SWIFTLETS WAVE SOUND PROCESSING THROUGH FREQUENCY ADOMAIN

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Introduction

The swiftlet is found in South East of Asia, namely Thailand, Cambodia, Vietnam, Philippines and Malaysia. In Malaysia, swiftlet farming industry is became the significant source of foreign exchange currency. According to unofficial report, 45,000 swiftlet farms are in Malaysia, 80% of them are located in or near cities. However, the location of swiftlet farms brings many complaints from public. Health hazard, noise pollution, and lack of the source are some of these complains. Currently, new effort is done to reduce these complains by constructing Guidelines which provides Good Animal Husbandry Practice for Edible-Nest Swiftlet industry. Swiftlet farmers embed loudspeakers inside and outside of swiftlet house to call the swiftlet. DWNP cooperates with Bird Nest Association to provide a guideline to play the audio sound properly and in exact time. This paper is an attempt to make a small contribution to solve some problems from swiftlet wave sounds. The main project aim is developing a new algorithm based on three processing stages: first identifying the bird calls through frequency domain using signal processing methods and then detecting the direction of that song and finally synthesizing (generating) that song signal by computer. The whole process is shown in Fig 1.

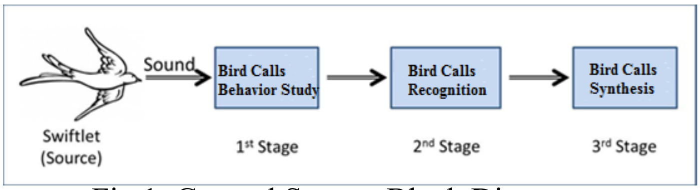

Fig 1: General System Block Diagram.

Methodology

One of the goals of this project is to create an algorithm, or a series of algorithms that will remove these areas or 'de-noise' the image. The identification task consists of two stages. The first step is segmenting the bird sound sequence and the second step is recognition. In recognition step, Linear Predictive Coefficients (LPCs) from each frame are extracted and they have been used as feature. These features are fed to SRNFN which is fuzzy with if-then structure. It helps to processing the pattern of temporal birdsong too. For birdsong recognition, a SRNFN is used to learn temporal relationships of just one swiftlet species. The error of this step is applied as a criterion for identification the species. For constructing experimental result, only 10 swiftlet species are consider which is expected to have high identification rate achieved. Also, some comparison among the proposed system with other systems based on Neural Network (NN) and fuzzy network are performed. Direction recognition of Swiftlet's sound can be done using a TDOA method. Estimating time difference between two or more microphones used to get the birds sound will be based on Generalized Cross Correlation (GCC) then using a linear equation to estimate the direction of the sound source. First, we perform our algorithms of time difference between microphones.

Secondly, using a triangulation formula determine the direction of sound. Finally we will implement designed and simulated algorithms to use them part of the whole system. The synthesis part will be based on the samples analysed in the recognition stage by extracting the pattern of the song signal and applying some of digital processing techniques (DSP) to add or subtract or manipulate many sound waves to produce the desired song signal. Using sound to identify certain species is not a new idea. T.A. Parker recorded the dawn choruses of bird in the Bolivian Amazon, and within 7 days he found he had captured 85% of the regional species on tape. In that same region, seven experienced ornithologists took 54 days to inventory the birds using a capture and release technique [1]. The basis of the project is to study and use bio acoustical recordings from birds to create a machine learning algorithm that, taking in an audio stream, will be used as an automated species recognition tool. Auto- mated recognition of bioacoustics signals has been reported with encouraging results in a variety of animals [2]. Birds species recognition in particular has been studied using support vector machines [3], sinusoidal modelling [4], hidden Markov models and dynamic time warping [5]. Using pre-recorded and pre-labeled data from the Cornell Macaulay Sound Library was away in which to create a database of sounds and species labels for the machine. However, there were many challenges to the project including noisy audio and unlabelled data. In case of sound direction detection a variety of methods proposed by researchers based on time difference of arrival (TDOA). Using microphone arrays which are spatially distributed microphones is the underlying principle in sound localization. Byoungho, Youngjin and Youn-sik proposed the sound source localization using the spatially mapped GCC (generalized cross correlation) functions based on TDOA [6]. Walworth et al. developed a formulation based on linear equation to compute wave source position in the three-dimensional (3-D) by using time delay values [7]. In addition, some effects on direction recognition that naturally comes from topology (front-back confusion effect) are avoided by incorporating more microphones [8]. The identification task has two steps. In recognition step, Linear Predictive Coefficients (LPCs) from each frame and fed to SRNFN. It helps to processing the pattern of temporal birdsong too. For birdsong recognition, a SRNFN is used to learn temporal relationships of just one swiftlet species. The error of this step is applied as a criterion for identification the species.

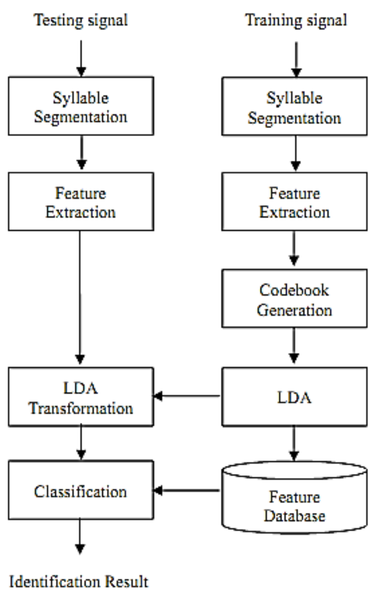

Fig 2: The block diagram of the proposed bird calls Recognition system.

The recognition process with two phase of identification is shown in Fig 2. In each phase, when the sound is recorded, it is divided to syllable, then form each syllable feature is extracted. In the training phase, features are used for generating codebook. Also, linear discrimination analysis is applied to select and reduce the codebooks size for efficiency. Finally, feature database is constructed. However, in testing phases, the extracted features are transformed by LDA to proper space then, by using database, which is constructed in training phase, the result is identified. Direction recognition of Swiftlet's sound can be done using a TDOA method. Estimating time difference between two or more microphones used to get the birds sound will be based on Generalized Cross Correlation (GCC) then using a linear equation to estimate the direction of the sound source. First, we get the result of recognition system and use Matlab to perform our algorithms of time difference between microphones based on which mentioned above .secondly, using a triangulation formula will give us the direction of sound. Finally we will implement designed and simulated algorithms to use them part of the whole system. The synthesis part will be based on the samples analysed in the recognition stage by extracting the pattern of the song signal and applying some of digital processing techniques (DSP) to add or subtract or manipulate many sound waves to produce the desired song signal. In this paper, subtractive synthesis technique will be tested to generate the song by processing the amplitude value (a1) and the frequency (f1) as illustrated in the block diagram Fig 3. Subtractive synthesis technique can be applied to some additive partials by using some GUI software like (Harmor).

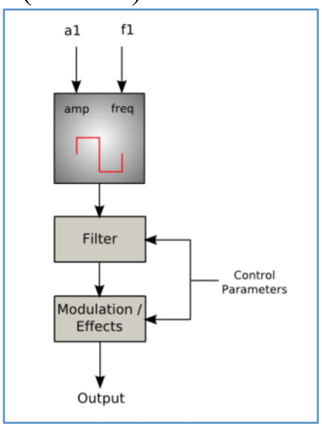

Fig 3: System Block Diagrams.

Fig 4 presents the proposed system for swiftlet call recognition and synthesis. First swiftlet sound is recognized based on acoustic features, then it is synthesized based on recognition step, finally swiftlets behaviour is supervised by CCTV cameras.

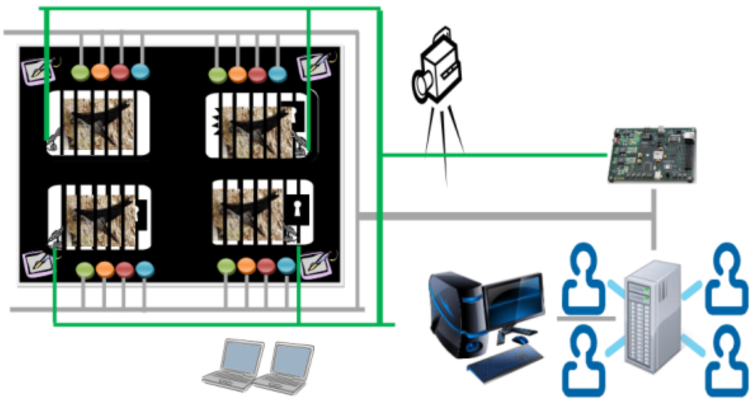

Fig 4: The proposed bird calls system.

Swiftlet frequency spectrum

Fourier and Linear Predictive (LP) transform are a strong tool for analysing frequency domain of any signal. In this research, Fast Fourier Transform (FFT) MATLAB function is applied for analysing the swiftlet signal. The internal and external swiftlet sound was recorded by Song Meter (SM2) which can record the ultrasonic sound till 48 kHz. Fig 5 shows SM2 devices at internal and external position of the swiftlet bird house. The swiftlet house is belong to Dr. Shful Nizam Tajuddin and located in Pahang.

Fig 5. Internal and external swiftlet sound collection by SM2.

In this experiment, every 2 s of swiflet calls was analysed to investigate the ultrasonic features inside it. As shown in Fig 6 the frequency is between 0-48Khz.However, there are two distinct peaks in LP spectrum that beyond the human hearing which are more than 20 kHz. Furthermore, from the spectrogram, it is seen that there are some frequency which are more than human hearing range (20 Hz to 20 kHz).

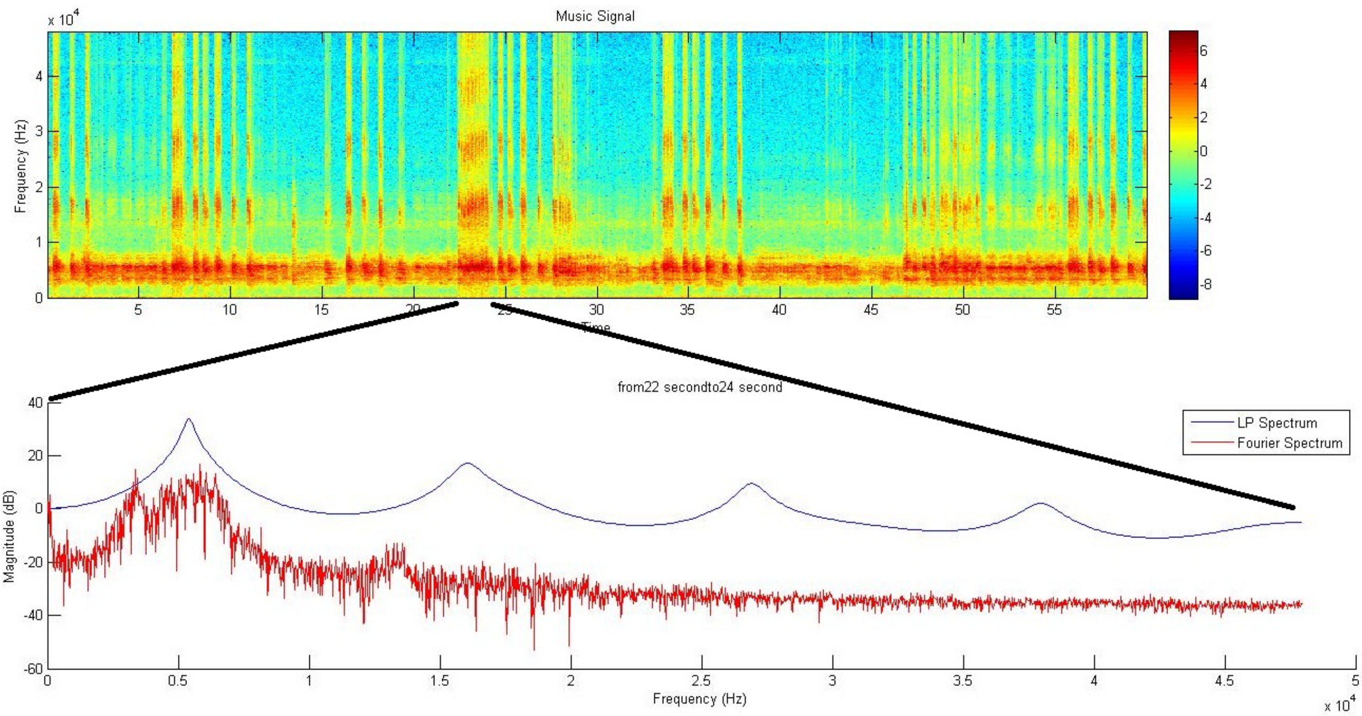

Fig 5: Swiftlet spectrogram, Fourier and LP spectral from 0 Hz to 48 kHz.

Conclusion and Future Work

Swiftlet industry has good potential to be invested by governments and organization. This paper proposed a new system to improve the traditional swiftlet calling system. Success of the proposed system will give big impact to the swiftlets industry especially in Malaysia and Asia's country by eliminate noisy voice produce by current systems (in the market).

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