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Development of a Web-Based Automated Production Inventory System

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Abstract

This research focuses on developing an automatic counting system for production items using the ESP32 microcontroller and E18-D80NK sensor to address inventory challenges, particularly in manual counting prone to errors and shortages. The device aims to improve employee efficiency and reduce human errors by integrating the ESP32 microcontroller for data processing and the E18-D80NK sensor for information capture, accessible via a website interface.

Methodologically, rigorous testing and calibration ensured the system's accuracy and reliability. The integration of ESP32's capabilities with the precision of the E18-D80NK sensor facilitated seamless data processing, resulting in an efficient counting mechanism.

The automated production inventory system offers significant industry benefits by enhancing operational efficiency, minimizing disruptions, and ensuring data integrity. Findings highlight its effectiveness in improving inventory management practices, accurately tracking items, and enabling data-driven decision-making.

In conclusion, the research presents an integrated solution to enhance efficiency, transparency, and accuracy in production counting. The automated system, with its advanced technologies and robust methodologies, emerges as a strategic tool for boosting productivity and reliability in manufacturing operations.

Keywords: Counter, IoT, Production

INTRODUCTION

The Internet of Things, often known as IoT, is an embedded system aimed at expanding the utilization of continuous internet connectivity (Irzaman *et al.* 2016). Capabilities such as data sharing, remote control, and so forth, also extend to real-world objects such as food items, electronics, and equipment connected with sensors and linked to a network (Fauzan et al. 2021).

In the modern industrial era, enhancing production efficiency has become a primary focus to achieve optimal productivity levels (Novianty *et al.* 2019). As part of these efforts, this research explores innovative solutions to address inventory challenges in manual production item counting (Irzaman *et al.* 2018). While previous attempts have been made to tackle these issues, there exists a gap that necessitates a more sophisticated and integrated approach (Ridwan *et al.* 2020).

Inventory management is a crucial key to ensuring the smooth operation of businesses. An effective inventory system not only enables companies to track the quantity and location of production goods but also minimizes the risk of stockouts or overstocks that can hinder production efficiency and customer satisfaction (Taupiko et al. 2023). However, in many cases, inventory systems that still use

manual or semi-automatic methods remain a challenge, especially when it comes to accuracy and responsiveness (Siskandar dan Kusumah 2019).

The use of sensor technology and microcontrollers has opened up new opportunities in the development of more efficient and accurate automated inventory systems (Kusumah et al. 2020). Sensors such as the E18-D80NK have the ability to detect the movement of goods in real-time, while microcontrollers such as the ESP32 provide a powerful platform for processing sensor data and making automatic decisions. Additionally, integration with web interfaces offers greater flexibility and accessibility for users to monitor and manage inventory remotely(Siskandar et al. 2022). Thus, the development of a web-based automated inventory counting tool becomes a promising solution in improving the efficiency and accuracy of inventory management across various industrial sectors (Siskandar dan Kusumah 2019).

This research aims to design the "Development of a Web-Based Automated Production Inventory System" in response to the urgent need to enhance employee performance efficiency and reduce the risk of human errors in production counting. Gap analysis will identify differences between the proposed approach and previous research, highlighting the novelty introduced through the implementation of the ESP32 microcontroller and E18-D80NK sensor (Nugroho *et al.* 2024).

Manually calculating production results poses significant implications for both employees and the overall security of the process (Siskandar et al. 2022). The impact on employee time utilization is substantial, as manual calculations often require more effort and time compared to automated methods. This inefficiency can hinder productivity and contribute to potential errors in the production process (Akbar *et al.* 2019).

Moreover, the manual calculation of production results is considered less secure due to the inherent risk of human error and the potential for data manipulation. Manual processes lack the safeguards and accuracy that automated systems provide, making them susceptible to inaccuracies, miscalculations, and potential security breaches (Fauzan et al. 2021).

The inaccuracy of production outcomes is also a consequence of manual calculations. The reliance on human calculations introduces a higher likelihood of errors, leading to discrepancies in the final production results (Kusumah *et al.* 2020a). This not only impacts the reliability of the data but can also have downstream effects on decision-making and overall operational efficiency (Siskandar et al. 2023).

By implementing automation in production data calculations, the efficiency of employee performance can be enhanced. Automation also plays a crucial role in preventing the potential for falsifying production data (Siskandar dan others). Additionally, automatically calculated production data will be more accurate, and with the storage of this data on a website platform, it has the ability to track production history more effectively (Siskandar et al. 2023).

The ESP32, short for Espressif Systems Processor 32, is a microcontroller designed by the Shanghai-based technology company, Espressif Systems, in China (Dardanella *et al.* 2022). It was developed as a standalone WiFi network solution to connect microcontrollers to a WiFi network. This microcontroller features a dual-core processor that operates with Xtensa LX6 instructions (Yanti *et al.* 2023).

In the context of an automatic counting device, the ESP32 serves as the central brain. Its primary task is to manage data and coordinate the functions of other components. As the main controller, the ESP32 reads data from the E18-D80NK sensor, which detects the movement of items on the conveyor. Additionally, the ESP32 controls the buzzer to provide notifications when items are detected, manages the display on the LCD to show the calculation results, and interacts with other components such as the ESP Extensions Board (Santosa et al. 2023).

By leveraging the integrated WiFi features of the ESP32, this device facilitates easy transmission of data to a web platform or enables remote monitoring (Agung Prayuda Hidayat *et al.* 2021). In other words, the ESP32 in this device not only functions as the main controller but also acts

as a link between the physical device and the possibilities of internet connectivity (Siskandar et al. 2023).

The ESP Extensions Board is an extension module designed to enhance the capabilities of the ESP32 microcontroller (Afifah *et al.* 2024). Throughout its history, this module was created as an additional solution to extend the functionality of the ESP32, enabling better integration with various external components (Hidayat et al. 2022).

In the context of an automatic counting device, the ESP Extensions Board serves as a support for the ESP32 in connecting and communicating with additional components (Siskandar *et al.* 2021). Its functions involve expanding I/O ports, adding expansion slots, and improving connectivity capabilities (Andre *et al.* 2020). For instance, the board can provide additional ports to connect additional sensors or external devices required in the development (Santosa et al. 2023).

With the presence of the ESP Extensions Board, the development of the automatic counting device can become more flexible and adaptable to specific needs (Yoridho *et al.* 2020). This board acts as a connector that extends the capabilities of the ESP32, allowing it to handle various tasks and integrations more efficiently (Rohim *et al.* 2024).

ESP Extensions Board is an extension module designed to enhance the capabilities of the ESP32 microcontroller (Lestari et al. 2020). In its history, this module was developed as an additional solution to expand the functionalities of the ESP32, allowing for better integration with various external components (Siskandar 2011).

In the context of the automatic counter tool, the ESP Extensions Board serves as a support for the ESP32 in connecting and communicating with additional components (Siskandar *et al.*). Its role involves expanding I/O ports, adding expansion slots, and improving connectivity capabilities. For example, this board can provide additional ports to connect additional sensors or external devices needed in the development (Santosa *et al.* 2021).

With the ESP Extensions Board, the development of the automatic counter tool can become more flexible and adaptable to specific needs (Siskandar *et al.* 2017). The board acts as a connector that extends the capabilities of the ESP32, enabling it to handle various tasks and integrations more efficiently(Siskandar et al. 2020).

The E18-D80NK Sensor belongs to the family of infrared sensors and was developed to detect motion (Agung Prayudha Hidayat *et al.* 2021). It was created to address the need for integrating motion detection capabilities in various applications (Aprilian *et al.* 2024).

In the context of the automatic counter tool, the E18-D80NK sensor functions as a motion detector for items on the conveyor. In brief, the sensor is designed to provide a sensitive response to changes in light that reflect the movement of items (Irzaman *et al.* 2017). When an item passes in front of the sensor, the change in light is interpreted as a detection, sending a signal to the microcontroller (ESP32) to take action (Maulana *et al.* 2021).

The primary function of this sensor is to provide information on the timing and location of when an item passes a specific point on the conveyor (Abiyaksa *et al.* 2020). This data is then used by the ESP32 to calculate the number of detected items and trigger corresponding actions, such as activating the buzzer or displaying information on the LCD (Rasya *et al.* 2020).

With the E18-D80NK sensor, the automatic counter tool can rely on swift and reliable motion detection, laying the foundation for accurate counting and overall tool functionality (Lestari et al. 2020).

The buzzer is an electronic device that produces sound or audible signals when activated (Siskandar dan Kusumah 2019b). In the context of the automatic counter tool, the buzzer functions as a notification device. Its main role is to provide an audible alert when an item is detected by the E18-D80NK sensor. The activation of the buzzer serves as a real-time indicator, notifying users or operators that an item has passed the sensor point on the conveyor (Wiyoto *et al.* 2023).

The buzzer's function is essential for enhancing the user experience and ensuring that the detection of items is not only recorded but also promptly communicated through an audible signal

(Sagala *et al.* 2020). It adds an additional layer of awareness to the system, contributing to the overall effectiveness of the automatic counter tool in a production or monitoring environment (Nabilah *et al.* 2016).

The Liquid Crystal Display (LCD) is a visual output device that provides a means to display information in a readable format (Banila *et al.* 2021). In the context of the automatic counter tool, the LCD serves as a display interface for presenting the calculated results. Its primary function is to visually showcase the count of items detected by the E18-D80NK sensor (Siskandar et al. 2020).

The LCD displays information in a clear and accessible manner, offering a user-friendly interface for operators to monitor the real-time counting results (Kusumah *et al.* 2021). It plays a crucial role in presenting the output data, such as daily, weekly, and monthly counts, allowing users to quickly and easily access relevant information without the need for additional devices (Siskandar et al. 2020).

The LCD is instrumental in enhancing the user interface of the automatic counter tool, providing a visual representation of the counting results for efficient monitoring and analysis (Siskandar et al. 2022).

PHP (Hypertext Preprocessor) is a server-side scripting language widely employed for web development purposes. Its versatility and capabilities make it a cornerstone in the creation of dynamic and interactive web pages. PHP is instrumental in handling various tasks crucial to web applications (Satriatama et al. 2020).

One primary function of PHP is server-side programming, enabling developers to create dynamic web pages by interacting directly with the server. It excels in processing form data, facilitating user interaction through input forms, and managing data input, such as user registrations or contact forms (Taupiko *et al.* 2023b).

Additionally, PHP plays a vital role in interacting with databases, allowing web applications to store and retrieve data seamlessly. Its ability to communicate with different types of databases enhances its utility in the development of robust and data-driven web applications (Agatha *et al.* 2022).

In the realm of web application development, PHP is frequently utilized for building complex applications, including e-commerce sites, content management systems, and various other web-based applications (Eriyadi dan Fauzian 2019). Its server-side capabilities contribute to the creation of feature-rich and responsive web interfaces (Chandra 2020).

PHP is also adept at file handling, enabling developers to manipulate files on the server, such as uploading files, reading, writing, and deleting. Moreover, it provides functionalities for image customization and processing, allowing for dynamic image creation or the manipulation of uploaded images (Ningrum 2020).

In summary, PHP serves as a backbone in web development, bridging the gap between static and dynamic web pages. Its broad spectrum of applications, encompassing server-side scripting, database interaction, form processing, file handling, and image manipulation, makes it an indispensable tool for creating powerful and interactive web applications (Aswin *et al.* 2022).

METHODS

To assess the impact of manual production result calculations, the use of several tools and materials is required to support this investigation. Some key tools include the ESP32 microcontroller, E18-D80NK sensor, and buzzer.

Table 1 Tools and Materials

No.	Tools and Materials	Information	Quantity
1	ESP32	As a microcontroller in a system designed to process data from input sensors and generate instructions based on the conditions conveyed by those sensor inputs.	1
2	ESP Extensions Board	Additional devices used to expand the capabilities and connectivity of the ESP32 module.	1
3	E18-D80NK Sensor	Used as an input sensor to detect objects or measure distance.	1
4	Buzzer	Used as an output when the sensor successfully detects an item.	1
5	LCD	Used as an output by displaying the calculated results of the items.	1
6	Casing	Tool protector	1
7	Adapter	Power source for the circuit	1

Here is the sequence of steps that must be taken to successfully implement the " Development of a Web-Based Automated Production Inventory System" Each stage will guide the implementation process with detailed steps to achieve the project's goals.

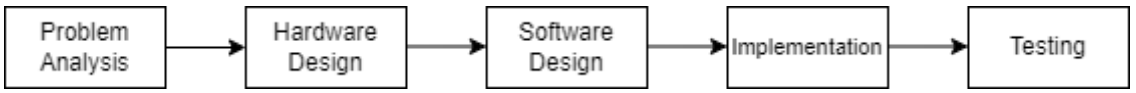

Figure 1 Work Procedures

The process begins with analyzing the issues. This analysis involves direct visits to identify potential problems in the production process. Following that, hardware design is conducted, including the development of schematics and mechanical design, as well as casing, considering the conditions inside the factory. Subsequently, software design is carried out because data from the devices will be presented through a website interface. The last two steps involve the implementation and testing of the tool.

Preparing for the use of the automatic counting tool to replace the manual production item counting system requires adjusting the placement location during the production process. It also involves preparing the website platform to display the generated data and store it in a database for ease of checking production results.

In last stage, testing is conducted by adjusting the placement location of the tool, followed by using the tool directly to perform the calculation of the quantity of produced items. Of course, in this stage, manual counting will also be carried out to ensure the accuracy of the results. The testing of the calculation results can also be observed through the LCD on the tool, and finally, testing the calculation results data within the created website platform.

There is a previous study utilized for comparative analysis.

Table 2 Comparative Researches

Research Title	Differences	Similiarity
The Production Counter Device for Mineral Water Boxes Using Microcontroller-Based Counter Technique	The core difference lies in the utilization of microcontroller (Arduino) and infrared sensors.	Both research projects focus on the automation of calculating the production output of factory goods.

RESULTS AND DISCUSSION

Data analysis is a crucial function in the initial stages of research, encompassing an understanding of concepts, formulating technical and functional requirements, and evaluating innovations needed to ensure that the developed tool is beneficial in solving the problem. The data analysis techniques used in the development of this tool are as follows:

1. Descriptive Analysis: Conducting descriptive analysis on data obtained from data collection techniques such as literature review, interviews, observations, and surveys to understand the characteristics and needs of potential users.
2. Comparative Analysis: Performing a comparative analysis of similar existing IoT tools to identify the strengths and weaknesses of those tools and opportunities to enhance the design and features of the tool to be developed.

In hardware design, the process typically begins with the creation of a block diagram. A block diagram serves as a visual representation that illustrates the structure and relationships among various components within a system or process in a simplified manner (Siskandar 2013). Each primary component is depicted as a block, and connections between these blocks are indicated with arrows or lines. The primary objective of a block diagram in hardware design is to offer a comprehensive overview of how these components interconnect and collectively constitute the entire system. Block diagrams play a crucial role in the initial stages of designing hardware, providing a visual aid for understanding, analyzing, and conceptualizing the structural aspects of the system (Hidayat et al. 2022).

In the diagram below, there is an explanation of the flow of input, process, and output in the design of the automatic counting tool. The infrared sensor E18-D80NK serves as the input, detecting the product being produced. Subsequently, the signal from this sensor is processed by the ESP32 microcontroller, generating outputs such as buzzer sound, calculation display on the LCD screen, and data results available on the website platform.

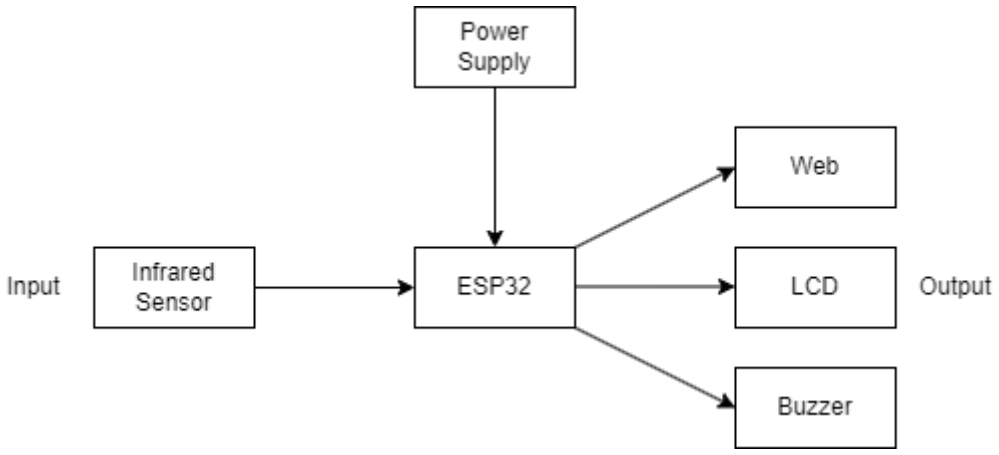

Figure 2 Diagram Block

The flowchart illustrates a working procedure within a system. This tool operates when an item moves in front of the sensor. The sensor will automatically detect the item, and if the item is not detected, it will not produce the indicated output. However, if the sensor successfully detects the item, it will generate an output with the buzzer sounding and the calculation displayed on the LCD screen.

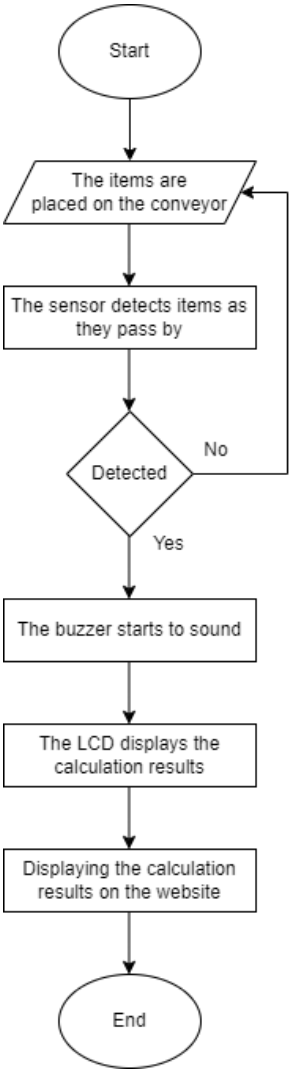

Figure 3 Flowchart

The image below is a 3D design representation of the tool created by the researcher. In this 3D design concept, the infrared sensor is positioned at the front, while the LCD for the calculation display is located on the top for ease of checking the calculation results.

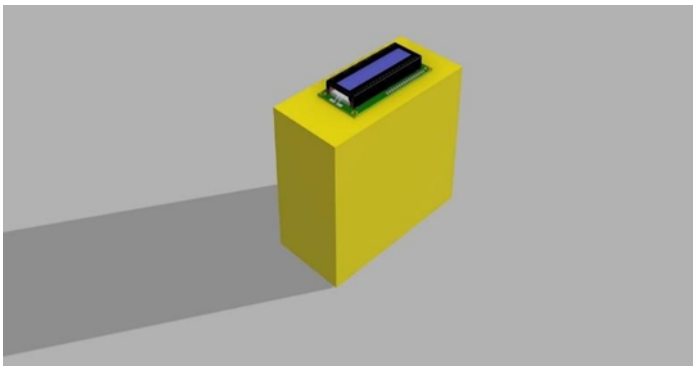

Figure 4 3D Design

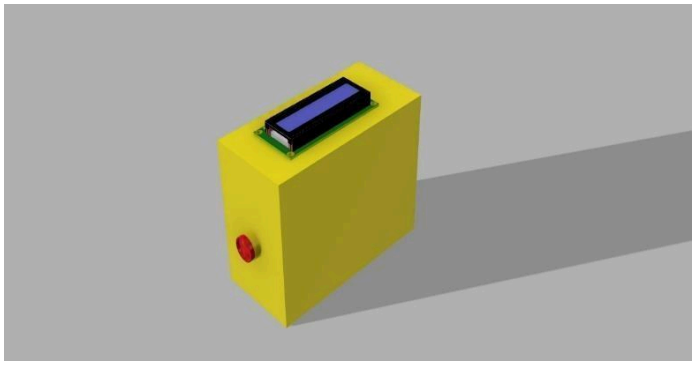

Figure 5 3D Design 2

The image below displays the schematic arrangement of the automatic counting tool designed by the researcher. It includes the E18-D80NK infrared sensor, which functions to detect the produced items. The ESP32 microcontroller is used as the data processing device. Additionally, there are output devices such as a buzzer for sound feedback and an LCD screen for displaying the calculation results.

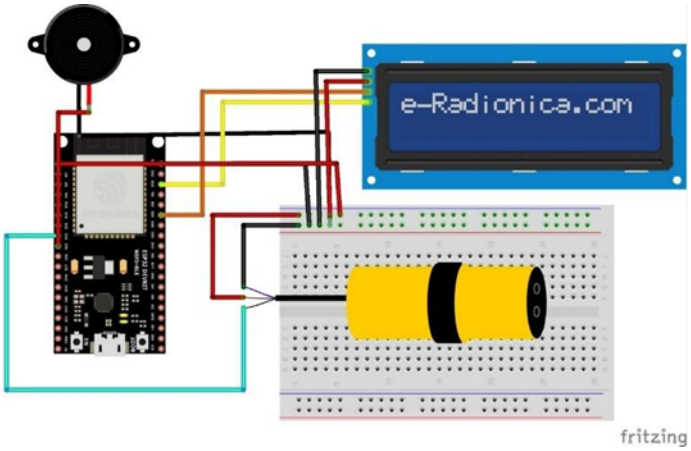

Figure 6 Schematic

The use case diagram in the image below is used to illustrate the functions accessible by actors in the website system that will be built. In this user case, there are two actors: the director and the employee. As shown in the user case diagram above, an employee is granted permission only to perform scanning without the ability to access or view the data. On the other hand, a director needs to log in first to access and view the data.

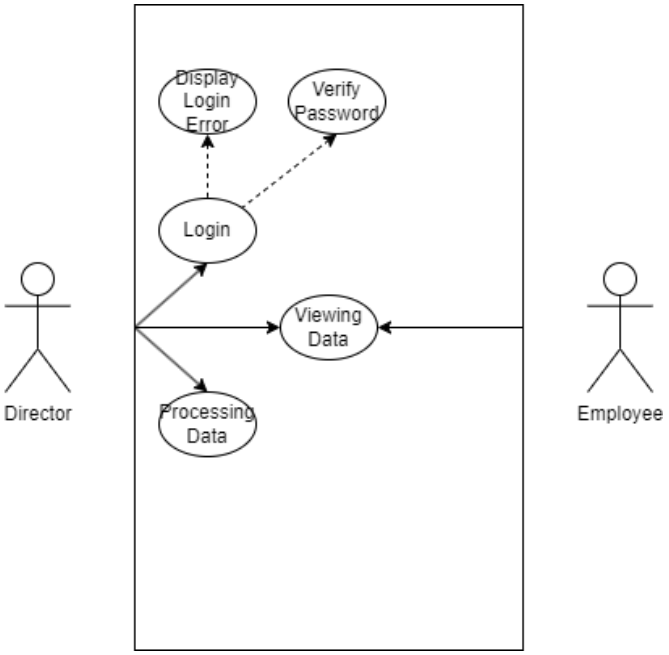

Figure 7 Usecase

The following is an image of the website interface that has been created, consisting of three menus: main menu, results summary, and issue report. The displayed image corresponds to the main menu, showcasing a summary of daily, weekly, and monthly values.

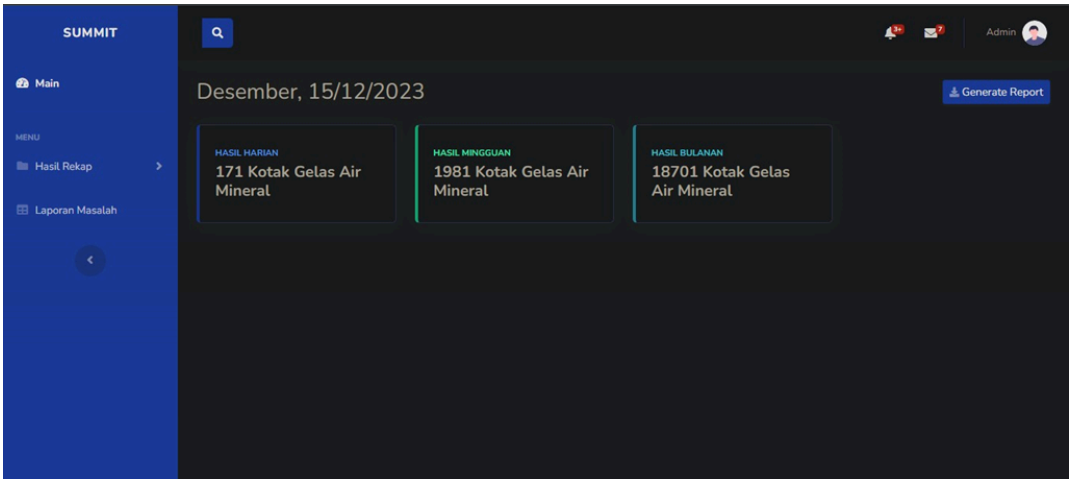

Figure 8 Web Interfaces

In the image below, on the date 10/12/2023, a preliminary test was conducted, and data for 11 production items were obtained. This was followed by testing on 11/12/2023, resulting in weekly data of 243 boxes. The calculation from the previous date, adding 11 to 232, yielded 243. With this, it can be confirmed that the calculation results are accurate.

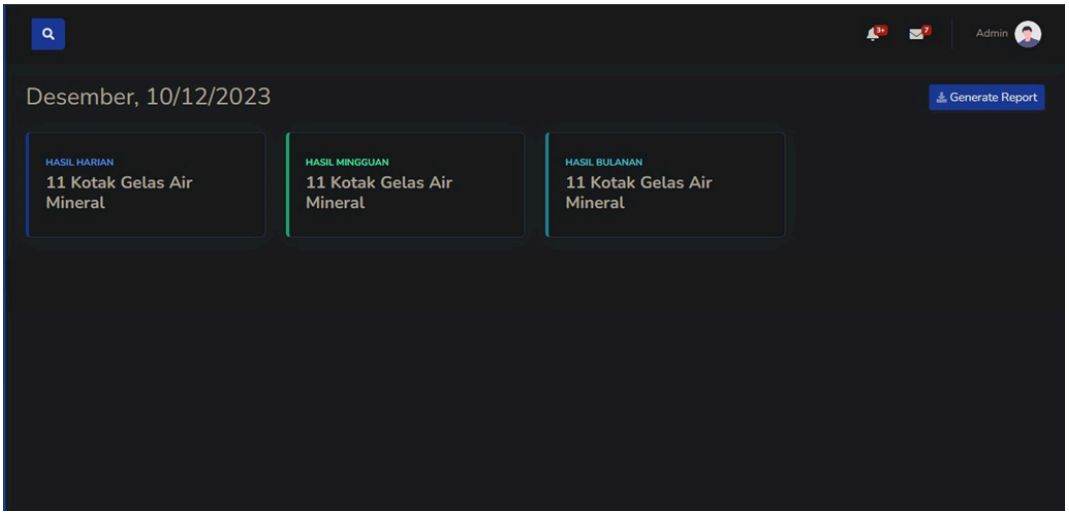

Figure 9 Web Interfaces 2

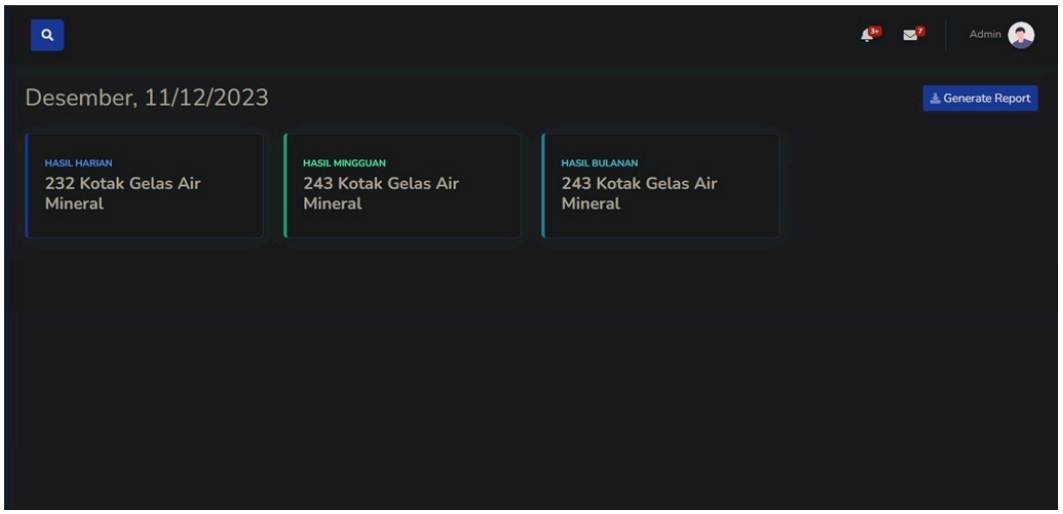

Figure 10 Web Interfaces 3

As a result and comparison of the previous study utilized for comparison, the core difference lies in the utilization of Arduino ATmega 328 microcontroller, while in this research, an ESP32 is used. Several differences in results have been obtained, wherein the Arduino ATmega 328 cannot utilize a website for calculation results due to the absence of a Wi-Fi module, whereas the ESP32 can do so without additional modules. This stands as one of the most significant advantages of this research.

CONCLUSION

This project aims to develop a web-based automatic counting tool using the ESP32 microcontroller, E18-D80NK sensor, and buzzer. The device will be placed next to the production item conveyor to provide notifications via the buzzer when items pass through the sensor. The main goals of this project are to enhance employee performance, provide more accurate calculation results, and store data on a website for easy inventory tracking. Through this implementation, it is expected to improve operational efficiency in production and inventory management in the long term.

REFERENCES

Abiyaksa D, Adi SH, Siskandar R. 2020. Pembuatan prototype smart budidaya ikan mas koki berbasis arduino. *Jurnal Sains Indonesia*. 1(1):45–50.

Afifah NPAP, Rahma H, Aziezah N, Siskandar R, Setiawan A. 2024. Pengaruh Minat Penggunaan Robot AI terhadap Tingkat Akurasi dalam Mendeteksi Kematangan Buah Tomat. *TEKTONIK: Jurnal Ilmu Teknik*. 1(2):144–149.

Agatha AA, Azmi Z, Pranata A. 2022. Sistem Kendali Penyemprotan Disinfektan Otomatis Dengan Teknik Counter Berbasis Mikrokontroler. *Jurnal Sistem Komputer Triguna Dharma (JURSIK TGD)*. 1(2):42–49.

Akbar MF, Wilantara P, Ikhsan M, Ikhtiarta H, Siskandar R, Novianty I, Irzaman I. 2019. The assembling of electrical socket for electricity usage monitor and electronic device control with ESP8266 microcontroller basis. Di dalam: *AIP Conference Proceedings*. Volume ke-2169.

Andre DJ, Triwisesa E, Siskandar R. 2020. Rancang Bangun Alat Monitoring Keadaan Air Danau Berbasis Arduino Terintegrasi Web di Limnologi LIPI. *Jurnal Sains Indonesia*. 1(2):106–112.

Aprilian AT, Rahmah H, Aziezah N, Sholihah W, Siskandar R, Setiawan A. 2024. Pengaruh Penampilan Dan Fitur Robot Quality Check Apilastik Terhadap Tingkat Kepuasan Pengguna. *Jurnal Publikasi Teknik Informatika*. 3(1):55–63.

Aswin M, Setiawan D, Syahputra G. 2022. Perancangan Jam Digital Dan Sistem Bel Otomatis Pada Sekolah Dengan Teknik Counter Berbasis Mikrokontroler. *Jurnal Cyber Tech*. 2(10).

Banila L, Lestari H, Siskandar R. 2021. Penerapan blended learning dengan pendekatan STEM untuk meningkatkan kemampuan literasi sains siswa pada pembelajaran biologi di masa pandemi covid-19. *Journal of Biology Learning*. 3(1):25.

CHANDRA DIOP. 2020. PERANCANGAN DAN IMPLEMENTASI SISTEM PERHITUNGAN BARANG OTOMATIS BERBASIS RASPBERRY PI DAN DATABASE PHPMYSQL.(DESIGN AND IMPLEMENTATION OF AUTOMATIC COUNTER BASED RASPBERRY PI AND DATABASE PHPMYSQL).

Dardanella D, Hidayat AP, Santosa SH, Siskandar R. 2022. Peramalan Harga Jual Cabai Merah Di Pasar Rakyat Kemang Perusahaan Umum Daerah Pasar Tohaga Kabupaten Bogor. *Jurnal Sains Indonesia*. 3(1):16–23.

Eriyadi M, Fauzian IF. 2019. Desain Prototipe Mesin Sortir Barang Otomatis. *JTERA (Jurnal Teknologi Rekayasa)*. 4(2):147–156.

Fauzan MF, Ridwan RS, Shubhi MSM, Triya TF, Vandame VRS, Alif NAF, Diana DPR, Nabila NF, Kaisar KRA, others. 2021a. Implementasi alat pengusir hama sawah dengan cara tradisional dan modern bertenaga surya menggunakan sensor PIR berbasis Android. *Jurnal Sains Indonesia*. 2(3):129–140.

Fauzan MF, Siskandar R, Falah NA, Maulana MS, Balle JL, Febriyanti T, Suhada VR, Wirastuti MA, Fakhiratunisa N, Al-ars KR, *et al.* 2021b. Alat Komunikasi Darurat dengan ESP8266 dan LoRa untuk Pendaki Gunung. *Jurnal Sains Indonesia*. 2(2):52–60.

Hidayat Agung Prayuda, Santosa SH, Siskandar R. 2021. Penentuan Rute Kendaraan Menggunakan Saving Matrix Terhadap Jasa Pengiriman Barang. *Jurnal Sains Indonesia*. 2(3):113–117.

Hidayat Agung Prayudha, Santosa SH, Siskandar R, Baskoro RG. 2021. Evaluation of Chicken Eggs Supply With Fuzzy AHP Approach Through Development of Safea Software. *Jurnal Logistik Indonesia*. 5(2):104–110.

Hidayat AP, Santosa SH, Siskandar R, Husyairi KA. 2022a. Analisis Kebutuhan Distribusi Barang Dengan Menggunakan Pendekatan Simulasi Monte Carlo. *Jurnal Sains Indonesia*. 3(3):178–182.

Hidayat AP, Siskandar R, others. 2022b. Karakteristik Fisik Kopi Arabika Berbagai Daerah di Indonesia Pada Tingkat Penyangraian Sama. *Jurnal Sains Indonesia*. 3(2):86–92.

Irzaman I, Siskandar R, others. 2017. Modified Spin Coating Method for Coating and Fabricating Ferroelectric Thin film as Sensors and Solar Cells. *Artifacts on Surface Phenomena and Technological Facets P.*, siap terbit.

Irzaman, Siskandar R, Aminullah, Irmansyah, Alatas H. 2016. Characterization of Ba0. 55Sr0. 45TiO3 films as light and temperature sensors and its implementation on automatic drying system model. *Integrated Ferroelectrics*. 168(1):130–150.

Irzaman, Siskandar R, Nabilah N, Aminullah, Yuliarto B, Hamam KA, Alatas H. 2018. Application of lithium tantalate (LiTaO3) films as light sensor to monitor the light status in the Arduino Uno based energy-saving automatic light prototype and passive infrared sensor. *Ferroelectrics*. 524(1):44–55.

Kusumah BR, Jaya AK, Iftitah D, Siskandar R, Lestari H, Umam K, Supriadi D. 2021. Penerapan teknologi tepat guna (e-ox level) kepada kelompok pembudidaya ikan lele di desa kepongpongan kabupaten cirebon. Di dalam: *Unri Conference Series: Community Engagement*. Volume ke-3. hlm 40–46.

Kusumah BR, Kostajaya A, Supriadi D, Nugraha EH, Siskandar R. 2020a. Engineering of automatically controlled energy aeration systems for fisheries cultivation pools. *Aquacultura Indonesiana*. 21(2):74–81.

Kusumah BR, Kostajaya A, Supriadi D, Nugraha EH, Siskandar R. 2020b. Engineering of automatically controlled energy aeration systems for fisheries cultivation pools.
Lestari H, Setiawan W, Siskandar R. 2020a. Science Literacy Ability of Elementary Students Through Nature of Science-based Learning with the Utilization of the Ministry of Education and Culture's" Learning House". *Jurnal Penelitian Pendidikan IPA*. 6(2):215–220.
Lestari H, Siskandar R, Rahmawati I. 2020b. Digital Literacy Skills of Teachers in Elementary School in The Revolution 4.0. Di dalam: *International Conference on Elementary Education*. Volume ke-2. hlm 302–311.
Maulana MS, Siskandar R, Fauzan MF, Balle JL, Febriyanti T, Suhada VR, Falah NA, Wirastuti MA, Fakhiratunisa N, Al-ars KR, *et al.* 2021. Robot Pemetik Buah Melon Dengan Sortasi Berat. *Jurnal Sains Indonesia*. 2(2):95–105.
Nabilah N, Islam HI, Saputra DH, Pradipta GM, Said S, Kurniawan A, Syafutra H. 2016. Pembuatan Prototipe Lampu Otomatis Untuk Penghematan Energi Berbasis Arduino Uno Di Departemen Fisika Fmipa Ipb. Di dalam: *PROSIDING SEMINAR NASIONAL FISIKA (E-JOURNAL)*. Volume ke-5. hlm SNF2016–CIP.
Ningrum RC. 2020. Desain Pengepakan Barang Dengan Counter Otomatis Menggunakan Plc Omron. *Jurnal Ilmiah Mahasiswa Kendali dan Listrik*. 1(2):51–57.
Novianty I, Ferdika A, Sholihah W, Siskandar R, Sari IP. 2019. Design of Portable Weather Station Using MQTT Protocol. Di dalam: *2019 2nd International Conference of Computer and Informatics Engineering (IC2IE)*. hlm 199–202.
Nugroho APA, Rahmah H, Aziezah N, Siskandar R, Setiawan A. 2024. Pengaruh Keefektifan Kinerja Robot" Apilastik" Terhadap Kepuasan Pengguna Dalam Mengidentifikasi Kerusakan Pada Gelas Air Mineral. *Jurnal Penelitian Rumpun Ilmu Teknik*. 3(1):121–126.
Rasya RH, Hardianto J, Siskandar R. 2020. Rancang Bangun Sistem Monitoring Kualitas Air Bersih Pada Konsumen PERUMDA Tirta Pakuan Bogor Berbasis web. *Jurnal Sains Indonesia*. 1(3):113–121.
Ridwan S, Indrawan NA, Billi RK, Sesar HS, others. 2020. Implementation of sortir machine engineering as determination of maturity of orange and red tomato based on image processing. *Jurnal Teknik Pertanian Lampung*. 9(3):222–236.
Rohim AA, Rahmah H, Aziezah N, Siskandar R, Setiawan A. 2024. PENGARUH HUBUNGAN ANTARA FITUR DAN PENAMPILAN DENGAN KETERTARIKAN PENGGUNA ROBOT QUALITY CHECK'APILASTIK'. *TEKTONIK: Jurnal Ilmu Teknik*. 1(2):228–232.
Sagala SH, Nugraha I, Siskandar R. 2020. Pembuatan Motion Graphics SOP Produksi Berita sebagai Media Promosi di PT Bintang Advis Multimedia. *Jurnal Sains Indonesia*. 1(3):152–161.
Santosa SH, Hidayat AP, Siskandar R, Rizkiriani A. 2021. Pengaruh Harga Jual Terhadap Permintaan Telur Ayam Menggunakan Pendekatan Regresi Studi Kasus: Agen Telur ABC. *Jurnal Sains Indonesia*. 2(3):106–112.
Santosa SH, Hidayat AP, Siskandar R, Rizkiriani A. 2023a. Production Scheduling Based on Smart Forecasting Model of Bottled Mineral Water Products. Di dalam: *E3S Web of Conferences*. Volume ke-454. hlm 3003.
Santosa SH, Indrawan P, Apriliani F, Siskandar R, Bayyinah AN, Septiyaningsih L. 2023b. Penjadwalan Produksi Optimal Air Mineral Kemasan Gelas Menggunakan Pendekatan jadwal Induk Produksi. *Jurnal Sains Indonesia*. 4(3):242–248.
SATRIATAMA R, DARLIS D, PANGARIBUAN P. 2020. Sistem Kontrol Troli Rotari Sebagai Tempat Penitipan Barang Otomatis Menggunakan Fuzzy Logic. *ELKOMIKA: Jurnal Teknik Energi Elektrik, Teknik Telekomunikasi, & Teknik Elektronika*. 8(3):575.
Siskandar R. 2011. Sintesa dan Karakterisasi Sifat Mekanik Membran Polisulfon yang Didadah Titanium Dioksida.
Siskandar R. 2013. Sensor Suhu Berbasis Bahan Ferroelektrik Film Ba0, 55 Sr0, 45tio3 (Bst) Berbantukan Mikrokontroler Atmega 8535. *Jurnal Biofisika*. 9(2).
Siskandar R, Dio FC, Alatas H, Irzaman I. 2021. Application Of Ba0. 5Sr0. 5TiO3 (Bst) Film Doped With RuO2 (0%, 2%, 4% and 6%) On A Rice-Stalk Cutting Robot Model Based On A Line Follower With Hc-05 Bluetooth Control.
Siskandar R, Fadhil MA, Kusumah BR, Irmansyah I, Irzaman I. 2020a. Internet of Things: Automatic plant watering system using Android. *Jurnal Teknik Pertanian Lampung (Journal of Agricultural Engineering)*. 9(4):297–310.
Siskandar R, Indrawan NA, Kusumah BR, Santosa SH, Irmansyah I. 2020b. Penerapan Rekayasa Mesin Sortir sebagai Penentu Kematangan Buah Jeruk dan Tomat Merah Berbasis Image Processing

[Implementation of Sortir Machine Engineering as Determination of Maturity of Orange and Red Tomato Based on Image Processing]. *J Tek Pertan Lampung*. 9(3):222–236.

Siskandar R, Indrawan NA, Kusumah BR, Santosa SH, Irmansyah I. 2020c. Penerapan Rekayasa Mesin Sortir sebagai Penentu Kematangan Buah Jeruk dan Tomat Merah Berbasis Image Processing [Implementation of Sortir Machine Engineering as Determination of Maturity of Orange and Red Tomato Based on Image Processing]. *J Tek Pertan Lampung*. 9(3):222–236.

Siskandar R, Kusumah BR. 2019a. Control device engineering for aquaponic monitoring system. *Aquacultura Indonesiana*. 20(2):72.

Siskandar R, Kusumah BR. 2019b. Design and construction of control devices for aquaponic monitoring management. *Aquacultura Indonesiana*. 20(2):16–23.

Siskandar R, Kusumah BR. 2019c. Design and construction of control devices for aquaponic monitoring management.

Siskandar R, Mandang T, Hermawan W, Irzaman I. 2023a. Engineering of Information Monitoring System Sensor Reading Data Based on Smart Wireless using NVDIA Jetson Nano and Arduino Mega on Agricultural Spraying Machines. *Jurnal Teknik Pertanian Lampung (Journal of Agricultural Engineering)*. 12(4):921–936.

Siskandar R, others. Synthesis and Application of Ba0. 55Sr0. 45TiO3 Film as Light Sensor and Temperature Sensor In Auto Dryer System Model of Agricultural Products Based on Microcontroller ATMega8535.

Siskandar R, Pramudianto RD, Hasan NA, Novianty I. 2017. Penerapan komunikasi berbasis cahaya tampak pada prototipe kendaraan remote control guna meningkatkan keamanan dan automatisasi komunikasi antar kendaraan. Di dalam: *Seminar Nasional*. hlm 261–268.

Siskandar R, Santosa SH, Wiyoto BRK, Hidayat AP. Control and Automation: Insmoaf (Integrated Smart Modern Agriculture and Fisheries) on The Greenhouse Model (Kontrol dan Otomatisasi: Insmoaf (Integrated Smart Modern Agriculture and Fisheries) pada Model Rumah Kaca).

Siskandar R, Santosa SH, Wiyoto W, Kusumah BR, Hidayat AP. 2022a. Control and automation: Insmoaf (Integrated Smart Modern Agriculture and Fisheries) on the greenhouse model. *Jurnal Ilmu Pertanian Indonesia*. 27(1):141–152.

Siskandar R, Santosa SH, Wiyoto W, Kusumah BR, Hidayat AP. 2022b. Control and automation: Insmoaf (Integrated Smart Modern Agriculture and Fisheries) on the greenhouse model. *Jurnal Ilmu Pertanian Indonesia*. 27(1):141–152.

Siskandar R, Wiyoto W, Hendriana A, Ekasari J, Kusumah BR, Halim G, Nugraha IJ. 2022c. Automated Redox Monitoring System (ARMS): An Instrument for Measuring Dissolved Oxygen Levels Using a Potential Redox Sensor (ORP) in a Prototype of Shrimp Farming Pond with an Internet-Based Monitoring System. *Journal of Aquaculture and Fish Health*. 11(2):238–246.

Siskandar R, Wiyoto W, Santosa SH, Hidayat AP, Rifa B, Kusumah MDMD. 2023b. Prediction of Freshwater Fish Disease Severity Based on Fuzzy Logic Approach, Arduino IDE and Proteus ISIS.

Siskandar R, Wiyoto W, Santosa SH, Sari JE, Darmawangsa GM, Hidayat AP, Dardanella D, Kusumah BR. 2023c. Potential Readings of Water Turbidity Values Based on Optical Sensors on Fish-Rearing Biofloc Media. *Photonics Lett Pol*. 15(1):1–3.

Taupiko A, Azmi Z, Ishak I, Dahria M. 2023a. Alat Penghitung Produksi Kotak Air Menggunakan Teknik Counter Berbasis Mikrokontroler. *Jurnal Sistem Komputer Triguna Dharma (JURSIK TGD)*. 2(1):60–69.

Taupiko A, Azmi Z, Ishak I, Dahria M. 2023b. Alat Penghitung Produksi Kotak Air Menggunakan Teknik Counter Berbasis Mikrokontroler. *Jurnal Sistem Komputer Triguna Dharma (JURSIK TGD)*. 2(1):60–69.

Wiyoto W, Siskandar R, Dewi RK, Lesmanawati W, Mulya MA, Ekasari J. 2023. Effect of stocking density on growth performance of African catfish Clarias gariepinus and water spinach Ipomoea aquatica in aquaponics systems with the addition of AB mix nutrient. *Jurnal Akuakultur Indonesia*. 22(1):47–54.

Yanti SD, Rahma H, Aziezah N, Siskandar R, Setiawan A. 2023. Analisis Pengaruh Artificial Intelligence Berbasis Images Preprocessing dalam Implementasi Deteksi Kematangan Buah Tomat. *Jurnal Penelitian Teknologi Informasi dan Sains*. 1(4):39–48.

Yoridho DD, Adi SH, Siskandar R. 2020. Rancang Bangun Sistem Navigasi Kekeringan dan Meluapnya Air pada Lahan Berbasis web di BALITKLIMAT. *Jurnal Sains Indonesia*. 1(3):144–151.