Design and Construction of an Automated Acid Rain and Weather Monitoring Station

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Abstract

Acid rain is a serious environmental issue in the world. Many countries are severely affected due to acid rain precipitation. The results of acid rain precipitations are seen after some time.

This thesis describes the development of an automated acid rain monitoring station with weather parameters. The monitoring of weather parameters were carried out by integrating temperature, humidity, wind speed, wind direction and rainfall sensors to a PIC microcontroller. A separate data logging system was developed to store the weather data. The entire acid rain monitoring system is based on mechatronics, which consist of pH, conductivity measurement probes and actuators with cooling system to maintain the condition of buffer solution. The measured pH, conductivity, weather and verification data were transmitted to a central location through a GSM network and displayed on a common graphical user interface. The sensors were calibrated and the measurement results were verified in order to maintain the accuracy and reliability of the measurements.

Since wind carries pollutants which contribute to acid rain formation as well as shifting of rain clouds from one place to another, the wind data obtained from the automated weather station was used to study the diurnal and seasonal wind characteristics. The study was extended to investigate the possibility of harnessing wind energy at Hambantota. The changing wind speed affect the power generation in wind power systems. Therefore, a fractal analysis was carried out to study the variation in wind speed and wind direction with time. The study showed that the scaling behavior of wind speed and wind direction is similar to the scaling behavior observed in previous studies which were carried out in other parts of the world. The seasonal wind speeds and wind direction change exhibits different scaling behavior. The scaling behavior does not change with height. The wind direction records show high multifractality compared to wind speed records.

The acid rain monitoring station was field tested by installing in the hill country during the south west monsoon period. The data show that during the period under investigation there was no acid rain precipitation in the hill country region. However, a slight change in pH and conductivity with continuous rainfall was observed. From the field tests it was concluded that the developed acid rain monitoring station can be marketed as a commercial instrument to operate in remote locations and transmit data to a central location successfully.