Realizing Memex… Digital Capture, Storage, and Utilization of All Personal Information

www.MyLifeBits.com

Gordon Bell, Jim Gemmell, Roger Lueder

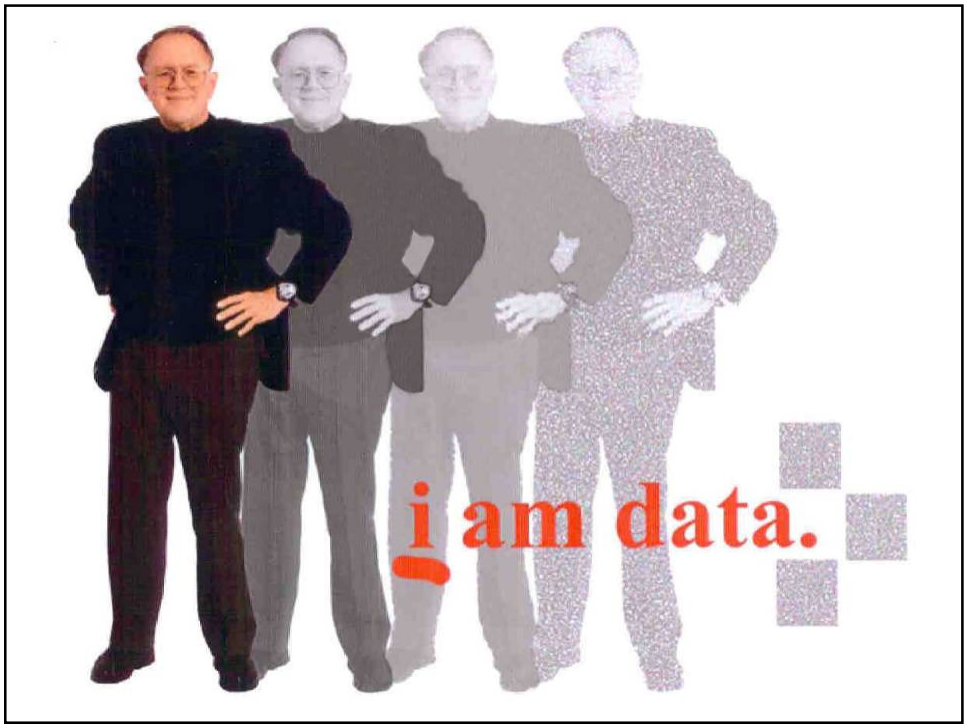
Microsoft Research

MyLifeBits Manifesto

- Digital information cost to store, transmit and replicate is negligible
- An individual's digital information is accumulating rapidly
- The information about an individual, including what one heard, said, and saw, will have a superlinear value that *exceeds acquisition & retention cost*.
  - to supplement human memory
  - to free one's life from clutter
  - to enable digital immortality
  - to enable information technology to help the individual in other ways
- Individuals must take on the responsibility for recording, managing and retaining the increasing number of evolving digital information streams i.e. computers, phones, IPTV, health sensors and legacy physical bits.
- Nothing should be deleted
- Software companies should provide a unified store for anywhere, anytime access while satisfying privacy, sharing, management, and retention needs.

Outline: past & future

1. Capturing a life's bits… then finding them
2. MyLifeBits aka Memex using a database
   a) How do we use MyLifeBits?
   b) How is it built?
   c) Size, shape, and evolution of the database?
3. Transaction Processing Dbase aka CARPE
   Continuous archiving and recording of personal experiences
   a) SenseCam and other real time capture?
   b) Relevance for devices and software?
4. Personal Health Records…
5. Those bits are now EVERYWHERE!

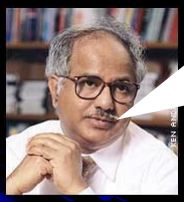


Ambience and Presence: Being there while being here

Dining at home on the "Orient Express"

History: The remote worker re-discovers the PERSONAL computer

Oct 1998



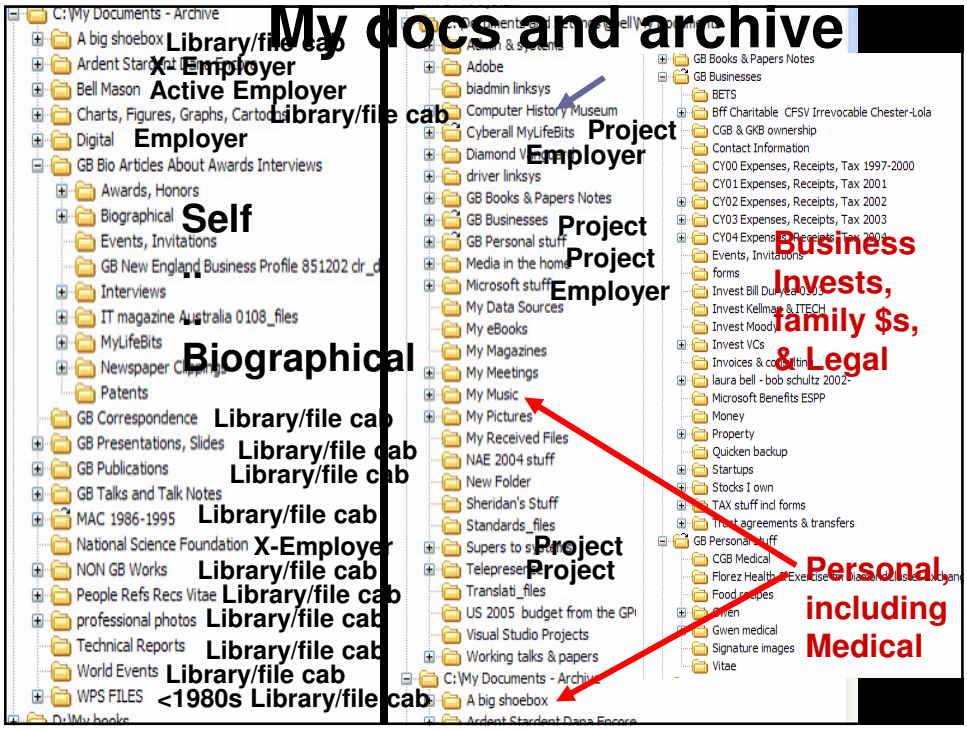
Raj Reddy

Can we scan your books and put them online?

Sure! Don't worry about copyright stuff. Microsoft has lots of lawyers

1999 – Scanning starts in earnest

"we" start to scan, put content into folders & files

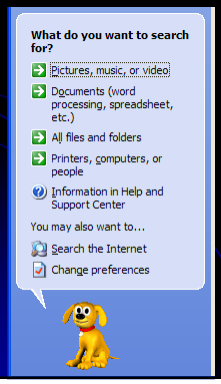


Now that it's in Cyberspace

How do you remember the 30,000+ file names?

Or in which of 2500 folders they live?

What's about a tool for finding stuff?



Jan 2001 CACM "A Personal Digital Store"

- 16 GB; +2/yr
- A good place to stop
- Began search for search engines, especially for email.
- Jim suggests that we build a system that would be easier to use and have many more capabilities.

GORDON BELL

Finding a place to efficiently store all of one's digital materials.

A PERSONAL DIGITAL STORE

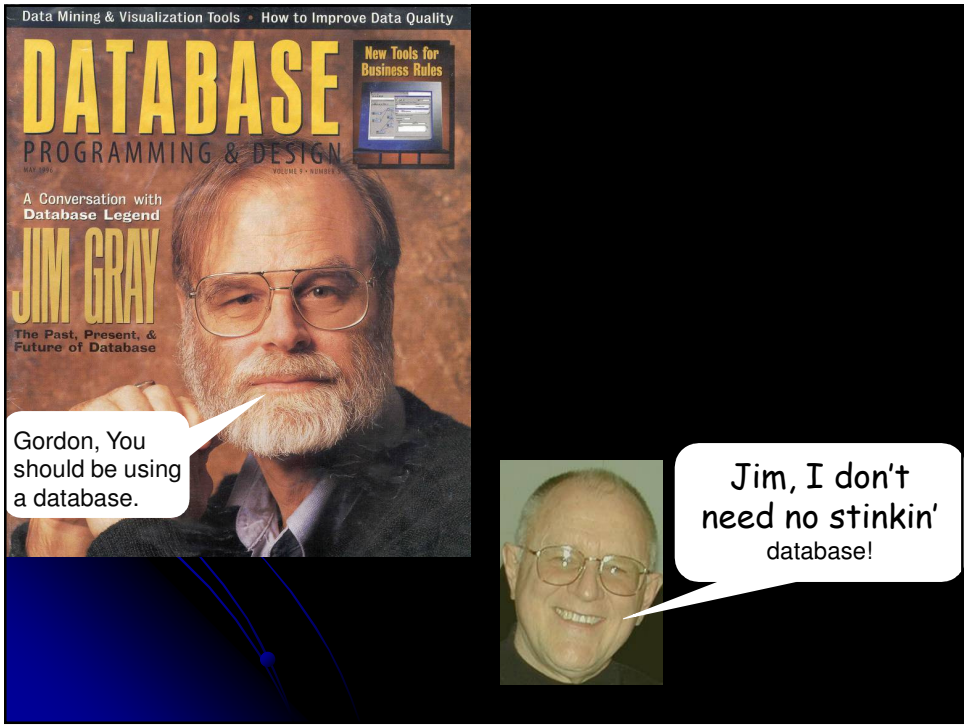
CyberAll[1] is a project to encode, store, and allow easy retrieval of all of a person's information for personal and professional use. The archive includes books, CDs, correspondence (such as letters, memos, and email), transactions, papers, photos and albums, and video. In 2000, only 16 gigabytes are required to store all the media in my personal and professional life—at a cost of $160 for disk storage. Two gigabytes are expected to be added next year. Encoding, indexing, and data-management costs far exceed the storage expense. The challenge is to automate capture, search, and retrieval.

CyberAll is a personal ontologer [5] in contrast to a library [6] or Kahle's effort to archive the Web and television channels (see www.archive. org). It is my store for documents, photos of people and computer heretofore would be physically stored, computer manuals, and magazines. At present, books are in "atomic" form; but CyberAll will include them as they become e-books.[2]

Within the next decade personal computers will be capable of storing a terabyte of information on an individual machine. In 2000, 40GB drives costing $400 are more than adequate to hold the content for most of a professional's lifetime reading, presentations, and audio recordings. A CD encoded at 128Kbps can be stored at a cost of $0.60. A user's CD collection is likely to use more storage space than the user's computer-generated and scanned paper files.

The next phase of CyberAll will capture conversations, interviews, meetings, and presentations. Recording speech from one's personal and professional lives will require over a terabyte (at 8Kbps)—but only a modest 25GB/year. Video is even more challenging. For home use, a terabyte holds 500 hours of DVD quality video and 1500

2001 Capture goes beyond paper

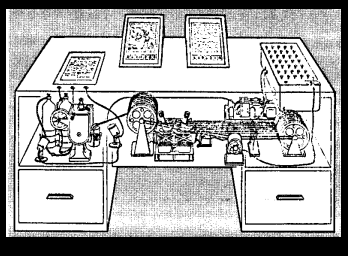


Re-discovery of Memex

As We May Think, Vannevar Bush, 1945

"A memex is a device in which an individual stores all his books, records, and communications, and which is mechanized so that it may be consulted with exceeding speed and flexibility"

- Full-text search, text & audio annotations, and hyperlinks



Feb 2005

Epiphany!

Memex is a database
&
personal TP system

Steve Mann timeline

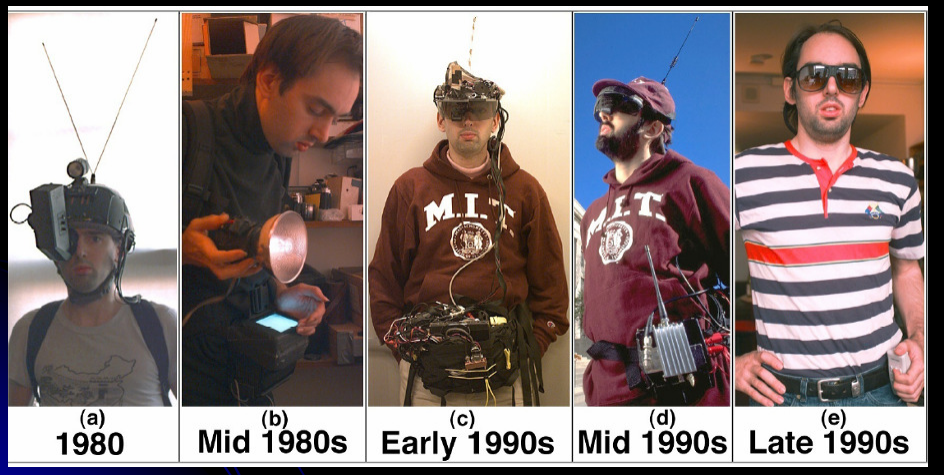
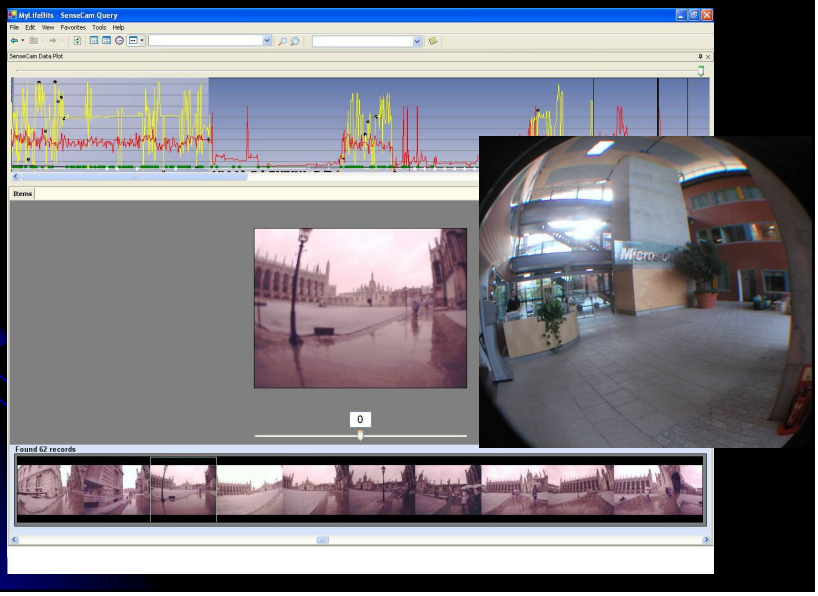


Figure 1. A volunteer wearing the low-vision aid. (photo courtesy of Ryland Bryant)

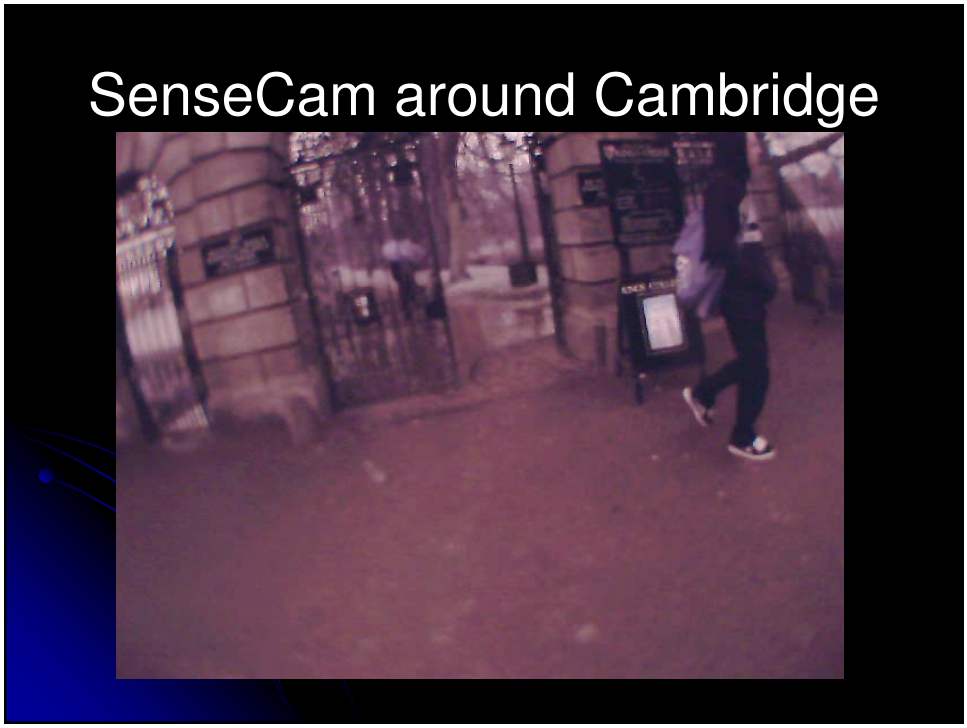
"I sensed"
Clarkson MIT c2001

Visually impaired
UW 2004

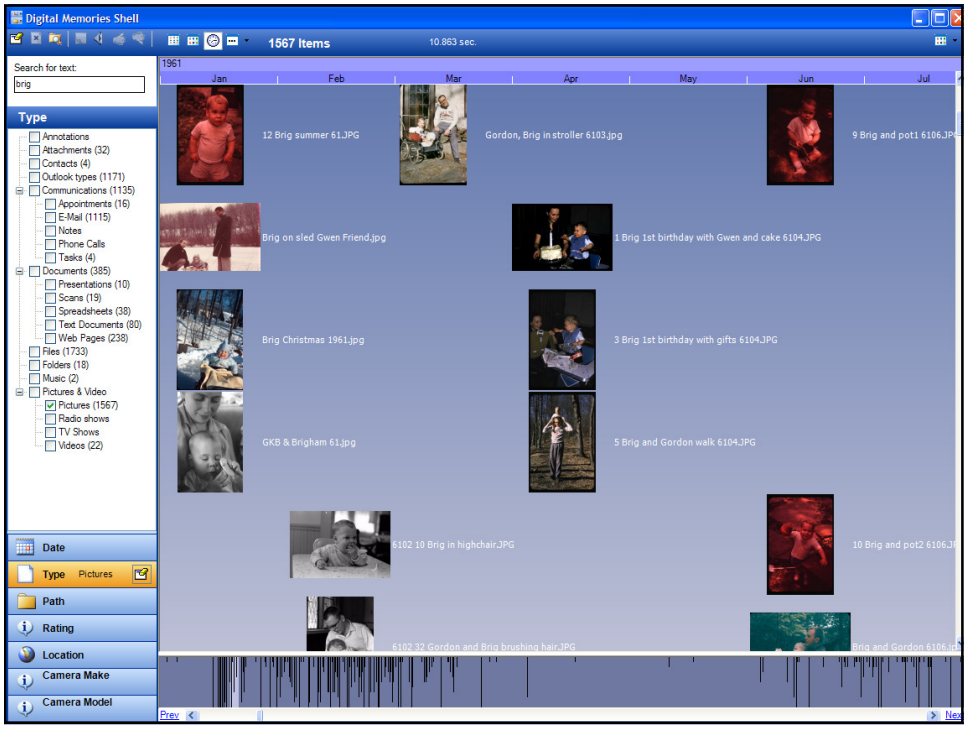
2003 - SenseCam

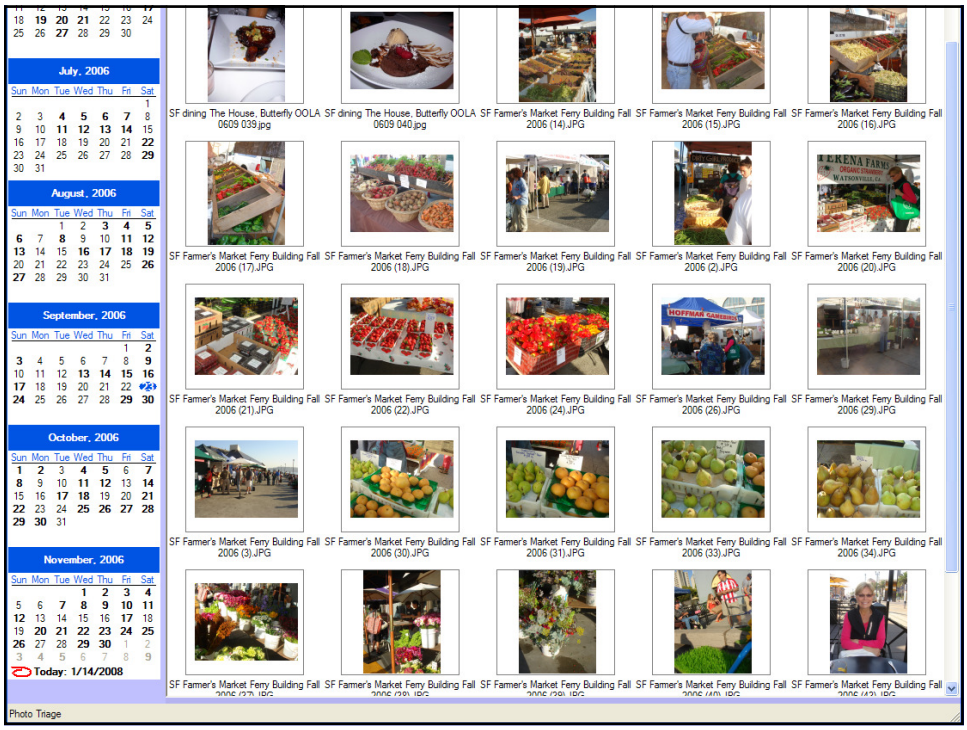



Gordon with SenseCam & Voice Recorder
SECURITY
CAMERA OPERATING
YOU WILL BE PHOTOGRAPHED • CONVERSATION MAY BE RECORDED


SenseCam around Cambridge

Demo Clips & Screens

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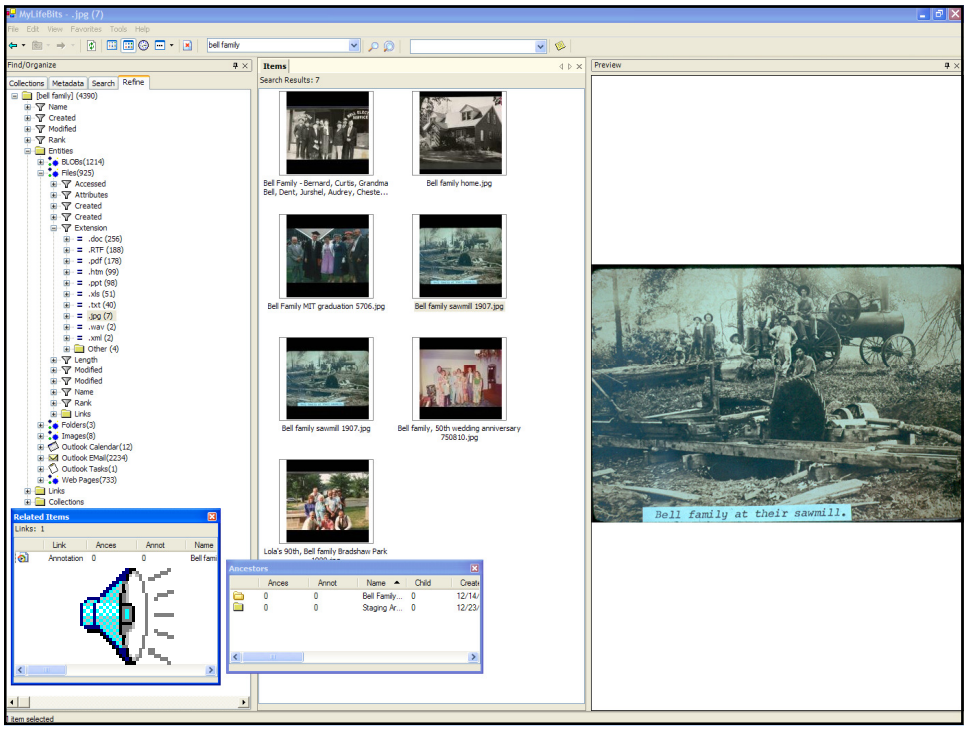
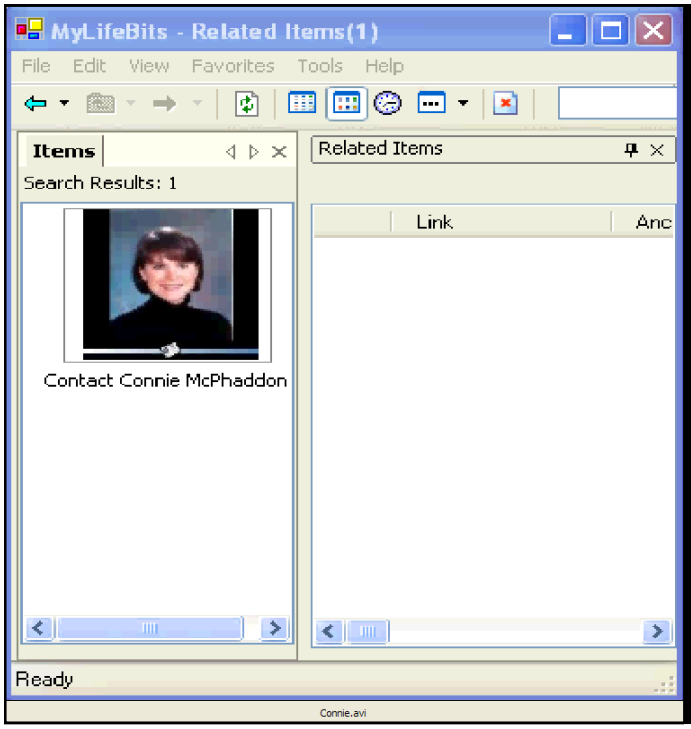
August, 2006
September, 2006
October, 2006
November, 2006
Today: 1/14/2008
Photo Triage


Bell family at their sawmill.



Pivoting:
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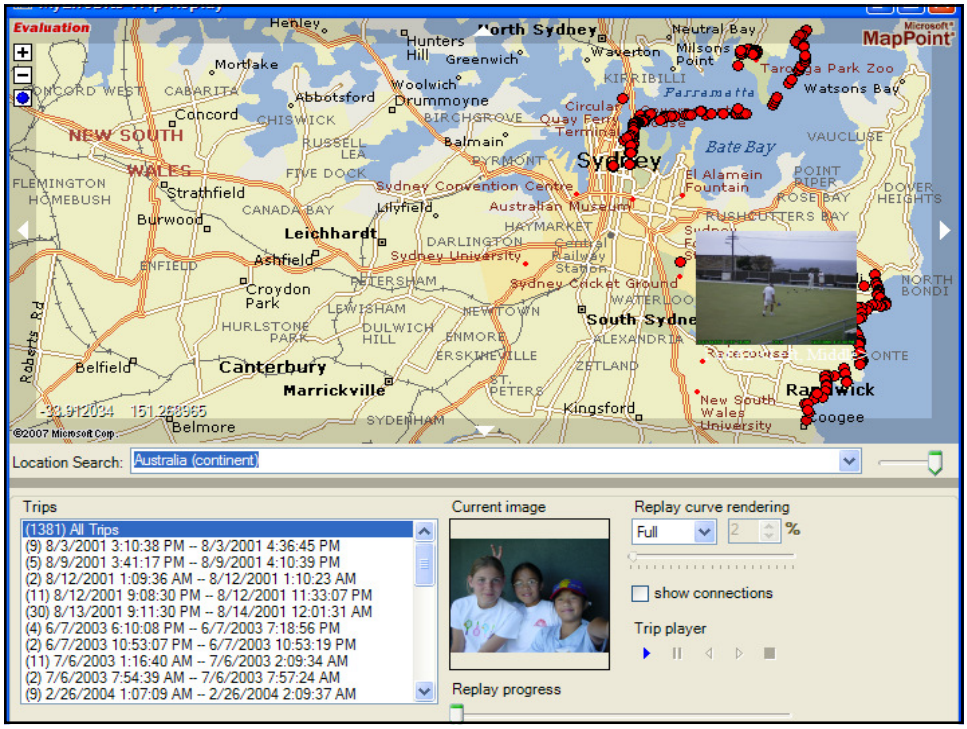
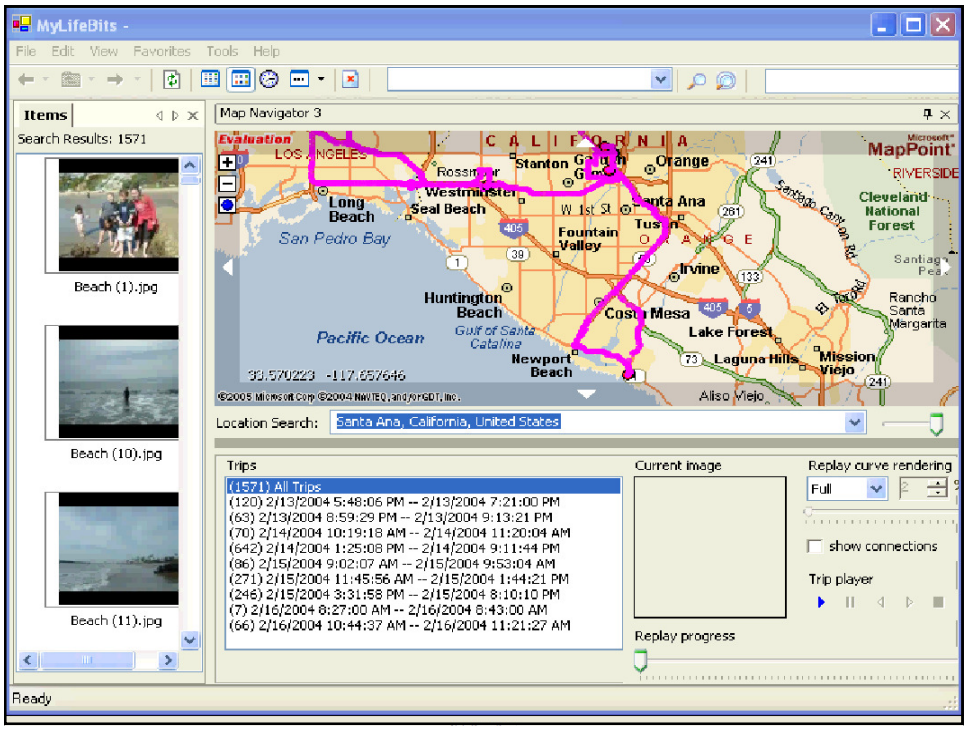
call>
t>
web page

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File Edit View Favorites Tools Help
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Beach (1).jpg
Beach (10).jpg
Beach (11).jpg
Map Navigator 3
Evaluation
LOS ANGELES
Long Beach
Seal Beach
San Pedro Bay
Stanton
Orange
Santa Ana
Fountain Valley
Irvine
Huntington Beach
Costa Mesa
Lake Forest
Laguna Hills
Mission Viejo
Newport Beach
Pacific Ocean
Gulf of Santa Catalina
Cleveland National Forest
Rancho Santa Margarita
MapPoint
RIVERSIDE
Aliso Viejo
Location Search:
Santa Ana, California, United States
Trips
(1571) All Trips
(120) 2/13/2004 5:48:06 PM -- 2/13/2004 7:21:00 PM
(63) 2/13/2004 8:59:29 PM -- 2/13/2004 9:13:21 PM
(70) 2/14/2004 10:19:18 AM -- 2/14/2004 11:20:04 AM
(642) 2/14/2004 1:25:08 PM -- 2/14/2004 9:11:44 PM
(86) 2/15/2004 9:02:07 AM -- 2/15/2004 9:53:04 AM
(271) 2/15/2004 11:45:56 AM -- 2/15/2004 1:44:21 PM
(246) 2/15/2004 3:31:58 PM -- 2/15/2004 8:10:10 PM
(7) 2/16/2004 8:27:00 AM -- 2/16/2004 8:43:00 AM
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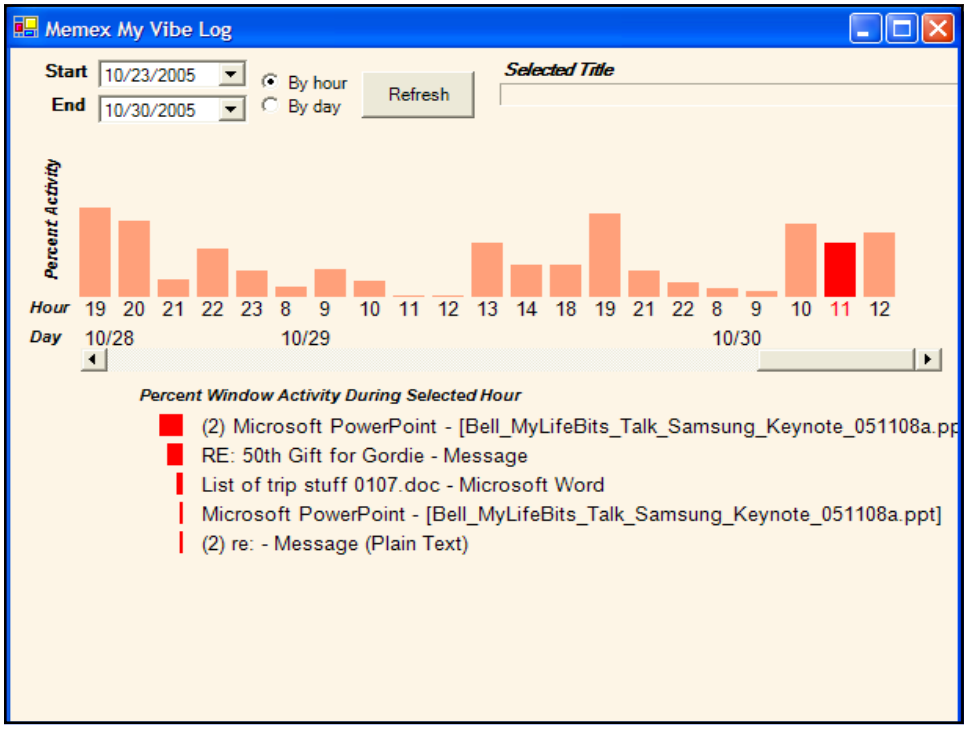
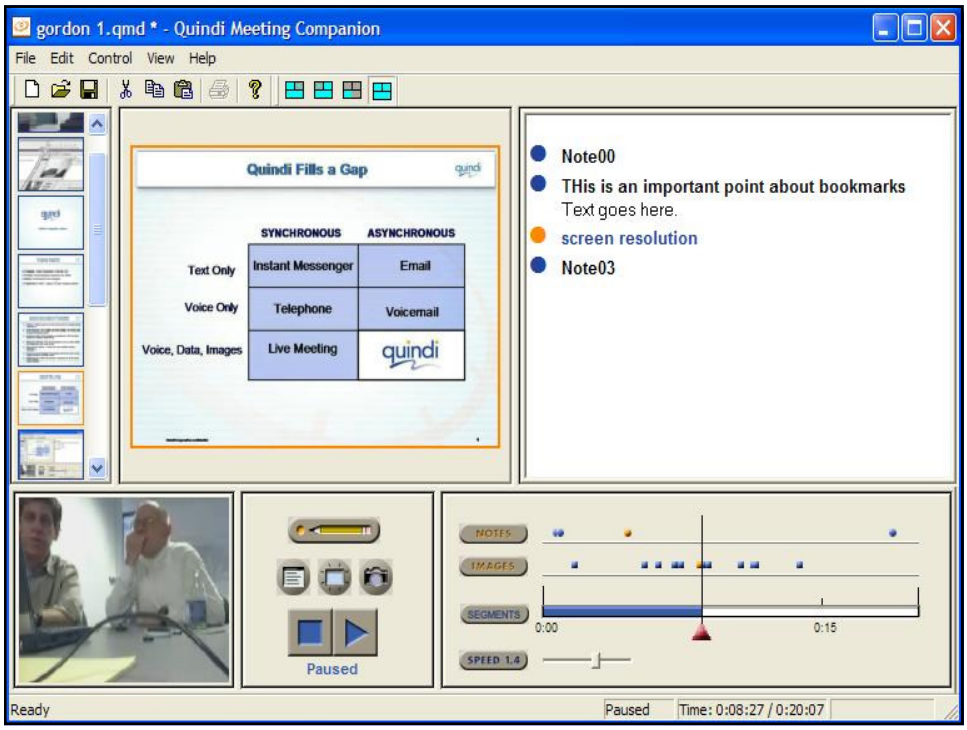
Current image
Replay progress
Replay curve rendering
Full
show connections
Trip player
Ready


Memex My Vibe Log
Start 10/23/2005
End 10/30/2005
By hour
By day
Refresh
Selected Title
Percent Activity
Hour 19 20 21 22 23 8 9 10 11 12 13 14 18 19 21 22 8 9 10 11 12
Day 10/28 10/29 10/30
Percent Window Activity During Selected Hour
(2) Microsoft PowerPoint - [Bell_MyLifeBits_Talk_Samsung_Keynote_051108a.pp
RE: 50th Gift for Gordie - Message
List of trip stuff 0107.doc - Microsoft Word
Microsoft PowerPoint - [Bell_MyLifeBits_Talk_Samsung_Keynote_051108a.ppt]
(2) re: - Message (Plain Text)


gordon 1.qmd * - Quindi Meeting Companion
File Edit Control View Help
Quindi Fills a Gap
SYNCHRONOUS
ASYNCHRONOUS
Text Only
Instant Messenger
Email
Voice Only
Telephone
Voicemail
Voice, Data, Images
Live Meeting
quindi
Note00
THis is an important point about bookmarks
Text goes here.
screen resolution
Note03
Paused
NOTES
IMAGES
SEGMENTS
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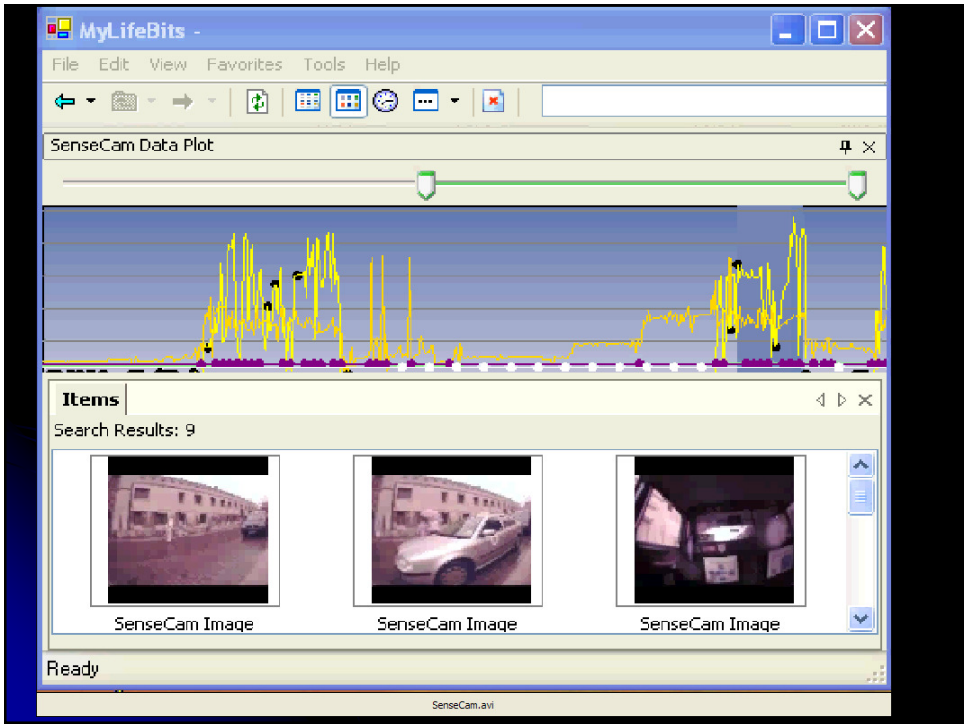
0:15
Ready
Paused
Time: 0:08:27 / 0:20:07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SenseCam Data Plot
Items
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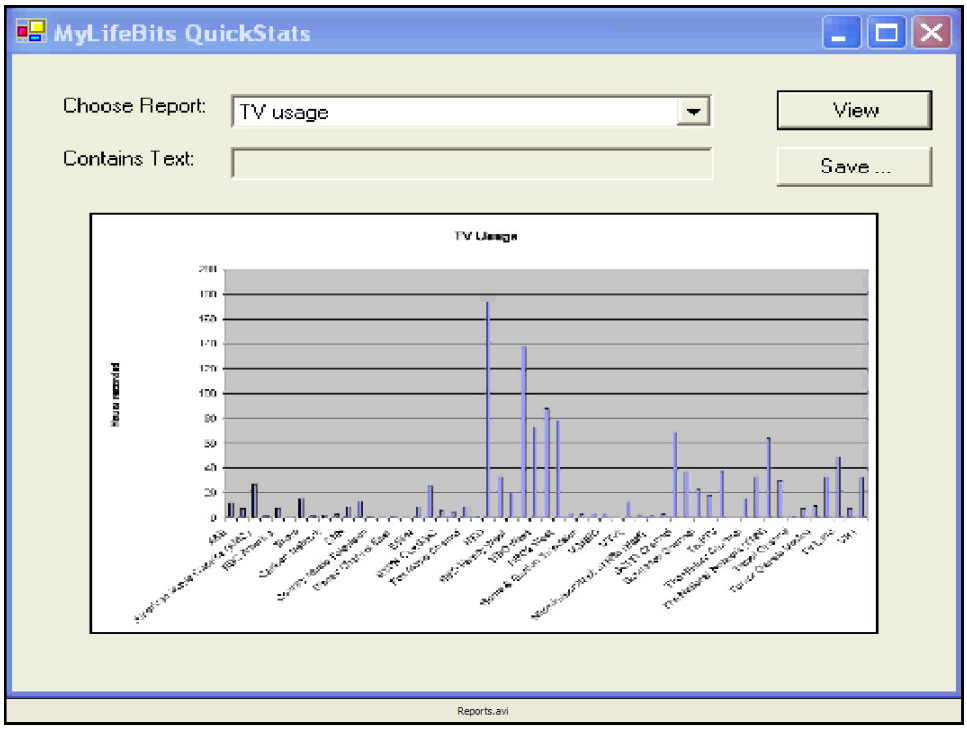
SenseCam Image
SenseCam Image
Ready
SenseCam.avi



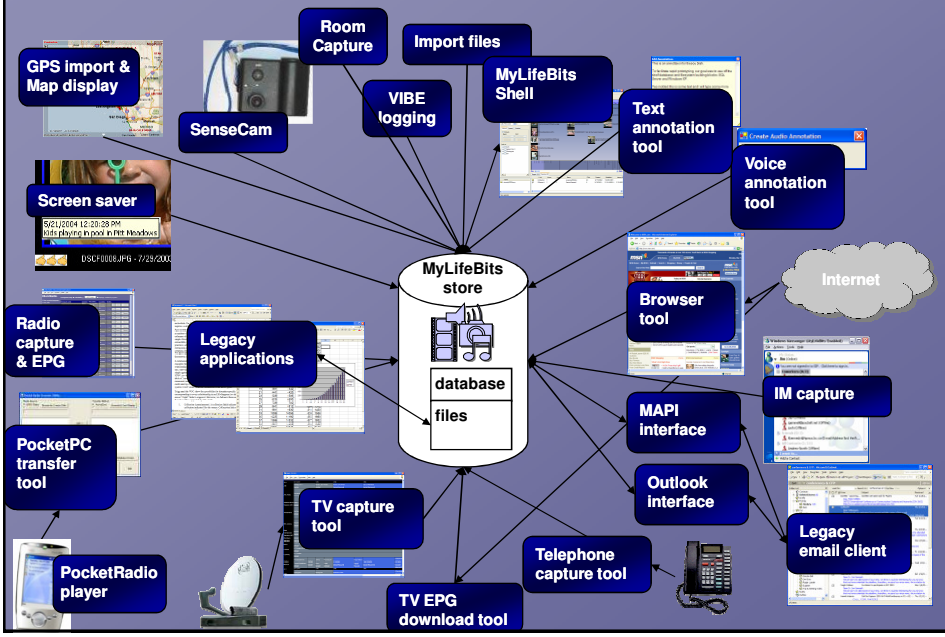
MyLifeBits Software

Everything goes in a database

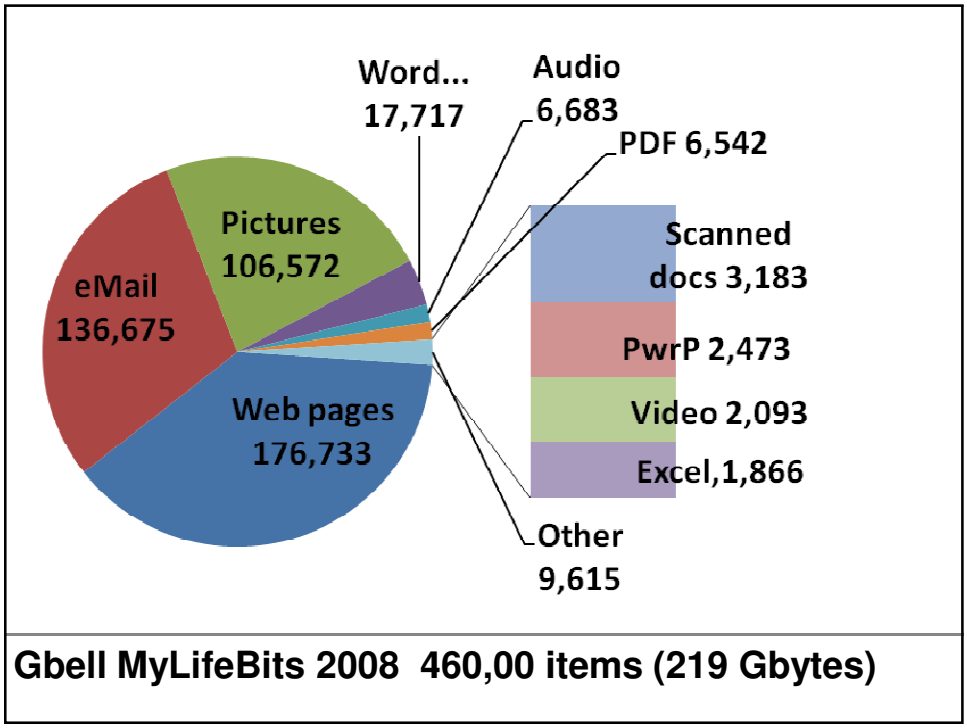
- MyLIfeBits need[illegible] of a database (Consistency, Indexing, Pivoting, [illegible]s, Speed/scalability, Backup, Replication)
- If we didn't use[illegible]lly create one!
- Files as blobs; s[illegible]em for legacy apps
- We are part of J[illegible]Area Research Lab

SQL

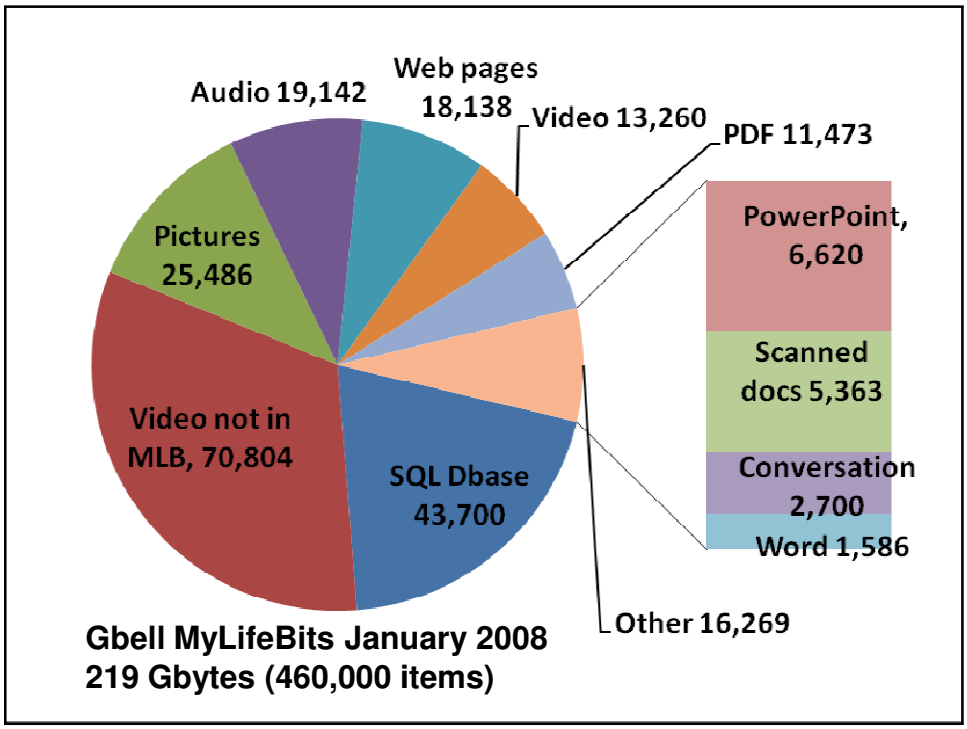
MyLifeBits Software



The Shape & Size of Gordon Bell's LifeBits January 2008



Gbell MyLifeBits 2008 460,00 items (219 Gbytes)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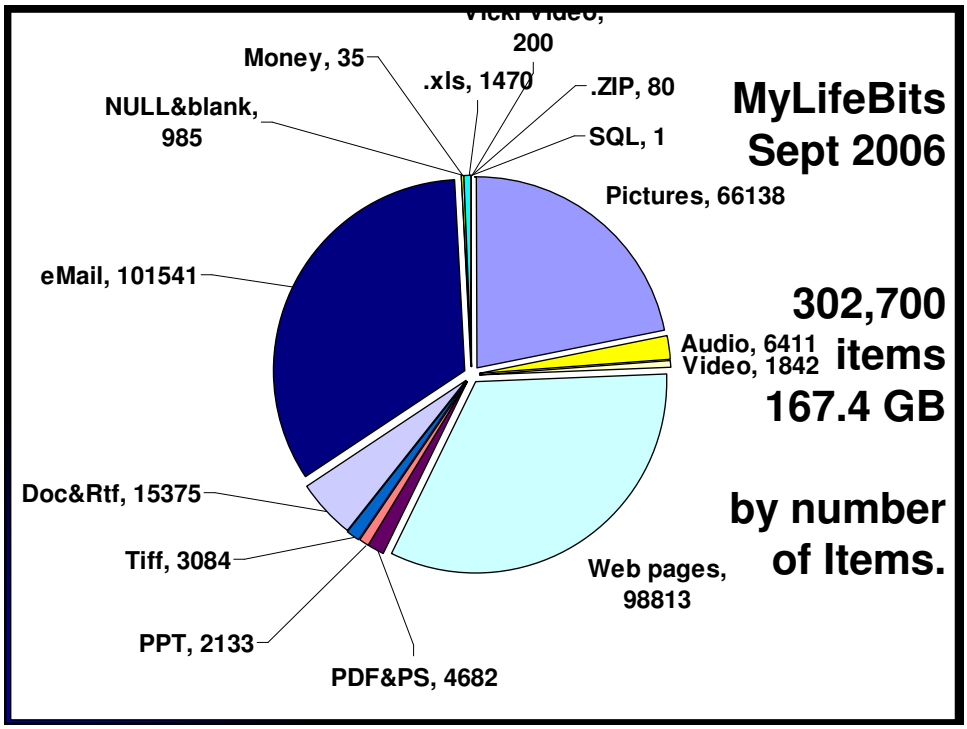
Video 13,260
PDF 11,473
Pictures 25,486
PowerPoint, 6,620
Scanned docs 5,363
Conversation 2,700
Word 1,586
Video not in MLB, 70,804
SQL Dbase 43,700
Other 16,269
Gbell MyLifeBits January 2008
219 Gbytes (460,000 items)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SQL, 1
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Video, 1842
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by number of Items.
PPT, 2133
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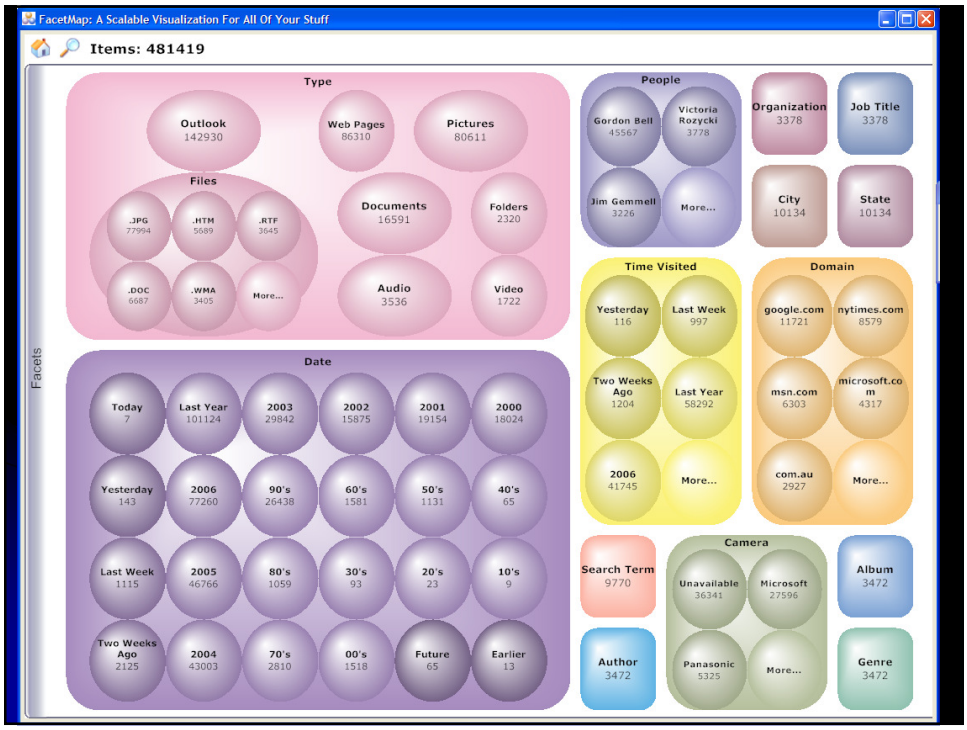
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Facets
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Pictures 80611
Files
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.HTM 5689
.RTF 3645
.DOC 6687
.WMA 3405
More...
Documents 16591
Folders 2320
Audio 3536
Video 1722
Date
Today 7
Last Year 101124
2003 29842
2002 15875
2001 19154
2000 18024
Yesterday 143
2006 77260
90's 26438
60's 1581
50's 1131
40's 65
Last Week 1115
2005 46766
80's 1059
30's 93
20's 23
10's 9
Two Weeks Ago 2125
2004 43003
70's 2810
00's 1518
Future 65
Earlier 13
People
Gordon Bell 45567
Victoria Rozycki 3778
Jim Gemmell 3226
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Organization 3378
Job Title 3378
City 10134
State 10134
Time Visited
Yesterday 116
Last Week 997
Two Weeks Ago 1204
Last Year 58292
2006 41745
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google.com 11721
nytimes.com 8579
msn.com 6303
microsoft.com 4317
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More...
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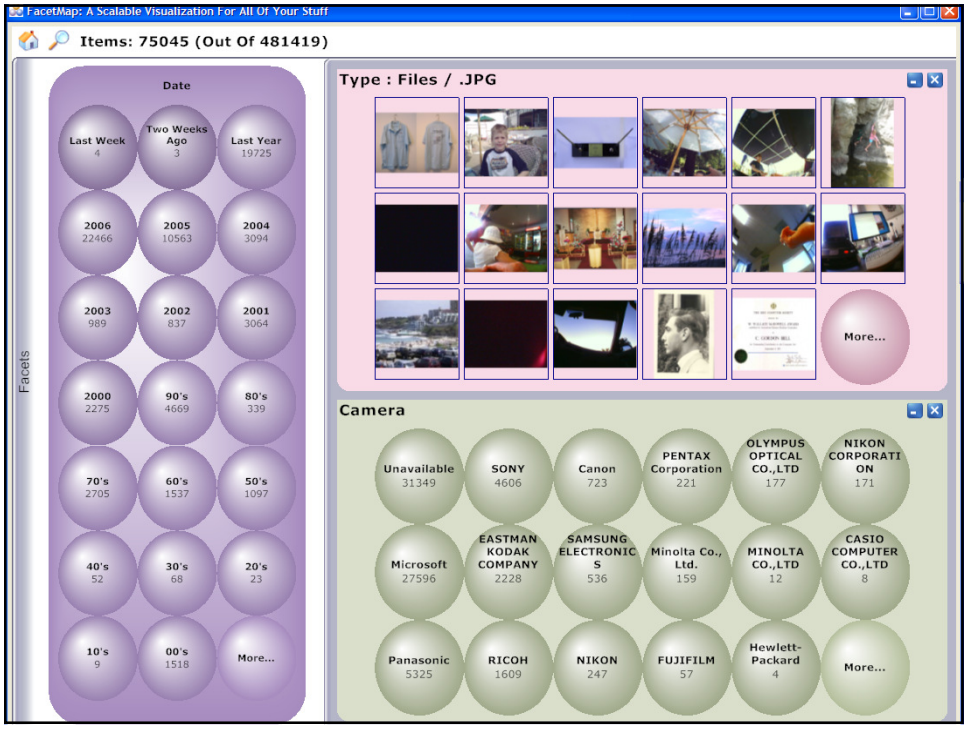
Genre 3472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Two Weeks Ago 3
Last Year 19725
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2005 10563
2004 3094
2003 989
2002 837
2001 3064
2000 2275
90's 4669
80's 339
70's 2705
60's 1537
50's 1097
40's 52
30's 68
20's 23
10's 9
00's 1518
More...
Type : Files / .JPG
More...
Camera
Unavailable 31349
SONY 4606
Canon 723
PENTAX Corporation 221
OLYMPUS OPTICAL CO.,LTD 177
NIKON CORPORATION 171
Microsoft 27596
EASTMAN KODAK COMPANY 2228
SAMSUNG ELECTRONICS 536
Minolta Co., Ltd. 159
MINOLTA CO.,LTD 12
CASIO COMPUTER CO.,LTD 8
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RICOH 1609
NIKON 247
FUJIFILM 57
Hewlett-Packard 4
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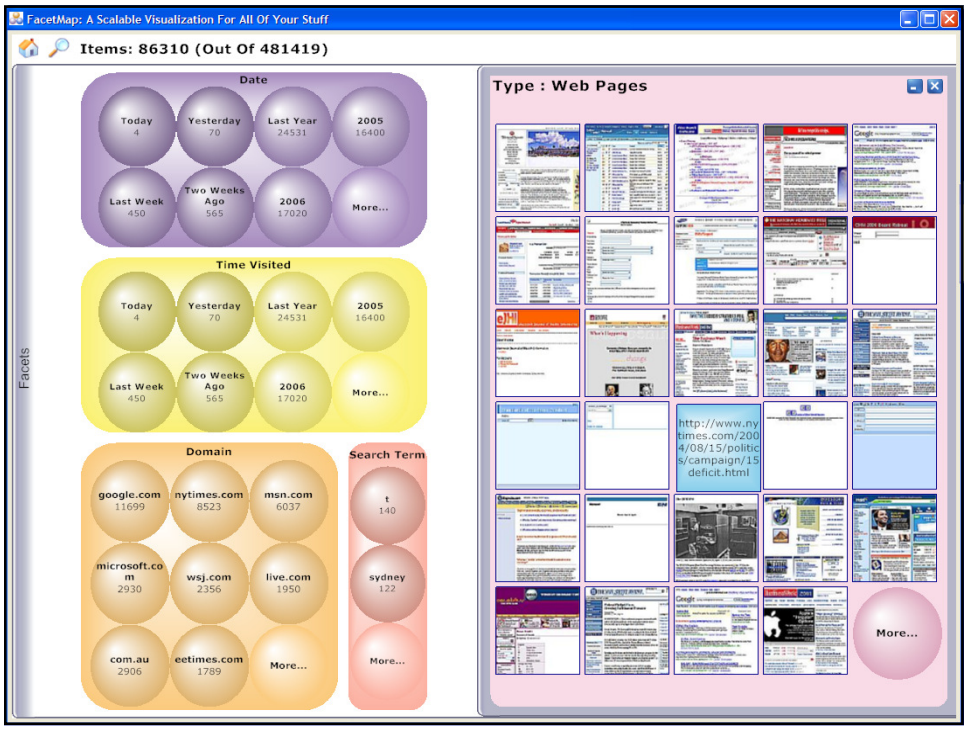
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Yesterday 70
Last Year 24531
2005 16400
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2006 17020
More...
Time Visited
Today 4
Yesterday 70
Last Year 24531
2005 16400
Last Week 450
Two Weeks Ago 565
2006 17020
More...
Domain
google.com 11699
nytimes.com 8523
msn.com 6037
microsoft.com 2930
wsj.com 2356
live.com 1950
com.au 2906
eetimes.com 1789
More...
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sydney 122
More...
Type : Web Pages
http://www.nytimes.com/2004/08/15/politics/campaign/15deficit.html
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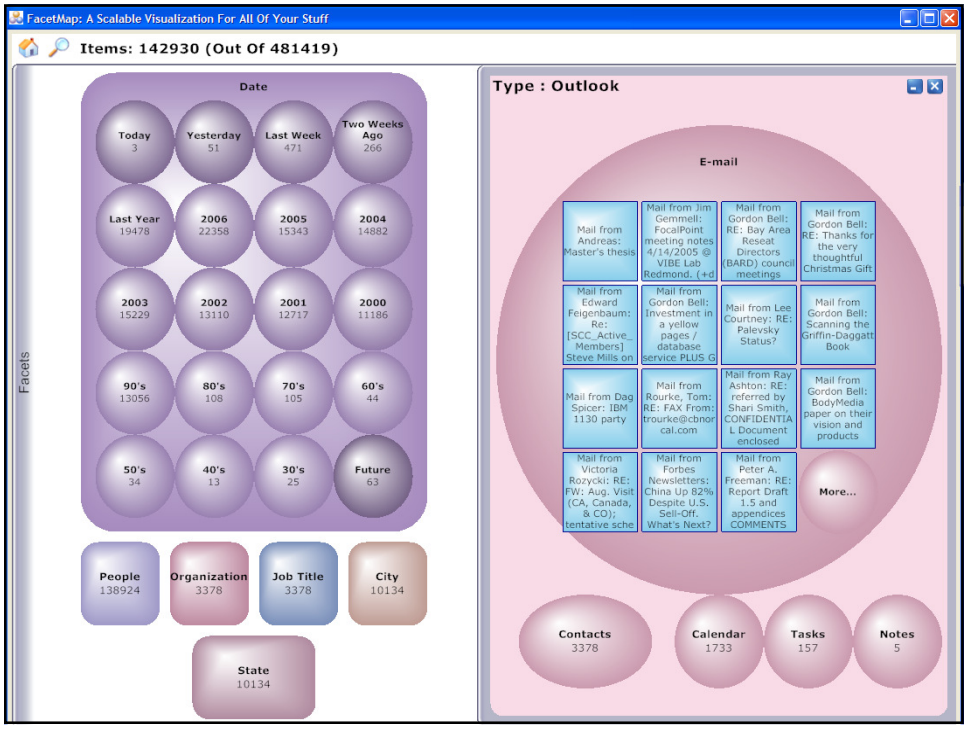
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2005 15343
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2003 15229
2002 13110
2001 12717
2000 11186
90's 13056
80's 108
70's 105
60's 44
50's 34
40's 13
30's 25
Future 63
People 138924
Organization 3378
Job Title 3378
City 10134
State 10134
Type : Outlook
E-mail
Mail from Andreas: Master's thesis
Mail from Jim Gemmell: FocalPoint meeting notes 4/14/2005 @ VIBE Lab Redmond. (+d
Mail from Gordon Bell: RE: Bay Area Reseat Directors (BARD) council meetings
Mail from Gordon Bell: RE: Thanks for the very thoughtful Christmas Gift
Mail from Edward Feigenbaum: Re: [SCC_Active_Members] Steve Mills on
Mail from Gordon Bell: Investment in a yellow pages / database service PLUS G
Mail from Lee Courtney: RE: Palevsky Status?
Mail from Gordon Bell: Scanning the Griffin-Daggatt Book
Mail from Dag Spicer: IBM 1130 party
Mail from Rourke, Tom: RE: FAX From: trourke@cbnorcal.com
Mail from Ray Ashton: RE: referred by Shari Smith, CONFIDENTIAL Document enclosed
Mail from Gordon Bell: BodyMedia paper on their vision and products
Mail from Victoria Rozycki: RE: FW: Aug. Visit (CA, Canada, & CO); tentative sche
Mail from Forbes Newsletters: China Up 82% Despite U.S. Sell-Off. What's Next?
Mail from Peter A. Freeman: RE: Report Draft 1.5 and appendices COMMENTS
More...
Contacts 3378
Calendar 1733
Tasks 157
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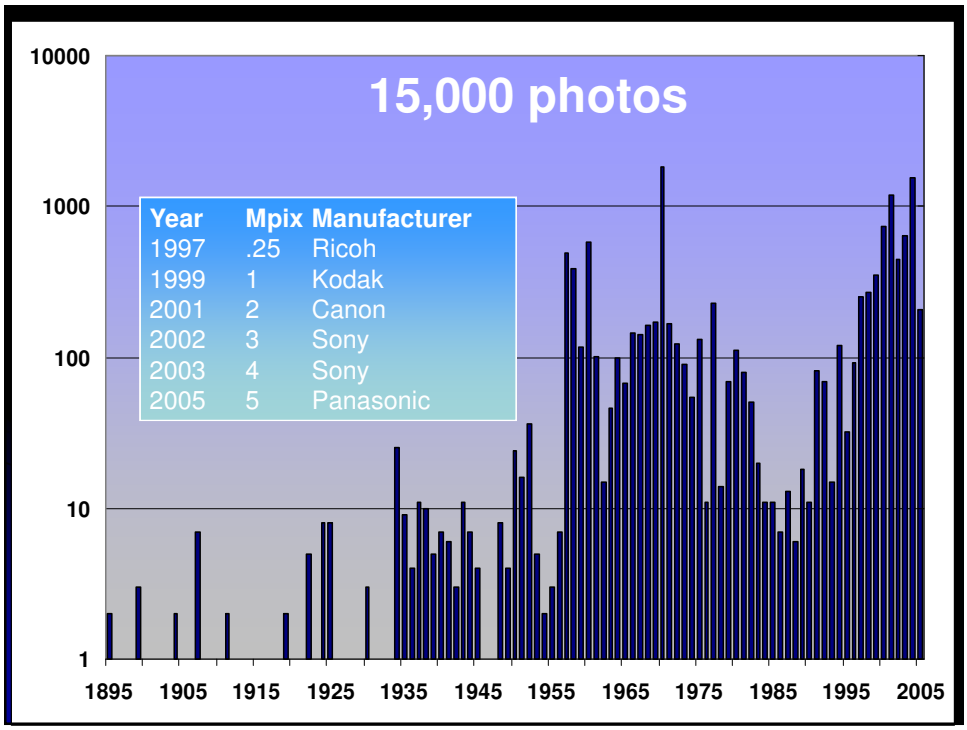
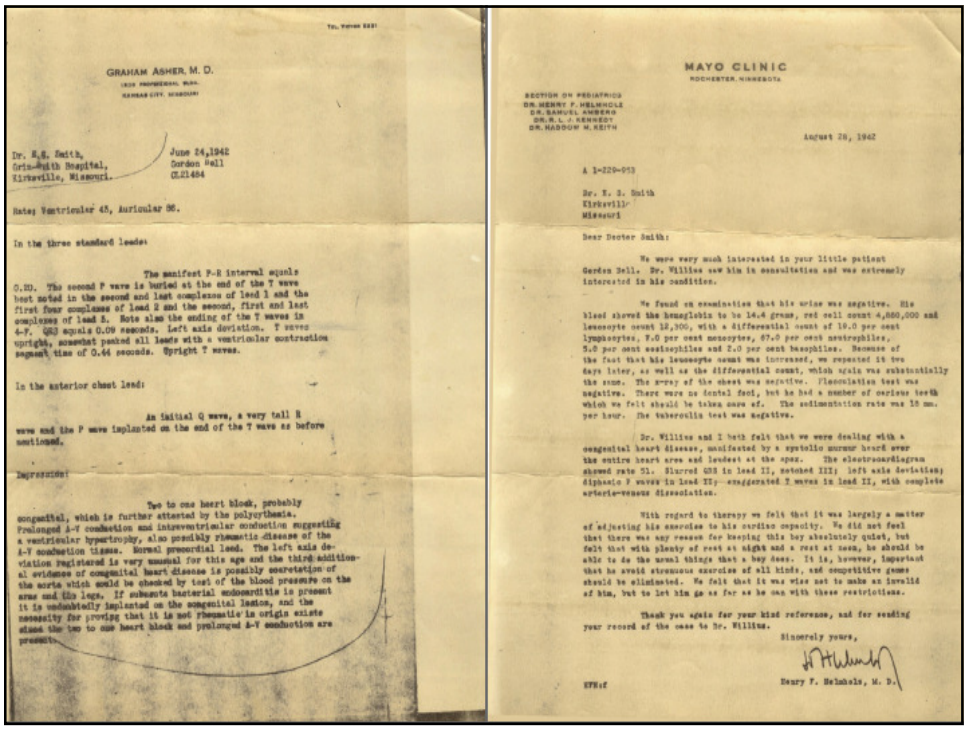


Storage Requirements c2008

	amount per day	per day (Mbytes)	per month (Gbytes)	82 year lifetime (TB)
Email @ 33 KB w/ saved attach	200	6.6	0.20	0.20
Office docs @0.1	5	0.5	0.02	0.02
PDF & Tiff @1.8 MB 20 pp	3	5.4	0.16	0.16
Web pages @0.09 MB	200	18	0.55	0.55
Songs 4 MB	1	4	0.12	0.12
Photos @1 MB	10	10	0.30	0.30
				1.35
SenseCam		40	1.2	1.2
SenseCam event/20 days --40 MB	0.05	2	0.06	0.06
Personal Video (10 Min event / 20 d)	0.05	16.12	0.49	0.49
Phone Capture 8KB/sec	30 min.	1.8	0.05	0.05
Stereo Audio 44 KHz	1 hr	28.5	0.87	0.87
Sub-total, practical capture…		92.93	2.82	2.82
Capture Everything				
Phone quality capture (1KB/sec)	10 hr	36	1.09	1.09
Quality audio record 8 KB/sec	10 hr	285	8.66	
Video 200KB/sec	10 hr	900	27.36	27
Video .5 GB/hr	10 hr	5000	152	152
DVD Video 4.3 Mbps	1 hr	1935	58.82	58.82

The “killer app”… Health?



GRAHAM ASHER, M. D.

Dr. H.S. Smith,
Grim-Smith Hospital,
Kirksville, Missouri.

June 24,1942
Gordon Bell
CL21484

Rate: Ventricular 45, Auricular 86.

In the three standard leads:

The manifest P-R interval equals 0.32. The second P wave is buried at the end of the T wave best noted in the second and last complexes of lead 1 and the first four complexes of lead 2 and the second, first and last complexes of lead 3. Note also the ending of the T waves in 4-V. QRS equals 0.09 seconds. Left axis deviation. T waves upright, somewhat peaked all leads with a ventricular contraction segment time of 0.44 seconds. Upright T waves.

In the anterior chest lead:

An initial Q wave, a very tall R wave and the P wave implanted on the end of the T wave as before mentioned.

Impression:

Two to one heart block, probably congenital, which is further attested by the polycythemia. Prolonged A-V conduction and interventricular conduction suggesting a ventricular hypertrophy, also possibly rheumatic disease of the A-V conduction tissue. Normal precordial lead. The left axis deviation registered is very unusual for this age and the third additional evidence of congenital heart disease is possibly coarctation of the aorta which could be checked by test of the blood pressure on the arms and the legs. If subacute bacterial endocarditis is present it is undoubtedly implanted on the congenital lesion, and the necessity for proving that it is not rheumatic in origin exists since the two to one heart block and prolonged A-V conduction are present.

MAYO CLINIC
ROCHESTER, MINNESOTA

SECTION ON PEDIATRICS
DR. HENRY F. HELMHOLZ
DR. SAMUEL AMBERG
DR. R. L. J. KENNEDY
DR. HADDOW M. KEITH

August 28, 1942

A 1-229-953

Dr. H. S. Smith
Kirksville
Missouri

Dear Doctor Smith:

We were very much interested in your little patient Gordon Bell. Dr. Willius saw him in consultation and was extremely interested in his condition.

We found on examination that his urine was negative. His blood showed the hemoglobin to be 14.4 grams, red cell count 4,880,000 and leucocyte count 12,300, with a differential count of 10.0 per cent lymphocytes, 7.0 per cent monocytes, 67.0 per cent neutrophiles, 5.0 per cent eosinophiles and 2.0 per cent basophiles. Because of the fact that his leucocyte count was increased, we repeated it two days later, as well as the differential count, which again was substantially the same. The x-ray of the chest was negative. Flocculation test was negative. There were no dental foci, but he had a number of carious teeth which we felt should be taken care of. The sedimentation rate was 18 mm. per hour. The tuberculin test was negative.

Dr. Willius and I both felt that we were dealing with a congenital heart disease, manifested by a systolic murmur heard over the entire heart area and loudest at the apex. The electrocardiogram showed rate 51. Blurred QRS in lead II, notched III; left axis deviation; diphasic P waves in lead III; exaggerated T waves in lead II, with complete arteric-venous dissociation.

With regard to therapy we felt that it was largely a matter of adjusting his exercise to his cardiac capacity. We did not feel that there was any reason for keeping this boy absolutely quiet, but felt that with plenty of rest at night and a rest at noon, he should be able to do the usual things that a boy does. It is, however, important that he avoid strenuous exercise of all kinds, and competitive games should be eliminated. We felt that it was wise not to make an invalid of him, but to let him go as far as he can with these restrictions.

Thank you again for your kind reference, and for sending your record of the case to Dr. Willius.

Sincerely yours,

Henry F. Helmholz, M. D.

HFH:f

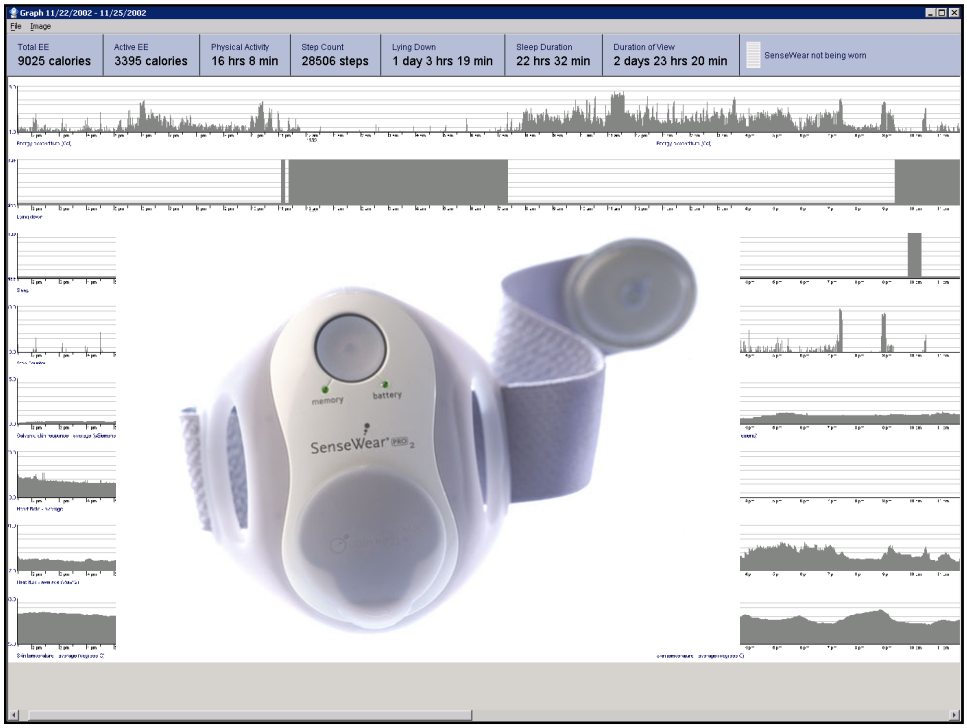
Capturing every heartbeat

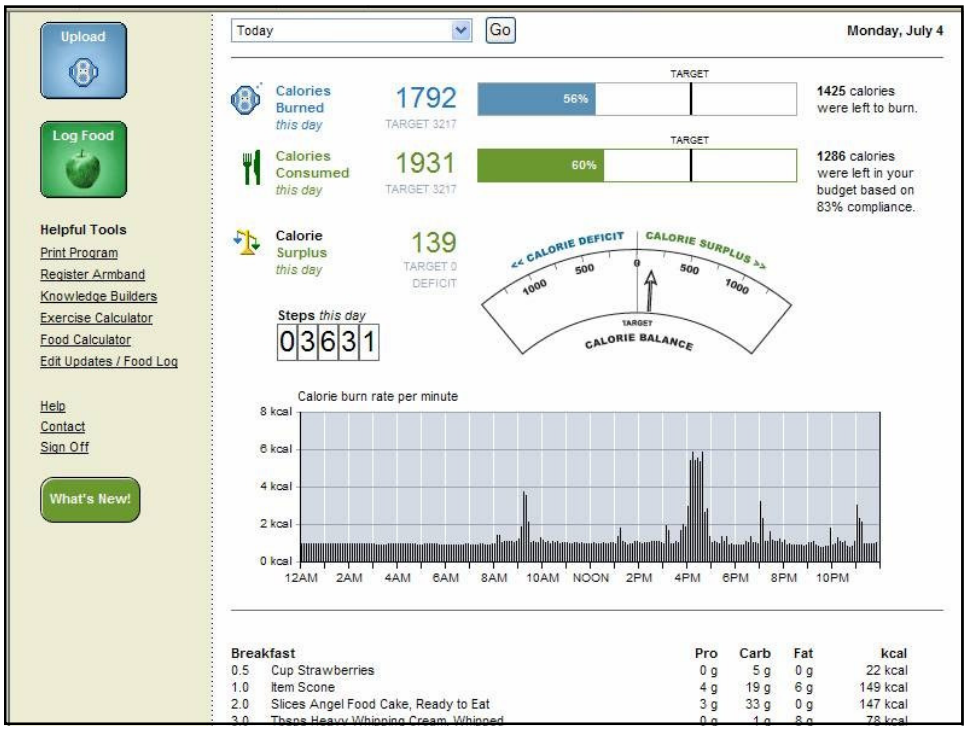
- 72.6 beats/min; 38.16 Million beats/year
- 3.13 billion beats year
- The important number is 4-4.5 years, or ETS
- Battery life: the expected trip to surgery!

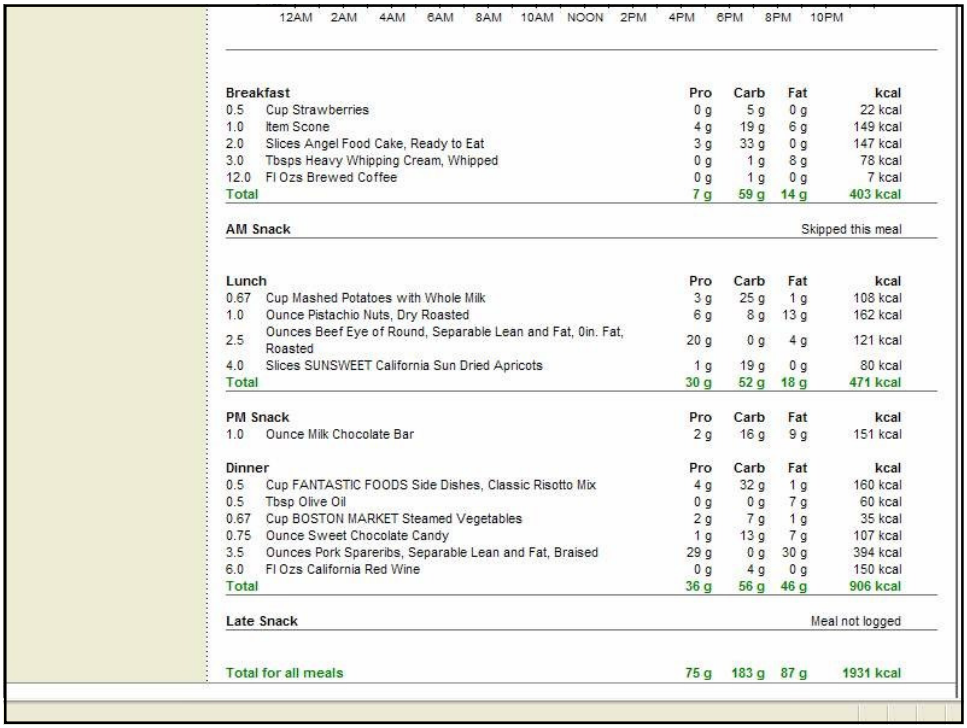
Event Counts

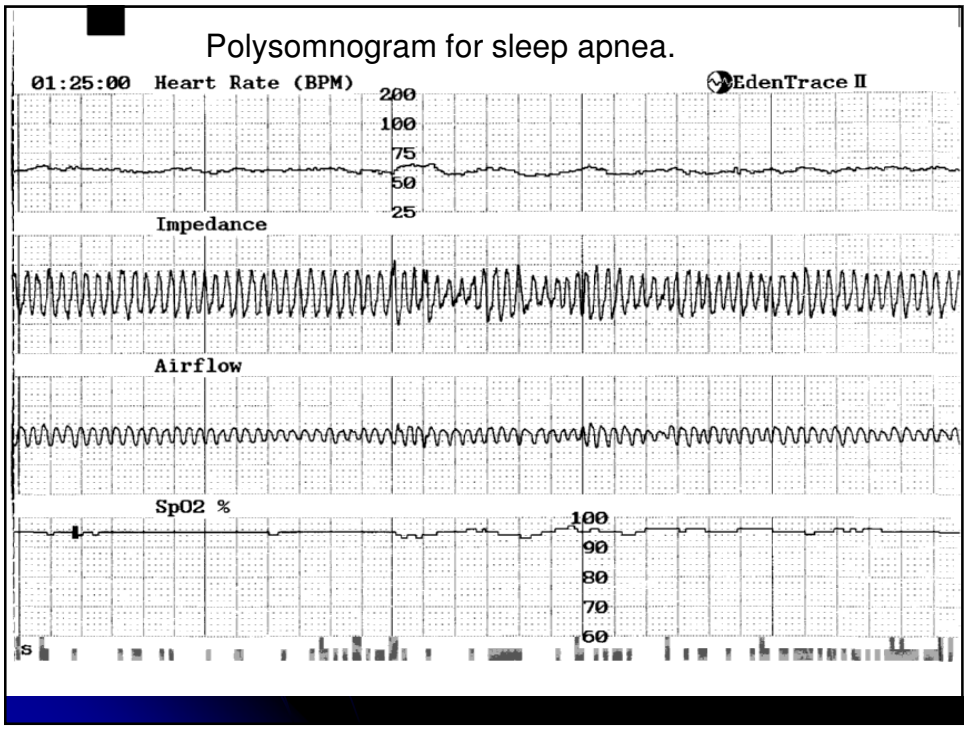
Rate (ppm)	PV	PR	AV	AR	PVE
30 - 54	411,860	4	28,630	1	0
55 - 69	6,824,410	195	4,614	3,609	12
70 - 89	8,113,024	1,359	0	0	274
90 - 109	2,516,074	524	0	0	386
110 - 129	451,814	212	0	0	180
130 - 149	12,599	104	0	0	114
150 - 179	292	46	0	0	112
180 - 224	0	1	0	0	6
225 - 249	0	2	0	0	2
> 250	0	0	0	0	3
Total:	**18,330,073**	**2,447**	**33,244**	**3,610**	**1,089**

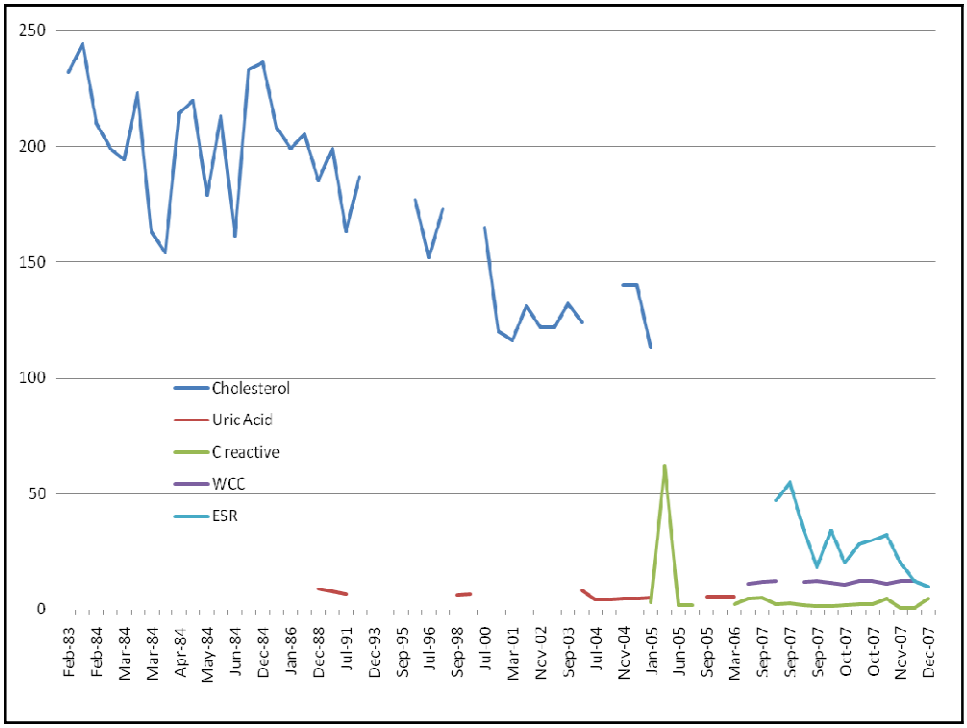
Total Event Count: **18,370,463**




Upload
Log Food
Helpful Tools
Print Program
Register Armband
Knowledge Builders
Exercise Calculator
Food Calculator
Edit Updates / Food Log
Help
Contact
Sign Off
What's New!
Today
Go
Monday, July 4
Calories Burned this day
1792
TARGET 3217
TARGET
56%
1425 calories were left to burn.
Calories Consumed this day
1931
TARGET 3217
TARGET
60%
1286 calories were left in your budget based on 83% compliance.
Calorie Surplus this day
139
TARGET 0 DEFICIT
<< CALORIE DEFICIT
CALORIE SURPLUS >>
1000
500
0
500
1000
TARGET
CALORIE BALANCE
Steps this day
0 3 6 3 1
Calorie burn rate per minute
8 kcal
6 kcal
4 kcal
2 kcal
0 kcal
12AM 2AM 4AM 6AM 8AM 10AM NOON 2PM 4PM 6PM 8PM 10PM
Breakfast Pro Carb Fat kcal
0.5 Cup Strawberries 0 g 5 g 0 g 22 kcal
1.0 Item Scone 4 g 19 g 6 g 149 kcal
2.0 Slices Angel Food Cake, Ready to Eat 3 g 33 g 0 g 147 kcal
3.0 Tbsps Heavy Whipping Cream, Whipped 0 g 1 g 8 g 78 kcal


12AM 2AM 4AM 6AM 8AM 10AM NOON 2PM 4PM 6PM 8PM 10PM
Breakfast Pro Carb Fat kcal
0.5 Cup Strawberries 0 g 5 g 0 g 22 kcal
1.0 Item Scone 4 g 19 g 6 g 149 kcal
2.0 Slices Angel Food Cake, Ready to Eat 3 g 33 g 0 g 147 kcal
3.0 Tbsps Heavy Whipping Cream, Whipped 0 g 1 g 8 g 78 kcal
12.0 Fl Ozs Brewed Coffee 0 g 1 g 0 g 7 kcal
Total 7 g 59 g 14 g 403 kcal
AM Snack Skipped this meal
Lunch Pro Carb Fat kcal
0.67 Cup Mashed Potatoes with Whole Milk 3 g 25 g 1 g 108 kcal
1.0 Ounce Pistachio Nuts, Dry Roasted 6 g 8 g 13 g 162 kcal
2.5 Ounces Beef Eye of Round, Separable Lean and Fat, 0in. Fat, Roasted 20 g 0 g 4 g 121 kcal
4.0 Slices SUNSWEET California Sun Dried Apricots 1 g 19 g 0 g 80 kcal
Total 30 g 52 g 18 g 471 kcal
PM Snack Pro Carb Fat kcal
1.0 Ounce Milk Chocolate Bar 2 g 16 g 9 g 151 kcal
Dinner Pro Carb Fat kcal
0.5 Cup FANTASTIC FOODS Side Dishes, Classic Risotto Mix 4 g 32 g 1 g 160 kcal
0.5 Tbsp Olive Oil 0 g 0 g 7 g 60 kcal
0.67 Cup BOSTON MARKET Steamed Vegetables 2 g 7 g 1 g 35 kcal
0.75 Ounce Sweet Chocolate Candy 1 g 13 g 7 g 107 kcal
3.5 Ounces Pork Spareribs, Separable Lean and Fat, Braised 29 g 0 g 30 g 394 kcal
6.0 Fl Ozs California Red Wine 0 g 4 g 0 g 150 kcal
Total 36 g 56 g 46 g 906 kcal
Late Snack Meal not logged
Total for all meals 75 g 183 g 87 g 1931 kcal


Polysomnogram for sleep apnea.
01:25:00 Heart Rate (BPM)
EdenTrace II
200
100
75
50
25
Impedance
Airflow
SpO2 %
100
90
80
70
60


250
200
150
100
50
0
Cholesterol
Uric Acid
C reactive
WCC
ESR
Feb-83
Feb-84
Mar-84
Mar-84
Apr-84
May-84
Jun-84
Dec-84
Jan-86
Dec-88
Jul-91
Dec-93
Sep 95
Jul-96
Sep-98
Jul 00
Mar 01
Nov 02
Sep-03
Jul-04
Nov-04
Jan-05
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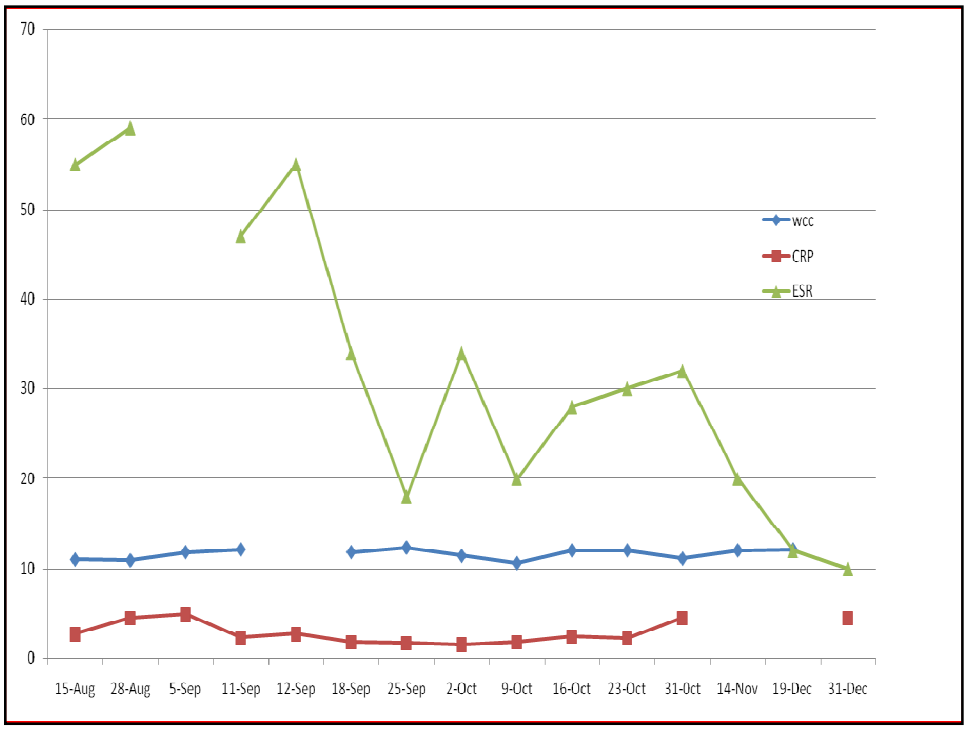
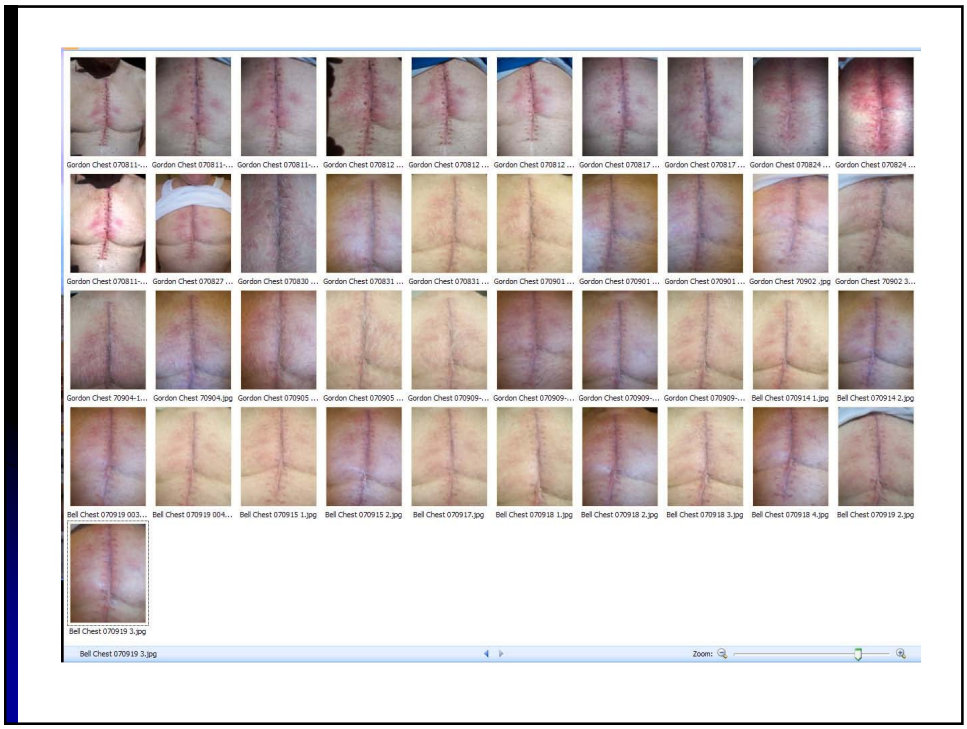
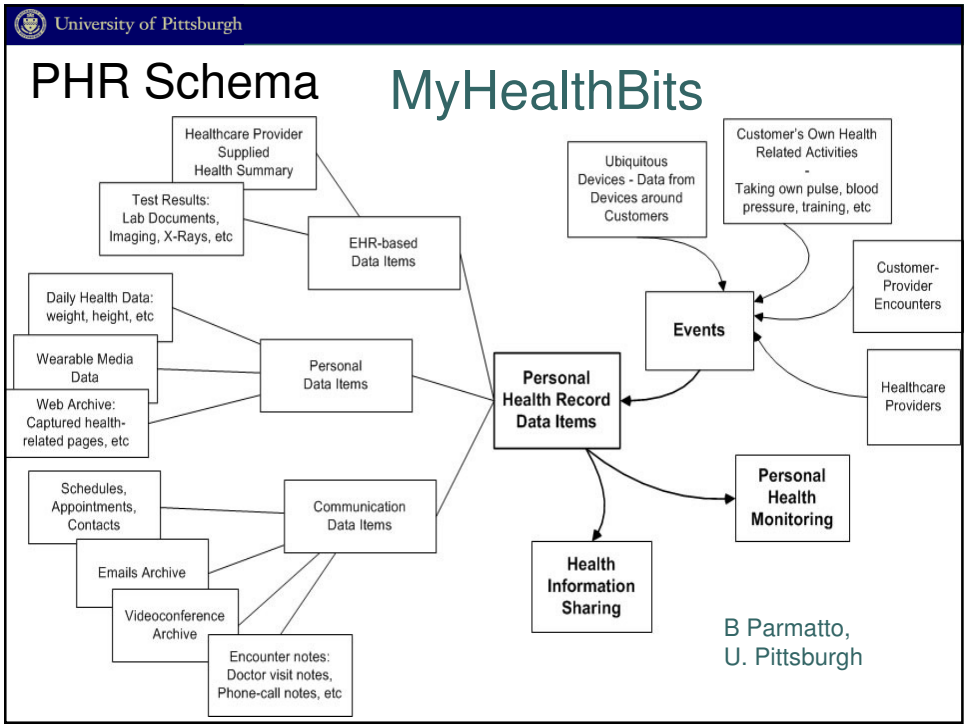
Sep-07
Sep-07
Oct-07
Oct-07
Nov-07
Dec-07


70
60
50
40
30
20
10
0
15-Aug
28-Aug
5-Sep
11-Sep
12-Sep
18-Sep
25-Sep
2-Oct
9-Oct
16-Oct
23-Oct
31-Oct
14-Nov
19-Dec
31-Dec
WCC
CRP
ESR




Broken LF Little Finger 2007-02 (5).jpg
Broken LF Little Finger 2007-02 (4).jpg
Broken LF Little Finger 2007-02 (6).jpg
Broken LF Little Finger 2007-02 (1).jpg
Broken LF Little Finger 2007-02 (3).jpg
Type: JPG File
Size: 121 KB
Dimension: 1280 x 1024 pixels
Broken LF Little Finger 2007-02 (3).jpg
Broken LF Little Finger 2007-02 (2).jpg
Broken LF Little Finger 2007-02 (7).jpg
Broken LF Little Finger 2007-02 (7).jpg
Zoom: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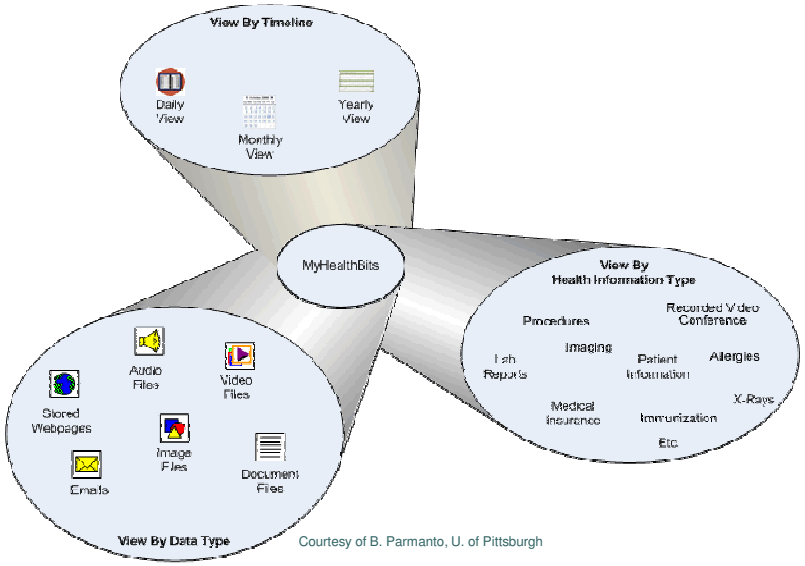
PHR Schema
MyHealthBits
Healthcare Provider Supplied Health Summary
Test Results: Lab Documents, Imaging, X-Rays, etc
EHR-based Data Items
Ubiquitous Devices - Data from Devices around Customers
Customer's Own Health Related Activities - Taking own pulse, blood pressure, training, etc
Customer-Provider Encounters
Events
Daily Health Data: weight, height, etc
Wearable Media Data
Web Archive: Captured health-related pages, etc
Personal Data Items
Personal Health Record Data Items
Healthcare Providers
Schedules, Appointments, Contacts
Emails Archive
Videoconference Archive
Encounter notes: Doctor visit notes, Phone-call notes, etc
Communication Data Items
Personal Health Monitoring
Health Information Sharing
B Parmatto,
U. Pittsburgh

University of Pittsburgh

Record View



Courtesy of B. Parmanto, U. of Pittsburgh

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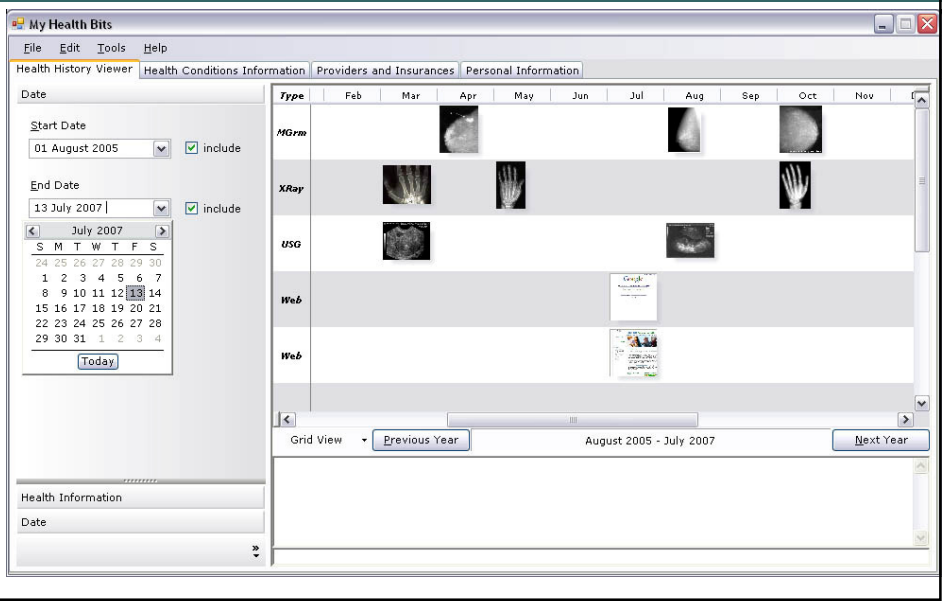
Defining Timeframe



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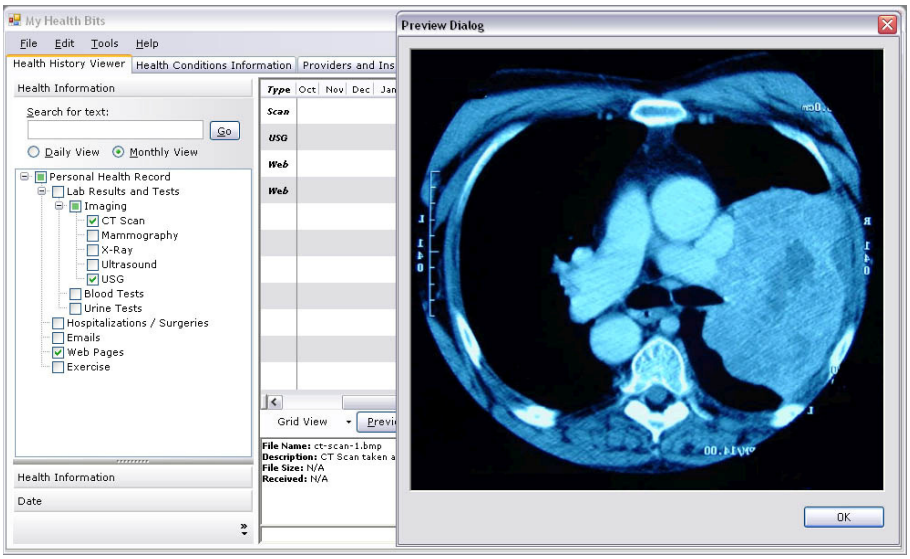
Preview



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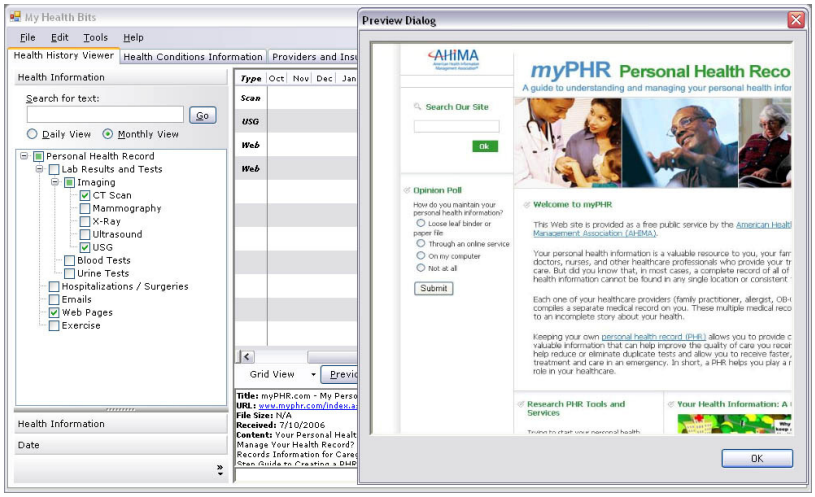
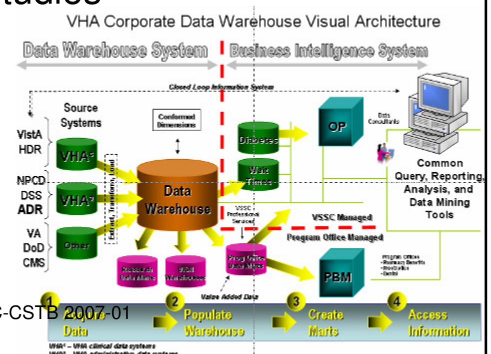
Preview: web page



Courtesy of B. Parmanto, U. of Pittsburgh

VHA Health Informatics

- VHA: largest standardized electronic medical records system in US.
- Design, populate and tune a ~20 TB Data Warehouse and Analytics environment
- Evaluate population health and treatment outcomes,
- Support epidemiological studies
  - **7 million enrollees**
  - **5 million patients**
  - **Example Milestones:**
    - **1 Billionth Vital Sign loaded in April '06**
    - **30-minutes to population-wide obesity analysis (next slide)**
    - **Discovered seasonality in blood pressure -- NEJM fall '06**



HDR Vitals Based Body Mass Index Calculation on VHA FY04 Population
Source: VHA Corporate Data Warehouse

Wt/Ht	5ft 0in	5ft 1in	5ft 2in	5ft 3in	5ft 4in	5ft 5in	5ft 6in	5ft 7in	5ft 8in	5ft 9in	5ft 10in	5ft 11in	6ft 0in	6ft 1in	6ft 2in	6ft 3in	6ft 4in	6ft 5in
100	230	211	334	276	316	364	346	300	244	172	114	73	58	16	11	3	1	1
105	339	364	518	532	558	561	584	515	436	284	226	144	102	25	13	4	4	1
110	488	489	836	815	955	972	1,031	899	680	521	395	256	161	70	23	10	6	4
115	526	614	1,018	1,098	1,326	1,325	1,607	1,426	1,175	903	598	451	264	84	59	17	6	4
120	644	714	1,419	1,583	1,964	2,153	2,612	2,374	1,933	1,450	1,085	690	501	153	95	38	13	9
125	672	855	1,682	1,933	2,628	3,005	3,521	3,405	2,929	2,197	1,538	1,144	756	253	114	46	32	8
130	753	944	1,984	2,392	3,462	3,968	5,039	4,827	4,285	3,223	2,378	1,765	1,182	429	214	81	41	12
135	753	1,062	2,173	2,852	4,105	4,912	6,535	6,535	5,797	4,500	3,393	2,467	1,668	596	309	108	70	15
140	754	1,073	2,300	3,177	4,937	6,286	8,769	8,750	7,939	6,303	4,837	3,493	2,534	977	513	144	106	22
145	748	1,053	2,254	3,389	5,412	7,334	10,485	11,004	10,576	8,084	6,511	4,686	3,344	1,207	680	221	140	41
150	730	1,077	2,361	3,596	6,152	8,665	12,772	14,335	13,866	11,255	9,250	6,545	4,796	1,792	979	350	162	48
155	683	923	2,178	3,391	6,031	8,891	14,181	15,899	16,594	13,517	11,489	8,056	5,741	2,155	1,203	472	249	70
160	671	872	2,106	3,532	6,184	9,580	15,493	18,869	19,939	17,046	14,650	10,366	7,708	2,831	1,618	615	341	100
165	627	772	1,894	3,074	5,773	9,549	16,332	20,080	22,507	19,692	17,729	12,588	9,558	3,548	2,032	716	399	117
170	596	750	1,716	2,900	5,428	9,080	16,633	21,550	25,051	22,568	21,198	15,552	12,093	4,548	2,626	944	489	124
175	493	674	1,521	2,551	4,816	8,417	15,900	21,420	26,262	24,277	23,756	18,194	13,817	5,361	3,178	1,152	586	144
180	486	599	1,411	2,323	4,584	7,855	15,482	20,873	26,922	26,067	26,313	20,358	16,459	6,451	3,848	1,441	737	207
185	420	546	1,195	1,985	3,905	6,918	13,406	19,362	25,818	25,620	27,037	21,799	18,172	7,206	4,458	1,548	867	247
190	424	495	1,073	1,729	3,383	5,909	11,918	17,640	24,277	25,263	27,398	22,697	19,977	8,344	4,937	1,858	963	287
195	341	463	913	1,474	2,803	5,207	10,584	15,727	22,137	23,860	26,373	22,513	20,163	8,754	5,683	2,178	1,120	309
200	315	384	763	1,338	2,602	4,551	9,413	14,149	20,608	22,541	25,452	23,358	21,548	9,284	6,221	2,294	1,295	372
205	265	338	633	1,026	1,993	3,736	7,765	11,940	17,501	19,944	23,065	21,094	20,354	9,270	6,350	2,597	1,322	376
210	275	284	543	853	1,794	3,148	6,804	10,540	15,647	18,129	21,862	20,540	20,271	9,566	6,816	2,786	1,509	418
215	205	244	501	746	1,389	2,645	5,747	8,712	13,064	15,560	19,089	18,191	19,063	9,019	6,675	2,798	1,509	454
220	168	208	415	652	1,231	2,326	4,950	7,751	11,645	13,900	17,577	17,239	17,583	8,896	6,818	2,948	1,635	484
225	156	160	325	522	968	1,873	4,015	6,340	9,794	11,890	14,898	15,097	15,741	8,332	6,441	2,915	1,647	452
230	141	160	259	486	880	1,653	3,334	5,410	8,657	10,500	13,532	13,488	14,815	7,901	6,258	2,859	1,701	496
235	115	119	244	373	738	1,251	2,795	4,570	7,192	8,784	11,489	11,857	12,796	7,113	5,544	2,744	1,617	465
240	72	116	214	313	562	1,099	2,422	3,861	6,044	7,652	9,982	10,692	11,825	6,496	5,392	2,606	1,581	449
245	71	76	169	253	509	888	1,858	3,167	5,076	6,446	8,312	8,647	9,910	5,638	4,742	2,263	1,479	469
250	70	55	152	226	452	753	1,647	2,826	4,505	5,509	7,569	8,064	8,900	5,183	4,319	2,177	1,451	469
255	59	61	128	174	316	599	1,289	2,130	3,468	4,540	5,957	6,451	7,438	4,320	3,741	1,903	1,271	443
260	50	64	117	167	281	493	1,107	1,929	2,963	3,947	5,190	5,797	6,725	3,900	3,429	1,828	1,218	481
265	37	34	88	122	234	454	894	1,449	2,457	3,152	4,374	4,818	5,729	3,350	2,984	1,539	1,028	406
270	47	42	67	119	203	367	800	1,291	2,110	2,740	3,878	4,133	5,075	2,934	2,685	1,468	918	403
275	22	34	44	85	184	291	662	1,064	1,767	2,235	3,113	3,412	4,267	2,598	2,362	1,247	837	334
280	21	20	51	69	139	286	548	903	1,513	1,955	2,770	3,126	3,604	2,273	2,020	1,152	763	300
285	12	12	36	68	118	201	451	720	1,318	1,613	2,208	2,394	3,132	1,924	1,780	994	677	241
290	16	14	47	38	92	182	387	667	1,050	1,301	1,904	2,150	2,655	1,749	1,529	881	688	252
295	9	12	22	53	92	127	341	493	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1,445	1,333	813	533	202
300	12	10	30	43	59	117	309	434	764	988	1,428	1,588	1,989	1,255	1,212	709	479	205

DRAFT

Legend
- BMI < 18 Underweight
- BMI 18-24.9 Healthy Weight
- BMI 25-29.9 Overweight
- BMI 30+ Obese

Total Patients
23,876 (0.7%)
701,089 (21.6%)
1,177,093 (36.2%)
1,347,098 (41.5%)
3,249,156 (100%)

Jim Gray NRC-CSTB 2007-01

Total Recall of everything in a home; Deb Roy

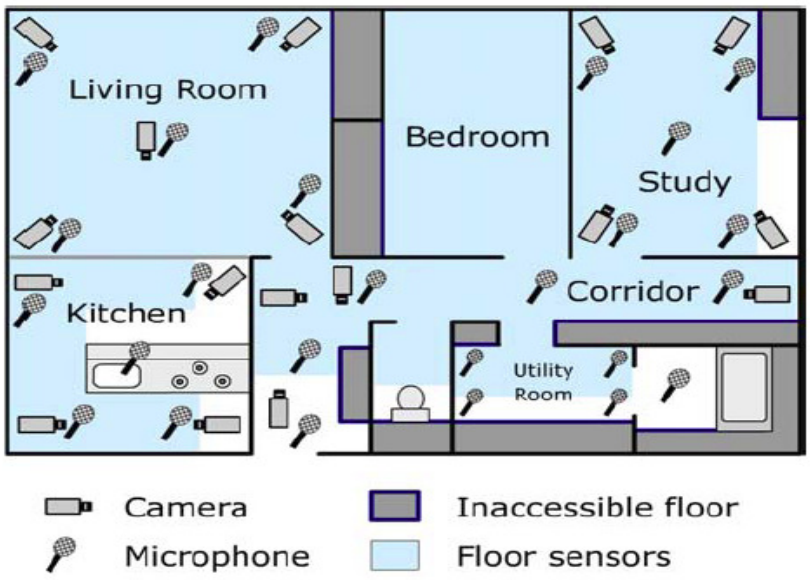
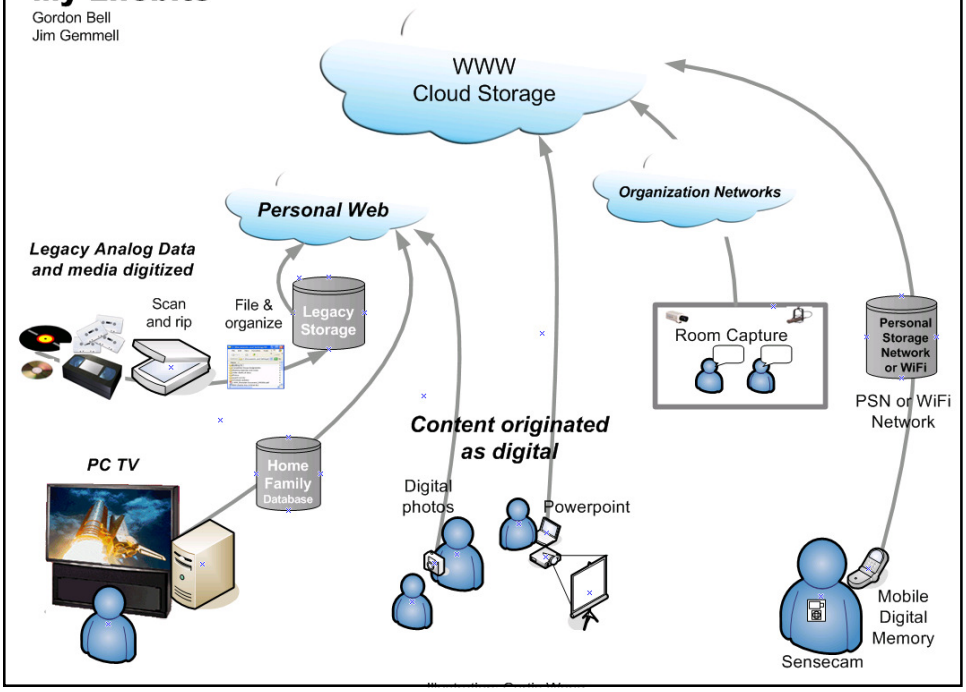


Figure 1. Ubiquitous home senor layout.

My Lifebits

Gordon Bell
Jim Gemmell



Challenges

- "Dear Appy": Monitoring and automatic migration of files that are unlikely to be understood on future platforms … automatic platform migration.
- Going beyond a PC to a distributed environment
  - Expanding network: PC > LANs > web > p2p(eer) > CPSD
  - Into the cloud. Especially for blogs, social sites, etc.
  - Periphery… smart buildings, smart buildings, … objects
  - Servers & Management: Backup, migration, and caching
- Security, privacy, ownership, discoverability, deniability, forgetfulness, and expungability
- CARPE—continuous archival recording of personal experiences (real time data capture)
  - SenseCam, health transducers, phone calls, rooms, etc.
- Degree to which your life logs are made blogs.

…More challenges for computing

- Computer needs to understand-- recognize people in photos and videos; translate speech to text
- Schema sharing among disparate systems
- Schema and extensions for new applications e.g. org charts, family relationships.
- Creation of file organization and automatic filing
- Get What I Need: GWIN…Endless evolutionary search improvements: misspellings, stemming, etc
- Versioning: never over-write an item, file,… field
- Scaling.. Decades to terabytes. What happens
- "Cloaking" as a way to eliminate clutter
- Commenting on everything using voice, text, file
- Vibe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