



(51) International Patent Classification:

G11B 27/038 (2006.01) G11B 27/036 (2006.01)
G10H 1/40 (2006.01) G10H 1/00 (2006.01)

(21) International Application Number:

PCT/GB2016/051862

(22) International Filing Date:

22 June 2016 (22.06.2016)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

1510907.7 22 June 2015 (22.06.2015) GB

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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM,

AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

- with international search report (Art. 21(3))
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))

[Continued on next page]

(54) Title: RHYTHMIC SYNCHRONIZATION OF CROSS FADING FOR MUSICAL AUDIO SECTION REPLACEMENT FOR MULTIMEDIA PLAYBACK

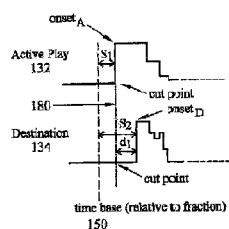


FIG. 6a

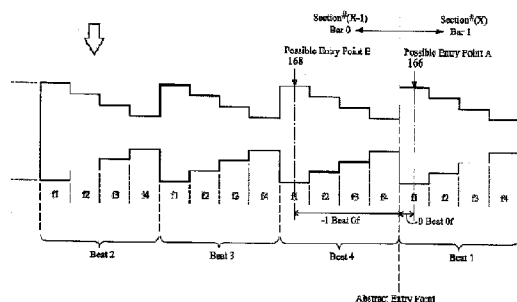


FIG. 7c

(57) Abstract: Music context system, audio track structure and method of real-time synchronization of musical content fig. 2 represents a system (30) that permits identified musical phrases or themes to be synchronized and linked into changing real-world events (12). The achieved synchronization includes a seamless musical transition - achieved using a timing offset, such as relative advancement of a significant musical "onset", that is inserted to align with a pre-existing, aligned, identified beat, music signature or timebase - between potentially disparate pre-identified audio sections (e.g. musical phrases) having different emotive themes defined by their respective time signatures, intensities, keys, musical rhythms and/or musical phrasing. Synchronisation of cross-fading or cutting or splicing audio sections with beat for rhythmic coherence. The earliest onset is faded first. The system operates to augment an overall sensory experience of a user in the real world by dynamically changing, re-ordering or repeating and then playing audio themes within the context of what is occurring in the surrounding physical environment, e.g. during different phases of a cardio workout in a step class the music rate and intensity increase during sprint periods and decrease during recovery periods. Based on a pre-inserted key, the accompanying music is re-ordered from an original track and selected automatically - optionally in real-time - to accompany detected or identified changing physical events, such as a heart-rate sensed and reported during a cardio-workout session. The system therefore produces and supplies for use, such as immediate play or broadcast, a

composite media file (54) that correlates instantaneous or changing real-world events with customized and user-selectable audio components designed to augment an overall sensory experience.



(88) Date of publication of the international search report:

2 February 2017

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2016/051862

A. CLASSIFICATION OF SUBJECT MATTER

INV. G11B27/038 G10H1/40
ADD. G11B27/036 G10H1/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

G10H G11B H04H G06F A63B H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2015/018993 A1 (TRIVEDI MEHUL A [US]) 15 January 2015 (2015-01-15) user-generated trigger to transition audio tracks; mix point aligning beat; offset for song 2; paragraph [0048] trigger events; paragraph [0008] optimum time for transition between audio tracks; paragraph [0022] paragraph [0028] ----- -/-	1-10, 32-41



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

6 December 2016

Date of mailing of the international search report

13/12/2016

Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT

International application No

PCT/GB2016/051862

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2014/076124 A1 (GORGES P; KELLETT P) 20 March 2014 (2014-03-20) anacrusis/pickup; offset thereof; paragraph [0022]; figures 2, 3c real time fade; paragraphs [0023], [0051], [0052] metadata: pickup length = offset in musical beats relative to start of section; paragraph [0025] start-fade to avoid unwanted clicks; paragraphs [0073], [0074] loop; paragraph [0049]; figure 7 -----	1-10, 32-41
Y	WO 2015/053278 A1 (YAMAHA CORP [JP]) 16 April 2015 (2015-04-16) abstract & US 2016/240179 A1 (UEMURA NORIHIRO [JP] ET AL) 18 August 2016 (2016-08-18) Ahead-of-beat: preventing twice sounding that would occur at the time of switching when tones are performed earlier than the beat positions indicated by the notes; paragraphs [0070], [0075]; figures 4a, 4b, 7 cross fade; paragraph [0094]; figure 7 onset after switching time; paragraph [0077] database with section accompaniment associated with parts; music genre; paragraph [0097] switching /onset positions of waveforms; paragraph [0030] sets of accompaniment pattern data in database; paragraphs [0035], [0043]; figure 3 -----	1,5,6,20
X	US 2006/272485 A1 (LENGELING GERHARD [US] ET AL) 7 December 2006 (2006-12-07)	1
Y	cross-fading; onset ; fade-in is earlier than mix point; paragraph [0047] - paragraph [0048]; figure 4B onset of a transient; paragraph [0035] paragraph [0037] -----	5,6
A	EP 2 541 552 A1 (SONY CORP [JP]) 2 January 2013 (2013-01-02) 4 points edit; paragraph [0173] paragraph [0027] ----- -/--	37

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2016/051862

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 476 308 B1 (ZHANG TONG [US]) 5 November 2002 (2002-11-05)	11-14,17
Y	low pass filter; column 3, line 26 - line 61; figure 2 peaks in the first order difference of the temporal energy envelope; column 4, line 10 - line 32 filter; figure 4 envelope divided in 3 periods; compute slope rise; column 7, line 4 - line 33; figure 4 temporal energy envelope; paragraph [summary] column 7, line 47 - line 50 -----	15,16, 18,19
Y	US 2007/291958 A1 (JEHAN TRISTAN [US]) 20 December 2007 (2007-12-20) extract higher-level musical structures from the low-level musical audio metadata; paragraphs [0036], [0066]; figures 3-5 pattern-, meter-, beat- synchronous-self-similarity matrix (of timbre); paragraphs [0098], [0073], [0079] Resynthesis; paragraph [0100] transition length and beat matching; paragraph [0105] Synthesis; cross-fading; paragraph [0110] softest pre-onset moment (previous local minimum in the loudness); paragraph [0059] Onset Detection; paragraph [0056] -----	11-19
X	US 2011/054648 A1 (MAXWELL CYNTHIA [US] ET AL) 3 March 2011 (2011-03-03)	11-17
Y	variable size sample window filtered temporal signals; paragraph [0022] paragraph [0007] - paragraph [0008] ----- -/--	18,19

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2016/051862

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	RUOHUA ZHOU ET AL: "Music Onset Detection Based on Resonator Time Frequency Image", IEEE TRANSACTIONS ON AUDIO, SPEECH AND LANGUAGE PROCESSING, IEEE SERVICE CENTER, NEW YORK, NY, USA, vol. 16, no. 8, 1 November 2008 (2008-11-01), pages 1685-1695, XP011329083, ISSN: 1558-7916, DOI: 10.1109/TASL.2008.2002042 Time frequency processing, detection, peak-picking; paragraph [0011] first-order difference mark onset times; paragraph [000A] algorithm looks backward to locate onsets from the beginning of each steady time span using the spectrum, Energy based detection; peak-picking; page 1689, paragraph IV-C. Tolerance window duration 10ms to 50ms; table V	11-19
E	US 2016/249093 A1 (STOJANCIC MIHAILO M [US] ET AL) 25 August 2016 (2016-08-25) onset detection in time domain; audio frame envelope tracking and continuous moving average tracking.; paragraph [0058] ----- -/--	11

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2016/051862

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2009/003802 A1 (TAKAI MOTOYUKI [JP] ET AL) 1 January 2009 (2009-01-01) music database with timing metadata (beats, bars); paragraphs [0043], [0055]; figure 4 start point, end point; claim 2 body movement sensor; synchronised content playback; claims 1, 10 Synchronizing timing of content with walking tempo: Start music before first step; 2nd bar shortened.; paragraphs [0056], [0058] - paragraph [0061]; figure 5 short sections of music are spliced to create one piece of continuous music; paragraph [0003] music sections are stored with beat timing information; paragraph [0053] fading out or fading in the bars before and after the spliced portions; paragraph [0082] paragraph [0045] paragraph [0040] paragraph [0080] -----	20,29-31
Y	US 2012/118127 A1 (MIYAJIMA YASUSHI [JP]) 17 May 2012 (2012-05-17) the break of the musical composition section does not correspond to the half way through the lyrics; paragraph [0110]; claim 5 beat synchronised music sections; claims 6,7,9 music composition such that lyrics are not interrupted; paragraph [0146] - paragraph [0147]; figure 17 ----- -/--	20,29-31

INTERNATIONAL SEARCH REPORT

International application No
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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	GAINZA MIKEL: "Automatic bar line segmentation.", CONVENTION PAPER, AES, 123RD CONVENTION, 7270, 5 October 2007 (2007-10-05), pages 1-7, XP040373598, Dublin Institute of Technology Anacrusis candidates detection; page 4, paragraph 2.2.1; figure 8 Hint : bar length changes due to time signature or abrupt tempo changes will affect accuracy; page 7, line upper left, paragraph 4. - line end Multiresolution (bars / fraction of note) audio similarity matrix; page 3; figures 1,3, 4 100ms sliding window; peak picking; page 4, paragraph 2.2 database; page 6, right-hand column, last paragraph Application: DJs automatic audio markers to perform loops; page 1, right-hand column, line 1 - line 10 -----	20,29-31
Y	US 2002/155416 A1 (BARTON MICHAEL [US]) 24 October 2002 (2002-10-24) Anacrusis movements; paragraph [0036] -----	30
Y	O'KEEFFE K: "Dancing Monkeys (Automated creation of step files for Dance Dance Revolution))", INTERNET CITATION, 18 February 2004 (2004-02-18), XP002359789, Retrieved from the Internet: URL:http://web.archive.org/web/20040218070433/http://www.monket.net/files/dancingmonkeys/DancingMonkeys.pdf [retrieved on 2005-12-16] Tempo and Beat Analysis of Music; paragraph [5.2.1] ----- -/--	29

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2016/051862

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2009/272253 A1 (YAMASHITA KOSEI [JP] ET AL) 5 November 2009 (2009-11-05)	31
A	Time line metadata : with cut-in, cross-fade, song portions, bars, beat count in the first bar, bar beginning position; paragraph [0079]; figures 5,9,15,20, 25 Remix to bio rhythm; bar synchronous signal and beat synchronous signal; paragraphs [0116], [0125]; figure 25 time-based metadata = beat positions, part (intro, end...), tempo, bars begin positions, THEMES; paragraphs [0056], [0081] - paragraph [0082]; figure 7 Time based metadata with time stamps of their beats. No fractions; paragraph [0122]; figures 6, 23A-23C part of song A is cross faded with intro of song B; paragraph [0084] - paragraph [0085] bar/beats in first bar; detailed timing of beat synchronous reproduction; loop; paragraphs [0079], [0118]; figure 21 SE is for example cross-fade, it ends several bars before the relevant bar; paragraph [0078] remix; DJ; paragraph [0013]; claim 1 ----- -/--	20,21,29

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2016/051862

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FLORENT BERTHAUT ET AL: "Advanced Synchronization of Audio or Symbolic Musical Patterns: An Algebraic Approach", SEMANTIC COMPUTING (ICSC), 2012 IEEE SIXTH INTERNATIONAL CONFERENCE ON, IEEE, 19 September 2012 (2012-09-19), pages 302-309, XP032265400, DOI: 10.1109/ICSC.2012.11 ISBN: 978-1-4673-4433-3	21-24,28
A	cross-fading; anacrusis; continuity; pattern combinations; paragraph [000I] subinterval; page 303 - right-hand column audio patterns: advanced recombination; auto mixing; paragraph [00IV] musical pattern starts and ends at given dates. subinterval described by two other dates indicates how this pattern must be combined with others; paragraphs [00II] - [C.Realizationandsynchronizationwindows] Hint to prior art expanding sections. Hint at limitations : Summing function must be continuous to avoid audio artefacts; paragraph [A.Audioadvancedsynchronization] Synchronization and realization times; figure 1 reconstruction; page 307, right-hand column, last paragraph -----	29-31

INTERNATIONAL SEARCH REPORT

International application No.
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Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☒ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-10, 32-41

Adjusting the initial cross fading to replace an audio segment.

2. claims: 11-19

Identifying onsets.

3. claims: 20, 29-31

Music database and selection and splicing of audio sections matching real world events.

4. claims: 21-28

Categorizing and splicing audio sections in synchronisation with beat fractions.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/GB2016/051862

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2015018993 A1	15-01-2015	AU 2014287072 A1 CA 2917595 A1 CN 105766001 A EP 3020214 A1 US 2015018993 A1 WO 2015006627 A1	28-01-2016 15-01-2015 13-07-2016 18-05-2016 15-01-2015 15-01-2015
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