Internet of Things in Overall Equipment Effectiveness Production System Applications

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Abstract: Utilization of Internet of Thing (IoT) can increase efficiency, and real-time optimization. IoT integration in industrial machines helps the process of monitoring the production processing, thus avoiding single point of failure and easier for resource expansion, so that the machines will be optimal in their use because it can be known at the right time for maintenance. The purpose of this study is to optimize the use of machines in production, especially the process of monitoring production machinery. Using the IoT and Overall Equipment Effectiveness (OEE) approach to the machine, the data is calculated to facilitate the analysis process. The application of the Internet of Things in the field of manufacturing production especially in this company has proven to be effective in making industrial machine services become smarter, more transparent and efficient.

1 INTRODUCTION

PT. Ultra Sakti is a pharmaceutical company that produces OTC (Over The Counter) medicines, which are drugs that can be sold freely on the market. In carrying out these drug production activities, PT. Ultra Sakti always makes efforts to produce quality products by differentiating through quality strategy and value strategy. Quality strategy is to provide products with better quality than competitor products to build satisfaction and loyalty from customers. Strategy value is carried out by submitting more amounts to customers, both through more functional and better services, while always maintaining an affordable price for the products sold.

PT. Ultra Sakti is present in the pharmaceutical industry with the awareness that this industry must be faced with innovation and the creation of high quality and competitive products. To strengthen the company’s presence, PT. Ultra Sakti is positioning itself to be a pharmaceutical company that implements standard and modern production standards. Accompanied by firm commitments and innovations that are carried out sustainably, the company’s contribution to industry acquisition is expected to increase. To create a quality product, one of the systems development that is carried out is to use internet technology that is implemented on a production machine, its application is carried out in the form of machine and data integration that can be used for the OEE (Overall Equipment Effectiveness) process (see figure 1).

![Production Process Flowchart](image)

Figure 1: Production Process Flowchart.

To support the implementation and implementation of Industry 4.0 in PT. Ultra Sakti, the process of developing technology and information that can help the means of production activities, must be done automatically and has been integrated with the core ERP system, where data and information processing can be done and generated quickly, easily and precisely. One of the things that can be done to support this process is to optimize the use of machines in production. To find out and monitor the effectiveness of the use of these machines, it can be done by calculating OEE on these machines, so that the device can be known easily.

The application of IoT to manufacturing and supply chain management has become popular in various industries like smart cities (Tanwar et al., 2018), transportation (Murad et al., 2018), bigdata (Hashem et al., 2016). Connected equipment, tracking people and goods or devices, sampling cycle management, and production cycle monitoring are one of the IoT applications in the industry, data acquisition...
at the level of PLC (Programmable Logic Control) and supervisor systems, then the data is processed in Computing to connect to MES (Management Exclusion System) and ERP (Enterprise Resource Planning) system. Meanwhile, a system that is interrelated to connect the central system owned by the company (ERP) with production tools can help the process of monitoring the performance of existing production machines and can assist in analyzing and calculating OEE.

This research utilizes the Internet of Things (IoT). IoT is a concept where particular objects have the ability to transfer data over a network without requiring interaction from human to human or from human to computer devices. IoT emphasizes the integration of process and management with the system by providing all data on-board (Nasir et al., 2018b) (Nasir et al., 2018a). Utilization of IoT has also been carried out by (Gunasekaran and Periakaruppan, 2017) where IoT is implemented to create a smart home by using Arduino as an I / O signal receiver from the installed device, the working principle of the invention is the same, Arduino is programmed to carry out commands from the received signal, then the system will work as instructed. With recent developments and the IoT application, it has been possible to resolve this problem. It is hoped that the system created can help the parties involved, including production staff, operators & heads of production and management, to monitor production activities and know the results of OEE calculations in real-time so that they can quickly assist in making decisions.

The purpose of this research is to build integrated system automation between machines, technology, and information using IoT. Based on that, the research questions in this study are how the use of IoT can help OEE systems become availability, performance, quality, and achievement in the use of machines.

2 LITERATURE REVIEW

2.1 Hardware

Hardware or hardware is all the physical parts of a computer and is distinguished from the data that is in it or that operates in it and is separated from the software (software) that provides instructions for the hardware in completing its work.

In this study, the authors use the following hardware:

1. Computer

   The computer is used as a web server; the operating system used is Windows 10. The machine is in charge of storing scripts, images, and website page content. Web Servers must be accessible from all areas that have an internet connection.

2. M2M Controller

   M2M Controller is hardware with Modbus / TCP as a tool used to communicate between the signal signaling device and other controller units such as PLC or SCADA. The M2M controller can also function as an input/output unit for long distances in a client server-based communication control system.

   Figure 2: CONPROSYS M2M Controller

3. Arduino Uno R3

   Arduino is an open-source single-board microcontroller, derived from the Wiring platform, designed to facilitate the use of electronics in various fields. Arduino also simplifies the process of working with a microcontroller. Here are the reasons for the authors to use Arduino, as a signal sensor to the controller, namely:

   (a) Arduino prices are relatively low, ranging from IDR 100,000, up to the cost of IDR 400,000, - the price is cheaper than other professional microcontroller platforms.

   (b) Arduino libraries are easy to get, available in full on the Arduino website and even on other Arduino community websites.

   (c) Multi-platform, not only for Windows but also suitable for working on Linux.

   (d) Simple and easy programming, Arduino is easy to use for beginners and flexible enough for those who are already advanced. Arduino is based on a processing programming environment, so if students or students are accustomed to using processing, of course it will be easy to use Arduino.
2.2 Previous Research

Some of the studies that correlate with this study are summarized in Figure 4. There are several uses of IoT in the same field with different methods and approaches.

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
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<td><strong>Method</strong></td>
<td><strong>Result</strong></td>
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<tr>
<td>Home Automation uses Arduino Uno, equipped with a Motor Driver, WiFi Module, PIR Sensor, MQ6 Sensor built with the Android platform</td>
<td>IoT based home automation using Arduino Uno has brought a better quality of life, where users can control the devices or devices that are owned in the home, besides making it more efficient and more cost-effective because everything can be controlled automatically. This research produces a new architecture for low cost and flexible home environment monitoring systems using Android-based smartphones, which are built using micro web servers and Bluetooth communication as an application layer that can be operated to communicate between remote users and home devices. Android-based smartphones with built-in support for Wi-Fi can be used to access and control devices at home. When a Wi-Fi connection is not available, cellular networks such as 3G or 4G can be used thereby eliminating the need for an external voice recognition module.</td>
</tr>
<tr>
<td><strong>Limitation</strong></td>
<td><strong>Method</strong></td>
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<td>When the internet is not available, communication with the smart home cannot be done</td>
<td>DMAIC (Define, Measure, Analyze, Improve and Control) Approach &amp; Six Sigma Approach</td>
</tr>
<tr>
<td><strong>Result</strong></td>
<td><strong>Limitation</strong></td>
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<td>The DMAIC approach helps to identify and clearly define the problem as the specified stage. It provides a systematic methodology by giving step by step analysis to the micro level to get the root cause of why OEE is low.</td>
<td>To be able to know OEE, it is not only done by DMAIC and Six Sigma Approach, but this is also because the needs and conditions in each company are different.</td>
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<tr>
<td><strong>Method</strong></td>
<td><strong>Result</strong></td>
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<td>The IoT-based performance model is consistent with the ISA-95 and ISO-22400 standards</td>
<td>Implement the proposed performance measurement model using ISA-95 and ISO-22400 where the IoT device can be used to calculate OEE. Besides, for the configuration of the IoT-based performance measurement system architecture, ERD was created to enable modeling of complex relationships between various data entities. The study was conducted by combining performance measurement models with ERD architecture outputs to develop BPM models, accuracy validated by virtual factory simulations. The virtual factory model, which consists of the set of machines obtained and the production process, is developed to enhance realism</td>
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Figure 3: Arduino Uno R3

Figure 4: Previous Research.

**Figure 4:** Previous Research.

**Figure 5:** Previous Research (cont.).
Based on the literature review, the Internet of things can be used to help make the whole process automatic, where devices can be controlled by programs that can be run from various places, according to the needs that are expected. The results of the research review can also be used by the writer in understanding the use of the Internet of Things in the manufacturing and smart factory world where these influences to provide support in real-time in the world of production and improve OEE.

From study 1, the method used is the same, namely by utilizing Arduino Uno and acting as an automation system, the difference lies in its use where this thesis is used to support OEE applications at PT Ultra Sakti. Study 3 also deals with improving OEE, but the difference is that study 3 uses DMAIC & Sig Sixma Approach. In Research 2, 4, and 5, the similarities are discussed concerning the use of IoT in the manufacturing and smart factory world.

### 3 RESULT AND DISCUSSION

The system built is to capture machine activity using internet technology, where the OEE process of recording activity data from machine activity is done automatically.

The process of implementing IoT (Internet of Things) in the production process at PT. Ultra Sakti is to use a digital input and digital output sensor system and M2M Controller installed on the production machine, where the sensor system will send data through the internet about the activities carried out by the device, starting from the engine running until it is turned off. This process is carried out automatically by using tools and data sent to the server, and then the data will be processed into reports that can be used for various analysis and strategy development to make the production process more efficient and effective.

The following Figure 7 shows the business process and IT infrastructure by utilizing IoT as a liaison or identifier for several devices in the system is built.
As per Figure 7, the system generates information that supports business processes that are better and smarter. Intelligent information systems that are formed produce information in real-time based on data input from Arduino supported by IoT. Here are some access and dashboard views for each system user:

1. **Management**
   Management has access to see all activities that occur in the system; in general, management only sees the whole system through the dashboard report.

2. **Division Head and Department Head (All Departments)**
   Division Heads and Department Heads have access to view detailed data per production line, per batch (lot), per item, and view by the target.

3. **Production Supervisor & Admin**
   To make a schedule and configure the queue list in the system is done by the supervisor & admin of the production department.

4. **Production Staff & Operators**
   The user who interacts the most is the staff and operators of the production department, where every procedure for the process carried out follows the conditions set by the system.

### 4 CONCLUSIONS

From the results of the ongoing system analysis, it is known that the OEE calculation process, availability, performance, quality, and achievement have several problems so that all of these problems can lead to an analysis process in dealing with issues and obstacles that occur in the production department requires a long time to find solutions and preventive maintenance. So, in the research conducted by the author, several results have been obtained, namely:

1. **Industry 4.0 implementation by implementing data processing automation between machine devices and systems using IoT technology so that it can improve effectiveness and can be appropriately measured.**

2. **Communication between devices can be done using internet technology, where the tool sends a signal to the server, and the data is processed into the system.**

3. **M2M Controller can be made efficiently in a simple way, by developing a programming language**
that can give commands to the controller to provide the data needed by the system.

4. Web Application-based systems can support OEE calculation processes, availability, performance, quality and achievement faster than before, this application system can be accessed by users through a variety of devices and platforms.

5. OEE calculation system which previously took 3 hours to prepare documents and calculations. However, the proposed system process that has been developed, then it accelerates the calculation process time in real time.

REFERENCES


