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Automatic Safe Security System Using Pin Code And Fingerprint Based On Microcontroller With Telegram Notification

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ABSTRAK

The primary purpose of a security system is to protect valuable and important items. A safe is a medium for storing valuables, adjusted to the size of the safe compartment. Therefore, a proper security system is needed to ensure the owner does not worry about the loss or theft of the contents. This security system is adapted to the current era of advanced and modern technology. The sensors and microcontroller used include the NodeMCU ESP8266, fingerprint sensor, keypad, and LED indicator lights. Telegram notifications or alerts via the application can be received through an internet connection. This security system is implemented to secure the safe and can be accessed via an Android smartphone with the Telegram app installed. It enables the owner to receive access notifications indicating whether an attempt was successful or failed. This research was conducted using an experimental method by building a device to enhance the safety of the safe, providing peace of mind about the stored items. The experiment was carried out at a residence located in Bendosari Village, Ngantru District, Tulungagung Regency. Based on the results, it can be concluded that the development of an automatic safe using a pin code and fingerprint based on a microcontroller with Telegram notifications has successfully met the research objectives. All sensors and components within the safe function properly, ensuring the protection of valuables inside and offering peace of mind to the owner.

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1. INTRODUCTION

Security systems are generally designed to safeguard objects that contain important and valuable items. A safe is a medium for storing such valuables, tailored to the compartment size. Therefore, a proper security system is essential to ensure that the owner does not worry about theft or loss of the contents stored inside the safe. We often encounter safes equipped with conventional key systems and rotary code locks. However, in today's modern era, security systems need to evolve. The current era is digital and fully automated. [1].

The use of digital and automated systems cannot be separated from electronic components, particularly microcontrollers and sensors. These tools can be used as security control mechanisms for safe doors. This security approach aligns with the modern and sophisticated era. The sensors and microcontroller used in this research include the NodeMCU ESP8266, fingerprint sensor, keypad, and LED indicator light. [2].

In addition to sensors and microcontrollers, notification to an Android smartphone is also necessary for easier monitoring of the safe's condition. Telegram notifications can be accessed through an internet connection. Telegram is an application capable of sending alerts, messages, or videos within specific size limits, based on the platform's policy. It can be used in groups of multiple users and serves as a communication platform among users who have installed and registered using a phone number or email.

Telegram Messenger is an instant messaging application with end-to-end encryption, which can be installed on smartphones, tablets, or computers. [3].

This security system is implemented for safes, which can be accessed using an Android smartphone with the Telegram application installed. It allows the owner to know whether an access attempt was successful or failed. [4]. Before determining success or failure, the user must go through an authentication process using a password and fingerprint. This technology uses the NodeMCU ESP8266 as the interface for safe monitoring and automation notification. [5].

2. RESEARCH METHOD

This research was conducted using an experimental method by creating a device designed to enhance the security of a safe, ensuring safety and reducing concerns about the stored items. The experiment was carried out at a residence located in Bendosari Village, Ngantru District, Tulungagung Regency.

Tools and Materials Used:

1.1 Tools :

1. Laptop for programming
2. AVO Meter
3. Screwdrivers (+) and (–)
4. Other supporting tools

1.2 Materials:

1. NodeMCU 8266 Lolin V3: Functions as a control unit integrating ROM, RAM, processor, and I/O in one module. It can also be connected to the internet. [6]
2. Fingerprint Sensor FPM10A: Used to detect fingerprint patterns and verify individual identity. [8]
3. 12V Battery or Adapter: Serves as a power source with positive and negative poles. [11]
4. Solenoid Door Lock: A special electronic door lock system with two operating modes: NO (Normally Open) and NC (Normally Closed). [12]
5. Android Smartphone: Acts as a communication and notification medium. It is used to receive alert messages regarding the system's operation and must have mobile data or internet access. [13]
6. LCD 16x2: Used as the main display screen for showing text, letters, numbers, symbols, or images. [14]
7. LED Indicator Light: Serves as a visual signal to indicate whether access is granted or denied. [15]
8. Buck Converter LM2596: Used to convert and stabilize high or low voltage currents. [16]
9. Arduino Relay Module: Functions as a timing controller to operate devices or electronic components at a preset duration. [17]

Analysis Technique:

This study involves observation, literature review, problem analysis, design, testing, result discussion, conclusions, and suggestions.

System Analysis:

To obtain the necessary data, system analysis was performed based on experimental results and conclusions drawn from those trials as a reference.

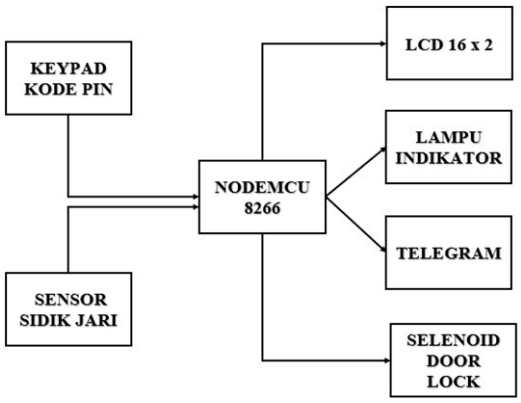

Figure 1. Block Diagram

Figure 1. Block DiagramThis block diagram illustrates the system design for the Automatic Safe Security. When attempting to open the safe, the user inputs a fingerprint and PIN code, which are processed by the NodeMCU 8266 microcontroller. The LCD screen then displays whether access is granted or denied. If successful, the indicator LED lights up; if failed, the user must re-enter the credentials. If the inputs are correct, the solenoid door lock will open, followed by a Telegram notification sent to the owner via the application.

1.3 System Design

The development of the Automatic Safe Security System using PIN Code and Fingerprint with Telegram Notification consists of both hardware and software design.

1.4 Arduino Software

The programming languages used are C and C++, and the software used is the Arduino IDE.

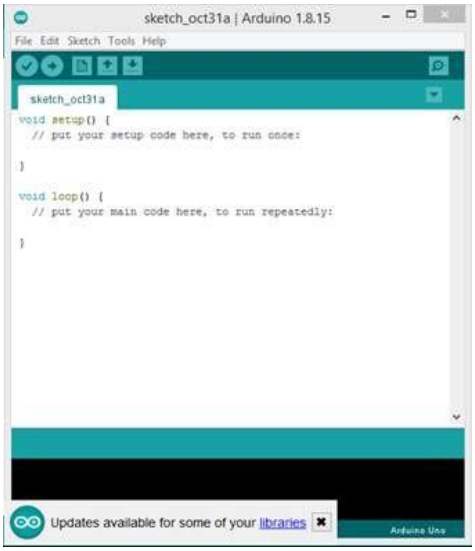

Figure 2. Arduino Software

Figure 2. Arduino Software This figure shows the Arduino 1.8.15 IDE software interface. The software can be downloaded for free from the official Arduino website. After downloading, install the software and set the board to Arduino Uno.

Table 1. Arduino IDE Toolbar Menu

No.	Toolbar Menu Arduino Software	Function
1	Verify	Checks for errors in the sketch.
2	Open Sketch	Opens an Arduino sketch file.
3	Save Sketch	Saves the created sketch
4	New Sketch	Creates a new sketch.
5	Upload	Uploads the sketch to the microcontroller.
6	Serial Monitor	Displays real-time data readings from the system.
7	Console	Displays messages or errors while running or verifying sketches.
8	Sketch Line	Shows the active cursor's line position in the sketch
9	Port Information	Displays port information in the menu.

Table 1. Arduino IDE Toolbar This table describes the toolbar options in the Arduino software that are applied in programming the microcontroller for the safe. [18]

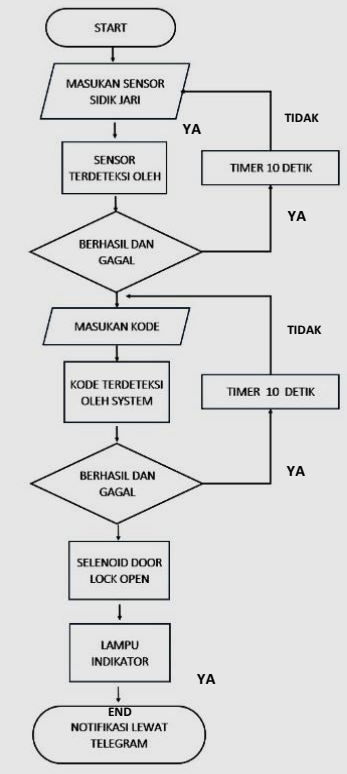

Figure 3. Flowchart

Figure 3. Flowchart This flowchart outlines the step-by-step process of the Automatic Safe Security System using a PIN code and fingerprint with Telegram notifications, from start to finish.

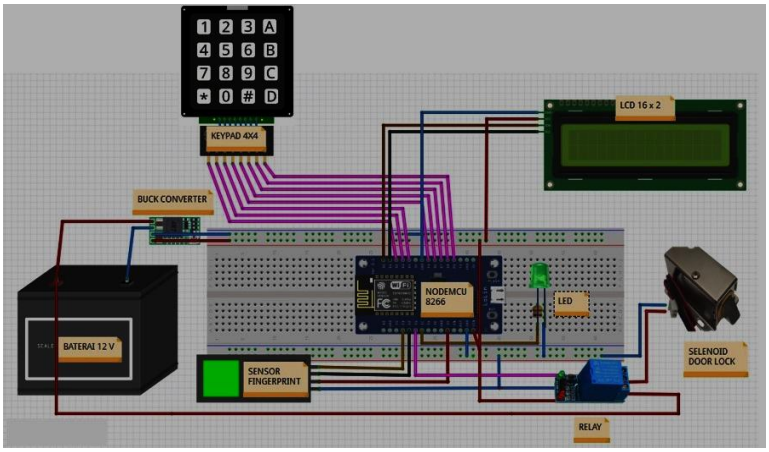

Figure 4. Complete Wiring Diagram

Figure 4. Complete Wiring Diagram This wiring diagram shows the full electrical connections of the system, including how each component connects to the NodeMCU 8266 microcontroller.

3. RESULTS AND DISCUSSION

The design developed in this study is a prototype of an Automatic Safe Security System Using PIN Code and Fingerprint with Telegram Notification, built using a cube-shaped box.

Figure 5. Tool Design in Open and Closed Conditions

Figure 5. Tool Design in Open and Closed Conditions This figure illustrates the physical form of the safe security system in both open and closed conditions. The cube-shaped box has been modified to accommodate the placement of sensors, output components, and the microcontroller.

3.1 Device Mechanism (How the Tool Works)

The system operates by being connected to a 12V power source, which is then converted to 5V to activate the microcontroller.

3.1.1 Fingerprint Sensor Testing Results

In the first access step, the user scans a fingerprint using the FPM10A sensor, which has been pre-programmed in the Arduino IDE. The accuracy results are as follows:

Table 2. Fingerprint Sensor Test Results

No	Right Thumb Data	Left Thumb Data
1	Detected	Detected
2	Detected	Detected

Table 2. Fingerprint Sensor Test ResultsThis table shows that the fingerprint sensor successfully detected both

the right and left thumb, based on data programmed in the Arduino IDE.

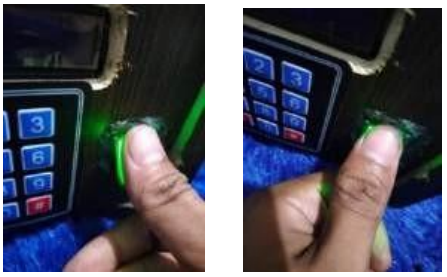

Figure 6. Fingerprint Testing

Figure 6. Fingerprint Testing Shows the testing process using the right and left thumb placed on the sensor, which is located next to the keypad on the front of the box.

3.1.2 Keypad Testing Results

In the second access step, users input a PIN code using the keypad. The pre-programmed data is shown below:

Tabel 3. Keypad Password Data

No	Pasword 1	Pasword 2
1	123	345

Tabel 3. Keypad Password Data Keypad Password Data for login using pin code is divided into two passwords

3.1.3 LCD 16x2 Testing Results

The LCD displays whether access input is accepted or denied based on the fingerprint and PIN.

Figure 7. LCD Access Result Display

Figure 7. LCD Access Result Display This figure shows messages on the LCD indicating successful or denied access based on fingerprint input.

3.1.4 Telegram Notification Testing Results

The Telegram notification is programmed into the NodeMCU ESP8266 using pre-configured Wi-Fi credentials. It sends real-time updates to the user's Android smartphone.

Figure 8. Telegram Notification Data

Figure 8. Telegram Notification Data This figure shows how the Telegram app displays safe access notifications when the device is connected to the internet.

3.2. Table Voltage Measurement Results of Components and System

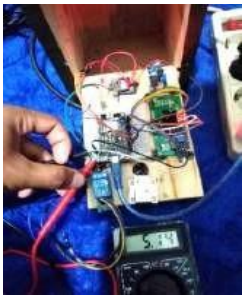

Figure 9. Voltage Measurement

Figure 9. Voltage Measurement. This figure displays the measurement of component voltage in the system using a multimeter in DC mode.

Table 4 These measurements confirm that

No.	Component	Parameter Tested	Method Range	Measuring Range	Average	Standard Referensi
1	Adapter 12 v	Voltage (V)	Multimeter	12 v	12,06 v	12 v
2	LCD 16 x2	Voltage (V)	Multimeter	3v -5 v	5,06 v	5 v
3	Fingerprint Sensor	Voltage (V)	Multimeter	3v -5 v	3,35 v	3v
4	LED Lamp	Voltage (V)	Multimeter	3v -5 v	3,34 v	3 v
5	Keypad 4 x3	Voltage (V)	Multimeter	3v -5 v	5,11 v	5 v
6	Buck converter	Voltage (V)	Multimeter	5 v & 12v	5,08 &12,06 v	5v &12 v
7	Selenoid door lock	Voltage (V)	Multimeter	12 v	12,06 v	12 v
8	Relay single	Voltage (V)	Multimeter	12 v	12,06 v	12 v
9	Nodemcu esp 8266	Voltage (V)	Multimeter	3v -5 v	5,08 v	5 v

Tabel 4 These measurements confirm that. The adapter component used has an average voltage of 12 v which is in accordance with the standard for activating other components and the current which was initially 220 v AC from the PLN voltage [18] changes to 12 v DC current so that it is in accordance with the application of this automatic safe [19].

LCD16x2 functions as a component for the screen on this automatic safe. The average voltage is 3v – 5v. The clear difference between this voltage is that the higher the voltage, the brighter the LCD screen will be and if the voltage is lower, the LCD screen will be dimmer. The standard for this LCD is 5v according to the NodeMCU ESP 8266 control component [20].

This safe FPM 10A type fingerprint sensor uses a fingerprint sensor that functions as an input for access and the voltage used for this tool is an average of 3.5v according to the standard determined when the sensor input is working and has been programmed according to the user's finger that has been programmed.

This LED lamp has a DC voltage current with an average of 3.34 according to the standard, functioning as a notification sign on an automatic safe [21]. The 4x3 keypad has an average operational voltage of 5.11v, which is in accordance with the standard, namely 5v, with this voltage it is in accordance with the microcontroller on this safe.

Buck converter when measuring using an avometer has an average voltage of 5.8v and 12.6v, this is in accordance with the standard. This buck converter functions as a converter of 12v current to 5v as for

12 v is for activating the door lock sensor in the automatic safe system and 5v is for applying the Nodemcu 8266 microcontroller which requires a voltage of 5v [22].

The solenoid door lock has an average voltage of 12.06v according to the standard, namely 12v. This solenoid functions as a lock on the automatic safe door [23]

A single relay when measuring using an avometer, the average DC voltage is 5v - 12v. The function of this relay is to control the time when opening and closing the NO and NC door lock solenoids [24].

The NodeMCU ESP 8266 microcontroller used in this automatic safe system has an average voltage of 5.08V according to the 5V standard which is expected to function properly and normally, providing power appropriate to the entire system [25].

4. CONCLUSION

Based on the development and testing of the automatic safe system using a PIN code and fingerprint based on a microcontroller with Telegram notifications, it can be concluded that the system has successfully met the objectives of this research. All sensors and components integrated into the safe function correctly and fulfill their purpose of securing valuable items stored within the safe. As a result, users can feel secure and not worry about the safety of their belongings.

This study demonstrates that microcontroller-based technology can be used to create innovative solutions beyond conventional manual methods. As a continuation, this system can be further developed by adding new features, additional sensors, or integrating other types of microcontrollers for larger-scale implementations.

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DAFTAR PUSTAKA

[1] W. N. Alamsyah, M. Nurkamid, and T. Listyorini, "Rancang Bangun Sistem Keamanan Brankas Menggunakan Radio Frequency Identification (Rfid) Dengan Notifikasi Via Sms," *Indones. J. Technol. Informatics Sci.*, vol. 2, no. 1, pp. 1–4, 2020, doi: 10.24176/ijtis.v2i1.5176.

[2] O. R. Arsyad and K. P. Kartika, "Rancang Bangun Alat Pengaman Brankas Menggunakan Sensor Sidik Jari Berbasis Arduino," *JATI (Jurnal Mhs. Tek. Inform.*, vol. 5, no. 1, pp. 1–6, 2021, doi: 10.36040/jati.v5i1.3285.

[3] M. Ilham Ali, S. Adi Wibowo, and A. Panji Sasmito, "Keamanan Brankas Menggunakan E-Ktp Dan Notifikasi Via Telegram Berbasis Iot (Internet of Things)," *JATI (Jurnal Mhs. Tek. Inform.*, vol. 5, no. 2, pp. 589–596, 2021, doi: 10.36040/jati.v5i2.3793.

[4] M. Communication, "Rancang Bangun Smart Home System Menggunakan NodeMCU Esp8266 Berbasis Komunikasi Telegram," vol. 18, no. 4, pp. 348–360, 2019.

[5] F. W. Perdana, S. D. Ayuni, A. Wisaksono, and S. Syahrorini, "Prototype Social Distancing Reminder Using HC-SR04 Sensor At The Payment Counter Via A Smartphone," *Procedia Eng. Life Sci.*, vol. 1, no. 2, 2021, doi: 10.21070/pels.v1i2.952.

[6] A. B. Sinabang, M. Martias, and H. Adianto, "Alat Pengaman Brankas Berbasis Fingerprint Menggunakan Nodemcu Esp8266 Notifikasi Telegram," *Insantek*, vol. 4, no. 1, pp. 18–24, 2023, doi: 10.31294/insantek.v4i1.2121.

[7] S. D. Ayuni, S. Syahrorini, and J. Jamaaluddin, "Lapindo Embankment Security Monitoring System Based on IoT," *Elinvo (Electronics, Informatics, Vocat. Educ.*, vol. 6, no. 1, pp. 40–48, 2021, doi: 10.21831/elinvo.v6i1.40429.

[8] H. Indra and R. Supriyanto, "Prototype Sistem Keamanan Brankas Berbasis Sensor Sidik Jari," *J. Ilm. Komputasi*, vol. 23, no. 1, pp. 131–138, 2024, doi: 10.32409/jikstik.23.1.3519.

[9] S. D. Ayuni, S. Syahrorinni, and J. Jamaaluddin, "Sosialisasi Aplikasi Monitoring Keamanan Tanggul Lapindo via Smartphone di Desa Gempolsari," *J. Pengabdi. Masy. Progresif Humanis Brainstorming*,vol. 5, no. 1, pp. 154–161, 2022, doi: 10.30591/japhb.v5i1.2717.

[10] A. A. Mahfudh, S. Ramadhani, and M. A. R. Fathoni, "Sistem Keamanan Ruangan Berbasis Arduino Uno R3 Dengan Sensor PIR dan Fingerprint," *Walisongo J. Inf. Technol.*, vol. 3, no. 2, pp. 95–106, 2021, doi: 10.21580/wjit.2021.3.2.9616.

[11] A. L. Utami, W. Hadi, and A. R. Chaidir, "Rancang Bangun Generator A xial F lux Tiga Fasa dengan Magnet Permanen Neodymium (NdFeB) Rotor dan Stator Ganda untuk Pengisian Baterai 12 Volt," *TELKA - Telekomun. Elektron. Komputasi dan Kontrol*, vol. 9, no. 2, pp. 84–98, 2023, doi: 10.15575/telka.v9n2.84-98.

[12] A. Hakim *et al.*, "Perancangan Smart Door Lock System dengan Multi Sensor untuk Sistem Keamanan Rumah," no. November, pp. 333–342, 2023.

[13] J. Fernando, I. Ratna, I. Astutik, and H. Setiawan, "MAKMUR," vol. 17, pp. 127–139, 2023.

[14] R. Zulfikar, R. Mukhaiyar, D. E. Myori, D. T. Elektro, F. Teknik, and U. Negeri, "Rancang Bangun Keamanan Pintu Otomatis Menggunakan Face Recognition Berbasis Internet Of Things (IoT)," vol. 4, no. 2, pp. 445–453, 2023.

[15] P. L. Jatika, R. Lukman, Y. Fernando, and A. Jayadi, "Perancangan Alat Pakan Bebek Otomatis Terjadwal Berbasis Arduino Uno Dengan Penjadwalan Android," vol. 4, pp. 10–21, 2023.

[16] D. Rahmawati, M. Ulum, M. Farisal, and K. Joni, "Lantai Pembangkit Listrik Menggunakan Piezoelektrik dengan Buck Converter LM2596," *J. Arus Elektro Indones.*, vol. 7, no. 3, p. 84, 2021, doi: 10.19184/jaei.v7i3.28128.

[17] Y. Rahmanto, A. Burlian, and S. Samsugi, "Sistem Kendali Otomatis Pada Akuaponik Berbasis Mikrokontroler Arduino Uno R3," *J. Teknol. dan Sist. Tertanam*, vol. 2, no. 1, p. 1, 2021, doi: 10.33365/jtst.v2i1.975.

[18] F. Teknik, D. A. N. Komputer, P. Studi, T. Informatika, and U. P. Batam, "Perancangan dan implementasi tempat sampah pintar menggunakan arduino voice control," 2018.

[19] J. Jamaaluddin, S. D. Ayuni, I. Apriliana, and S. Wulandari, "Design of Automatic Transfer Switch System Solar Power Plant – PLN," vol. 7, no. 2, pp. 57–64, 2023.

[20] F. Ilmu, T. Informasi, U. Gunadarma, J. Margonda, R. No, and J. Barat, "Sistem Kontrol dan Monitoring Kadar PH Air pada Sistem Akuaponik Berbasis NodeMCU ESP8266 Menggunakan Telegram," *J. Ilm. Komputasi*, vol. 19, no. 4, pp. 597–604, 2020, doi: 10.32409/jikstik.19.4.336.

[21] M. Nauval, K. Hamdani, I. Sulistiyowati, and S. D. Ayuni, "Automatic Stove Control System Based on the NodeMCU ESP8266 Microcontroller," vol. 6, no. 2, pp. 103–111, 2022.

[22] K. Yanel, "Manutech : Jurnal Teknologi Manufaktur Alat Pengusir Hama Burung," *J. Agroekoteknologi*, vol. 15, no. 1, pp. 99–110, 2023.

[23] G. Prabowo, E. Purwanto, S. D. Nugraha, F. H. Sholihah, and A. Qudsi, "IMPLEMENTASI SINGLE STAGE REDUCER- BUCK CONVERTER PADA MOBIL LISTRIK DUA PENUMPANG Teknik Elektro Industri , Politeknik Elektronika Negeri Surabaya , jalan Raya ITS Sukolilo Kampus PENS , Surabaya , 60111 PENDAHULUAN Kendaraan listrik telah muncul sebagai," vol. 9, no. 1, pp. 128–135, 2023.

[24] Mariza Wijayanti, "Prototype Smart Home Dengan Nodemcu Esp8266 Berbasis Iot," *J. Ilm. Tek.*, vol. 1, no. 2, pp. 101–107, 2022, doi: 10.56127/juit.v1i2.169.

[25] M. N. Bashir, K. M. Yusof, M. R. Jasman, and C. Y. Leow, "Outage Performance of Cooperative Relay Protocol on Uavs-Based Flying Adhoc Network," *J. Teknol.*, vol. 84, no. 3, pp. 185–192, 2022, doi: 10.11113/jurnalteknologi.v84.17552.

[26] A. Herlina, M. I. Syahbana, M. A. Gunawan, and M. M. Rizqi, "Sistem Kendali Lampu Berbasis Iot Menggunakan Aplikasi Blynk 2.0 Dengan Modul Nodemcu Esp8266," *INSANtek*, vol. 3, no. 2, pp. 61–66, 2022, doi: 10.31294/instk.v3i2.1532.