information, having the highest transfer speed (cc.3.106 bits/s). Sight facilitates man almost all actions to investigate the environment - identifying objects and their configuration, position and orientation, appreciating distances.

Devices Used

1. Weight sensor
2. Module HX711
3. Display LCD 20X4
4. Module I2C
5. Sevomotors
6. Keypad 4X4
7. Module RFID RC522
8. Leds
9. ARDUINO MEGA 2560 [5]

4. ELECTONIC CIRCUIT DIAGRAMS

Electronic Diagram of the Circuit

The electronic diagram of the circuit, Fig. 3, shows the diagram of the electronic circuit of the monitoring system of the components on the assembly line. The power supply of the circuit is made from a 9V battery or a 5V direct current source through the Arduino Mega 2560 development board.

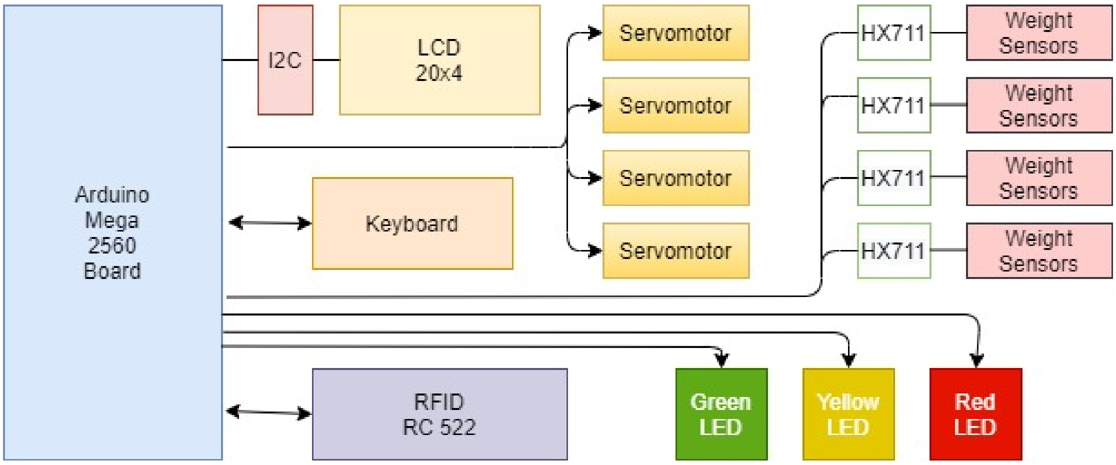

FIG. 3 Electronic diagram of the circuit

To make the circuit we used an Arduino Mega 2560 development board to which we connected four weight sensors connected separately to the Arduino through the HX711 mode which converts the analog signals transmitted by the sensor into digital signals for a much higher reading accuracy. For the display I used a 20x4 LCD connected via I2C and three LEDs of different colors. On the data entry / reading side I used a 4x4 matrix keyboard and an RFID RC522 module, and to help the operator in the assembly flow and the exact indication of the component to be assembled I used a servomotor.

Block Diagram of the Weight Sensor

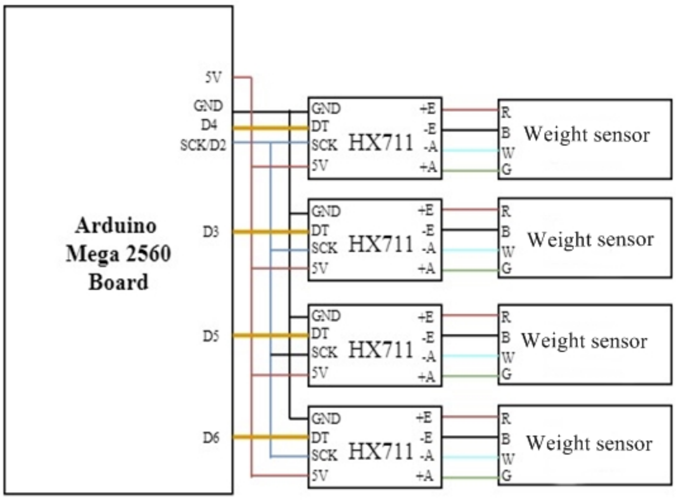

FIG. 4 Block diagram of the weight sensor

To identify and monitor the number of components we used a weight sensor for each box. The weight sensors are connected to the arduino via the HX711 module. It helps to increase the measurement sensitivity due to the conversion of analog signals into digital signals at a resolution of 24 bits. The HX711 modules are powered by a 5V voltage from the Arduino, and the sensors in the module. The data pins are different for each module, sharing only the SCK, because there must be the same clock signal on the entire circuit. The red wire from the weight sensor connects to the + E pin on the module, the black wire to -E, the white wire to -, and the green wire to + A.

Block Diagram of Servo Motors

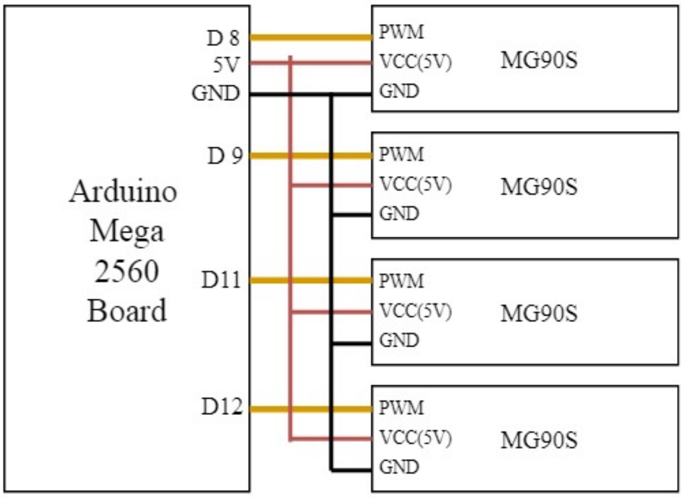

FIG. 5 Block diagram of servo motors

In the application were selected as execution elements of the process of lifting the lids of component boxes. For the connection of the servomotors, they have three wires of different colors. They usually represent: • brown = GND • red = VCC (5V here) • orange = servo signal (PWM) MG90S toretically has a range of position variation of 180º in both directions, 90º on one side and 90º on the other hand, but the tests performed and the information provided by the product talk page indicate that it cannot rotate more than 160º. To obtain the maximum range of variation it is necessary to introduce a servo controller which, in the case of this paper, was not included because it involved additional costs.

Block Diagram for LCD

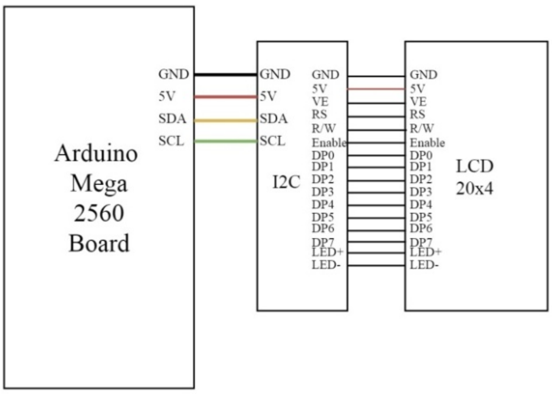

FIG. 6 Block diagram for LCD

Figure 6 shows the wiring diagram of the connection between the Arduino and a 20x4 LCD. The LCD is used to present to the operator at the assembly table the number of components in each box. It is connected via I2C because it is a simple mode of communication, in the sense that it requires only two wires of communication, and allows the connection of as many devices (with different addresses). Each I2C device has an address that may or may not change. For the Arduino Mega, digital pin 20 is SDA pin and digital pin 21 is SCL pin.

Block Diagram for RFID

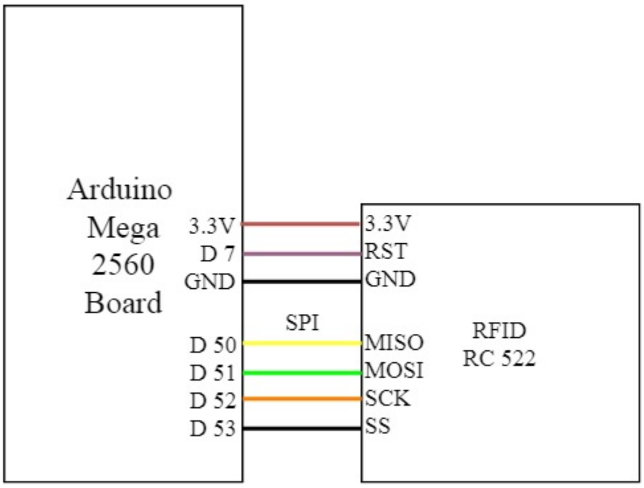

FIG. 7 Block diagram for RFID

For an easier and faster use of the system I chose to connect an RFID module through which to read certain commands with the help of cards. It is connected to Arduino via SPI. SPI is a way to communicate with master-slave devices. One device is master, usually Arduino and the other devices are Slavic. SPI communication is done using four channels: • MISO - the wire through which the slave devices send data to the master • MOSI - the wire through which the master device sends data to the slave • SCK - the wire through which the clock is transmitted • SS - this channel is specific SPI, and it's interesting.

Keyboard Block Diagram

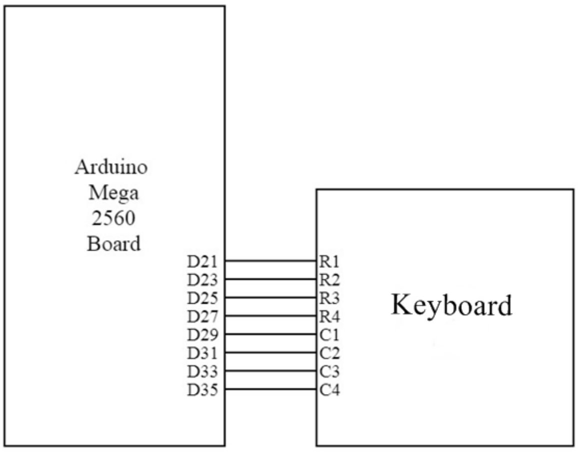

FIG 7 Keyboard block diagram

Figure 7 shows the connection of a 4x4 matrix keyboard to the Arduino. With the help of the keyboard you can enter the commands necessary for the operation of the system. The keyboard consists of four columns and four rows, so every time a button is pressed, the column and row of that button are shorted, and the processor realizes what character it should display. For example, the second and second rows are short-circuited for the "5" key.

Block Diagram for LEDs

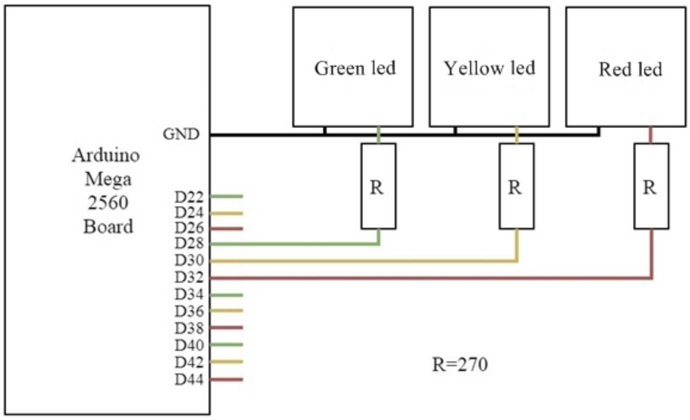

FIG. 8 Block diagram for LEDs

For a more suggestive indication of the number of components in each box we used three LEDs of different colors, green, yellow and red. I connected them to the digital pins of the Arduino using a 270 ohm resistor and defined them as output voltages.

Through this project I want to implement a system for monitoring components on the production line and indicating the next step in assembling electronic equipment. Each box will be prepared for a type of components, because with the help of the weight sensor I will identify the number of components. To avoid mixing components in boxes, each type of component is accompanied by a unique identification code. Entering this code on the keyboard will open the box specific to that component.

5. CONCLUSIONS

The purpose of the project was to develop a monitoring system for components in the assembly line to facilitate the production flow. In addition to this monitoring system, a way has been implemented in which the operator is helped to assemble the electronic equipment correctly. When scanning an order, it appears on the monitor which components must plant and the respective order. The following graph shows a situation of the number of incorrect assembly defects before the implementation of the system for a period of 15 weeks. After the installation of the system in week 16, following some analyzes on the production line a value that tends to 0.

REFERENCES

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[5]https://docs.google.com/viewer?a=v&pid=sites&srcid=dWxic2liaXUucm98bGF1cmVhbi1ib2dkYW58Z3 g6ZmFmMDg4YjM1YzdjNjk2.