Using Microcontroller for Intelligent Production Control System

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Abstract – Computer-aided solutions have become indispensable due to the effective use of both software and hardware units. Computer-aided production is indispensable for today's industry as it can use software and hardware units effectively. One of the most important components of smart hardware systems is microcontrollers. Microcontrollers are widely used in smart electronic systems due to their low cost, small size and programmability. In this study, a microcontroller-controlled smart electronic system is designed to count and pack the products produced by a machine that produces metal products. This machine, which produces metal products, is controlled by the designed electronic system. Production control in the electronic system is carried out with a microcontroller. PIC18F4550 microcontroller is used in the designed electronic system. Pic C programming language was used to prepare the microcontroller software. With the keyboard module designed for the electronic system, the number of products that the machine should produce can be adjusted. In addition, the operator can follow the production process of the machine from the LCD screen placed on the electronic system. The products produced by the machine are detected by the inductive sensor connected to the microcontroller and the microcontroller calculates the number of products produced. When the number set by the operator and the number calculated by the microcontroller are the same, the production of the machine is stopped. Production starts again when the operator places a new work order on the machine.

Keywords – Microcontroller, Inductive Sensor, Control System, Smart Electronic Systems, Inductive Sensor

I. INTRODUCTION

Computer-aided systems are often used in variety of fundamental operations such as product counting and faulty product control in serial production lines. Such systems, which are often used to determine if there are any missing products in the line, operate at high performance and offer considerable advantages over a control made by an expert. Since these controls by an expert usually cause faults, computer-based quality control systems are more preferred in today's industry. Computer aided approaches are very important in today's industry. Computer technologies used in quality control systems are of high importance in terms of fast, smooth and accurate control of the products in a line. Given the problems of classical control methods, the significance of the concept of computerized control will be understood more clearly [1]. Computerized control of electronic devices is aimed in today's technology. Because of this need, some special microprocessors have been produced. The PIC18Fx series microcontrollers are manufactured by Microchip Technology. PIC18F2550 and PIC18F4550 series microcontrollers have the ability to communicate with the computers over the USB connection. Using these PICs, any hardware connected to computer via USB can be controlled. The data from the hardware can be processed and saved in computer [2]. Increasing the labor mobility, labor

market transparency and productivity in direct relation to employees' ability to find and change jobs are all the more important in employment [3]. Magnetic sensors are passive sensors than can perceive the changes that metal such as iron bring to the magnetic field of the earth [4]. Inductive sensor detects the presence of approaching metal object without contact. Inductive sensor creates a magnetic field in its own detection range. A metal object entering the detection range triggers this magnetic field. This trigger is processed in the electronic circuits of the sensor and changes the output signal of the sensor. Thus, the presence of the metal object entering the detection range is determined. This output signal informs the main control of certain system. An example of this is the approach of a metal tool to the inductive sensor, sensor's detection of the approach and the change to the output signal, the evaluation of the output signal by a control unit such as PLC and the sending of the stop command to the electric motor that moves the metal tool [5]. In this study, a 18F4550 microcontroller system is designed for controlling and counting the products of a metal producing machine that are detected by inductive sensors.

II. Materials and Method

In the studies metal production control system, the software prepared for PIC18F4550 microcontroller were written in PROTON BASIC programming language. Printed circuit boards were prepared with the ARES printed circuit program in the Proteus Professional software package. In addition, the microcontroller codes and the principles of the integrated parts were tested with ISIS Professional which is an electronic simulation program [6]. During the test phase, printed circuit boards were prepared using the ironing method in a workshop environment. After the desired results in the test phase, the mass production of the printed circus boards was prepared to the professional firms.

A. Implementation of the Designed System

The designed system consists of three basic modules. The first module is the mainboard module which is the brain and the controller of the system [7-9]. The PIC18F4550 microcontroller is included in this module. Number of products produced and the value set by the operator is constantly compared and when the desired amount of product is produced, the production stops until a new job order is issued. The second module is the keypad module that the operator controls the system. The operator enters the desired number of products via this module. The third module is the machine that produces metal products. An inductive sensor is placed on this machine. The microcontroller counts the products by reading the data it receives from this sensor[10].

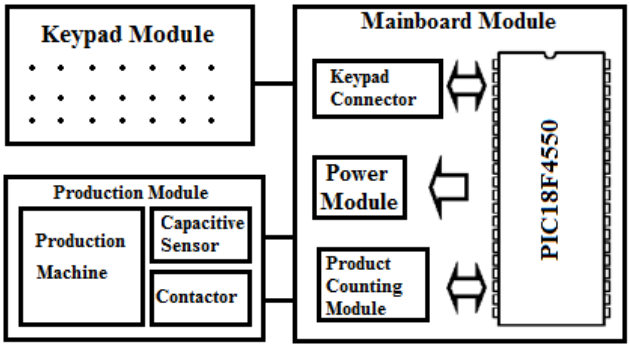

Fig. 1. Block Diagram of the Designed System

B. Mainboard Module

This module provides control over the designed system. It receives commands from the keypad and reads the sensor data that is coming from the production module. When the desired number of products produced, it stops the machine by closing the contactor. The PIC18F4550 microcontroller used for this module. The data that the operator programmed via keypad and the number of products produced is saved in the internal EEPROM of the 18F4450 microcontroller. In this way, even if the electricity goes out during the production, the production can continue from where its left. The operator can also see the number of products produced at the time via LCD display on this module. This display also allows operator the monitor the status of the system. If there is any error during the production, the error message is displayed on this display.

C. 18F4550 Microcontroller

This microcontroller is the brain of the designed mainboard module. The software for The Metal Production Control System is installed on this microcontroller. The pin structure of the PIC18F4450 microcontroller is shown in Figure-2.

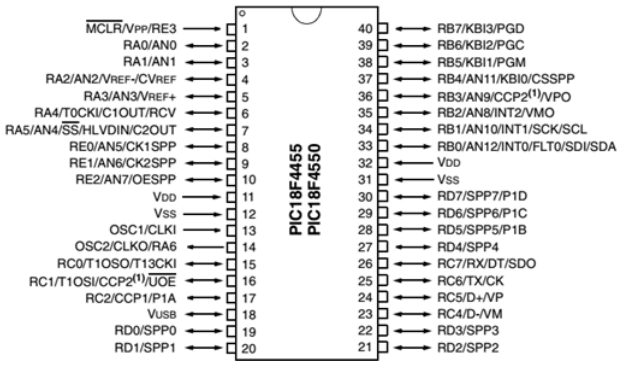

Fig. 2. Pin structure of Pic18F4550 Microcontroller [11].

D. Keypad Module

The number of products that the machine should produce is programmed via this module. A keypad with 16 buttons and letters and numbers is designed for this module. This model is inspired by the keypads on the mobile phones. For example, button with the number '2' should be pressed 3 times for entering the letter 'C'. The block diagram of the designed keypad is shown in Figure-3.

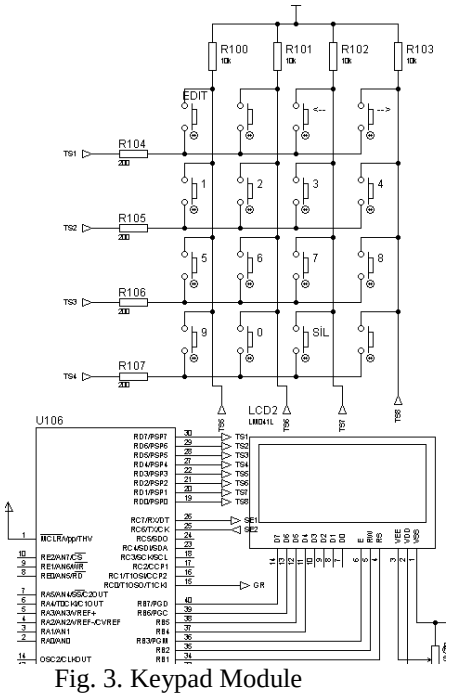

Fig. 3. Keypad Module

E. Production Module

The production of the products is done with the machine used in this module. The capacitive sensor placed on the machine detects each product produced by the machine and generates a "1" signal. Since the sensor used is 24V, the sensor generates a 24V signal every time it detects a product. The NPN transistor is used in the motherboard module to read this 24V signal. When number of products produced is reached to the value the operator programmed, the mainboard module stops the production by closing the contractor in the production module. When the operator orders a new job, production resumes.

III. RESULTS

In this study, a system which counts and controls the products produced by a machine that produces metal products is designed and explained. In this way, the designed circuit can do the counting of thousands of products. The circuits designed for the product counting system have been tested in the workshop environment. After hardware and software problems during the testing were solved and the system reached the desired final state, the system was tested on real machines. Very successful results have been obtained for calculating the number of products produced. As a result of the tests, the usability of the designed system was observed.

IV. DISCUSSION

In future studies, a computer-controlled electronic system will be designed instead of a keyboard module to control more than one machine. Thus, the products produced by each machine will also be recorded.

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