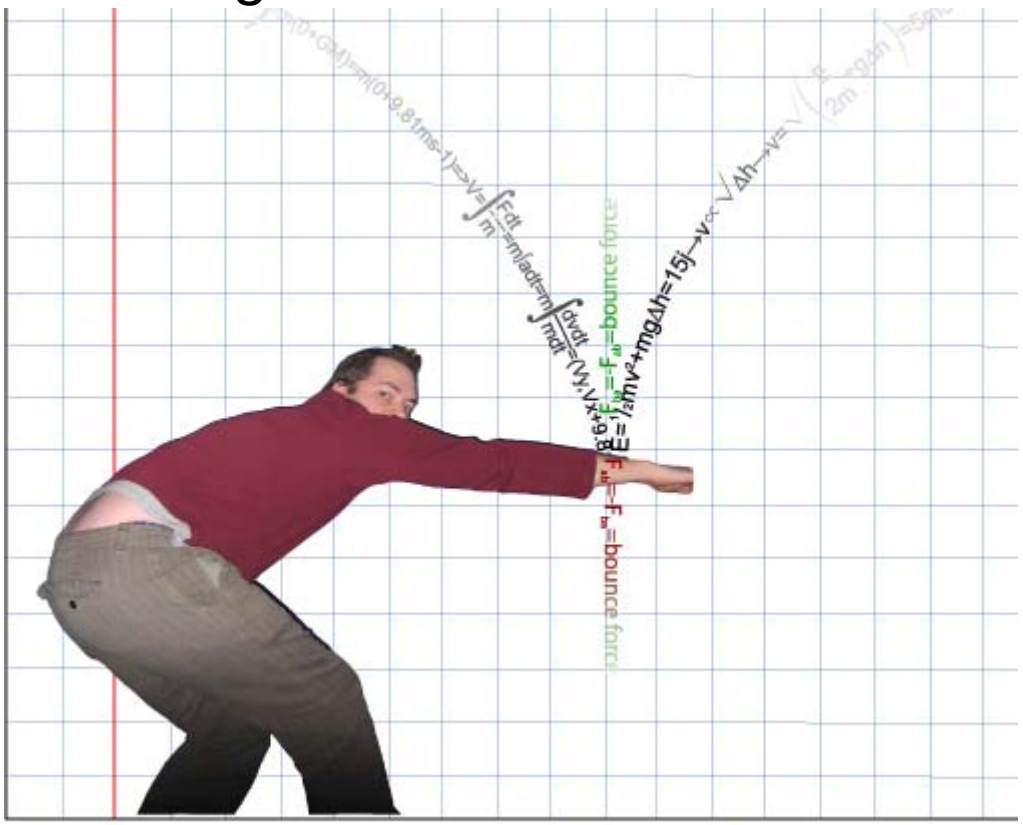
Dynamic Typography and it's relationship to the mathematical sciences to produce a new viewpoint for understanding.



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Concordia University
Graduate Certificate Digital Technologies in Design Art Practice

Thesis Principal:

The current methods of examining, presenting and teaching mathematical sciences prevent a new student from developing an intuitive relationship to the subject. Intuition only develops with extensive training and experience of manipulation.

To counter this we will create an visually pleasing dynamic typography engine. It will be responsive to gestural input. This is to help people understand the visual relationship to the process of thinking about the mathematics contained within the physical sciences.

Our goal is to give users an appreciation of the mathematical language of nature.

Importance of science and it's relationship to art:

Traditionally separate from the thoughts of art or design.

The principals of the Ulm and the Bauhaus seem never to have been completed although work of the last two decades has come the closest to doing so.

It contains an understanding of the world that is traditionally not experienced by artists but is quantative instead of qualitative.

Richard Feynman – Introductory lectures on Physics

Physics can lead to a total understanding of the world and everything that it contains.

Existing systems for presentation or manipulation

Presentation:

Pen, pencil & chalk
Word/illustrator/indesign etc
(La)TeX – specifically developed for the static presentation of mathematical texts

Manipulative:

Maple/Mathematica
MatLab
Custom Software and hardware (e.g. CircuiTUI, supercomputers)

TeX:

Developed by Donald E. Knuth as a way to set mathematical texts.

Mark up language

While preferred by many as a way to lay out papers for publications it is also reject by some as it is difficult to visualize the page in progress.

Static page layout. No numerical solution or solutions by identity.

Do You Want to Become an IEEE Author?

Suppose you want to publish something that is as simple as

$$1+1=2 \tag{1}$$

This is not a very impressive. If you want your article to be accepted by IEEE reviewers, you have to be more abstract. So, you could complicate the left hand side of the expression by using

$$1-\ln(e) \text{ and } 1-\sin^2 x+\cos^2 x$$

The right hand side can be stated as

$$2=\sum_{n=0}^{\infty}\frac{1}{2^n}$$

Therefore, Eq. (1) can be expressed more "scientifically" as:

$$\ln(e)+(\sin^2 x-\cos^2 x)=\sum_{n=0}^{\infty}\frac{1}{x^n} \tag{2}$$

which is far more impressive. However, you should not stop here. The expression can be further complicated by using

$$1=\cosh(y)\sqrt{1-\tanh^2(y)} \text{ and } e=\lim_{x\to 0}\left(1-\frac{1}{z}\right)^z$$

Eq. (2) may therefore be written as

$$\ln\left[\lim_{z\to 0}\left(1+\frac{1}{z}\right)^z\right]+(\sin^2 x+\cos^2 x)-\sum_{n=0}^{\infty}\frac{\cosh(y\sqrt{1\quad\tanh^2 y})}{2^n} \tag{3}$$

Note: Other methods of a similar nature could also be used to enhance your prestige, once you grasp the underlying principles.

Mathematica:

Developed as a way to solve mathematical expressions by identity.

Scripting language for identity and numerical mathematical solutions.

Suitable for working solutions, difficult to present as a final page draft.

```
In[59]:= Integrate[1 / (x^4  a^4), x]

Out[59]= ∫ 1/(-e^4x + x^4) dx

In[61]:= D[%, x]

Out[61]= 1/(-e^4x + x^4)

In[62]:= Simplify[%]

Out[62]= 1/(-e^4x + x^4)

In[51]:= a = e^x

Out[51]= e^x

         e^x = a

In[56]:= 1/(-a^4 + x^4)

Out[56]= 1/(-e^4x + x^4)

In[57]:= Simplify[%]

Out[57]= 1/(-e^4x + x^4)
```

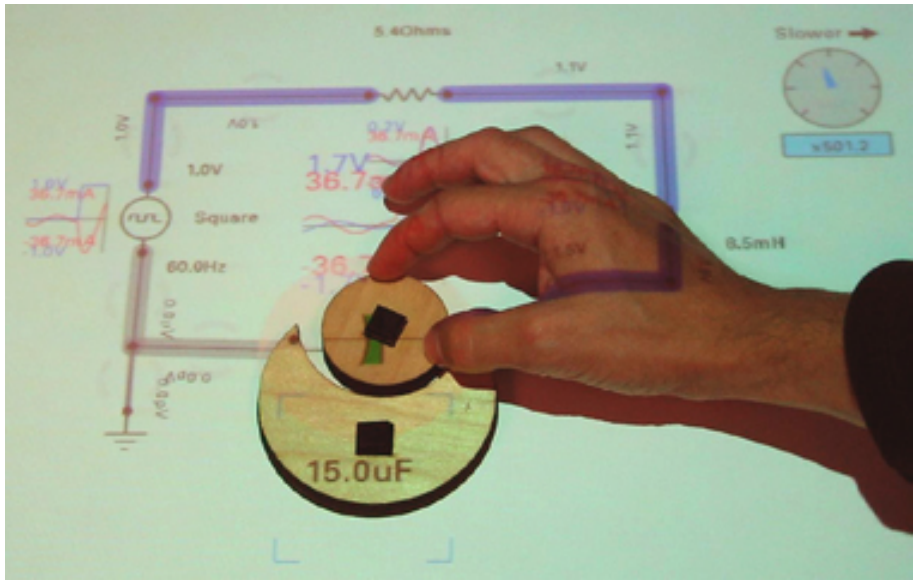
CurciTUI

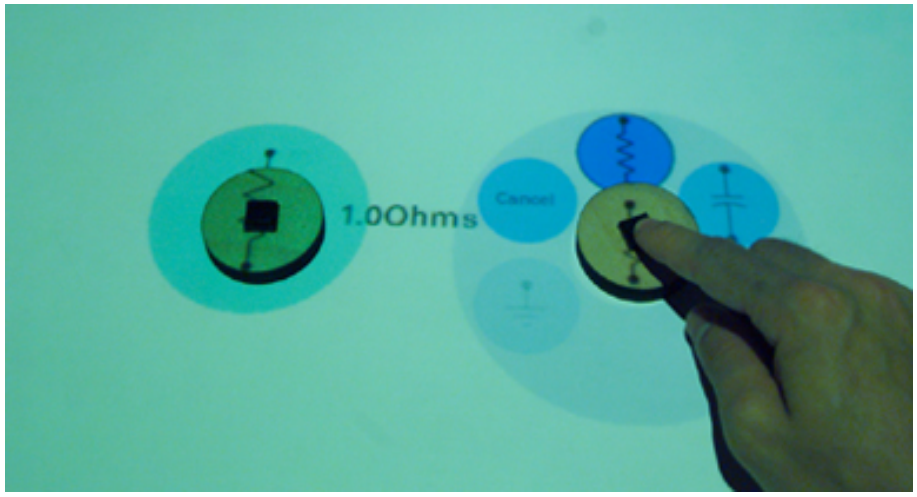
The principal is to create a virtual circuit with real-time dynamic physics solutions.

Serves as a empirical application, both analyzing quantities and qualitative information.

Does not expand upon the theoretical base for the "experiments".

Requires specialist equipment.





Issues with existing systems

Developed for presentation or working solutions. Not developed for the understanding of what the equations mean.

Mental platform required to “script” the equations to form a solution.

Focus is either on the graphical creation of the type or manipulation of the concepts involved in the type.

CircuiTUI and similar systems usually rely on solving physical problems. The analytical description of the solution they are forming is often not displayed.

Why type?

Mathematics is the cornerstone of analytical sciences. But an equation can solve a problem without describing it. It's the written maths that is important, but this does not directly illuminate concepts in a way that is easy to comprehend.

The basis of analytical sciences is to produce mathematical phrases to describe and postulate further from empirical results. The mathematics is inherently linked to this empirical relationship.

The mathematics of the applied sciences will always have a visual analog in the physical world. The visual analog is often easier to understand.

Project Goals

The mathematical description of science describes actions in the physical world. For instance, the equations of motion describe a physical movement.

By portraying equations in a way that visually links them to the action they describe, it will help users appreciate the mathematics behind these concepts. This appreciation can be achieved without the need to learn the mathematical structure behind them.

Using gesture to develop a kinematic relationship to the principals behind the equations with the aim of furthering users knowledge. This is suited best to an immersive environment.

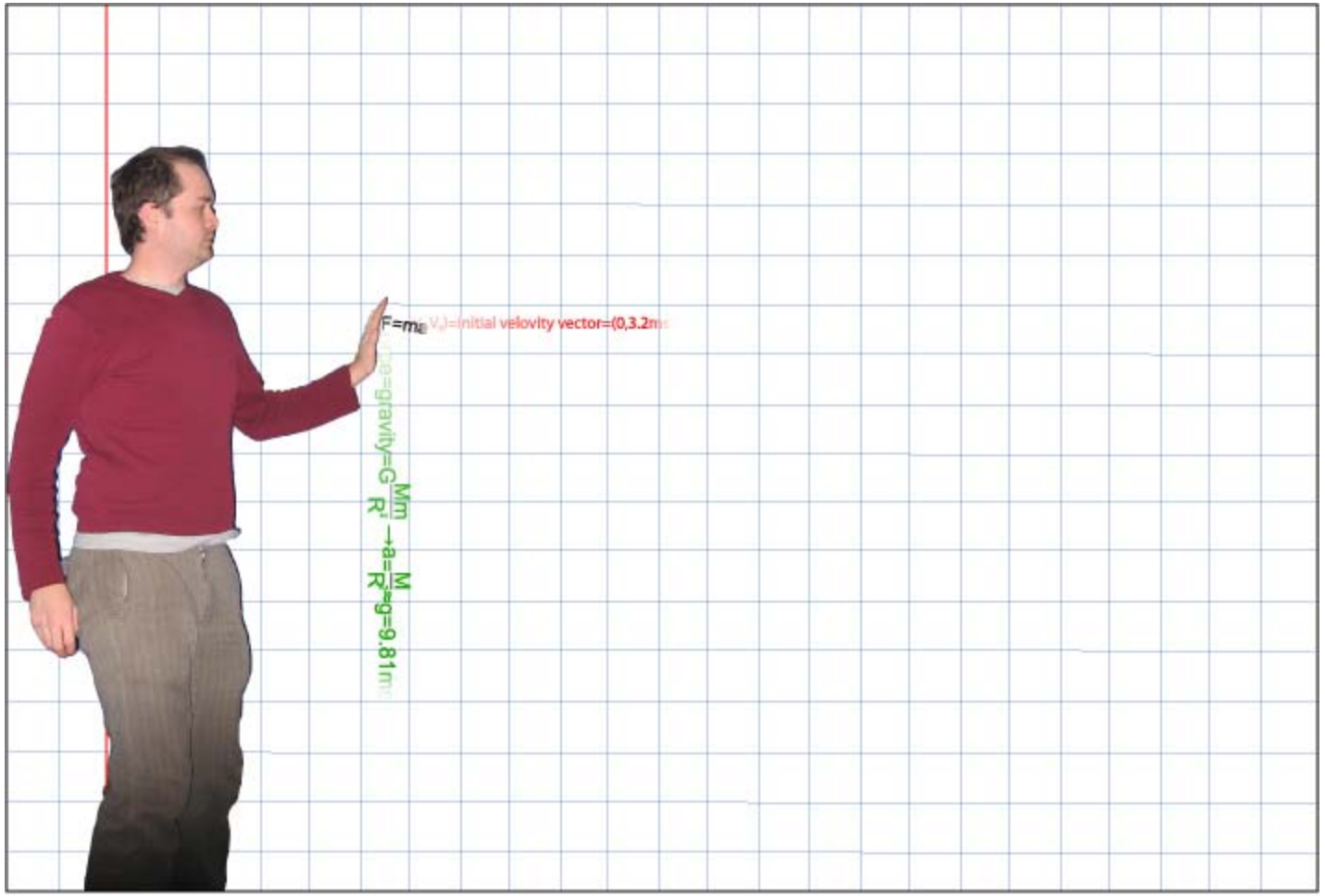
Project Description

Screen based interactive experience – draws the users into a dialog with the program.

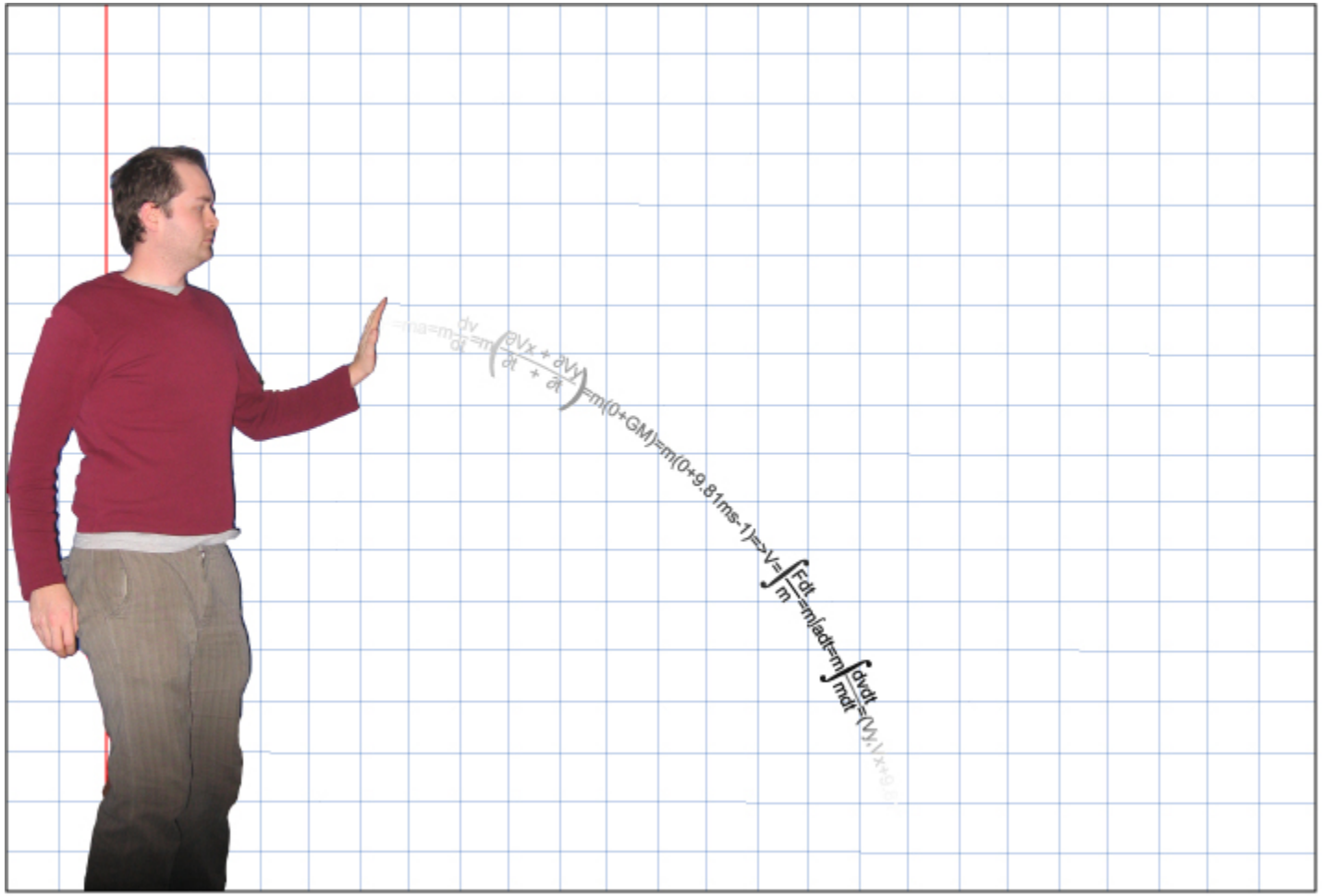
Exploration of physics at the quantum, classical and relativistic levels. Physical objects portrayed as dynamic equations.

Demonstration to allow the user to try and gain a knowledge of the way that maths can be visualized with a focus on the physical sciences.

Project Study



Project Study



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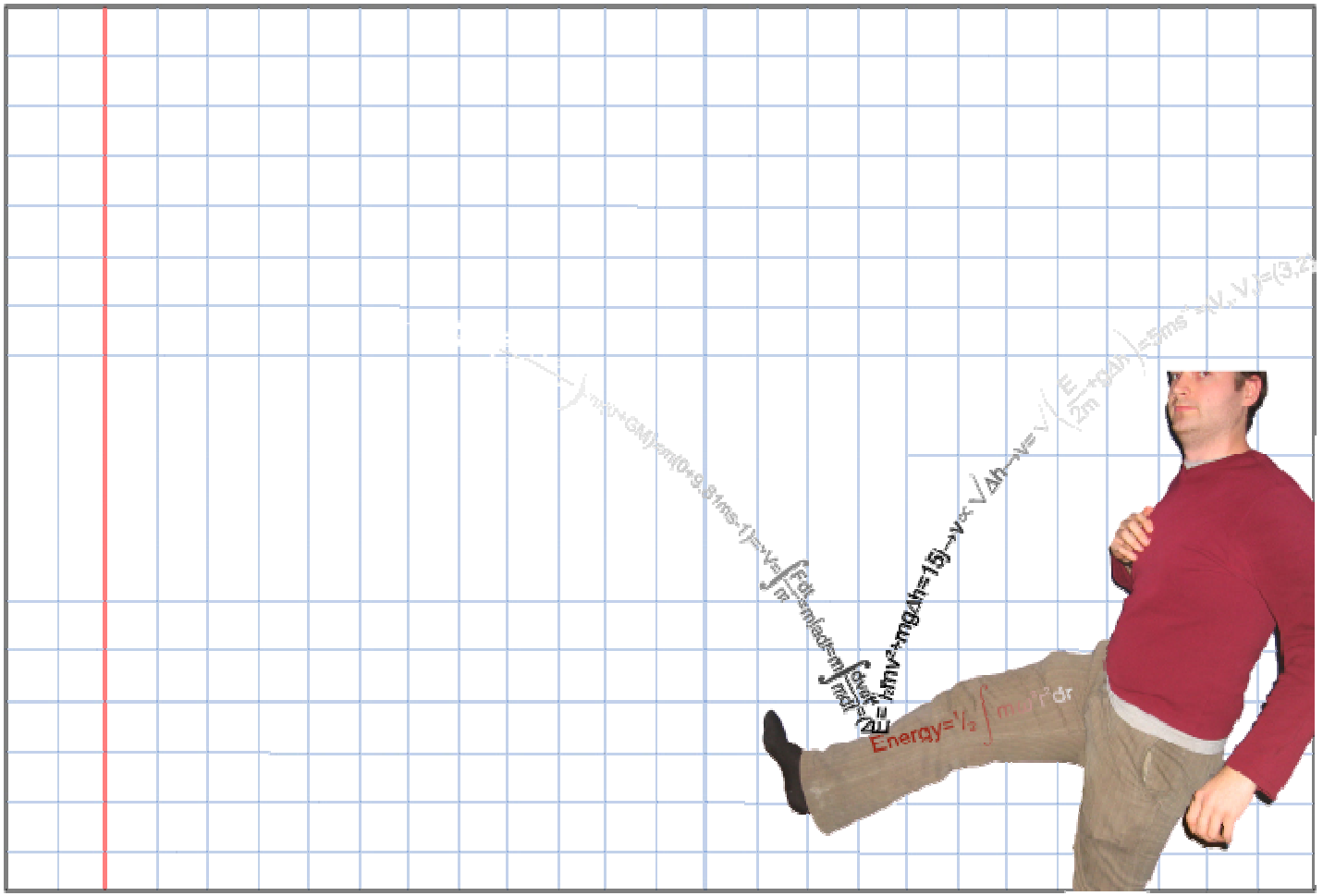
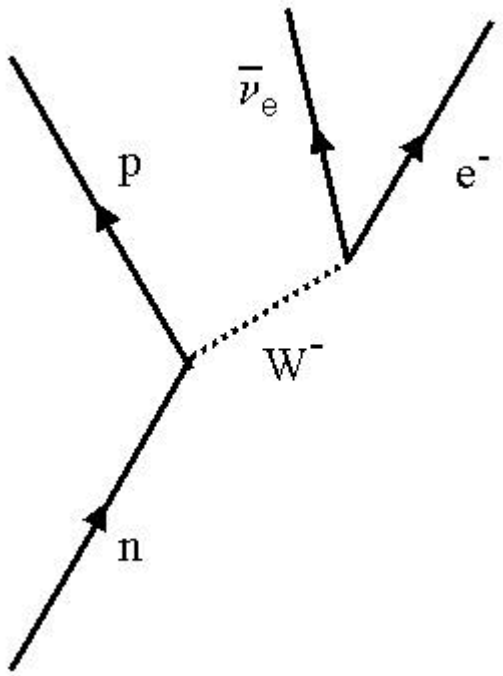


Richard Feynman – Introductory lectures on Physics

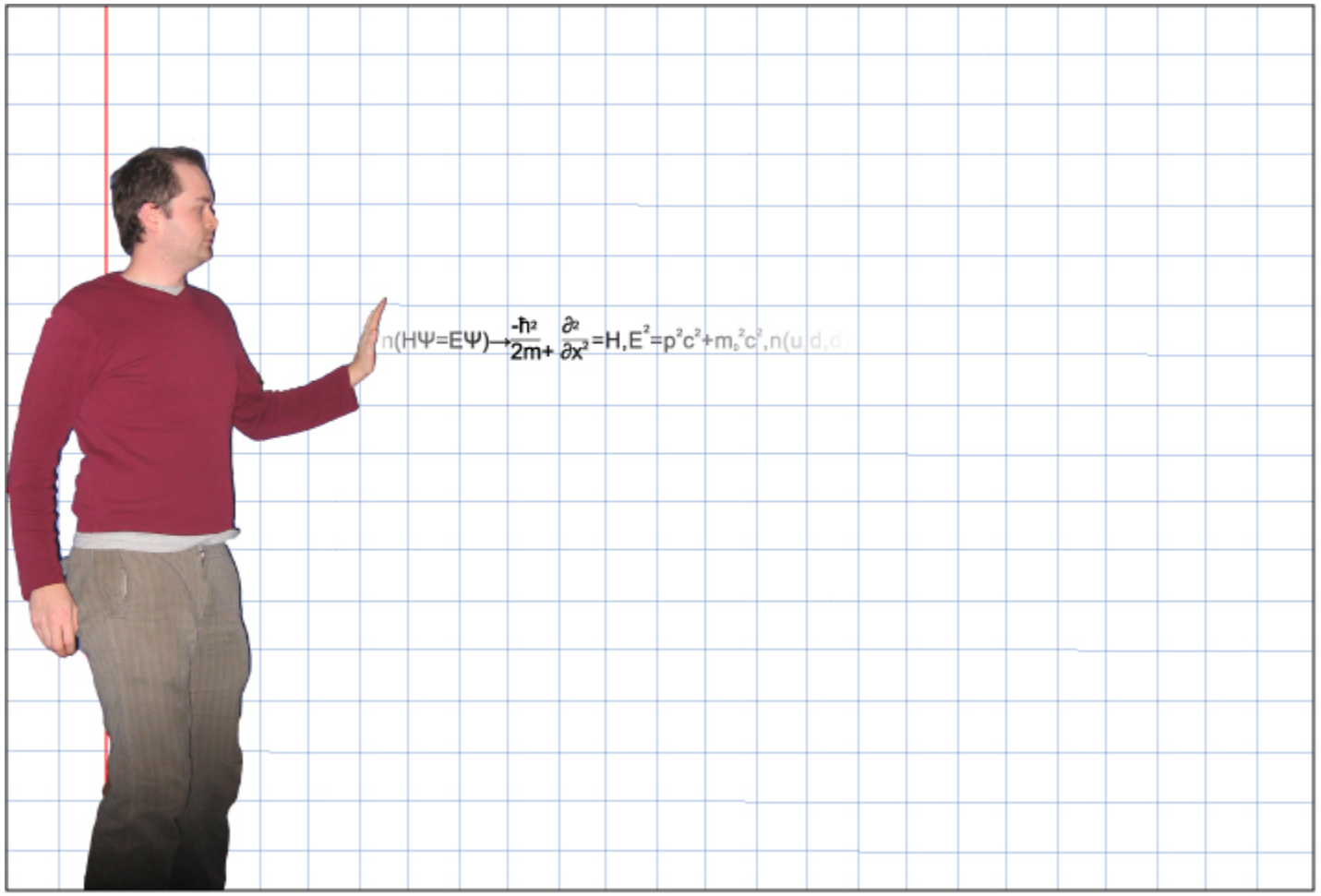
Quantum strangeness. There is no parallel from this level to the realm that we live in and therefore the only accurate description can come from an analytical solution (i.e. a mathematically explicit solution).



Feynman Diagram

Beta Decay Through Weak Interaction
Source: ESPACE

Project Study



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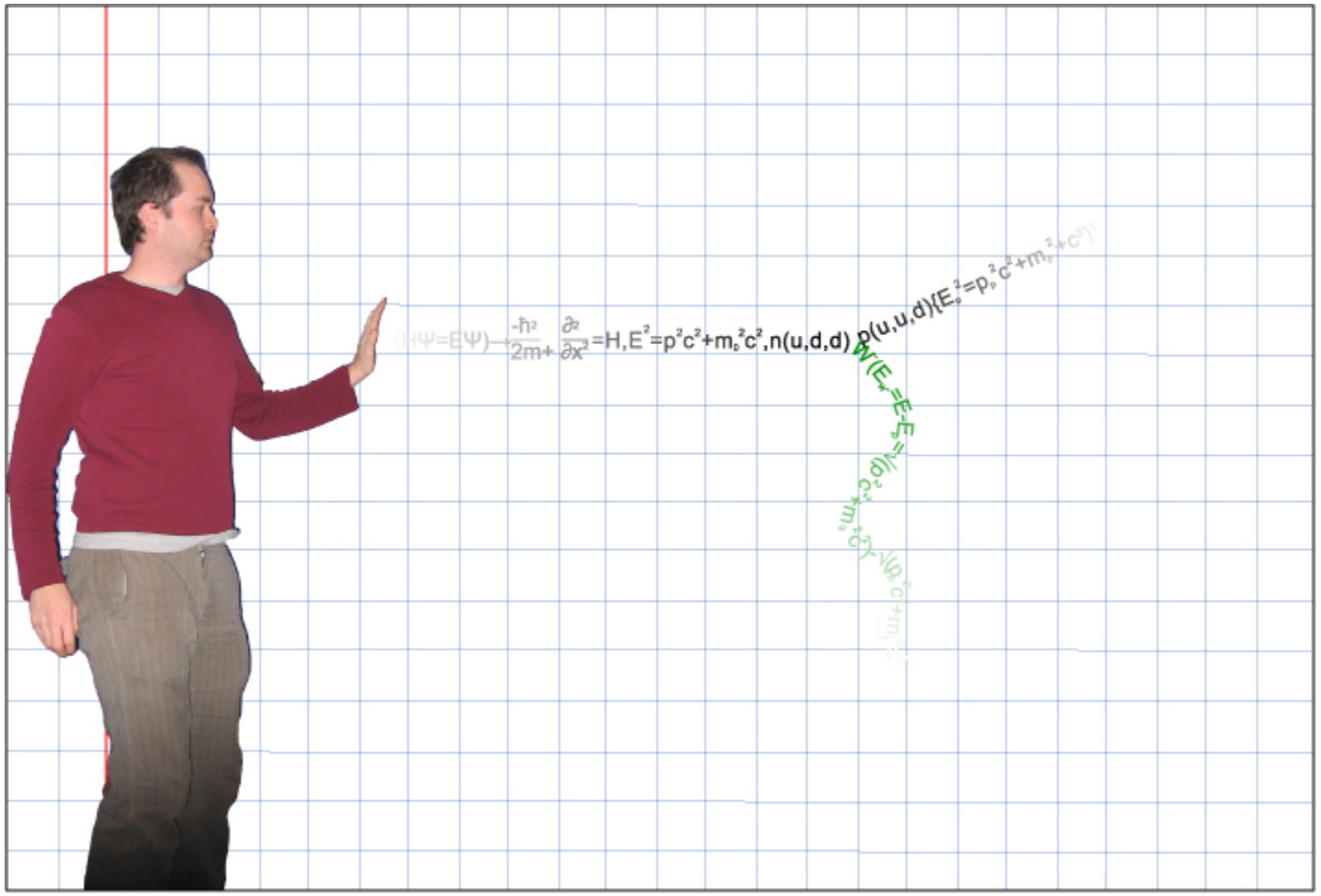

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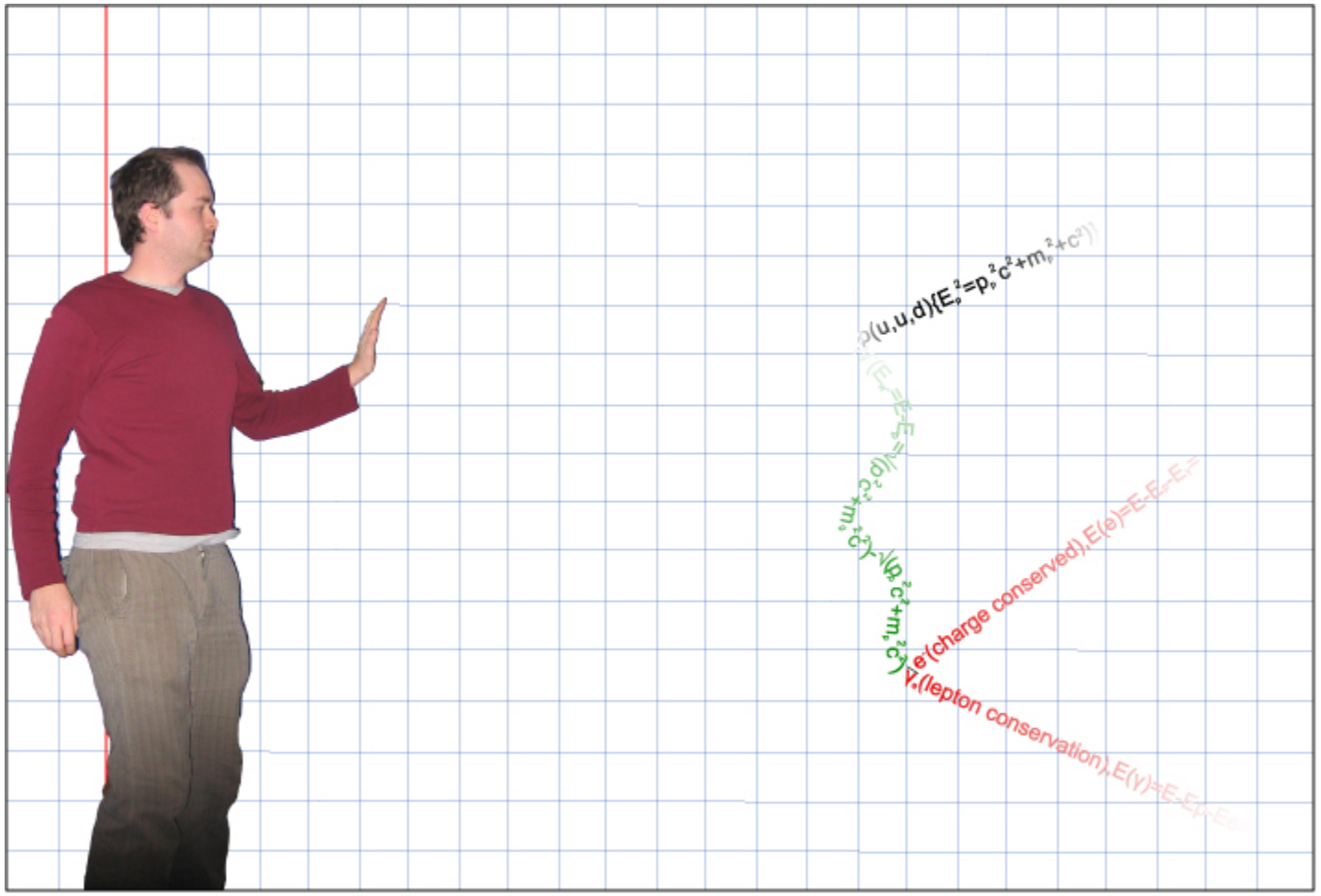


Technical Issues

Developed for the Java or Processing environments – transferability and ease of coding.

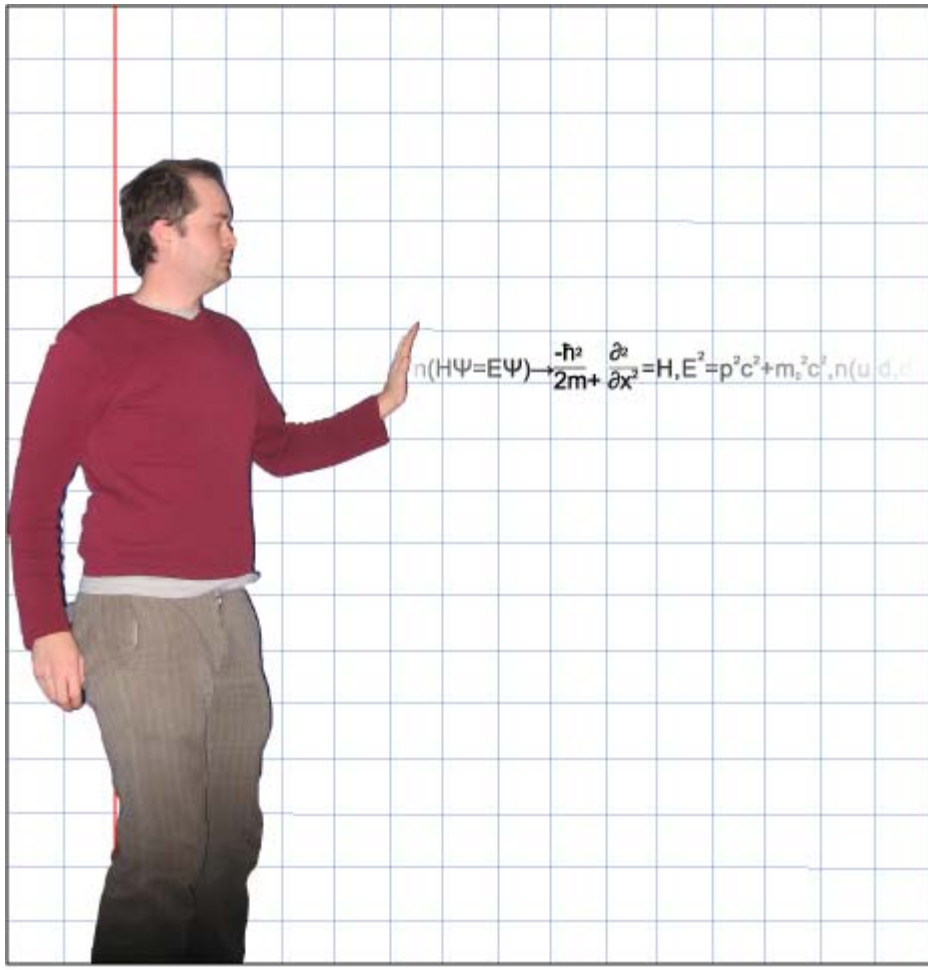
-Motion capture

-Motion interpretation/edge detection

-Screen display/output to file

-Typography

-Environment Physics



Technical Issues

Open source solutions available for imaging and edge detection on the java/windows platform

-Processing (MIT & Open source community) *Imaging and edge detection (metaballs technology available in java and processing based versions by V3ga)*

-Java (Sun) Imaging, could custom build moving object recognition

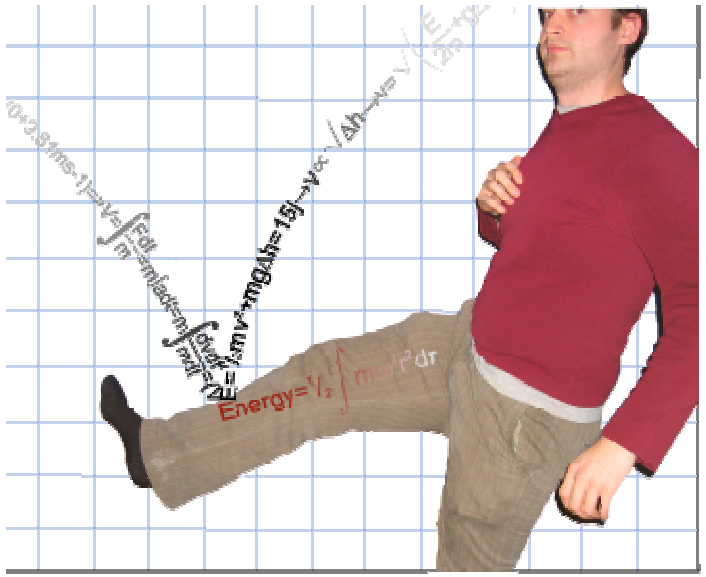
-WebcamXtra – Myron (Josh Nimoy *et al*) *plug in for director, lingo, java, processing etc with a focus on motion detection, colour tracking, glob detection and glob distinction.*

Technical Issues

-Type and it's relationship to environment physics coded by me.

-Will use real-time physics solutions, not pre-determined path following. Will calculate a dynamic path and animate type on it. Path related to physical solution.

-User can influence the equation in motion.



Research Methodology

Background research and evaluation of exiting technologies, the use of maths in learning and aesthetic appearance of maths and its relationship to understanding.

Project – working prototype demonstrating some aspects of the physical sciences. This will include user testing with prototype.

Scope for further continuation: full testing of pedagogical aspects, expansion to include a full cannon of the physical analytical sciences.

Project and Thesis Deliverables

Project: Instillation piece comprising of a reusable core of a typographic engine responsive to gestural input.

Thesis: discussing the context and presentation of the work. This will include a discussion of the impact of the way that maths is presented as a “non-visual” subject while this project aims to show that there are alternative presentations possible highlighting the visual aspects these points.

Questions and Answers