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MODULAR SMART ELECTRONIC SWINGHANDLE WITH REMOTE CONTROL BASED INTERNET OF THINGS (IOT)

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Abstract: *The traditional mechanical locks used in the industry are starting to leave their place to electronic lock models in which user input and output information can be monitored, remote authorization can be provided and lock status can be monitored with the developing technology. Due to the priority of security in lock systems, the need for electronic locks, which are safer than mechanical locks, has increased even more. The electronic swinghandles are especially preferred in usage areas such as data centers, server rooms and telecommunication cabinets. In this study, it is aimed to remotely control electronic swinghandle locks and monitor their open/closed states thanks to the Internet of Things (IoT) based smart control system via mobile application and/or web application.*

Key words: *Electronic Swinghandle Lock, Industrial Lock, Internet of Things, IoT, NodeMCU, Smart Lock.*

1. INTRODUCTION

The Internet of Things (IoT) is an emerging global Internet-based information architecture facilitating the exchange of goods and services. The IoT has the purpose of providing an IT-infrastructure facilitating the exchange of "things" in a secure and reliable manner, i.e. its function is to overcome the gap between objects in the physical world and their representation in information systems. The IoT will serve to increase transparency and enhance the efficiency of global supply chain networks [1-10].

Smart swinghandle locks provide a good model for IoT architecture, because of they can connect without cable to the gateway and to communicate with each other and with users. Some examples of smart door lock applications already existed, such as camera-based cabinet security systems [2-6], electronic locks with password [3-9], electronic locks with smart card [4-7] and locks with proximity or location detection [5-8].

The ultimate purpose of this research is to control an electronic swinghandle lock system, which can be opened safely and without any contact, with a control module created using IoT technology, unlike applications such as card reader, keypad, fingerprint reader used in the current system. In line with this target, an electronic swinghandle lock with Internet of Things based smart control system has been developed. The electronic swinghandle lock control system will be operating via the web and the mobile app.

2. USED AND DESIGN OF THE PROPOSED SYSTEM

Fig. 1. System Communication

The modular smart electronic swinghandle system with remote control based IoT include the below units:

- Modular Electronic Swinghandle
- Mobile app
- Web app
- NodeMCU (Control Unit)

The communication of the whole system is shown in figure 1 theoretically.

2.1. Application of Swinghandle Lock System

The variety of data centers global is growing at a fast charge as each business and individuals generate more data than ever before.

However, the huge quantity of critical data saved in a data center makes them popular goals for safety breaches. It is for this reason invincible to put into effect a comprehensive, incorporated, and solid safety answer in an effort to deter intrusion, decrease risk, and permit rapid response withinside the case of an incident.

Electronic swinghandle lock solutions help to keep under control the data security by allowing access to cabinets to be recorded and users to be given special access [11].

2.2. System Algorithm and Workflow

As shown in Figure 2, IoT-based control unit to operate the electronic swinghandle lock in system operation;

- Checks the required network connection and IP settings.
- If the information is correct, it proceeds to the next verification.
- If the information is not correct, it continues to query until it is verified.
- The authentication token created by the mobile application is compared with the token defined in the firmware of the control unit.
- If the unique authentication token and the token defined in the swinghandle lock's control system do not match, the lock cannot be operated in any way from the mobile application.
- If the tokens are matched, the system connects to the application and the swinghandle lock is ready for remote control.

Due to the unique authentication token, the security of the lock is ensured.

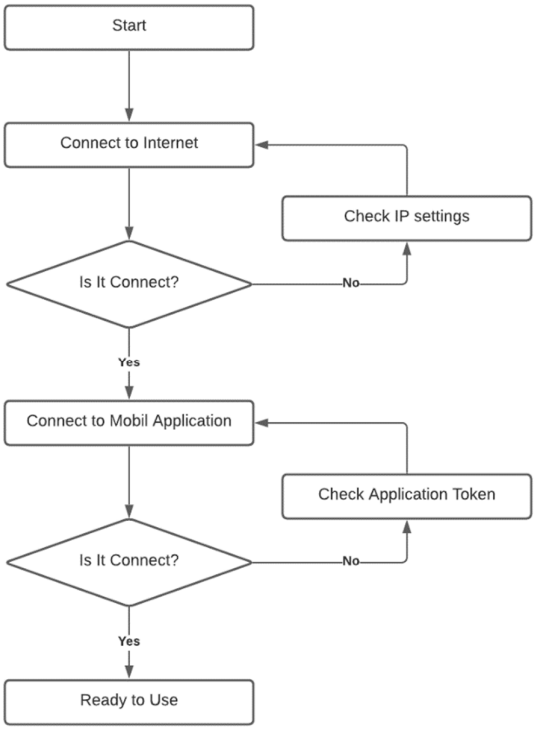

Fig. 2. System algorithm flowchart

2.3. The Hardware Design of the System

NodeMCU was chosen as the microcontroller to be used in the control unit, as it is easy to use and has a built-in Wi-Fi module. As seen in Figure 3, the 12 Volt source has been reduced to 5 Volts with a regulator to supply the microcontroller and the electronic swinghandle lock.

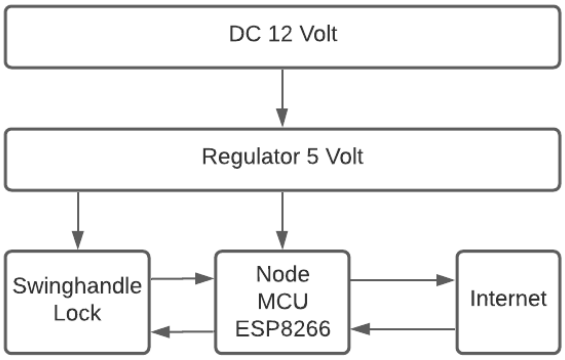

Fig. 3. Block Diagram of the Swinghandle Lock Control System

As indicated in figure 5, Atmel atmega328p model was chosen as the microprocessor in the PCB of the electronic swinghandle lock. There are pins for bootloading and programming. PCB has been completed with motor driver circuit, reed switch, regulator circuit and peripheral components.

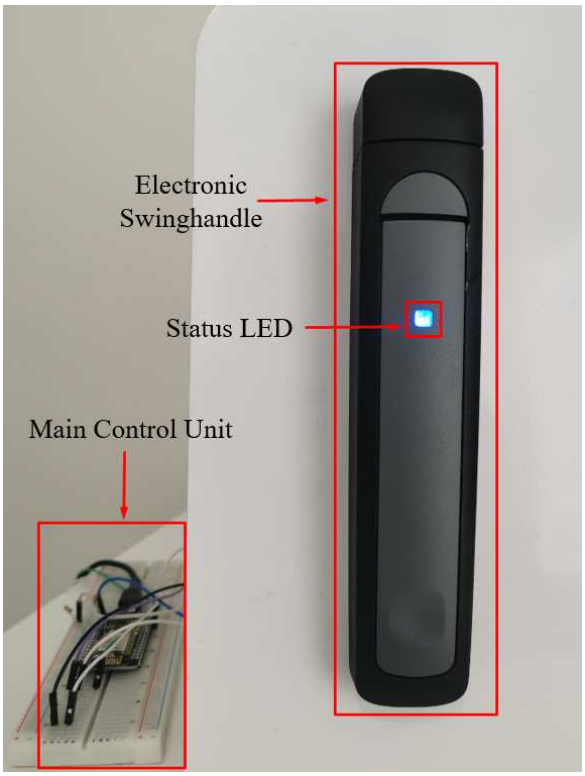

Fig. 4. Application of our system

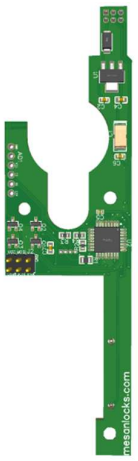

Fig. 5. Electronic Swinghandle PCB

Connection which between electronic swinghandle lock and NodeMCU is as seen in figure 6, The supply voltage of the electronic swinghandle lock is 12VDC ~ 24VDC, and the NodeMCU supply voltage is 5VDC. Electronic swinghandle lock has a regulator. The handle position of the lock is read from the 1st pin of the electronic swinghandle lock. An unlocking signal is sent to the lock from the 4th pin.

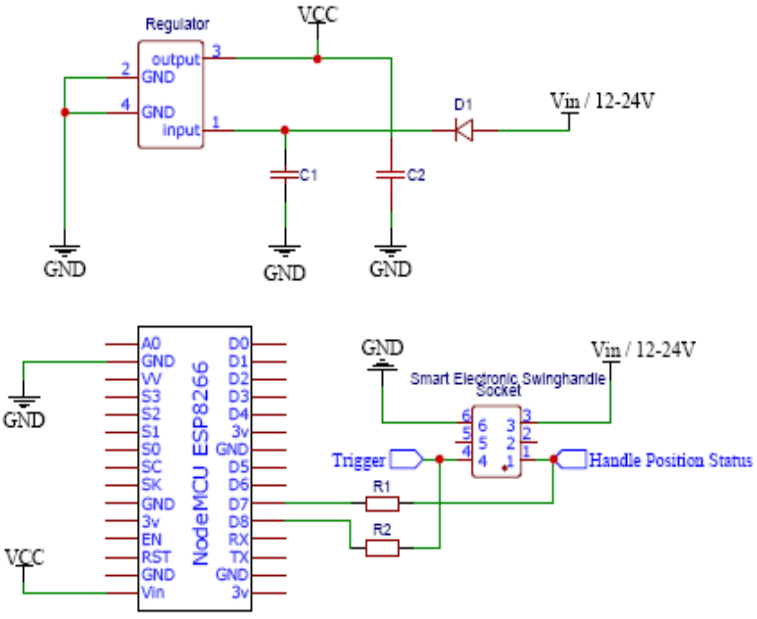

Fig. 6. Schematic of modular smart electronic swinghandle with remote control based internet of things

The Software Design of the System

It has been mentioned in the previous sections that NodeMCU is preferred in the control system of the electronic swinghandle. In order to program NodeMCU in Arduino IDE, necessary hardware files have been installed and adjustments have been made. ESP8266WiFi.h and BlynkSimpleEsp8266.h libraries were used to control the Wi-Fi module. Some setup codes are as shown below.

- char auth[] = "Unique Auth Token";
- char ssid[] = "Wi-Fi_name";
- char pass[] = "Wi-Fi_password";
- Blynk.begin(auth, ssid, pass);

The mobile application allows sending unlock signal and monitor the swinghandle position of the lock. As seen in Figure 7, when the "open lock" button is pressed, the unlock signal is transmitted to the lock. After the handle is opened, the “handle open” indicator lights up. When the handle is closed again, the “handle closed” indicator lights up. The application is suitable for increasing the number of locks. After the NodeMCU relates to the application, the button and led controls are provided with the below codes.

- Bylink.virtualWrite(DO1,HIGH);//Button defining
- WidgetLED led1(V1);//Led1 defining
- WidgetLED led2(V2); //Led1 defining
- if (digitalRead(reedSwitch) == HIGH) {
- led1.on();
- led2.off()}
- else {
- led2.on();
- led1.off();}

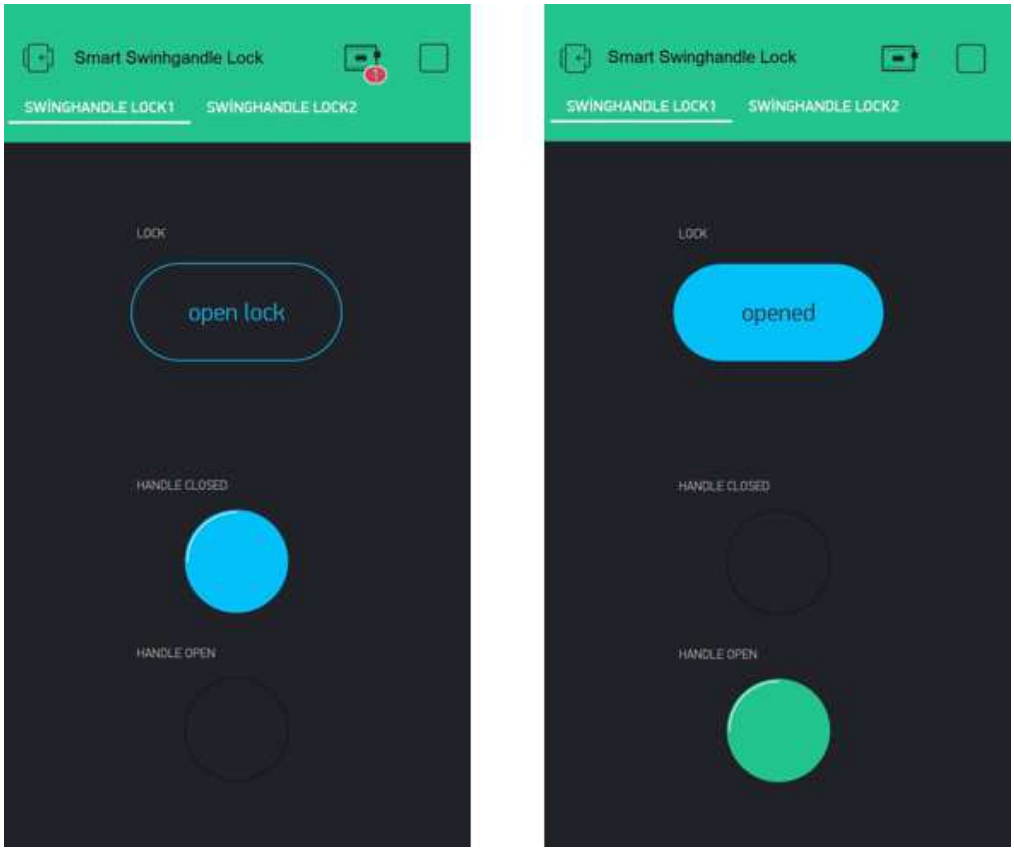

Fig. 7. Mobile application screenshots

The control system of the electronic swinghandle lock can also be operated via the web browser. In the web application, login is made with the user password, not with the Auth token. In applications with high security, web application control can be removed. In order to log in to the web application, the IP address which the control system is connected to is written to the browser. When logging in, the previously determined verification code is requested. If the password is correct, the system is logged into. In the same way, when the button

is pressed in the web application, the unlock signal is transmitted. After the handle is opened, the "handle open" indicator lights up. When the handle is closed again, the "handle closed" indicator lights up (Figure 8).

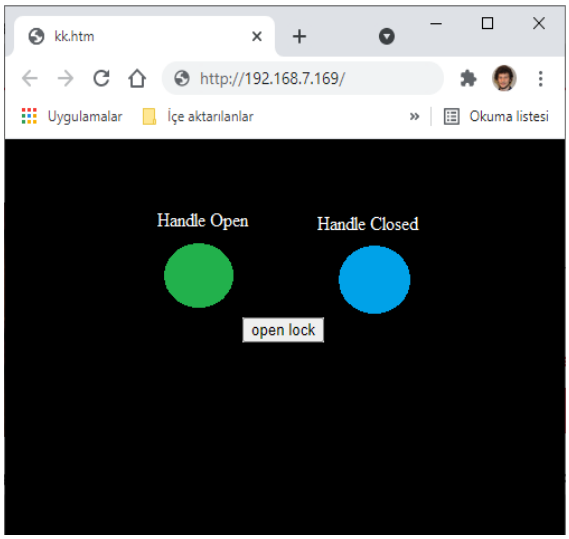

Fig. 8. Web Application

3. CONCLUSION

In this paper, the design of an IoT-based remotely controlled electronic swinghandle lock system is described. In this system, the swinghandle lock can be controlled from the web and mobile application and the handle status of the swinghandle lock can be monitored. It is possible to connect and control multiple locks to the system.

Locks can communicate with each other and see each other's status. With the results of the study, an ergonomic system is presented while providing the lock control of the last operator. The final operator is provided to unlock without the need for a card, key or physical contact.

In addition, since the number of cables in the cabinet is decreased, both the ease of installation and the possibility of failure due to wiring are reduced.

In the next phase of the work, we aim to integrate the modules we use for IoT on the control system into the PCB of the swinghandle lock that we designed and make the locks smart on their own.

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Încuietoare electronică inteligentă modulară controlată de la distanță folosind Internetul lucrurilor (IoT)

Rezumat: *Încuietorile mecanice tradiționale utilizate în industrie încep să lase locul modelelor de încuietori electronice în care informațiile de intrare și ieșire ale utilizatorului pot fi monitorizate, poate fi furnizată autorizarea de la distanță și starea de blocare poate fi monitorizată cu tehnologia în curs de dezvoltare. Datorită priorității securității în sistemele de blocare, nevoia de încuietori electronice, care sunt mai sigure decât încuietorile mecanice, a crescut și mai mult. Încuietoarele electronice sunt preferate în special în zonele de utilizare cum ar fi centrele de date, camerele de servere și dulapurile de telecomunicații. În acest studiu, se urmărește controlul de la distanță a încuietorilor electronice cu mâner mobil și monitorizarea stărilor lor deschise/închise datorită sistemului de control inteligent bazat pe Internetul lucrurilor (IoT) prin intermediul aplicației mobile și/sau a aplicației web.*

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