I. INTRODUCTION
Respiration is one of the physiological phenomena for maintaining important function for the homeostasis, which exchanges oxygen and carbonic acid between body cells and air [1]. The use of auscultation in pulmonary medicine has not theoretically been developed yet, so it calls for the quantitative analysis of the breath sound [2]. The purpose of this study was to develop a new auscultation system for the detection and analysis of the breath sound from trachea, which includes small size microphone encapsulated in a housing for resonant effect and hardware for the sound detection.

II. METHODS
Previous studies were progressed for the detection of breath sound from trachea. It made possible to perceive approximately constant sound and hardly be affected in the transmission of the sound. With considering of variability of the sound characteristics in the detection of breath sound from thorax, it was shown that the level of breath sound from trachea was higher than that from chest or dorsum and could maintain detecting position of sound consistently [3].

Figure 1 is a diagram illustrating overall hardware system for the detection of tracheal breath sounds by attaching the microphone to the neck.

![Diagram of total hardware system](image)

Breath sound detector was fabricated by inserting ECM WM-063T microphone to a small cylindrical housing for the resonant effect, which could be positioned comfortably on the neck using strap.

III. RESULTS
Developed breath sound detection system has the characteristic of frequency response with the band of 90Hz ~ 1600Hz, which could detect the breath sound in both normal person and patients who have pulmonary function disease. Figure 2 shows the wave signals of breath sounds when inhaling and exhaling obtained using developed system with 2048Hz sampling rate for the duration of 3 seconds.

![Inhaling and exhaling respiratory signals](image)

Fig. 2. Inhaling and exhaling respiratory signals

IV. CONCLUSIONS
A developed system for detecting breath sound from trachea could be useful for new auscultatory method which could distinguish normal subjects and patients who have pulmonary disease. This study could be extended to estimate specific variables in time and frequency domain from breath sound, and to find the correlation with those variables obtained from pulmonary function tests.

REFERENCES