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INVENTOR(S)/APPLICANT(S)		
Given Name (first and middle [if any])	Family or Surname	Residence (City and either State or Foreign Country)
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[Page 2 of 2]

Number 1 of 1

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Nicholas Seet

Nicholas Seet
Auditude.com, Inc.
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Pasadena, CA 91106

To Whom It May Concern:

This memo is to certify that Auditude.com, Inc. is a small business, with two employees and revenues of \$150,000. We thus wish to submit our provisional patent application as a small-business.

Sincerely,

A handwritten signature in black ink, appearing to be 'N. Seet', with a long horizontal line extending to the right.

Nicholas Seet
CTO



Media Content Database Creation and Maintenance Using Time-Delayed Auto-Correlation Of Frequency Characteristics

2/17/2004

Nicholas Seet, CTO, Auditude, Inc., Vivien Zapf, Auditude, Inc.

Assumptions

Media will be defined as any streaming audio source in any form, be it radio, television, cable, satellite, internet stream or the like. Audio can be music, speech, advertisements, promotions, or the like. This system requires an underlying passive frequency-based identification technology such as that contemplated in patents filed by Jeff Caruso and Auditude, Inc.

Background

One of the biggest challenges for an audio identification or "audio fingerprinting" company is the development and maintenance of a database of audio against which identifications are attempted. Gaining access to the source audio and then fingerprinting it and inserting it into a database is a complex process from a licensing and update management process.

Consider, for example the application of radio or television ad monitoring. In order to identify when an ad is playing, the current process is to get the high-quality original ad from the advertiser, extract and normalize the audio layer, extract the frequency characteristics (fingerprint the audio), then insert the fingerprint and ad information into a database for subsequent retrieval.

This process presents many operational issues, since getting ad data from the advertiser may come in many different forms (tape, beta, VHS, MPEG, etc), and conversion is time consuming and unreliable. Furthermore, there is no guarantee that the content that was provided is in fact what would be broadcast by the radio or television station. Also, the ability for advertisers to monitor their competitor's advertising strategies is also impossible, since obtaining their competitor's ads for this purpose would be problematic.

The invention described herein attempts to solve the issue of content acquisition by utilizing the signal itself as the data source, and discusses a method by which this database can be created in an automated fashion.

The Invention

Instead of using a high-quality original master recording (say a CD, or digital video tape, etc), we suggest using the same audio signal that is to be identified, but from a previous period. In the case of radio or television monitoring, we propose that the previous period (i.e. day or day-period) for that particular station (or genre, or group of similar stations), be fingerprinted, and inserted into a fingerprint database. This could be accomplished by dividing up the recorded audio for the day into small (~4 second) increments and storing



each increment with a unique identifier. A 4 second sample should be short enough to occur three to seven times during a standard 15 to 30 second broadcast commercial.

During the subsequent period, matches are then performed against this database of previous samples, and if matched, then the identifier (or identifiers if multiple-matches are found) and a time-stamp are recorded. A post-process now goes back into the list of identified audio, and attempts to group audio together by examining relative alignment of identified sequential samples against the previous day samples in the database. It is important to use both the inter-sample spacing, and the time-stamp from where the audio was matched to determine which sequence of samples (and where in those samples) constitutes a complete content section (i.e. advertisement, or music piece).

Now that a relationship has been established between the previous period's database and the current period's samples, it can be asserted that the portions of the previous period database that were matched are repeated content like advertisements, promotions, songs or the like. Now a human reviewer can manually listen to just the series of identified samples to add meta-data (like ad name, or artist, and title information) to the series of samples. Note that this manual process only needs to be done once for each unique piece of content. It is likely that this process will also improve accuracy of the matches as signal quality is matched between source and test audio.

Identified content is left in the database for all future days until a set expiration date is reached since the last identification, and any samples from the current day that did not match are now added into the database for the next day's identification; the cycle repeats.

To illustrate:

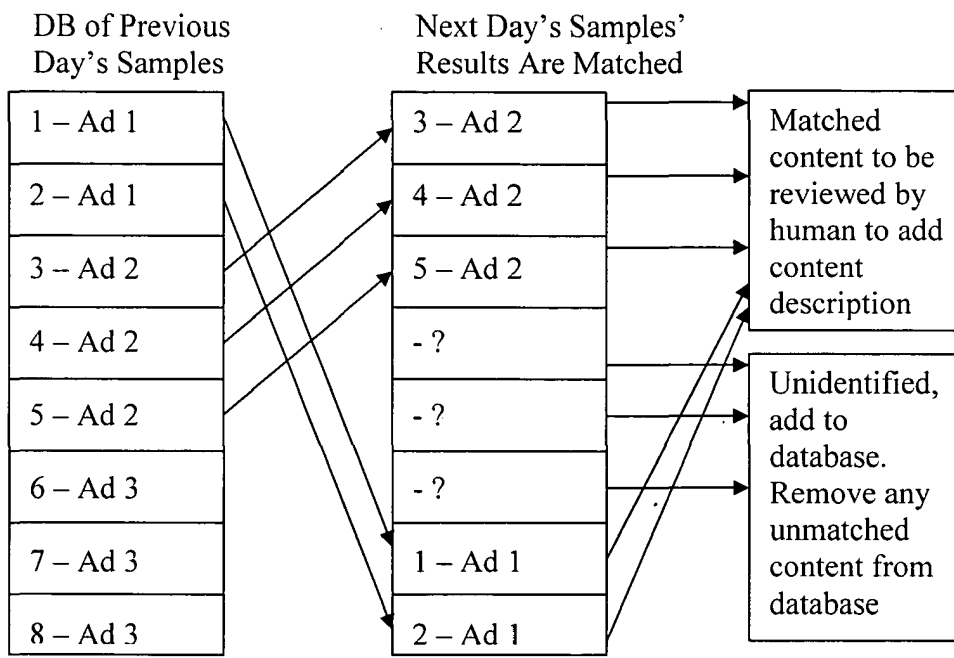


Figure 1. Auto-correlation Example

Refinements

Since there is envisioned to be a great deal of database activity, efforts should be taken to reduce the search time, such as loading the database into a RAM drive, or dividing the active portion of the database into day-parts that correspond to the well-known listening patterns of the medium (for instance morning-drive time for radio, and prime-time for television).

Additionally, should the database itself contain duplicates, the post-processing algorithm should include measures to group matches into sets that correspond to the duplicate sample sets. This requires that the underlying fingerprinting software returns all matches, not just the first match.

Further, if some matches are not made, but surrounding samples are in the correct sequence and timing to infer the identity of the missing sample, that sample can thus be identified. To illustrate:

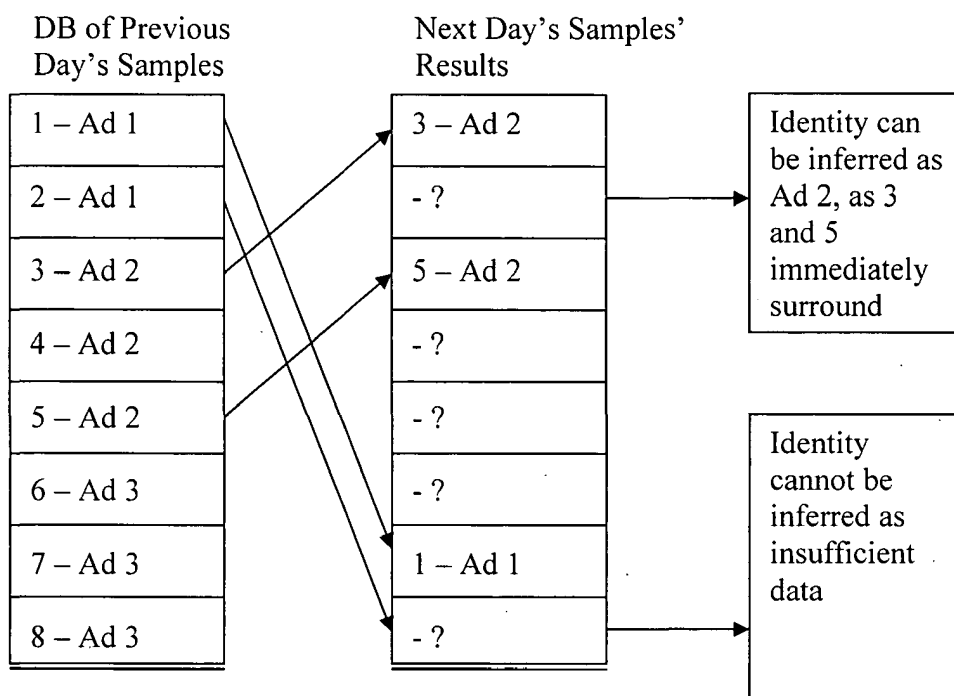


Figure 2. Auto-correlation Identity Inference Example

Finally, an elegant user interface could present the sets of matched samples to the user in such a way as the user can just listen to as much of the sequence of samples and he or she likes, and enter in the content meta-data before jumping to the next sequence. This interface could be available as a software application or as an Internet based website.

```

#!/usr/bin/perl

use Broadcastid;
use strict;

my $MAX_LOOK = 2;  #at most look back 2 skims

my @play_data;
my @play;

my $statement = "SELECT play_id, media_id, min(play_data_offset),
avg(play_data_confidence), count(*)
                FROM play_data
                WHERE play_data_status = 1
                GROUP BY play_id, media_id
                ORDER BY 1 ASC,4 DESC";

my $sth = &Broadcastid::Execute($statement,$Broadcastid::dbh);

    $statement = "UPDATE play_data SET play_data_status = 2
                WHERE play_data_status = 1";
    &Broadcastid::Execute($statement, $Broadcastid::dbh);

my $i = 0;
my $n = 0;
my $last_play_id = 0;

while(my ($play_id, $media_id, $min_data_offset, $avg_data_confidence,
$count) = &Broadcastid::Fetch($sth))
{
    $play_data[$i]->{'play_id'} = $play_id;
    $play_data[$i]->{'media_id'} = $media_id;
    $play_data[$i]->{'min_data_offset'} = $min_data_offset;
    $play_data[$i]->{'avg_data_confidence'} = int($avg_data_confidence);
    $play_data[$i]->{'count'} = $count;

    if($play_data[$i]->{'play_id'} != $last_play_id)
    {
        $n++;
    }

    $last_play_id = $play_data[$i]->{'play_id'};
    $i++;
}

my $num_play_data = $i;
my $num_play = $n;

my $n = -1;
my $last_i = 0;
my $first_i = 0;
for(my $i = 0; $i < $num_play_data; $i++)
{

```

```

    if($last_i != $play_data[$i]->{'play_id'})    #new play_id or first
play_id
    {
        if($first_i && $play[$n]->{'media_id'} eq "")    #new play_id, but
last did not find match, set to first value
        {
            $play[$n]->{'media_id'} = $play_data[$first_i]->{'media_id'};
            $play[$n]->{'play_offset'} = $play_data[$first_i]-
>{'min_data_offset'};
            $play[$n]->{'play_confidence'} = $play_data[$first_i]-
>{'avg_data_confidence'};
        }

        $n++;
        $play[$n]->{'play_id'} = $play_data[$i]->{'play_id'};
        $first_i = $i;
    }

    $last_i = $play_data[$i]->{'play_id'};

    if($play[$n]->{'media_id'})    #already matched, skip
    {
        next;
    }

    elsif(!$play_data[$i]->{'media_id'})    #unidx, set and skip    [add
inference portion]
    {
        $play[$n]->{'media_id'} = 0;
        $play[$n]->{'play_confidence'} = 0;
        $play[$n]->{'play_offset'} = 0;

        next;
    }

    #if this play is the same as either of the last two plays, found it!
    for(my $attempt = 1; $attempt <= $MAX_LOOK; $attempt++)
    {
        if($n - $attempt < 0)    #can't look back yet
        {
            next;
        }

        elsif($play[$n - $attempt]->{'media_id'} == $play_data[$i]-
>{'media_id'})
        {
            || $play[$n - $attempt]->{'media_id'} == $play_data[$i]-
>{'media_id'} - $attempt )
            {
                $play[$n]->{'media_id'} = $play_data[$i]->{'media_id'};
                $play[$n]->{'play_offset'} = $play_data[$i]-
>{'min_data_offset'};
                $play[$n]->{'play_confidence'} = $play_data[$i]-
>{'avg_data_confidence'};

                next;
            }

```

```

}

#Now check next play_data entries for match
my $last_j = 0;
my $attempt = 0;
for(my $j = $i+1; $j < $num_play_data; $j++)
{
    if($play_data[$j]->{'play_id'} == $play_data[$i]->{'play_id'})
    {
        next;
    }

    if($last_j != $play_data[$j]->{'play_id'}) #done with this
attempt
    {
        $attempt++;
    }

    if($attempt == $MAX_LOOK)
    {
        last;
    }

    if($play_data[$j]->{'media_id'} == $play_data[$i]->{'media_id'}
    || $play_data[$j]->{'media_id'} == $play_data[$i]->{'media_id'} +
$attempt )
    {
        $play[$n]->{'media_id'} = $play_data[$i]->{'media_id'};
        $play[$n]->{'play_offset'} = $play_data[$i]-
>{'min_data_offset'};
        $play[$n]->{'play_confidence'} = $play_data[$i]-
>{'avg_data_confidence'};
        last;
    }

    $last_j = $play_data[$j]->{'play_id'};
}
}

for(my $n = 1; $n < $num_play; $n++) #leave the first one
{
    #If first and third are rationally spaced, set second to expected
value
    if($play[$n - 1]->{'media_id'} + 1 != $play[$n]->{'media_id'} &&
        $play[$n - 1]->{'media_id'} + 2 == $play[$n + 1]->{'media_id'})
    {
        $play[$n]->{'media_id'} = $play[$n - 1]->{'media_id'} + 1;
        $play[$n]->{'play_offset'} = 0;
        $play[$n]->{'play_confidence'} = 0;
    }

    #If first and fourth are rationally spaced, set second and third to
expected value
    if($play[$n - 1]->{'media_id'} + 1 != $play[$n]->{'media_id'} &&

```

```

        $play[$n - 1]->{'media_id'} + 2 != $play[$n + 1]->{'media_id'}
    &&
        $play[$n - 1]->{'media_id'} + 3 == $play[$n + 2]->{'media_id'})
    {
        $play[$n]->{'media_id'} = $play[$n - 1]->{'media_id'} + 1;
        $play[$n]->{'play_offset'} = 0;
        $play[$n]->{'play_confidence'} = 0;

        $play[$n + 1]->{'media_id'} = $play[$n - 1]->{'media_id'} + 2;
        $play[$n + 1]->{'play_offset'} = 0;
        $play[$n + 1]->{'play_confidence'} = 0;
    }
}

for(my $n = 0; $n < $num_play; $n++)
{
    print STDERR "$n: $play[$n]->{'play_id'}, $play[$n]->{'media_id'},
    $play[$n]->{'play_offset'}, $play[$n]->{'play_confidence'}\n";
    $Broadcastid::play->{'play_id'} = $play[$n]->{'play_id'};

    &Broadcastid::update_play("media_id=$play[$n]-
>{'media_id'},play_offset=$play[$n]-
>{'play_offset'},play_confidence=$play[$n]-
>{'play_confidence'},play_retrieved=NOW(),play_status=6");

    $Broadcastid::media->{'media_id'} = $play[$n]->{'media_id'};
    #&Broadcastid::update_media("media_count=media_count+1");
}

```

PATENT APPLICATION SERIAL NO. _____

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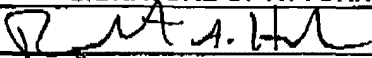
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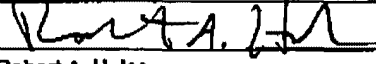
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		Filing Date	February 17, 2004	
		First Named Inventor	Nicholas Seet	
		Group Art Unit Number	Not Yet Known	
		Examiner Name	Not Yet Known	
Total Number of Pages in This Submission		3	Attorney Docket Number	23271-08890

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POWER OF ATTORNEY OR AUTHORIZATION OF AGENT	Application Number	New Application
	Filing Date	February 17, 2004
	First Named Inventor	Nicholas Seet et al.
	Title	Media Content Database Creation and Maintenance Using Time-Delayed Auto- Correlation of Frequency Characteristics
	Group Art Unit	Not Yet Known
	Examiner Name	Not Yet Known
	Attorney Docket Number	23271-08890

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☒ Practitioner(s) named below:

Name	Registration Number
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Robert R. Sachs	42,120
Greg T. Sueoka	33,800

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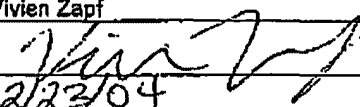
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Date	2/23/04

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SIGNATURE of Applicant or Assignee of Record

Name	Vivien Zapf
Signature	
Date	2/23/04

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