

IMPLEMENTATION OF THE INTERNET OF THINGS IN ENERGY BUDGET EFFICIENCY IN THE OPD OF SEMARANG CITY



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Abstract

This research reviews the potential and strategies for implementing the Internet of Things (IoT) in increasing the efficiency of energy use and reducing the energy budget in Semarang City Regional Apparatus Organizations (OPD). The research method used is qualitative with data collection techniques through interviews, observation, and documentation. The research results show that IoT has great potential to increase energy efficiency in the Semarang City OPD. This potential can be optimized through several strategies, such as building integrated IoT infrastructure, implementing energy monitoring and control systems, using energy-saving devices, and increasing awareness and education of energy users.

Keywords: Implementation of the Internet of Things, Energy Budget Efficiency, Semarang City OPD

INTRODUCTION

The increase in energy consumption in various Regional Apparatus Organizations (OPD) in Semarang City has been in the spotlight in recent years. This phenomenon not only indicates the growth of administrative activities but also has a significant economic impact on the Semarang City Government (Mashuri e Zulfa 2022). With increasingly large energy budgets, the sustainability of energy management in OPD becomes a critical thing to consider.

In this context, the Internet of Things (IoT) emerges as an attractive solution. IoT, as a technology that allows electronic devices to connect and communicate via the internet, promises significant innovation in energy management (Singh 2023). The potential of IoT to optimize energy use in various sectors, including energy management in OPD environments, is an interesting area for further research.

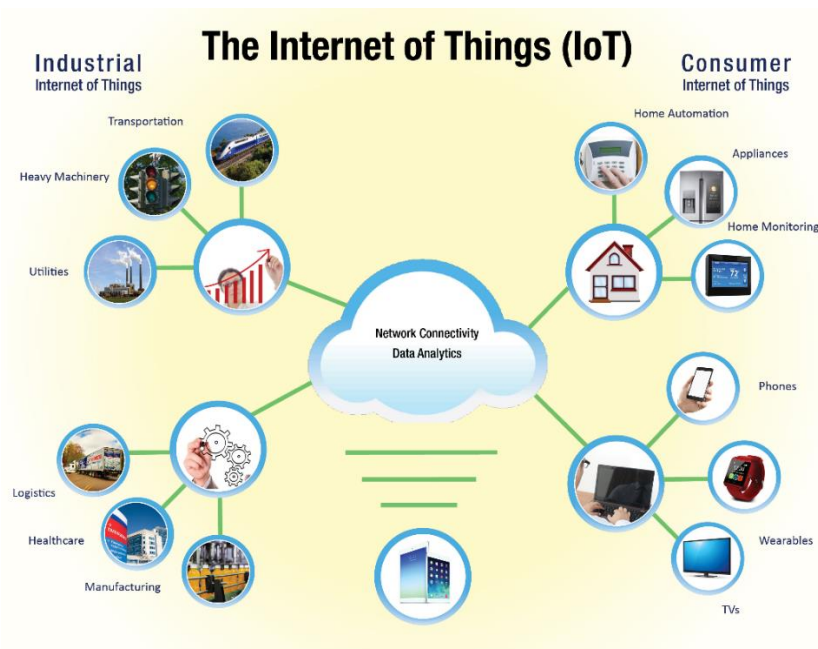


Figure 1.

The Internet of Things

The main challenge faced is the high energy consumption in the Semarang City OPD, which not only increases the allocated energy budget but also creates non-optimality in energy use (Handoko, 2023). Thus, the gap between expectations (das sollen) of energy efficiency and a minimum energy budget and the reality (das sein) of high energy

consumption and a large energy budget becomes increasingly clear (Sardi Salim, Ade Irawaty Tolago e Maharani RP Syafii 2022).

This research offers a new contribution by analyzing the potential and strategies for implementing IoT in increasing energy budget efficiency in the Semarang City OPD. The focus is not only on identifying problems but also on developing practical and sustainable solutions. By analyzing the novelty of the research results, it is hoped that this research can provide a more comprehensive view and sustainable solutions for facing energy challenges in the OPD environment.

The main objective of this research is to investigate the potential and strategies for implementing IoT in increasing energy budget efficiency in the Semarang City OPD. By analyzing the gap between expectations and reality, and developing appropriate strategies, this research aims to provide practical guidance for more effective and efficient energy management in OPD. Thus, it is hoped that the results of this research can make a significant contribution to efforts to achieve energy sustainability in the city of Semarang.

As an effort to overcome the challenges faced in energy management in the Semarang City OPD, this research explores the potential and strategies for implementing the Internet of Things (IoT). IoT promises better integration between electronic devices and energy systems, enabling more effective monitoring, control, and optimization of energy use.

Given the gap between expectations for energy efficiency and the reality of high energy consumption, this research becomes increasingly relevant in the context of efforts to improve energy management in OPD. It is hoped that through a better understanding of the potential of IoT and the development of appropriate strategies, a more sustainable and energy-efficient work environment will be created in the Semarang City OPD.

In a global context that is increasingly aware of the importance of energy sustainability, this research can also make a broader contribution to expanding understanding of the potential of IoT in energy management in the public sector. By strengthening the conceptual and practical framework for the application of IoT in energy efficiency, it is hoped that this research can make a significant contribution to the development of energy policy at the local and national levels.

Thus, this introduction provides a strong foundation for further research by identifying the background, theoretical studies, problems, existing gaps, novelty of research results, and research objectives. Through this approach, it is hoped that this research can provide valuable insights and sustainable solutions in efforts to increase energy efficiency in the Semarang City OPD.

RESEARCH METHOD

This research, which is qualitative research with a descriptive approach, aims to understand the potential and strategies for implementing the Internet of Things (IoT) in increasing energy budget efficiency in Semarang City Regional Apparatus Organizations (OPD). A case study approach method was used to analyze infrastructure and systems related to IoT implementation, while data collection techniques included interviews, observations, and document analysis to gain insight into needs and challenges. The results of data analysis use qualitative descriptive methods to identify patterns, themes, and trends related to IoT architecture. With this approach, this research aims to contribute to the development of more effective and sustainable energy management practices in the Semarang City OPD.

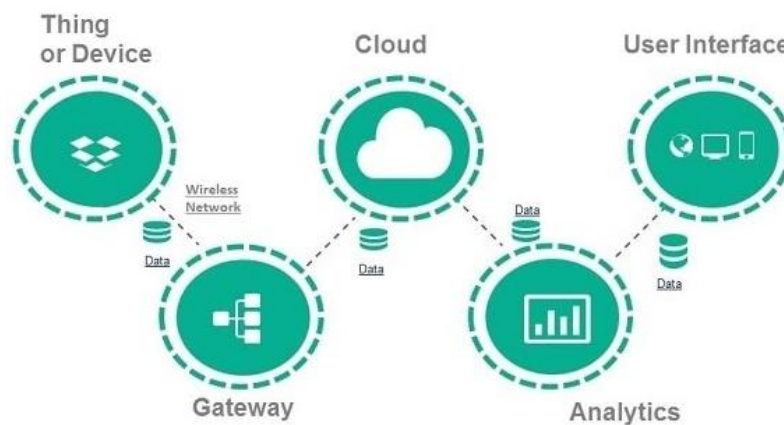


Figure 2.

IoT Architecture

RESULTS AND DISCUSSION

The results of this research reveal the significant potential of implementing the Internet of Things (IoT) in increasing the efficiency of energy management in Semarang City

Regional Apparatus Organizations (OPD). Through an in-depth analysis of energy use practices in OPD and IoT implementation, it was found that an integrated IoT infrastructure can effectively monitor, control, and optimize energy use in real time. Additionally, the adoption of energy-efficient devices connected to IoT systems can also make a significant contribution to reducing overall energy consumption.

Discussion of the results of this study highlights several key aspects. First, IoT integration allows OPDs to have a better understanding of their energy usage patterns, enabling earlier identification of energy waste and rapid implementation of corrective actions. Second, the adoption of energy-saving devices connected to IoT not only reduces energy consumption directly but also increases operational efficiency and extends the life of electronic devices.

In addition, the results of this research highlight the importance of awareness and education of energy users in maximizing the benefits of IoT implementation. By strengthening understanding of the importance of energy efficiency and the benefits of IoT technology, OPD can generate sustainable behavioral change and encourage active participation in more effective energy management.

However, the discussion also notes several challenges that need to be overcome in implementing IoT in OPD environments, including challenges related to data security, system interoperability, and required initial investment. Therefore, developing a comprehensive strategy and strong support from various stakeholders is key to ensuring the successful implementation of IoT for energy efficiency in the Semarang City OPD.

Overall, the results of this research provide valuable insight into the potential and challenges of implementing IoT for energy efficiency in local government environments. By understanding the practical implications of these findings, the Semarang City OPD can take concrete steps to improve its energy management, reduce energy budgets, and contribute to overall environmental sustainability.

IoT Potential in Energy Budget Efficiency

The potential of the Internet of Things (IoT) in increasing energy budget efficiency in Semarang City Regional Apparatus Organizations (OPD) is very large and diverse. One of the main aspects of this potential is IoT's ability to significantly reduce energy

consumption. By utilizing sensors connected to the IoT system, OPD can automatically identify and overcome energy waste, such as inefficient use of lights and AC. For example, sensors installed on electrical equipment can detect when a room is not in use and automatically turn off the equipment, reducing unnecessary energy consumption.

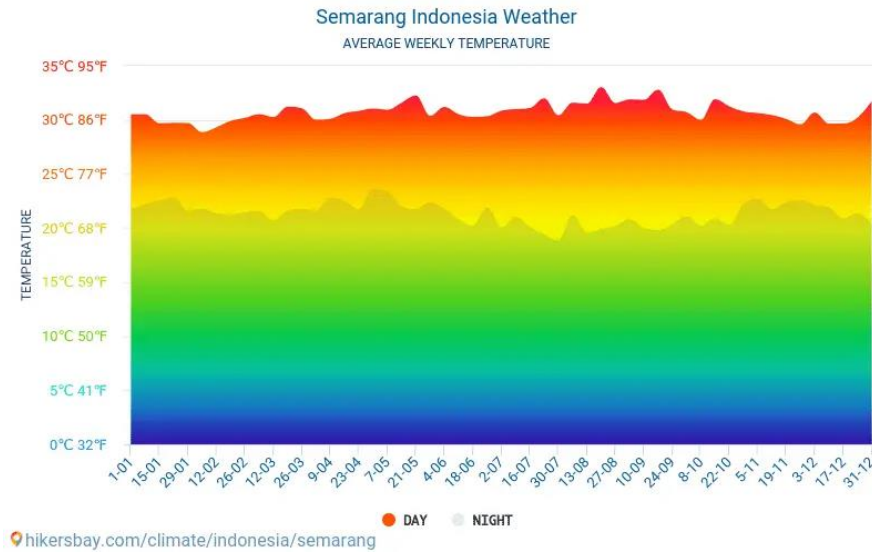


Figure 3.

Temperature and Climate Profile of Semarang City

The temperature and climate profile of Semarang City has a direct impact on the implementation of the Internet of Things (IoT) in energy budget efficiency in the Semarang City Regional Apparatus Organization (OPD). Factors such as air temperature, humidity, and weather conditions influence energy consumption for cooling, heating, and lighting in OPD buildings (Febrinasti 2019).

First, high air temperatures can increase the use of air conditioning systems in OPD buildings. With an IoT system integrated with a temperature sensor, the air conditioning system can be adjusted automatically according to the detected environmental temperature. When the temperature rises, the cooling system will activate more intensively to maintain comfort in the room, and conversely, when the temperature falls, air conditioning use can be reduced to save energy.

Apart from that, changing weather conditions can also affect energy consumption. For example, on days with strong sunlight, the need for artificial lighting may be reduced due to sufficient natural light from the sun. With an IoT system that can monitor weather

conditions in real time, lighting settings in buildings can be adjusted according to actual needs, thereby reducing energy waste.

Furthermore, air humidity can also affect heating needs in OPD buildings. In humid air conditions, heating use may need to be increased to maintain comfort, while in low humidity, heating use can be reduced. With an IoT system that can measure air humidity, heating settings can be adjusted automatically to be efficient and appropriate to environmental conditions.

Thus, the temperature and climate profile of Semarang City are important factors that need to be considered in implementing IoT for energy efficiency in OPD. By utilizing information about environmental conditions appropriately, IoT systems can be optimized to manage energy use efficiently according to actual needs, thereby helping to reduce energy budgets and create a more sustainable work environment.

Apart from reducing energy consumption, IoT can also contribute to increasing operational efficiency in OPD environments. By using an energy monitoring and control system integrated with IoT, OPD can monitor and manage their energy usage in real time. This makes it possible to identify inefficient energy use patterns and take corrective action quickly. In this way, operational efficiency can be improved, which in turn will help reduce the overall energy budget.

Apart from that, the potential of IoT also lies in its ability to directly reduce energy costs. By optimizing energy use through IoT-connected sensors and control systems, OPD can reduce unnecessary energy consumption and avoid waste. Apart from that, the use of energy-saving devices integrated with IoT can also help reduce energy costs effectively (Nilamsari et al. 2021).

Table 1.

IoT Potential in Energy Budget Efficiency

Sector	Potential Energy Savings	Examples of IoT Applications
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Building	10-30%	<ul style="list-style-type: none"> - Smart lighting system: Adjust lighting based on occupancy levels and natural light - Automatic room temperature setting: Optimizes temperature based on time of day, weather, and occupancy
Industry	10-20%	<ul style="list-style-type: none"> - Production process monitoring and control: Optimize energy use in the production process - Predictive maintenance: Identify and address problems before they occur, preventing downtime and wasted energy
Transportation	10-20%	<ul style="list-style-type: none"> - Smart traffic management system: Optimize routes and reduce congestion - Electric and connected vehicles: Increase energy use efficiency and reduce emissions
Electricity	5-10%	<ul style="list-style-type: none"> - Smart grid: Improve energy distribution efficiency and reduce energy loss - Renewable energy network: Utilize renewable energy more optimally

Overall, the potential of IoT in energy budget efficiency in the Semarang City OPD includes reducing energy consumption, increasing operational efficiency, and reducing direct energy costs. By optimally utilizing this technology and integrating it into energy management practices, OPDs can generate significant savings in their energy budgets, as well as contribute to overall environmental sustainability.

IoT Implementation Strategy

The IoT implementation strategy described is closely related to the main concepts in using the Internet of Things (IoT), including IoT control, IoT comfort, IoT synchronization, and IoT security. First, the development of an integrated IoT infrastructure enables the implementation of effective IoT control, where OPDs can control devices and energy systems directly remotely via an internet connection. This enables energy management that is more flexible and responsive to operational needs.

Furthermore, the implementation of an energy monitoring and control system is also closely related to the IoT control concept, where OPD can monitor and control energy use in

real time to optimize energy efficiency and prevent energy waste. Then, the use of energy-saving devices integrated with IoT also reflects the IoT comfort concept, where these devices are designed to increase user comfort while remaining efficient in energy use.

Meanwhile, the integration of energy-saving devices with IoT systems enables better synchronization between devices and energy systems in the OPD. By using IoT synchronization technology, OPD can optimize overall energy usage, avoid overlaps and ensure consistency in operations.

Finally, energy user awareness and education strategies also relate to IoT security, where a better understanding of safe and efficient energy use practices can help in preventing security threats that may arise from the use of IoT devices.



Figure 4.
IoT Applications

Increasing awareness and education of energy users is one of the key strategies in implementing the Internet of Things (IoT) to increase energy budget efficiency in Semarang City Regional Apparatus Organizations (OPD) (Suyono e Prianto 2018). Through this strategy, the main goal is to provide energy users with a better understanding of the

importance of energy efficiency and how wise use of energy can help reduce the overall energy budget.

In this context, outreach, training, seminars, and outreach can be effective instruments for increasing awareness and knowledge of energy users in the OPD environment. Through this activity, energy users will be given an understanding of energy efficiency practices that can be applied in their daily activities, such as turning off electrical devices that are not in use, using energy-saving devices, and adopting habits that support efficient energy use.

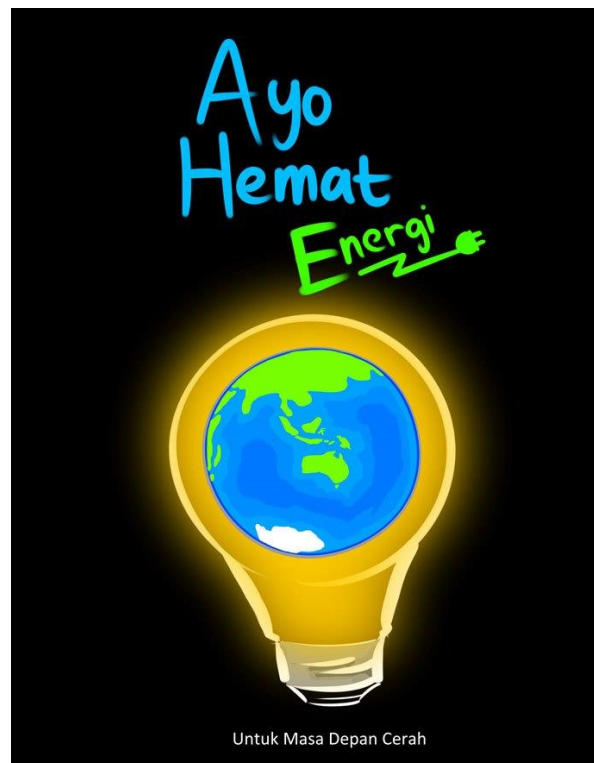


Figure 5.

Educational Poster about Energy Efficiency

Apart from that, education can also involve an introduction to IoT technology and how its use can help in optimizing energy management in OPD. Energy users need to be given an understanding of how IoT systems work in monitoring and controlling energy use in real-time, as well as the benefits that can be gained from integrating energy-saving devices connected to IoT. With a better understanding of these concepts, energy users will be more motivated to actively participate in energy efficiency efforts in their work environment.

Overall, increasing awareness and education of energy users is an important step in the strategy of implementing IoT for energy efficiency in the Semarang City OPD. Through these efforts, it is hoped that a strong energy awareness culture will be created, which in turn will support successful IoT implementation and create a more energy-efficient and sustainable work environment.

By paying attention to these aspects holistically, implementing IoT in the Semarang City OPD can create a more efficient, safe, and comfortable work environment overall. By implementing these strategies comprehensively, Semarang City OPD can optimize the potential of IoT in the efficiency of their energy budget, create a more sustainable and energy-efficient work environment, and generate significant savings in their energy budget.

CONCLUSION

Based on the results of research and discussions that have been carried out, it can be concluded that the Internet of Things (IoT) has great potential to increase energy efficiency and reduce the energy budget in Semarang City Regional Apparatus Organizations (OPD). Through IoT integration, OPD can utilize sensor technology and monitoring systems to monitor and optimize energy use effectively. However, to optimize the potential of IoT, it is necessary to implement the right strategy. This includes building an integrated IoT infrastructure, implementing an energy monitoring and control system, using energy-saving devices connected to IoT, as well as increasing awareness and education of energy users. Thus, the appropriate application of IoT will make a positive contribution to environmental sustainability and energy management efficiency at the local government level.

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