(REVIEW ARTICLE)

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Atmega328p microcontroller based biometric starting system design for caterpillar D3k dozer heavy operators

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Abstract

Heavy equipment industry is an employment sector with potentially high rate of accidents, which might occur due to the operator's own fault, where he or she does not have competence in operating such an equipment. This operator's fault accident ranks number two after that of the mechanic's accident rate, which is the focus of this research. In line with the latest digital electronic development, companies have been able to solve problems confronted with operators, one of which is through the application of biometric authorization device, which has been expected to be able to reduce the rate in the industrial accidents in heavy equipment rental. This device works by requiring authorization of the operator without inserting the manually inserted ignition key to the machine, but the operator's fingerprint that has been authorized into the system to operate such a machine. This, in turn, Will be able to reduce risks of getting an accident among operators.

Fingerprint has its function to recognize the operator's identity as well as password to the electronic Ignition key to the machine that not everybody can get access to operating the machine to start it up. Design of this electronically control device is to produce biometrically engine start-up replacing the currently recognize Ignition switch to crank and switch off the engine using microcontroller ATmega328P system. Results of the study gained from the tests based on the standard operating procedures show based on the standard Operating procedures show a 100% success without any obstacles.

Keywords: Biometric; Starting system; Microcontroller; Fingerprint

1. Introduction

The development of science and technology will give birth to various solutions to solve human problems. Problems that arise, due to limited human abilities or from other factors, are now gradually being overcome. One of the solutions that can help human problems is by using a computer-based control system. One of them is a starting system that uses fingerprint authorization. Biometrics is a method of proving and automatically recognizing the identity of a person based on finger strokes. Fingerprint biometrics has a very high level of accuracy, because it is stated that almost all individuals do not have the same fingerprints. The fingerprint security system is very good to apply. With fingerprint authorization, only authorized persons can turn on or operate the device/vehicle. Several previous studies have been carried out by making fence locks using the ATmega328P Microcontroller-Based Fingerprint [1]. Likewise, research on access control of room doors using fingerprints based on ATmega 328P [2] and access control of room doors using fingerprints based on fingerprints were developed with android smartphones [3]. And even safe door security using fingerprint sensor and digital password with ATmega 19 microcontroller [4].

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2. Research Method

The research method in this journal makes use of existing journals and references from the website, so that the data in this journal does not necessarily correspond to the actual situation. This method is called the literature method.

3. Literature review

3.1. Fingerprint

Fingerprint is a form of biometrics, a science that uses the physical characteristics of a population to identify. Fingerprints are ideal for this purpose because they are cheap to collect and analyze and they never change, even with the age of the person.
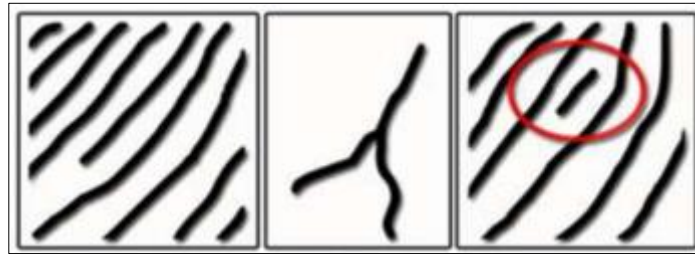

Figure 1 Fingerprint

Although the hands and feet have many jagged areas that can be used for identification, fingerprints are becoming a popular form of biometrics because they are easy to classify and sequence. They are also accessible.

Fingerprint technology is one of the most secure ways because fingerprints cannot be manipulated. Fingerprint has been proven to be quite accurate, safe, easy and convenient to use as an identification when compared to other systems of the retina of the eye or DNA. This can be seen in the characteristics possessed by fingerprints, among others [7]:

- Perennial nature, namely the scratches on fingerprints that are attached to human skin for life;
- Immutability, ie a person's fingerprints never change, except getting a serious accident;
- Individuality, fingerprint pattern is unique and different for each person.

These three properties, fingerprints can be used as an identification system in information technology applications such as:

- Access System Security, namely access to enter a certain area or certain limited room;
- Authentication System, namely data access that is confidential and limited.

Simply put, fingerprints work by "recording" someone's fingerprint, then storing their signature pattern. Identification is done by matching the data that has been stored. If stated equal, automatic access opens. Fingerprints consist of many prominent lines that tend to be circular. This can be seen clearly, one of which is when we make fingerprints using ink for official letters. From there it can be seen, just one fingerprint has many complex patterns. If all these patterns are used, the fingerprint identification process will take too long. On the other hand, if the pattern taken is too simple, the scan may be less accurate. As a solution, the scanner only captures and stores three types of patterns in fingerprint strokes. The pattern is taken from the part where the ink on the fingerprint looks thicker. The patterns include the ridge ending, bifurcation, and short ridge-like lines. The three details in these fingerprints are never the same in humans.

3.2. Arduino Uno

A microcontroller is a small computer device that has the form of an IC (Integrated Circuit) chip and is designed to perform certain operations. In essence, a Microcontroller IC consists of memory (RAM and ROM), at least one Processor Core (CPU) and programmable OUTPUT INPUT holes.

In its use, the Micro Controller is used in products or devices that are automatically controlled such as medical devices, car engine control systems, electrical equipment, remote controls, toys and devices that use other embedded systems.

Figure 2 Arduino UNO microcontroller

Because of its ability to reduce the size and cost of a product or design, the use of this microcontroller is increasingly popular when compared to designs that are built using a microprocessor with memory and separate input and output devices.

3.3. Fingerprint Scanner

Figure 3 Fingerprint Scanner

Finger scanner sensor is an electronic device that is used to capture a digital image of the fingerprint pattern, the image is called a live scanner. Live scanning is a digital processing to create a biometric telplate that is stored and used for matching. This is an overview of some of the more commonly used fingerprint sensor technologies.

A fingerprint scanner system has two jobs: it takes a fingerprint image, and decides whether the fingerprint path pattern of the captured image is the same as the fingerprint pattern in the database. There are several ways to take a picture of a person's fingerprint, but one of the most widely used methods today is optical scanning.

At the heart of optical charge coupled device (CCD) scanners, the same light sensor system is used in digital cameras and camcorders. A CCD is a simple array of light-sensitive diodes called photosites, which generate an electrical signal in response to photons of light. Each photosite records a pixel, the tiny dot that represents light and shapes it. These pixels form light and dark pillars of a fingerprint scanned image.

4. System Design and Discussion

An overview of the device scheme is shown in Figure 4. It consists of several input components, namely a finger scanner and a power switch, then the signal will be processed by a microcontroller processor as a control component that will send information to output components such as relays.

For more detail on the working principle of the designed equipment, a flow chart is hereby made as shown in Figure 5 below.
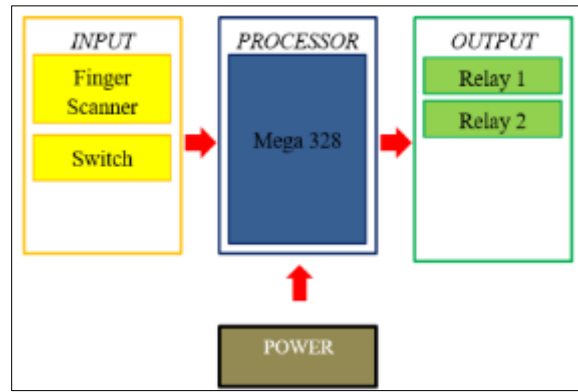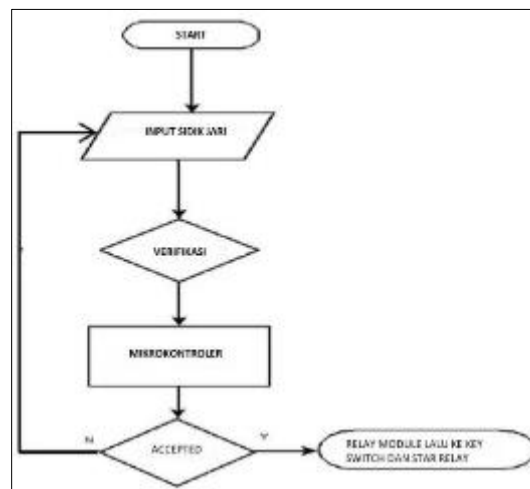
Figure 4 Block Diagram System Design
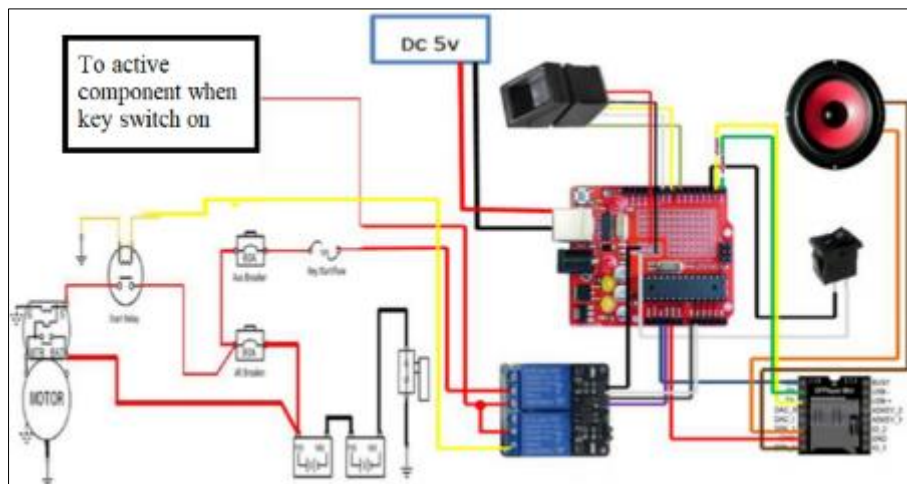

Figure 5 Flowcart Diagram

Figure 6 BSS circuit schematic and D3K starting starting unit system

The parameter model used is a fingerprint which will be read by the optical sensor from the fingerprint module which then converts the captured finger strokes into a coding form that can be read by the microcontroller, if the fingerprint is correct or has been registered and has authority, the microcontroller will send a signal to 2 relay modules which then

it will disconnect from connecting the electric current to the key switch and start relay, and if the finger read by the fingerprint module is wrong or has no authority, a warning will appear in the form of a sound.

In order for the tool that is made to control the D3K heavy equipment unit to turn on and activate the starting system, a scheme for D3K electricity is needed. The circuit scheme must be able to disconnect and connect electricity to the key start switch and neutral start relay. The disconnection and connection of electricity to the key start switch and neutral start relay is controlled by the microprocessor via a two-channel relay module. Here is the circuit in Figure 6.

4.1. Fingerprint Reading input data

Fingerprint recording can be done after entering coding into the microcontroller. There are several programming processes in the manufacture of this tool, namely: program/coding of fingerprint registration and reading, coding of warning sound, coding of fingerprint module.

4.2. Test Result and Error Analysis

Test result with Oscillator Frequencies 16 MHz are displayed in table 1.

Table 1 Test Result with Oscillator Frequencies 16 MHz

| Baud Rate (bps) | f_{osc} = 16.0000MHz | | | |
| | U2Xn = 0 | | U2Xn = 1 | |
	UBRRn	Error	UBRRn	Error
2400	416	-0.1%	832	0.0%
4800	207	0.2%	416	-0.1%
9600	103	0.2%	207	0.2%
14.4k	68	0.6%	138	-0.1%
19.2k	51	0.2%	103	0.2%
28.8k	34	-0.8%	68	0.6%
38.4k	25	0.2%	51	0.2%
57.6k	16	2.1%	34	-0.8%
76.8k	12	0.2%	25	0.2%
115.2k	8	-3.5%	16	2.1%
230.4k	3	8.5%	8	-3.5%
250k	3	0.0%	7	0.0%
0.5M	1	0.0%	3	0.0%
1M	0	0.0%	1	0.0%
Max.[1]	1Mbps		2Mbps	

1. UBRRn = 0, error = 0.0%

5. Conclusion and Suggestions

This biometric starting system can be applied to all types of heavy equipment using a 10 Ampere key switch system. With this technology, it is expected to minimize traffic accidents due to operators who do not have a permit or have not received competency training beforehand.

It is hoped that this biometric starting system technology can be applied throughout the mining industry using vehicles that have a risk of experiencing a traffic accident. Especially Light Vehicles (LV) that drive on the houling lane which have a very high risk of accidents if the driver is inexperienced and does not go through the competency training process to get simpler.

Compliance with ethical standards

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