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Implementation of an IoT-Based Smart Water System as a Means in Monitoring the Use of Consumer Water Debit Using Photovoltaic in Seboro Village Probolinggo

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Abstract

Seboro Village, which is located in Probolinggo Regency, has a BUMDES whose business unit is the “Sumber Abadi” Drinking Water Supply Facility Management Group (KP.SPAM). The group is engaged in the field of consumption water which will be used by the people of Seboro Village who subscribe. In its implementation, the manager will monitor the use of conventional consumer water discharge by coming to each house that subscribes as a step to calculate the cost of billing water usage per month. This community service activity program aims to make it easier for water managers to monitor the use of consumer water discharge in the "Sumber Abadi" Drinking Water Procurement Facility Management Group (KP.SPAM) by creating an IoT-based smart water system using Photovoltaic. With the smart water system, it is hoped that the manager's work in monitoring the use of water discharge for consumers will be more effective and efficient because the manager does not need to record directly to the location of the consumer's home and can do this by monitoring the use of water discharge using apps/websites remotely. Another advantage of this tool is that data storage management for water discharge usage is more regular because the data will be stored on a cloud server. The source of electricity from an IoT-based smart water system device using photovoltaic as a renewable energy from solar irradiation is converted to electrical energy as a step from environmentally friendly energy.

Keywords: Smart Water System, IoT, Photovoltaic, Consumer Water Debit

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INTRODUCTION

BUMDES or Village-Owned Enterprises are business entities that are useful in meeting community needs such as basic needs and the availability of human resources capable of managing business entities in driving the community's economy (Anggarani & Puspitosarie, 2020; Dhone, 2022; Fitrianita dkk., 2022; Isnaini & Nawangsari, 2018; Maulidiah & Megawati, 2022; Munawir dkk., 2022; Nisaa & Hidayati, 2022). One of the villages in Probolinggo Regency that established BUMDES is Seboro Village which has several business units, one of which is the "Sumber Abadi" Drinking Water Procurement Facility Management Group (KP.SPAM). The Drinking Water Procurement Facilities Management Group (KP.SPAM) "Sumber Abadi" is one of the fastest growing businesses because the quality of the water sources in Seboro Village is known to be clean. In terms of water usage by consumers, the manager uses the conventional method, namely by visiting every month at the subscribed house to record the water discharge which is used to determine the bill. This is inefficient and takes a lot of time because you have to monitor directly the subscribed house(Gunastuti, 2018; Imansyah & Widiastuti, 2022; Utomo dkk., 2021).

Figure 1. "Sumber Abadi" Drinking Water Procurement Facility Management Group (KP.SPAM)

The problem encountered by the Seboro Village Drinking Water Procurement Facility Management Group (KP.SPAM) is that the manager must check the water meter usage of each subscribed house directly to find out the amount of usage in that month by calculating the difference between the current and previous months. The total water usage will be used to determine the amount of bill that must be paid by multiplying the nominal amount of money per unit (m3). The process of checking and controlling water carried out by managers is inefficient and takes a lot of time considering that current technological developments can help with this problem.

Figure 2. Water Meter Recording Every Month

Therefore, in overcoming the problem of monitoring water meters carried out by managers, a solution or method using technology is needed. The technology is simple and capable of monitoring water consumers who subscribe without having to come to the location directly, making it more efficient and optimal. Apart from that, managers are also able to apply knowledge in using facilities to monitor consumer water consumption.

Based on the background description above, the service team is interested in designing a tool for monitoring consumer water discharge based on IoT. The function of this tool is to monitor the water discharge used in real time and will be displayed directly on the display at the measurement location or outside the location using apps/websites, making it easier for managers. Apart from that, consumers can also directly monitor apps/websites for water usage. The apps/website will also immediately display the conversion price that must be paid for water usage. IoT itself functions as remote monitoring of water usage which will later be sent to the cloud server as storage media and displayed in the form of apps/websites(Budiarti dkk., 2019; C.G. dkk., 2019; Jewel & Al Mamun, 2022; Munara dkk., 2022; Prawiyogi & Anwar, 2023; Roy dkk., 2022; Sujito, Mayrawan, dkk., 2021; Sujito, Syah, dkk., 2021). This water usage monitoring tool also uses Photovoltaic which functions as a producer of electrical energy which makes the tool not dependent on electrical energy from PLN and can stand alone (Abdillah dkk., 2020, 2022; Erlina dkk., 2023; Faiz dkk., 2023; Falah dkk., 2023; Ilman dkk., 2021; Parningotan dkk., 2023). It is hoped that this technology will make it easier for water managers to monitor consumer water usage so that they do not need to record directly at the consumer's home location.

METHOD

For problem solving and solutions offered to the "Sumber Abadi" Drinking Water Procurement Facility Management Group (KP.SPAM) in Seboro Village, it is structured with the following problem solving framework:

1. Create an IoT-based Smart Water System tool as a means of monitoring consumer water usage using photovoltaics to monitor water usage remotely.
2. Design and installation of IoT-based Smart Water System equipment in the "Sumber Abadi" Drinking Water Procurement Facilities Management Group (KP.SPAM).
3. Testing the performance of the IoT-based Smart Water System tool that has been provided to partners. This test was carried out to find out that the IoT-based Smart Water System tool works well and according to its function.
4. Training on the use of IoT-based Smart Water System tools for the "Sumber Abadi" Drinking Water Procurement Facilities Management Group (KP.SPAM).
5. Evaluation.

For problem solving and solutions offered to the "Sumber Abadi" Drinking Water Procurement Facility Management Group (KP.SPAM) in Seboro Village, it is structured with the following problem solving framework:

A series of activity methods carried out by the community service team to implement the IoT-based Smart Water System tool for the Drinking Water Supply Facility Management Group (KP.SPAM) "Sumber Abadi":

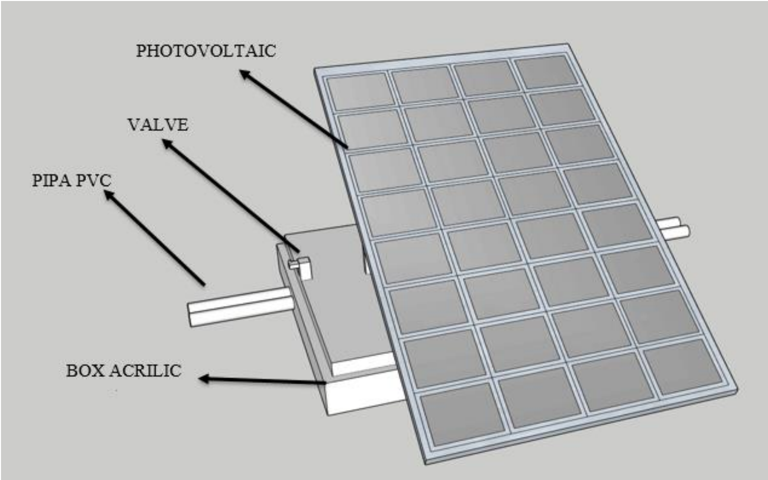
1. Observation

The aim of the observation stage is to analyze needs and identify problems by partners, usually this stage is carried out by direct interviews with all members and owners of the partner. The service team will immediately go to the partner's location and document the interview taking place (Arisanti & Islamiyah, 2020; Azhari dkk., 2023; Putri dkk., 2023).

2. Planning and Designing IoT-Based Smart Water System Tools

At this stage the service team will prepare a series of activity schedules, purchase equipment and materials needed to create an IoT-based smart water system and determine a training location with the "Sumber Abadi" Drinking Water Procurement Facilities Management Group (KP.SPAM).

Figure 3. Design of Consumer Water Usage Monitoring IoT-based smart water system



The following are the steps in the process of making an IoT-based Smart Water System, as follows:

a. Creation of a series of IoT-based smart water system tools.
b. Making a charging system from photovoltaic to battery using SCC.
c. Creating a C++ program on the NodeMCU to activate the water flow sensor so that it can be read by the system for monitoring water discharge.
d. Creating an IoT-based monitoring feature with water usage data will be sent to the cloud server for data storage via the protocol used and will be displayed on the LCD at the equipment location and will also be displayed on the apps/website for the user (Data Record).
e. Assembly

The tools needed to design an IoT-based smart water system are as follows:

a. Cables for electrical installations and control with IoT, electricity sources (photovoltaic) and electricity storage sources (batteries).
b. Solar Charging Control (SCC) as a control for the electrical power produced by the photovoltaic which will later be transferred to the battery.
c. Photovoltaic produces energy from solar irradiation sources which will later be converted into electricity.
d. NodeMCU controls the water flow sensor in monitoring water discharge and will be displayed on the LCD and sends monitoring results data to the cloud server and can be displayed on the apps/website interface for the user.
e. LCD as a display of water flow sensor readings for water flow usage.
f. Water flow sensor as a sensor for reading water usage discharge (m3).
g. The MQQT protocol is a communication protocol for sending data received by the NodeMCU from the water flow sensor and will be forwarded to the cloud server and user apps/websites via this protocol.
h. IoT as remote monitoring of device operations.

RESULT AND DISCUSSION

This community service has produced great results with far-reaching implications. The program aims to address the challenges faced by water management authorities in accurately monitoring water consumption while minimizing the need for labor-intensive in-person data collection visits to consumers' homes. By integrating smart technology with renewable energy sources, the project aims to simplify water management practices, increase efficiency and encourage more sustainable water consumption behavior among rural residents.

Figure 4. (a) and (b) Implementation of IoT-based smart water system using Photovoltaic

(a) (b)

The implementation of IoT-based smart water system using Photovoltaic marks a significant milestone. Through the deployment of IoT devices equipped with sensors and data communication modules, real-time water usage data is collected and sent to a central platform. This provides water management authorities with information about consumer consumption patterns. As a result, the need for physical visits to record water usage directly from consumers' homes is greatly reduced. This not only saves time and resources but also eliminates potential errors that may arise from manual data collection.

The use of solar panels (photovoltaic) as a power supply for Smart Water devices further strengthens the sustainability of this program. By utilizing solar energy, this system operates autonomously, ensuring continued functionality without requiring electricity from PLN. This aspect not only emphasizes the environmental awareness of the project but also contributes to its long-term viability by minimizing operational costs. This combination of advanced technology and sustainable energy sources not only modernizes water management practices but also provides an example for other rural communities facing similar challenges.

Figure 5. Handover of of IoT-based smart water system using Photovoltaic to the Head of Seboro Village

The results of this community service activity are more than just the implementation of technology. By empowering consumers to monitor their water consumption patterns through a provided interface, the program encourages a sense of ownership and responsibility among village residents. This new awareness encourages individuals to adopt more careful water use practices, thereby contributing to overall conservation efforts. Additionally, the program fosters a collaborative environment where water management authorities and consumers work together to achieve a common goal – efficient and sustainable water management. This collaboration is critical to the continued success of these projects, as it ensures the survival of new practices and technologies in society.

CONCLUSION

This community service activity offers transformative solutions to make water management practices more effective. By utilizing advanced technology and renewable energy, this project succeeded in eliminating the need for manual recording of water consumption on site. The system's real-time monitoring capabilities provide accurate insight into consumer water usage, empowering water management authorities to make informed decisions without having to collect physical data at each consumer's residence. This innovative approach not only increases the efficiency of water resource management but also encourages sustainable practices by enabling consumers to visualize and manage their water consumption patterns. This project is a testament to the potential of smart technology to revolutionize community engagement, optimize resource utilization, and contribute to the overall advancement of rural water management practices. The implementation of IoT-based smart water system using Photovoltaic in Seboro Village is an example of a paradigm shift in monitoring water use. By reducing the need for in-person household visits to record water consumption, this tool not only simplifies the task of water managers but also empowers consumers to actively participate in water conservation efforts. This community service activity demonstrates the significant impact of combining technology, renewable energy and community engagement to effectively address local challenges. As smart systems continue to develop, there is potential for greater optimization of water management processes, further underscoring the importance of implementing innovative solutions for sustainable development in rural areas such as Seboro Village.

REFERENCES

Abdillah, H., Afandi, A. N., Falah, M. Z., & Firmansah, A. (2020). Solar Energy Monitoring System Design Using Radio Frequency for Remote Areas. *2020 International Conference on Smart Technology and Applications (ICoSTA)*, 1–6.

Abdillah, H., Afandi, A. N., Hadi, M., Wibawa, A. P., Firmansah, A., & Falah, M. (2022). IoT based PJUTS performance monitoring system utilizing extended star topology. *AIP Conference Proceedings*, *2453*(1).

Anggarani, D., & Puspitosarie, E. (2020). Pengembangan Ekonomi Dan Peningkatan Pendapatan Asli Desa (Pad) Melalui Bumdes Di Desa Sumberporong Kecamatan Lawang. *Conference on Innovation and Application of Science and Technology (CIASTECH)*, *3*(1), 63–68.

Arisanti, D., & Islamiyah, S. A. (2020). Pemanfaatan Ampas Tahu dalam Pembuatan Sosis Nabati bagi Siswa SMKN 4 Gorontalo Utara Kabupaten Gorontalo. *Jurnal Ilmiah Pangabdhi*, *6*(2), Article 2. https://doi.org/10.21107/pangabdhi.v6i2.7764

Azhari, M. H. R., Syah, A. I., Falah, M. Z., Handoko, W. T., Afifah, F. W., & Sucipto, S. (2023). Strategies for empowering persons with disabilities to increase technology-based creativity in the pdk- pro community probolinggo regencY. *Community Development Journal : Jurnal Pengabdian Masyarakat*, *4*(4), Article 4. https://doi.org/10.31004/cdj.v4i4.18162

Budiarti, R. P. N., Tjahjono, A., Hariadi, M., & Purnomo, M. H. (2019). Development of IoT for Automated Water Quality Monitoring System. *2019 International Conference on Computer Science, Information Technology, and Electrical Engineering (ICOMITEE)*, 211–216. https://doi.org/10.1109/Icomitee.2019.8920900

C.G., R., V.A., T., Liloja, & Shahzad, M. (2019). IOT Based Water Quality Monitoring with Android Application. *2019 Third International conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC)*, 446–451. https://doi.org/10.1109/I-SMAC47947.2019.9032468

Dhone, M. K. F. (2022). *Peran badan usaha milik desa (bumdes) dalam pengelolaan air bersih di desa ulubelu kecamatan golewa kabupaten ngada provinsi nusa tenggara timur* [PhD Thesis]. Institut Pemerintahan Dalam Negeri.

Erlina, Suyanto, H., Diantari, R. A., & Pramono, T. J. (2023). Optimization Of Photovoltaic Types Of Solar Modules For Batteries On Load Characteristics. *2023 4th International Conference on High Voltage Engineering and Power Systems (ICHVEPS)*, 92–97. https://doi.org/10.1109/ICHVEPS58902.2023.10257548

Faiz, M. R., Sujito, S., Putranto, H., Muladi, M., Falah, M. Z., & Syah, A. I. (2023). Utilizing renewable alternative energy sources for public street lighting in sambigede village. *Community Development Journal : Jurnal Pengabdian Masyarakat*, *4*(3), Article 3. https://doi.org/10.31004/cdj.v4i3.17538

Falah, M. Z., Handoko, W. T., Syah, A. I., Azizah, F. Z., Sujito, & Gumilar, L. (2023). Implementation of smart farming based solar cell system in hydroponic in the agricultural area of blitar village. *Community Development Journal : Jurnal Pengabdian Masyarakat*, *4*(4), Article 4. https://doi.org/10.31004/cdj.v4i4.18161

Fitrianita, N., Setiawati, B., & Mone, A. (2022). Strategi Pengelolaan Badan Usaha Milik Desa (Bumdes) Di Desa Maccini Baji Kecamatan Bajeng Kabupaten Gowa. *Kajian Ilmiah Mahasiswa Administrasi Publik (KIMAP)*, *3*(2), Article 2.

Gunastuti, D. A. (2018). Pengukuran debit air pelanggan air bersih berbasis iot menggunakan raspberry pi. *EPIC (Journal of Electrical Power, Instrumentation and Control)*, *1*(2), 167–175.

Ilman, A. F., Jauhari, M., Nur, M., & Dzulkiflih. (2021). Design of DC-Voltage Arc Fault Detection Equipment In Solar Power Generating System. *2021 Fourth International Conference on Vocational Education and Electrical Engineering (ICVEE)*, 1–6. https://doi.org/10.1109/ICVEE54186.2021.9649737

Imansyah, N., & Widiastuti, S. H. (2022). Sistem Kontrol dan Monitoring Penggunaan Air Berbasis IoT Menggunakan Modul ESP8266. *Jurnal Informasi dan Teknologi*, 108–113.

Isnaini, A. J., & Nawangsari, E. R. (2018). Peran Badan Usaha Milik Desa (BUMDES)"Usaha Mandiri Sejahtera" Dalam Pengelolaan Himpunan Penduduk Pemakai Air Minum (HIPPAM) Di Desa Kesamben Wetan Kecamatan Driyorejo Kabupaten Gresik. *Dinamika Governance: Jurnal Ilmu Administrasi Negara*, *8*(2).

Jewel, M. H., & Al Mamun, A. (2022). Internet of Things (IoT) for Water Quality Monitoring and Consumption Management. *2022 4th International Conference on Sustainable Technologies for Industry 4.0 (STI)*, 1–5. https://doi.org/10.1109/STI56238.2022.10103355

Maulidiah, N., & Megawati, S. (2022). Implementasi kebijakan badan usaha milik desa (bumdes) dalam pengembangan desa wisata (studi pada bumdes sambimadu, desa sambibulu, kecamatan taman, kabupaten sidoarjo). *Publika*, 391–406. https://doi.org/10.26740/publika.v10n2.p391-406

Munara, M., Kumar, N., & Shanmugam, K. (2022). Recommending IoT based Real-time Water Quality Monitoring System in Malaysia. *2022 IEEE 2nd Mysore Sub Section International Conference (MysuruCon)*, 1–5. https://doi.org/10.1109/MysuruCon55714.2022.9972745

Munawir, Z., Riyanto, R., & Mulia, A. (2022). Sosialisasi pentingnya badan usaha milik desa (bumdes) di desa jatikesuma kecamatan namo rambe kabupaten deli serdang provinsi sumatera utara. *Jurnal Pengabdian Kontribusi Unhamzah*, *1*(2), Article 2.

Nisaa, K., & Hidayati, N. (2022). Peranan Badan Usaha Milik Desa (Bumdes) dalam Pemberdayaan Masyarakat di Desa Lambang Sari. *Jurnal Sosial Dan Sains*, *2*(7), Article 7. https://doi.org/10.59188/jurnalsosains.v2i7.444

Parningotan, H. T. S., Tampubolon, D. K. F., & Hendriyanto, A. K. (2023). Semau solar hybrid interactive microgrid. *27th International Conference on Electricity Distribution (CIRED 2023)*, *2023*, 4078–4082. https://doi.org/10.1049/icp.2023.0456

Prawiyogi, A. G., & Anwar, A. S. (2023). Perkembangan Internet of Things (IoT) pada Sektor Energi: Sistematik Literatur Review. *Jurnal MENTARI: Manajemen, Pendidikan dan Teknologi Informasi*, *1*(2), 187–197.

Putri, N. P., Saputro, E. A., & Panjaitan, R. (2023). Pelatihan Pembuatan Susu Kefir di Desa Giripurno Kota Batu Malang. *Jurnal Ilmiah Pangabdhi*, *9*(1), Article 1. https://doi.org/10.21107/pangabdhi.v9i1.18045

Roy, A., Mukhopadhyay, S., & Roy, S. (2022). IoT Based Water Quality Monitoring System. *2022 Second International Conference on Computer Science, Engineering and Applications (ICCSEA)*, 1–4. https://doi.org/10.1109/ICCSEA54677.2022.9936512

Sujito, Mayrawan, D., Wirawan, I. M., Aziz, F. S., Syah, A. I., & Shidiqi, M. A. A. (2021). *Development Internet of Things for Water Quality Monitoring System for Gouramy Cultivation*. 197–201. https://doi.org/10.2991/ahe.k.210205.035

Sujito, Syah, A. I., Zaeni, I. A. E., Mayrawan, D., Hadi, M. S., Wirawan, I. M., & Aziz, F. S. (2021). *Water Quality Monitoring System in Guorami Fish Cultivation Based on Microcontroller*. 119–122. https://doi.org/10.2991/ahe.k.210205.022

Utomo, W. A., Nugroho, A., & Nugroho, M. (2021). Alat Pengukur Debit Air dan Harga Menggunakan Mikrokontroler Arduino Uno Berbasis IoT. *Go Infotech: Jurnal Ilmiah STMIK AUB*, *27*(1), 25–32.