JIEE Časopis priemyselnej elektrotechniky
Journal of Industrial Electrical Engineering
ISSN 2454-0900
www.jiee.eu

The design of automated production line

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***Abstract* — The paper solve, design of part of automated production line. The basic parts of the model include a tray, a vice and a conveyor. All of the parts was designed in software Pro/DESKTOP. After creating the final design of the entire system, individual components will be printed by the 3D printer.**

***Keywords* — automated production, automation, microcontroller, electric actuator**

I. Introduction

Our system will be customized on a CNC milling machine. By creating an automation line, we can automatically replace and fix workpieces. The system will ensure greater production efficiency, as reflected in the financial cost of production and reduce the need for human services.

II. AUTOMATION

Automation is the stage of technology development, which is characterized by the implementation of production, management and other processes without direct human intervention, associated with the discovery of automatic production lines (1920s), automatic plants and plants, using modern computing and control technology (since the 1950s). Automation does not exclude the complete involvement of a person who controls and generally controls the work of machines (machine setting, program entry, material supply, maintenance), although these functions are increasingly taken over with the development of machine automation. [1]

Automation is the penetration of knowledge in various fields: electrical engineering, engineering, informatics. It integrates them and creates more effective management of technological processes. Automation creates opportunities to rapidly increase labor productivity, increase production, reduce costs, and improve product quality, and increase production management efficiency. All this ultimately results in higher labor productivity and a reduction in human labor (and thus the resulting errors) in production. [1]

III. The needed hardware components for the production line

A. *Electrical motors*

An electric motor is an electrical device that converts electric current into mechanical work, respectively. For mechanical motion - rotary motion (rotary motor) or linear motion (linear motor). Electric motors use the physical phenomenon of electromagnetism, but there are also motors based on other electromechanical phenomena, electrostatics, piezoelectric phenomenon and the like. [2]

The basic principle of electromagnetism is the mutual force acting of electromagnetic fields generated by electrical conductors through which the electric current flows, respectively. The interaction of these fields with the magnetic field of the permanent magnet. This force is called the Lorentz force. Each electric motor consists of two basic parts - a static or non-moving part - of a stator, and a movable part of a (usually rotating) rotor. In a conventional rotary engine, the rotor is positioned such that the magnetic field generated in the rotor conductors and the stator magnetic field exert a torque transmitted to the machine rotor. This torque then causes the rotor to rotate, the motor rotates to perform mechanical work. [2]

B. Optical sensors

An energy beam emanating from an energy source hits the object, from which it is reflected and is placed on the detector by the optical system. The optics of the transmitter and receiver ensure that the light passes through a small area called a sensitive zone. If the object is outside this area, the beam is not reflected, so the detector does not receive any energy and no signal is generated. The optical sensor detects the amount of reflected light incident on the optical detector. Specifically, the amplitude or light power level is measured and compared to the desired value. This allows you to measure distance but also incorporate other optical parameters such as contrast and colour. [3]

C. Nucleo f446re

The NUCLEO-F446RE is a STM32 Nucleo-64 Development Board with STM32F410RB microcontroller. The board provides a flexible way for users to try out new ideas and build prototypes with any STM32 microcontroller line, choosing from the various combinations of performance, power consumption and features. The Arduino™ connectivity support and ST Morpho headers make it easy to expand the functionality of the STM32 Nucleo open development platform with a wide choice of specialized shields. The board does not require any separate probe as it integrates the ST-LINK/V2-1 debugger and programmer. The board comes with the STM32 comprehensive software HAL library together with various packaged software examples, as well as direct access to mbed online resources.

- USB VBUS or external source (3.3V, 5V, 7 to 12V) and power management access point
- USB communication (LD1), user LED (LD2), power LED (LD3)
- Two push buttons - USER and RESET
- USB re-enumeration capability - virtual com port, mass storage, debug port
- Supported by wide choice of IDEs including IAR™, Keil®, GCC-based IDEs

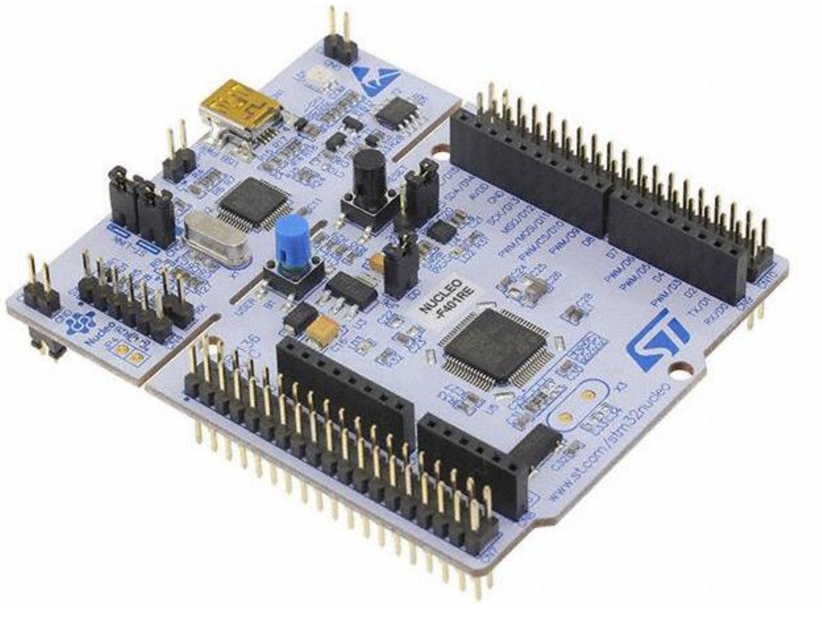

Fig. 1 Nucleo F446RE [4]

Nucleo will be programmed in the online Mbed system. Mbed is a device management platform that includes an operating system for IoT (Internet of Things) systems using microcontrollers (MCU) with a 32-bit Arm® core. One of its most popular aspects is the online compiler, which offers the ability to quickly start developing various applications for Mbed OS. The IDE is entirely online, free, and well documented with an active community to provide support to newcomers. Still, Mbed is much larger than just the compiler itself since there are also cloud services and TLS (Transport Layer Security) solutions to secure communications, among other things.

IV. 3D MODEL PARTS OF AUTOMATED LINE

The production line model will consist of a tray, a conveyor and a vice. The tray will be powered by the stepper motor which consist from the circle there will be protrusions in which will be placed 4 kinds of workpiece for processing. The circle will rotate. When you enter a number on the keypad 1, 2, 3, or 4, the motor-driven circle turns to the position of the selected number. A motor-driven runner is placed in a spur in a circle. After stopping the circle at the given position, the engine that controls the runner is started. The runner selects one of the bodies placed in the protrusions. The body with the help of the slider is transported to the position where the optical barrier will be placed. By switching the signal, the motor stops and the next motor that controls the vice starts. The vise jaws move at the same speed as each other. A button is located on one of the jaws. When the body is clamped, the button is closed and the motor that drives the vise is turned off. The body is ready for working. After processing, the jaws of the vise expand and the runner transports the workpiece into the bin.

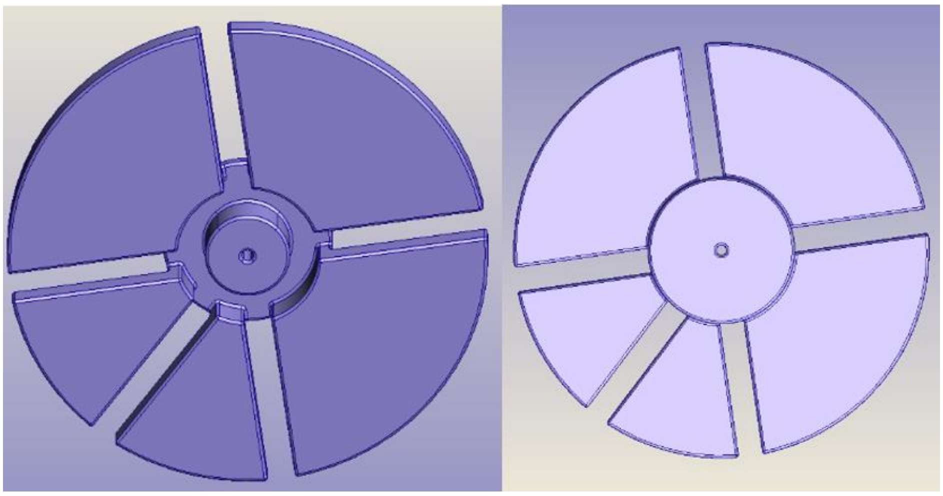

Fig. 2 The bottom of the rotary tray

In Fig. *2* we can see the design of the circle that will be rotated by the motor. Four types of workpieces will be placed on the circle. The trolley will move through the groove. One protuberance will return and, depending on the position of the circle, the rider will select one of the four kinds of workpiece from the protrusion.

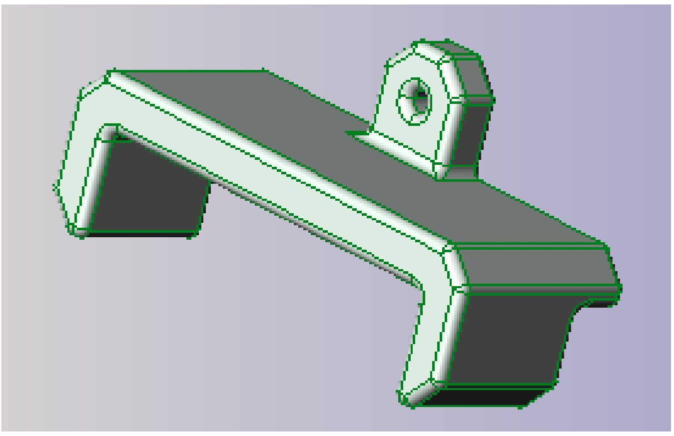

Fig. 3 The workpiece holder

In Fig. *3* we can see the design of holder, in which the workpieces will be placed. The projections will be placed on a circle two opposite each other on four carriage ways.

In Fig. *4* we can see the vise design. The threaded rod is connected to the motor. Under the jaws there will be a structure that will serve to prevent the vise jaws from rotating with the threaded rod. The threaded rod has a left-hand thread on one side and a right-hand thread on the other. When turning the threaded rod, the jaws will move evenly towards each other and apart.

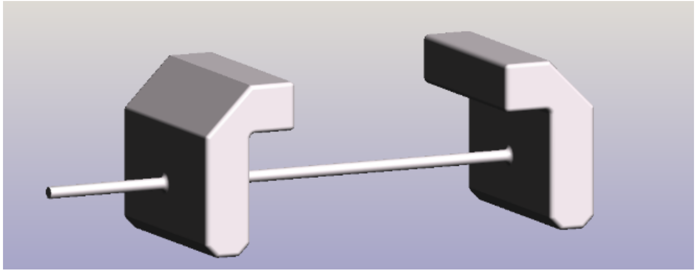

Fig. 4 The part of a vice

V. Conclusion

During the design model of an automated production line, we were able to draw on and use the knowledge of electrical engineering, informatics and engineering. These three sectors had to be merged to create a functional model. This work, we have created the introduction to our automated line that will be gradually extended to other implementation of the system.

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