Tracking Attendance Pilot

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Abstract – *Students experiencing difficulty with their studies often don't identify themselves as students in need of support. The Science Student Success Centre at Carleton University actively seeks out these science students to give them the help they require. One approach is to look at a student's grades as an indicator of need. Another indicator, along side of grades, is attendance in class. In this paper we look at the usage results of piloting an attendance tracking system in two classes, both containing less than 50 students. While our online card swiping attendance tracking system is usable for small class sizes, we also discuss the groundwork of our attendance tracking Android mobile application that is suitable for much larger classes.*

Keywords: Attendance, Tracking, Android, Pilot

1 Introduction

In [1], we described the initial view of our attendance tracking system. Our motivation for building the system came from The Science Student Success Centre (SSSC) at Carleton University. The SSSC collaborates with other on-campus departments to offer workshops, events, and activities that help to develop a student's academic and professional skills. The SSSC also takes an active role in helping science students struggling in their first-year computer science, math, and science courses with the mission as follows:

- Increase the engagement and retention of students in the Faculty of Science
- Foster the growth and achievements of high performing students
- Identify and support students who may be experiencing difficulty with their studies
- Inform students of professional and academic development opportunities
- Aid in the recruitment of outstanding students to the Faculty of Science

One of the questions for the SSSC was how to determine students in need of its services. One indicator it used was to look at first term, mid-term marks in late October. We also believe that looking at students' attendance records for the same period provides another key indicator for students in need. The SSSC already contacts students with marks less than 60% and asks them to come in and visit with the SSSC team to talk about the issues they are facing with their courses and possible techniques and actions they can take to overcome the issues. We also felt that looking for students with less than 60% attendance records was another group we should meet with individually and that there would likely be a crossover between low grades and low attendance students.

Before the SSSC could track low attendance students, we needed to build an attendance tracking system and pilot its usage in classes to examine its performance and usability. In this paper we look at the results of piloting the attendance tracking system in two classes, both containing less than 50 students. Taking attendance using paper and pen was one approach we could have used for these classes, but we knew it was slow and prone to errors. In addition, the paper method required a data entry phase in order to generate reports, which also suffered from the same problems. Therefore, using pen and paper was ruled out from the beginning.

1.1 Goals

Reiterating our goals and objectives from [1]. Our main goal was to provide a fast and efficient attendance tracking system. In addition, the system must work in any and all classrooms at Carleton University, including its electronic classrooms – those with computers and projectors – and those classrooms containing no computers. Finally, a further goal was to provide a system that requires minimum hardware, and can be maintained at minimum cost.

1.2 Objectives

To meet the goals, we had the following objectives:

- Use easily found, inexpensive hardware
- Make use of students' mobile devices to help with the attendance tracking process
- Use open source software to minimize development and maintenance costs
- Installation, either for end users or system administrators, should be fast and simple
- Attendance reports should provide end users with the greatest flexibility for manipulating the collected attendance data
- Support both Mac and PC platforms, and Android and iOS mobile devices

1.3 Outline

In section 2 we further describe literature on existing attendance tracking systems. Section 3 describes our current

system and how it was used in the classes to take attendance in our pilot study. Section 4 describes the results of our pilot. Section 5 provides our conclusion and identifies our future work.

2 Background

Attendance tracking has been used in universities and colleges as a means of improving attendance, retention rates, and grades [1]. As [2] points out in their conclusion:

> *"The results of this study indicate that attendance does matter for academic achievement in a Principles of Economics courses. The evidence suggests that the effect is nonlinear, becoming important only after a student has missed four classes during the semester. That really seems to mater is excessive absenteeism."*

Attendance tracking is also used for other purposes and in different domains. For example, in [8] a system that deals with attendance tracking in remote locations is described.

> *" Hyke combines voice-biometrics with accurate location tagging for tracking attendance in remote locations without the need for a trusted mediator on-site. Hyke was designed based on our observation of a currently deployed teacher attendance tracking system in rural Rajasthan, India. We have implemented some of the key components in Hyke, and discuss some of the security concerns in the system. The Hyke biometric stack for voice recognition is built atop several open source technologies, and provides a simple interface for non-expert users. Our evaluations with Indian speakers over telephone audio suggests the biometric stack is at par with the current state of the art. We believe this will be a useful tool for researchers who would like to incorporate voice technologies in their developing world projects"*

In [1] we reported on several attendance tracking systems specifically built for such a purpose. However, one can also use generic systems, such as Google Docs and its Google Forms capability, and build a simple tracking and reporting system [3,4]

It is interesting to see that organizations, such as Heriot Watt University, go so far as to providing a policy on student attendance. In [5], they outlined four aims and objectives to developing their policy:

> *"2.1.1 Support and encourage students to achieve their full potential in their studies and in developing lifelong skills and competencies;*
>
> *2.1.2 Enhance the overall learning environment by encouraging active participation through regular attendance in all areas of study;*
>
> *2.1.3 Provide guidance on why attendance is important;*
>
> *2.1.4 Use attendance as one of the factors to be taken into account in reviewing a student's commitment to, and performance in, their academic studies and in developing an appropriate response to specific concerns about performance."*

Glassgow Caledonian University is another institution with such a policy, approved in June 2013. In their policy, they outline several principles outlining both the student and university's commitment to attendance:

> *"a. Students are active participants in their learning experiences and must take responsibility for achieving their potential through successful completion of each stage of their studies.*
>
> *b. Monitoring attendance can provide an indication of student commitment, motivation and any difficulties which need to be addressed.*
>
> *c. Regular attendance and academic achievement are closely linked. Students who attend regular student-supervisor meetings and researcher personal, professional and research training and development are more likely to enjoy a rewarding experience in which core skills and abilities, such as team-working, are developed.*
>
> *d. Schools will ensure that effective mechanisms are in place to both identify students considered to be at risk and offer appropriate support and guidance."*

Are these policies important? We believe the answer is yes as do others. As reported in [10] and outlined in [6]:

> *"The impact of attendance policy was significant. When attendance was explicitly required, 80% of the students missed 4 times or less and less than 1% missed 8 times or more. When the attendance policy was non-required and implicit, 73% of the students missed 4 times or less and almost 7% missed 8 times or more. When the attendance policy was explicitly non-required, only 52% of the students missed 4 or fewer times while 18% missed 8 times or more. The conclusion seems to be that professors do*

get the type of attendance that they encourage by the policy that they adopt."

Is tracking and increasing attendance enough to help increase a student's academic performance? In the study reported in [7] attendance is "clearly associated with academic performance". However, like [9], it is also believed that student engagement "to the extent in which the student is involved with his/her studies" also plays and important role.

3 Approach

There are two types of people that interact with our attendance tracking system. The first type of person is called a user. A user is a person that is involved with taking attendance and reviewing the results. To login to the system, a user is presented with the screen shown in Figure 1.

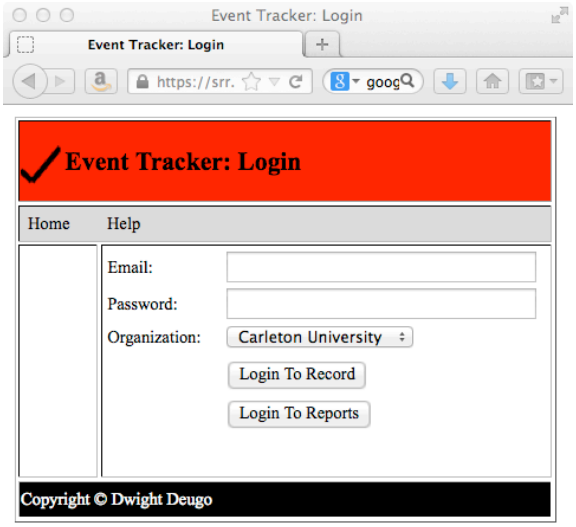

Figure 1: Login Screen

After entering their email address and password, a user can choose to login to either recording attendance or look at their attendance records for their associated events. A user must also identify the organization they are with, such as Carleton University. The system's administrator assigns a user's email address, password, organization, and the events they are tracking. The system administrator has access to the backend of the system and is outside the scope of this paper.

After providing the correct credentials and selecting Login To Record, a user is presented the screen shown in Figure 2. In this screen the user selects the corresponding event they wish to record attendance for, enters an individual's swipe information and then selects the Record button to record that individual's attendance in the event for the current time.

An individual is a person that is having their attendance tracked. They have a first and last name, an email address, and id and swipe information. Swipe information is data that can be read from an individual's id card, such as a student card, and is often, but not always, different from their student id or number.

The attendance tracking system has been built to accommodate two different types of organizations. The first is an organization that allows swipe information to be validated against a backend system and information returned from it about the corresponding individual to the attendance tracking system. The second type of organization is one where individual information based on swipe information is not available. In the latter case, every individual that will be tracked by the system must have his or her information entered manually into the system by a user. A user does this by selecting Login To Records from the login screen or simply selecting Record in the left hand menu from any screen once they are logged in. In fact, if a user attempts to take the attendance using swipe information that can not be associated with a given individual, they are taking directly to the Individual Registration Screen, as shown in Figure 3, automatically

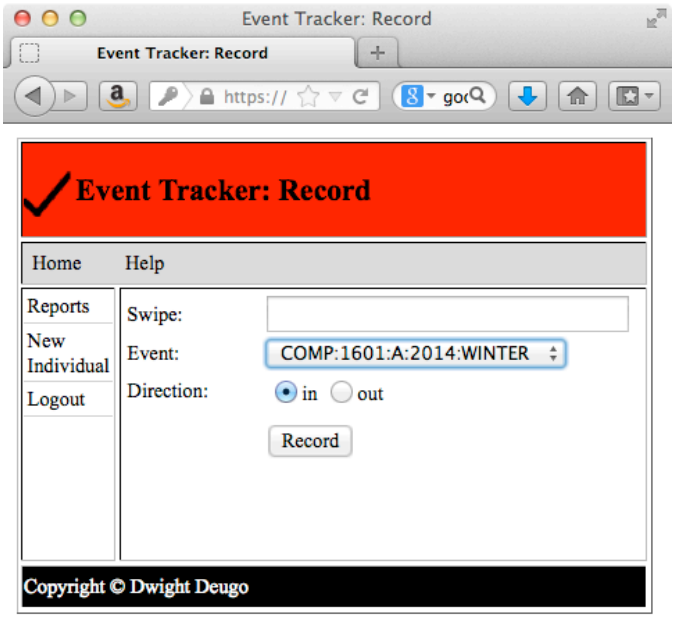

Figure 2: Record Screen

Swipe information is entered in one of two ways. The first is manually typing in the information. This approach can be error prone, as there is significant amount of information on a standard identification card that is not in an easily human readable format [11] and it can be difficult to identify the information without a card reader. The second method of entering the swipe information is to connect a card reader to computer that is tracking attendance. Provided the card reader has a HID or Keyboard Emulation mode, once simply places the cursor in the swipe field, swipes the card in the reader and the information is automatically entered in the swipe field. The source of error in this situation is where the action of swiping the card was incomplete. Depending on the card reader, errors in swiping will produce an entry that can be recognized as an error. For example, the MagTek SureSwipe

Reader, Model#: 21040145 produces an ;E? when a card is misread.

By selecting Reports in the left hand menu or selecting Login to Reports in the home screen a user is taken to the Reports Screen shown in Figure 4. All of a user's events are listed in this screen and by selecting one and clicking the download button, an Excel spreadsheet of results is downloaded for the user's review, as shown in Figure 5.

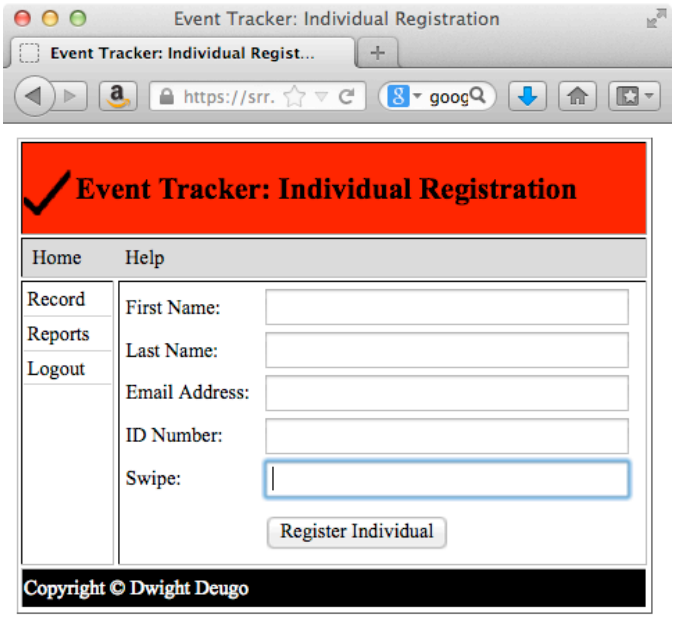

Figure 3: Individual Registration Screen

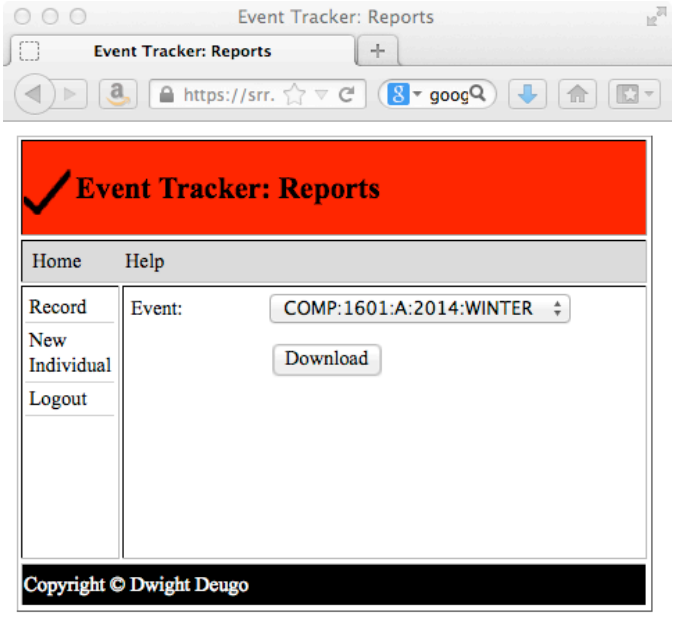

Figure 4: Reports Screen

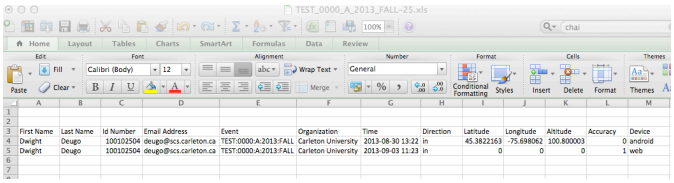

Figure 5: Excel Report

Each entry in the Excel spreadsheet provides information on an individual checking in or out of an event. This information includes the following:

- First Name
- Last Name
- ID Number
- Email Address
- Event Name
- Organization
- Time
- Direction (In/Out)
- Latitude
- Longitude
- Altitude
- Accuracy
- Device

The Device entry can be Android, iOS or web, identifying the three methods of data entry available for the system. This paper discusses the web approach and the interface of our Android mobile device app. The only significant difference with the apps is that the GPS coordinates are taken off the mobile device and an accuracy percentage between 0 and 1 is calculated indicating where the device was used to identify an individual's attendance at an event. In the case of web entry, the accuracy is always 1 and the latitude, longitude and altitude are 0.

4 Results

Of significance to this paper is how quickly individual registration takes and how quickly individual attendance takes.

To answer the first question, we examine the time required to register and swipe in two different classes at Carleton University under two different scenarios. The first class had 41 students stand in line and register one after another. The instructor (user) performed all individual data entry. The total time required to register all 41 students was 2064 seconds for an average of 50.34 seconds per student. The second class had 31 students remain in their seats and come up one a time to register. The instructor performed all individual data entry. The total time required to register all 31 students was 3338 seconds for an average of 107.68 seconds per student. As mentioned, registration is a one-time operation. After a student (individual) is in the system, they can be swiped in for any and all events.

To answer the second question we examine three different event-tracking scenarios. The first scenario was to swipe people in for the period starting 5 minutes before a class until 5 minutes after class started. In one class, we had 26 people arriving in this period for a total of 528 seconds processing time, taking an average of 20.31 seconds to process each student.

In another scenario, students stood in line at the end of class and were swiped out. In one class, we had 21 waiting for a total of 208 seconds processing time, taking an average of 9.9 seconds to process each student.

In the final scenario, student cards were collected in batches and swiped out during class. A typical outcome for processing 5 student cards required a total of 19 seconds processing time, taking an average of 3.8 seconds to process each student card.

Table 1 summarizes these results.

Table 1: Registration and Swipe Timings

	Reg. in Line	Reg. in Seats	Swipe Before Event	Swipe End of Event	Batch Swipe
Students	41	31	26	21	5
Total Processing Time (seconds)	2064	3338	528	208	19
Average Processing Time (seconds)	50.34	197.68	20.31	9.90	3.8

5 Conclusions

We believe our current web-based system can be used for tracking attendance in events of up to 50 people. At this number, a little less than 1 hour (50.34 seconds * 50 = 41.95 minutes) is required to register them with the system. This is a one-time operation that can be done before the start of the first occasion of an event or class. Moreover, if people attend different events, they do not need register with subsequent events as they are known to the system. The registration operation can be eliminated completely if the event organization provides access to an individual's information. The system has been developed with a plugin style architecture, where validation and retrieving of individual data can be done through accessing a local database or assigned a different software component that accesses an organization's remote database.

Swiping people's attendance at the start or end of an event is also within reasonable time limits. Swiping in 50 people before the start of an event takes (20.31 seconds * 50 = 16.93 minutes) based on our observed arrival times of people. Moving this process to the end of the event and swiping people leaving the event speeds up the process. In this case, the total processing time is decreased to less than 10 minutes (9.9 seconds * 50 = 8.25 minutes).

The web-based system breaks down as event sizes increase beyond 50 people. In tables 2 and 3, the timings for registration and swiping people at the start and the end of an event are shown. In cases of 100 and 200 people, the numbers show that processing times are unmanageable, except for the 100 people case of swiping at the end of an event.

Table 2: Registration Timings for Typical Event Sizes

Students	Average Processing Time per person (seconds)	Total Processing Time (seconds)	Total Processing Time (minutes)
50	50.34	2517	41.95
100	50.34	5034	83.9
200	50.34	10068	167.8

Table 3: Swiping Timings for Typical Event Sizes

Students	Total Processing Time (minutes) Swipe Before Event	Total Processing Time (minutes) Swipe End of Event
50	16.3	8.25
100	33.85	16.5
200	67.7	33

Our solution to this problem was to create and Android mobile application that permits people to "swipe" in using their mobile device. The application contains three functional areas. The first area, shown in Figure 6, instructs a user to enter their first name, last name, id and email address. This is equivalent to the data we gather when we register individuals on the web.

The second area, shown in Figure 7, is where individuals enter and save the names of the events they wish to use the app to swipe in. The user that requests the event tracking provides the event name to an individual. A sample event name is shown in Figure 4, e.g. COMP:1601:A:2014:WINTER.

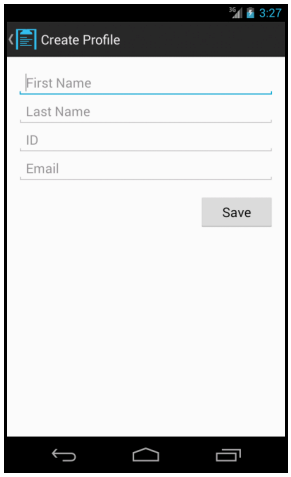

Figure 6: User Data

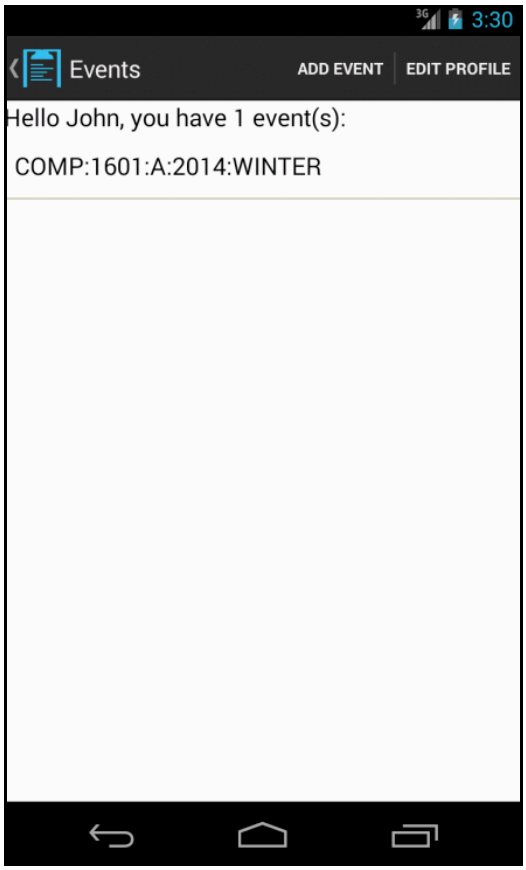

Figure 7: Event Identification

The third area, shown in Figure 8, is where an individual signals that they are at the event. This is simply a matter of selecting the event and initiating a check in request to our attendance tracking server. The device's GPS location is sent as part of this message and compared against the GPS location of the actual event to ensure the individual is at the event.

The benefit of this approach is that only the number of simultaneous connections the server can manage limits the number of simultaneous event trackings. Even then the actual processing time is minimal, so classes of 100 and 200 do not create a problem for the system. The disadvantage to this approach is that people require the app on their mobile devices. In the situation where an individual doesn't have a mobile device or doesn't want to install the app, the fall back approach is the manual swiping and registration method.

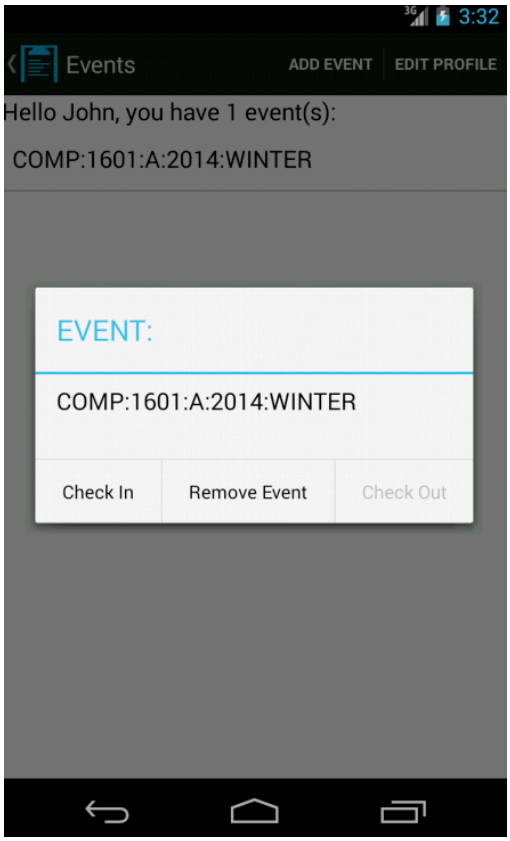

Figure 8: Event Swipe

6 References

[1] Deugo D., "Attenance Tracking". The 9th International Conference on Frontiers in Education: Computer Science and Computer Engineering (FECS 2013), 79-85, 2013.

[2] Durden G. and Ellis L., 1995. The Effects of Attendance on Student Learning in Principles of Economics. The American Economic Review, 85(2), 343-346. Available at <http://www.jstor.org/stable/2117945> [Accessed Jan 15 2014].

[3] http://www.fordham.edu/academics/office_of_research/research_centers__in/center_for_teaching_/teaching_tip_archive/taking_attendance_in_90441.asp, [Accessed Jan 15 2014].

[4] https://support.google.com/drive/answer/87809?hl=en, [Accessed Jan 15 2014].

[5] Heriot Watt University, http://www.hw.ac.uk/registry/resources/studentattendancepolicy.pdf, [Accessed Jan 15 2014].

[6] Minnesota State University, http://www.mnsu.edu/cetl/teachingresources/articles/classattendance.html, [Accessed Jan 15 2014].

[7] Nyamapfene A., Does class attendance still matter?, Engineering Education, Vol 5, 2010.

[8] Reda A., Panjwani S., and Cutrell E., Hyke: a low-cost remote attendance tracking system for developing regions. InNSDR, Washington, D.C., 2011, Jan 15, 2014, http://research.microsoft.com/pubs/156114/nsdr011-reda-Hyke.pdf.

[9] Rodgers J.R., Encouraging tutorial attendance at university did not increase performance, Australian Economic Papers, 41 (3), 255-266, 2002.

[10] Romer D., Do Students Go to Class? Should They?, Journal of Economic Perspectives, Vol 7, Num 3, 167-174, Summer 1993.

[11] http://www.gae.ucm.es/~padilla/extrawork/tracks.html, [Accessed Jan 15 2014].