Projectile Motion

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Purpose: To study projectile motion.

Background:

A projectile is defined as having to wings, or engine to alter it's flight. The only force acting on it is gravity which on earth is about -9.8 m/s^2 , we will be ignoring air resistance for this lab. In this lab we used a tennis ball, which we threw up 5.9 meters. When graphed over time the ball's vertical height creates a parabola with the form $y=Ax^2$.

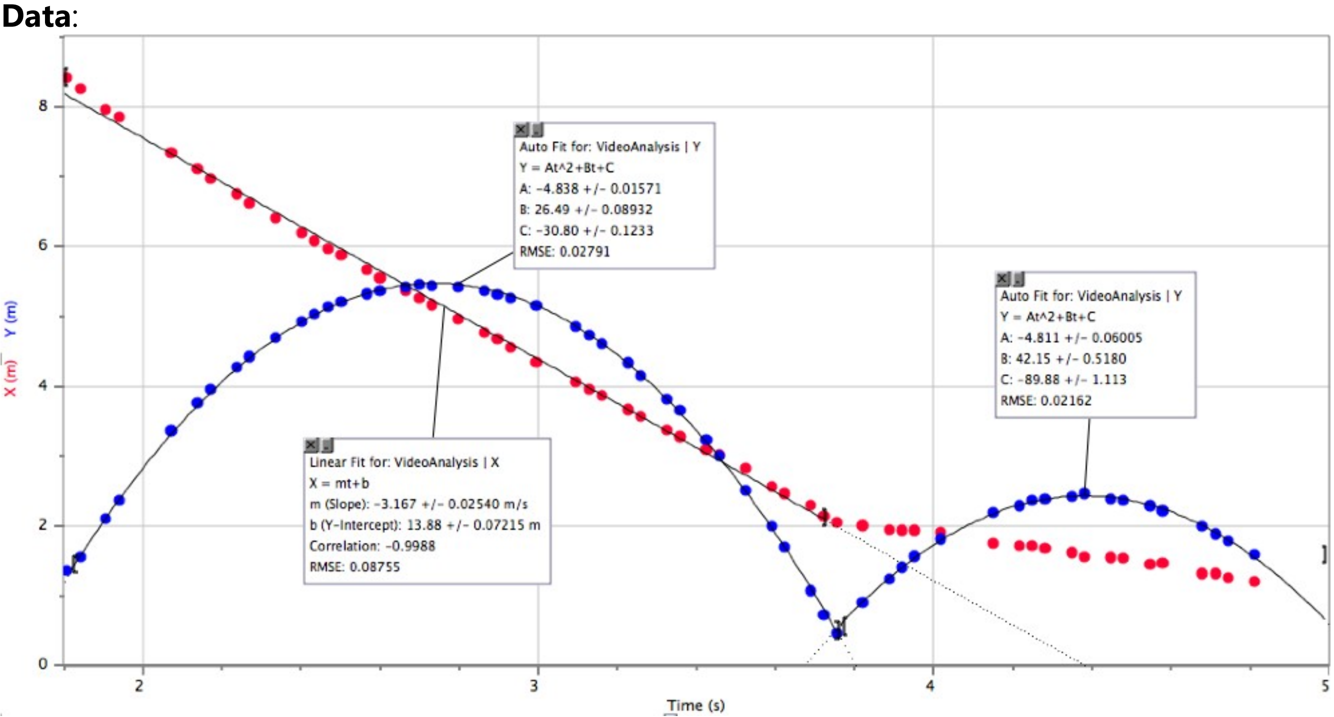
Materials:

- A small object which can be thrown
- A meter stick
- A computer
- A camera
- Logger Pro
- A person to throw and catch the ball
- 2 traffic cones

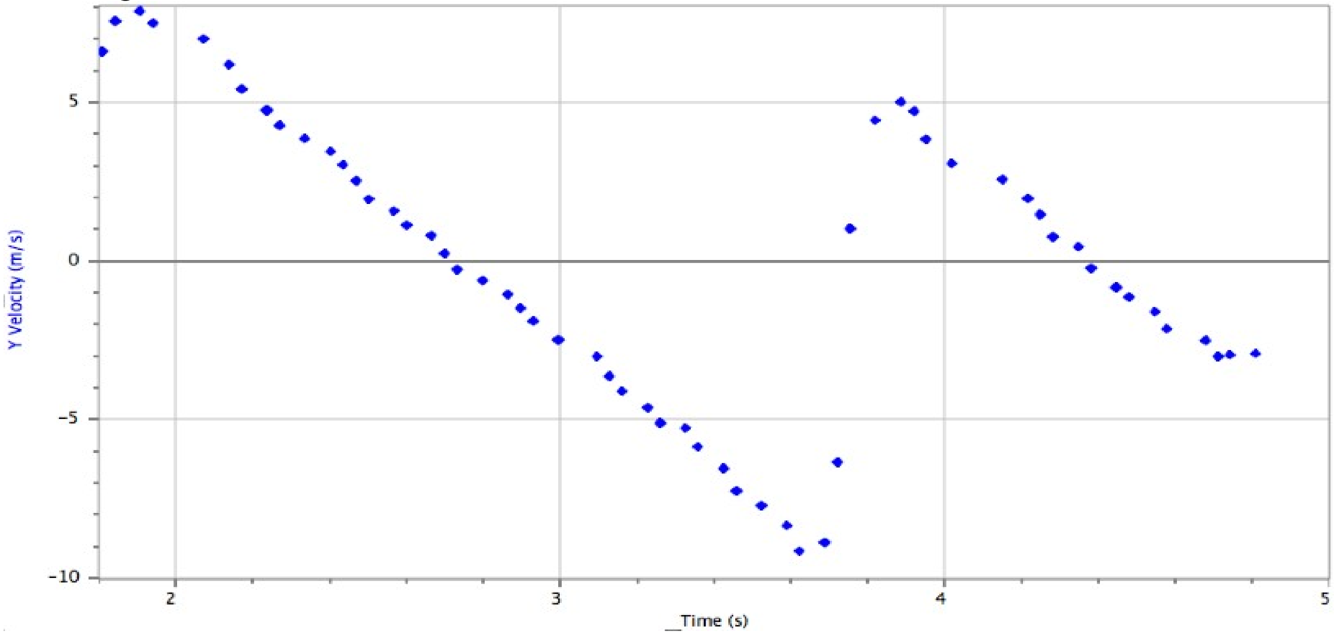
Procedure:

1. Set up the camera pointing at the meter stick, make sure the ball and meter stick will stay in the frame at all times.
2. Begin recording and throw the ball at approximately a 45° angle.
3. Stop recoding and import the movie into logger pro.
4. Do a video analysis on the movie by tracking the ball's location with the dot thing.
5. Finally graph the data and analyze it.

Data:



Graph 1.0: this shows the x and y position of the ball over time. Notice that the y (vertical) position follows the curve of a parabola within 2-8%, according to this data our calculated gravity is -9.676. In addition, the x (horizontal) position is a constant speed of -3.16 m/s until it hits the ground and slows down.



Graph 1.1: This shows the y velocity, as the graph shows the ball is constantly slowing down, except for the short time when it is changing directions at 3.8 seconds.

	Time (s)	X (m)	Y (m)	Vx (m/s)	Vy (m/s)
1	1.808	8.422	1.364	-4.630	6.602
2	1.842	8.265	1.552	-4.458	7.562
3	1.907	7.965	2.103	-4.145	7.872
4	1.940	7.851	2.364	-3.873	7.492
5	2.072	7.336	3.365	-3.770	6.996
6	2.138	7.108	3.757	-3.709	6.189
7	2.172	6.965	3.960	-3.625	5.420
8	2.237	6.751	4.279	-3.507	4.749
9	2.270	6.622	4.424	-3.439	4.264
10	2.335	6.408	4.700	-3.318	3.855
11	2.402	6.194	4.932	-3.295	3.446
12	2.435	6.079	5.033	-3.309	3.043
13	2.468	5.965	5.135	-3.107	2.516
14	2.502	5.879	5.207	-3.118	1.945
15	2.567	5.665	5.323	-3.203	1.569
16	2.600	5.551	5.367	-3.073	1.127
17	2.665	5.365	5.425	-2.977	0.799
18	2.698	5.265	5.454	-2.990	0.231
19	2.732	5.165	5.439	-2.998	-0.275
20	2.798	4.965	5.425	-3.016	-0.619
21	2.863	4.765	5.367	-2.999	-1.054
22	2.897	4.679	5.309	-3.153	-1.495
23	2.930	4.551	5.265	-3.190	-1.893
24	2.995	4.351	5.149	-3.026	-2.489
25	3.095	4.065	4.859	-3.006	-3.014
26	3.128	3.951	4.729	-3.023	-3.629
27	3.160	3.865	4.613	-2.954	-4.101
28	3.227	3.665	4.337	-2.966	-4.631
29	3.260	3.565	4.148	-2.919	-5.103

Table 1.0: this shows part of our data, for the first 3.2 seconds.

Observations:

It was a bit breezy when we did the experiment, the wind could have pushed the ball closer to the camera thus changing the angle at which the camera viewed it from and messed up our data. Also the meter stick was the same color as the dead grass so we had to use two traffic cones to calibrate logger pro.

Analysis:

Our calculated gravity from this experiment was -9.676 m/s^2 so our error, assuming that the gravity outside Mr. 's office is -9.8 m/s^2, is $\frac{-9.676--9.8}{-9.8}$ =-1.2%. This is very good considering this was a video capture so it wasn't quite exact. Possible sources of error include wind changing the relative position of the ball to the camera. Beeka might have messed up when doing the dot analysis, or maybe our exact set of data caused a glitch in logger pro's algorithm and it gave us false results.

Conclusion:

Overall this lab went without incident, if I ever did this again I would try to find a way to do this inside a large building to eliminate any wind. I would also try to find a different program that could track the ball automatically, which would eliminate all human error.