UNIVERSITAS AMIKOM YOGYAKARTA

CONFERENCE BOOK

3rd ICOIACT 2020

International Conference on Information and Communications Technology

Exploring the Role of Artificial Intelligence for Creative Industry 4.0

24 - 25 November, 2020
Indonesia

Organized By

UNIVERSITAS AMIKOM YOGYAKARTA

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PREFACE

Let us expressed our gratitude to Allah SWT because, with His permission, we can organize the 3rd International Conference on Information and Communications Technology 2020 (The 3rd ICOIACT 2020) 24th – 25th November 2020. This conference is an annual event jointly organized by Universitas Amikom Yogyakarta, Amikom IEEE Student Branch, and technically co-sponsored by IEEE Indonesian Section.

Conference Committee would like to express our gratitude to the honorable keynote speakers for sharing their knowledge in the plenary session of this conference. We are also very grateful to all participants coming from various institutions from 10 countries, four continents. High appreciation is also addressed to all committee members who have worked hard for this conference's success.

This conference program is designed to help participants to find relevant information related to this conference, such as schedule and paper abstracts in this conference. However, should there be any confusion associated with this conference, please feel free to approach one of our committee members.

At last, we apologize for any mistakes in managing this conference, from the paper submission process until the post-conference activity.

Yogyakarta, November 2020
The 3rd ICOIACT 2020 Committee

WELCOME SPEECH FROM THE GENERAL CHAIR OF ICOIACT 2020

Welcome to the third International Conference of Information Communication and Technology (ICOIACT) 2020.

I am glad to welcome the honorable speaker and excellent participant from all around the world at this conference. ICOIACT started three years ago to enable a meeting point between academia, industry, and government to share their research achievement in information and communication technology for better human life.

This year, in an unprecedented situation due to the COVID-19 pandemic, the committee migrate the conference into a fully online forum under the strict regulation of IEEE. We bring forward the topic "Exploring the role of Artificial Intelligence for creative industry 4.0.". Considering that this year the world is experiencing a historical moment of an unplanned digital revolution, the role of information and communication technology has to take their role and responsibility to keep the world running more than ever in human history. We cannot imagine most of the schools and universities in the world adopt online learning in a matter of months. Healthcare now desperately needs technology to deliver a service with minimum contact to avoid the virus's spread. Supermarket, convenience store, and even the traditional market has to migrate their business into online commerce. The facts have emerged in less than a year since the COVID-19 was detected in China in late 2019.

Today, scientists have to take their roles and responsibilities to share their expertise to solve the problem in the new world order. The world still lacks an understanding of how human can change their social relationship, healthy behavior, and many more unprecedented transformation of human life. Researchers have to take their responsibility to find out an explanation, methods, and tools to enable people to adapt to the new way of life. In the field of artificial intelligence, for example, we need to improve our online learning with extra information on participant's engagement, their learning attitude to enhance the online learning experience. In supporting public health, computer scientists have to improve and invent online health assessment and monitoring. The demand for such technology right now remains high, and everyone is waiting for our contribution to humanity.

Finally, I would like to extend our sincere gratitude and appreciation for all of the hard work and dedication provided by the technical program committee, reviewers, and keynote speakers.

I would like to express my gratitude to the steering committee members, the conference chairman, the organizing committee, the IEEE Indonesian Section, IEEE Student Branch of Universitas Amikom Yogyakarta, and the financial support from the conference sponsors that conducted the success of The 3rd ICOIACT 2020.

The General Chair of 3rd ICOIACT 2020

Dr. Arief Setyanto, S.Si.,MT

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CONFERENCE INFORMATION

Dates	: November, 24th 2020 - November, 25th 2020
Organizer	: Universitas Amikom Yogyakarta
Venue	: Zoom Virtual Meeting
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Secretariat	: Universitas Amikom Yogyakarta Jl. Ring Road Utara, Condong Catur, Sleman, Yogyakarta, Indonesia 55281
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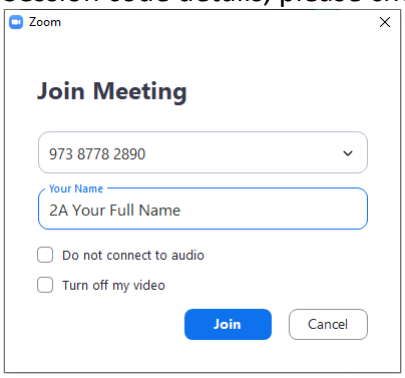

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Time		Room A	Room B	Room C	Room D	Room E
Monday, November 23, 2020						
01:00 pm - 03:00 pm	180	**Practice: Free Practice + Simulation** (id: 963 1816 8547 | pass: precon)				
Tuesday, November 24, 2020						
06:30 am - 07:00 am	30	**Log In: Log in to ZOOM Meeting** (id: 973 8778 2890 | pass: icoiact)				
07:00 am - 09:00 am	120	**1A**: Parallel Session 1-A	**1B**: Parallel Session 1-B	**1C**: Parallel Session 1-C	**1D**: Parallel Session 1-D	**1E**: Parallel Session 1-E
09:00 am - 12:00 pm	180	**Opening Ceremony + Plenary Speakers**				
09:00 am	3	Greeting from MC				
09:03 am	2	National Anthem of Republic Indonesia: "Indonesia Raya"				
09:05 am	10	Speech from The Committee as General Chair: **Dr. Arief Setyanto**				
09:15 am	15	Speech from Rector of Universitas Amikom Yogyakarta: **Prof. Dr. M. Suyanto, M.M.**				
09:30 am	15	Opening Speech from Head of Region V Higher Education Service Institute: **Prof., Didi Achjari**				
09:45 am	10	Speech form IEEE Indonesia Secsion: **Prof. Wisnu Jatmiko**				
09:55 am	5	Plenary Session Moderated by: **Dr. Alva Hendi Muhammad**				
10:00 am	45	Plenary Speaker 1: **Prof. Ir. Zainal Arifin Hasibuan, MLS., Ph.D.I.**				
10:45 am	45	Plenary Speaker 2: **Prof. Kamal Z Zamli, Ph.D.**				
11:30 am	30	Discussion: Q & A				
12:00 am	5	Closing and Photo Session				
12:05 pm - 01:00 pm	55	Break: Break Time				
01:00 pm- 03:00 pm	120	**2A**: Parallel Session 2-A	**2B**: Parallel Session 2-B	**2C**: Parallel Session 2-C	**2D**: Parallel Session 2-D	**2E**: Parallel Session 2-E
03:00 pm- 03:30 pm	30	Break: Break Time				
03:30 pm- 04:30 pm	60	**3A**: Parallel Session 3-A	**3B**: Parallel Session 3-B	**3C**: Parallel Session 3-C	**3D**: Parallel Session 3-D	**3E**: Parallel Session 3-E
05:00 pm- 05:30 pm	30	**Awarding + Closing Ceremony**				

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PROFILE PLENARY SPEAKER

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Prof. Zainal A. Hasibuan, Ph.D. was born in Pekanbaru, Indonesia in 1959. He received BSc. degree in Statistic from Bogor Institute of Agriculture, Indonesia, 1986, MSc. and PhD in Information Science, Indiana University, in 1989 and 1995 respectively. Currently, he is a lecturer and PhD supervisor at Faculty of Computer Science, University of Indonesia. He is also the Head of Digital Library and Distance Learning. His research interests include e-Learning, Digital Library, Information Retrieval, Information System, and Software Engineering.

2B: Parallel Session 2-B Room: Room B

Chair: Bety Wulansari

Smart Kost: a Proposed New Normal Boarding House Controlling and Monitoring System in Industry 4.0 Era

Alfredo Gormantara, Julius Galih Prima Negara and Suyoto Suyoto

Industry 4.0 is the term for automation and transparency of data using the latest technology. This concept can be applied in several aspects of life besides the manufacturing industry. The Boarding house is a type of industry that has been thrived in D.I. Yogyakarta. It was became a place of residence for students and workers in urban areas. As one type of business, boarding houses need a good management system for best service and run efficiently. At this time the boarding house is still managed traditionally. Along with the development of IoT (Internet of Things) technology, several problems and its challenges can be solved with this technology. 5 types of sensors are used to realize this research. The sensor sends data and then the information is processed in a software application. This research uses a mobile application and integrates the sensors to monitor and control boarding rooms. This research can be used to face the new normal challenges, using the latest technology. The challenge of contactless process, energy efficiency, open information and data can be well prepared by boarding house owners. The proposed system is predicted to save electricity costs for each bedroom by approximately 38% and also affect the saving of electricity bill payments by managers.

Smart Kost: a Proposed New Normal Boarding House Controlling and Monitoring System in Industry 4.0 Era

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***Abstract* — Industry 4.0 is the term for automation and transparency of data using the latest technology. This concept can be applied in several aspects of life besides the manufacturing industry. The Boarding house is a type of industry that has been thrived in D.I. Yogyakarta. It became a place of residence for students and workers in urban areas. As one type of business, boarding houses need a good management system for the best service and run efficiently. At this time the boarding house is still managed traditionally. Along with the development of IoT (Internet of Things) technology, several problems and its challenges can be solved with this technology. 5 types of sensors are used to realize this research. The sensor sends data and then the information is processed in a software application. This research uses a mobile application and integrates the sensors to monitor and control boarding rooms. This research can be used to face the new normal challenges, using the latest technology. The challenge of contactless process, energy efficiency, open information, and data can be well prepared by boarding house owners. The proposed system is predicted to save electricity costs for each bedroom by approximately 38% and also affect the saving of electricity bill payments by managers.**

Keywords — Industry 4.0, IoT, New Normal, Smart Boarding House.

I. INTRODUCTION

Jogjakarta is a city in Indonesia that is known as a city of students, tourist cities, and also a city of culture. As a city with many visitors, the hotel industry and boarding business are growing rapidly in this city. As a city of students, Jogjakarta has been visited by students from all cities in Indonesia and overseas students. Because of this many boarding houses have sprung up offering services for their stay. Boarding houses in this city vary, ranging from simple boarding houses to boarding houses with complete room facilities. Good management is a must so that residents feel comfortable because they get good service and facilities. In terms of boarding house owners, the efficiency and effectiveness of boarding management is a must. The application of technology in the boarding industry is a belief. Technology can help someone in providing boarding houses and management. With the right technology to reduce operational costs and improve the income for the boarding house owner.

Urban development has resulted in a changing paradigm in the 21'st century and the research activities for the smarter city became priority tasks with direct participation from industrial and political entities, practitioners and the scientific community [1]. The concept of Industry 4.0 can be applied to solve the challenges of accelerating, efficiency, and improving the results of the business performance of boarding houses. The concept first appeared in Germany. These articles published at the end of 2011 by the government. The German government gave rise to the concept of "Industry 4.0" in response to industry challenges for 2020. German industry is very concerned about facing globalization and also handle the digitalization of society. The government keeps the state as an ultra-modern and innovative business partner [2]. The concept of industry 4.0 was very revolutionary and spread throughout the world including Indonesia. Not only the manufacturing industry, but the fields outside of manufacturing can also apply this concept.

The Indonesian government says the community must maintain productivity amid the COVID-19 pandemic with a new order called the new normal. The new habits, and behaviors based on adaptation to civilize clean and healthy living behaviors are what is then referred to as new normal. The method is done by washing hands regularly with soap, wearing a mask when leaving the house, keeping a safe distance, and avoiding crowds. To realize the new normal scenario, the government is currently collaborating with all relevant parties including community leaders, experts, and experts to formulate protocols or SOPs to ensure that the citizens can do their activities but remain safe from COVID-19. Human activities can be facilitated by the use of technology appropriately and efficiently. For example, in the boarding house business, with the help of IoT can reduce contact with objects that are often touched by many people by controlling using a smartphone.

The concept of Industry 4.0 makes energy efficiency one of its goals. This manufacturing system must reduce the use of energy sources by using renewable sources and the best technology [3]. As one of the industries, boarding houses can be developed into objects that are environmentally conscious and energy-efficient. Interoperability, information transparency, technical assistance and industry independent scenarios 4.0 are the objectives of this study. Besides, in facing the new order applied by the government, which is new normal, the use of technology, especially IoT, can help to reduce contact with others so that they can keep their distance and avoid the crowd. This research will focus on the use of sensors, mobile applications, and the use of IoT to automate the boarding house so that it can return to normal

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activities despite applying physical distancing.

II. LITERATURE REVIEW

A. Industry 4.0 Concept

The development of the Industry 3.0 era towards Industry 4.0 through several strategies and stages applied. Germany as a country that is concerned with technological developments the concept of Industry 4.0 prepares a strategy. The latest concepts born from this industrial world promise to increase flexibility. Industrial activists can do mass customization in industrial development as desired. Screening the demands of the times, this concept answers the challenge of increasing speed. Therefore, it is possible for the company to respond to various challenges, such as increasing product production, shortening distribution time to consumers in the market, and excellent product quality [3]. Smart Kos strives to realize the goal of Industry 4.0 revolutionary concept for performance improvement, interconnection, and open data.

This concept aims to contribute to building infrastructure that is flexible, easy to maintain, safe, and can evolve. Industry 4.0 Service Enabler (I4SEA) became a paradigm in development. Architecture targets the development of infrastructure that enables the development of Smart Grid and Smart Living. Both of these services are under industry 4.0 up-to-date principles [4]. This was stated by reference to this paper.

B. IoT and Smart Home Systems

We can describe IoT as connecting objects like computers, smartphones, sensors, and the others object to the internet which communicates each other, data exchange, and data saving. Significant progress in the concept of IoT technology over the past few years has created a new paradigm for the world of information and communication technology. This progress gives anyone, anytime, and anywhere (AAA) connectivity to things in the hope that this expands and creates a dynamic network that is fully developed from IoT. The IoT paradigm can be used to realize new concepts and broad development spaces for smart homes, to make homes smarter, more comfortable, and improved quality of life [5].

This can provide a homeroom with intelligence, increase the comfort of the home, and improve the quality of life of its residents [6]. IoT implementation can be done in developing a boarding house management system. Electrical automation systems, security systems, water metering, and several other sensors whose data can be used as valuable information. Sensors are the machine's gateway to sense its surrounding physical environments [7].

IoT system architecture also includes several types of elements which are shown as follows. Sensors a small electronic device that is used to detect changes in the sensor. This information is captured by appliances, wearable devices, some specific device mounted controls, and so on. The sensors are the devices that are useful for gathering the information at the point of activity. Thus these are the elements of IoT that sense any type of information depending upon the purpose of the application.

This research was using several sensors. The sensor is very capable of realizing the IoT concept and can help realize the Smart Kos system. The sensors are according to the reference [5][6][10][11][12] are: Relay Switch Sensor is an object that can disconnect and connect the electric current according to the programmed. This sensor is often used and programmed to connect or disconnect electricity at a certain time. This sensor can be connected to the Arduino Uno Board and connected to internet access.

Similar to the relay switch, the ACS 712 sensor is also a sensor for electricity. ACS 712 sensor is a sensor to measure current electric current or current measurement. In this research, both sensors that can disconnect the current and measuring the electric current are used. The power meter device is a device that can show electricity usage and monitor it where it is installed. In some previous studies, written this portable digital power meter can measure a three-phase power supply for small devices. This tool optimizes power usage in a plant [13]. The fingerprint sensor is one of the answers to improve security for the home. We can program when the fingerprint pattern matches the programmed one, then the system will execute the command according to what was previously set. The fingerprint sensor can be installed to identify anyone who can open the door to access a house or a room

Water flow sensors help face the challenges of the world to suppress and monitor water use. Information on water use is expected to change people's patterns of water use. In the end, the community's concern for the environment and the green earth increased [14][15]. So the peoples can use the new technologies of the mobile water meter, and get the data fast.

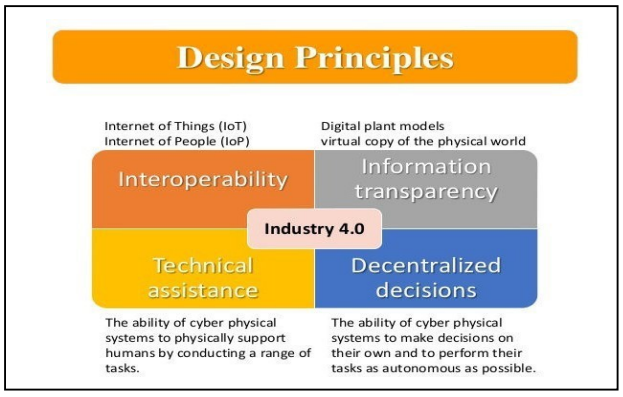
Motion sensors are devices that detect the movement of an object within a certain radius. This device called a sensor is often integrated as a component of a system that automatically performs tasks or notifies movement in an area. This device can play an important role in improving energy efficiency, increasing security, automatic light regulation, controlling the home and several other systems.

On of our concern is the greener earth. Now there is an increase in network energy consumption due to increased data rates. Increased number of services supported by the internet and fast growth of internet-connected services. Thus, green technology needs to be adopted to make energy efficient network devices [16].

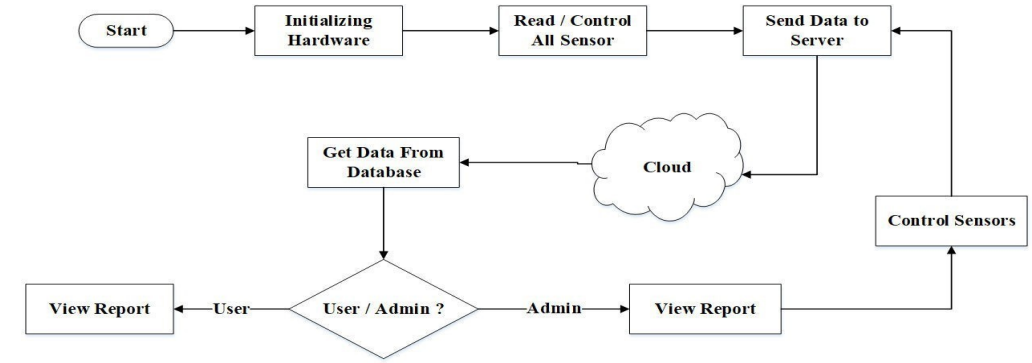
III. PROPOSED SYSTEM AND ARCHITECTURE

3.1 Principles of Industry 4.0

In industry 4.0 there are four design principles. These principles support companies or businesses in identifying and



implementing industry 4.0 scenario. That principles are



interoperability, information transparency, technical assistance, and decentralized decisions which can be seen in Figure 1.

Interoperability is the ability of one or more devices, sensors, machines, and humans to communicate with each other through the Internet of Things (IoT) or the Internet of People (IoP). So later sensors used will be connected to the Arduino device and Arduino device will send data to the server. From the server, users can be access and control sensors from a user's smartphone.

Information transparency is the ability of the system to convert physical information to virtual with those obtained through sensor data. This principle requires collecting raw sensor data to produce high-value context information. Interconnectivity allows for collecting immense amounts of data and information from all sensors in the bedroom.

Assistance systems support humans to solve problems in urgent decision making with short notice to the user. The information provided is collected and visualized comprehensively. In the form of a pie chart or graph based on electricity and water.

Decentralized decisions are the ability of the system to make decisions independently and carry out their duties as a whole. Examination for cases of interference, or several different goals, assignments took or delegated to more levels. A system that is made capable of making its own decisions such as billing the cost of renting a bedroom every end of the month and also shutting down electricity usage if the tenant has not paid from the deadline.

3.2 Description of the Proposed Architecture

This section shows the proposed architecture and design of the smart kost controlling and monitoring system. The proposed architecture is grouped into two users: Admin (Manager) and User (Tenant) in Figure 2.

The manager can monitor and control the system from their smartphone app using the internet. Arduino will collect data from sensors in the bedroom. After that data will be sent to Arduino device and sent to the server. The task of the server is to manage data, monitor, and control system components, namely the sensors module successfully execute the assigned task. Managers can control all sensors from each bedroom via smartphone. This makes it possible to monitor and control energy management systems such as lighting, electrical plugs, air conditioning, water, and security systems such as door locks.

Besides, there is an electric cut-off mode that can be scheduled by the manager. For example, if a bedroom tenant has not paid the rent for 3 months, it can be done automatically electric cuts that have been scheduled in the proposed system so that it can assist the manager in the control room rental payment. Whereas each tenant will have an account to be able to monitor electricity usage or water use and what is the total rental cost at this time.

IV. RESULT

4.1 Hardware Implementation and Smart Kost Devices

Hardware architecture in the monitor and manage smart board control is shown in illustrations such as Figure 3. In this research uses several sensors:

- ACS712 sensor for measure electricity usage
- G1/2 water debit sensor for measure water discharge
- Motion sensor for turn on/off the light automatically
- Fingerprint sensor as the key to the door opener
- Relay module for control all sensors and cut electricity in a bedroom

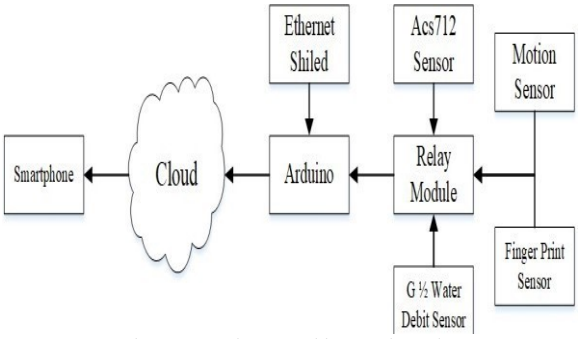
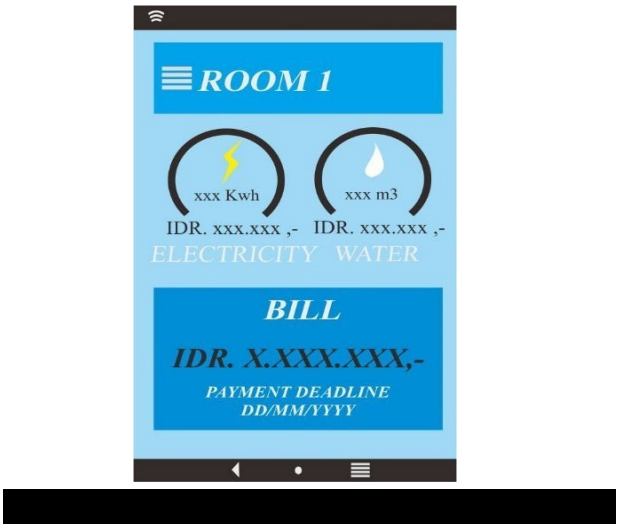


Figure 3. Hardware Architecture in Bedroom

Arduino is used as a microcontroller in the circuit. All sensors that have been installed in the bedroom will be connected to the relay module. Arduino will receive all data from the sensors and process the data. Arduino uses an Ethernet shield for connecting to the internet. After that, it will be sent to cloud computing to be stored in the database. Users will access data on the database through the application on their smartphone.



Acs712 sensor functions to measure electricity usage from a bedroom. Data from the acs712 sensor will be processed by Arduino so you can generate cost from a bedroom rental. Previous research has developed measurements of water use and using the SMS report system. These meters are present in every house and will take the water readings and send them wirelessly to the water company base station via GSM modules. The proposed system is a simple, cheap, fast, and friendly user**.** G ½ water sensor functions to measure water usage from a bedroom. Water usage costs will be summed up with electricity costs to generate room rental costs.

Motion sensors besides functioning as turning off/on the lights can also function as sensors to check the presence of people in the bedroom in Figure 5. As for the security part of the bedroom, the bedroom uses a fingerprint sensor to open the door so that it helps the manager to secure the bedrooms.

4.2 Proposed Smart Kost Application

The smart kost system proposed in the study was developed and tested. Each bedroom will install all sensors that can monitor and control by the tenant and manager. The manager can monitor and control each bedroom via smartphone. Figure 4 shows the application view of manager and tenant. Tenant or manager can monitor electricity usage and water usage in each bedroom to calculate the cost of renting a bedroom. Besides, the manager can control the electricity of each room to turn off or turn on electricity when someone has not paid the rent in Figure 5.

4.3 Test Result Analysis

Previously it has been monitoring electricity usage from several boarding rooms and produced as in table 1. From table I, the amount of electricity usage during November is 2.683KwH. So that the total cost to be paid is IDR 3.889.988 (1 KwH = IDR 1.450).

TABLE I. Electricity use in November

No Room	November		
	KwH /day	KwH / month	Bill / Month
1	9,625	288,75	IDR 418.688
2	10,225	306,75	IDR 444.788
3	9,625	288,75	IDR 418.688
4	9,625	288,75	IDR 418.688
5	9,625	288,75	IDR 418.688
6	9,625	288,75	IDR 418.688
7	10,725	321,75	IDR 466.538
8	9,625	288,75	IDR 418.688
9	10,725	321,75	IDR 466.538
Total	89,425	2.683	IDR 3.889.988

After that to show the benefits of the Smart Kost system, this research tries to calculate the reduction in electricity used in bedroom lights that have been fitted with motion sensors. Each bedroom has 3 lights with different capacities, AC, TV, and notebook as in Table II.

TABLE II. List of Electrical Equipment

Area	Total	Power (Watt)
Lamp 1	2	12
Lamp 2	1	5
AC (¾ pk)	1	530
TV	1	50
Notebook	1	45
Total	6	642

If seen from table II, there are 6 that can be controlled by room tenants, namely 3 lights, 1 AC, 1 TV, and 1 notebook. The average room tenant is a student. A student usually leaves his room for about 6 hours to go to campus. Suppose the tenant forgets to turn off the lights and air conditioning, by using the Smart Kost application they can turn off the lights and air conditioning from their smartphone anywhere so that they save electricity costs. If calculated, tenants can save electricity costs for 6 hours in Table III.

TABLE III. Estimated Calculation of Electricity Costs

Power (Watt)	Kwh / day	Bill / day	Kwh / Month	Bill / Month
642	3,852	IDR 5.585	115,56	IDR 167.562

From table III, approximately one bedroom can save costs of IDR 167,562. So the tenant can save electricity costs by approximately 38% of the previous payment. In addition to tenants, managers can also save on electricity costs due to optimal electricity usage from each room.

V. CONCLUSION

In this research, a system was proposed to assist boarding houses entrepreneurs in managing their business. The proposed system includes the principles of industry 4.0. The four principles namely Interoperability, Information transparency, Technical assistance, Decentralized decisions are embedded in all features of the Smart Kost application so that boarding houses business can compete and grow. From the results of experiments conducted with an estimate of saving electricity as much as 6 hours per day from the use of lights, AC, TV, and Notebook, it can be obtained approximately as much as 38% savings in electricity costs using the Smart Kost application. This will also affect the saving of electricity bill payments by managers.

This research also supports the implementation scenario of the new normal in the boarding house business. Boarding owners can continue to do business by minimizing physical contact with tenants. As a further step can build some systems that can help to raise energy efficiency awareness. For the next research, we also can develop a system that can arrange on or off electronics things in a room. It can be developed by changing the hardware architecture and add the relay module.

REFERENCES

[1] M. Eremia, L. Toma, and M. Sanduleac, "The Smart City Conceptin the 21st Century," *Procedia Eng.*, vol. 181, pp. 12–19,2017.

[2] H. Kargermann, W. Wahlster, and J. Helbig, "Deutschlands Zukunft als Produktionsstandort sichern: Umsetzungsempfehlungen für das Zukunftsprojekt Industrie 4.0: Abschlussbericht des Arbeitskreises Industrie 4.0," no. April, pp. 1–116, 2013.

[3] P. Zheng *et al.*, "Smart manufacturing systems for Industry 4.0: Conceptual framework, scenarios, and future perspectives," *Front. Mech. Eng.*, vol. 13, no. 2, pp. 137–150, 2018.

[4] L. Pocero, D. Amaxilatis, G. Mylonas, and I. Chatzigiannakis, "Open source IoT meter devices for smart and energy-efficient school buildings," *HardwareX*, vol. 1, pp. 54–67, 2017.

[5] S. Kumar, "Ubiquitous Smart Home System Using Android Application," *Int. J. Comput. Networks Commun.*, vol. 6, no. 1, pp. 33–43, 2014.

[6] R. Piyare, "Internet of Things: Ubiquitous Home Control and Monitoring System using Android based Smart Phone," *Int. J. Internet Things*, vol. 2, no. 1, pp. 5–11, 2013.

[7] "Service innovation and smart analytics for Industry 4." .

[8] B. Anderson, S. Lin, A. Newing, A. B. Bahaj, and P. James, "Electricity consumption and household characteristics: Implications for census-taking in a smart metered future," *Comput. Environ. Urban Syst.*, vol. 63, pp. 58–67, 2017.

[9] M. E. Shoukry and M. M. Ibrahim, "Electronic Water Billing System," *Int'l Conf. Embed. Syst. Cyber-physical Syst. Appl. | ESCS'17*, pp. 29–31, 2017.

[10] S. I. Popoola, A. A. Atayero, T. T. Okanlawon, B. I. Omopariola, and O. A. Takpor, "Smart campus: Data on energy consumption in an ICT-driven university," *Data Br.*, vol. 16, pp. 780–793, 2018.

[11] V. Fabi, G. Spigliantini, and S. P. Corgnati, "Insights on Smart Home Concept and Occupants' Interaction with Building Controls," *Energy Procedia*, vol. 111, no. September 2016, pp. 759–769, 2017.

[12] M. Pau *et al.*, "A cloud-based smart metering infrastructure for distribution grid services and automation," *Sustain. Energy, Grids Networks*, vol. 15, pp. 14–25, 2018.

[13] I. Elamvazuthi, M. K. A. Ahamed Khan, S. B. Bin Shaari, R. Sinnadurai, and M. Amudha, "Electrical power consumption monitoring using a real-time system," *2012 IEEE Conf. Sustain. Util. Dev. Eng. Technol. STUDENT 2012 - Conf. Bookl.*, no. October, pp. 295–298, 2012.

[14] M. Suresh, U. Muthukumar, and J. Chandapillai, "A novel smart water-meter based on IoT and smartphone app for city distribution management," *TENSYMP 2017 - IEEE Int. Symp. Technol. Smart Cities*, no. July, 2017.

[15] N. Bawane, P. K. Gautam, A. Dewase, V. Mishra, and S. S. Go, "Automation of Irrigation System using Android Technology," vol. 7, no. 3, pp. 5580–5582, 2017.

[16] R. Khan, S. U. Khan, R. Zaheer, and S. Khan, "Future internet: The internet of things architecture, possible applications and key challenges," *Proc. - 10th Int. Conf. Front. Inf. Technol. FIT 2012*, pp. 257–260, 2012.