
THE CONCEPT OF APPLICATION OF MACHINE LEARNING IN THE ENVIRONMENT INTERNET OF THINGS

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ABSTRACT

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Machine Learning is an application of computers and mathematical algorithms adopted by means of learning that comes from data and produces predictions in the future. The learning process in question is an attempt to acquire intelligence through two stages, including training and testing. The Internet of Things is a network that can connect anything in the supply chain, including people, machines and systems, where efficient supply chain management is guaranteed. This is done through visualizing any object/thing in the supply chain by monitoring, tracking and providing a third dimension to organizational data, that if analyzed can improve all supply chain processes. In the IoT environment, Machine Learning is very suitable to be applied which can provide many benefits including Resolving Data Inefficiency Problems, Automating Business Processes, Visualizing Supply Chain Management (Supply Chain), Risk Management and Maximizing Profits. By implementing IoT and Machine Learning, of course, it can fulfill business opportunities, namely: process optimization, speed optimization, adaptability optimization and reliability optimization.

Keywords : *Machine Learning, Internet of Things, IoT environment*

1. INTRODUCTION

The Internet of Things is a network that can connect anything in the supply chain, including people, machines and systems, where efficient supply chain management is guaranteed. This is done through visualization of any object/thing in the supply chain by monitoring, tracking and providing a third dimension to organizational data, that if analyzed can improve all supply chain processes [1]. The method used by the Internet of Things is wireless or automatic control without knowing the distance. The implementation of the Internet of Things itself usually always follows the wishes of the developer in developing an application that he created, if the application was created to help monitor a room, then the implementation of the Internet of Things itself must follow the flow of programming diagrams regarding sensors in a house, how far is the distance so that the room can be controlled, and the speed of the internet network used.

Machine Learning has been successfully applied to various fields in our daily lives. With the abundance of data, Machine Learning is getting smarter with higher accuracy, some of which have even surpassed human capabilities in providing information for decision making [3]. This is because Machine Learning algorithms are procedures that are implemented in code and executed on data. Machine Learning models are issued by algorithms and consist of data models and prediction algorithms.

Machine Learning Algorithm provides a type of automatic programming where the machine learning model represents the program, which in the process is more to collect a lot of data which is then analyzed with certain algorithms and models in mathematical form. This is what underlies this production planning optimization model that can be applied as a model for Machine Learning algorithms used in the IoT environment in the future. The formulation of the problem in this research is in the form of a

study to create a concept for the application of Machine Learning in the Internet of Things Environment with a case study of using models for production planning problems.

2. METHOD

2.1 Research Framework

The research steps to be carried out based on Figure 1 will be described as follows:

a. Literature Review

The literature review is related to the concept of Machine Learning, Internet of Things and other concepts related to this research problem. Literature review is carried out by examining sources sourced from journals and other research results as references for previous research, textbooks, online sources (internet) and other sources related to the research topics discussed.

b. Data Collection

The data collection carried out in the study includes several techniques to provide the accuracy of the research results. The techniques used are as follows:

- Primary data

Data were obtained directly at the specialist doctor's place through observation and interviews.

- Secondary data

Data were obtained by analyzing documents from various sources related to the research topic.

c. Data Needs Analysis

Analyze the data requirements needed to review the study of Machine Learning and the Internet of Things.

d. Concept Analysis

Analyze and study the concepts of Machine Learning and the Internet of Things and their interrelationships.

e. Completion of Machine Learning Concepts

Completion of Machine Learning concepts to get the expected results

f. Framework Design

Designing a Machine Learning concept framework in the Internet of Things environment by applying a case study of a production planning model.

g. Final Report and Publication to Reputable Journals.

Prepare final reports, evaluate research results and publish concepts for research outputs to reputable journals Sinta 4.

2.2 Internet of Things

The emergence of the term Internet of Things (IoT) comes from the ability to connect physical objects and virtual components using the internet. IoT can be defined as a network of digitally connected physical objects to sense, monitor and interact within an enterprise including suppliers, manufacturers, distributors, retailers and customers. IoT from a supply chain perspective as "The Internet of Things is a digitally connected network of physical objects to sense, monitor and interact within the enterprise and between enterprises and supply chains that enable tracking and sharing of information resources to facilitate planning, control and coordination of supply chain processes that on time" [1].

The Internet of Things is a network that can connect anything in the supply chain, including people, machines and systems, where efficient supply chain management is guaranteed. This is done through visualizing any object/thing in the supply chain by monitoring, tracking and providing a third dimension to organizational data, that if analyzed can improve all supply chain processes. As an example for the problem of inventory, In the industrial field, the Internet of Things opens new horizons for efficient inventory management of perishable and durable products [7].

2.3 Machine Learning

Artificial Intelligence is a field in computer science that is aimed at making software and hardware that can function as something that can think like humans. Artificial intelligence is widely used to solve

various problems such as business, robotics, natural language, mathematics, games, perception, medical diagnosis, engineering, financial analysis, scientific analysis, and reasoning [5]. Machine Learning can be defined as the application of computers and mathematical algorithms adopted by means of learning that comes from data and produces predictions in the future [9]. The learning process in question is an attempt to acquire intelligence through two stages, including training and testing [4].

The field of machine learning is concerned with the question of how to build computer programs to improve automatically based on experience [3]. Recent research reveals that Machine Learning is divided into three categories: Supervised Learning, Unsupervised Learning, Reinforcement Learning [9].

3. RESULT AND DISCUSSION

In this study, the concept of combining Machine Learning with the Internet of Things was obtained as an implementation of the production planning model found in previous research (August 2020), with title “Desain Internet of Things Untuk Perencanaan Produksi Pada Sektor Usaha Kecil Dan Menengah”.

3.1 Production Planning Optimization Model Concept for Machine Learning

Machine Learning Algorithm provides a type of automatic programming where the machine learning model represents the program, which in the process is more about collecting a lot of data which is then analyzed with certain algorithms and models in mathematical form. This is what underlies this production planning optimization model that can be applied as a model for Machine Learning algorithms used in the IoT environment in the future. The following picture is the concept of a production planning model that is applied to Machine Learning from the results of this study:

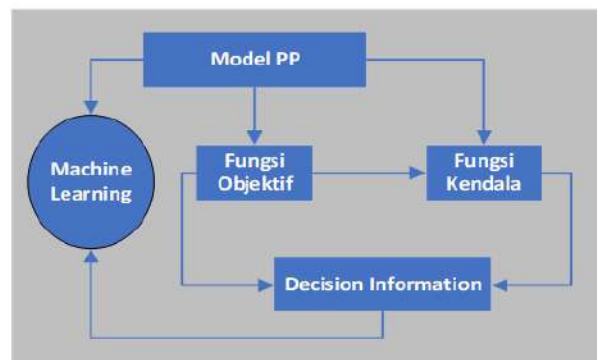


Figure 2. Production Planning Model Concept for Machine Learning

In the picture above the PP Model can be applied to Machine Learning where in the formulation of the model using the objective function and the constraint function to produce the information needed in the formulation of decision making.

3.2 Machine Learning Concepts in IoT Environment

The purpose of applying Machine Learning to IoT is to consider that Internet of Things and Machine Learning are two technologies that can bring significant benefits to companies. The application of these two technologies can revolutionize and promote digital business. The concept of implementing the production planning optimization model used in the IoT environment can be seen in the following figure:

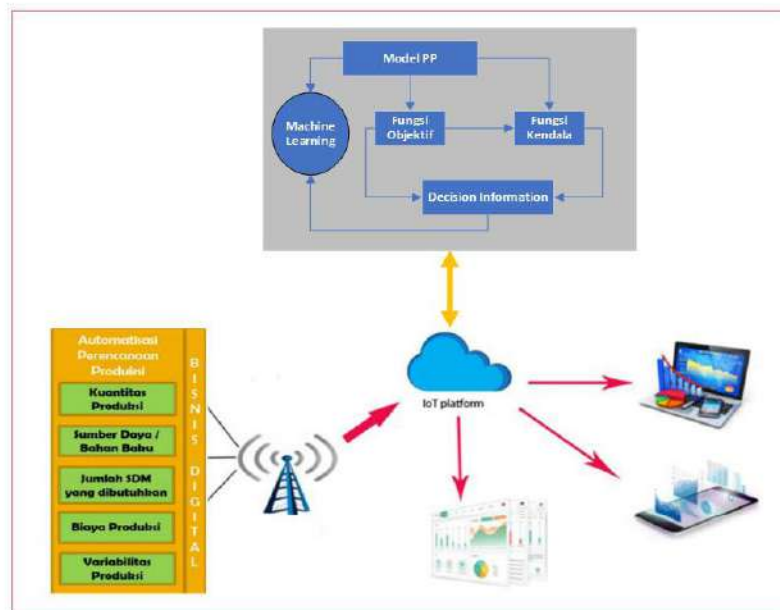


Figure 3. Concept of Production Planning Model in IoT Environment

From the picture above, the condition of the IoT environment in which data control and storage will interact continuously with the optimization model. The applied model provides integrated and real-time information on the presentation of data and information needed for production planning, which is the basis for combining IoT devices and machine learning is a natural process. The underlying premise is that Machine Learning requires a large amount of relevant data to be most effective and the Internet of Things can provide this data. With the level of need for real time information, of course this technology will become a trend that is needed by companies in making decisions to maintain the company's popularity in the current era of the industrial revolution. The benefits that will be obtained from using the production planning model in Machine Learning in the IoT environment are able to maximize profits and popularity for the company, where Machine Learning and IoT are able to:

1. Solving Data Inefficiency Problems

Various levels of data needs have resulted in more and more companies today who have used IoT devices as the most effective place to collect data. By analyzing data in real time, Machine Learning can present information in real time as well by making connections between data points that humans might miss due to various inefficiency conditions. Machine Learning makes predictions much faster because IoT devices provide more data in real time, so the combination of IoT and Machine Learning will help the process to be faster and more accurate.

2. Business Process Automation

IoT and Machine Learning can also automate everyday tasks. Business process automation uses Machine Learning to handle a series of management tasks, so workers don't need to do this anymore because IoT devices will automatically collect and provide more data through sensors, which big data is needed by Machine Learning. Automation will simplify tasks in data collection and processing so that real time information will be generated so that work will be more effective

3. Visualization of Supply Chain Management (Supply Chain)

One of the most promising areas for IoT implementation is the supply chain. IoT sensors can provide important information to companies by automatically collecting data. This data alone can increase supply chain visibility. Of course, combining IoT and Machine Learning can make changing business easier. This is because Machine Learning programs can obtain real-time data from IoT sensors and apply them. It can predict possible supply chain delays and alert staff. So that reactions to handling production problems can be carried out quickly in accordance with established procedures. This predictive analytics can enable companies to avoid the supply chain delays that these two tools already detect combined.

4. Risk Management

If companies can't understand the weaknesses they face, business leaders certainly can't make the right decisions. IoT devices can provide companies with the data they need in real time to understand the production risks they will face. By combining Machine Learning will be able to go even better. IoT devices can collect data in real time, which is then processed by Machine Learning, so that the information obtained for production planning is more accurate and real time so as to reduce business risk.

5. Maximize Profits

Another way IoT and machine learning can improve the quality of a company's business is by eliminating waste. Data from IoT sensors can reveal where companies can use more resources than they need. Then Machine Learning can analyze the data and produce better methods. One of the main causes of waste in business is energy, due to various conditions of inefficiency. IoT sensors can measure where waste occurs and adjust it through Machine Learning to prevent waste. The combination of Machine Learning and IoT devices can limit energy use. So processes only use what they need. While this may seem small, the combination of these two technologies can save a lot of money.

By implementing IoT and Machine Learning, of course, it can meet business opportunities, namely: process optimization, speed optimization, adaptability optimization and reliability optimization.

4. CONCLUSION

The conclusions from the results of the research conducted are as follows Machine Learning is an application of computers and mathematical algorithms adopted by means of learning that comes from data and produces predictions in the future. The learning process in question is an attempt to acquire intelligence through two stages, including training and testing. Internet of Things is a network that can connect anything in the supply chain, including people, machines and systems, where efficient supply chain management is guaranteed. This is done through visualizing any object/thing in the supply chain by monitoring, tracking and providing a third dimension to organizational data, that if analyzed can improve all supply chain processes. In the IoT environment, Machine Learning is very suitable to be applied which can provide many benefits including Resolving Data Inefficiency Problems, Automating Business Processes, Visualizing Supply Chain Management (Supply Chain), Risk Management and Maximizing Profits. The results of the analysis of this research are the concept of a production planning model for machine learning and the concept of a production planning model in the IoT Environment

REFERENCE

- [1] Daugherty, P., Banerjee, P., Negm, W., & Alter, A. E. (2014). Driving Unconventional Growth through the Industrial *Internet of Things*. *Accenture*. <https://doi.org/10.1016/j.molcata.2003.10.018>
- [2] Gubbi, J., Buyya, R., Marusic, S., & Palaniswami, M. (2013). *Internet of Things (IoT): A vision, architectural elements, and future directions*. *Future Generation Computer Systems*. <https://doi.org/10.1016/j.future.2013.01.010>
- [3] G, D. E., & Holland, J. H. (1988). Genetic algorithms and *Machine Learning*. *Machine Learning*, 3(2), 95–99
- [4] Huang, G.-B., Zhu, Q.-Y., & Siew, C.-K. (2006). Extreme learning machine: theory and applications. *Neurocomputing*, 70(1–3), 489–501.
- [5] Russell, S. J., & Norvig, P. (2016). *Artificial intelligence: a modern approach*. Malaysia; Pearson Education Limited.
- [6] Ratasuk, R., Vejlgard, B., Mangalvedhe, N., & Ghosh, A. (2016). NB-IoT system for M2M communication. *2016 IEEE Wireless Communications and Networking Conference Workshops, WCNCW 2016*. <https://doi.org/10.1109/WCNCW.2016.7552737>
- [7] Romascanu, D., Schoenwaelder, J., & Herberg, U. (2015). Management of Networks with Constrained Devices: Problem Statement and Requirements. *Internet Engineering Task Force*. <https://doi.org/10.17487/RFC7548>



- [8] Severi, S., Sottile, F., Abreu, G., Pastrone, C., Spirito, M., & Berens, F. (2014). M2M technologies: Enablers for a pervasive *Internet of Things*. *EuCNC 2014 - European Conference on Networks and Communications*. <https://doi.org/10.1109/EuCNC.2014.6882661>
- [9] Somvanshi, M., & Chavan, P. (2016). A review of *Machine Learning* techniques using decision tree and support vector machine. 2016 International Conference on Computing Communication Control and Automation (ICCUBEA), 1–7. <https://doi.org/10.1109/ICCUBEA.2016.7860040>