Development of an automatic meteor shower observation and the notification system
~Web broadcast of meteor appearance~

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Introduction

Radio meteor observation is a worldwide method using a receiver and antenna for receiving a specific radio wave frequency (*i.e.,* HRO or FRO method). Meteors traversing the ionosphere create ionizing trails. The HRO or FRO method is based on the characteristic that ionized meteor trail reflects radio waves in a certain frequency band transmitted from the ground. The audio data obtained by this method is output as image files by HROFFT or MROFFT software. The conventional method of radio meteor observation requires expensive devices such as receivers, and it is needed to construct the observation system. Therefore, we have developed an automatic observation system and a quick notification system of meteor appearance so that anyone can easily observe meteor showers. In our previous study, we have succeeded in constructing an automatic meteor observation system with HRO, completely automating the process from detection of meteor appearance signals to data output, and stably collecting quantitative data and meteor appearance information. The system we have developed was equipped with a function to broadcast only the analyzed values of audio data, which is recorded during meteor observation. Furthermore, it could be more user-friendly and practical when the system automatically detects the meteor appearance signals from the audio data and broadcasts the signals. In this study, we aimed to upgrade our system with a new function of “quick notification of meteor appearances.”

Method

Our system consists of three sections: 1) the radio meteor observation section using a 2-element antenna and radio wave receiver, 2) the analysis section using a computer with Arduino, and 3) the bot-transmitting section made by Python running on a computer. We carried on three experiments in this study: 1) transmitting the audio (recorded) data of meteor observation to the devices, 2) transmitting the audio (in real-time) data of meteor observation to the devices, and 3) analyzing the audio (recorded) data and notifying the meteor appearance to the devices when a meteor appearance signal was detected.

Results and Discussion

The meteor audio data was analyzed by the Fast Fourier Transform (FFT) library in Arduino in order to extract the specific data observed at the time of meteor appearance (data with a frequency of approximately 495 Hz where the volume increases significantly). And then, we converted the meteor appearance data into the text data. The text data was shared and broadcasted to the bots created on Discord and LINE platforms.

In Experiment 1, the data transmitted by the bot running on Python was consistent with the received data

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on the devices. It means that a “quick notification of meteor appearance system” was available. In Experiment 2, we succeeded in transmitting the data in real-time without any significant difference. In Experiment 3, we demonstrated a function to analyze the audio data and notify the meteor appearance to the devices when the meteor appearance signal was detected. Therefore, we succeeded in completely automating the procedure from the radio meteor observation section to the bot-transmitting section with a low-cost and simple method.

This system automatically distinguishes the meteor appearance signal from noises by analyzing the audio data collected during the radio meteor observation. When a meteor appearance signal is detected, the signal is broadcasted simultaneously to the devices as meteor appearance information. Our new system is expected to obtain the meteor appearance information easier with personal devices (*e.g.,* smartphones).

Conclusion

Our system with new functions allows us to broadcast the meteor appearance information to the individual devices in real-time at low-cost, instead of the conventional high-cost method. Our next goal is to provide “meteor shower forecasting” using our detecting system of the meteor appearance signals and the data storage system.

Keywords: Radio meteor observation, Automatic web broadcasting, Arduino, Python

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