Silver Team

MOBI Summer

PRESENTATION BY:

Jack Anderson, Hannah Burnau, Mifta Darge, Janna Jackson, Sammie Ng, Evan Pearson, Harivansh Vaid

Mid-semester progress

INTRODUCTION

MOBI team continuation

Beep Baseball project

Indy Edge team

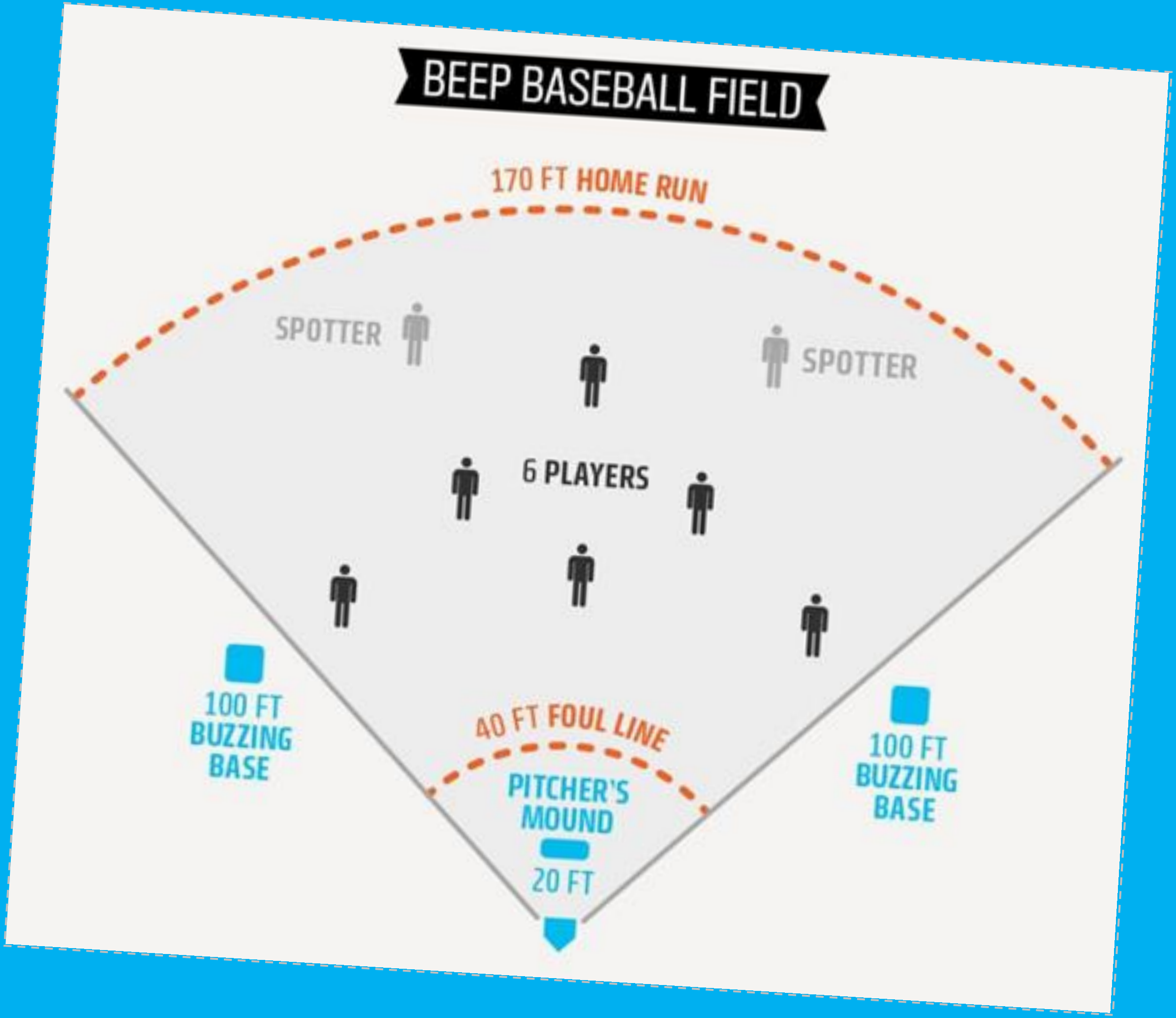
Bosma Enterprises stakeholder

INTRODUCTION

A Brief Look

The Game of Beep Baseball

- Gameplay
  - 2 bases
  - Pitcher on the hitter’s team
  - 6 fielders - blindfolded
  - Sighted volunteers - call once
  - 6 innings - 90 mins



CURRENT DESIGN

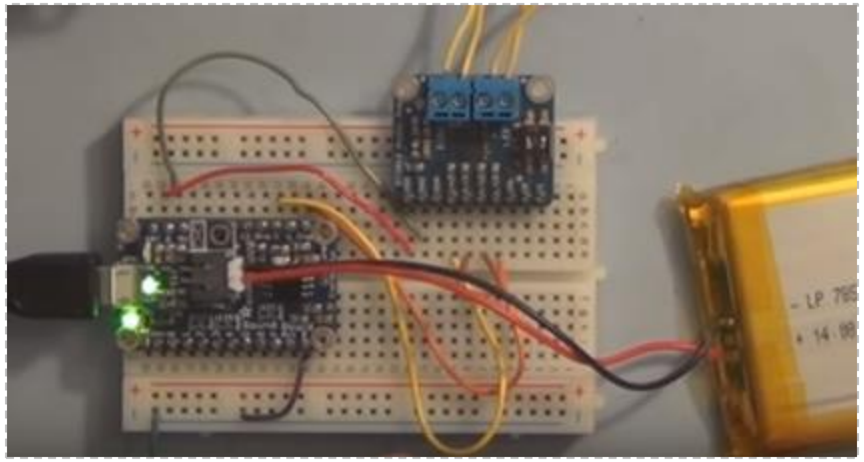
Current Official Baseball Design

- ❑ Old telephone speaker components
- ❑ Developed in 1970’s by a telephone company
- ❑ Silicon shell for electronics
- ❑ Speaker under leather material
- ❑ No longer being made
- ❑ Loud high pitch beep
- ❑ Recharge by pin

PAST DESIGN CONSIDERATIONS

MOBI Spring 2019 Design

- ❑ ABS 3D printed shell
- ❑ Microcontroller



PROBLEM IDENTIFICATION

Materials and Electrical subteams

1

Easily manufacturable

High cost, shortage of materials in current design

2

Easily accessible battery/charging system

Ineffective charging system, potential cause of failure

3

Durable internal components

Prevent borrowing from other teams, balls only last two innings

4

Lower beep pitch, yet still loud enough

Aging players cannot hear the beep

Community Partner Feedback

Phone conversation Week 2

- ❑ Seeking feedback on initial problem identification
- ❑ Identifying points of failure
- ❑ Wanted a consistent ball
- ❑ Gave us free-reign to go in any direction we wanted with for the design

Specifications

- ❑ 90 decibels at 10cm
- ❑ Ball lasts minimum of one game
- ❑ Must withstand about 2000 lbs of force from hit
- ❑ Must travel at least 40 ft and preferably not more than 170 ft
- ❑ Must be able to turn on/off beeping
- ❑ Must be rechargeable - which can mean batteries

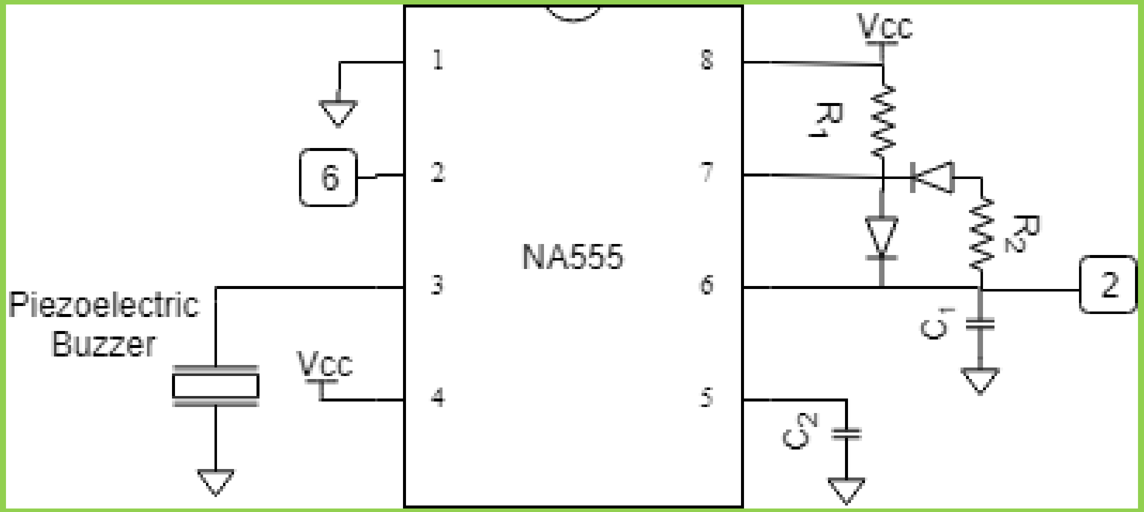
Early Prototyping Materials subteam

- ❑ Capsules that were more rigid
- ❑ Plastic tubes for carrying the sound
- ❑ Large 555 timer speaker

Early Low-fidelity Prototype

- ❑ The materials subteam:
  - ❑ Developed an original idea to hold the speaker yet determined it was too brittle
  - ❑ Swapped the original idea for a flexible foam core

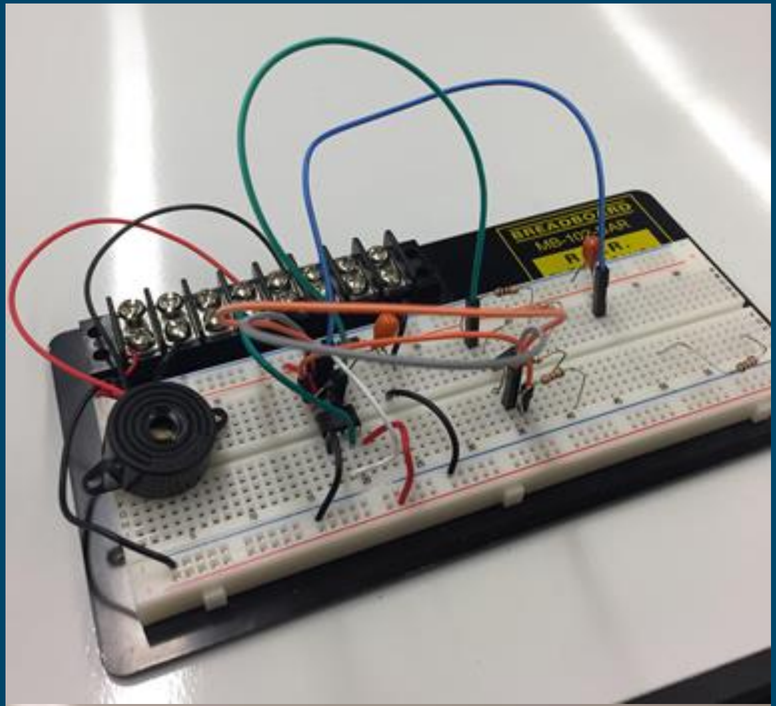
Early Ideation for Electrical Subteam

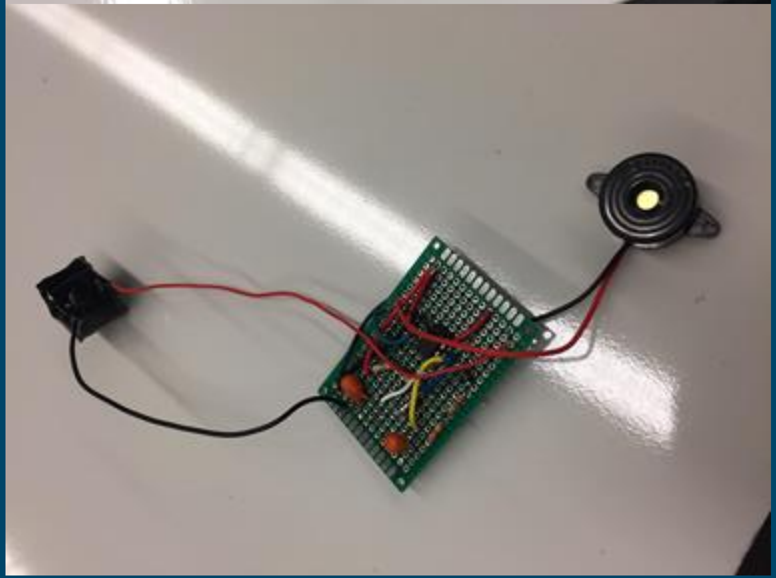


- ❑ Coin Cell batteries are more compact than other choices such as 9V
- ❑ The NA555 timer was chosen due to its versatility
  - ❑ 4.5-16V input/output
  - ❑ a simple change of resistors R1 and R2 can change the frequency of the output waveform

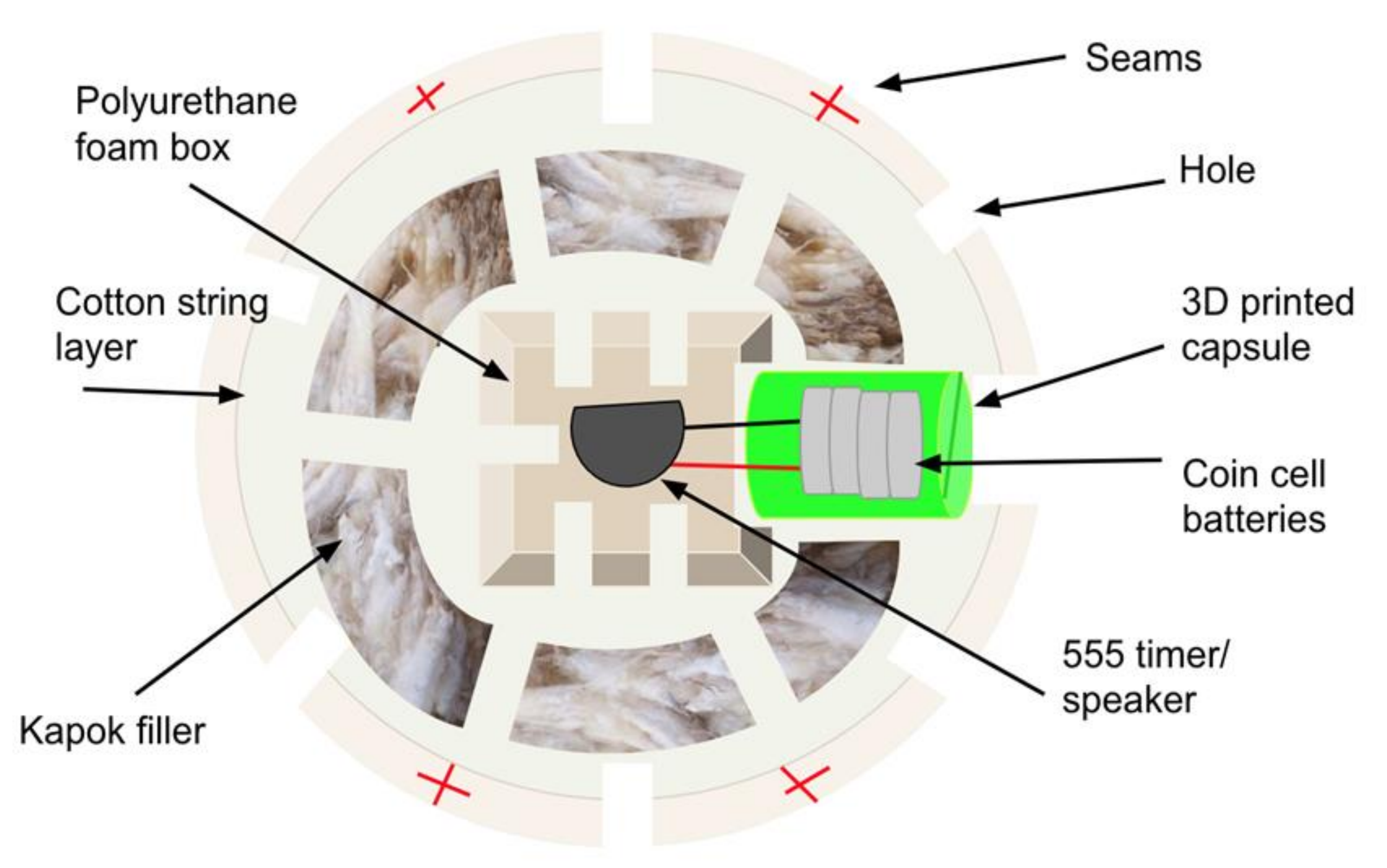
Early Low-fidelity Prototype

- The electrical subteam:
  - Used a waveform generator to determine the input the speaker required
  - Made a circuit that will beep the speaker at a 4Hz interval
  - Soldered Protoboard circuit to be inserted in prototype ball
  - Use multiple speakers to create redundancy as well as a louder beep





Conceptual Design



Failure Analysis from Low-Fidelity

Purpose:

❑ Identify *potential* failure points within current design

Main Concerns:

❑ Volume of the beep, Durability

Future work:

❑ Creating scales for severity, occurrence, and detection

Budget

- ❑ The team has spent 150$ on the project by mid-semester
  - ❑ Balls - 80$
  - ❑ Speakers - 15$
  - ❑ Stitching Materials - 16$
  - ❑ Batteries and battery holders - 16$
  - ❑ Capsules and tubing - 14$
  - ❑ Timers and electrical components - 8$

COMMUNITY PARTNER FEEDBACK

Visit to Indy Edge practice Week 3-4

- ❑ Same weight
- ❑ Waterproof possibility
- ❑ Durability – Some teams go through more balls than others
- ❑ Louder beep with a lower pitch
- ❑ Way to easily recharge the ball – Batteries

UPDATED PROBLEM IDENTIFICATION

Materials and Electrical subteams

1

Easily manufacturable

2

Durable and waterproof internal components

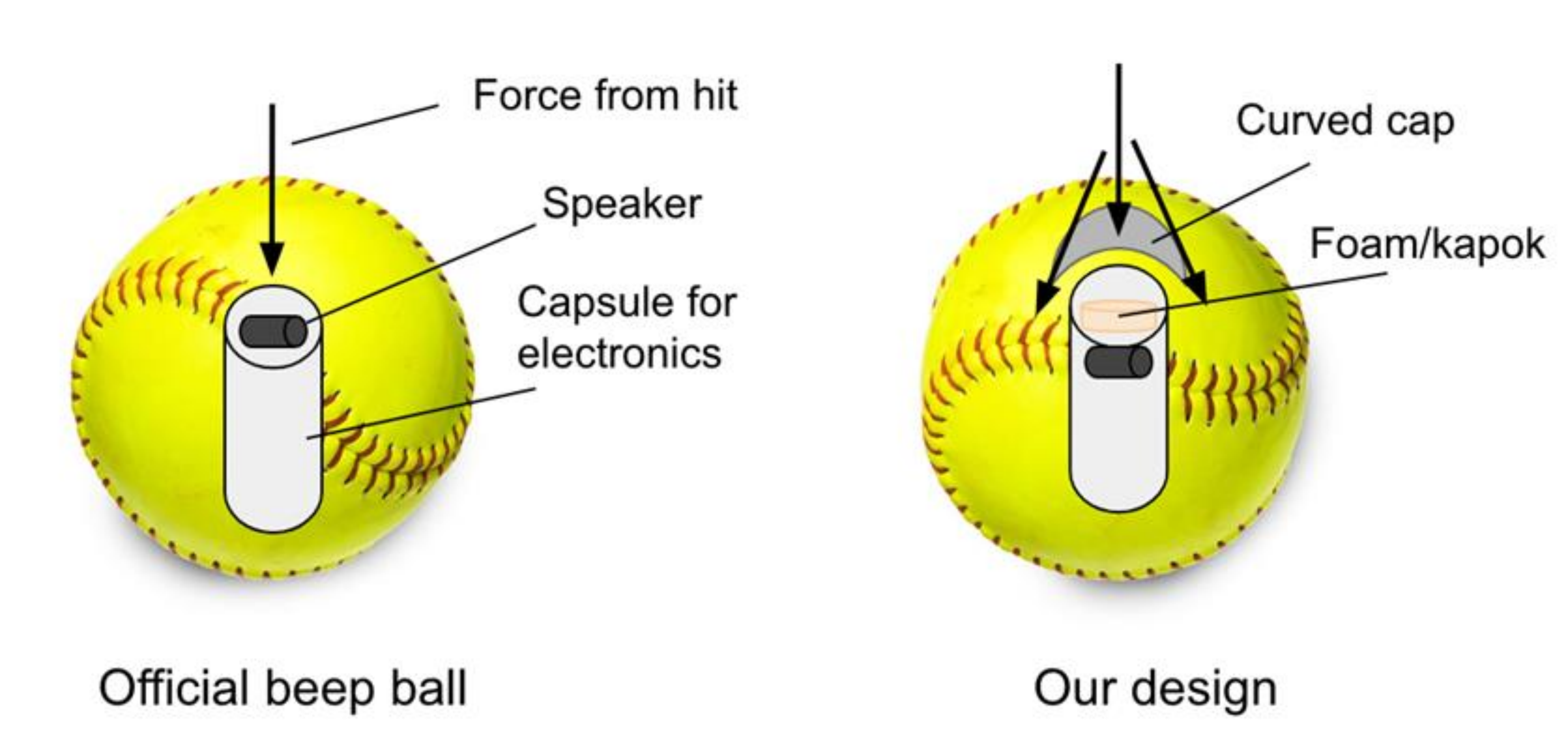
3

Lower beep pitch, yet still loud enough

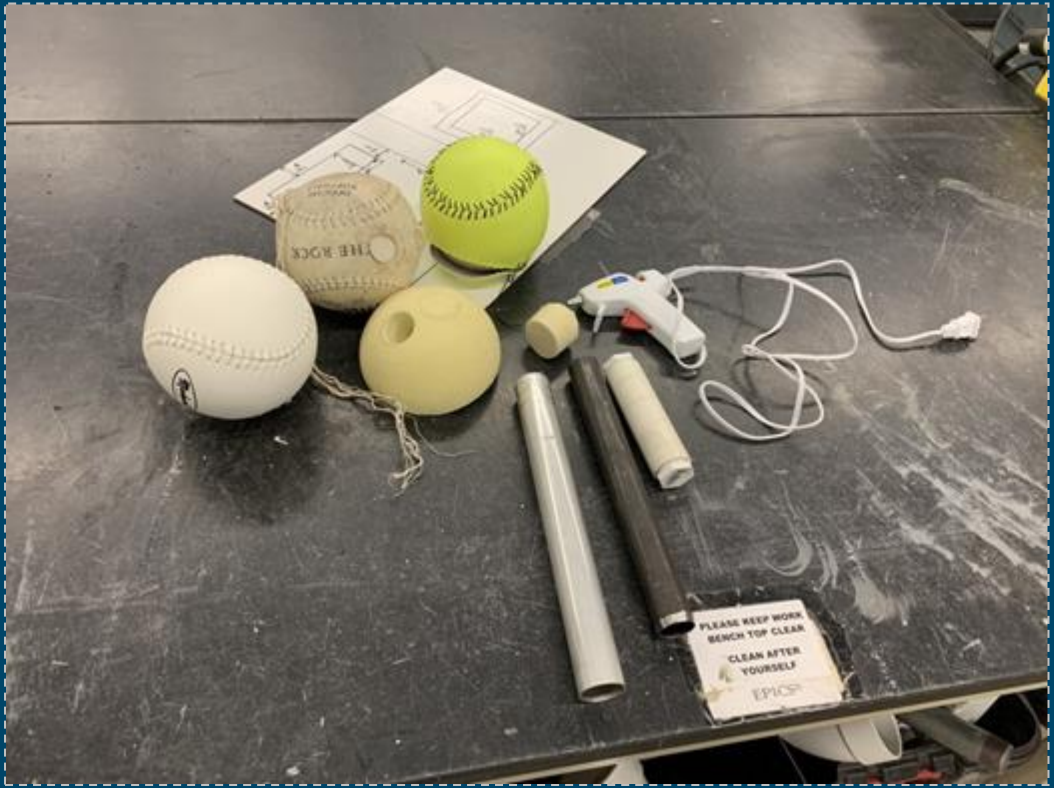
Updated Specifications – Force Analysis

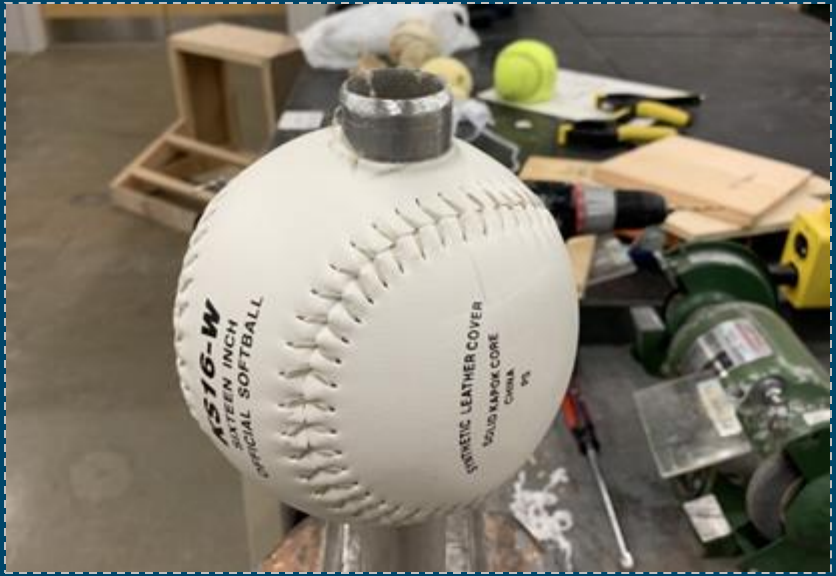
Equation for force: coefficient of restitution + 2000 lbs maximum hit

Force acting on ball: $F = ma$



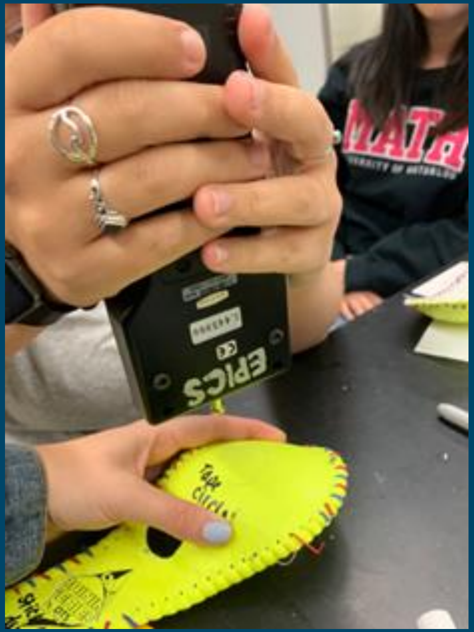
New materials prototypes

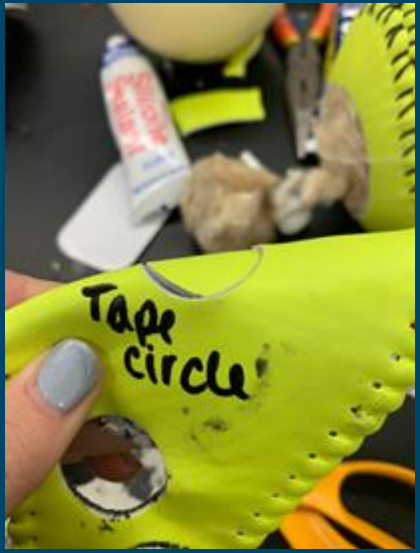




New materials prototype

- Reinforced adhesives
- Heat treated patches melt the leather
- Bending test and force gauge

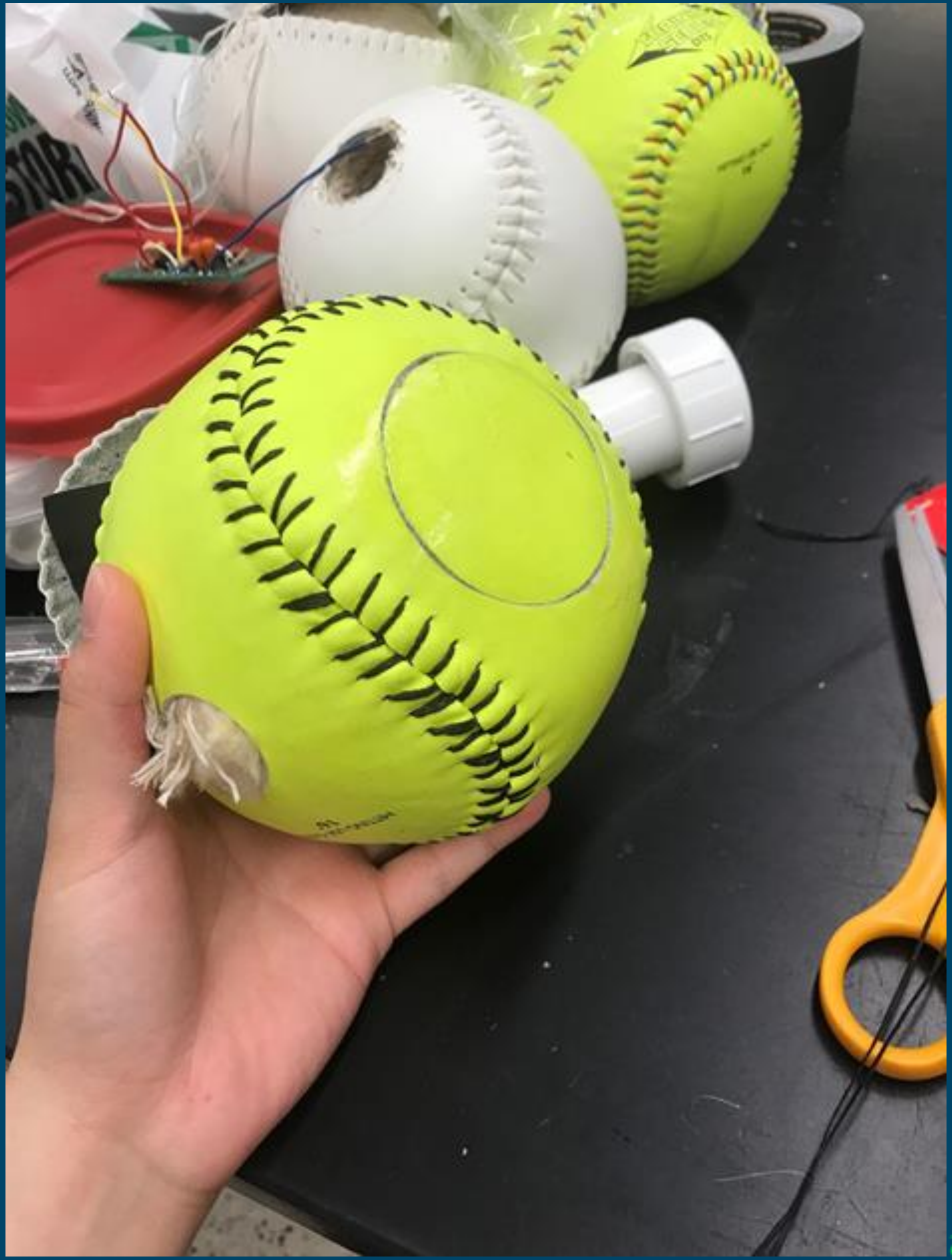




GLUES	Bends Well	Waterproof	Strength (in g)	Point value Strength		Total	
Silicon Sealant	1	5	0	1		7	
Shoe Glue	4	5	1915	3		12	
Power Tack	3	5	1422	2		10	
PATCHES	Bends Well	Waterproof	Strength	Point Value Strength	Cracks in Seal	Feasibility	Total
Tent Tape	5	5	4746	5	5	3	23
TRex Tape	4	5	4711	5	5	2	21
Stick on Denim	2	1	4500	5	2	4	14

New materials prototype

- Option 1: Cap + silicon gel
- Waterproof "tent sticker" underneath (used for patching holes in tents)
- Shoe repair glue used for sides of the leather patch for waterproofing

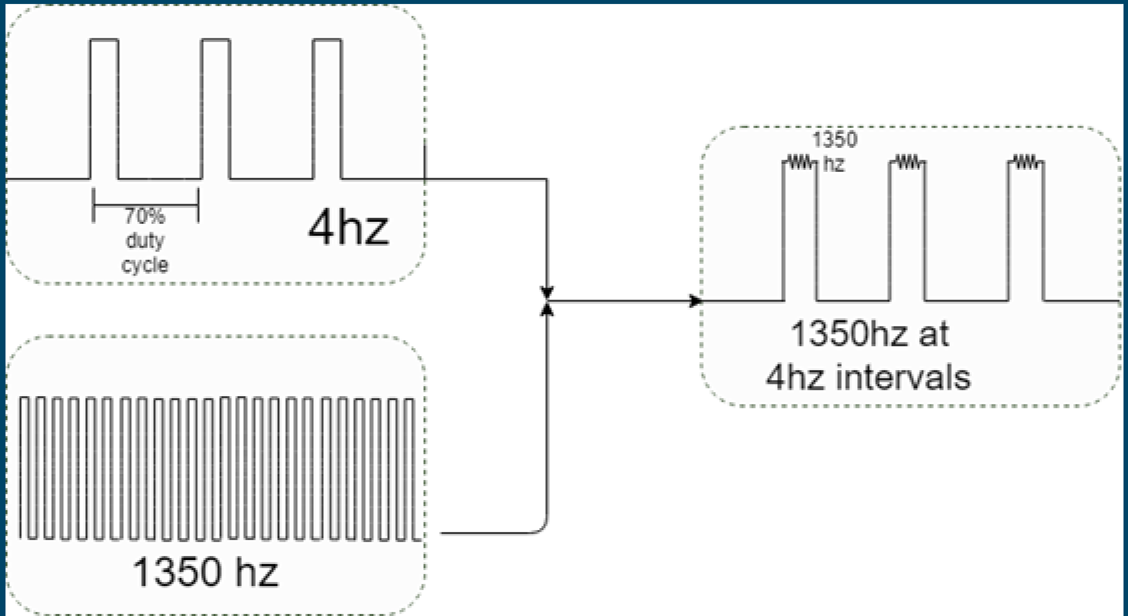


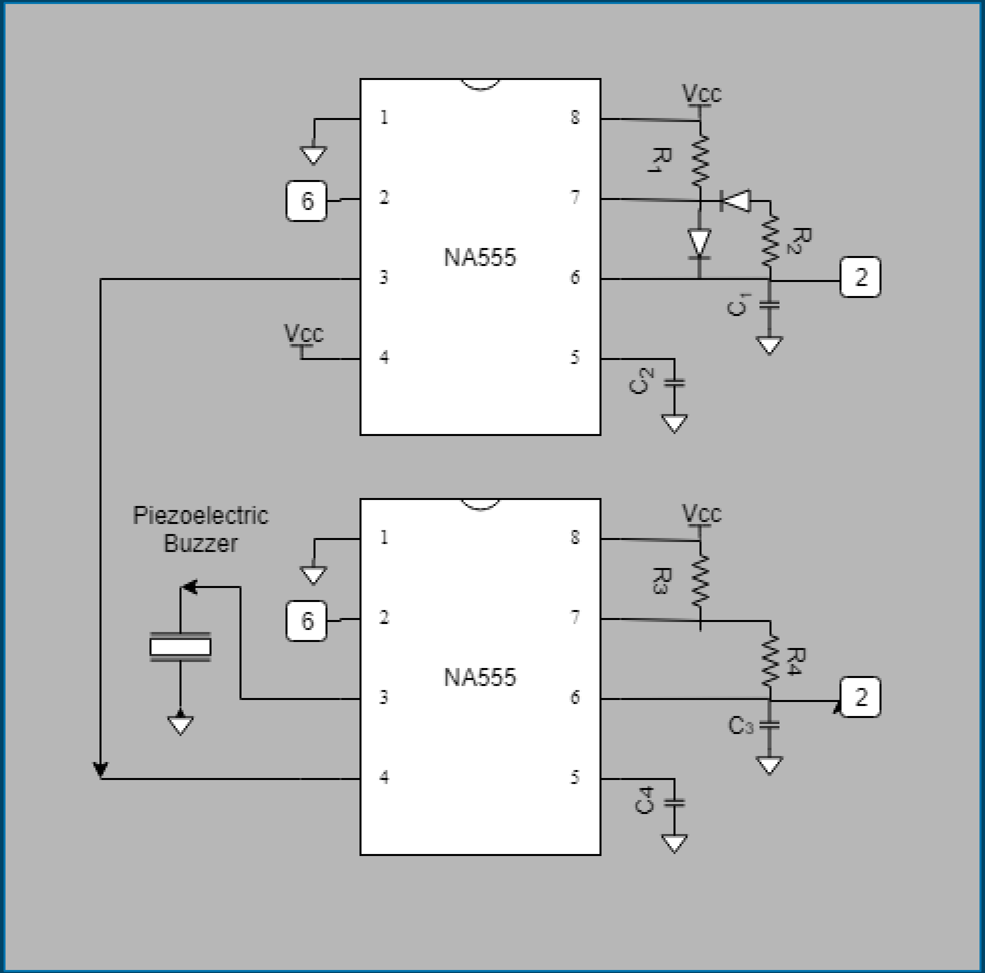
New materials prototype

- Option 2: Capped PVC pipe through center
- Electrics housed in the middle of the ball
- Pipe is placed inside the ball and then the leather is resewn

New electronic prototype

- The electronics subteam:
  - New Design features two 555 timers
    - **First Timer: Sets 4 Hz beep interval**
    - **Second Timer: sets 1350 Hz beep tone**





Electrical Considerations

- ❑ Piezoelectric buzzer is more durable than regular speaker
- ❑ Frequency is important not only for tone, but volume
- ❑ Natural frequency of piezoelectric buzzer produces the loudest sound
- ❑ Battery needs enough mAh for at least one game

Updated Budget

- ❑ The team has spent 110$ more for final design
  - ❑ PCBs - 25$
  - ❑ Remote switch - 20$
  - ❑ Speakers & Buzzers - 15$
  - ❑ Adhesive reinforcements - 50$

SEMESTER PLAN

Week 1: Background research on beeping baseball and arrangement for call with community partner.

Week 2: Community partner call and specifications and expectation set. Ideation of prototype, brief discussion of several specifications of baseball.

Week 3: Establishing sub-teams, ordering materials, early breadboard prototyping, developing design failure mode and effect analysis (dFMEA).

Week 4: Mid-semester design review.

SEMESTER PLAN

Week 5: Discussion of design reviewer feedback, discussed ways to isolate kapok from electronics, PCB modeling, working towards new prototype.

Week 6: Figuring out reinforcement methods of leather to kapok layers, mechanical testing of the ball.

Week 7: Testing more reinforcement methods, moving towards detailed design of final prototype, PCB assembling and determining battery choice.

Week 8: Final design review, take notes for improvements and suggestions and document it in transition document for next semester.

Future Goals – Project Plan

- ❑ Community partner feedback from sending completed hitting prototype
- ❑ Tensile testing of adhesive reinforcement
- ❑ Assembling materials with electronics
- ❑ Electronics audibility testing through materials
- ❑ Finalizing battery
- ❑ Adapting on/off switch with battery and circuit
- ❑ Accelerometer to hit-able prototype for fastest hits possible by user
- ❑ Power consumption - mAh

Any questions?

Hannah Burnau
Project Manager

burnau@purdue.edu

THANK YOU