(Un)folding Events

Jacky Myint
MFA Design and Technology
Parsons School of Design
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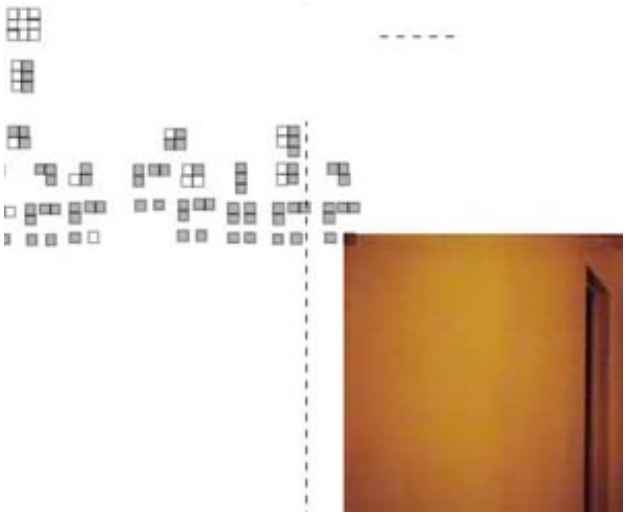
Thesis Professors: Golan Levin, Dave Kanter
Thesis Advisor: Ted Byfield



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E-Mail: jmyint@parsons.edu

Abstract

This thesis project is an exploration of the concept of the event through the material form of a folding structure whose folding enacts a path down a non-linear, branching narrative. The folding presents itself as a metaphor for a non-discrete choice at a point leading to many possibilities of the branching narrative. This exploration of the event through folding is in reaction to a phrase used frequently in U.S. media "as the events unfold" existing as, but not solely as, linguistic play. The challenges to realize this materialization of the concept of the event are discussed, along with a description and evaluation of the final form of this materialization. These challenges include conceptual and technological concerns, since the structure employs physical computing technology to enable the exploration of the event.

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1. Introduction

1.1 Motivation

"I can't believe this happened." This statement or one similar to it was uttered frequently by distressed and mournful people throughout New York City and the whole nation on the day of and many days following September 11, 2001. Many could not fathom how the catastrophe of September 11 could have occurred. It seemed to them to come out of nowhere, appearing in the sky in an instant. It incited questions of how an event like this and even others of similar implications could occur. It seemed to have been conceived whole, borne upon the world the moment it occurred.

The phrase "as the events unfold" heard among the news channels and newspapers to describe the events surrounding September 11, when analyzed, suggests an event as not having been conceived whole but instead as having and occurring in a process. As a phrase that is part of the current vocabulary of modern society, "as the events unfold..." is usually used to describe events of some magnitude that are happening in the world. But like many words or phrases commonly used in a society, its meaning is taken at face value; it has become a simplification or abstraction of the meaning of original conception. The intent of this project is not to discover so much the origination of this phrase but to exist as a response to this phrase, as an exploration of the event as existing in a process and system, in an attempt to obtain a better understanding of the concept of the event.

The cognizance of "as the events unfold" in the general public is due to its pervasive use in the media. It is the precursor to further description and reportage of events in news sources ranging from CNN, The New York Times to the local newspaper. It is the foreshadowing or presage that more related events are to occur. When one looks beyond this aspect of linguistic accessory, one realizes that the phrase subsumes events as being at the cusp of change, as

Figure 1. The event of September 11 receives a "Day of Terror" logo and catchphrase. (www.wbrc.com/images/daterror.jpg)

occurring in the present with a past and a soon-to-come future. Its past and future determine the very form of the change, the event. Yet, in the news media, the event becomes a narrative packaged for the public's consumption, static and linear as presented on screen and in print.

An event receives its own logo and catchphrase. September 11 became known as "The Day of Terror" with a logo that was some variation on the combination of the Twin Towers, the American Flag, planes, and targeting crosshairs. But, what is the heart of the phrase, "as the events unfold," the event, exists beyond this media packaging, beyond the role of news media's content and story.

This static narrative packaged by the media of an event is a persona that is often the only experience of the event that members of society acknowledge. The event has become linked to the news media as if the news presentation of the event is inherent to its existence as an event, as if an event cannot be an event until presented in the media. Yet an event can range from large, news worthy, ground breaking, thrilling, political, historical, social, cultural occurrence to small, personal, or everyday occurrence.

No one would deny that September 11 was an event, perhaps even the event of all events in recent history. The images, video footage, interviews, news updates, logos, catchphrases seen on TV are forever etched in our minds, so much so, that it seems an event can only be as life-changing and as media-saturated to become part of the collective consciousness. But at the moment this, this monumental event was impacting the world, each person was in the midst of her own events. "We were standing, half-way home from the day job and momentarily distracted by a good-looking parking cop, when it happened. It happened" (Wipond 20). The large event became part of these everyday events, whether merely interrupting them or changing them forever. And yet, when an occurrence as shocking and as large as this one happens, it is the everyday events that are reference.

They are part of the framework upon which the more noteworthy and moving events occur. They are perhaps even a comfort or a pattern of normality. It is this very comfort and normality that makes these everyday events invisible to one's attention. They lack the drama, intrigue, notoriety, and presence usually associated with an "event."

An event is an event even if no one sees it on TV. In a society where events are not realized without the accompanying media persona, can the true nature of the event be understood or discovered, if even such a thing as "the true nature" exists?

1.2. Intention

It is the "unfold" part of the phrase that is my starting point for discovery. For even though the phrase is used for the beginnings of a linear, static narrative, the unfolding and thus requisite folding reveals a more complex nature of events: the event existing in a process, in iterations of change. It is exactly the revealing and hiding due to external and internal factors that may give insight into the event. Thus, this thesis project takes the form of a physical folding structure whose folding represents choices down a path of a non-linear, branching narrative. The structure is a materialization of the abstract concept of the event, one whose change of state, the enacting of event, requires the exploration and interaction of participants. Rather than focus the narrative of the event on the kind of the event that is the arena of news media, the focus is on the other end of the spectrum, on the personal, small, everyday.

The folding through the narrative of the everyday event is a metaphor for non-discrete choices down a path of the branching narrative. Thus, the folding structure exists as a system of possible events where each fold is a progression down a certain possibility of an event. In its nascent form, the folding structure can be seen as a landscape of events,

one in which an event arises from the coordination of a progression of folds, where the event takes form from the folds made in the past and the possible folds that can be made in the future. Thus, each fold is a node of simultaneous possibilities, a choice of which parallel universe to enter into. The fold is an attempt to offer the experience of the event that is not linear, discrete, and purely sequential, in opposition to the one usually experienced through media subjugation.

The possibilities that the fold presents consist of everyday events in an attempt to explore the event stripped down, extracted from any media jacket of images and connotations. Traditionally, simplification of a system through a structure or model is done to comprehend the principles of the system so that those principles can be applied to a more complex scenario or to another system. It is thus the folding through everyday events in a branching narrative that I hope will offer participants the seeds of comprehension of an event, both small and large, to show that an event is not conceived whole but in a process, becoming one out of many possibilities.

The folding in the structure is actualized through the use of physical computing technology with the folding as analog input for digital presentation of the visuals representing everyday occurrences.

It is my hope that this project will be an exploration of "as the events unfold" as linguistic connector or clue to what makes an event in modern society.

1.3. Overview of the Thesis

The subsequent parts of the paper discuss the process by which the project took form, from the research of past, related works and past theories of events to the practical workings toward the material and technological

manifestations of the project. These parts are comprised of four chapters.

Chapter 2, *Theory and Rationale*, discusses the existing range of theory, aesthetic investigation, and interactive investigation that have come to form this thesis project. The influences of the project are admittedly far-reaching; the project is not a purely original conception. It began with an interest that became almost an obsession driven by a simple paper structure that was an exercise of thought for my first Parsons project. But it was not borne upon the world the moment I conceived of it. The references that are drawn and learned from can be divided into those informing the concept and theory of the project and those informing the form and actualization of the project. The concept and theory are driven by French theory of the event and the connection between the event and the fold. It is also driven by the Fluxus Movement whose theory involves the event as stripped-down, performative unit of experience. The form and actualization of the project are driven by: the work of the Tangible Media Lab at MIT as an example of physical interactivity with digital information, the work of conceptual artist and sculptor, Carl Andre, as an example of aesthetic focus on form and form as place, and the work of avant-garde filmmaker Dziga Vertov as an example of non-linear narrative. The *Theory and Rationale* section concludes with a statement of the goals that each of these influences establish for the project. These culminate in a project that seeks to be an interactive physical folding structure that explores the event through a non-linear narrative of small, everyday occurrences, using the fold as the means of progression through the narrative. It seeks to be materialization of a space and form where an event can be experienced.

Chapter 3, *Design and Implementation*, discusses how the project took form materially, technically, and logically. The section first discusses the iterations of prototypes that were made to discover the correct materials and design of the project. The final materials and form are subsequently laid

out. The section then discusses the mapping of the possible folds and sequences that are possible from the structure. The sensors, circuit, and programming that enable the structure to determine the fold and sequencing of folds are then explained. Each technological component had to undergo a process of trial and error. Subsequently, the installation set-up in which the project is ideally situated is explained. Finally, the challenges faced in determining what kind of event is experienced are discussed, leading to the final decision of everyday events.

Chapter 4, *Evaluation*, discusses the success with which the project in its design and implementation meets the goals set forth in Theory and Rationale. The section first summarizes these goals and then analyzes the project for its successes and failures in carrying these goals out.

Chapter 5, *Conclusion*, discusses what has been learned from this project and its possible future directions.

The four chapters are followed by a technical appendix that contains additional circuit diagrams and the actual code used in programming the project. The appendix is followed by the bibliography, list of figures, and acknowledgments for the creation of this project.

2. Theory and Rationale

The foundations of this project consist of: a personal interest sparked during the first semester of my first year at the MFADT program, various theories of the event as explored by philosophers and artistic movements, interactivity as established by works of tangible interfaces, non-linear narrative techniques as informed by avant-garde cinematic traditions, and aesthetic investigations of material and form produced by past artists. Each of these components establishes goals that inform and drive my project, ranging from personal to aesthetic to technological. The project attempts to answer these goals as a product of the synthesis of these goals.

2.1. The Spark

Figure 2. The simple folding structure made of cut-up postcards and tracing paper that became the catalyst for this thesis project.

The personal interest that was sparked during my first major studio involved a rudimentary paper folding structure used to exemplify the connections made possible by "folding in" or narrowing down information. This paper folding structure was meant to act as a model for me to understand the interactions of making connections between different pieces

Figures 3 (above) and 4 (below). These iterations of the Flash interface were based on the simple folding structure. The interface attempted to exemplify the connections made between the pieces of text

of information and making subsequent patterns of connections. These interactions eventually culminated in an onscreen multimedia environment. Although the model served only as an exercise to think through an interface of connections, the actual onscreen environment with its Flash interaction and eventual database interaction still fell short of the simple model composed of cut-up postcards and tracing paper. The limitations of the onscreen environment included the inability to express the complexity of making these connections and to show that there was more to the process of making another connection, whether the interface was an attempt at a new interface of searching the Internet or a sort of literary engine of words that are used within different contexts. The primary goal of the iterations of the Flash interface was to show the patterns of connections made by manipulating the placement of information through representational box form, text, and representational line form. Yet I was dogged by the possibility of the simple paper structure. I became interested in how the physical form could be simultaneously visual, conceptual, and procedural in representation through its very structure. Thus the interest followed me into the conception of this thesis project.

The spark became the catalyst for the project when I was able to let go of the idea of the connections being literally informational. The physical interface did not fit with this reason of interaction. It did not feel inherent to the form of the interface. The challenge was to discover the reason of interaction that was nascent to the form of the folding structure and not one that was forced. I realized that I was interested in the interface whose focus was on process rather on outcome or search results. It was the beginning of my thesis year that saw the occurrence of September 11 and saw the subsequent inception of the folding structure as exploration of the concept of the event in reaction to "as the events unfold" and the questions of how such events could occur.

2.2. Theory of the Event

To begin my own exploration of the concept of the event, it was necessary to conduct an investigation into past attempts to understand the event and into the differing views of the concept of the event. The investigation led to predominantly French theoreticians and philosophers whose ultimate conclusions found a connection between the event and the materialization of forms such as the fold. It also led to the Fluxus movement which saw the event as a "form" in itself and as a unit of temporality (Blom 67). Both point to the concept of event as not purely definable or predictable but rather experiential and indeterminate. But the occurrence of an event is also not arbitrary. What can be defined is the event-space, the situations by which an event can arise, the states in between what constitutes the event. As a result of my muddling through the sometimes dense theory of French theorists, the theory is organized and perhaps simplified into these parts: the event, conditions of the event, modeling of the event, and the event in context. Following these parts is a discussion of the Fluxus movement which looks to examine events out of context so that "one is finally capable of seeing events as events" (Blom 67). These perspectives of the event do not contradict but rather inform each other in this project.

2.2.1. French Historicism and Post-structuralist Theory

2.2.1.1. The Event

The perpetual question that bogs the mind of many the philosopher is "what is an event"? What can be said is that event is concept and actualization. Its presence is felt through its physical aftereffects. This is how an event is very real to people and yet at the same time very abstract. Jean-Louis Lyotard, a postmodernist philosopher, saw events as "all-important paradoxes, occurrences which we cannot think

adequately" (Williams 22). They are what occur to us and affect us in our life, but their reasoning and expression is beyond the capabilities of our language and thus cuts short our ability to think about them (Williams 22). For Lyotard, the event is held almost in a realm beyond, with connotations of transcendence and the sublime. It can be described by its effects on the physical self, how it can change the body, how it can "shake the body in its own quasi-understanding, as in emotion, rendering it out of touch with itself and other things" (Williams 43). The body, the senses, emotions maintain the closest recognition of an event because they are able to "attend to the immediate presentation of the event, the occurrence" (Williams 21). Because the nature of the event, itself, is so abstract, Lyotard reasons that the event becomes instead a sign, something people can only name and recognize. The sign is the representation of the event, which itself is the representation of the system that the event exists within. In this case, the energy that flows through the system is desire. It is when various desires meet that events, which Lyotard refers to as “intensities”, occur. They are the points of meeting of different, opposed drives and forces with events occurring at the impact of collisions, intensities from the joining of these incompatible desires, forces, and feelings (Williams 95). This energy is similar to sexual energy and thus is very unstable and verges on the unpredictable (Williams 40).

The difficult situation is that the unpredictability of events gives rise to figures and dispositions, or forms and set-ups, for further occurrences, but it is the collision of these conflicting figures and dispositions that determine where the event takes place. These dispositions or formed tendencies, for example the capitalist economy, the Church, or aberrant behavior patterns, may "attempt to control intensities in a specific situation, but they (also) claim to understand the proper way for all dispositions to exploit all feelings." It may be possible for one to influence the occurrence of intensities or events within a disposition, but according to Lyotard an exact prediction of which will emerge is not possible

(Williams 42). Lyotard speaks of events in terms of what can be represented and what cannot be represented. Although the validity of his arguments toward the impossibility of representing events and the resulting absence of ability to reason through an event is debatable, the significant aspect of his arguments is the construction of the concept of dispositions and event in a system where desires collide (Bennington 46).

The transcendent aspect of Lyotard's theory is the most uncertain part. Gilles Deleuze, another postmodern philosopher, criticized Lyotard for creating a theory in which:

> the concept of intensity is developed in terms of limit events, that is, in terms of a paradoxical passing of energy from beyond a limit defined as an event. Instead of putting forward a philosophy of immanence, where all events are immanent to a world consisting of different but connected planes, Lyotard is accused of constructing another means of transcendence. His philosophy is seen as replicating the religious dependence on the theatrical set-up, where the scene refers to another more real but lost world and where the source of all truth is and value is transcendent to the world in which the play develops. (Williams 130)

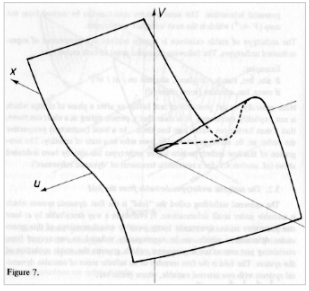


Figure 5. The event exists as an act, a movement, or a change. (Wildgen)

In place of Lyotard's realm of transcendence, Deleuze suggests with his theory that the event is inherent to the system. Its very form is tantamount to the system and its variables. In examining Leibniz, a Baroque philosopher, Deleuze finds that the event is neither an attribute nor quality but is an act, a movement, a change and not the state or description of the state itself. In language, the event is a verb, what Leibniz terms the predicate which rather than being an attribute is more a type a relation, "relations to existence and time" (Deleuze 52). In this way, " the world itself is the an event, and as incorporeal (= virtual) predicate, the world must be included in every subject as a basis from which each one extracts the manners that correspond to its point of view (aspects)" (Deleuze 53).

Deleuze himself asks the question, "What is an event?" and finds in examining Whitehead, a similar philosopher to Leibniz, that "an event does not just mean that a man has been run over. The Great Pyramid is an event, and its duration for a period of one hour, thirty minutes, five minutes, a passage of Nature, of God, or a view of God" (Deleuze 76). The system of the event in this case is chaos with the provision that a "screen" intervenes, filtering chaos, making something perceptible out of chaos. Because of its intrinsic connection to the screen, it can be said that chaos does not exist; it becomes an abstraction for the screen.

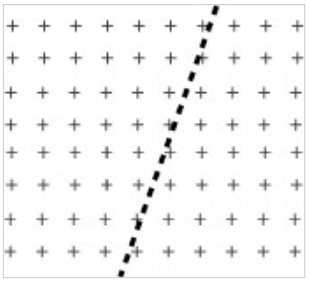


Figure 6. The event exists as a Singularity among the Multiplicity. (CHORA)

The event in this system is the singularity among the multiplicity, a One among a pure Many, an indefinite article from a disjunctive diversity. Events in relation to each other are a connected series of prehensions, "the 'datum' of another element that prehends it" (Deleuze 78). Everything apprehends that which has preceded it and that which occurs concurrently with it, and also in some sense the world. Thus this apprehension, this prehension, is public; it moves from that which is being prehended to that which is prehending. Information is passed from the world to the subject, from public to private. And yet the link or chain that occurs is one of the prehended having been a prehension and thus the prehension being a prehension of prehension. The event is the chain of these prehensions. "Each new prehension becomes a datum. It becomes public, but for other prehensions that objectify it; the event is inseparably the objectification of one prehension and the subjectification of another; it is at once public and private, potential and real, participating in the becoming of another event and the subject of its own becoming" (Deleuze 78). One can make the comparison that for Lyotard what is passed between events, how events "participate in the becoming of another event," is the dispositions and desires versus this concept of prehensions. But where Lyotard denies the ability to think about an event due to the representational shortcomings of language and art, Deleuze finds that "everything has a reason" including causations. "If an event is called what

happens to a thing, whether it undergoes the event or makes it happen, it can be said that sufficient reason is what includes the event as one of its predicates: the concept of the thing, or the notion" (Deleuze 41).

The reasoning of the causations of events perhaps takes some manifestation in a mathematical analysis. "The concept of event takes on its mathematical dimension: an event is any one of all possible occurrences, one of which must happen under stated conditions. According to the theory of probability, the likelihood of such an event happening can even be calculated" (Virilio ix). Similarly to Deleuze, Rene Thom, French mathematician and theoretician, denies that our world, our system, is chaos; "it is indisputable that our universe is not chaos. We perceive beings, objects, things to which we give names" (Thom 1). We are able to qualify these objects and to qualify their change over time. The system of events is similar to other systems in which change occurs. In fact it is these changes or rather the manifestations of these changes to which we refer to as an event. The system exists in states of equilibrium and disequilibrium, states of rest and change. "The event is nothing other than a disruption of the equilibrium on which it is based" (Nora 431). It is a change or a creation of a state of affairs, a change or creation of a stable state (Wildgen 10). Rene Thom's catastrophe theory attempts to categorize and qualify these changes in the system. Events can be described by dynamic primitives, or unfoldings, in the sense that in Thom's philosophy, "three-dimensional space is underlying all abstract forms" (Wildgen 9). The mathematics of catastrophe theory is thus based on topological analysis and is more a qualitative than quantitative science. But Thom was sure to prevent any misconceptions of his theory as a universal prediction of the change of forms.

> If the change of forms were to take place at all times and places according to a single well-defined pattern, the problem would be much easier; we could then set out, once and for all, the necessary order of the change of form (of system of forms) in the

> neighborhood of any point (e.g., as a graph or a table), and this would then be at least an algorithm giving a prediction of phenomena, if not an explanation...The fact that we have to consider more refined explanations-namely, those of science-to predict the change of phenomena shows that the determinism of the change of forms is not rigorous, and that the same local situation can give birth to apparently different outcomes under the influence of unknown or unobservable factors. (Thom 1-2)

The change of phenomena is classified depending on a set of internal variables and a set of external variables. The unfoldings include fold, cusp, swallowtail, butterfly, elliptic umbilic, hyperbolic umbilic, and parabolic umbilic. The fold is the simplest of the unfoldings, also known as catastrophes, having only one external parameter. Each of the subsequent catastrophes increases directly with the number of external variables.

Name	**Unfolding**
Fold	x^3 + ux
Cusp	x^4 + ux^2 + vx
Swallowtail	x^5 + ux^3 + vx^2 + wx
Butterfly	x^6 + tx^4 + ux^3 + vx^2 + wx
Elliptic umbilic	x^2y - y^3 + ux^2 + vy + wx
Hyperbolic umbilic	x^2y + y^3 + ux^2 + vy + wx
Parabolic umbilic	x^2y + y^4 + uy^2 + vx^2 + wy + tx

(Wildgen 8)

It is with these classifications that a change in form is systematically analyzed and the possible paths within the system can be obtained. The attempt is to calculate the probability of the change, of the event, but again not to deterministically predict the occurrence.

The consistency in the responses to the question "what is an event" involves the inability to discretely define an event. Rather, understanding the situation of an event within a system is the closest sort of definition. The situation involves the meeting of desires according to Lyotard, the act of meeting being inherent to the form of the system according to Deleuze, and the meeting of variables modeled in three-

dimensional space according to Thom. Thus, an event is a manifestation of the underlying processes that comprise the event. These processes are determined by the conditions of the system, and the exact process out of the possibilities that become an event is determined by the interaction of certain conditions. These conditions thus form the event-space where an event can emerge and begin to point to the possibilities of creating such a space.

2.2.1.2. Conditions of the Event

The classifications of the catastrophes in Rene Thom's theory are based upon the variables of the system: the external variables, those within the system influencing change, and the internal variables, those contained within the change itself. These variables are the conditions of the event. They are what affect the form and occurrence of the event, and as event concedes to event, each event is made a variable to the one occurring after it. In catastrophe theory, Thom speaks of variables called attractors which, in a simplified explanation, move the system toward a more stable state and thus attract the form of change.

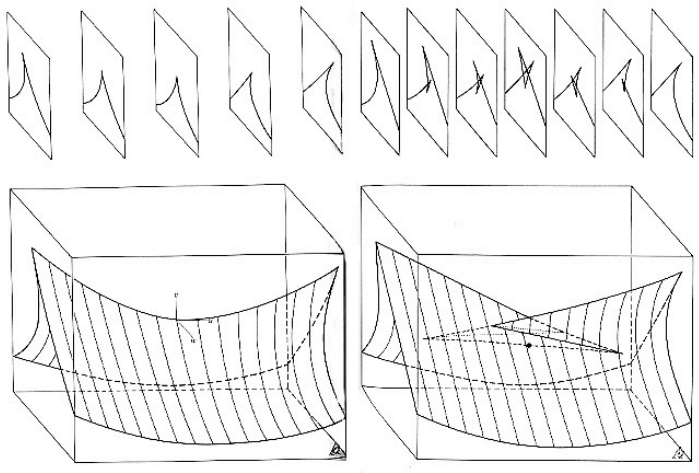


Figure 7. An infinite series of being and becoming have intrinsic properties, conditions inherent to the system of events. (Thom)

When Deleuze examines Whitehead in asking what an event is, he discusses Whitehead's four conditions of the event that

include extension, intrinsic properties, the individual, and ingressions. "Extension exists when one element is stretched over the following ones, such that it is a whole and the following element are its parts. Such a connection of whole-parts forms an infinite series that contains neither a final term nor a limit" (Deleuze 77). The event is the whole composed of variables, but at the same time, it is a part, a component of the event occurring after and perhaps even before it. The infinite series of being and becoming have intrinsic properties that are intensities, measurements of degree in the variable range. "If we call an element everything that has parts and is a part, but also what has intrinsic features, we say that the individual is a concrescence of elements. This is something other than a connection or a conjunction. It is, rather, a prehension: an element is the given, the 'datum' of another element that prehends it" (Deleuze 78). The event is formed by amassing together the related conditions of infinite series and intrinsic features, resulting in the prehensions that were discussed earlier. These prehensions are the method by which event becomes part and exists as a whole. It is the variable being transferred. The fourth condition that Whitehead defines is ingression. In this he is referring to eternal objects producing ingression, a means of entering, in the event. "Sometimes these can be Qualities, such as a color or a sound that qualifies a combination of prehensions; sometimes Figures, like the pyramid, that determine an extension; sometimes they are Things, like gold or marble, that cut through a matter" (Deleuze 79). These eternal objects are not eternal until they are apprehended in the event. These eternal objects may be similar to stable attractors of Thom's theory.

On the other hand, Lyotard was interested in the energy of the system in which events were the disturbances of highest energy, the intensities. The desires are akin to Whitehead's intrinsic properties in that they seem to be measured in degree and that they influence the outcome of the collision of desires. The greater the degree of opposition of these desires perhaps results in the larger event. Lyotard's dispositions

are similar to prehensions in that they exist between events, influencing possible events and the event to come. Both can be related to influencing the path of events in the system. With these complex interactions of variables, from an infinite series of whole-part forms to dispositions and schemas, the occurrence of events seems difficult to determine.

Again, it is not the occurrence of events that can be predicted with statistical accuracy or defined with precision, but it is the understanding that certain factors, variables, conditions, and desires create the opportunity for an event to occur. The interaction of these variables is complex and points to the inability of an event to be explored fully by language. Rather it points to a spatial reasoning, one that leads to the fold.

2.2.1.3. Modeling of the Event

"In those ambiguous or catastrophic situations where the evolution of phenomena seems ill determined, the observer will try to remove the indeterminacy and thus to predict the future by the use of local models" (Thom 2). Although the previously discussed theories begin to explain the concept of event, the value of their abstraction is also the reason behind the difficulty in really intellectualizing and understanding the processes of the event. As Thom states,

> But I am certain that the human mind would not be fully satisfied with a universe in which all phenomena were governed by a mathematical process that was coherent but totally abstract….In the situation where man is deprived of all possibility of intellectualization, that is, of interpreting geometrically a given process, either he will seek to create, despite everything, through suitable interpretations, an intuitive justification of the process, or he will sink into resigned incomprehension which habit will change to indifference. (Thom 5)

Thom attempted to create a dynamic model that would in essence aid in the interpreting of complex processes to prevent this indifference.

"The form of a dynamic model reflects its organization relative to time and space. Dynamic models are organizational form" (CHORA 128). Models are used to understand an unknown process in that "a known situation is projected onto an unknown situation and vice versa, a mental construct is projected via that which the hand knows how to make" (CHORA 110). The model removes from its context that which is modeled so that its underlying process can be better understood. What a model is able to do is "compensate for the renunciation of sensible dimensions by the acquisition of intelligible dimensions" (Levi-Strauss 24).

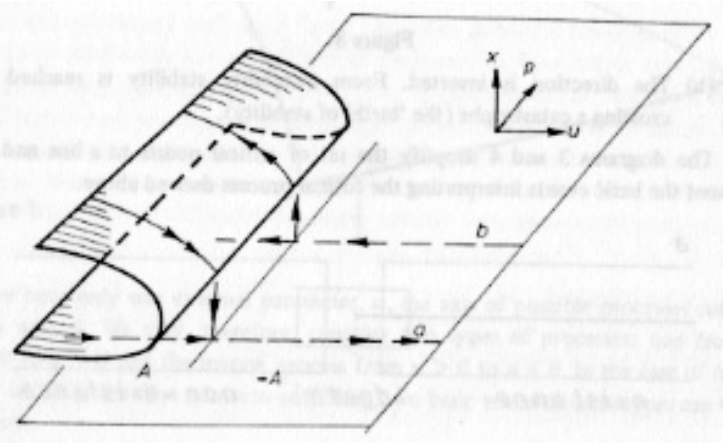


Figure 8. The fold is the simplest of Thom's unfoldings, existing simultaneously as boundary and continuous form. (Wildgen)

In Rene Thom's theory, the modeling is enacted through the unfoldings, or catastrophes, of which the fold is the simplest. The fold constitutes a borderline in which one moves from a stable state or toward it. Thus the fold is the change between "two states, which are fundamentally contradictory: stability (=existence) and instability (=nonexistence)" (Wildgen 42). Thus this modeling becomes about negation and duality. Deleuze's idea of the fold contains the duality of the unseen and seen and also the quality of enveloping. For Deleuze the fold is contrary to a linear narrative. "A fold is always folded

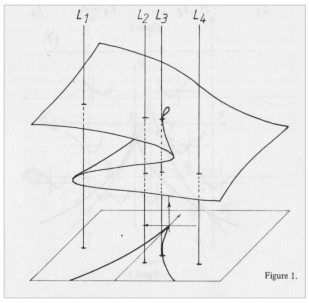


Figure 9. A fold is always folded within a fold, like a cavern in a cavern. (Wildgen)

within a fold, like a cavern in a cavern. The unit of matter, the smallest element of the labyrinth, is the fold, not the point which is never a part, but a simple extremity of the line.…Unfolding is thus not the contrary of folding but follows the fold up to the following fold" (Deleuze 20). The fold is the catastrophe of interest due to its ability to express the process of prehension between events and the forming of dispositions. Its continual enfolding is analogous to the whole-part interaction of the prehension, and the enfolding is analogous to Lyotard's dispositions. The fold also defies the linear narrative that is the usual context for an event. It is actually the narrative that best hides the event. "By coming to an end and organizing the temporality of events retroactively, narrative suggests that there could be a last sentence making some sense of all preceding sentences" (Bennington 160). It is perhaps the fold that is best fit to model the event. The fold is a simple enough gesture for the intellectualization and understanding of the process of the event and yet still models the complexity of the event. A model cannot fully capture the whole system but can capture an aspect whose understanding is mapped to the larger system.

2.2.1.4. The Event in context

The larger system that the model is framing is events in the context of our modern society. The context of this society is increasingly informed but also formed by the information networks of the society, i.e., the media. The media has transformed events into spectacles, scenes played immediately for public consumption. Yet the immediacy of the event gives the false impression that what is seen and heard from the media is the truth of the event. "Now, however, the intermediaries are cut out of the loop, a sort of telescoping of event and reportage takes place, and in the incandescence of multiple meanings we are blinded" (Hunt and Revel 433). The event is thus available to all, but it incurs different meaning.

> If there is no event without critical consciousness, then an event can exist only if it is available to all but not the same for everyone...A curious reciprocity therefore develops between a type of society and its event-ial existence. On the one hand, to the extent that information networks are social institutions, the succession of events define a society's surface. Conversely however, such events bring to the surface a large mass of emotions, habits routines, and representations inherited from the past. (Hunt and Revel 433)

An event is a rend in the social fabric in the system itself such that the underlying processes of a society are brought to light. "The information-event is precisely what allows you to understand the nature of the system's structure and function, that is, the 'feedback process' through which the information is integrated, as well as the resulting modification in the system" (Hunt and Revel 435). Because of the prominent nature of the media in society, understanding the event allows the understanding of the forces of society in which the event occurs and vice versa. The society of the event can be said to exist as an extension of events. The whole-part relationship extends itself to society and the event, and in doing establishes an infinite series of relationships.

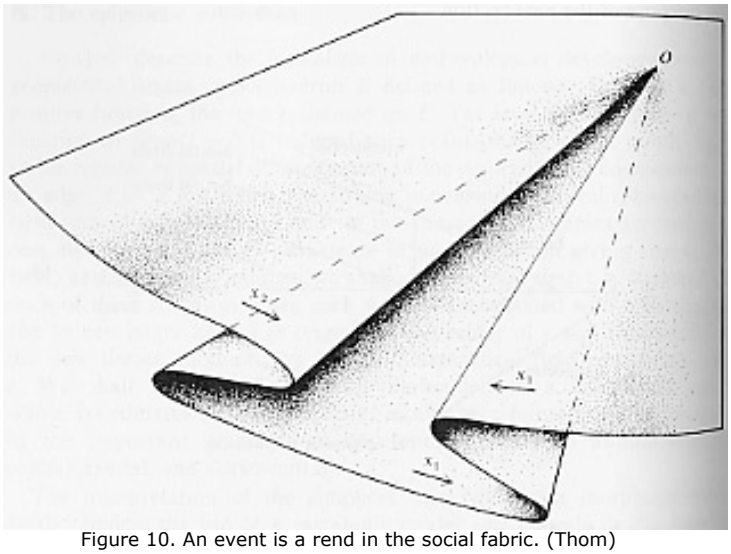


Figure 10. An event is a rend in the social fabric. (Thom)

2.2.1.5. Importance of Theory

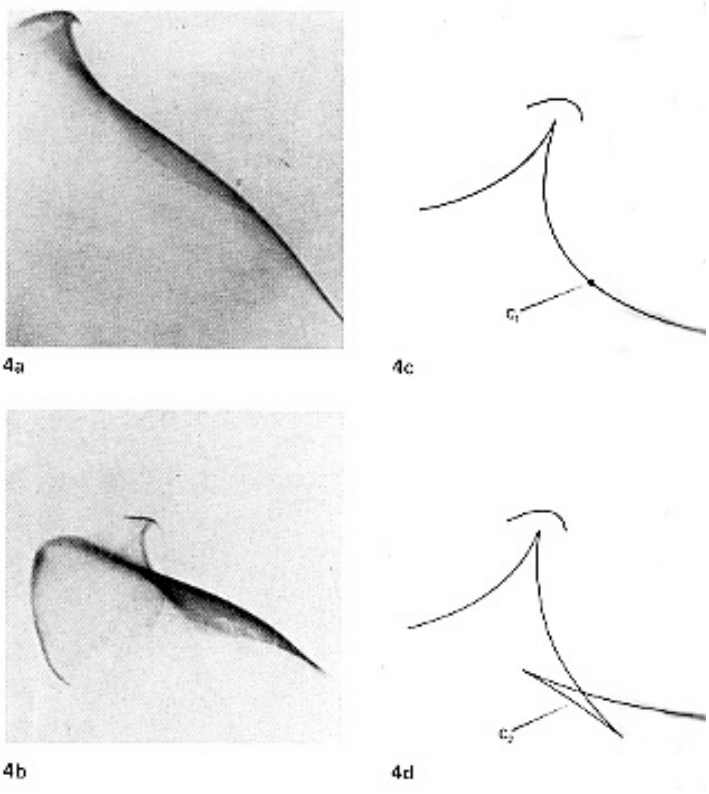


Figure 11. The fold is inherent to the form of the event-space. It extends over past folds to determine future folds. It, like the event, exists as whole-part. Past events and possible future events form the present event. (Thom)

"There is nothing arbitrary about the unfolding of an event, however indeterminate it might appear. It is not the occurrence of the event that matters but the prominence, the volume, the pace, the interconnections, the relation to other events, the sequellae, and the aftershocks" (Hunt and Revel 434). In understanding the event, the question does not focus on the prediction of an event. The knowledge of how is only important in the revealing of the interconnected patterns between events and of the process of creation of these patterns. In analyzing past theories, events are inherent to themselves in the sense that past events have become part of their form and possible future events define the limitations in form. Increasingly what must be done to obtain meaning is investment of the self in making decisions,

in determining one's desires. Thus, the importance of the theory is its pointing to the creation of the event-space, model, set-up that can realize the succession of forms of an event through the enacting of one's desire to reveal or to hide, to choose one part of the duality. This enacting is carried out by a form inherent to the model itself, the fold. The fold allows for both continuity and separability, both sameness and boundary where the duality is not strictly yes and no but interconnected (Blom 71). It is the fold through which the conditions of the space, of the system, interact and through which the event emerges.

2.2.2. The Fluxus Movement and the Event

Figure 12. The Fluxus Movement views the event as a "form" or unit of performative experience. (http://www.moca-lyon.org/Pages/actualite/Comment%20va%20ta%20vache%3F/brecht$.html)

The Fluxus Movement finds that the true nature of the event emerges or is discovered "at the level of super-boredom " where "one is, in other words, exposed to the workings of the Event" (Blom 67).

The Fluxus Movement is an artistic movement begun in the late 1950's whose works involve an emphasis on the way one approaches life and experiences. Thus, much emphasis in the work is on the idea of immersion, immersion of the self in the artwork such that the normal schemas that one has in viewing the world are changed. Much of the work is definedas intermedia or transmedia where media refers to the medial aspect of the artwork rather than the medium of the art itself. Rather, the medium of the artwork is the spaces between and the spaces outside of media or categories. It is in these spaces that the self becomes immersed.

The artwork becomes about "a performative" or "an agent of change or transcoding" (Blom 65). It is this emphasis on the work being only experienced when performed and enacted that my project takes clue from the works of the Fluxus movement. Additionally the emphasis on showing the spaces between media is similar to this project's intent to explore the spaces in between where the event takes place, between

what usually becomes collapsed to create the narrative of the event.

The artworks of Fluxus took much influence from the eastern religion of Zen, resulting in artworks that become "like little enlightenments" (Doris 97). George Brecht, a Fluxus artist, was the first to use the term 'event' to describe these 'little enlightenments'. One such artwork of Brecht's is *Three Telephone Events*.

Figure 13. The event occurs when an object is performed on. (www.l2l1.com/image/tel23.jpg

Three Telephone Events

- When the telephone rings, it is allowed to continue ringing, until it stops.
- When the telephone rings, the receiver is lifted, then replaced.
- When the telephone rings, it is answered.

Performance note: Each event comprises all occurrences within its duration. Spring, 1961.

This work of Brecht's is an example of an event score of the Fluxus Movement where the focus is on a singular simple phenomenon but is meant to explicate the multiplicity within the singularity. The multiplicity becomes the possibilities of occurrences within the duration of the performance that could perhaps exist as different perceptions of the same phenomenon (Doris 97). What was important to Brecht was to form a simple interaction with an object as a performance space for the performer to become immersed into the art. "The events themselves--elegant ephemeral monostructural gestures which may be performed before an audience, alone or in a group, or in the mind--and the objects which are revealed within their structures, unfold in a space to which words have limited access: this space is not the space of

language, nor of silence, but of being or rather becoming" (Doris 99). Similar to Lyotard's definition of an event as an experience that cannot be spoken of, the Fluxus event is an experience in a space of process of action or becoming rather than language. The Fluxus event points toward an event being understood by the interaction of the performer and the performance where the performance involves only simple phenomena.

It is the simple phenomena that bring the performer or participant to "the level of super-boredom" where "one is, in other words, exposed to the workings of the Event" (Blom 67). At this level, the intensities of the work or event are not contained within boundaries but are allowed to ebb and flow along with the participants' expectations of structure and the resulting experience of non-structure (Blom 65). The lack of structure demands for total immersion into the work such that boundaries between the work and participant are blurred. Full participation, even bored participation, allows for the workings of the event to be discovered.

Thus, as an event-space for the exploration and experience of an event, this project sets out to create an experience that involves the simple phenomena of everyday occurrences. Without the typical involvement of character and plot progression in the narrative of the event, the project demands from the participant that extra step of participation, that further attention to be able to create in their minds the construction of a narrative when one is not really presented. The project's intent is not to create an experience of super-boredom but to create an experience in which the simplicity, the banality of the occurrences that are presented give the opportunity to see events almost as pure, extracted from external variables. Furthermore, the work of Fluxus shows that this opportunity is only realized in performance, in participation, in a space that allows for the immersion.

2.2.3. Summary of Theory

In summary, the theory of both French theoreticians and Fluxus artists point to the event-space. The event-space becomes one where the defining of the event does not occur and the prediction of the occurrence of the event does not happen. What can be designed are the conditions of the space. How the conditions interact determines the event and is determined by the fold, a figure inherent to the simultaneous existence of possibilities that allow for progression through the choice to fold. Thus the conditions of the event-space involve desires (those of the participant), the choices (the past folds) that have already been made, and the possible choices (the future folds) left to make. The fold allows for the continuous existence of possible events within the event-space while allowing for the separateness for an event to emerge. In this project, the event-space can exist as a structure, as an object, because the object is being performed on. The interaction between object and participant allows for the creation of the event-space and the event. Having the event experienced as everyday occurrences magnifies the interaction, demanding further involvement from the participant and immersing the participant enough in the space so that an understanding of the workings of the event can begin to be perceived.

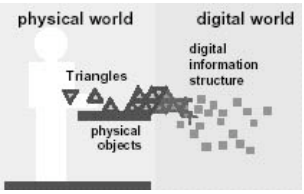


Figure 14. The projects of the Tangible Media Group at MIT, including the Triangles System, seek to connect the physical and digital worlds. (Gorbot, Ishi, and Orth)

2.3. Tangible Interactivity

Thus, for the folding structure of this project to exist as an event-space, it must also exist as a successful tangible interface to engage the participant. As this project involves the use of the computer to present the everyday occurrences, it is one of tangible interaction with, essentially, digital information. The work of the Tangible Media Group at MIT is at the forefront of creating systems of physical interaction with digital information, systems of human

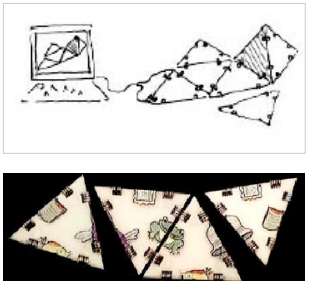
computer interaction (HCI). The Tangible Media Group terms these systems 'Tangible Bits'. One of the goals of the group that pertains to this thesis project is the "coupling of bits and atoms, seamless coupling of everyday graspable objects (e.g., cards, books, models) with the digital information that pertains to them" (Ishi and Ulmer 2). It is the Tangible Media Group's research and projects that inform this project's gauge of success in tangible interactivity.

Figure 15. The Triangles System is a tangible interface for digital information, existing as a physical embodiment of digital information topography. (Gorbot, Ishi, and Orth)

One of the group's projects that particularly informs this project in terms of tangible interactivity is Triangles: Tangible Interface for Manipulation and Exploration of Digital Information Topology (Gorbot, Orth, and Ishi 1). The similarities that can be drawn between this thesis project and the Triangles project are: the use of a system of physical tiles that "provide a physical embodiment of digital information topography…of the relationships and connections between data elements," an emphasis on physical interaction by grasping with one's hands, and the use of a system that purveys "persistent indicator of state" (Gorbot, Orth, and Ishi 1-2). But while comparisons are being made, the Triangles system is more generalized in its approach to interactivity, patterning its use for a range of applications, becoming more utilitarian in interface. The metaphor for the Triangles system is a building block; the system is a hybrid physical and digital construction kit where flat plastic, triangles become the unit of construction.

Figure 16. Flat, plastic triangles are the 'building blocks' of the Triangles system. (Gorbot, Ishi, and Orth)

The generality of structure was one of the group's goals in creating such a system; the group wanted the shape to be able to "represent any type of digital information without carrying the semantic weight often associated with everyday physical object" (Gorbot, Orth, and Ishi 3). While this project does not seek to reference any particular physical object, it does carry the semantic weight of the phrase "as the events unfold" and is particular to an exploration involved with that phrase. The goal of this project, in contrast to the group's, is to make the digital information particular to the form of the physical as discussed in the *Spark* section.



Figures 17 (above) and 18 (below). The Triangles system is a reaction to the limitations of the mouse. (Gorbot and Orth)

In the Triangles system, the method of organization, how one puts the set of triangles together, determines what one sees on the screen, what digital information is presented. Another point to make about the Triangles system is that this method of representation of digital architecture has the physical system still separate from the digital information being manipulated. The digital information is presented on a monitor screen and/or aurally through speakers. When information is presented on the triangle units themselves, it is static and permanent. The system is in reaction to the constraints of the mouse and the keyboard for computer GUI interaction. In this thesis project, the folding system is meant to be more cohesive in experience with the presentation of visuals as part of the physical structure itself.

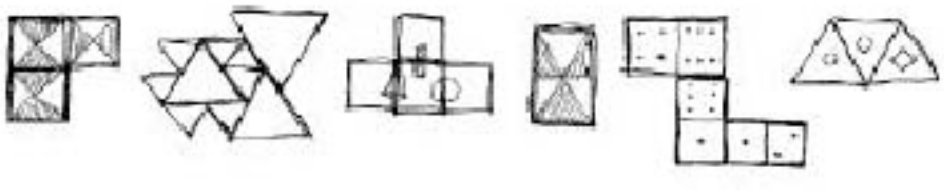


Figure 19. The Tangible Media Group conducted several investigations into geometrical forms before choosing the shape of the triangle. (Gorbot, Ishi, and Orth)

The Triangles system shows that methodical investigation and specific intent of form are required in a system that is both physical and digital. Before choosing the shape of triangles, the research group considered other basic

geometric shapes, such as squares, on the basis of the number of sides of connection. With a triangle, there are three sides of connection that allow for complex options of branching structures, one point of input and two points of output or vice-versa, and three-dimensional forms (Gorbot, Orth, and Ishi 3). Also, the group went through several iterations of prototypes to figure out the means of connection and of conveying the state of connection that fits the form of the system. The connectors that were considered include: conductive Velcro, snaps, slotted edges, and zippers. But the connectors had to be physical connectors as well as digital ones. So, the final connection became one of magnetic connectors that convey to each triangle's onboard microprocessor chip the identity of the triangle itself and the identity of the triangles connected to it. Each triangle was fitted with an onboard chip rather than the whole system using a sensing environment so that the modularity of the triangles could be maintained. The process for the Triangles system is very similar to this project's in that simultaneously physical design, technical electronic design, software programming, and conceptual design have to be considered.

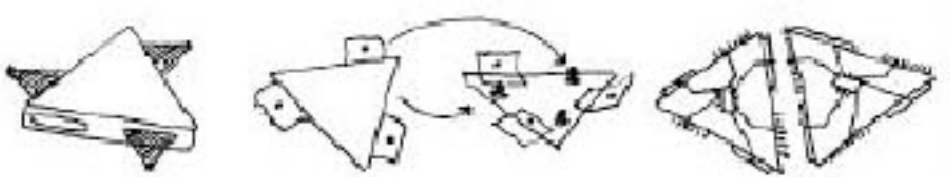


Figure 20. Several methods of connection for the triangles were investigated ranging from slotted edges, snaps, conductive Velcro, to zippers. (Gorbot, Ishi, and Orth)

This project is very much built upon the foundations of the Tangible Media Group, upon the goals of determining ease and reason in combining the physical and digital worlds. The principles of tangible interactivity set by the Tangible Media Group that inform my project include: physical form as representation of thought and reasoning, form as conducive to method of interaction, technical enabling of form that suits the form and interaction, and the focus of physical, technical,

and conceptual design on the tactile exploration of the form and content.

2.4. Aesthetic Investigation into Form

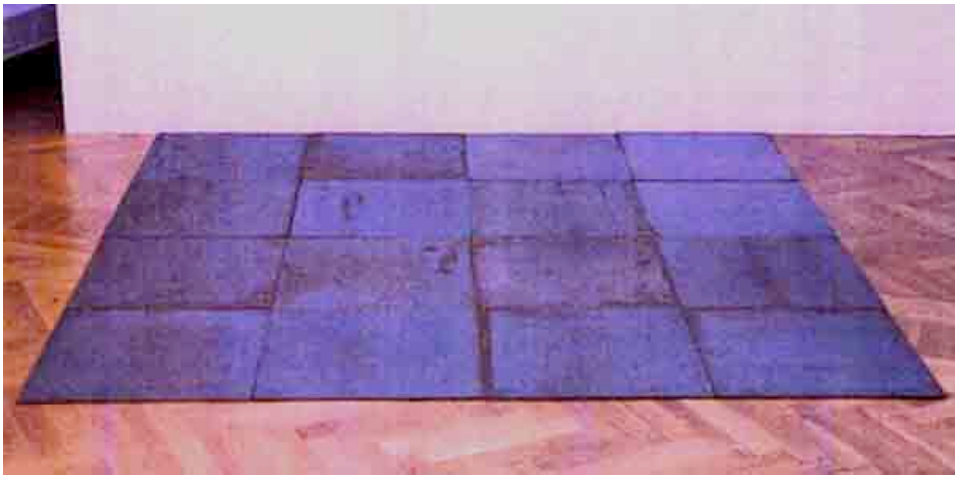
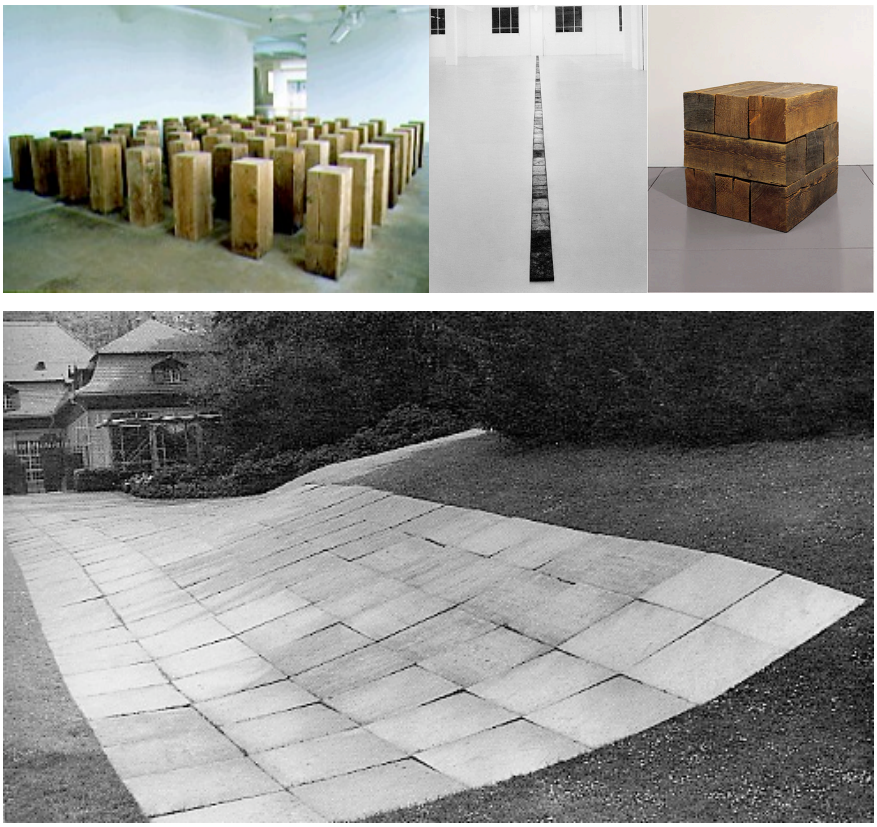


Figure 21. Carl Andre focuses on material, form, and arrangement of space in his sculptures. (http://www.modern-art.ch/english/andre.html)

What is literally at hand, the form and material of a structure, determine the sensory and experiential outcome of the work of Carl Andre, minimalist artist and sculptor of the 20th century. His emphasis on material, form, and arrangement in space in his sculptures inform this project in its aesthetics of form, attention to the inherent qualities of the material, and its use of iterative, identical tiles or panels. Andre's exploration of serial sequences of material result in modular units of material, usually stone, wood, or metal, arranged systematically and at regular intervals. These arrangements are an expression of Andre's desire to create sculpture as space rather than sculpture as purely object. The space that Andre creates has no fixed perspective; experience of the work changes depending on the perspective of the viewer. "One only comprehends the work during the process of perceiving it: 'My idea of a piece of sculpture is a road. That is a road doesn't reveal itself at any particular point or from any particular point.' (Carl Andre)" (http://www.modern-art.ch/english/andre.html).

Figure 22. Andre's sculptures are spaces with no fixed perspective; they are to Andre akin to a road. (Andre)

Similarly, in this project, the folding structure is an object but an object as space, event-space. When presented with the folding structure, standing before it at one of its sides, the user should not feel any constraints in interaction with the space; she should not feel bound to interact with the space at only one point. The experience and understanding of the work is made complete by interacting with it from multiple viewpoints. The kind of iterative form and placement that Andre and this project use accentuate the lack of starting point in the experience, contributing to the feeling of multiplicity of experience. As in the works of Fluxus, object can convey the feeling of a space because the object is involved in a process of performance, participation, and perception with the user.



Figures 23, 24, 25 (top row) and 26 (bottom). Andre sees his sculptures as spaces rather than objects. They become spaces of perception. (Andre)

"My art springs from my desire to have things in the world which would otherwise never be there. By nature, I am a materialist….It is exactly these impingements upon our sense of touch and so forth that I'm interested in" (http://www.modern-art.ch/english/andre.html). This quote reveals Carl Andre to be a conceptual materialist. It is his obsession with the inherent properties of a material to convey concept that becomes an influence for this project. Andre is concerned with the material properties of mass, space, volume, and gravity as parameters of the method of form and interaction of his sculptures. Physically, the fold is similarly a consequence of the material being folded. Paper folds differently from cloth. The fold is inherent to the form and material of the structure. Abstractly, the parameters of the fold are the conditions inherent to the system of the structure. As mentioned previously, these conditions consist of desires and which previous folds have been made. How the folds can be made and cannot be made become metaphors for the rules and limitations of the system of folding, the system of events.

As discussed with Deleuze and the fold, the event is formed by amassing together the related conditions of infinite series and intrinsic features in the system of events. Andre's sculptures consist of this combination of series and intrinsic features. Although he never stated an intention to create sculptures as spaces of events, in the Fluxus tradition of creating objects of performance, he did create event-spaces where the performance is in perceiving. It is also this combination of series and intrinsic features that this project includes.

2.5. Non-linear Narrative Techniques

While the previous sections dealt with the experience of the event as felt through form and structure, this section discusses the technique of non-linear narrative as progressing through the multiplicity of the event. The non-

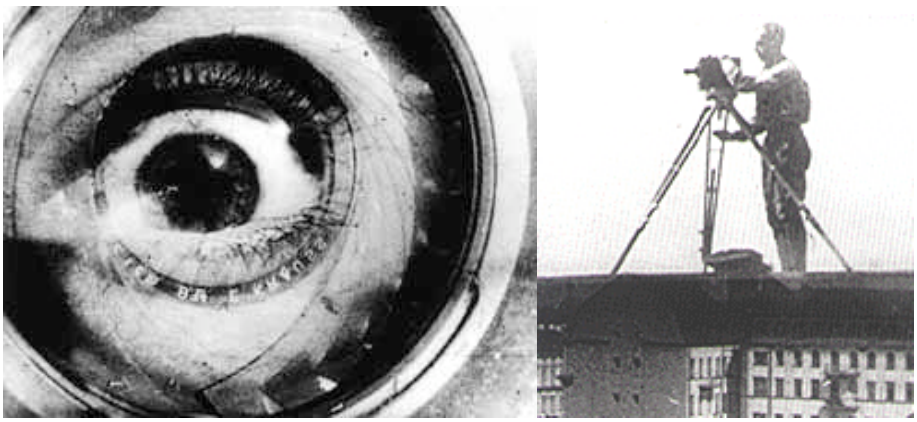
Figures 27 (above) and 28 (below). Vertov utilizes film techniques such as montage and superimposition to convey the rhythm of city life. (www.touch.demon.co.uk/images/man_camera.jpg, www.manovich.net/Vertov/Vertov-superimposition-1.JPG)

linear narrative frees the event from the constraints and boundaries of traditional plot and character development which is very linear, static, and chronologically one-dimensional. This is the manner in which the event is usually presented in the media. Yet experimenters in cinema have long questioned the linearity of this traditional narrative. One of the most important is Dziga Vertov, a Russian avant-guard filmmaker of the 1920's. His movie, *Man with a Movie Camera*, is considered to be the major example of non-linear narrative in cinema. The movie is a movie of three levels: "one level is the story of a cameraman shooting material for the film, the second level consists of shots of the audience watching the finished film in a movie theater, and the third level is the film, itself, which consists of footage recorded in Moscow, Kiev, and Riga, arranged according to the progression of a single day: waking up–work–leisure activities" (Manovich 241). Vertov uses an array of film techniques–fades and superimpositions, freeze-frames, acceleration, split screens, various types of rhythm and intercutting, different montage techniques-- for each shot to express the rhythm and associations of the Communist way of life. This editing transforms the banal scenes of city life into an experience that is not itself banal (Manovich 241).

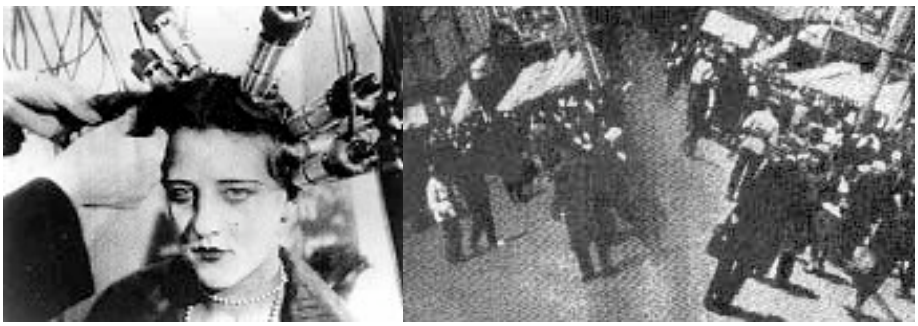
Shots are repeated and put in different sequences throughout the film. Lev Manovich, a new media theorist, refers to Vertov as a 'database filmmaker' in that the shots of the city seem to form a database of city living. "Records drawn from a database and arranged in a particular order become a picture of modern life--but simultaneously an argument drawn about this life, an interpretation of what these images, which we encounter every day, every second, actually mean" (Manovich 240). Vertov goes beyond the storage and organization of the database and places some reason and logic in the ordering of contents drawn from the database to create the non-linear narrative of everyday life.

Figure 29. Man with a Movie Camera is a 'database film' , a collection of images of everyday life. But the trajectory through the collection is not random; Vertov established an order to convey an argument. (www.manovich.net/Vertov/Vertov-database.JPG)

The narrative of the film is not a typical narrative; it depends heavily on the viewer's use of perception to understand the underlying subject of the film: "the filmmaker's struggle to reveal (social) structure among the multitude of observed phenomena" (Manovich 240). This subject must be gleaned from shots of everyday life that are repeated and rearranged.



Figures 30 (left) and 31 (right). Vertov imposes some reason and logic in the ordering of contents drawn from the database to create the non-linear narrative of everyday life. (cours.cegep-st-jerome.qc.ca/530-gjb-p.l/ images/Kino1.jpg, www.manovich.net)



Figures 32 (left) and 33 (right). The film is a multifarious experience consisting of filmmaker taking shots of everyday life, an audience watching the footage, and the actual footage itself. It pushes the boundaries of non-linearity to express Vertov's desire to create structure from multiple observed scenes. (www.babab.com/no10/images/vertov1.jpg, www.manovich.net)

This method of multi-level, non-linear narrative of everyday life heavily informs the way narrative is presented in this project. Akin to *Man with a Movie Camera*, the visuals of everyday occurrences in this project are drawn from a database, and the method of folding is the order or logic that transcends the database to form the narrative of the event. The difference between this project and the film is the very nature of the film existing as a film onscreen. By nature of the medium, the film is limited in interactivity. Although Vertov has pushed the boundaries of interactivity of film, especially for his time, it is not equivalent to physical interaction with a structure. This project seeks to tear the narrative away from the flat screen of a TV monitor or movie screen. In addition, Vertov has determined the path through which the visuals in the film are seen while this project allows the user to choose a path within a multitude of possibilities.

2.6. Summary of Rationale

The theory, works, and artists that have been presented in the *Theory and Rationale* section influence this project at many levels. They have set parameters for different aspects of this project's attempt to exist as a materialization of the concept of the event. The inception of this project was based upon a simple paper structure whose initial use in thought process for a Flash interface was contrary to the structure.

The structure's ability to physically and conceptually represent process and connections was not fully realized until the theories, works, and artists previously discussed were analyzed. The theories of French philosophers and theorists like Deleuze, Lyotard, and Thom have shown that such physical representation of process can convey an understanding of the concept of the event. They impart on folding the capability not only to model the emergence of an event but to also create a system where an event emerges. Thus the goal of this project *insofar as it is* informed by these theories is to create a materialization of the system of events, an event-space, that is enabled by the fold. Inherent to this goal is the desire to successfully convey complex concept.

The theory and work of the Fluxus movement have shown that an object can become space when it is performed on and that the event is understood in the immersion into this space. Such immersion occurs at the level of boredom. Thus, the goal of this project *insofar as it is* informed by the Fluxus movement is to create a structure that becomes event-space when the user becomes performer in the action of folding. In this space, the user/performer is immersed into the workings of the event through the banality of everyday occurrences.

The work of the Tangible Media Group, particularly the Triangles system, has shown that the realization of such a structure requires the simultaneous consideration of physical design, technical electronic design, software programming, and conceptual design. The goal of this project *insofar as it is* informed by the Tangible Media Group is to create a successful integration of the afore-mentioned design considerations to create the experience of the event-space.

The work of Carl Andre has shown that object can be experienced as space and that focusing on the intrinsic properties of the material and form at hand can convey space and concept. The goal of this project *insofar as it is* informed by Carl Andre is to create an object that is experienced as

event-space and utilizes the properties and arrangement of the material chosen to help create such an experience. The arrangement becomes similar to Andre's use of series of repeated elements of form.

Finally, Dziga Vertov's film, *Man with a Movie Camera*, has shown that non-linear narrative can exist as a trajectory through a database of images of everyday life. This trajectory is endued with a logic or reason from Vertov to express his desire to create order or reason from a multitude of observed phenomena. The experience of this trajectory is enhanced by such film techniques as montage and superimposition. The goal of this project *insofar as it is* informed by *Man with a Movie Camera* is to create a structure that allows the user to create order from the images of simple, everyday occurrences to form the non-linear narrative of the event. The fold is the means by which such order is created. The fold as a form of continuous boundary also allows the possibility of the use of superimposition to enhance this property of connected separation. The event-space created by the fold can also be seen as a montage of the images representing simultaneous possibilities of occurrences. The form of montage and superimposition is controlled by the user within the conditions set by the interface.

3. Design and Implementation

To carry out the goals set forth in the previous section, the project has been actualized through a methodic and systematic process of investigation, technically, physically, and logically. The result is a design that can be broken down into six parts: Material form, Mapping, Technological Backbone, Installation Set-up, Narrative, and finally Synthesis. Within each part, the iterations of investigation are described and analyzed, showing the process of thought that leads to the final form.

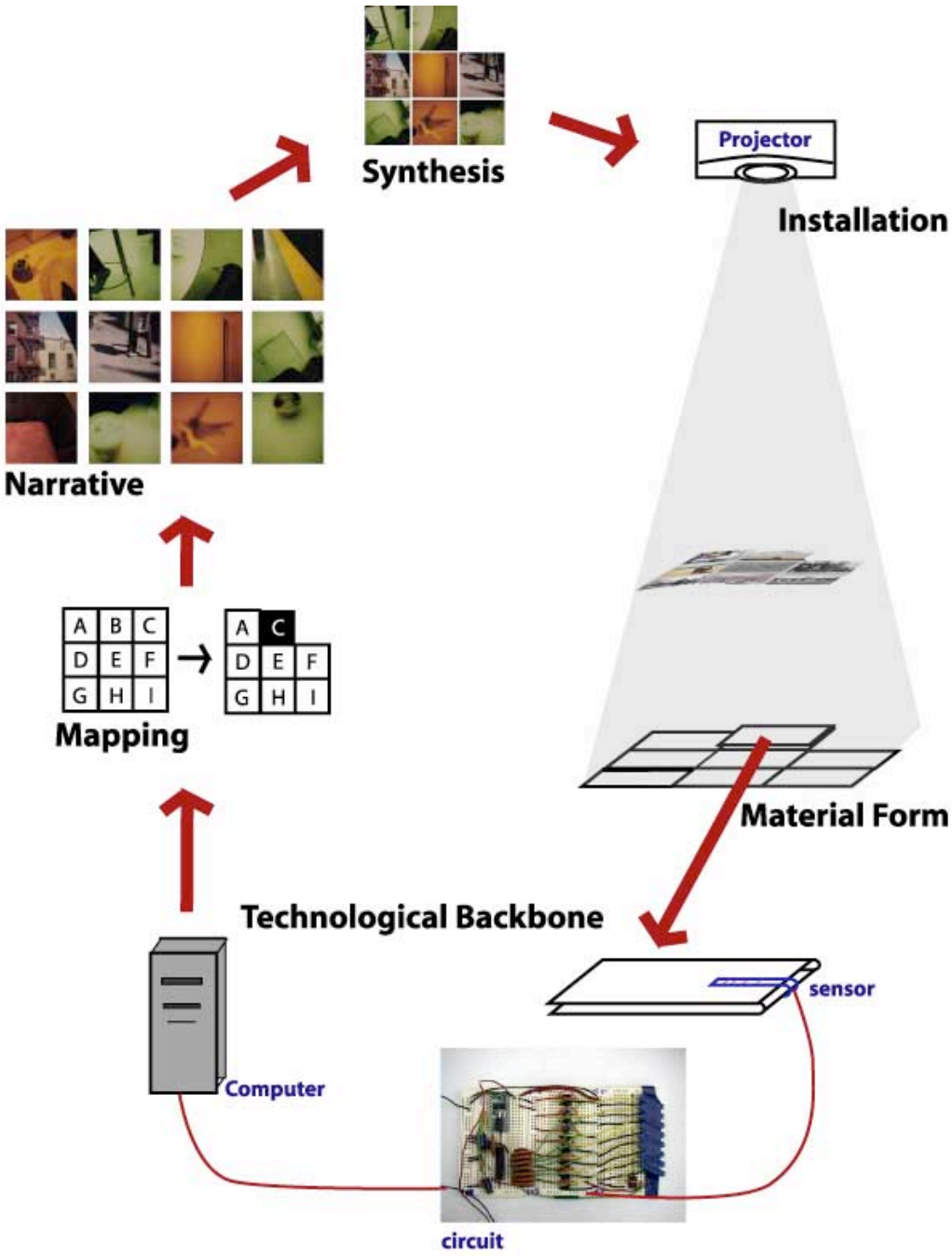


Figure 34. Diagram of Overall design and implementation of project existing as contained system.

3.1. Material Form

3.1.1 Iterations of Prototypes

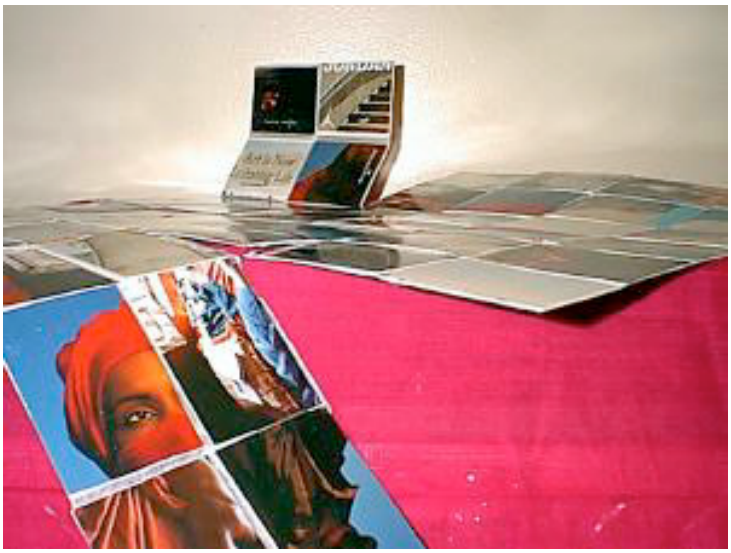


Figure 35. First prototype: the spark.

As discussed previously, the spark for the project was a simple folding structure composed of cut-up postcards and tracing paper, thus becoming the first prototype for material form. This first prototype consists of a grid of 8 by 6 panels. Each panel is rectangular in shape and consists of a quarter of a cut-up postcard, measuring 2 1/8” by 2 7/8”. Tracing paper connects the grid of panels, becoming the hinge for the prototype. The prototype is constructed with the tracing paper glued to and sandwiched between two panels with the visuals of the panels remaining on the outside. The result is a patchwork of visuals that can be grasped with the hands and manipulated. The physical sensation of the structure is pleasing in the simultaneous stiffness offered by the card material and the flexibility offered by the tracing paper. The grid is broken up by two cuts or slits, two panels in, at opposing sides. The prototype was experimented with before and after the cuts were administered. By comparing the two experiences, the slits in the grid allow a more complex interaction, allowing more folds and forms to be created from the structure.

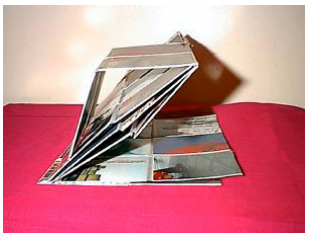


Figure 36. Complexity of form and interaction is multiplied by the introduction of slits into the grid.

The visuals presented by the structure are random, consisting of the images and artwork that one finds on free postcards. Yet, when placed in a grid and interacted with, the mind tends to create situations or stories out of these visuals. The use of text along with the visuals was tested as well. But perhaps in support of Lyotard and the idea of the inability of language to express an event, the text interferes with the experience and also forms too close an association with a book. Similar to the goal of the Tangible Media Group, to represent digital information without carrying the semantic weight often associated with everyday physical objects, this project does not mean to have the semantic load of a book.

Figure 37. Prototype 2: fold following fold.

Following this line of investigation, the next prototype consists of cut-up postcards glued together in a form where fold can only follow fold. The structure is constructed by pasting together four halves of a postcard at right angles to each other. Creases were made a third of the way in on each side of the rectangular half of the postcard to enable the folding. This prototype creates a very small system of folding such that only a few folds can be made to create different states; only a few collages of visuals are possible. The advantage of this prototype is the sense of cohesion in folding, following Deleuze's statement of a fold following a

fold. But, the order of the system is not evident at first and requires multiple passes through the system of folding.

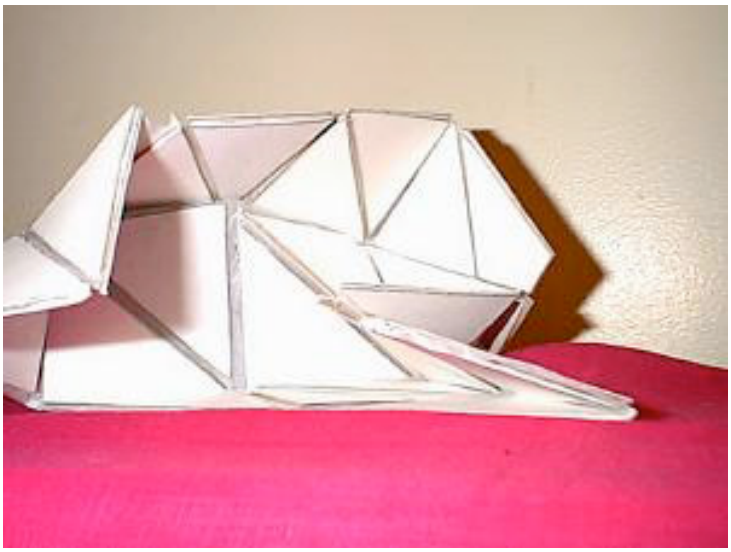


Figure 38. Prototype 3: an experiment in triangular dimensionality.

The third prototype was an investigation into the possibility of triangular tiles. Similar to the Triangles System of the Tangible Media Group, attempts to explore the different geometrical shapes in the context of a folding structure had to be made. The prototype was constructed in a similar manner as the first prototype, using tracing paper as connection between panels of triangles when sandwiched between two panels. The result is a system multiplied in complexity. Folds tend to make the structure polyhedral and three-dimensional. These folds explicate very well the existence of a fold within a fold. But, as a whole, this system is not practical in terms of technical possibility of actualization. To be able to keep track of this level of complexity in the folding is an almost impossible endeavor.

Figure 39. Triangles create a very complex system in folding, showing well how a fold is like a cavern within a cavern.

This prototype also was an investigation into the method of presentation of the visuals. In this case, the panels are blank, forming a white surface of possibility. Instead of having the visuals static and on the surface of the panels themselves, the blank surface allows changeability of visuals on a particular pattern depending on the process of folding

when used in conjunction with image projection onto the surface.

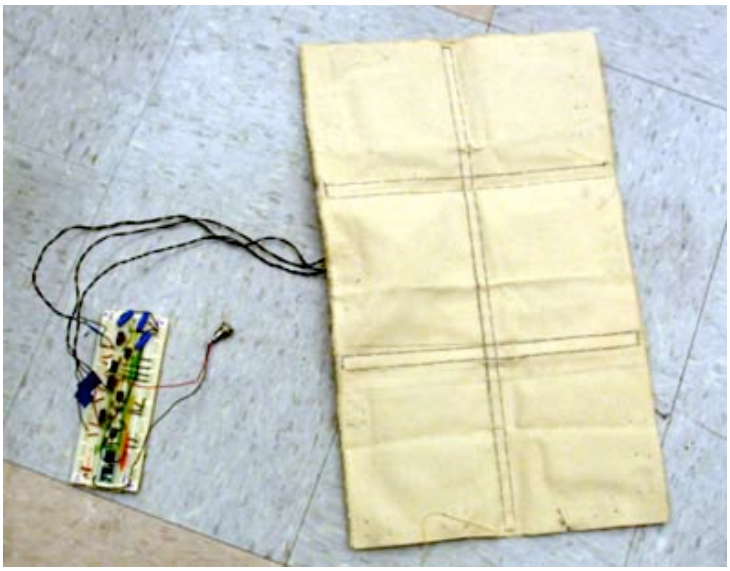


Figure 40. Prototype 4: Technical and material form.

The fourth prototype was produced as the final project for my Physical Computing class. Thus form with technical ability could be investigated. The prototype is constructed with canvas material sewn together along the axes of folding. The panels again take the form of rectangles but unlike the previous prototypes, hinging material is the same as the surface of the panels. The prototype inverses the relationship in material established in prototype 1; the hinging material now sandwiches the stiffer panel material. Within each rectangle, a sort of backbone exists, consisting of black foam glued to thin balsa wood. The foam is practical; it is used to alleviate the stresses upon the flex sensors that are used in this structure (the sensors will be discussed in further detail in the following section).

Figure 41. The anchor board of the flex sensors within the center panel.

Also with the practicalities of needing a circuit connection through wires, the prototype has the property of having a front and thus a back. The flex sensors are anchored to a board within one of the middle panels, connected to wires that leave the structure through a slit in the back. There is also the practical concern of securing the placement of the

flex sensors in the axes of folds. Thus the sewing was done so that space was left for the sensor to situate itself into a channel between the two sides of canvas material.

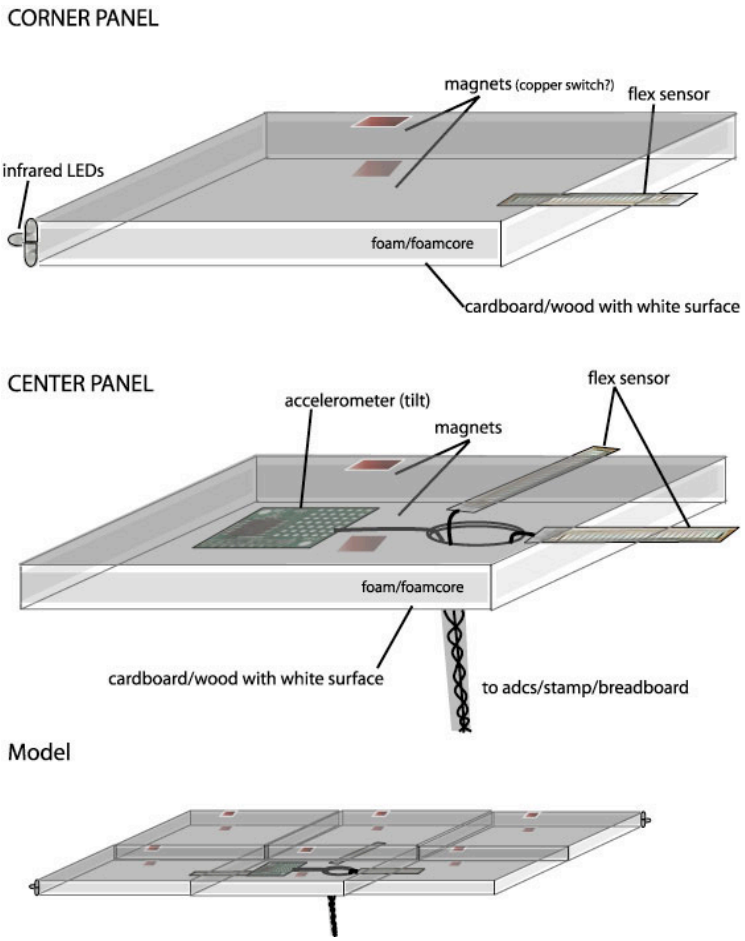


Figure 42. Diagram of Prototype 4: Placement of sensors in conjunction with material and form.

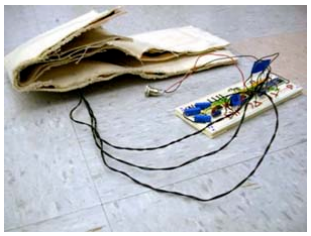
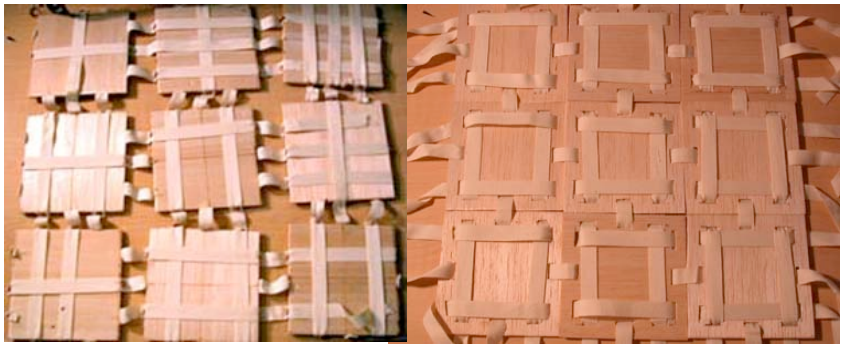


Figure 43. The thickness of the structure makes folds difficult unless the hinge material is stretchy or there is space between panels.

The diagram shown above is a preliminary layout of the Prototype 4. The integration of sensors into the structure requires a careful consideration of layout of the sensors and the material best suited to protect the sensors from damage while not impeding functionality. The structure consists of a 3 by 2 grid of panels measuring 7” by 5”. Magnets were also considered to lock panels in place after being folded. Also, realized in this layout was the inevitable existence of thickness in the structure. This is due to the sandwiching of

sensors between material for placement and protection. Such thickness subsequently requires consideration of the ability of the hinge material to fold over many previous folds. There must be a combination of a range of stretchiness in the material and a range of distance between the panels. This prototype uses a large distance between panels since stretchiness in canvas material is almost non-existent.

This prototype also brings to light the need to have access to sensors for maintenance, repairs, and changeability. For practicality, the sensors cannot be permanently enclosed within the structure. Thus, Velcro strips were used on the lining sides of the structure. They allow easy access to the sensors if, for example, a sensor has to be returned to its correct position if knocked out of place. Thus, this prototype is successful on many levels, but it fails in the feeling of form; the prototype is too flimsy due to the inverse relationship of sandwiched and sandwiching materials.



Figures 44 (left) and 45 (right). Prototypes 5 and 6: Wooden panels and interwoven hinging.

Prototypes 5 and 6 are investigations into different methods of hinging and materials. Also, it is with these prototypes that the decision to use square panels for an overall square structure was made. The hinging is composed of cloth ribbon that is interwoven between the panels. The inspiration for this type of hinging was the children's toy, Jacob's Ladder. In Prototype 5, the cloth is interwoven around the panels and attached to the panels with copper tacks at the sides. In Prototype 6, the cloth ribbon is interwoven through slits

made in the panels themselves. Each side of a panel has three slits so that, in total, there are nine slits in a panel.

Prototype 5 is a 3 by 3 grid of square panels measuring 4” by 4”. Each panel or square tile is made of balsa wood of medium weight. The thickness of the wood was enough for copper tacks to be inserted on the sides of the panels to hold the cloth ribbon hinging. In this structure, the problem of the hinging material not containing any amount of stretchiness or leeway for folding gives rise for much space between the panels. But the combination of heavier panels and larger space results in a floppiness of structure that is not pleasing. Thus for Prototype 6, the use of slits was an attempt to find an alternative to the indirect relationship of space and stretchiness. But, instead of requiring space in between the panels, there had to be additional length of cloth on the exterior sides so that when a fold occurs the panel can slide through that additional length. But this sliding ability also lends the structure the feeling of ease in falling apart. This prototype is a 3 by 3 grid of square panels measuring 4” by 4” as well. Each panel is made of very thin balsa wood. Although the attempt to find an alternative in hinging from the ones previously explored was necessary, the prototypes were not successful overall in structure, either too floppy or too unstable in structure.

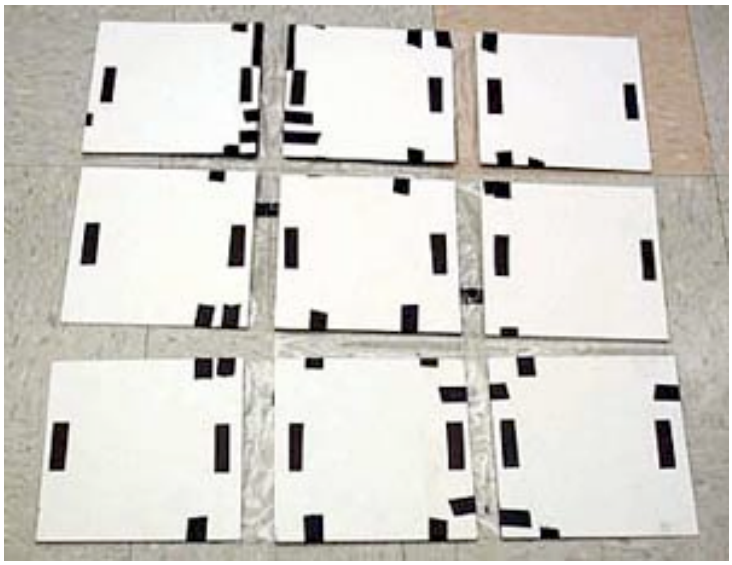


Figure 46. Prototype 7: Black and white, larger structure.

The seventh prototype was an investigation of size, breaks in the grid, and the reinvestigation of the use of magnets. The 3 by 3 square panel structure had been established as the norm at the point of production of this prototype. Each panel consists of card material measuring 8 1/2” by 8 1/2”. The card material is white on one side and black on the other, establishing the difference between front and back. White indicates front, and black indicates back. The hinging is composed of clear plastic that has slight elastic qualities but an attempt was made to make the space between the panels as minimal as possible so that the structure would be aesthetically and structurally sound. This hinging is attached along the axes of folding, on the back of each panel with tape. Magnets are actualized in this prototype and were found to work well in keeping folds in place. The prototype was a good learning experience in the placement required for the magnets as well; one has to consider all the possible ways in which a connection between magnets could be made.

Figure 47. A 2 slit configuration was decided upon after experimentation with Prototype 7.

The larger size of the prototype gives it the sensation of space. The interaction thus varies away from one that is akin to a strictly small model or toy and moves toward a space of possibility. More possibilities are actualized also with the introduction of slits or breaks in the grid. Four slits were attempted at first, but this configuration was decided against for its complexity of folding. Thus, a 2 slit configuration is the norm for the project.

3.1.2. Final Form and Material

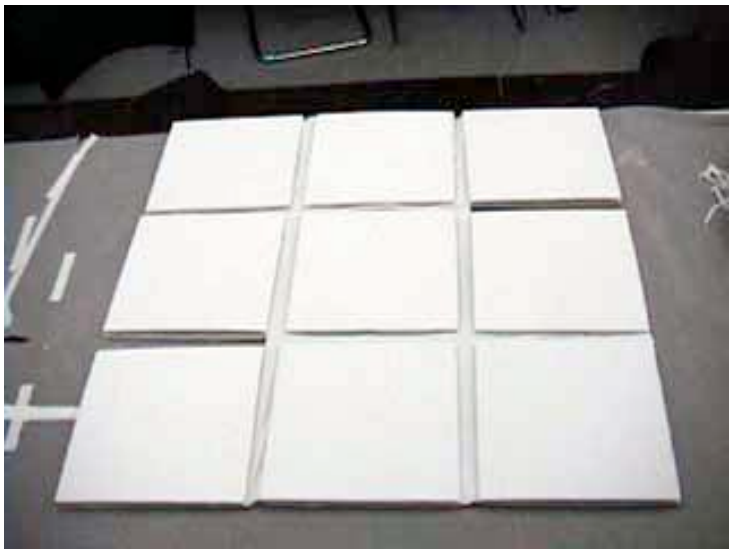


Figure 48. Final Form: White fabric-covered panels and white fabric hinging.

These iterations of prototypes culminate in the final form of the project. This form maintains the 3 by 3 square panel grid with 2 slits to break that grid. Each square panel measures 10” by 10”; the whole form measures 32” by 32” with the space in between the panels measuring 1”. The slits occur at 2 opposing corner panels; in the image above slits occur below the top, right corner panel and above the bottom, left corner panel.

Figures 49 (above) and 50 (below). Each board is covered in white fabric with the white side of the board facing outwards and the black inwards. Two boards sandwich the hinging fabric.

The final form is similar to Prototype 1 in that the stiffer cardboard material of the panels sandwiches a hinging material. In the final form the cardboard material is the black and white board used in Prototype 7. Each cardboard panel is covered in white spandex fabric on the white, front side, and is attached to the plane of stretchy, thinner, white, hinging fabric on the black, back sides. A cross-section of the complete panel would be fabric-covered panel, hinging fabric, hinging fabric, and fabric-covered panel. With fabric-covered panels sandwiching another fabric, the panels on the whole have a good amount of thickness. Thus, the sandwiching fabric has to have a considerable amount of ability to stretch. The white fabric that covers the panels was

chosen for its ability to hold a projection and its tactile sensation; it is heavier than the hinging fabric and also has a nice feel to it. Even with the ability of the fabric to stretch considerably, a 1-inch space had to occur for those final folds after many folds. This makes the form slightly floppy, but this property of the form is negated by the fact that it is too large to pick up as a whole.

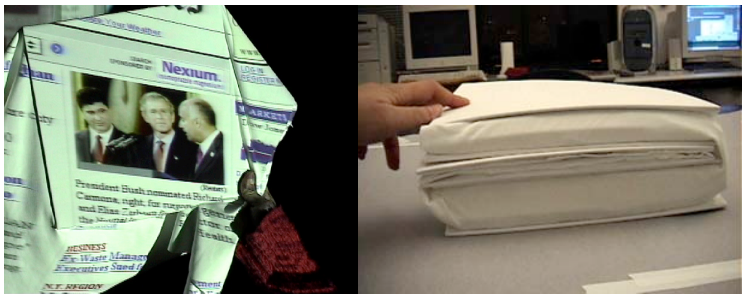


Figure 51 (left). The heavier spandex fabric holds a projection well.
Figure 52 (right). The hinging fabric is able to stretch over several folds already made.

As in prototype 4, the sensors are contained within the form. The sensors are sandwiched between the two sheets of hinging fabric so that the cross-section contains: fabric-covered board, hinging fabric, sensor, hinging fabric, fabric-covered board. When the sensor traverses an axis of fold, the cross-section becomes hinging fabric, sensor, hinging fabric. The very center tile's bottom panel contains a rectangular space cut out for wires from the sensors to connect to the circuit. As in prototype 4, there is an anchoring board for the sensors that provides connection to the wires. The anchoring board is also placed between sheets of hinging fabric and over the rectangular space.

Figures 53-58. Final prototype in the process of folding.

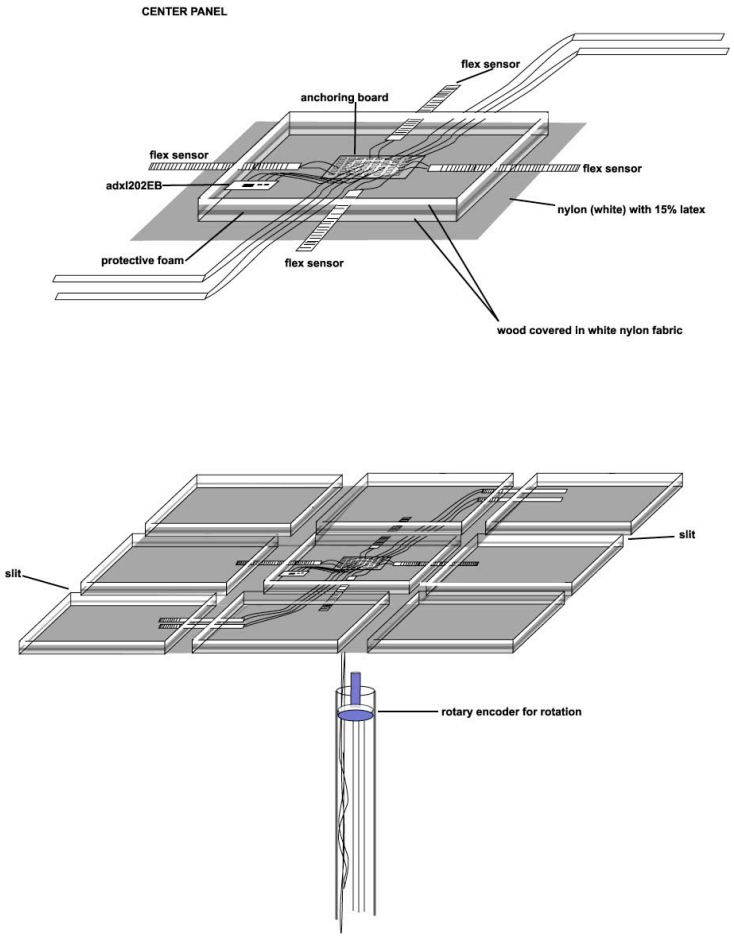


Figure 59. Diagram of layout of sensors and forms of Final prototype.

In this final form, the materialization of a space to interact with projected images of occurrences by folding is realized.

3.2. Mapping

To actualize the space of interaction, it was necessary to understand this space as representing a system, which conceptually is the system of events. Similar to Thom's approach to understanding complex systems spatially and visually through three-dimensional forms, I sought an understanding of the system I was creating in this project through creating a visual language of mapping. The mapping is a two-dimensional representation of the sequences of

folding in the system, consisting of the visual representation of each sequence of the form and the labeling of each sequence of the form.

3.2.1. Process of Logic

In order to create a language, it was necessary to map the possibilities of the event-space, to understand their scope and logic, to create a language for them. The results are massive diagrams showing the sequencing of possible folds in a visual language. As mentioned earlier, a process of investigation into the exact configuration of the structure was done. This investigation involved mapping the 3 by 3 panel grid with no breaks in the grid, with four breaks in the grid, and finally with two breaks in the grid.

The visual language of the mapping takes the white-front, black-back property of the cardboard panels used in Prototype 7 to denote the front and back of each panel of the 3 by 3 grid. Also, each panel is assigned a letter. The top row of panels is labeled: A, B, C. The second row of panels is labeled: D, E, F. The third row of panels is labeled: G, H, I. The mapping is a diagram of all sequences of folding, showing how and which panels are seen after folding. For example, one path of folding would be: fold C, F, and I to show A, the backs of C and D, the backs of F and G, and the back of I; fold A and C to show the back of A, the backs of B and G, and the back of I; fold the backs of A and G to show the back of D and the back of G; finally fold the back of G to show the back of H. In the mapping of the 3 by 3 square, no-slit grid, there are 36 different possible combinations, 9 different possible configurations, and 12 complete paths of folding. This system is thus limited in the range of possibilities. The possible events that could occur are few, and so the experience of the structure would be limited; the user would not be compelled to interact with the structure extensively with a low degree of variability in experience.

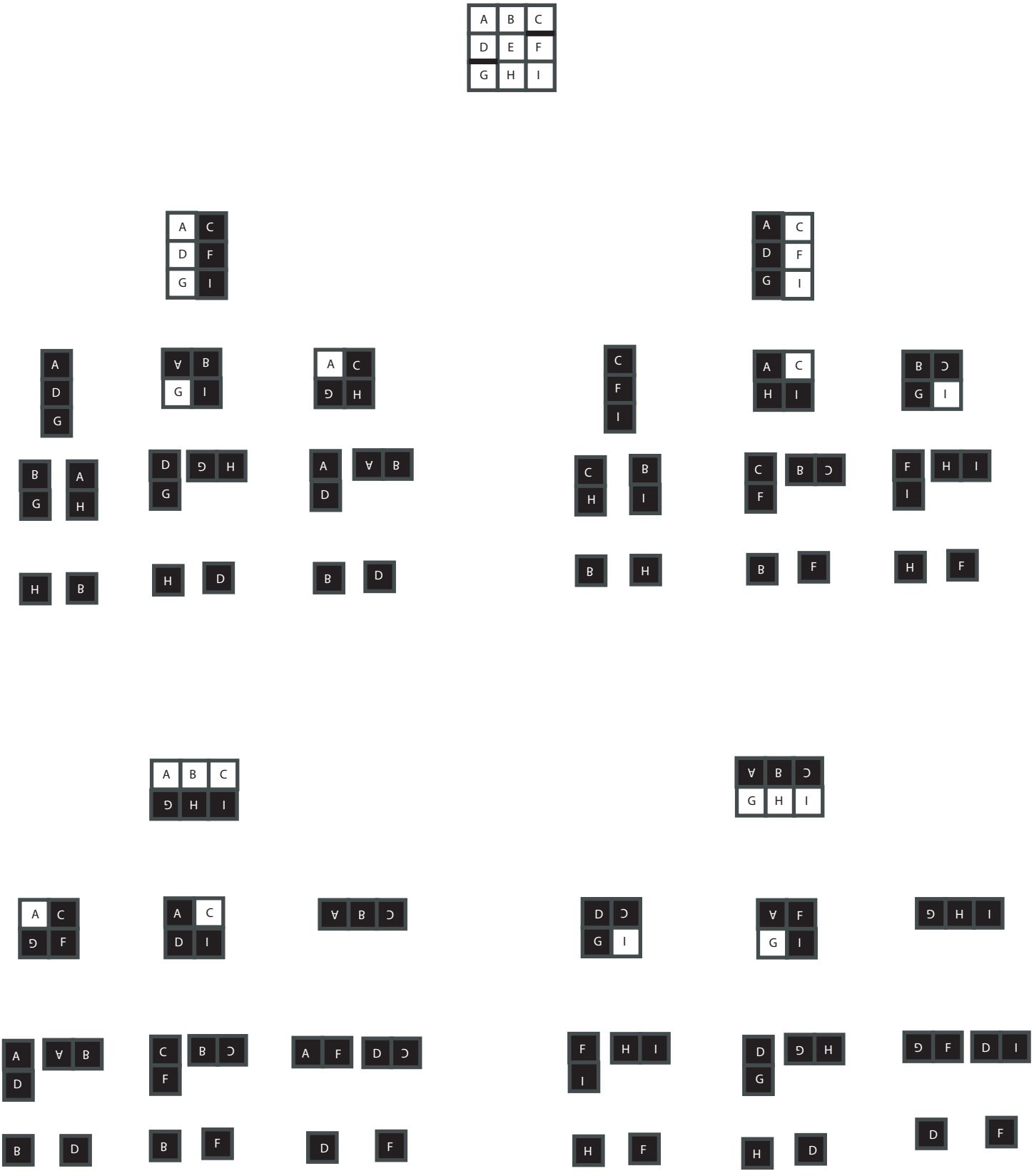


Figure 60. Complete mapping of the 3 by 3 grid with no slits or breaks.

Thus, an investigation into the range of possibilities of a grid with four slits was made. The mapping for the 4-slit configuration only proceeded as far as mapping the sequence of folding when the square labeled "A" is folded. The possibilities that the four-slit configuration offers are vast, too large to be practically enabled, at least within the time constraints of this project. Thus, mapping of this form was halted after seeing the enormity of possibilities that the mapping of "A" being folded predicted.

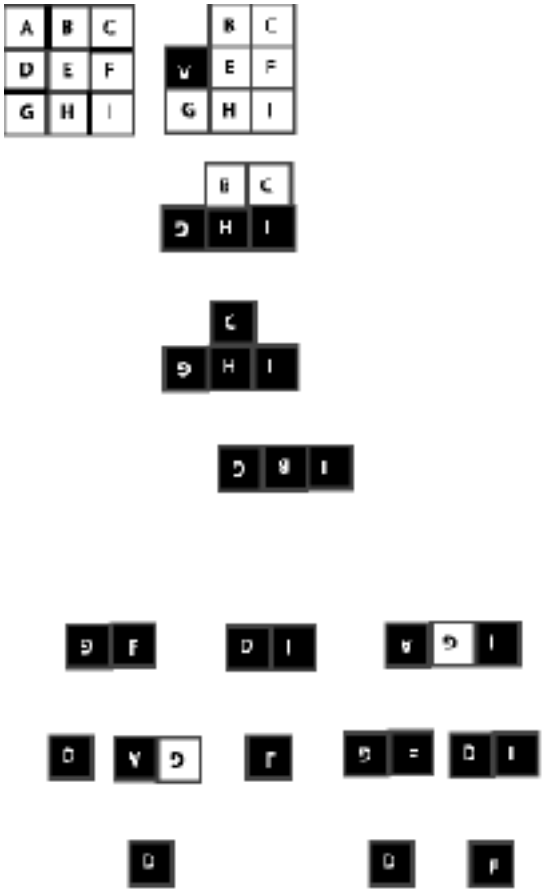
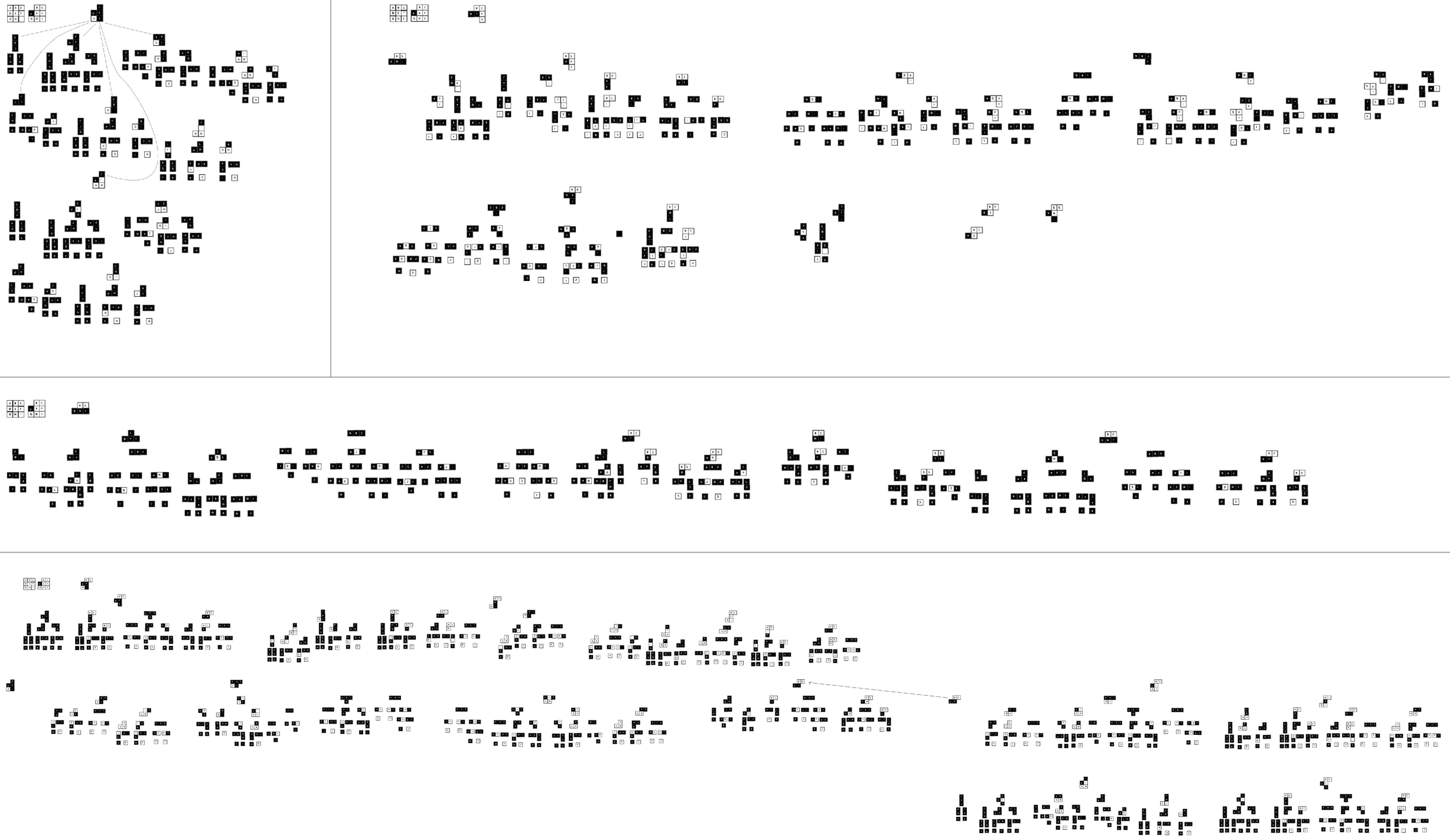


Figure 61. Excerpt from mapping of "A" folded.



Figures 62-65. Mapping of the sequences of folding of 4-slit congfiguration after "A" has been folded. Scaled down to 25 percent of original size.

Middle ground was found between the no-slit and four-slit configurations, with a 2-slit configuration. With a sort of *Goldilocks and the Three Bears* outcome, the 2-slit configuration is just the right size. It results in a configuration that allows a high degree of variability in experience, and yet is manageable to realize technically. Thus a multitude of possibilities of events could arise through different sequences of foldings. The mapping of the 2-slit configuration was possible to complete, and it was found that there are about 500 different sequences of complete foldings.

As the mapping shown in the previous diagrams creates a visual language of folding in the structure, an additional mapping was made to create a lexical and technical language. The result is a language that is based on the letters that label the squares and the numbers assigned to the flex sensors being used. This language and diagram provide an overall logical breakdown of the actions involved in the folding, providing a map of what needs to be done in the programming. The language involves noting which panels have been folded by their letters and which sensors have been folded by their numbers. For example, if panel A and D are folded, then sensor 1 is folded; the notation becomes AD_1. If subsequently panel C is folded, then sensor 7 is folded; the notation for the overall sequence becomes AD_1, C_7. These diagrams smooth the process of thinking through how to enable the folding structure in the programming and sensors.

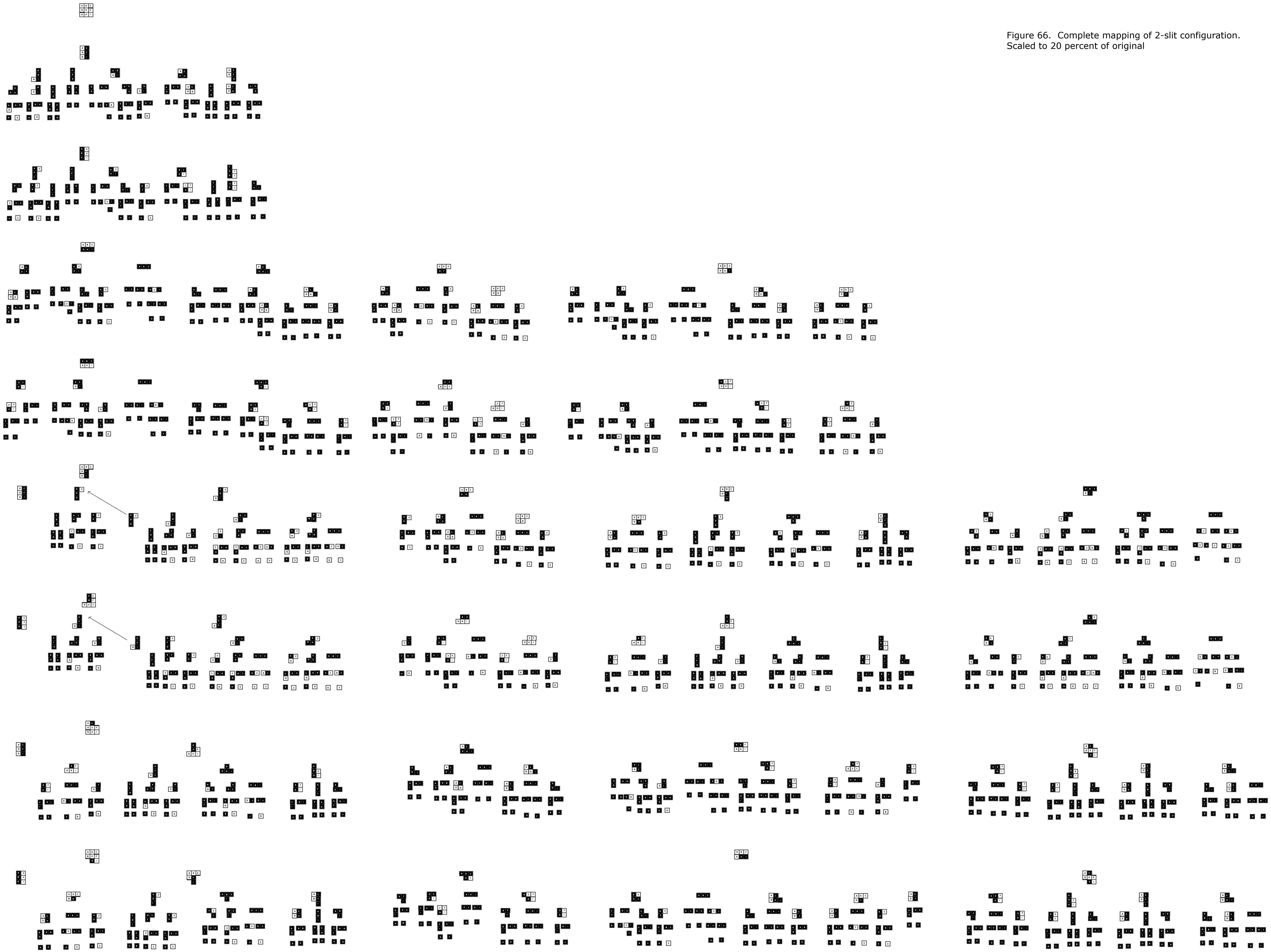


Figure 66. Complete mapping of 2-slit configuration.
Scaled to 20 percent of original

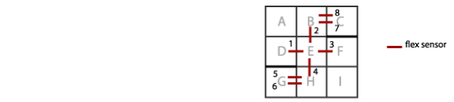
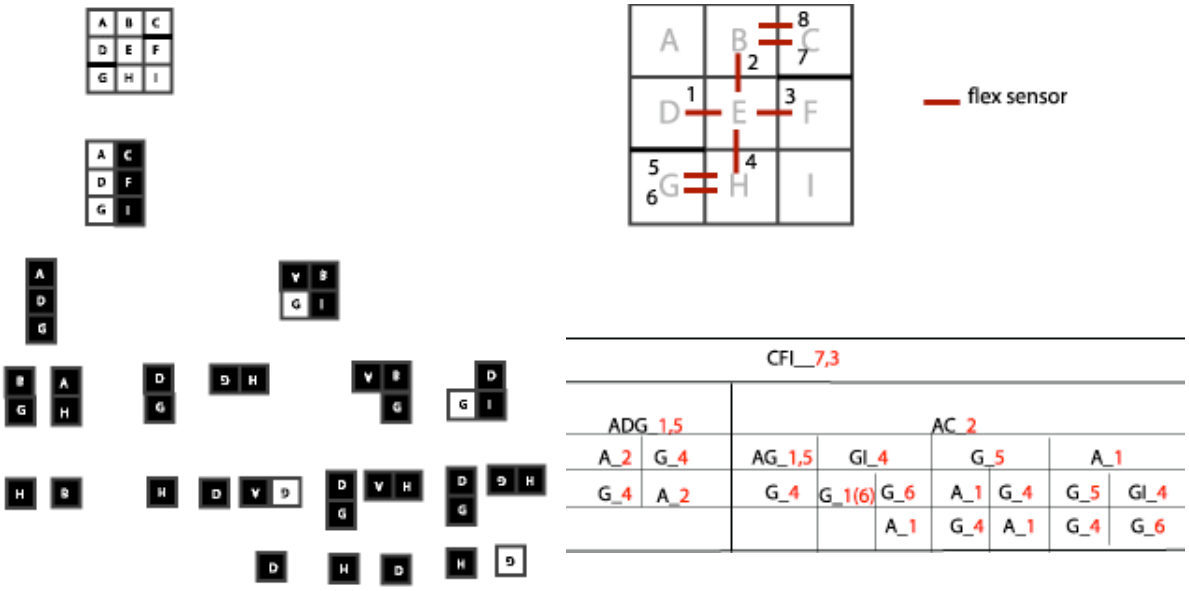


Figure 67. Complete mapping of 2-slit configuration in lexical and numerical language of panels and sensors folded. Scaled down to 30 percent of original.



Figures 68 (left) and 69 (right). Excerpts from visual mapping diagram and language mapping diagram of 2-slit configuration, showing the same sequence of folding.

3.3. Technological Backbone

The material form of the folding structure is able to realize the possibilities shown in the mapping through the technological infrastructure of the form. This infrastructure is comprised of sensors capturing the input of the fold, circuits capturing the information of the sensors, and the programming using that information to determine the images shown.

3.3.1. Sensors

As mentioned previously in the paper, the sensors chosen for the structure are flex sensors. But, other sensing technology was considered and evaluated; this mainly involved some variation on kind of switches. Switches are an easy and very stable way to determine if a panel or panels have been folded. Pushbutton switches placed just above the surface of the panels and on panels “B”, “C”, “C” back, “D”, “F”, “G”, and “G” back can sense what folds have been made. But the

sensing only occurs after a panel is on top of a panel; it does not happen while the folding is occurring. The emphasis is on the "have been made". By the very nature of the sensors being switches, the experience is strictly on/off and is thus limited. The experience is not so much about folding but pushing a button to see a new image. Nine switches were experimented with in a circuit. As switches are digital input, they only require a 10k resistor and connection to the input pins of the microprocessor. Any form could have suited the switches to find some progression of narrative. A book-like structure could have been made, but the emphasis is on the fold. Switches do not provide this emphasis.

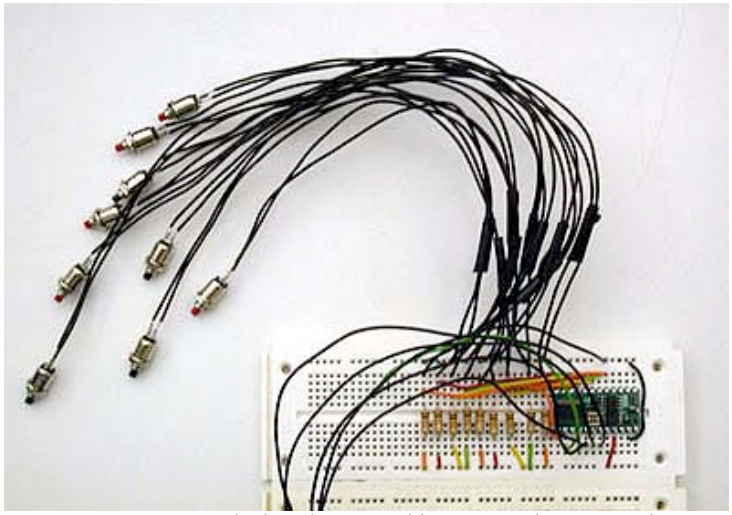


Figure 70. A circuit built with nine pushbutton switches to test the possibility of the use of switches.

Thus, flex sensors were decided upon for their ability to measure variable resistance in bending. The flex sensors that are being used measure a range of 10K to 30-40K ohms. When they are not bent, the range is at 10K; when they are completely bent, the range is at 30-40K. Thus, the flex sensors are able to measure the fold in the act of folding, not just after that the act has been done. In the configuration settled upon, 8 flex sensors are required to measure all axes of folding. Using the language established for the configuration, these axes involve AD_1, ABC_2, FI_3, GHI_4, G_5, G_6, C_7, and C_8. The G_5-G_6 and C_7-C_8 layout is a requirement of the two slits. For example, "G" can be folded in, bending flex sensor 5, or following the folding in of

GHI, bending flex sensor 4, the back of G can be folded in to bend flex sensor 6. Overall, the flex sensors work well in the sensing of folding. There is some difficulty found in interference with the sensors. The numbers obtained from the sensors fluctuate due to electromagnetic noise or perhaps even temperature. This fluctuation is dealt with in the programming and the circuit. There is also concern about the level of fragility of the sensors; after many bends, the flex sensors may not be as accurate as originally encountered.

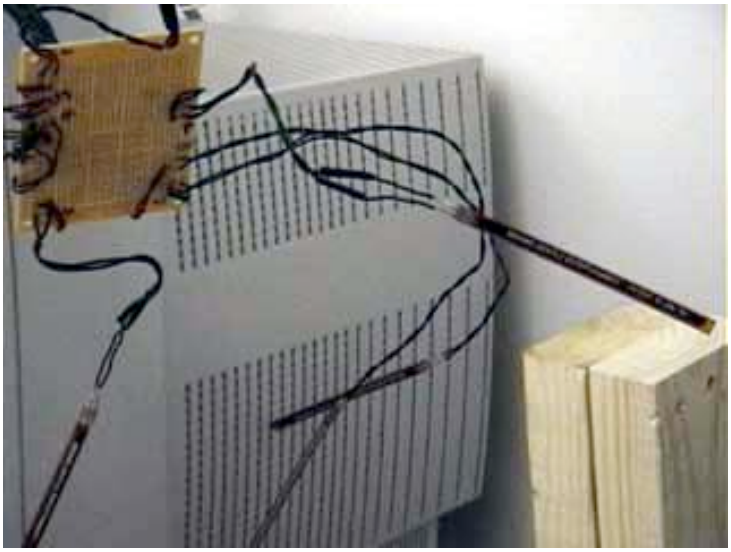


Figure 71. Flex sensors attached to anchoring board. Eight in total.

Other sensors considered for this project are for future directions for the structure. A rotary encoder may be used to sense the rotation of the overall structure. When positioned at the base of the structure, the rotary encoder can measure degree of rotation so that the images being projected can follow that degree of rotation. Also, an accelerometer is in consideration to be used as a tilt sensor. The ADXL202EB is a two axis tilt sensor, measuring x-axis and y-axis degree of tilt. When positioned on the anchoring board of the structure, the ADXL202EB can measure degree of tilt of the overall structure, affecting the skew of the projection of the images. At the moment, the ADXL202EB can measure almost 180 degrees in both axes after much research in coding and circuit layout. It is being used in conjunction with two .1 uF

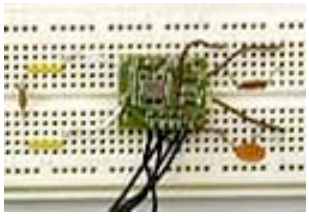


Figure 72. ADXL202EB is tested for use as a tilt sensor.

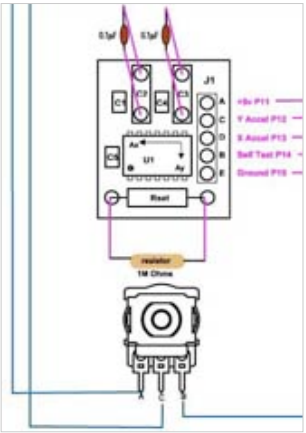
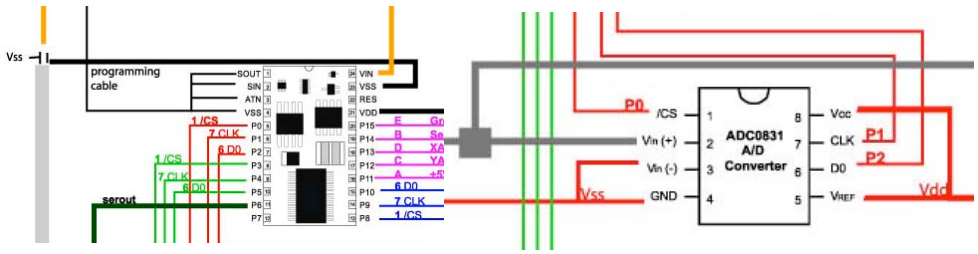


Figure 73. ADXL202EB and a rotary encoder are possible sensors to be used in the future.

capacitors and 1M resistor. Both sensors give digital input and thus only require connection directly to the microprocessor. The use of these sensors cannot be arbitrary, for just a technical-wow factor. There must be a conceptual basis for the use of these sensors that goes beyond strict simulation of projection to structure. The rotation may enact a change of logic, and the tilt may cause a further degree of superimposition or montage to reveal something behind the image of the panel. If such a conceptual link is not established, the use of these sensors is wasted. The link is still yet to be found.

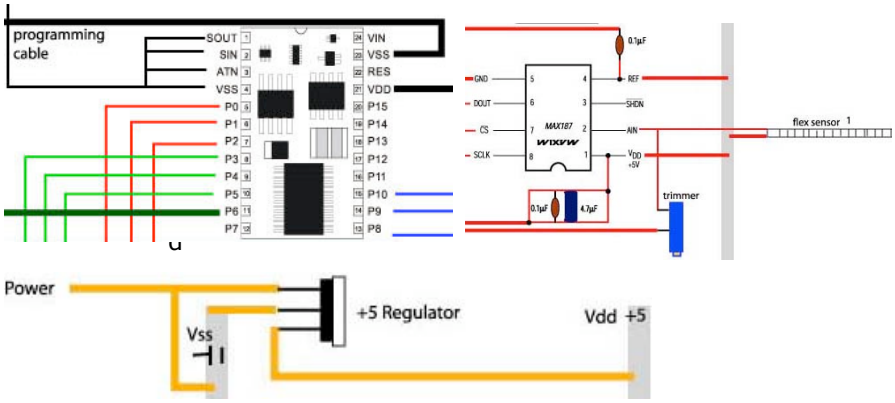
3.3.2. Circuit

The circuit design for the flex sensors has been changed many times in accordance to needs of accuracy, efficiency, and change in number of sensors. The first circuit designed was for Prototype 4, discussed earlier. This circuit involved the use of: a Parallax Basic Stamp 2-IC, three ADC0831, three flex sensors, a programming cable with a female DB-9 serial connector, and a power cable. The Basic Stamp (BS2) is a microprocessor that can be programmed with instructions using Pbasic. It is programmed using the Stamp Editor software on a PC with the programming cable connecting the BS2 to the serial port of the PC. The ADC0831 is an 8-bit analog to digital converter, taking the analog information of bend in the sensor and coverting it to 8-bit digital information for stamp to recognize and pass on. This circuit resulted in a low range of numbers from the bend sensors.



Figures 74 (left) and 75 (right). Circuit 1: Basic Stamp 2-IC and the ADC0831.

Thus, in the next iteration of the circuit, the ADC0831 is replaced with the MAX187, a 12-bit analog to digital converter. The MAX187 gives a larger range of numbers but requires additional capacitors to reduce noise from the voltage. Each MAX187 requires a .1 uF capacitor at REF and a .1 uF capacitor and 4.7 uF capacitor in parallel at Vdd (+5V). In addition, a 1M cermet trimmer is used to increase the range of numbers for the flex sensor. The configuration becomes flex sensor connected to analog-in pin of the MAX187 and connected to cermet trimmer. In this configuration the flex sensor gets higher voltage than +5V; it is connected to the unregulated voltage, 7-9V. Thus, an external regulator was utilized to ensure the protection of the BS2 and MAX187 chips which can only take 5V. The overall circuit is composed of: a Parallax Basic Stamp 2-IC, three MAX187, three flex sensors, three 1M cermet trimmers, three 4.7 uF capacitors, 6 .1 uF capacitors, a 5V external regulator, a programming cable with a female DB-9 serial connector, a serial cable with a female DB-9 serial connector, and a power cable. The serial cable is used to enable the BS2 to send data to Director, using SerialXtra. This circuit worked well for Prototype 4.



Figures 76 (top left), 77 (top right), and 78 (bottom). Circuit 3: BS2, MAX187, capacitors, trimmers, and +5 Regulator.

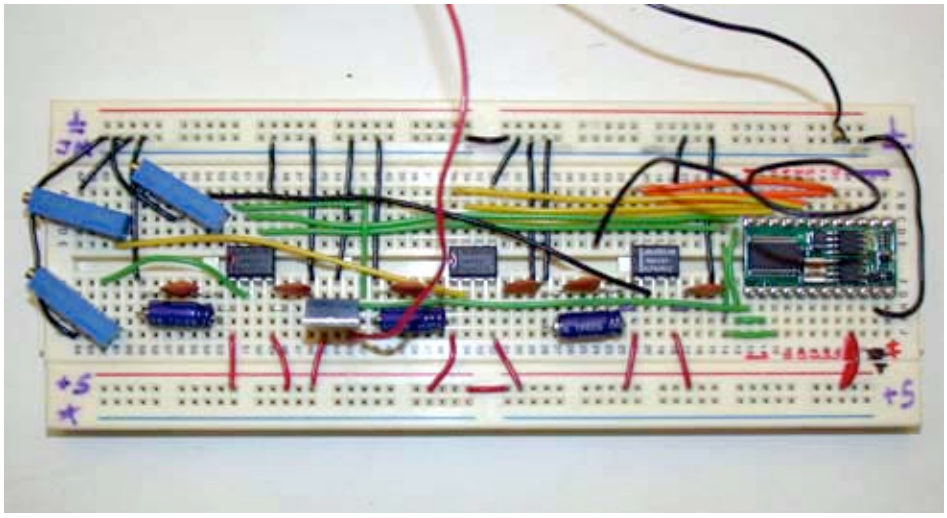
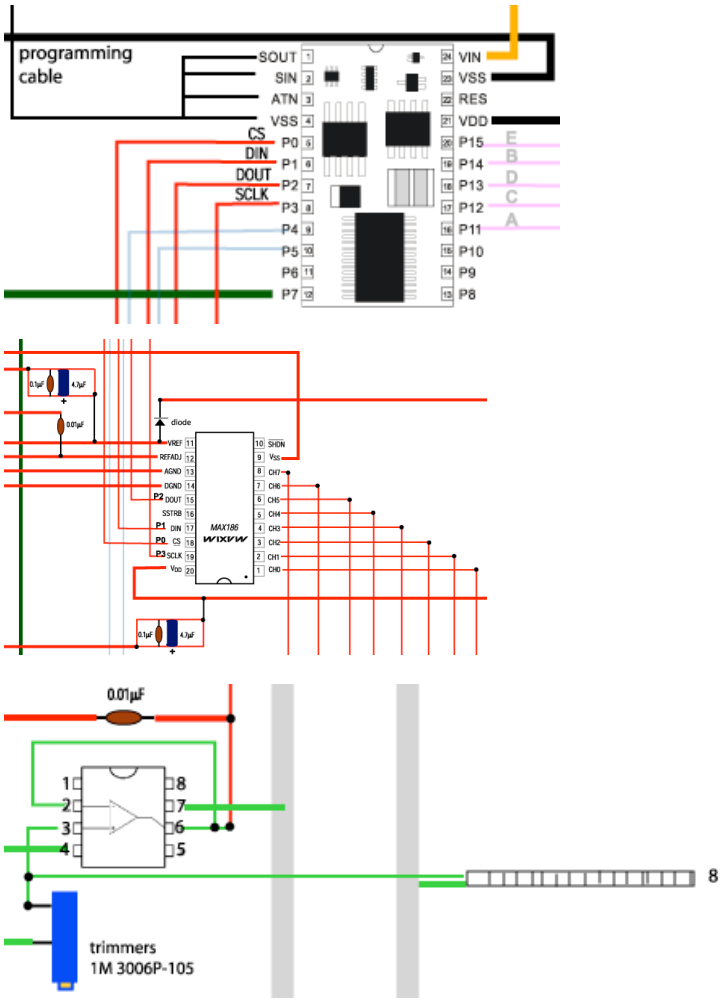


Figure 79. Picture of Circuit 2 on breadboard.

When eight flex sensors were decided upon for the final configuration, the circuit had to be changed again. If eight sensors are used in combination with eight MAX187, two stamps are required and networked. This is due to the fact that each MAX187 takes 3 pins of the BS2, thus 8*3 equals 24. Twenty-four pins of stamp are needed while one BS2 only contains 16 pins for input/output (I/O). The use of two stamps was avoided with the use of the MAX186. The MAX186 is a 12-bit, 8 channel analog to digital converter, reading 8 sensors and requiring only 3 pins of the BS2. But when the MAX186 was placed in the previous circuit, adding 5 more flex sensors, problems were encountered. At first, no readings from the MAX186 were obtained. After much error checking and part analysis of the circuit, it was found that the circuit would not work with the external regulator. Then, the numbers obtained from the MAX186 for the flex sensors were wildly fluctuating. The MAX186 was already being used with a .01 uF capacitor at REFA, a .1 uF capacitor and a 4.7 uF capacitor in parallel at VREF and VDD. To even out the numbers read from the sensors, a diode was added at VREF and an op-amp was used for each channel. The op-amp takes the voltage readings from the sensor and levels out the voltage. These added parts helped to reduce the fluctuation.

But, in attempt to truly minimize the fluctuations, a call was made to the tech support line of the company that produces the MAX186. The applications engineer of the company suggested the use of a .01 uF capacitor at each channel of the MAX186 as well. This suggestion was enacted, and the fluctuations were further reduced. The range of numbers read from the sensors is satisfactory. The overall circuit is composed of: a Parallax Basic Stamp 2-IC, one MAX186, eight flex sensors, eight 1M cermet trimmers, eight op-amps, two 4.7 uF capacitors, two .1 uF capacitors, nine .01 uF capacitors, one diode, a programming cable with a female DB-9 serial connector, a serial cable with a female DB-9 serial connector, and a power cable.



Figures 80-82. Final circuit: BS2, MAX186, capacitors, a diode, op-amps, trimmers, and flex sensors.

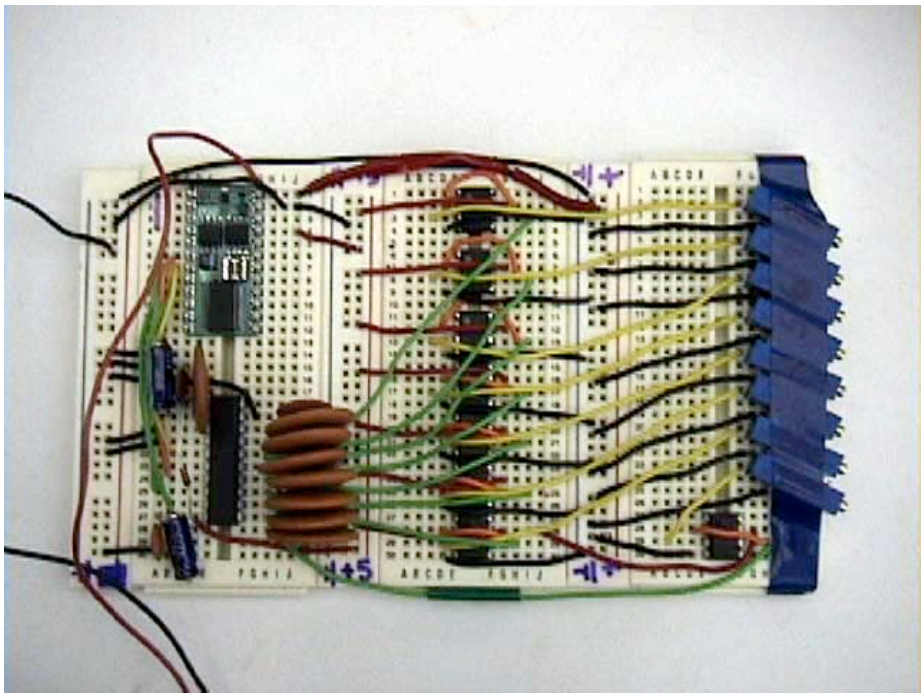


Figure 83. Picture of final circuit on breadboard.

3.3.3. Programming

The programming that is involved to enable the circuit and sensors is written in Pbasic for the Basic Stamp Editor and in Lingo for Director 8.5. For the BS2 to obtain the numbers from each sensor, the BS2 must read each channel of the 8 channel MAX186. This is done through the basic programming combination of loops and arrays.

```
for k=0 to 7
        low CS
        channel = k
        lookup channel, [142,206,158,222,174,238,190,254], chsel
        shiftout serDin, serCLK, msbfirst, [ chsel]
        shiftin serDo, serCLK, msbpost, [ADCin\12]
        myArray(k)=ADCin
        high CS
        pause 10
next
```

First, a loop is made to read each channel of the MAX186. For each channel, starting at channel 0 and ending at channel 7, the BS2 looks up the number it recognizes for the particular channel. This is done by looking up the position given by the channel number in the array,

[142,206,158,222,174,238,190,254]. This number, chsel, enables the BS2 to start a conversation with that channel and obtain the reading assigned to variable ADCin. ADCin is then put into an array, MyArray, at the channel position.

A loop is then used to display the readings from the sensors or to send them to Macromedia Director with the serout command.

```
for j=0 to 7
        testval=myArray(j)

        'debug dec j+1,": ", bin12 testval, cr
        'debug dec j+1, ": ", dec4 testval, cr

        testval= (testval-1860)/8
        'debug dec j+1, ": ", dec4 testval, cr
        'pause 10

        serout 7, 16468, [testval]
        pause 30
next
```

The loop obtains the readings at each position in the array by using the variable *testval* to store the current reading and displays or sends out *testval*. Before *testval* is sent out, some massaging of numbers is done to get the number under 255. This is due to Director's inability to recognize numbers larger than 8-bit.

In testing the BS2 programmed with this code, it was found that Director becomes confused about which reading is from channel 0 and so on. This is due to timing issues, and one strategy to counteract these issues is to send out an ascii character before sending out the reading for channel 0 and subsequent channels. Also, it was found that there is some delay between the sensors and the readings in Director of those sensors. Thus, the baud rate of the serial connection between stamp and director was set to the highest possible rate for the BS2, 19200, making the delay very small.

The Lingo programming in Director involves the use of the SerialXtra to communicate with the BS2 by serial connection.

```
on configureSerial
  openxlib "SerialXtra"
```

```
  showxlib  --this tells you which xtras director currently has access to, serial xtra should show up
  put mmessagelist( xtra "Serialxtra" )  --this tells director which commands this xtra offers

  set gSerialPort = new( xtra "SerialXtra", "COM1" )  --specify which port.  you can say modem and printer from mac
  gSerialPort.SetProtocol(19200, "n",8,1) -- the default is 9600,"n",8,1  so we don't really need say this
  gSerialPort.readString()   --clear out anything that was in there
  gSerialPort.writeString("Z")  --prime the pump with some character in case the stamp was stuck in serin
end
```

The code opens a connection with the BS2 and tells Director which serial port to expect information from.

The Lingo programming also determines the visuals being presented on each panel and the visual folding of those images. By getting the readings from each sensor through serial connection with the BS2, the programming is keeping track of which sensors have been folded and thus which images should be shown and not be shown. This is laid out in the mapping diagrams shown previously. Also, to enact the visual folding of an image when the readings show that the sensor is being bent, the programming changes the width or height of the image sprite according to the numbers. For example, if panels “A” and “D” are being folded over, then the widths of the images of “A “ and “D” become smaller. When the panels pass being perpendicular to the surface of the structure, the widths of the images of the back of “A” and the back of “D” become larger until the panels are completely folded over. The programming stores into an array that flex sensor 1 is folded over.

The logic of the programming that enables the correct images to be projected according to the sequence of folding involves thinking of each completed fold as a narrowing down of possibilities. Each fold is stored in an array as the number of the flex sensor that was bent in the fold. The array becomes the list of folds made. Combining the use of arrays and conditional statements allows the path down the branching of possibilities to be determined. In an extremely simplified explanation, if, say, flex sensor 1 is folded first and then flex sensor 4, the array stores 1 at position 0 then 4 at position 1, becoming [1, 4]. Essentially, the conditional

statements determine: if 1 is followed by 4 in the array, then show movie x and y folding in. Thus, the movies are not randomly generated; they are essentially predetermined and mapped to the sequence of folding.

This switching in and out of images in the visual folding may not take full advantage of the continuous range of numbers given by folding or the concept of physical folding itself. To really express the fold as boundary and as continuity, the visual folding could exist as a superimposition of the images being switched or an expression of the folds made previously. These possibilities will be explored.

3.4. Installation Set-up

As discussed with Carl Andre's sculptures, the spatial arrangement of form in space affects participants' perception and experience of an artwork and the way in which they approach an artwork. Thus, the space in which this project is situated, in relation to the space offered *by* the project, is important. The spatial setup of the project is meant to bring focus to the folding structure as the event-space. Thus, the various components of presentation are arranged to emphasize the emergence of events within the structure and emphasize the user's role as active participant.

The images controlled by Lingo in Director are ultimately projected on top of the folding structure. Thus, the folding structure becomes a sort of interactive projection screen. In the installation set-up, the folding structure lays on top of a table that contains the circuit and computer protected within it. Thus the structure is anchored down at the center panel where the wires of the flex sensors exit the structure.

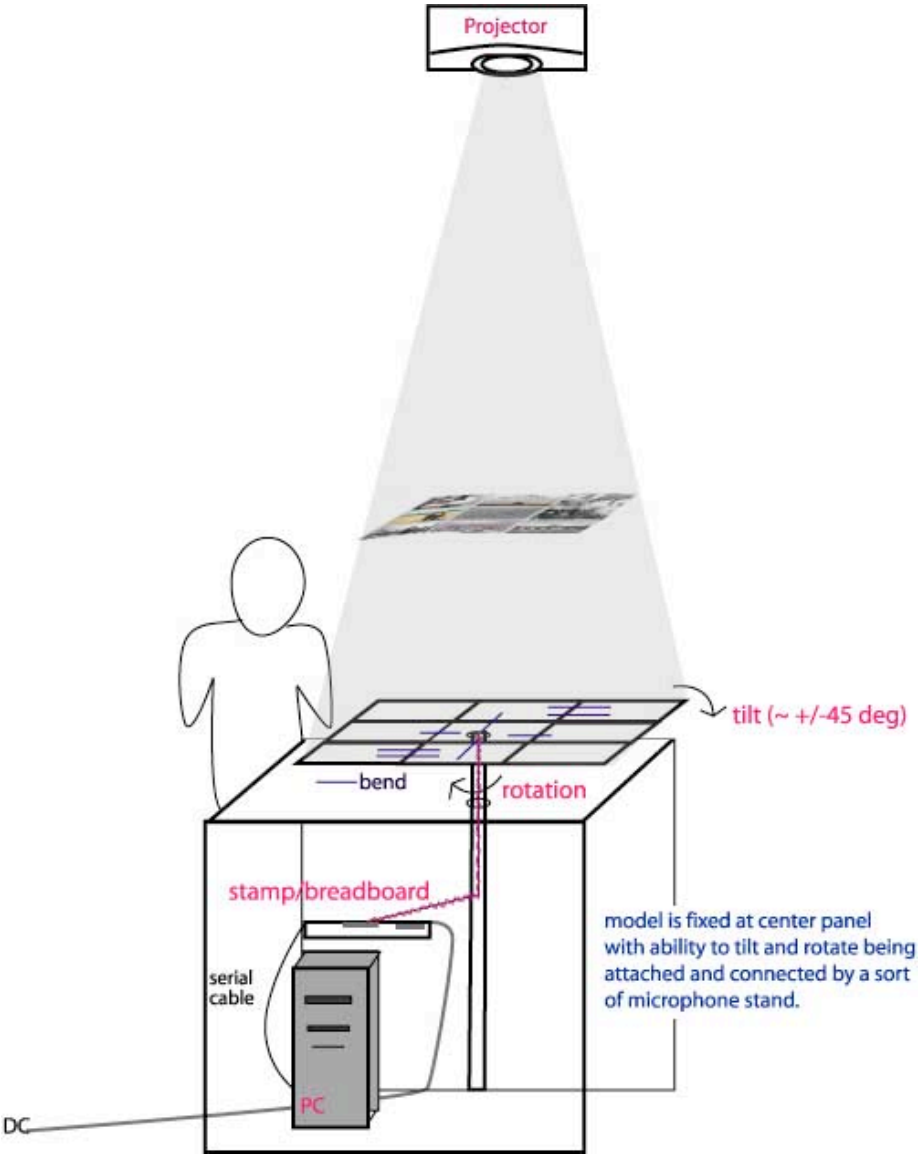


Figure 84. Overall diagram of installation involves a projector and a table for the structure.

3.4.1. Table

The table exists to place the folding structure at the level of the participants' hands to induce interaction and exists to impart to the participants the ability to approach the structure from any side. Thus, the table is a simple, white cube, with a square surface measuring 34" by 34" and a

height of about 3.25 feet. Within the table is a PC tower with the circuit box on top. The circuits shown previously were made in breadboards, but for the actual installation of the project, the circuit will be soldered into a PC board and contained within a project box. The table has an opening 2 inches in diameter in the center of the top surface. This opening is for the wires of the sensors to come through. The table also requires an opening on the bottom of one side for the power cords of the circuit and PC and also for a cable connecting the PC to the projector. A removable, sliding, or opening panel is also needed to gain access to the PC for start-up, shutdown, and general maintenance.

The possibility of using a microphone stand is being explored. The microphone stand would protect the wires of the sensors from noise induction and would provide an anchoring joint for the model that could rotate and tilt. As discussed previously, the rotation and tilting of the structure is being kept as a possibility if conceptual reason and integration is found. If used, the microphone stand would be attached to the model at the center panel opening and come through the table opening. The wires would then lead out from the stand to the circuit box to connect to the circuit at the level of the circuit box.

3.4.2. Projection

To integrate the result of folding with the act of folding, the installation requires a top-level projection onto the structure. Thus, a projector is set centered above the model. The exact distance required between the projector and the structure has yet to be determined. The space that the installation is in should be dim but does not have to be completely dark. The problem of the user's shadow interfering with the projection of images has been considered, but no better solution for the integration of images with the structure has been found.

3.5. Narrative

The reason, the purpose, for the fold in this project is the narrative of the event. Although Deleuze states that it is the narrative that best hides the event, the narrative in this project does not attempt to summarize an event; it does not assume that an event can be reduced to one concluding sentence or outcome that represents that which comprises an event. Rather, the narrative of this project opposes the assumption often made by the media that an event can exist between a beginning and an end and is experienced through the linear sequence of occurrences in between. Similar to Carl Andre's sculptures, the event is not meant to be entered at a specific point or experienced from a certain point.

Realizing what imagery would best constitute this narrative of the event was the largest challenge that I had to overcome in this project. This aspect of the project was very much at an impasse. In retrospect, the difficulty arose from the very associations that we as a society have with the term "event." The hurdle that I had to overcome was the belief that an event necessarily had to be large and earth shattering. Rather, I realized that the occurrences that are considered non-events may be the best to represent the emergence of an event. As discussed with the Fluxus movement, these events allow immersion into the workings of an event. They are pure events, stripped of media narrative or connotations. Thus, the decision was made to show everyday occurrences, focusing on everyday objects and scenes.

3.5.1. Images/Movies

An aid to making this decision was taking pictures with a Polaroid Spectra camera. With this camera, pictures could be taken of banal objects, like a toothbrush, a bed, a ceiling, an empty room, and a mirror, and quickly placed together. These everyday objects offer what Whitehead terms

ingression, one of the four conditions of an event. They are objects that produce a way of approaching an event. They are objects that consistently exist in our daily lives and connect events, becoming means of extension of events.

Similar to Vertov's *Man with a Motion Camera*, these pictures intend to capture slices of life, moments that are quickly passed, hardly noticed, and yet meaningful. Like the movie, there is an order to the seemingly banal moments. Many of these little occurrences culminate in larger ones. Even the smallest decisions affect what happens in the future. Little occurrences often propel superstitions of luck. One creates a routine to ensure a good day or a good game. Thus, these small occurrences can become the standard to gauge the larger, more dramatic occurrences.

The imagery also conveys the perspective of events from a very personal level, as opposed to one that is social. I did not set out to use images that were intimate in nature; this happened intuitively. In retrospect, the reasoning behind this personal perspective is derived from the fact that, ultimately, understanding of an event lies with the individual. Especially in our modern society where an event is telescoped by the media until we are blinded with multiple meanings, it is up to the individual to determine her own meaning. Thus to begin to understand the nature of the event, the individual begins with the individual, personal events.

Yet, the individual, personal events are not isolated from the larger, more public events, for each individual, they are interconnected. It is the sharing of a public event in the midst of each individual's perception of meaning that is left for further exploration and discovery.

Figures 85-90. Polaroid pictures of everyday occurrences.

As still images, these Polaroid pictures only imply living, an act, an action. Thus, the use of very short, ten second movies was explored. These movies were found to give a better impression of life than the still pictures. Even if these movies contained no large movements, no signs of action, they were able to confer the feeling of living.

Figures 91-93. Short, looped movies of everyday occurrences.

The challenge is to create a narrative that keeps the user exploring the many possibilities of events. The question becomes whether an impetus needs to be enacted along some point of the progression.

3.5.2. Director

Around a hundred movies make up the "database" of everyday occurrences in Director. The iterations of folding become the trajectory or path through this library of images so that an event emerges. As mentioned previously, Director keeps track of the order of folding, which sensors and which order those sensors have been folded. This order determines which progression of possibilities of events is shown. The path is a path down a multitude of possibilities, a multi-layered system.

Practically, Director has difficulty in showing multiple simultaneous movies in Quicktime format. The movies become choppy, and the visual folding becomes delayed. Thus, the possibility of breaking down the movies into sequences of images and making those sequences into film loop cast members in Director is being explored.

3.6 Synthesis

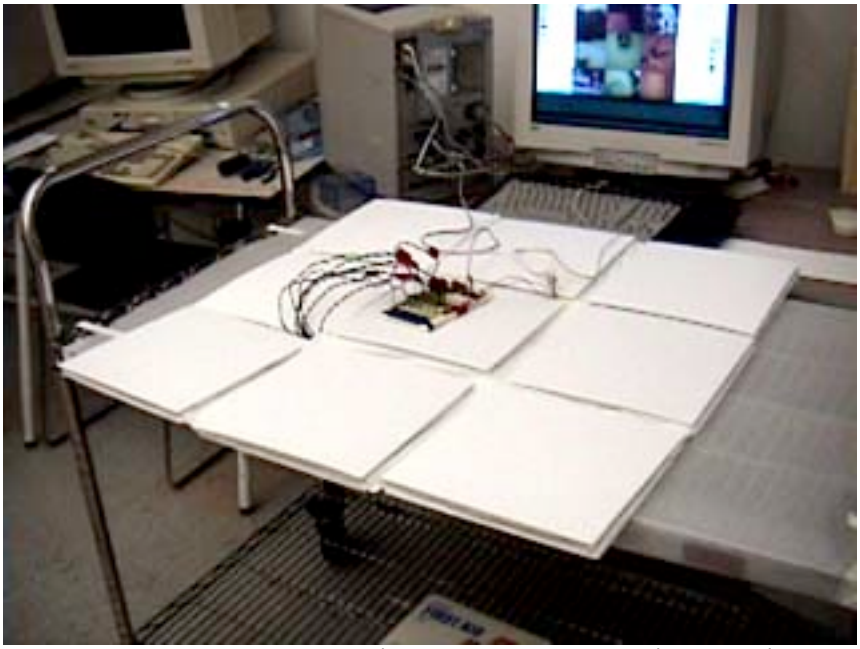


Figure 94. Final prototype in conjunction with circuit and imagery.

When material form, mapping, technological backbone, installation set-up, and narrative are combined, the result is a 3 by 3 square, 2-slit, folding structure composed of white fabric and board whose folding requires the interaction of a user. This folding is sensed by flex sensors whose analog bending is converted to digital information and read by a microprocessor in a circuit. The microprocessor sends the data over serial communication to the Director program running on a computer. The Director program determines which sensor has been folded and, through the programming that was informed by the detailed mapping of the logic of folding, knows which images to show and which visual folding to enact. Director draws from its cast member library the images of everyday events in this process. The stage of director is projected onto the structure itself so that the images are integrated with their respective panels. The overall experience should be a structure as event-space, where events emerge by iterations of actions of change through folding.

4. Evaluation

4.1. Goals

4.1.1. Summary of Goals

As stated previously in the *Summary of Rationale* section, the goals of this thesis project are:

> 1) To create a materialization of the system of events, an event-space, that is enabled by the fold. Inherent to this goal is the desire to successfully convey complex concept.
>
> 2) To create a structure that becomes event-space when the user becomes performer in the action of folding. In this space, the user/performer is immersed into the workings of the event through the banality of everyday occurrences.

3) To create a successful integration of physical design, technical electronic design, software programming, and conceptual design that enables the experience of the event-space.

4) To create an object that is experienced as space and utilizes the properties and arrangement of the material chosen to help create such an experience.

5) To create a structure that allows the user to create order from the images of simple, everyday occurrences to form the non-linear narrative of the event. The fold is the means by which such order is created.

The ultimate goal is to create some understanding of the concept of the event and what truly constitutes the nature of an event through this event-space.

4.1.2. Successes

The successes of this project are in its material form, interactivity, and extensive study of possibilities. The form succeeds in existing as a logical configuration of possibilities that can be mapped. In doing so, it realizes a system of set conditions and possibilities. The form also succeeds in the ease of interactivity. The fold is a simple gesture and is a natural act of the hand. The form in its feel of material and structure of material induces the desire to fold. The form is relatively successful in gauging the amount of folding through the use of flex sensor and the circuit design. Attention to the properties of the material used and to the arrangement of elements in the structure is also carried out well. Physical design, technical electronic design, and software programming are integrated together well also.

But the big questions are: does the concept get conveyed to the user so that the user becomes performer in the event-space? Is the form successful in being inherent to concept? Or was the concept made to fit the interface?

4.1.3. Failures

The failures lie in falling into the trap of a linear narrative when non-linearity is desired and not taking full advantage of the sensing of the fold visually and conceptually. Even if the structure allows for a branching narrative, the feeling is still linear in that images are switched in and out depending on the progression of folding. The montage of images has not been taken advantage of. The levels of folding are also not indicative in the visuals shown; there is no designation or sign of place within the process except in the physical structure itself. The user does not realize their path is a singularity among a multiplicity until different ways of folding are experimented with. And also as of yet, there are no established ends of the narrative when the point of no additional folds is reached and no established rules to the progression of the different paths of the narratives.

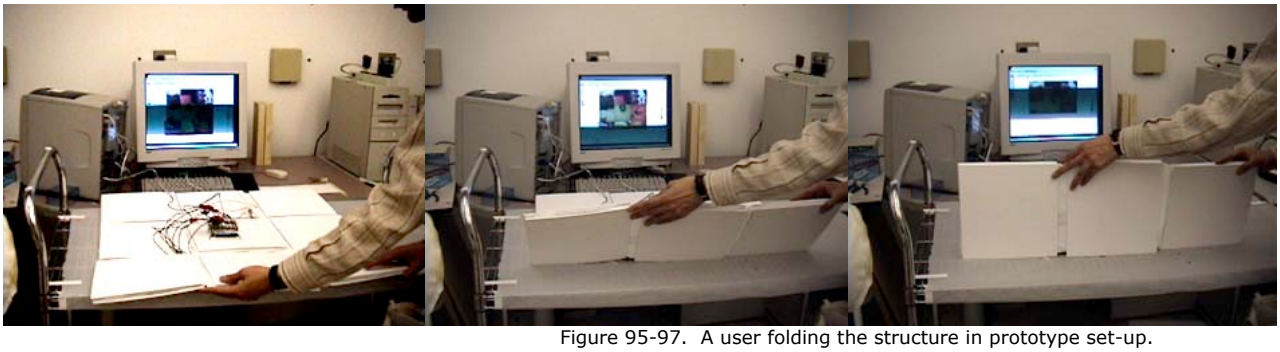


Figure 95-97. A user folding the structure in prototype set-up.

5. Conclusion

5.1. Summary of Materialization of Concept

This project began as an attempt to understand the concept of the event. The context of this attempt was the event of September 11 where the very occurrence and nature of an event plagued and haunted the minds of a whole nation. This event was THE event; how could any other occurrence take on the same label? The shock that accompanied this event was understandable; the incomprehensible nature of this occurrence numbed the mental functions that could have found any reason or logic. But this numbing was also due to the barrage of media coverage where this event became objectified; it became a story with cover (logo), title (catchphrase), and pictures (repeated horrific imagery). And yet this extreme simplification does not help in comprehension, it actually hides the true nature of the event. It would be invaluable to understand such an event for an event is a manifestation of the underlying currents of a society. Tragedy added to enormous tragedy would be to let this event happen without beginning to understand the nature of it and our society, to let events cascade out of our control, to let events outrun our understanding.

And so I began the long process of finding means of comprehension in the materialization of the concept of the event. This materialization is inspired by a phrase used by the news media itself, "as the events unfold." As a phrase that seems to have been subverted by the news media to become linguistic accessory, the phrase, once torn away from such subversion, becomes a lead, a clue, to the nature of the event. But how does one really expect to materialize an abstract concept especially into a form that can be held in one's hand? Is this a goal too lofty to succeed? Perhaps.

But I took the challenge on anyway. The materialization became actualized in a folding structure whose folding is measured by flex sensors and presents visuals of everyday

events for the emergence of an event. The structure has been termed frequently in this paper as an event-space of folding. It is a space where an event emerges from the collision of factors; it is a system of events. The possibilities offered by this system are complex yet manageable enough to carry out technically.

But the possibilities are not complex enough to represent the emergence of an event like September 11. This materialization does not pretend to establish rules that will bring complete understanding of all events. Such work would be comparable to discovering an accurate and proven universal theory of everything. I only intend to provide some discovery of an event emerging and existing in a system. This intention is why I stayed away from events that have already occurred; I do not intend to establish rules that will map how an event occurred. I intend to create a space where an event emerges, to create an understanding that an event doesn't just happen, that within that event are contained, like "a cavern within a cavern, a fold within a fold," past occurrences, factors, etc. An event is its past and its future.

5.2. Lessons Learned

To partake in such a large challenge conceptually and technically, one must expect that no right answers will really be found. There is always some improvement to be made in carrying out concept and in technical configurations. This is especially true in terms of physical computing technology. There always seems to be a better sensor out there to suit the project, a means to make the circuit or sensing more efficient. Also, one must learn to keep all components of a multi-faceted project in balance. It was difficult in this project to not fall into the trap of only focusing on material form and technology while letting the narrative aspect of the project fall aside. And, one must not use sensing technology just because one can. There must be conceptual reason and not just the added bonus of an additional feature to the project.

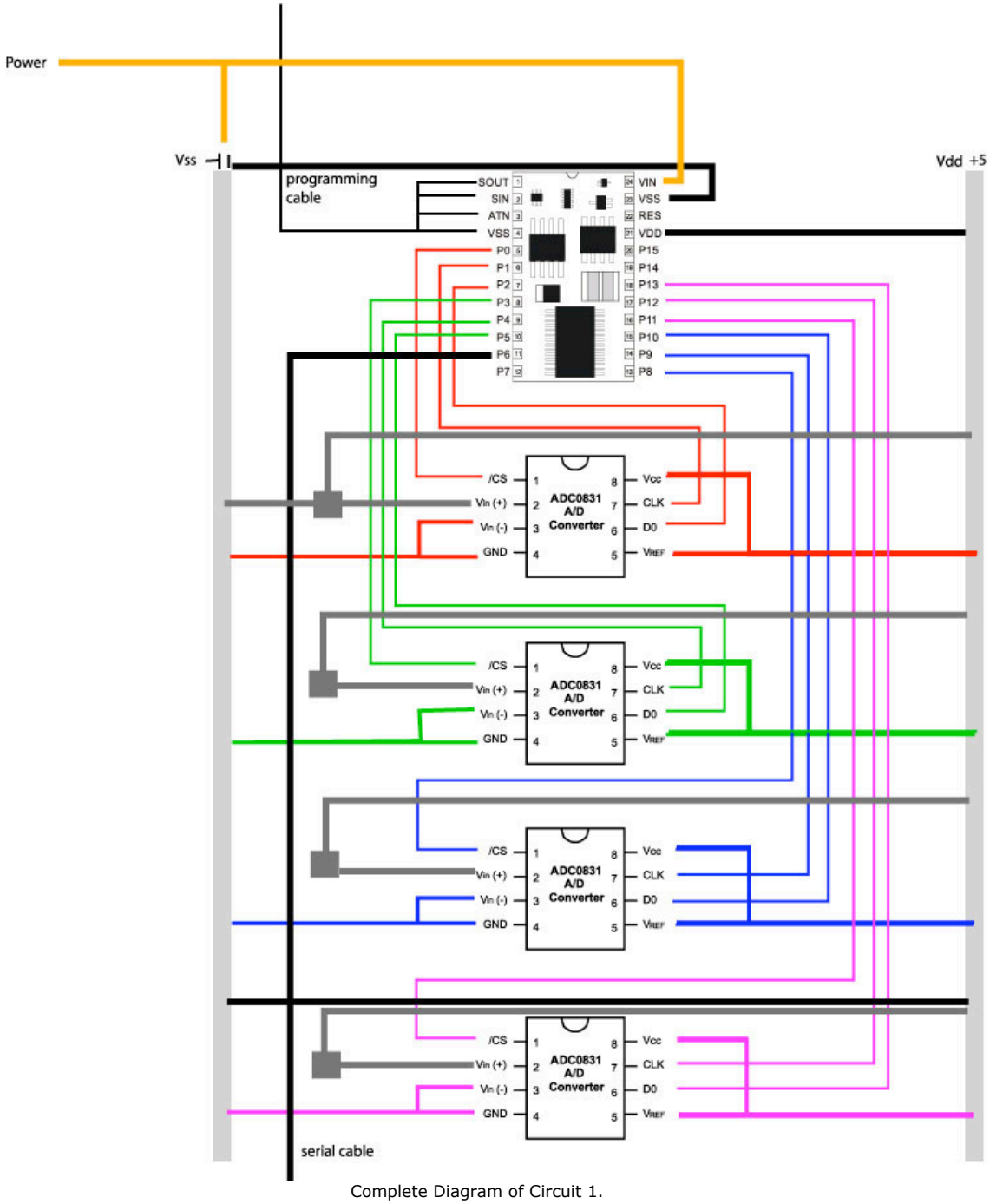
One must also learn to reign in the scope of the project to something that is possible because even projects smaller in scope are an extensive process. It is a process of investigation, experimentation, evaluation, re-investigation, re-experimentation, re-evaluation, and so on. One begins to ask if a project ever really finished? Or is this project an iteration in a series? Materialization #1 in an infinite series?

5.3. Future Directions

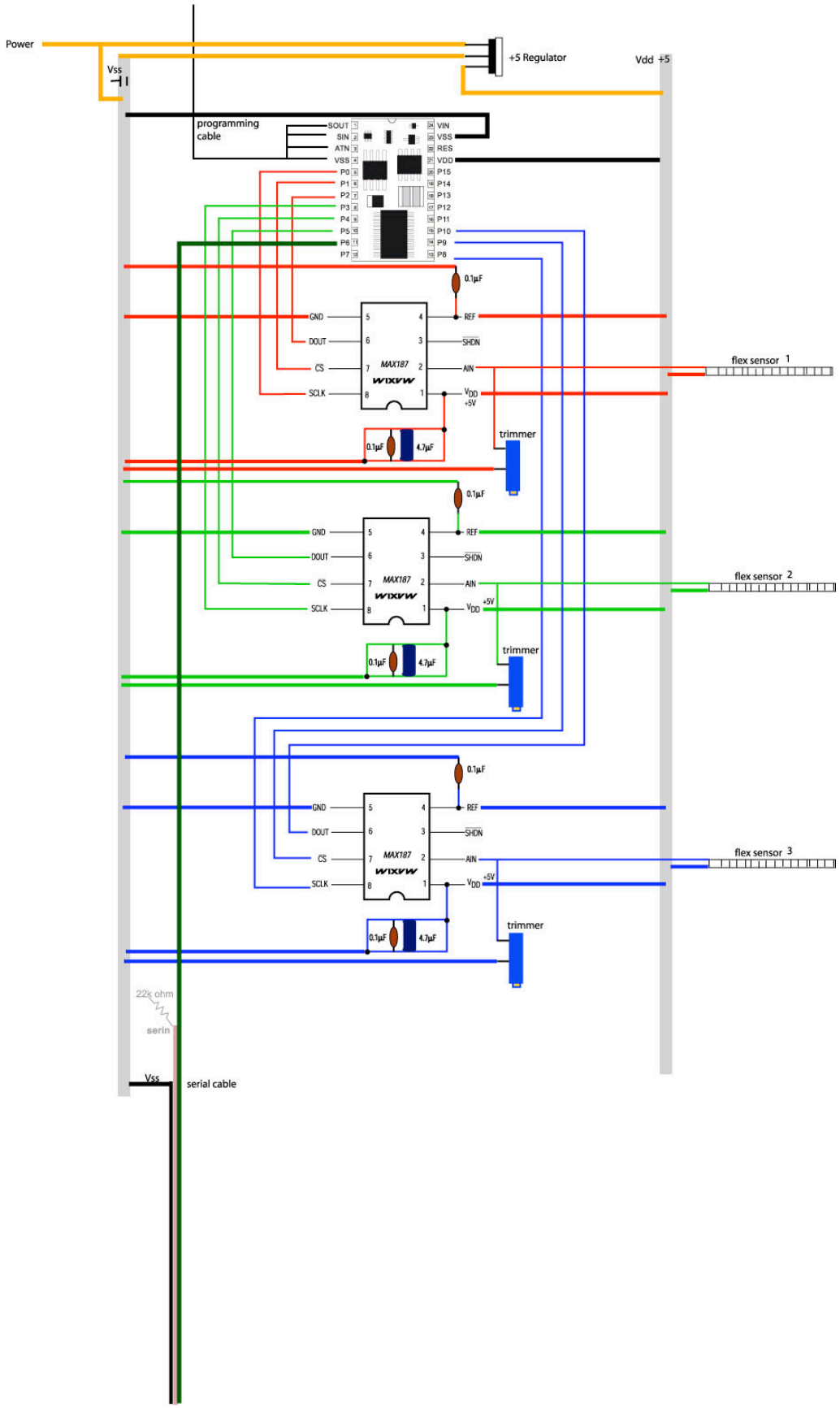
Those questions will be answered in further workings with this project. By nature of the large question I began with, "what is the nature of an event?", there is much to still discover. It could indeed lead to a life-long series of projects. For this particular project (iteration?), I still need to discover the existence of purpose of the rotary encoder and accelerometer, if there indeed is one. I still need to really push the possibility of the fold in the interface and to push the non-linearity of the narrative to become 'non-narrative'. Also, one idea that I came upon but eventually abandoned is a larger collaborative folding structure, to explore an event as simultaneously personal and public experience. This and many ideas to be inspired by the concept of the event are to be explored.

Appendix A. Technical Supplements

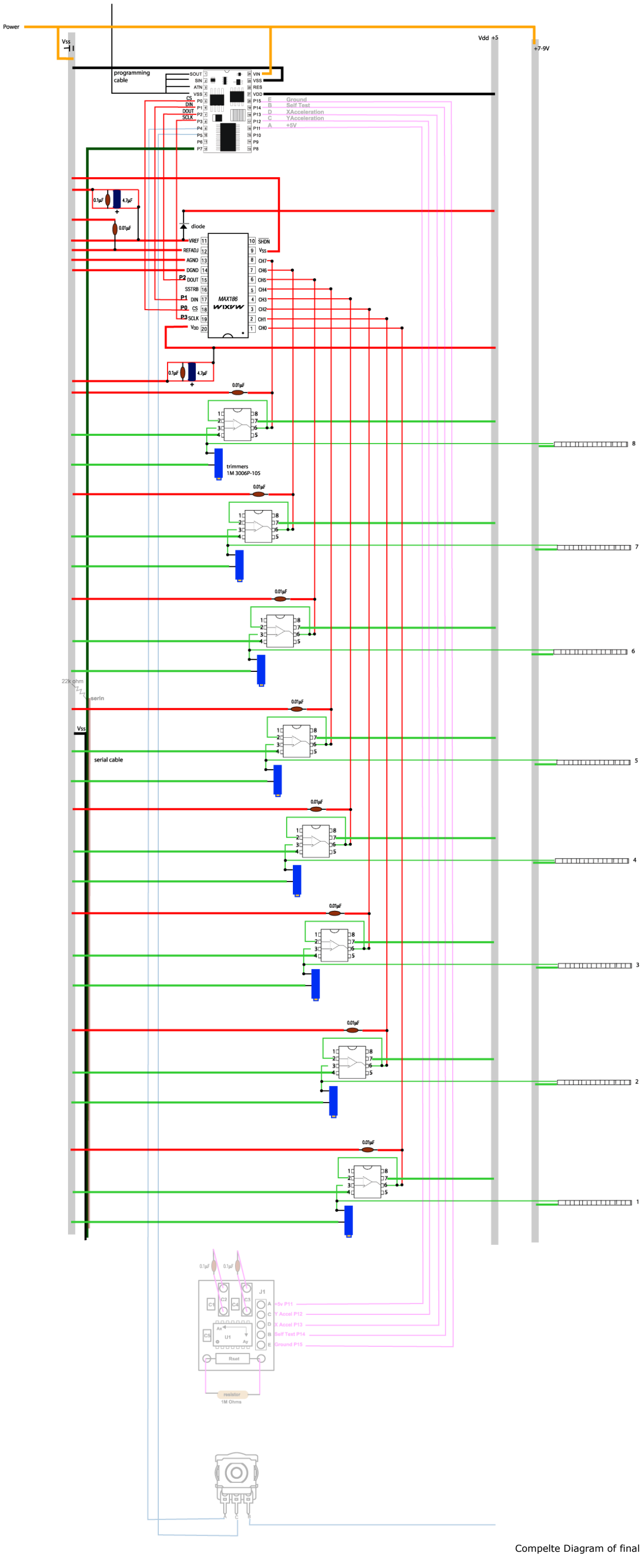
A.1. Circuit Diagrams



Complete Diagram of Circuit 1.



Complete diagram of circuit 3.



Compelte Diagram of final circuit.

A.2. Code

A.2.1. Code for BS2 with 3 MAX 187 and 3 flex sensors:

```
' { $STAMP bs2 }
'
' Pinout for the MAX187 12-Bit Serial ADCs
'                  _______
'         VDD     -|       |-      SCLK    -> Connect to Pin 0 on BS2
'         AIN     -|       |-      CS      -> Connect to Pin 1 on BS2
'         SHDN    -|       |-      DOUT    -> Connect to Pin 2 on BS2
'         REF     -|_____  |-      GND


'         Pin     Name    Description
'         ---     ----    ---------------------------
'         1       VDD     Positive power supply (+5V)
'         2       AIN     Sampling analog input
'         3       SHDN    Shutdown input (leave floating)
'         4       REF     Reference voltage (connect to +5V and bypass
          with a 0.1uF cap to GND)
'         5       GND     Analog and digital ground
'         6       DOUT    Serial data output for daisy-chaining
'         7       CS      Active-low Chip Select
'         8       SCLK    Serial clock input


'Pinout for the ADXL202EB
'
'         Pin     Description
'         ---     -----------------------------------
'         A       Positive power supply (+5V)
'         C       Y Acceleration
'         D       X Acceleration
'         B       Self-test
'         E       Ground
'

' ------[ Pin Outs ]-------------------------------

'-------flex sensor 1--------------
SCLK                con     0
CS                  con     1
DOUT                con     2

'-------flex sensor 2--------------
SCLK2               con     3
CS2                 con     4
DOUT2               con     5

'-------flex sensor 3--------------
SCLK3               con     8
CS3                 con     9

DOUT3               con     10


'-------adxl202EB-------------------
'E                  con 15  'ground
'B                  con 14  'self-test
'D                  con 13  'x accel
'C                  con 12  'y accel
'A                  con 11  '+5V

' ------[ Variables ]-------------------------------

maxdata  var        word                ' result from MAX187 (12 bits, MSB)
maxdata2 var        word
maxdata3 var        word
```

```
FREQ            var     word            'variable declarations for
adxl202EB
T1x             var     word            'T1 X channel
T1y             var     word            'T1 Y channel
T2              var     word            'PWM period
Xdeg            var     word            'X tilt
Ydeg            var     word            'Y tilt


'-----[ Program Loop ]------------------------------
pause 100                               ' Wait for the capacitor on
REF to charge
CONVERT:

 '-----bend sensor and maxim187----------------------

high CS                                 ' Set the CS line high, then...
low CS                                  ' ...pull CS line low to start the
conversion
pause 10                                ' Give the MAX187 time to convert
shiftin DOUT,SCLK,MSBPOST,[maxdata\12]          ' Shiftin the data from the
MAX187
high CS                                 ' Raise the CS line after the LSB has
been read

high CS2                                ' Set the CS line high, then...
low CS2                                 ' ...pull CS line low to start the
conversion
pause 10                                ' Give the MAX187 time to convert
shiftin DOUT2,SCLK2,MSBPOST,[maxdata2\12]     ' Shiftin the data from the
MAX187
high CS2                                ' Raise the CS line after the LSB has
been read

high CS3                                ' Set the CS line high, then...
low CS3                                 ' ...pull CS line low to start the
conversion
pause 10                                ' Give the MAX187 time to convert
shiftin DOUT3,SCLK3,MSBPOST,[maxdata3\12]     ' Shiftin the data from the
MAX187
high CS3                                ' Raise the CS line after the LSB has
been read

'-----------adxl-----------------------------------------
'LOW       E                                   'pin 15=ground
'HIGH A                                 'pin 11=+5v

' INPUT C                               'pin 12 input Ay
' INPUT D                                       'pin 13 input Ax
 'LOW B                                 'pin 14 self test off


' COUNT 8,500,FREQ
' T2=25000/(FREQ/20)
' PULSIN 12,1,T1y
' T1y=2*T1y
' PULSIN 13,1,T1x
' T1x=2*T1x

' Xdeg=8*T1x/T2
' Ydeg=8*T1y/T2

 'maxdata = (maxdata-300)/4
'maxdata2 = (maxdata2-300)/4
'maxdata3 = (maxdata3-300)/4


 '----------debugging window for testing-------------------------

'debug "flex1 bin12: ", bin12 maxdata, cr        ' Show the result on the PC
'debug "flex1 dec: ", dec maxdata,cr
'pause 100                              ' Wait for 1 second

`debug "flex2 bin12: ", bin12 maxdata2, cr      ' Show the result on the PC
```

```
'debug "flex2 dec: ", dec maxdata2,cr
'pause 100



'debug "flex3 bin12: ", bin12 maxdata3, cr          ' Show the result on the PC
'debug "flex3 dec: ", dec maxdata3,cr

'pause 100



' debug "Xtilt: ", bin12 Xdeg, cr
' debug "Ytitt: ", bin12 Ydeg, cr

 '-----------serial out-----------------------------------------------

 serout 7, 16468, [maxdata]
pause 30
serout 7, 16468, [maxdata2]
pause 30
serout 7, 16468, [maxdata3]
pause 30
goto CONVERT                                ' Go take another conversion
```

A.2.2. Code for BS2 with 1 MAX186 and 8 flex sensors:

```
'{$STAMP BS2}
'-------------------------------array and max186--------------------
'--------variables------------------------

channel    var nib
chsel                var byte

myArray   var word(8)
ADCin                var word

j                    var byte
k                    var byte

testval     var word

'---------connection to stamp pins-----------------

CS                   con 0
serDin     con 1
serDo                con 2
serCLK     con 3

'---------routines-------------------------
main:
gosub max186
debug home
for j=0 to 7
            testval=myArray(j)

            'debug dec j+1,": ", bin12 testval, cr
            'debug dec j+1, ": ", dec4 testval, cr

            testval= (testval-1860)/8
            'debug dec j+1, ": ", dec4 testval, cr
            'pause 10

            serout 7, 16468, [testval]
```

```
        pause 30
next
goto main



max186:
for k=0 to 7
        low CS
        channel = k
        lookup channel, [142,206,158,222,174,238,190,254], chsel
        shiftout serDin, serCLK, msbfirst, [ chsel]
        shiftin serDo, serCLK, msbpost, [ADCin\12]
        myArray(k)=ADCin
        high CS
        pause 10
next
return
```

A.2.3. Code for BS2 and 8 debounced switches:

```
'{$STAMP BS2}

'simultaneously debounce multiple inputs

'-----------------------------------------------------------------
SwIn            VAR     InL     'pins 0-7
swtches VAR     byte            'debounced inputs
x               VAR     Nib     'loop counter

'-----------------------------------------------------------------

Main:

        GOSUB   GetSwitches
        'display in binary mode

        DEBUG CLS, IBIN8 swtches
        pause 20
        serout 9,16468,[swtches]

        PAUSE 100                       'a little time between readings

        GOTO Main                       'do it again
        END

'-----------------------------------------------------------------

GetSwitches:

        swtches = %11111111             'enable all eight inputs

        FOR x = 1 to 10

                swtches = swtches & ~SwIn   'test inputs
                PAUSE 5                 'delay between tests

        NEXT
        RETURN
```

A.2.4. Code for BS2 with ADXL202EB:

```
'{$STAMP BS2}
' -----------------------------------------------------
' G-sensor I/O 0-3 ( Dual axis accelerometer ADXL202EB)
' -----------------------------------------------------
' | Stamp I/O | ADXL202EB connections             | Connector 2       |
' -----------------------------------------------------
' | I/O 11    |        pin A  Vdd                 |          1        |
' | I/O 12    |        pin C      Y out           |          2        |
' | I/O 13    |        pin D      X out           |          3        |
' | I/O 14    |        pin B      Self Test  |          4        |
' | I/O 15    |        pin E      GND             |          5        |
' |               |               switch (return)     |          6        |
' -----------------------------------------------------

'-------------------------------------------------------------------
'---------------- Constants and variables Measurements ----------------
'-------------------------------------------------------------------
temp                    var         word
Index                   var         word
TimeX                   var         word        ' T1 X channel
TimeY                   var         word        ' T1 Y channel
AX                      var         word
AY                      var         word

signX                   var         byte
signY                   var         byte
TcenterAxcon            17610       ' Time Axis X for G=0 orig 665
TcenterAycon            17260       ' Time Axis Y for G=0
GAx                     con         4070        ' Time diff. Axis X Gmax-Gmin
GAy                     con         4120        ' Time diff. Axis Y Gmax-Gmin


INITIALISATION:
HIGH 11                 ' switch on accelerometer
low 14                  ' disable self-test
'low 15           ' give ground to E
pause 1000
INPUT 12
INPUT 13



PULSE:
signx=0
signy=0
PULSIN 12,1,TimeY
PULSIN 13,1,TimeX
'debug "TimeY= ", dec TimeY," ", "TimeX= ", dec TimeX, cr
'debug "TcenterAx = ", dec TcenterAx, cr
'debug "TcenterAy = ", dec TcenterAy, cr
if TimeX >= TcenterAx then XSIGN
SIGNTESTX:
if TimeY >= TcenterAy then YSIGN
SIGNTESTY:
TimeX = abs(TimeX-TcenterAx)*10
TimeY = abs(TimeY-TcenterAy)*10
AX = (TimeX/407)*10+((TimeX//407)*10/407) max 1000
AY = (TimeY/412)*10+((TimeY//412)*10/412) max 1000
temp=AX
gosub INTERPOLATION
if signx=0 then POSX
gosub SIGNED
POSX:
AX=temp
temp=AY
gosub INTERPOLATION
if signy=0 then POSY
gosub SIGNED
POSY:
AY=temp
debug "Ax: ", DEC Ax," ", "Ay: ", DEC Ay, cr
```

```
pause 100
goto PULSE

XSIGN:
signX=1
goto SIGNTESTX

YSIGN:
signY=1
goto SIGNTESTY

SIGNED:
temp=359-temp
return


'-------------------------------------------------------------------------
'---------------------------- INTERPOLATION ------------------------------
'-------------------------------------------------------------------------
' You need this part to convert from sin(x) to angle in deg.
'
INTERPOLATION:
if temp >=342 then d20
temp=temp/17
goto dend:

d20:
if temp >=643 then d40
temp=temp-342/15+20
goto dend:

d40:
if temp >=820 then d55
temp=temp-643/12+40
goto dend:

d55:
if temp >=906 then d65
temp=temp-820/9+55
goto dend:

d65:
if temp >=940 then d70
temp=temp-906/6+65
goto dend:

d70:
if temp >=966 then d75
temp=temp-940/5+71
goto dend:

d75:
if temp >=985 then d80
temp=temp-966/4+76
goto dend:

d80:
if temp >=996 then d85
temp=temp-985/2+80
goto dend:

d85:
if temp=1000 then d90
temp=temp-996+85
goto dend:

d90:
temp=90

dend:
return
```

Bibliography

Andre, Carl. *Carl Andre*. Haags Gemeentemuseum Den Haag and Stedelijk Van Abbemuseum Eindhoven, 1987.

Andre, Carl. *Wood*. Van Abbemuseum Eindhoven, 1978.

Bennington, Geoffrey. *Lyotard: Writing the Event*. New York: Columbia University Press, 1988.

Blom, Ina. "Boredom and Oblivion." *The Fluxus Reader*. Great Britain: Academy Editions, 1998.

CHORA, and Bunschoten, Raoul. *Urban Flotsam: Stirring the City*. Rotterdam: 010 Publishers, 2001.

Deleuze, Gilles. *The Fold: Leibniz and the Baroque*. Minneapolis: University of Minnesota Press, 1993.

Doris, David T. "Zen Vaudeville: A Medi(t)ation in the Margins of Fluxus." *The Fluxus Reader*. Great Britain: Academy Editions, 1998.

Gorbot, Matthew; Ishi, Hiroshi; and Orth, Maggie. *Triangles: Tangible Interface for Manipulation and Exploration of Digital Information Topography*. CHI '98: ACM, April 1998.

Gorbot, Matthew and Orth, Maggie. *Triangles: Design of A Physical/Digital Construction Kit*. DIS '97: ACM, March 1997.

Hallen für neue Kunst. Carl Andre exhibit. <http://www.modern-art.ch/english/andre.html>

Hunt, Lynn and Revel, Jacques. *Histories: French Constructions of the Past*. New York: New Press, 1995.

Leibniz, G.W. *Monadology and Other Philosophical Essays*. USA: Bobbs-Merrill Company, Inc., 1965.

Levi-Strauss, Claude. *The Savage Mind*. Chicago: University of Chicago Press, 1968.

Manovich, Lev. *The Language of New Media*. Cambridge, MA: MIT Press, 2001.

Thom, Rene. *Structural Theory and Morphogenesis: An Outline of a General Theory of Models*. Reading, MA: Benjamin Cummings Publishing Company, 1975.

Virilio, Paul. *A Landscape of Events*. Boston: MIT Press, 2000.

Wildgen, Wolfgang. *Catastrophe Theoretic Semantics: An Elaboration and Application of Rene Thom's Theory*. Philadelphia: John Benjamins Publishing Company, 1982.

Williams, James. *Lyotard: Towards a Postmodern Philosophy*. Cambridge: Polity Press, 1998.

Wipond, Rob. "Closing the Door: Everything, and Nothing, Has Changed." *Adbusters*. Jan/Feb 2002: 20.

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