Research Article

The Comparison of the Performance of Telegram and Blynk as Monitoring Media on the Prototype of Internet of Things-Based Soybean Planting System

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Abstract: Indonesia is the country with the second-largest soybean consumption in the world after China. Meanwhile, to meet the needs, Indonesia still depends on imports since the soybean production has still been under the national demand. Therefore, the Indonesian government has included soybeans in Prioritas Riset Nasional. Agriculture in Indonesia is able to use IoT to increase soybean production; therefore, this research has built a prototype of an IoT-based soybean planting system with a soil humidity sensor and network time protocol (NTP) as the tools for automation. Some elements essential to be observed were informed to the user through Telegram and Blynk applications. This study ran well as the humidity sensor NTP timer could control the watering and fertilizing system, and notifications could be sent to the user. From a QoS standpoint, Blynk exhibits a delay of 62 ms, while that of Telegram was 59 ms. Regarding throughput metrics, Blynk's performance was nearly equivalent to that of Telegram.

Keywords: Soy, IoT, Sensor, NTP, Telegram, Blynk

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1. Introduction

Prioritas Riset Nasional (PRN) or National Research Priority has included soybean as one of the agricultural products whose production is prioritized to be increased [1]. It is understandable since Indonesia is the country with the second-largest soybean consumption in the world after China. Soybeans are mostly used for tofu and tempeh production. Meanwhile, to meet the needs, Indonesia still depends on imports since the soybean production in Indonesia is still about 32% of 2.5 million tons of national soybean needs. Badan Pusat Statistik (BPS) or Central Statistics Agency noted that 89.9% of the total of 1.27 tons of Indonesia's soybean imports for the whole of the first semester of 2020 came mostly from the United States[2]. Data from Gabungan Asosiasi Koperasi Tahu-Tempe Indonesia (Gakoptindo) or The Indonesian Tofu and Tempeh Producer Cooperatives Union shows that, besides the United States, all soybeans supplied for tofu and tempeh producers also come from Canada, Brazil, and Uruguay [3].

Forum Tempe Indonesia or Indonesian Tempeh Forum reveals that Indonesia's soybean productivity is half of that of the U.S. Indonesia's soybean productivity is around 1.5-2 tons per hectare, while the U.S. one is 4 tons per hectare. The U.S. productivity is higher as the country has 16 hours of daylight, while Indonesia has only 12 hours. Besides, the profit per hectare that the farmers receive from soybeans is smaller than that from corn or paddy. Consequently, farmers prioritize their lands for those two kinds of crops [2].

Furthermore, to enhance productivity, developed countries have already integrated machines and IoT technologies into their agricultural operations. In order to get a high level of production on agricultural products, developed countries have adapted advanced technology supported by substantial capital investment. Developing countries should step-by-step adopt IoT technology to manage their farmland efficiently as well as to increase the plant productivity. It can be seen from Figure 1 that IoT technology can be adopted in different areas of agriculture [4].

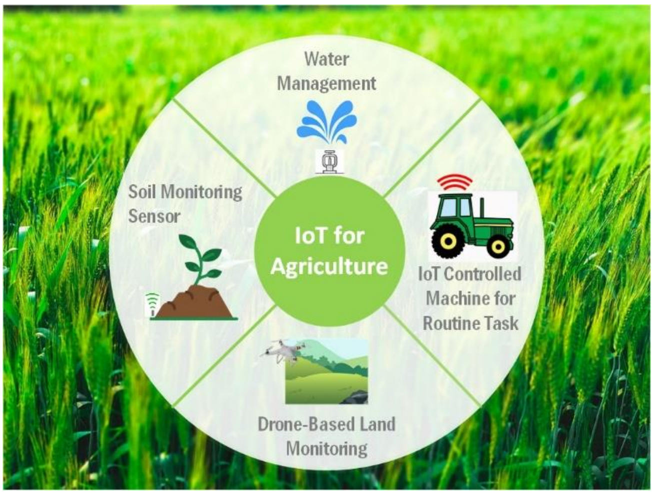

Figure 1. IoT for Agriculture (*Sources*: [5])

Soybeans can grow in different soil types. However, the soil used as the land to grow it should have good drainage and aeration. Besides, the right cultivation technique for it is by using soil with a pH of 5.8 to 7. Its planting area should also be right since it requires a highland area of 600 mpl with rainfall of 100 to 400 ml per month, with a temperature of 23 to 30 °C and a humidity level of 60% to 70% [6]. By the data received on soybean farming, Indonesia can use technologies to increase production. One, which is popular today, is by using Smart Agriculture technology, i.e., by adopting the Internet of Things in agriculture.

There have been a number of studies related to IoT implementation in agriculture, including the one highly related to this study is that of Sharma and Khanta [7]. The study [7] uses the Blynk application to control NodeMCU, where it also explains the steps required to connect NodeMCU with Blynk. However, the study of Sharma does not take any sensors as the input device that can be further processed by a microcontroller. The use of Blynk in IoT applications has also been studied by Durani et al. [8]. Durani uses Blynk for smart home applications. However, the study [8] has not used the QoS test to complete its results. The other study related to this study is that of Perdana, Kusuma, and Alinursafa [9], where the study explores an automatic fertilizing system in soybean farmland using IoT and LoRA. This study, however, resembles that of Arafat [10]. In the study [10], the humidity and fertilizing control system has adopted IoT, where any related information as well as notifications have also been delivered to the User using Blynk. However, the plants used in the study [10] are chilies. Above all, none of the studies has used Telegram as the medium for notifying the User on any activities carried out in soybean cultivation.

Based on the explanation above, this study is eager to implement a prototype for a soybean planting system in which the monitoring and control use a soil humidity sensor and NTP as the device to get any information related to time (NTP). The prototype of this study is built in a glass miniature, where it has soil, water/fertilizer pipe installation, NTP tool, and sensor. The soil humidity sensor will trigger the watering system to keep the soil humidity so that it may always be in the ideal condition for soybeans, while the NTP tool may provide information related to time used as the reference for the fertilizing system to run automatically as scheduled by the Management/User. The soil humidity and all of the activities (watering and fertilizing) are reported to the user, in this case, the Management, by using Blynk and Telegram platforms. The study is further compiled following the following systematics: after the Introduction in Part I, it is followed by Theory in Part II, Methods in Part III, Analysis in Part IV, and is closed with the Conclusion in Part V.

2. Theory

This research utilizes two widely adopted IoT platforms—Blynk and Telegram—both of which can be used for monitoring and controlling purposes. As one of the research objectives is to compare their performance, it is essential to understand the network architecture each application uses. The subsequent section presents the network architecture employed by each application, which serves as the foundation for interpreting the collected performance metrics.

2.1 Exploring Telegram Network

Initially, Telegram is a smartphone messenger application aimed at sending and receiving text messages and multimedia to and from a personal user. One thing that distinguishes Telegram from other messenger applications is that it has a security feature through data encryption and the ability to make Telegram Bots using the Telegram Bot API. Telegram Bots are machine Telegram users, while Telegram Bot API is a set of functions to make Telegram Bots using programming languages like Python, JAVA, C/C++, and Lua [11][12].

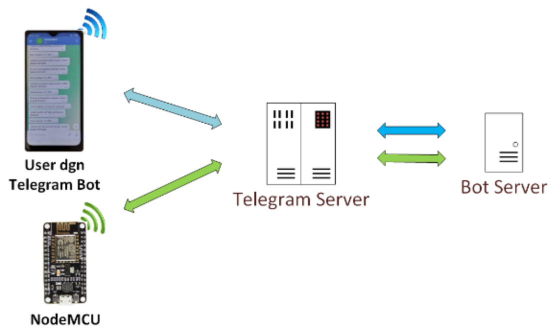

Figure 2. Telegram Bot Architecture

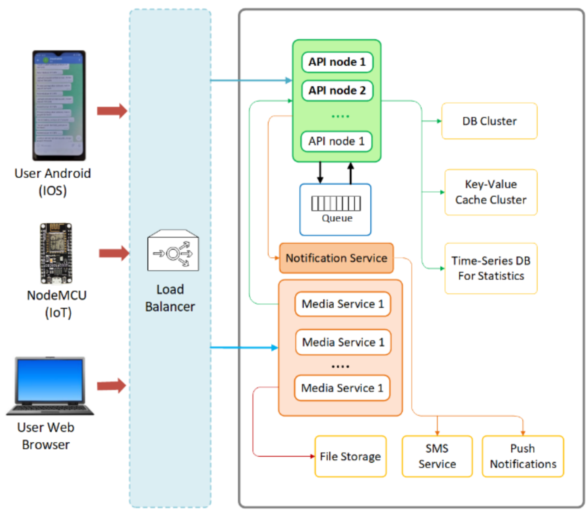

Figure 3. Telegram Server Architecture [14]

Figure 2 shows the architecture of Telegram used to send data from the sensor reading results on the prototype [11][13]. It is seen from the figure that either User or the NodeMCU connects to the Server Bot via the Telegram Server. Furthermore, Figure 3 shows the architecture of a Telegram Server, which consists of different entities. Each entity runs a set of functions, Such as: (a) saving, processing, and returning pictures, videos, or other data, (b) saving user profiles, settings, chat, event, etc. [14].

2.2 Exploring Blynk Network

Blynk is one of the platforms for iOS or Android smartphones used to control different microcontrollers like Arduino, Raspberry Pi, or NodeMCU through the Internet. Blynk can do various services for data generated from sensor readings. Those data are able to be saved, shown, or visualized in the form of graphs and are able to perform different functions. In Blynk, there are 3 main components, including: App, Server, and Libraries [19,20,21,22,23]. App is used to create interfaces, while Server is used for the communication between smartphone and hardware, and Libraries are used to ensure that hardware can communicate with the server [15][16][24][25].

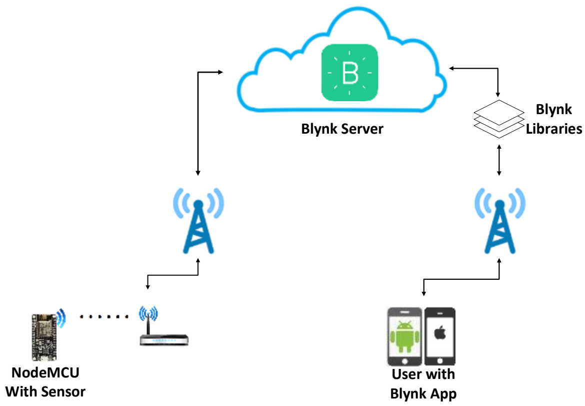

Figure 4. Blynk Architecture (Resources: [15][16])

Figure 4 is the Blynk architecture. Based on the picture, the data from NodeMCU is sent via wireless through WiFi devices, which is then forwarded by the ISP (Internet Service Provider) to the Blynk Cloud. The Cloud is used as the place to save data, while the data is then sent to the user to be displayed. Users can access the data saved in Blynk Cloud through either a WiFi connection or a cellular connection that is connected to the Internet.

3. Method

In this study, the performance comparison of two notification applications was analyzed. The two applications are Telegram and Blynk. This study followed some steps that can be seen in Figure 5. The following is the explanation of parts A, B, C, D, and E in the figure.

- Part A: Exploring Telegram and Blynk networks to get an analysis related to the performance of each application as a notification system.
- Part B: Explaining the implementation of the prototype of the soybean planting system along with its interconnection to Telegram and Blynk.
- Part C: Ensuring the system in the prototype runs well, the soil humidity sensor can control the soil humidity, the NTP protocol can control the fertilizing schedule, and the notification can be well delivered to the User.

- Part D: Explaining the test and analysis of QoS on Telegram and Blynk, where the QoS Parameters monitored are delay and throughput.

While part A has been explained in section II, the whole parts of B to D will be explained in section III, Analysis. After the A to D parts have been processed, a complete set of data is ready to be analyzed, and the performance of Telegram and Blynk as the notification support device in this study can be concluded.

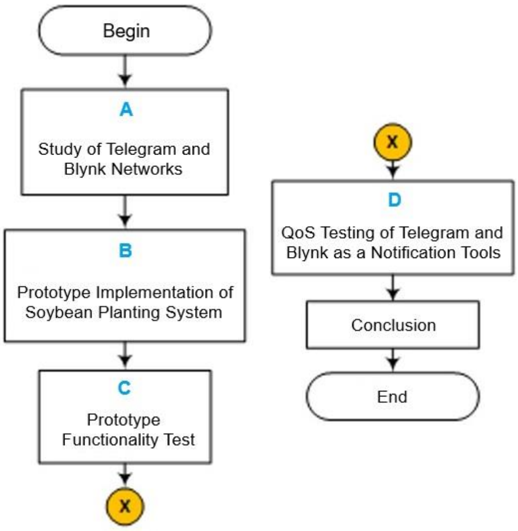

Figure 5. Research Methodology

4. Result and Analysis

4.1 The Implementation of the Prototype of the Soybean Planting System

The study was conducted based on the general picture shown in Figure 6, in which the data generated from the sensor reading on the condition of the soybean farmland is sent to the User/Management in the form of a notification through Blynk and Telegram platforms. However, a more detailed picture of the Soybean Farmland with Sensor System can be seen in Figure 7.

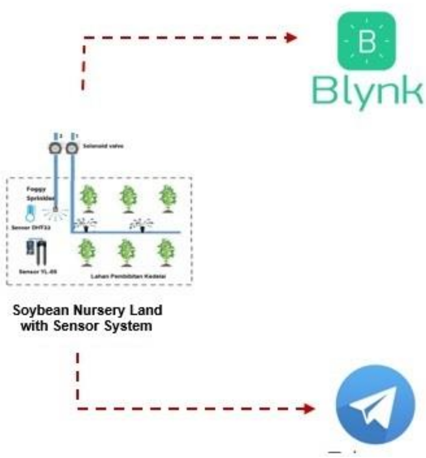

Figure 6. General Picture of the Soybean

4.2 Planting Prototype

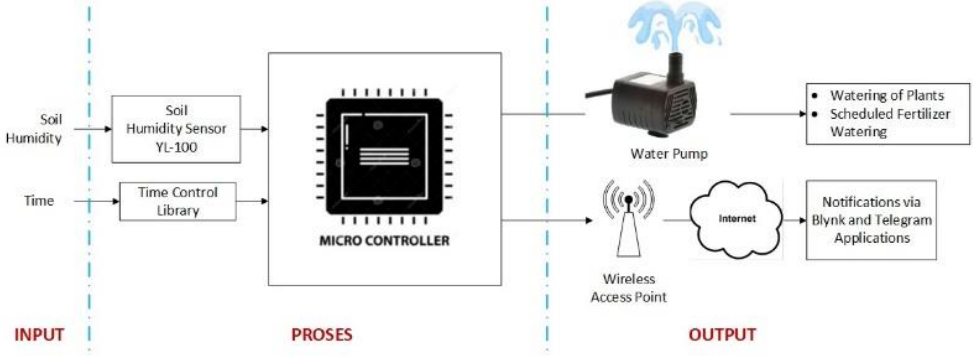

Figure 7. Input Scheme, Output, and Process on Soybean

4.3 Planting Sensor System

Figure 7 shows three main parts of the soybean planting sensor system: INPUT, PROCESS, and OUTPUT. The input of the system is the soil humidity that is going to be read by the YL-100 humidity sensor and the time received by the Internet through Network Time Protocol (NTP). The results of the YL-100 sensor reading are processed by a NodeMCU microcontroller, while the output is used to turn on the water pump. The pump sprays the water onto the soybean planting land so that the land's humidity is always maintained. Meanwhile, the time provided by NTP is processed by the microcontroller to turn on the fertilizer pump. The pump is used to fertilize at a scheduled time. Scheduled fertilizing is used because when soybeans are more than 2 weeks old, the plants should be fertilized once in 2 weeks.

Figure 8. Miniature of IoT-Based Soybean Planting

4.4 System Prototype

When the sensor and watering system had run well, the system of soybean planting miniature was implemented, as it is illustrated in Figures 8 and 9. The picture of the microcontroller system circuit can be seen in Figure 10. The figure shows that the microcontroller uses the NodeMCU of AMICA model with the YL-100 soil humidity sensor as the input device and two relays as the generator of the two water pumps. The two water pumps get an electrical voltage of 12 volts DC, where each pump is used to spray water and fertilizer.

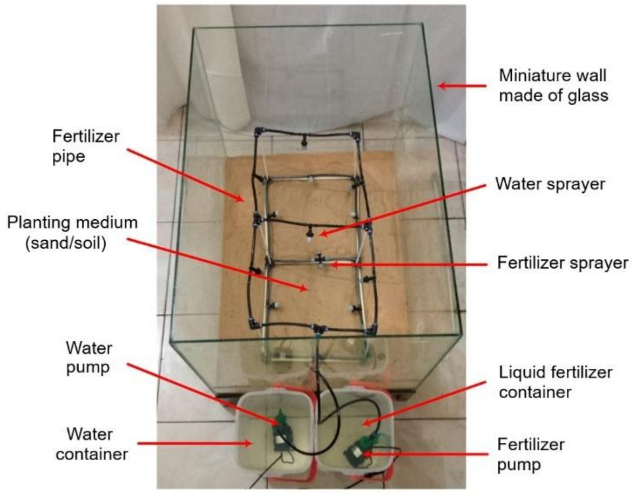

Figure 9. Details on Each Part of the Miniature of the Soybean Planting System Prototype

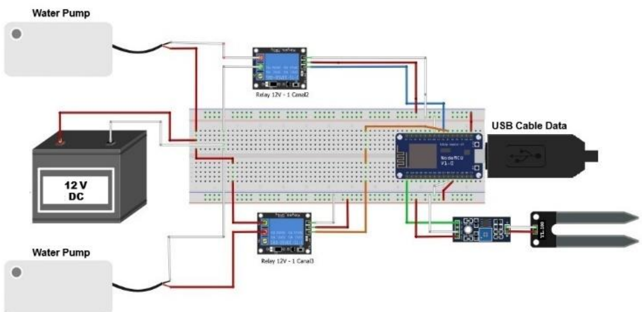

Figure 10. Series of Soybean Planting Prototype

4.5 Functionality Test on the Prototype

The functionality test revealed that the system ran well. Figures 11 to 14 show a number of activities running in the prototype. It can be seen from Figure 11 that when the system is in watering mode, the water flow resembles fog covering the entire part of the miniature. The watering process was conducted when the soil humidity was < 40%. Figure 12 shows that the prototype is in the fertilizing mode, where the process runs as scheduled following the time information given by NTP.

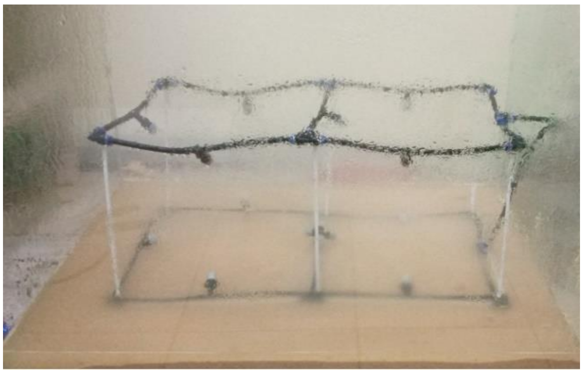

Figure 11. The Prototype in Watering Mode

The essential point of this functionality test was whether the system was able to send the notifications to the User through Telegram and Blynk applications or not. This study has been successful in implementing a system that can provide Users with some information through Telegram and Blynk, related to the condition/activity running in the soybean planting miniature. The notification coming to the User via Telegram and Blynk can be seen in Figures 13 and 14.

Figure 12. The Prototype in Fertilizing Mode

4.6 Test on the QoS of Telegram and Blynk as the Notification Media

In order to show the performance comparison of Blynk and Telegram applications as a media to send notifications, it was stated in the form of QoS comparison of the two applications was conducted in terms of data transfer. QoS parameters used to measure the performance were Delay and Throughput. Figure 15 shows QoS Telegram and Blynk for the delay parameter, while Figure 16 shows QoS for the throughput parameter.

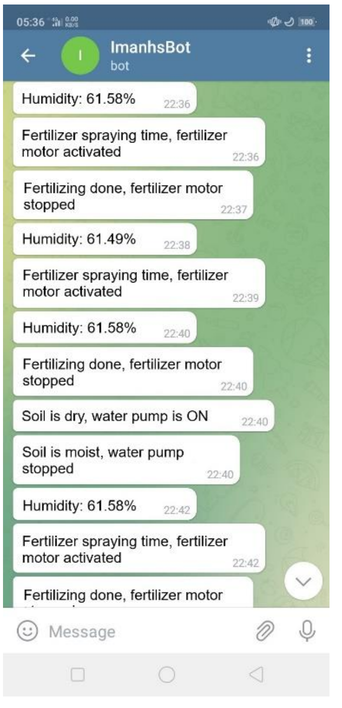

Figure 13. Notification to the User Using Telegram

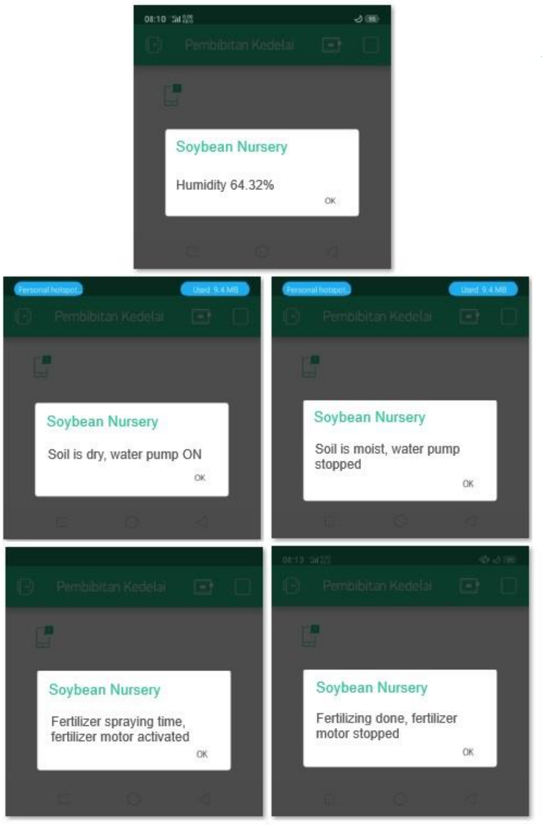

Figure 14. Notification to the User Using Blynk

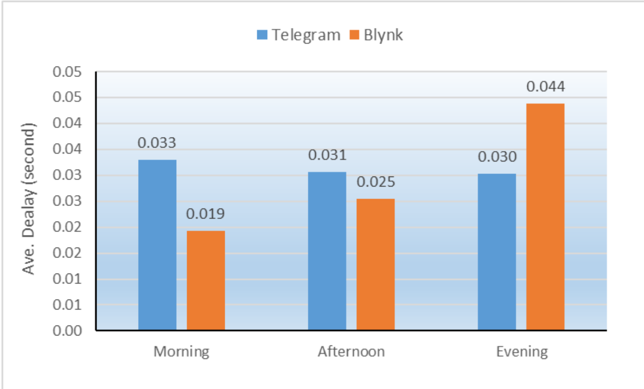

Figure 15. Comparison of the Delay Parameter on Telegram and Blynk

Figure 15 shows that the delay in Telegram is not better than Blynk. It can be seen from that figure that the delay in Telegram is higher than that in Blynk, except at night. The higher at-night delay of Blynk shows that the Blynk network serves a traffic weight far higher at night than that either in the morning or in the afternoon. However, for the throughput parameter, the value shown by Telegram was bigger than that of the throughput in Blynk. From Figure 16, it can be seen that the throughput in Telegram is about 1.5 times bigger than that in Blynk.

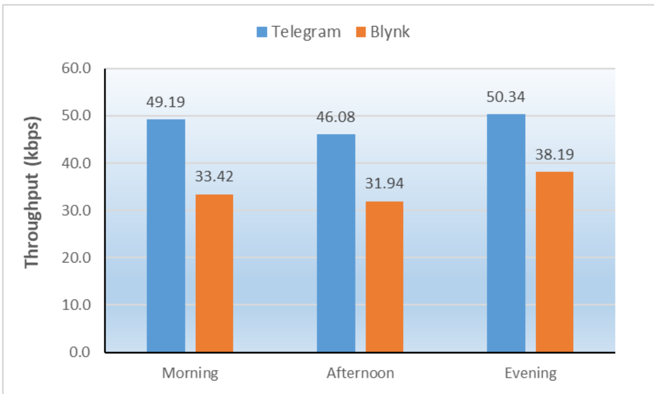

Figure 16. The Comparison of Throughput Parameter in Telegram and Blynk

Concerning the average delay in Telegram, which was bigger than that in Blynk or vice versa, it could not be considered as an indication of a weakness, since in a non-real-time data communication, the delay value is very tolerable. The ITU-T standard states that in a service which is not required to be real-time (as SMS or notification), a delay of 10 seconds can still be accepted [17]. In line with that, Tanganelli et al. [18] also state that the amount of data transfer in the form of parameter reports of delay, packet loss, and jitter is very tolerable.

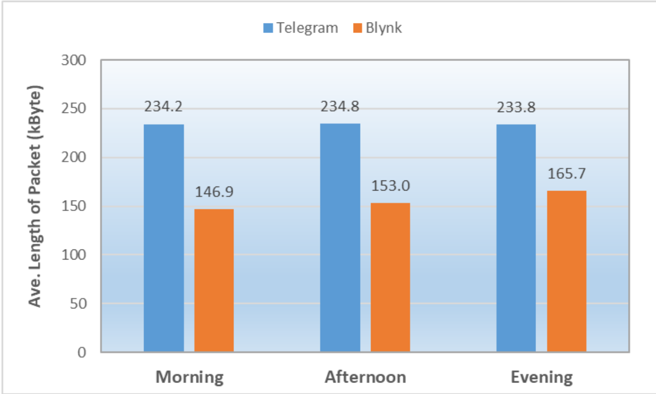

Figure 17. The Comparison of the Average Packet Length in Telegram and Blynk

In the case of throughput parameters, Telegram had a value of ± 1.5 bigger than the throughput in Blynk. However, it does not show that Telegram was better than Blynk, because the data from Wireshark shows that the Telegram packet size is ±1.5 bigger than the Blynk. Figure 17 shows the comparison of the average packet size of Telegram and Blynk. Therefore, under the terms of the throughput parameter, the performance of Telegram was almost the same as that of Blynk. Hence, based on the delay and throughput parameters, the performance of Blynk was a little bit better than that of Telegram when it was used for monitoring this IoT-based soybean planting system.

It is interesting to study why in the study, the QoS performance in Blynk was a little bit leading compared to that in Telegram. If the network architecture in Telegram is compared to that in Blynk, as can be seen in Figures 4 and 5, the Telegram server architecture seems to be more complicated than that in Blynk. What makes the architecture of Telegram complicated is that Telegram is a platform designed to serve different communication types, not only for IoT. However, the Blynk platform is indeed designed specifically to serve data communication in IoT. Therefore, it is understood why the performance of QoS in Blynk is better than that in Telegram, though the difference is not too significant.

5. Conclusions

The prototype of the soybean planting system has been well designed, where a glass miniature of soybean planting supported with a sensor system has been running as expected. In this prototype, the sensor has been able to monitor the humidity of the planting media, and the system has been able to send the results of sensor readings to the User through Telegram and Blynk applications. The system running in the prototype has also been able to run the fertilization process as scheduled. The QoS test result for Telegram and Blynk shows that, in terms of the delay parameter, Blynk was a little bit better than Telegram. The average delay value of Blynk was 62 ms, while that of Telegram was 59 ms. For throughput parameters, Telegram performance was almost comparable to that of Blynk. Based on the QoS performance test, it can be concluded that, as a monitoring system of the prototype of the soybean planting, the performance of Blynk was a little better than that of Telegram. For further research, it is recommended to make some modifications to the watering system in order to be able to spread more evenly with better positioning.

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