ECE445: Bird Box Project Proposal
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I. INTRODUCTION

I.i. Objective

Observation of animal behaviors and responses to certain audio stimuli can become the backbone for how our technologies are shaped or how our secret codes are constructed. Researchers at the University of Illinois are working to uncover patterns from these behaviors among birds through the means of conditioning. However, researchers are faced with a dire problem -- there is no existing system that would perfectly cater towards their research needs and is cost-efficient. Thus, the near to build a system suitable for their research needs becomes increasingly apparent.

The solution would be a system comprised of a hardware and software interface. The software interface would take parameters fed through a Graphical User Interface (GUI) to construct a unique file (with a certain amount of trials and shams) set by the researcher. The hardware would then respond to the data provided by the researcher in the GUI to play audio sounds for the bird to respond to. The bird would provide responses through color-differentiated buttons and these responses would trigger certain outcomes from the system. At the end of the research period, an excel sheet would be generated documenting the results of each unique response that the bird provided.

I.ii. Background

Modern technology has evolved at an incredible rate and digital signal processing is no exception to this rapid growth. With this growth in technology, it is important to also observe natural aspects regarding the field to draw more inspiration for advancements in signal processing. Thus, the analysis of bird behavior and responses to certain audio stimuli becomes a valuable observation for furthering knowledge in this field of study.

To highlight the problem, there will be varying tiers of impacts to provide emphasis on the scale in which the project contribution can help with understanding in this field. Creating a product to suit the needs of researchers will unlock further contribution towards various insights within the field. The trials the system would help conduct further enables understanding of bird communication, which can be applied to save certain endangered specifics upon identifying a certain cry (from a bird). Or, in a broader sense, this can contribute towards how language is perceived among birds-- how they communicate amongst each other or how certain sounds are assigned meanings [1]. Each of these observations can be used as a converging point for how digital signal processing can evolve in the field of animal sciences and behavior. And conversely, advancements analyzing sounds like this may also influence how digital signals are generated or modulated.

I.iii. High Level Requirements List:

• The software user-interface must create one cohesive excel sheet documenting the results of the trial.
• The project must be capable of running at least 20 consecutive trials/shams for the researcher.
• The project must be cost-efficient and within a $700 budget.
II. BLOCK DIAGRAM

II.i. High Level Block Diagram
II.ii. Physical Design

II.iii. Functional Overview

<table>
<thead>
<tr>
<th>Block Name</th>
<th>Specific Components</th>
<th>High Level Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Module</td>
<td>AC/DC Converter</td>
<td>• Convert input voltage to desired output within 10% error</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Carry up to 5A of current within 10% variance during operation</td>
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<tr>
<td>Control Module</td>
<td>IC</td>
<td>• Detect impulse from sensors within 50ms</td>
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<tr>
<td></td>
<td>Microprocessor</td>
<td>• Accurately output audio data within a timing difference of no more than 10ms</td>
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<tr>
<td></td>
<td></td>
<td>• Accurately receive video data with less than 10% loss</td>
</tr>
<tr>
<td>Sensor Module</td>
<td>Trial Start Button</td>
<td>• Button resistance must be low enough for a bird to peck</td>
</tr>
<tr>
<td></td>
<td>Trial Attempt Button</td>
<td>• Buttons must be differing color in order to distinguish function</td>
</tr>
<tr>
<td></td>
<td>Camera</td>
<td>• Video is accurately recorded</td>
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### Peripheral Module
- Food Dispenser
- Cage Speakers
- Cage Light

- Dispenser is consistent as well as accurate to designated amount within 10% mass
- Speakers accurately reproduce pitch and volume of data from connection
- Light switching latency is less than 30ms

### Transfer Module
- DSP Chip
- USB B Protocol

- Must be able to send and receive USB transfer event polls
- Able to accurately stream and receive data via USB
- Correctly interpret signals from control module to send to software module
- Must be able to preserve integrity of transferring signals

### Software Module
- USB Event Thread
- Data Transfer Thread
- Timeout Thread
- Processing Thread
- File Outputs
- GUI
- Room Speakers

- Must have a maximum run cycle of 10ms
- Accurately send and receive signals from transfer module
- Output to CSV or Excel
- Store user inputted data via dump file
- Possess a user friendly GUI

### III. ETHICS AND SAFETY

Following the ACM code of ethics #2.3: “Know and respect existing rules pertaining to professional work”, we need to learn them and make our project according to them. Before any work with animals start it is mandatory to submit IACUC protocols and they adhere to nationwide rules for animal care and research. Our project fulfills all these requirements and has been approved already. The birds are rewarded with specific amount of food for hits, which will ensure all animals get a proper portion of food during the task. To punish the bird, we cut the light which is an ethical way to punish for wrong answers, since it doesn't hurt or stress the bird. Also the There is also an automatic time out if the animal doesn't do anything after a while, which is ethical in making sure the animal isn't in the test for more that it wants to be. This also accords with the ACM code of ethics #1.2: “Avoid harm”, we are treating with animals so we need to avoid any harm that we can cause them.

We need to take care about the IEEE code of ethics #6: “To maintain and improve our technical competence and to undertake technological tasks for others only if qualified by training or experience, or after full disclosure of pertinent limitations”. Our project must be used by someone who has knowledge in the birds’ field so they know how much food the bird can eat and how much time the light can be off. Following this code, we need to make sure that we have and user friendly interface that everyone without programming knowledge can understand. We need to make sure that our project works good and without any kind of error because it is going to be use by other professionals for their own work so their reputation is at stake following the IEEE code of ethics #9.
IV. REFERENCES


[4] Illinois Institutional Animal Care and Use Committee (IACUC) [online] Available at: http://research.illinois.edu/regulatory-compliance-safety/iacuc