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Data transmission period consideration on the internet of thing node

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Data transmission period consideration on the internet of thing node

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Abstract. Internet of Things (IoT) has been very assistive in monitoring remote sites by placing some sensors connecting to the internet. Some sensors are located in fully available electrical sources; while some applications rely on the use of a battery. This paper concerns the latest, considering the quality of the sensed data against the power shortage. Vibration detection is chosen as the measured application. The remote sensor was designed by using MPU 6060, controlled by ATmega328 and connected to the internet through an intermediate node using 433 MHz radio. Intermediate node was controlled by ATmega8. Vibration data sent to the internet consists of minor and major vibrations. Major vibration occurs incidentally. Measurement shows that the sorter the data transmission period, the more effective sensor detecting major vibration. It is shown by the increment of vibration amplitude when the transmission period shorter. However, the more frequent the transmission, the more energy required. The assessment shows that data quality and power lifetime are determined by the transmission period.

1. Introduction

The Internet of Things (IoT) networks is now gradually implemented for many applications. However, as the new solutions, research on this matter is on progress. The IoT system is constructed by distributed sensors that are linked to a sink node by TCP/IP based communication networks which enable data collection from those sensors [1, 10]. Each sensor node sends data periodically or sporadically depending upon network requirements. Data collection and data transmission are controlled by a microcontroller with limited computing power, memory resource, and battery capacity [3].

Some applications such as temperature or pressure checks require periodic reports, while anomaly detections may send data sporadically. Limited energy resources restrict the number of transmissions that can be made by an IoT node. Logically, the more frequent data transmission, the more energy consumed, and the faster battery drained [4, 5].

Some method battery savings are available [6-9]. Data compression may reduce the number of data transmitted [6], however, the compression process has introduced additional processing load [7]. Finding the most efficient route may reduce data re-transmission and data relaying [8], but it works effectively for a multi-sensor network such as a wireless sensor network (WSN) [9].

Since power consumption increases as the transmission period decreases, spacing a larger transmission period may expand battery lifetime. However, data quality may decrease as the number of received data reduced. This paper studies correlations between transmission period, power consumption and data quality within the IoT network. In order to emphasize the importance of data quality, vibration data is applied as the transmitted object.

2. Research method

In order to examine data transmission period impact to power consumption and data quality, the expanded node of the internet of thing is set up as shown in Figure 1. The expanded sensor node, controlled by Atmega328, uses MPU 6050 to sense vibration data and sends them by using an amplitude shift keying (ASK) transmitter FST 1000 to ASK receiver CZS3 in the frequency of 433 MHz. The CZS3 receiver is a part of an IoT node, controlled my Atmega8. This IoT node supposed to send data to the IP network. However, in order to evaluate the aforementioned parameters, received data are forwarded to a PC.

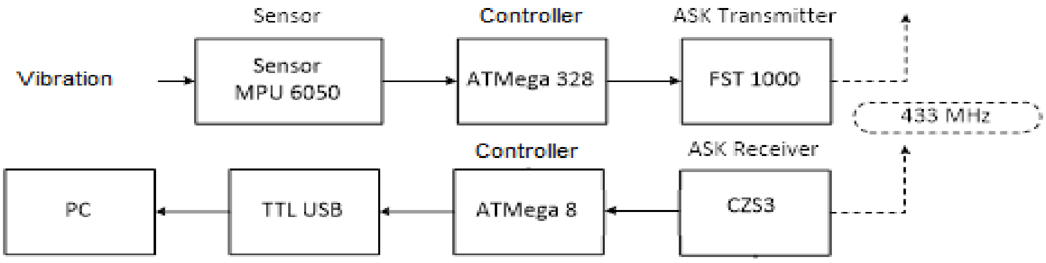
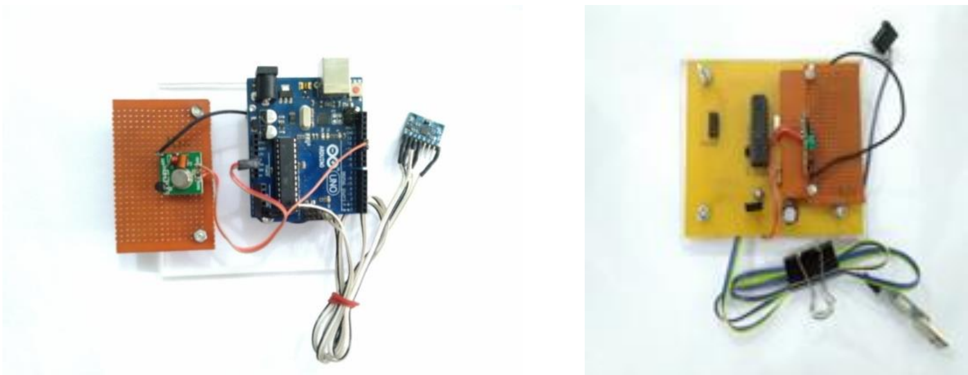


Figure 1. System evaluation.

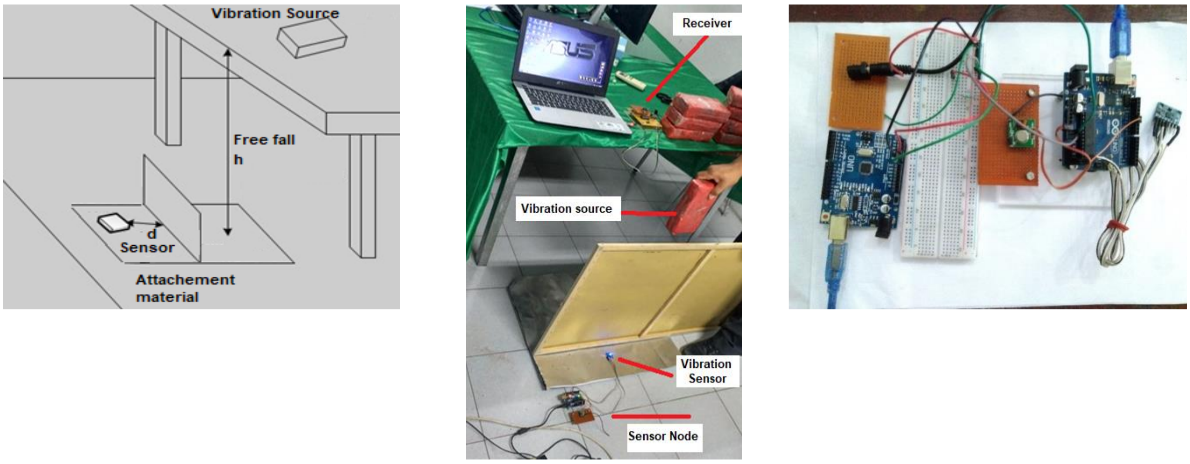
The designed circuits are made separately. Since transmitting power is well received in some distance, transmitter and receiver distance is considered not being an issue. Figure 2 shows the implementation of the transmitter and the receiver.



(a) (b)

Figure 2. Transmitter and receiver.

The sender uses the ATmega386 controller is adjusted to acquire data from MPU 6060 with a period varied from 25 ms to 700 ms. MPU6060 vibration sensor detects vibration acceleration amplitude in gravity unit, g. In order to obtain data with various quality; the evaluation construction is set up as shown in Figures 3a and 3b. The vibration source is made from a free fall load. The load is made of 3 kg bricks. The MPU 6060 sensor is laid on the ceramic floor. Voltage and current within the transmitting node are measured by an additional Arduino device as in Figure 3c.



(a) (b) (c)

Figure 3. The experiment set up.

3. Evaluation results

Figure 4 shows the measured power consumption. The consumed power decreases exponentially as the transmission period increases. For instance, a 25 ms transmission period causes the transmitting node consumed power of 3.62 mW. By expanding the transmission period to 500 ms, power consumption decreases to only 1.77 mW. This means, expanding period about 20 times, produced power reduction about 51.1%.

At this condition, by assuming power taken from 0.5 AH 4.5V battery, the 25 ms transmission period makes the battery lasts about 621.54 hours or 25.9 days. Meanwhile, when the transmission period is set to 500 ms, the battery lasts about 1271.19 hours or 52.97 days. This means that the battery lasts longer when the transmission period is set larger.

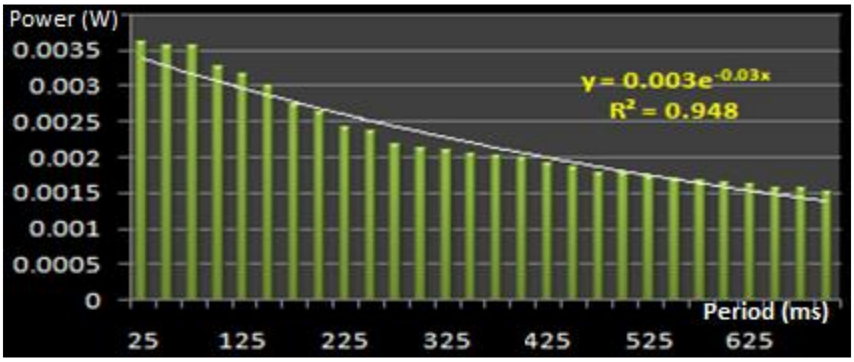


Figure 4. Power consumption versus transmission period.

Figure 5 shows that the quality of data in terms of detected vibration amplitude changes over time. The maximum amplitude in the experiment reaches 1.6 g. The samples are made by setting up the detection period at the smallest value.

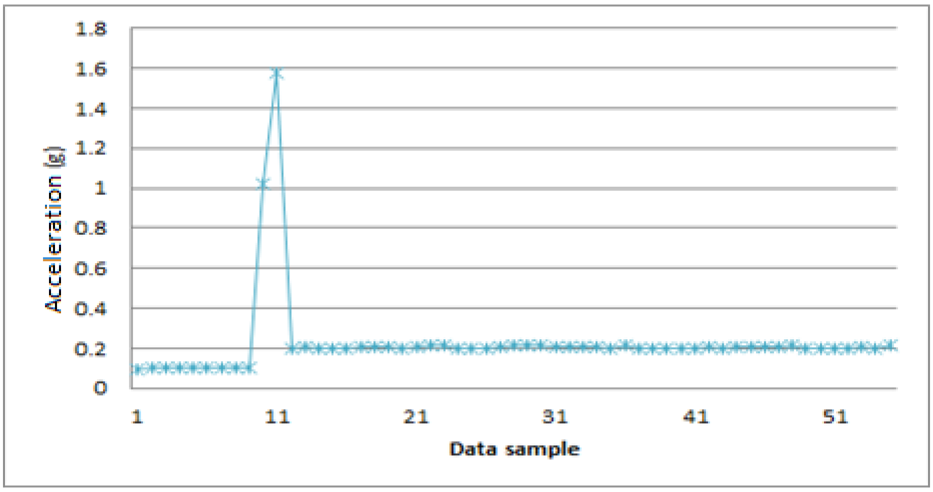


Figure 5. Vibration amplitude changes over time.

By setting up the transmission periods to 150 ms, 200 ms, and 250 ms; the average vibration amplitude changes. Figure 6 shows that the average amplitude of 150 ms reaches the highest value of 0.156 g. Meanwhile, the 250 ms period detects only about 0.102 g average vibration. This shows that the lower the transmission period exerts the higher average amplitude. The shorter transmission period enables a sensor to detect better data quality.

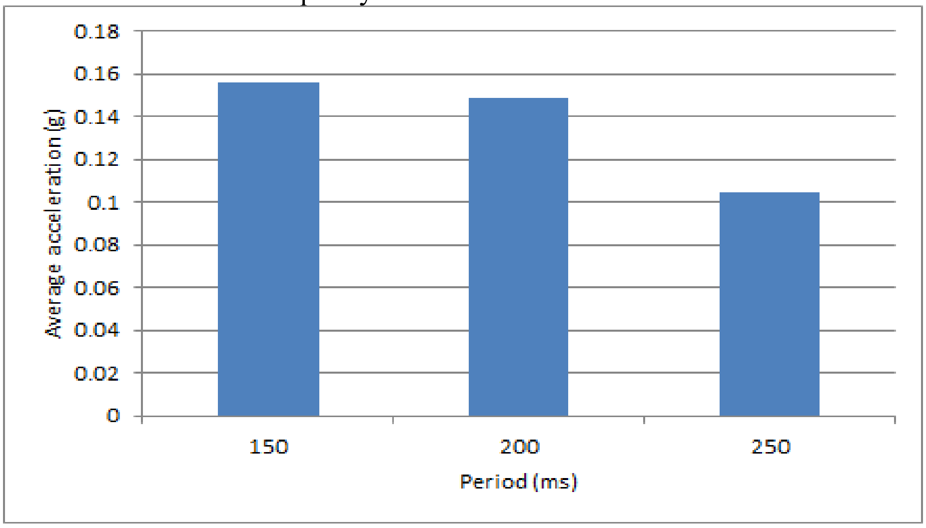


Figure 6. Vibration amplitude versus transmission period.

Some facts are found during the experiments. The more frequent or the shorter the transmission period results the higher power consumption and the fastest the battery drained. On the other hand, the shorter the transmission period produces the higher the detected vibration amplitude, which means the higher the data quality. This means battery lifetime changes slower than the transmission period.

4. Conclusions

This paper has examined the considerations of the transmission period in the IoT node against power consumption and data quality. It was revealed that the shorter the transmission period may cause the higher the power consumption. The twenty times lower transmission period results in about twice a longer battery life. However, a lower transmission period generates lower data quality.

Acknowledgment

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