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## A Study on Mobile Phone Collection and Return System based on Smart Sensors with Automatic Recording Functions

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**Abstract** Nowadays there has been a growing interest in biometrics security system. In this paper, we propose a new mobile phone collection and return system based on smart sensors with automatic recording functions, while also enhancing security through a 2D barcode scanner and biometric authentication system. The proposed mobile phone collection and return system consists of a fingerprint recognition sensor, a 2D barcode scanner, several servo motors, and an Arduino Uno board. In order to record the sensor's input value coming through the analog input of the Arduino board in a report, software that automatically processes and records sensor data using Excel was used. By using the PLX-DAQ v2 program to automatically process and record data, the accuracy of submission confirmation and convenience of reporting have been improved.

**Keywords** Internet of Everything (IoE), Fingerprint Sensor, 2D Barcode Scanner, Automatic Recording, PLX DAQ v2

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### Introduction

Internet of Everything (IoE) is an information technological term that combines sensing, computation, information extraction, and communication functionalities together in a device. IoE allows different electronic devices with different capabilities to sense the environment and to communicate for data exchange [1]. IoE is a complex approach with massive applications, dreams, and myths. It has uncountable applications in health, engineering, computer science, marketing, and even social sciences [2, 3]. However, it has many issues that require more investigation. Security and privacy dominated in the IoE research field [4, 5]. Since the announcement of the direction of the Ministry of National Defense's policy to implement the innovative policy for soldiers in 2018, in the current practice, it is possible to use a mobile phone after work by sailors. Accordingly, there is an inconvenience in collecting and distributing cell phones every day. In addition, the officer in charge writes a report that records the name, rank, service number, mobile phone submission time, turnaround time, the presence or absence of special matters, and the manager's confirmation, etc. We need to solve those problems.

Therefore, in this paper, we propose a new mobile phone collection and return system that improves the accuracy of checking the number of mobile phones and checking whether to submit them, and the convenience of writing a report, while also enhancing security through a 2D barcode scanner and biometric authentication system.

### System Design and Implementation

Currently, the military supplies and uses manual lock-operated storage boxes as shown in Figure 1. Because different keys must be matched for each locking device, the manufacturing cost increases and storage is difficult. In addition, since the mobile phone is directly submitted by the individual and the officer in charge



writes the report by hand, it is difficult to grasp the specifics such as reporting false without submitting the mobile phone. Currently, due to the increased use of mobile phones in the military, there are frequent imports and exits, and the resulting increase in work is growing enough to affect other fields.



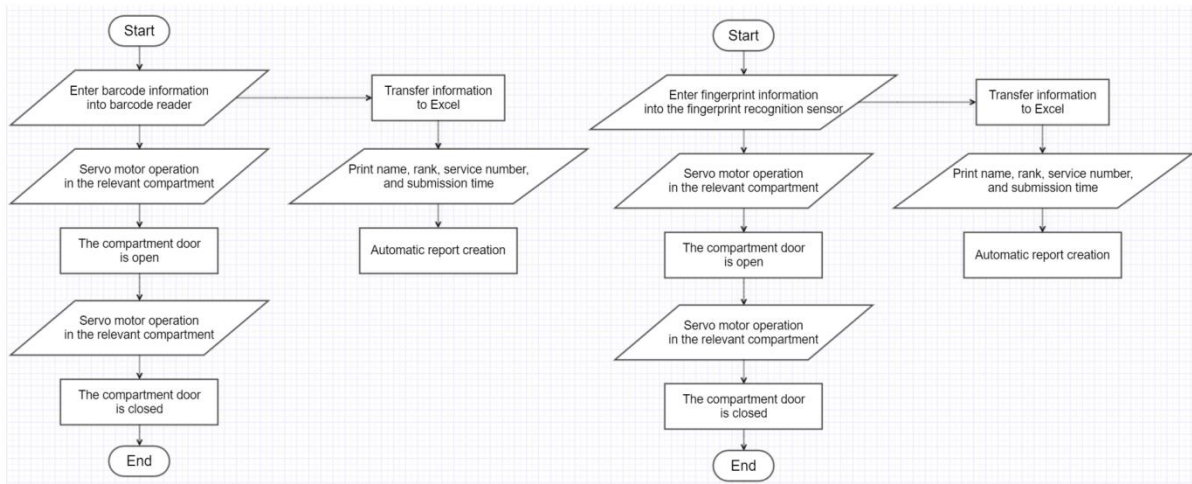
Name	Number	Submission Date, Time	Return Date, Time	Manager Check
OOO	8111111	'20.11.27. 07:31:29	'20.11.27.19:38:01	
OOO	8112222	'20.11.27. 07:31:29	'20.11.27.19:37:06	
OOO	8113333	'20.11.27. 07:45:29	'20.11.27.18:49:06	

< Existing manual smartphone collection box >

< smartphone carry-in log form >

Figure 1: Existing manual smartphone collection box and carry-in log form

The proposed system that has the automatic recording functions of collecting smartphones is composed of a fingerprint recognition sensor, a 2D barcode sensor, several servo motors, and an Arduino board. The operation scenario and flowchart of the system to be implemented in this paper are shown in Figure 2. At this time, personal information such as name, rank, and military number is stored in a barcode issued in advance. When the barcode attached to the mobile phone is recognized by the barcode reader, the submission time and personal information are automatically transferred to the Excel file, and the servo motor in one column rotates about 30 degrees to unlock. Also, after 10 seconds the door is automatically locked again.



< Submission Process >

< Return Process >

Figure 2: Operation scenario and flow chart of the proposed system

Figure 3 shows a programming of proposed system. There are three functions to be implemented in this system. There are 1) registration of information in barcode, 2) biometric authentication through fingerprint recognition, and 3) automatic report creation program. In order to record the sensor input value coming through the analog input of the Arduino board in a journal, software that automatically processes and records sensor data using Excel was used. As soon as the sensor input value comes into the Arduino board through the “PLX-DAQ v2” program [5], the information stored in the barcode or fingerprint and the input time can be transferred to Excel,

and the data can be arranged on the sheet. At this time, all communication is performed with the “Serial.println” command and can be easily tested and implemented on a large scale under real conditions.

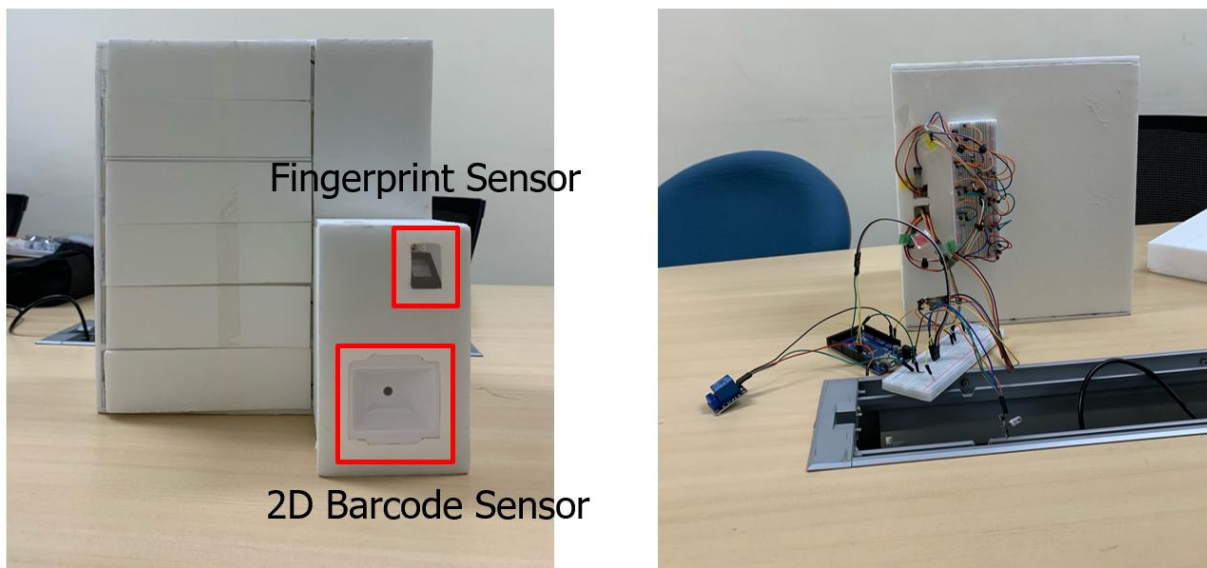
< 1. Fingerprint registration >

< 2. Drive servo motor after recognition >

< 3. Barcode reader operation >

Figure 3: Programming of proposed system

A practical implementation of proposed system is shown in Figure 4. The hardware implementation of the integrated systems was provided by a lab-scale model to show the usability, adaptability, durability, accuracy and low cost of the device. As a lesson to be learnt, we affirmed that the proposed system can easily be implemented on a wide scale under real conditions in the near future, and can be effectively deployed in various applications.



< Front >

< Rear >

Figure 4: Practical implementation of proposed system

Figure 5 demonstrates a practical implementation of an automatic recording program by using a PLX-DAQ v2 [6]. PLX DAQ v2 is a program used to establish an easy communication between Microsoft Excel on a Windows Computer and any device that supports serial port protocol. It was intentionally written to allow communication between Arduino and Excel. The proposed mobile phone collection and return system that improves the accuracy of checking the number of mobile phones and checking whether to submit them, and the convenience of writing a report, while also enhancing security through a 2D barcode scanner and biometric authentication system. Also, the designed prototype is highly extended further in the hardware section, and various applications can be added to reduce the human effort of upgrading.

Name	Number	Submission Date, Time	Return Date, Time	Manager Check
ooo	#####	20.12.03. 07:30:29	20.12.03. 19:36:01	Checked
ooo	#####	20.12.03. 07:30:29	20.12.03. 19:37:06	Checked
ooo	#####	20.12.03. 07:45:29	20.12.03. 18:49:14	Checked
ooo	#####	20.12.03. 07:30:29	20.12.03. 19:36:01	Checked
ooo	#####	20.12.03. 07:30:29	20.12.03. 19:37:06	Checked
ooo	#####	20.12.03. 07:45:29	20.12.03. 18:49:14	Checked
ooo	#####	20.12.03. 07:30:29	20.12.03. 19:36:01	Checked
ooo	#####	20.12.03. 07:30:29	20.12.03. 19:37:06	Checked
ooo	#####	20.12.03. 07:45:29	20.12.03. 18:49:14	Checked
ooo	#####	20.12.03. 07:30:29	20.12.03. 19:36:01	Checked
ooo	#####	20.12.03. 07:30:29	20.12.03. 19:37:06	Checked
ooo	#####	20.12.03. 07:45:29	20.12.03. 18:49:14	Checked
ooo	#####	20.12.03. 07:30:29	20.12.03. 19:36:01	Checked
ooo	#####	20.12.03. 07:30:29	20.12.03. 19:37:06	Checked
ooo	#####	20.12.03. 07:45:29	20.12.03. 18:49:14	Checked
ooo	#####	20.12.03. 07:30:29	20.12.03. 19:36:01	Checked
ooo	#####	20.12.03. 07:30:29	20.12.03. 19:37:06	Checked
ooo	#####	20.12.03. 07:45:29	20.12.03. 18:49:14	Checked
ooo	#####	20.12.03. 07:30:29	20.12.03. 19:36:01	Checked
ooo	#####	20.12.03. 07:30:29	20.12.03. 19:37:06	Checked
ooo	#####	20.12.03. 07:45:29	20.12.03. 18:49:14	Checked
ooo	#####	20.12.03. 07:30:29	20.12.03. 19:36:01	Checked
ooo	#####	20.12.03. 07:30:29	20.12.03. 19:37:06	Checked
ooo	#####	20.12.03. 07:45:29	20.12.03. 18:49:14	Checked
ooo	#####	20.12.03. 07:30:29	20.12.03. 19:36:01	Checked
ooo	#####	20.12.03. 07:30:29	20.12.03. 19:37:06	Checked
ooo	#####	20.12.03. 07:45:29	20.12.03. 18:49:14	Checked

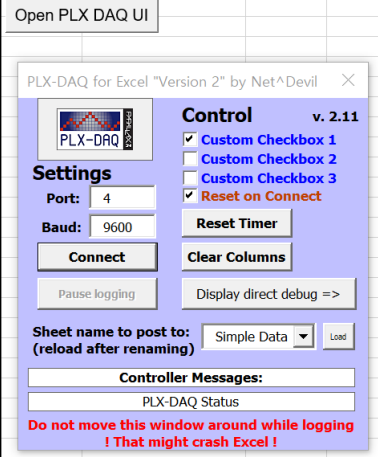


Figure 5: Practical implementation of automatic recording program by using a PLX-DAQ v2 [6]

## Conclusion

In this paper, a new type of mobile phone collection and return device with automatic recording functions is presented. This allows sailors to bring cell phones and is expected to be usefully applied to the situation in the navy for various security incidents that occur. In addition, if an integrated management program is developed so that it is possible to identify whether or not to submit with a single monitor and manage overall, and add a notification function to this, the utilization of the proposed device will further increase. In consideration of scalability in the future, detailed functions will be upgraded so that it can be used not only in the navy but also in the entire military. Future work will build upon the improvement of the detection system to increase accuracy and more functionality.

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## References

- [1]. L. Atzori, A. Iera, and G. Morabito. (2010). The Internet of things: a survey. *Computer Networks*, 54(15), 2787–2805.
- [2]. L. Da Xu, W. He, and S. Li. (2014). Internet of things in industries: a survey. *IEEE Transactions on Industrial Informatics*, 10(4), 2233–2243.
- [3]. E. Borgia. (2014). The Internet of things vision: key features, applications and open issues. *Computer Communications*, 54, 1–31.
- [4]. Z. Yan, P. Zhang, and A. V. Vasilakos. (2014). A survey on trust management for Internet of things. *Journal of Network and Computer Applications*, 42, 120–134.
- [5]. Meenakshi N, Monish M, Dikshit KJ, and Bharath S. (2019). Arduino Based Smart Fingerprint Authentication System. *1st International Conference on Innovations in Information and Communication Technology (ICIICT)*, 1-7.
- [6]. <http://forum.arduino.cc/index.php?topic=437398.msg3251256#msg3251256>

