ENGINEERING

McMaster University

Design Project 3 – Sense of Independence

IBEHS 1P10 – Health Solutions Design Projects

Tutorial 05

Team 35

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Submitted: March 06, 2022

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Academic Integrity Statement

The student is responsible for performing the required work in an honest manner, without plagiarism and cheating. Submitting this work with my name and student number is a statement and understanding that this work is my own and adheres to the Academic Integrity Policy of McMaster University.

Alexis Moutafis-Tymcio 400371000

x 

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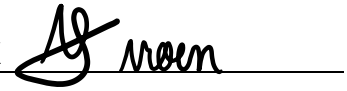
Andrea Siroen 400366956

x 

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Elias Taylor 400388518

x 

The student is responsible for performing the required work in an honest manner, without plagiarism and cheating. Submitting this work with my name and student number is a statement and understanding that this work is my own and adheres to the Academic Integrity Policy of McMaster University.

Declan Yorke 400395029

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Executive Summary

Baby gates are common devices used in the home for preventing injuries in young children by restricting their access to potentially dangerous environments, such as stairways and kitchens. Although intended to increase safety, the risk of baby gate-related injury is known to rise with age as young children learn to climb, unlock, or dismantle their gates [1]. Failure to remove the gate at this stage risks injuries, 16% of which are traumatic to the brain and associated with disability and poor health-related quality of life in both the short- and long-term [1, 2]. The current solution to this potential hazard is the removal of the baby gate, thus nullifying its original purpose and the security it provided [3]. Piece of Mind's mission with SmartGate is to provide an alternative solution to this globally faced child-safety concern by extending the useful lifespan of baby gates thereby helping parents reclaim their peace of mind.

The SmartGate minimizes the risks associated with conventional baby gates with its Climbing Alert System, SmartLock, and overall structural integrity. SmartGate's Climbing Alert System reduces the likelihood of falls with its force sensors and alarm to initiate guardian intervention before injury. The gate's SmartLock feature implements a button-activated linear actuator to eliminate the possibility of child unlocking, and an LED to signal locked status, making accidents due to unintentional unlocking less likely.

Piece of Mind, Inc. currently offers a short- and a long-term option for our safety gate design, the long-term being our SmartGate and the short term being a modification kit. The short-term kit is intended as a "universal starter kit", where customers pair the device with an existing hardware-mounted baby gate found within the home.

The short-term kit consists of a parent housing and all its associated components (Appendix G.3). This preliminary model integrates the usage of a pressure mat placed on the top of the parent housing to sense whether excess pressure is exerted vertically downwards on the device and thus if a child is interacting with the gate. Note that the device is not intended to be paired with a pressure-mounted gate given their tendency to collapse when children attempt to pass over.

The long-term SmartGate consists of a hardware-mountable gate model with the incorporation of an actuator, a parent housing, and a mesh covering to further discourage children from climbing the safety device (Appendix G.1 and G.2). This higher-quality device has the force sensors placed within its hinges where they are more integrated in the gate's structure, better protecting them from damage and maximizing their effectiveness.

Our company strongly believes in SmartGate's potential to bring peace of mind to parents of young, roaming children with its innovative alert and locking systems. Ultimately, we aim to reduce the number of gate-related injuries worldwide without compromising the security those gates provide, a need which only continues to grow as the baby gate and bedrail market is expected to reach $1.1 billion by 2026 [4].

Main Body

Summary of Design Objectives

Criteria

Constraints:

- Must conform to safety standards
- Must be easily adjustable
- Must be affordable for the average family

Functions:

- Prevents injury

- Indicates trespassing/signals to parents

Objectives:

- Should not prevent parents/older children from going about their lives
- Should have a life span of at least 3 years
- Should adhere to different surfaces

NEED STATEMENT:	Design a device for use by parents that automates household child safety to prevent falls in unsupervised children, which result in over 10,000 injuries per year in Canada.

Background and Research Summary

SmartGate's design incorporates two input devices, a push button, and a force-sensitive resistor (FSR). The button is composed of metal and high-density plastic [5], and its functionality relies on its metal component's conductive properties [6]. When pressed, a piece of metal moves to connect two separate parts of a circuit, allowing the Raspberry Pi to register the completed circuit via the T-Cobbler [6]. Our design implements a button to moderate the linear actuator-assisted locking mechanism; pressing the button moves the linear actuator to lock and unlock the SmartGate. The other input device, the FSR, is composed of two layers separated by air [5]. One layer with two sets of conductive stripes electrically isolated from one another, the other coated with a semi-conductive resistive material [7]. The FSR acts as a variable resistor that decreases its resistance as force is applied [8]. The reduced resistance causes a change in output voltage that the Raspberry Pi can register with an Analog-to-Digital / Digital-to-Analog (AD/DA) data acquisition device [8]. The SmartGate uses its FSR to constantly monitor the force placed on the gate to activate its climbing alert system when appropriate.

The SmartGate utilizes two output devices, excluding the linear actuator; these output devices are a light-emitting diode (LED) and a piezoelectric buzzer. LED is composed of a pair of conductive aluminum leads linked inside a translucent synthetic epoxy lens with a conductor that passes through a layer of semi-conductive material [9]. The light emitted by the LED results from released energy as electrons go from a state of high energy to low energy when they cross the semiconductor [9]. Most semiconductors used in LEDs are based on gallium [9]; our yellow LED, which indicates when the SmartGate is locked, uses a gallium phosphate semiconductor. The SmartGate's other output device, the piezoelectric buzzer, is composed of a piezoelectric ceramic which changes shape when voltage is applied, a silver electrode, a brass plate, two leads, and a plastic case [10]. The piezoelectric buzzer produces sound when an alternating voltage causes the piezoelectric ceramic to push against the brass plate, generating a pressure wave that the human ear can pick up [10]. The buzzers used in our design signal that the gate has detected a force indicating a child may be climbing on it and is at risk of injury.

Most of the materials in these devices are interchangeable so long as their specific material properties are maintained. For example, so long as the metal used in the button is conductive, it will complete a circuit and function correctly. Another example is that so long as the LED lens is translucent and impact-resistant, it does not need to be synthetic epoxy. It could be tempered glass or any number of other suitable materials. In short, the type of materials and those materials' properties are essential to the functionality of these devices, but any specific materials discussed above are not.

Market Analysis

The most comparable product to Piece of Mind's SmartGate device is a conventional baby gate. Many variations of such an appliance exist on the market, each with a multitude of features and price points.

One baby gate model from Perma Child Safety integrates motion sensors with LEDs, analogous to our baby gate; it employs a sensor to activate an output device (LED) [11]. The durable gate is structurally designed to prevent a child from exerting horizontal force on the device and falling through, despite being a pressure-mounted model [11]. The SmartGate model from Piece of Mind is classified as hardware-mounted, incorporating a mesh covering to reduce the ability for a child to scale the mechanism. Both gate models achieve the same function through differing approaches.

In contrast, the Perma gate includes an auto-close feature and automatically locks using magnetism [11]. Piece of Mind's SmartGate does not possess this attribute since the SmartGate's locking mechanism is more intricate, requiring a linear actuator and button. Additionally, our gate contains LEDs and buzzers (as opposed to solely the LEDs in the Perma gate) to alert parents of their child's activity concerning the gate. While the Perma gate would likely be a significantly cheaper option than our gate, its quality is highly variable, as demonstrated through numerous Amazon reviews [11].

The toddler door alarm from Hoidury differs significantly in appearance compared to our product but shares the function of alerting caregivers about their child's activity around the home [12]. Resembling SmartGate and the Perma gate, the door alarm employs sensors (i.e., piezoelectric accelerometer sensors and inclinometer sensors) and operates a door-chime alert to notify parents [12]. The physicality of the device is remarkably more space-conscious and compact than our device, and reviewers note that installation is uncomplicated [12]. However, while it notifies parents about their child's safety, it is incapable of preventing accidents from occurring. SmartGate aims to accomplish both tasks.

The final comparable product is a simple pressure-mounted gate from Regalo. It contains a conventional lock with no additional sensors and is rated the best-selling baby gate on Amazon [13]. It is very similar in structure to our baby gate but very different in function; it only serves as a mechanical barrier to children endeavouring to venture around the house unattended. Reviewers have noted that the material can be thin and fragile, and the overall device does a poor job of preventing children from passing through. Additionally, the material is rough, frequently scratching customers [13]. However, it is likely very popular due to its affordability and accessibility, which are crucial in marketing to parents.

Overall, while there seems to be a market for baby gates and alarms, there does not seem to be a market that combines both. SmartGate bridges these two features to provide a novel safety device for young, mobile children's parents. By alerting parents about their child's whereabouts and preventing falls simultaneously, Piece of Mind strives to create safer households for children and improve their quality of life.

Description of Device Design

The design of SmartGate took full advantage of our team’s capabilities and was achieved through the consideration of multiple design philosophies. Our unique perspectives allowed us to apply novel improvements to previous child safety gates, such as autonomous alert mechanisms, adjustable sizes, and easy parental access. SmartGate features both short- and long-term designs in the form of a starter kit and later a full gate **[F.1][F.2]**. Developing these designs involved numerous iterations of the Raspberry Pi housing unit and the overall assembly, ensuring the greatest possible suitability and efficiency as an automatic home security device.

The design of these devices is crucial: they are responsible for the lives of many vulnerable populations such as children. The kit's design reflects the importance of this purpose, with features meticulously constructed to offer the comfort of mind for those relying on the SmartGate kit. The first is the specially built ventilation holes that ensure proper thermoregulation of the Pi's circuit board **[F.3]**. The holes strewn about the inner case and greater shell allow for convection cooling in an otherwise stagnant environment. The Pi's lid is also well secured against any horizontal displacement that may result from infants shaking the gate while remaining fully accessible **[F.4]**. The design of the short-term parent itself has also had care invested into both the interior and exterior utility **[F.5].** Both the Raspberry Pi housing and larger case are purposefully designed for the integral role they play within the SmartGate.

The piece responsible for allowing the SmartGate to function in the long-term is the parent assembly accountable for integrating the breadboard, wiring, and the Pi housing directly into the gate. The assembly is based on a compact layered design featuring great spatial efficiency **[F.6]**. The result is a very flexible design, limiting enough to guide placements for easy modification but not too limiting to be challenging to work with. The parent assembly also fulfills its secondary purpose within the larger baby gate as a point of contact with the walls. The assembly structurally supports the larger gate through the assistance of a separately applied adhesive pad **[F.7]**. The parent assembly exemplifies the lengthy number of considerations made regarding every level of SmartGate's design from inside to out.

This attention to detail in the Pi housing and parent assembly sets SmartGate's design apart from similar products in both the short and long term. For the kit, we are able to provide helpful features such as ventilation holes, a horizontal buffer for the lid, and a custom-designed interior. These benefits are all repurposed in the long term, with additional care given to how the circuitry and assembly integrate within the larger gate. The resulting SmartGate is an incredibly well thought out design, inspiring confidence in its mission of mechanically keeping infants safe within homes across the globe.

Design Critique, Discussion, and Recommendation

Following the Design Exposition, Piece of Mind received valuable feedback from professors and teaching assistants to address areas of improvement and create a more desirable device for future customers.

One distinctive design feature of SmartGate is the Climbing Alert System to inform parents if their child has attempted to scale the safety gate. This alert delivers in two unique ways to ensure parents and caregivers attend to the situation as soon as possible: an audible alarm will ring out until disabled, and an SMS notification will send to the user's smartphone. Our current representation of the SMS feature involves printing an SMS alert message to the Python IDLE Shell. To improve and adequately implement this feature, Piece of Mind intends to import appropriate OS and SMS libraries, such as those provided by Twilio, to formalize the SMS element [14].

Additionally, Piece of Mind intends to include supplemental lines of code to the program, which would be responsible for horizontally translating the linear actuator in the long-term device. This modification would be accomplished by utilizing appropriate object construction and method used, as opposed to the current model of this movement which is represented by printing "forward", "off," and "reverse" to the Python IDLE Shell.

The ultimate goal for both the short- and long-term assembly models is to replace the current use of a Raspberry Pi with a more miniature, efficient computer capable of performing the same tasks. By reducing the size of the computer, the parent housing of both the short- and long-term kits can similarly be reduced in size to consume less space, providing a more sleek and discrete appearance for both models. Furthermore, this design refinement would enable the short-term kit to pair with a wider variety of gate sizes, specifically those with the bottom horizontal support found closer to the floor.

In marketing SmartGate, we anticipate having a more comprehensive range of customer demographics than initially expected, such as parents and caregivers with children affected by a developmental disability. This population of individuals experience a delay in milestones, such as learning to walk later in life. In learning this fundamental skill, children enjoy their independence. SmartGate allows these children to explore independently and enables parents not to constantly worry about their child's whereabouts. Additionally, there has been a drastic increase in parents with young children who choose to work from home since the COVID-19 pandemic began. Having to juggle work tasks and monitoring one's child causes immoderate stress but can be resolved through SmartGate. Unsafe areas are sanctioned off, and the parents are alerted if the child attempts to access the site.

Lastly, Piece of Mind discussed marketing the long-term SmartGate device at a price similar to baby gates presently found on the market. This would eliminate the need for customers to choose between security and affordability, as one should not put a price on a child's safety.

Through minor adjustments to SmartGate's current model, a more efficient and dependable device will evolve for future consumers.

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[Accessed: 06-Mar-2022].

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[3] "New Study finds number of children treated in U.S. emergency departments for baby gate-related injuries nearly quadrupled since 1990," Nationwide Children's Hospital, 15-May-2014. [Online]. Available: https://www.nationwidechildrens.org/newsroom/news-releases/2014/05/new-study-finds-number-of-children-treated-in-us-emergency-departments-for-baby-gate-related.
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[8] C. McDonald, *IBEHS 1P10 Force Sensitive Resistors*. McMaster University, 2022.

[9] Sask, K., Macdonald, C. Design Project Three, [unpublished lecture notes]. IBEHS 1P10: Health Solutions Design Projects I: Introduction to Fundamentals and Design, McMaster University; lecture given 1, 3, 7 February 2022.

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[12] "Amazon.com : Toddler Door Alarm, Door Alarms for Kids Safety, Wireless Doorbell Chime Kits with 14 Melodies 3 Volume Levels Mute Mode LED Flash for Home Child Elderly Patients Disabled Pets, 4 Detectors 1 Receiver : Baby." https://www.amazon.com/HOIDURY-Wireless-Movement-Monitor-Toddler/dp/B07R74H56F/ref=sr_1_7?crid=A6X425WEQ2LH&keywords=baby+gate+alarm&qid=1646362230&sprefix=baby+gate+alarm%2Caps%2C69&sr=8-7 (accessed Mar. 04, 2022).

[13] "Amazon.com: Regalo Easy Step 38.5-Inch Extra Wide Walk Thru Baby Gate, Includes 6-Inch Extension Kit, 4 Pack Pressure Mount Kit, 4 Pack Wall Cups and Mounting Kit : Baby." https://www.amazon.com/Regalo-39-Inch-6-Inch-Extension-Pressure/dp/B001OC5UMQ/ref=sr_1_5?crid=1EBLSJ22GM0MR&keywords=baby+gate&qid=1646362256&sprefix=baby+gate%2Caps%2C68&sr=8-5 (accessed Mar. 04, 2022).

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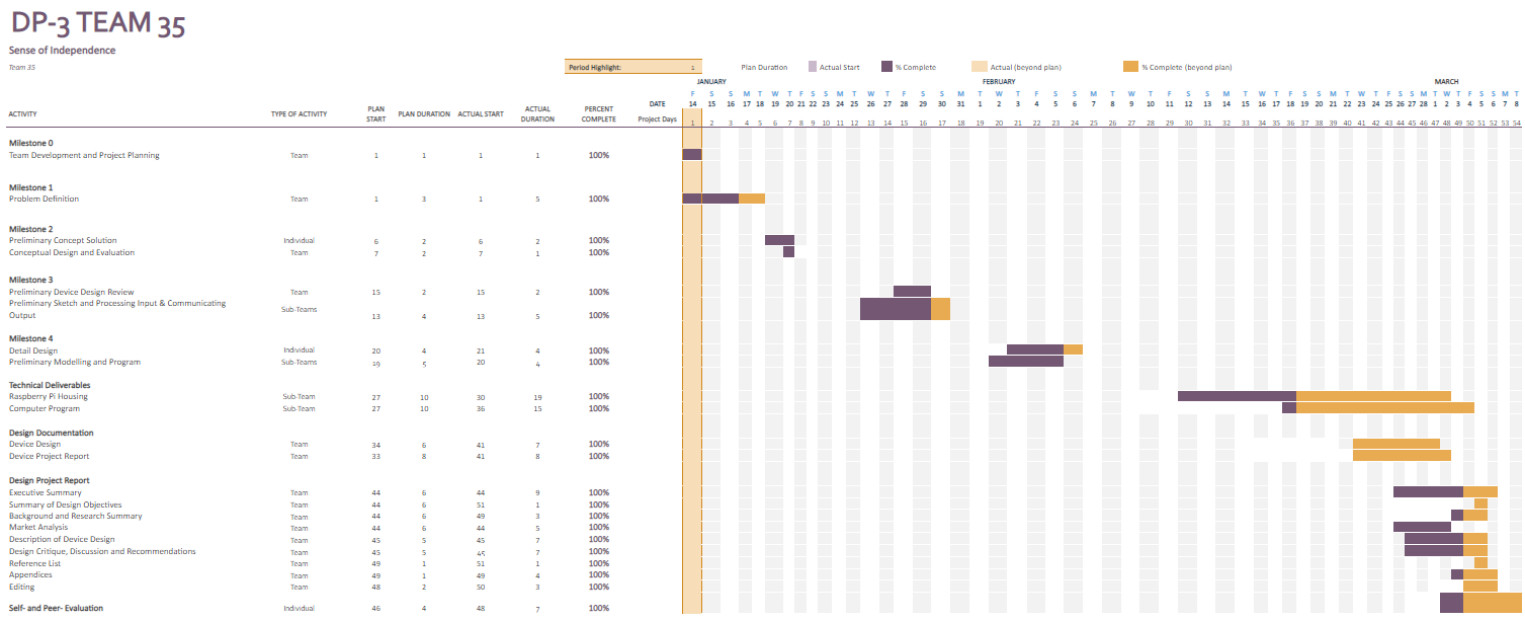
Appendices

Appendix A: Project Schedule

Preliminary Gantt Chart:

Final Gantt Chart:



Logbook of Additional Meetings and Discussions:

TEAM 35: MEETING MINUTES JAN 18

Location: Teams
Date: January 18, 2022
Time: 1:00-2:00

Attendance

Role	Name	MacID	Attendance
Manager	Andrea Siroen	siroena	Present
Administrator 1	Elias Taylor	tayloe26	Present
Administrator 2	Declan Yorke	yorked1	Present
Coordinator	Alexis Moutafis-Tymcio	moutafia	Present

Agenda Items

1. Check-in
2. Walk through of template
3. Statements of facts and references
4. List of criteria
5. Need statement
6. Closing remarks

Action Items

Action Item	Responsible	Deadline	Status
Milestone 0+1 Submission	Administrator 1 (Elias)	Before Jan. 21	Complete
Milestone 2 Preparation	Everyone	Before Jan. 21	To Do

Meeting Minutes and Discussions – Coordinator

Check-in

- Everyone is present
- Discussion of agenda items

Walk through of template

- No issues

Statements of facts and references

- References to be completed before submission
- Completed

List of criteria

- Arguing that cost is a constraint rather than an objective because otherwise the market for the product would be very limited
- 3 for each section
- Completed

Need statement

- Integrate each section of the document into need statement to “tie it all together”
- Complete

Closing remarks

- Complete assigned tasks
- Submit Milestones 0+1

TEAM 35: MEETING MINUTES JAN 27

Location: Teams
Date: January 27, 2022
Time: 1:30-1:40

Attendance

Role	Name	MacID	Attendance
Manager	Andrea Siroen	siroena	Present
Administrator 1	Elias Taylor	tayloe26	Present
Administrator 2	Declan Yorke	yorked1	Present
Coordinator	Alexis Moutafis-Tymcio	moutafia	Present

Agenda Items

1. Check-in
2. Preliminary design of device: low-fidelity prototype or Autodesk Inventor?
3. Modelling Team
    a. Where are we attaching the sensor to 'bypass'? Will it be inside or outside of the pi housing?
    b. Who will sketch?
    c. Who will create a rough prototype?
4. Computing Team
    a. Split up flow chart tasks.
5. Closing remarks

Action Items

Action Item	Responsible	Deadline	Status
CAD Gate Design	Eli	Jan. 28	In progress
Pi Housing Sketch	Andrea	Jan. 28	In progress
Alarm Flow Chart	Alexis	Jan. 28	In progress
Disable Feature Flow Chart	Declan	Jan. 28	In progress
Questions for Feedback	Everyone	Jan. 28	In progress

Meeting Minutes and Discussions – Coordinator

<u>Check-in</u>

- Brief discussion for "presentation"

<u>Modelling Team</u>

- Eli model gate design
- Andrea sketch Pi housing

<u>Computing Team</u>

- Alexis to make flow chart for alarm
- Declan make flow chart for "disable" feature

<u>Closing remarks</u>

- Have everyone come up with 1-2 questions in preparation for tomorrow's meeting, just to receive better feedback on design

TEAM 35: MEETING MINUTES MAR 1

Location: ABB
Date: March 1, 2022
Time: 6:00-8:30

Attendance

Role	Name	MacID	Attendance
Manager	Andrea Siroen	siroena	Present
Administrator 1	Elias Taylor	tayloe26	Present
Administrator 2	Declan Yorke	yorked1	Present
Coordinator	Alexis Moutafis-Tymcio	moutafia	Present

Agenda Items

1. Check-in
2. Coding subteam progress
3. CAD subteam progress
3. Closing remarks

Meeting Minutes and Discussions – Coordinator

Check-in

- Coding team finished all functions and compiled them together in main over the break
- CAD team has modelled various parts in Autodesk, ready to print housing

Coding subteam progress

- Troubleshooted compilation errors in IDLE on the Raspberry Pi
- All parts are wired on the breadboard, not fully functional with the project code but they can be turned on with simple code

CAD subteam progress

- Housing is 3D-printed, some parts need to be re-modelled/printed
- Introducing a short-term plan (kit that's integrated into existing gate) and long-term plan (a full gate with sensors built in)

Closing remarks

- We're all on track for Friday!
- We will meet up again in design studio to finish our work

TEAM 35: MEETING MINUTES MAR 2

Location: ABB
Date: March 2, 2022
Time: 6:00-8:30

Attendance

Role	Name	MacID	Attendance
Manager	Andrea Siroen	siroena	Present
Administrator 1	Elias Taylor	tayloe26	Present
Administrator 2	Declan Yorke	yorked1	Present
Coordinator	Alexis Moutafis-Tymcio	moutafia	Present

Agenda Items

1. Coding subteam progress

2. CAD subteam progress
3. Closing remarks

Meeting Minutes and Discussions – Coordinator

Coding subteam progress

- Code is now fully functional and can interact with force sensor/output devices properly
- Code is not finished but we have the basics done!

CAD subteam progress

- Pi housing is fully 3D printed
- Shaved down the print in order to fit the Pi

Closing remarks

- Coding team will make some edits to clean up the code and double check that we're meeting project criteria
- CAD team will finish modelling some components of the long-term kit in Autodesk

TEAM 35: MEETING MINUTES MAR 3

Location: ABB
Date: March 3, 2022
Time: 3:30-5:30

Attendance

Role	Name	MacID	Attendance
Manager	Andrea Siroen	siroena	Present
Administrator 1	Elias Taylor	tayloe26	Present
Administrator 2	Declan Yorke	yorked1	Present
Coordinator	Alexis Moutafis-Tymcio	moutafia	Present

Agenda Items

1. Technical deliverables
2. Device design
3. Closing remarks

Meeting Minutes and Discussions – Coordinator

Technical deliverables

- Coding team made the code neater, added comments and print statements as necessary
- CAD team continued modelling long-term kit in Autodesk and added components to integrate short-term kit into an existing gate

Device design

- Team has decided on making an infomercial video to showcase our design
- Filmed intro to video
- Took pictures of device design

Closing remarks

- We'll meet up tomorrow to go over our presentation
- Eli will do the video editing, Alexis will do the voiceover

TEAM 35: MEETING MINUTES MAR 4

Location: ABB
Date: March 4, 2022
Time: 4:00-6:00

Attendance

Role	Name	MacID	Attendance
Manager	Andrea Siroen	siroena	Present
Administrator 1	Elias Taylor	tayloe26	Present
Administrator 2	Declan Yorke	yorked1	Present
Coordinator	Alexis Moutafis-Tymcio	moutafia	Present

Agenda Items

1. Technical deliverables
2. Presentation prep
3. Closing remarks

Meeting Minutes and Discussions – Coordinator

Technical deliverables

- Coding team made formatting/printing edits to accommodate the actuator
- CAD team modified long-term gate to accommodate the actuator

Presentation prep

- Presentation order:
  - Intro-Alexis
  - CAD-Andrea and Eli
  - Coding-Declan and Alexis
  - Design Justifications-Andrea and Declan
  - Conclusion-Eli

Closing remarks

- Good job everyone and good luck on the presentation!
- Parts of the design report were already assigned, make sure to finish for Mar. 6

Appendix B: Scheduled Weekly Meetings

TEAM 35: MEETING MINUTES WEEK 1

Location: Teams
Date: January 14, 2022
Time: 12:30-2:30

Attendance

Role	Name	MacID	Attendance
Manager	Andrea Siroen	siroena	Present
Administrator 1	Elias Taylor	tayloe26	Present
Administrator 2	Declan Yorke	yorked1	Present
Coordinator	Alexis Moutafis-Tymcio	moutafia	Present

Agenda Items

1. Check-in
2. Customer demographic discussion
3. Chosen area of focus discussion
4. Closing remarks

Action Items

Action Item	Responsible	Deadline	Status
Statements of Facts	Everyone	Before Jan. 21	In Progress
Min. 2 Concept Solutions	Everyone	Before Jan. 21	To Do
Milestone 0+1 Submission	Administrator 1 (Elias)	Before Jan. 21	To Do

Meeting Minutes and Discussions – Coordinator

Check-in

- Introductions
- Discussion for DP3 roles
- Roles were finalized

Customer demographic discussion

- Elderly population
  - Ideas: fall detection, even though there are currently devices on the market for this
- Visually impaired
  - Ideas: notify when to stop pouring liquid into a cup, notify if drawer/cabinet is open
- Fine motor deficient individuals
- Wheelchair/mobility impaired
- Independent living
- Certain conditions i.e., sleep apnea, arthritis, etc.
- The elderly (or elderly with x condition)
- Recovering from surgery
  - Ideas: facilitate tasks that are restricted when recovering, or would alert the individual to not follow through with a task/action
- Deaf/hard of hearing
- Young children
  - Preventative
  - Developmental disabilities
    - Turner syndrome
  - Stair detection/monitoring
    - Possible sensors to use: distance, force
- Anti-scald devices
  - Temperature sensor for water i.e., taps, shower heads, baths
- Service animals

Chosen area of focus discussion

- Technology for automating tasks in the home

Closing remarks

- Please do the action item for this week!
- We will be in touch to schedule a meeting before the next design studio. Meeting will allow us to finish up Milestone 1.

TEAM 35: MEETING MINUTES WEEK 2

Location: Teams
Date: January 21, 2022
Time: 12:30-2:30

Attendance

Role	Name	MacID	Attendance
Manager	Andrea Siroen	siroena	Present
Administrator 1	Elias Taylor	tayloe26	Present
Administrator 2	Declan Yorke	yorked1	Present
Coordinator	Alexis Moutafis-Tymcio	moutafia	Present

Agenda Items

1. Check-in
2. TA Meeting
    a. Completed within the past week – Milestone 0 and 1; scheduled a meeting to further discuss possible solutions and directions for the project
    b. Findings – with our demographic, there will be many unintended customers that result due to overlap in needs
    c. Stumbling blocks – how to differentiate between child and user interaction, ideal sensor to use
    d. Plan for the coming week – complete Milestone 3 and tasks for sub teams
    e. Any other questions?
    f. Inquire about Gantt Chart submission date
3. Discuss individual concepts and use the Pugh Matrix
4. Concept evaluations
    a. Evaluation 1
    b. Evaluation 2
5. Closing remarks

Action Items

Action Item	Responsible	Deadline	Status
Preliminary Presentation for Device	Everyone	Next Design Studio	Not started
Pseudocode or Flowchart	Computation Sub-Team	Next Design Studio	Not started
Preliminary Sketch of Pi Housing	Modelling Sub-Team	Next Design Studio	Not started

Meeting Minutes and Discussions – Coordinator

Check-in

- Everyone finished stage 1 of milestone 2

TA Meeting

- Potential overlap between children and elderly for our product
- Preliminary Gantt chart is technically due today (Jan. 21) but not urgent

Discuss individual concepts and use the Pugh Matrix

- Elias:
    - Device attaches to child gate, can attach to walls with suction cup and notifies parents when it's disturbed
    - Making stairs safer, checks when child is in range and turns on lights automatically
- Declan:
    - Baby gate senses when baby tries to climb over gate and alerts parents
    - Baby gate that has force sensors embedded in the hinge, a signal is sent to the lock to make it impossible to open
- Alexis:
    - Baby gate that automatically locks if it senses pressure and notifies parents, but has a button that lets parents pass
    - Bracelet that notifies parents if a child falls or is hurt

- Andrea:
    - Force pad that can be adhered anywhere (e.g. doorknobs, gates); can be folded to adhere to any surface
    - Device that prevents getting into drawers, alarm goes off if it's opened with a disable feature

Concept evaluations

- Using baby monitor as our DATUM
- Affordability will depend upon choice of materials
- Lifespan will depend upon choice of materials and frequency of both user and child interaction
- Obstruction of parents will depend upon if a disable feature is used
- Things we like
    - Versatility of force pads→wouldn't use alone but can combine with other ideas
    - Getting into a drawer → unique idea, more demographics
    - Baby gates→using materials that are hard to latch onto, button bypass
- Concerns
    - Raspberry Pi housing→force pads, cabinet sensor, suction cup
    - Baby gates→hinges could be weak point, distinguishing between intentional vs unintentional opening, positioning in unconventional houses/staircases

Closing remarks

- Prepare for next week's meeting!

TEAM 35: MEETING MINUTES WEEK 3

Location: Teams
Date: January 28, 2022
Time: 12:30-2:30

Attendance

Role	Name	MacID	Attendance
Manager	Andrea Siroen	siroena	Present
Administrator 1	Elias Taylor	tayloe26	Present
Administrator 2	Declan Yorke	yorked1	Present
Coordinator	Alexis Moutafis-Tymcio	moutafia	Present

Agenda Items

1. Check-in
    a. Did everyone complete their preliminary tasks?
        i. Modelling Sub-Team – Raspberry Pi Housing
        ii. Computing Sub-Team – Processing Input & Communicating Output
2. Prepare for meeting with instructor/TA
    a. Questions for feedback
    b. What is our area of focus?
    c. Who is our customer demographic?
    d. What is our chosen sensor?
    e. What does the device accomplish and how does it work?
3. Design review and refinement
    a. Discuss ways to improve upon original design given the feedback from instructor/TA
4. Closing remarks

Action Items

Action Item	Responsible	Deadline	Status
Milestone 3 Submission	Eli	Jan. 29	To do

Meeting Minutes and Discussions – Coordinator

Check-in

- Everyone completed preliminary tasks

Meeting preparation

- Where would it be most useful to embed force sensors?
  - Good location where it is currently proposed
- Where would it be best to mount the Pi housing? In the gate or as an external attachment?
  - Inside the structure if wanting to mount with device, or on the underside of a counter
  - Look into Raspberry Pi, if they are wireless; if so, would be smart to but in a central room in the house to optimize
- Where would we place the 'unlock' button?
  - Out of reach for children but within reach for parents and older siblings (intended users)
- What if the power goes out? Should we have an internal emergency power supply to make sure the gate will still open?
  - Look into a battery addition
- SMS message, is that feasible for this prototype?
  - Print to a screen in the python shell, saying this is to be texted/sent to a device
  - Almost redundant when paired with alarm
    - Have this be an optional feature
- What is the parent doesn't have their phone on them?
  - No current solution
- Older sibling gat-interaction
  - When calculating the force of the child, keep in mind older siblings and their force applied
  - Have them use to device as an adult and intended user
  - How to avoid tampering with it
- Include a strong justification for reasoning for the unique features

Design review and refinement

- Measurements for gate
- Placement of housing and sensors
- Incorporate a screen or covering to avoid interaction with the gate that would activate sensors, but the child is not in danger

Closing remarks

- Milestone 3 submission – Eli

TEAM 35: MEETING MINUTES WEEK 4

Location: Teams
Date: January 4, 2022
Time: 12:30-2:30

Attendance

Role	Name	MacID	Attendance
Manager	Andrea Siroen	siroena	Present
Administrator 1	Elias Taylor	tayloe26	Present

Administrator 2	Declan Yorke	yorked1	Present
Coordinator	Alexis Moutafis-Tymcio	moutafia	Present

Agenda Items

1. Check-in
2. Were preliminary stages of milestone 4 completed?
    a. Modelling Sub-Team – detailed sketch of housing assembly
        i. Any issues or questions?
            1. Where did we decide to mount the Pi housing?
            2. Where did we decide to put the breadboard?
            3. We were given the suggestion to mount to Pi in a place that isn't in the same space as our device; is this allowed?
    b. Computation Sub-Team – computer program workflow
        i. Any issues or questions?
3. During class time:
    a. Preliminary modelling
        i. Housing Assembly Observations and Evaluations worksheet
        ii. Evaluations; similarities, differences
        iii. Justification for decisions
        iv. CAD for remainder of design studio; screenshot images to upload to Preliminary Modelling worksheet
    b. Preliminary programming
        i. Workflow Peer-Review worksheet
        ii. Evaluations; similarities, differences
        iii. Justifications for decisions
        iv. Program for remainder of design studio; screenshot images to upload to Preliminary Program worksheet
4. Discussion in preparation for next design studio
    a. Any meetings needing to be made?
5. Closing remarks

Action Items

Action Item	Responsible	Deadline	Status
Milestone 4 Individual Worksheet	Modelling Sub-Team	Feb. 5	To do
Milestone 4 Individual Worksheet	Computing Sub-Team	Feb. 5	To do
Milestone 4 Modelling Sub-Team	Eli	Feb. 5	To do
Milestone 4 Computing Sub-Team	Declan	Feb. 5	To do

Meeting Minutes and Discussions – Coordinator

Check-in

- Everything is completed

Preliminary tasks

- Everyone completed their individual tasks

Modelling sub-team discussion

- Question: Do we have to mount the Pi somewhere separate from the device, or can we put it close to our device?
    - Whatever the Pi is stored in (e.g. a box), it should be able to be stored on a wall, cabinet, etc.
    - Can mention future plans (e.g. wireless, Bluetooth) but for now use the resources available to us

- Discussion for Pi housing, measurements; dedicate time over reading week.

Computing sub-team discussion

- Possible issue/concern: multiple programs needed, running in parallel with two output tasks running at the same time

Closing remarks

- Submissions

TEAM 35: MEETING MINUTES WEEK 5

Location: ABB
Date: February 11, 2022
Time: 12:30-2-30

Attendance

Role	Name	MacID	Attendance
Manager	Andrea Siroen	siroena	Present
Administrator 1	Elias Taylor	tayloe26	Present
Administrator 2	Declan Yorke	yorked1	Present
Coordinator	Alexis Moutafis-Tymcio	moutafia	Present

Agenda Items

1. Check-in
    a. How did Physics go?
    b. How is everyone feeling about Calc?
    c. No formal preparation needed for this week's meeting
2. TA Meeting
    a. No current updates
    b. Likely will invest more time in the coming week and reading week to refining our design and project
    c. Any questions?
3. Free work period
    a. Things to work on:
        i. Computation Sub-Team – work on program
        ii. Modelling Sub-Team – work on Pi housing
        iii. Everyone – discussion for demonstration of form/functionality of the Computer Program and the Raspberry Pi Housing (this focus will overlap with Wk-6 content); finalize design project report
    b. Bring everyone's attention to the Gantt Chart to remind everyone of the upcoming proposed deadlines to keep everyone on track
4. Closing remarks
    a. Good luck tonight everyone!
    b. Spend some time over the next week working on the project to avoid rushing it all at the last minute

Action Items

Action Item	Responsible	Deadline	Status
None	N/A	N/A	i.e., In progress

Meeting Minutes and Discussions – Coordinator

Check-in

- Aim to have our technical deliverables done by the end of reading week, design report and other deliverables will be done the week after

Closing remarks

- Work on individual sub-team deliverables; will ideally print some components by the next week

TEAM 35: MEETING MINUTES WEEK 6

Location: ABB
Date: February 18, 2022
Time: 12:30-2:30

Attendance

Role	Name	MacID	Attendance
Manager	Andrea Siroen	siroena	Present
Administrator 1	Elias Taylor	tayloe26	Present
Administrator 2	Declan Yorke	yorked1	Present
Coordinator	Alexis Moutafis-Tymcio	moutafia	Present

Agenda Items

1. Check-in
2. Progress over the past week
    a. Any questions/concerns?
3. Setting deadlines
    a. When do we want the print finished by?
    b. When do we want the code finished by?
    c. Assign tasks for final deliverables, i.e., summaries and write ups
4. Break off into groups to discuss the following with sub-team members:
    a. Pi Housing
        i. Inclusion of features that facilitate assembly (Google: Design for Assembly)
        ii. Minimize print filament
        iii. Integrating output devices into housing
    b. Computer Program
        i. Appropriate output devices
        ii. Distinct processes
        iii. Careful with loop structures!
    c. Together
        i. Come up with a real-life experiment application
        ii. Inclusion of an “apparatus” which will help the TAs with grading
        iii. Ideally, your experiment should be repeatable
5. Book a printing time
6. Do we want to schedule a meeting over the break?
7. Closing remarks and looking ahead to next week
    a. Prepare a list of questions for client visit
    b. Documentation of discussions
    c. Need statement
    d. Customer requirements, design challenges for each client, select client of preference

Action Items

Action Item	Responsible	Deadline	Status
Program	Computing Team	End of reading week	In progress
CAD Model	Modelling Team	End of reading week	In progress

Meeting Minutes and Discussions – Coordinator

Check-in

- No new topics discussed

Assigning Tasks

- Executive summary
  - Everyone
- Background and research summary
  - Declan
- Market analysis
  - Alexis
- Description of device design
  - Eli
- Design critique, discussion, and recommendations
  - Andrea
- Appendices
  - Appendix A – Project Schedule
    - Prelim chart – Andrea
    - Final chart – Declan
    - Additional meetings – Alexis
  - Appendix B – Scheduled Weekly Meetings
    - Alexis
  - Appendix C – Design Studio Worksheets
    - Eli and Declan
  - Appendix D – Comprehensive list of sources
    - Eli
  - Appendix – Additional documentation (at minimum)
    - Iterations and progress
    - Everyone
- References
- Coding subteam
  - Setup function and force sensing function
    - Declan
  - Rolling average function and button function
    - Alexis
  - We'll both work on the main function

Meetings over the break

- With sub-team members
- Schedule a group meeting with everyone for progress updates as we go

Device Name Brainstorming

- Gate
- Safety
- Smart
- Security
- Alert

Closing remarks

- Mark 3 S+ for prusa printing

Appendix C: Design Studio Worksheets

MILESTONE 0 – COVER PAGE

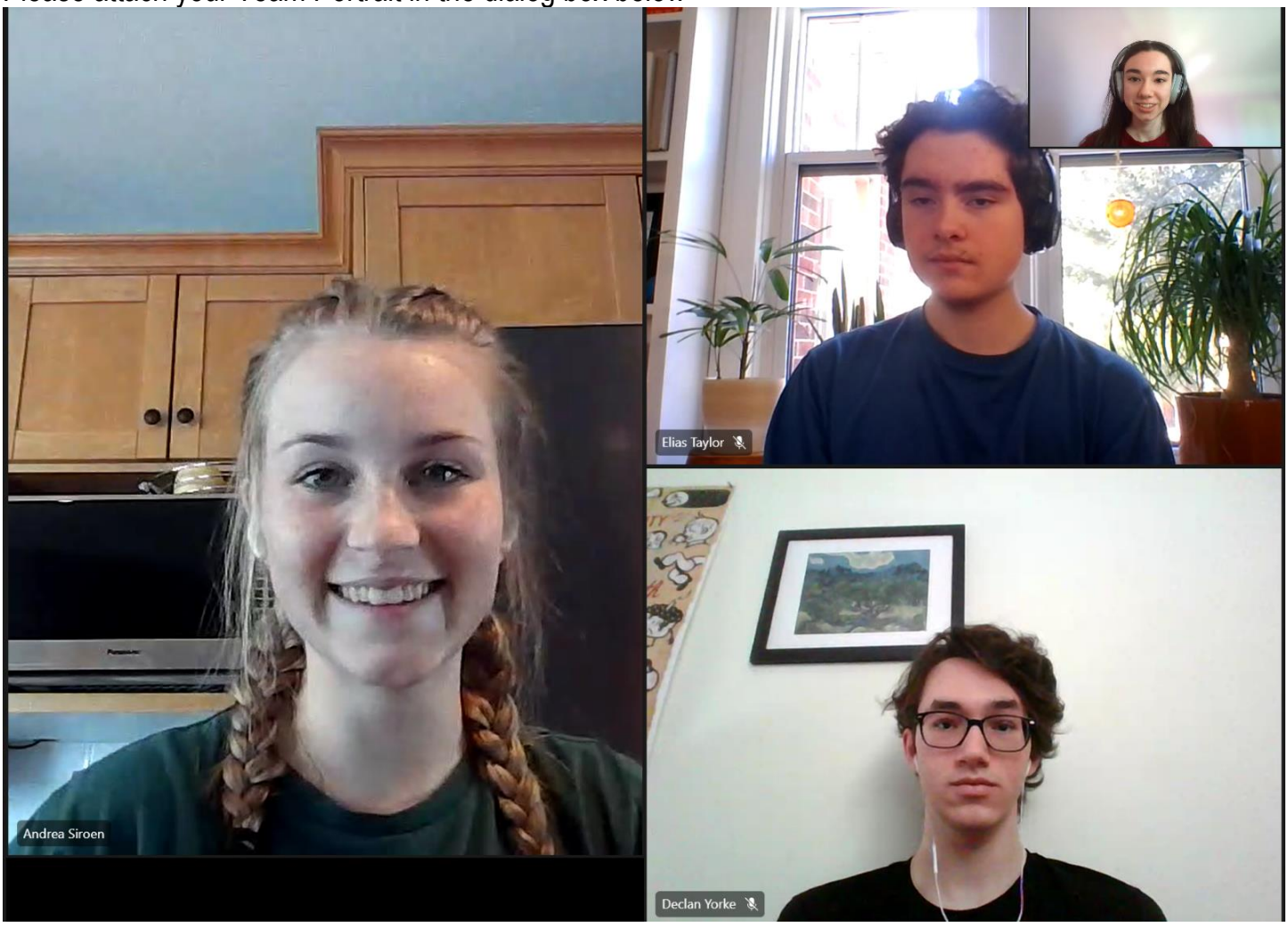
Team Number: 35

Please list full names and MacID's of all *present* Team Members

Full Name:	MacID:
Alexis Moutafis-Tymcio	moutafia
Declan Yorke	yoked1
Andrea Siroen	siroena
Eli Taylor	tayloe26

Any student that is ***not*** present for Design Studio will not be given credit for completion of the worksheet and may be subject to a 10% deduction to their DP-3 grade.

Please attach your Team Portrait in the dialog box below



MILESTONE 0 – TEAM CHARTER

Team Number: 35

Incoming Personnel Administrative Portfolio:

Prior to identifying Leads, identify each team members incoming experience with various **Project Leads**

	Team Member Name:	Project Leads
1.	Alexis	☒M ☒A1 ☐A2 ☐C
2.	Andrea	☐M ☒A1 ☐A2 ☒C
3.	Declan	☐M ☒A1 ☐A2 ☒C
4.	Eli	☒M ☐A1 ☐A2 ☒C
		☐M ☐A1 ☐A2 ☐C

To 'check' each box in the Project Leads column, you must have this document open in the Microsoft Word Desktop App (not the browser and not MS Teams)

Project Leads:

Identify team member details (Name and MACID) in the space below.

Role:	Team Member Name:	MacID
Manager	Andrea Siroen	siroena
Administrator 1	Eli	tayloe26
Administrator 2	Declan	yorked1
Coordinator	Alexis	moutafia

MILESTONE 0 – TEAM CHARTER

Team Number: 35

Project Sub-Teams:

Identify team member details (Name and MACID) in the space below.

Sub-team:	Team Member Name:	MacID
Computing	Alexis	moutafia
	Declan	yorked1
Modelling	Andrea Siroen	siroena
	Eli Taylor	tayloe26

MILESTONE 1 – COVER PAGE

Team Number: 35

Please list full names and MacID's of all *present* Team Members

Full Name:	MacID:
Alexis Moutafis-Tymcio	moutafia
Declan Yorke	yorked1
Andrea Siroen	siroena
Eli Taylor	tayloe26

Any student that is ***not*** present for Design Studio will not be given credit for completion of the worksheet and may be subject to a 10% deduction to their DP-3 grade.

Page Break

MILESTONE 1 (STAGE 1) – FOCUS AND DEMOGRAPHIC

Team Number: 35

Area of Focus

Indicate your team's chosen **area of focus** in the space below. There are two areas of focus you may choose from:

- Personal monitoring devices
- Technology for automating tasks in the home

Chosen Area of Focus:	Technology for automating tasks in the home

Customer Demographic

Indicate the **customer demographic** your team will be targeting in the space below.

- Your customer demographic may be *broad* or *specific*, and may be described in terms of a group of individuals (e.g., patients recovering from at home from a surgery) or a segment of the population (e.g., elderly with a particular disability)

Customer Demographic:	Parents of young children

MILESTONE 1 (STAGE 2) – STATEMENTS OF FACTS

Team Number: 35

As a team, list your **statements of facts** in the space below. As there is an expectation that you conduct some preliminary research and market analysis, each statement of fact should be supported by evidence. That is, it should be properly referenced (using IEEE standards) and should not be a made up 'fact'.

- Child/baby gates (even "high quality" ones) break or kids get through them [1]
- 20,000 children per year in Canada suffer from injuries around the home, with over half being from falls (~55/day) [2]
- Children/families with lower income may not be able to afford protective equipment (e.g., baby gates) [2]
- Falls account for 20-25% of emergency department visits involving childhood injury [3]
- Falls are the leading cause of traumatic brain injury, which significantly impact young children's developing brains [3]
- In 2009, unintentional injuries were responsible for 5,992 hospitalizations of children and youth aged 0 to 4 in Canada [4]
- Severe injury and trauma in childhood are associated with disability and poor health-related quality of life in both the short- and long-term [5]
- Unintentional injury is the leading cause of death among Canadian children, accounting for 237 deaths in 2008 [6]
- The rising costs of healthcare are causing a shift towards greater care within homes, leading to a marked increase in both variety and complexity of medical devices designed for use outside typical healthcare institutions [7]

- The number of baby gate-related injuries has nearly quadrupled since the year 1990 according to the U.S. Emergency Department [8]
- More than 60% if children injured are younger than two, withstanding injuries most commonly from falls down the stairs after misuse of the gate (i.e., gate left open, climbing over the gate, gate collapsing), causing soft tissue injuries and even traumatic brain injuries [8]
- To reduce injury, it is recommended for baby gates to be removed once the child has learned to climb over the appliance, which nullifies the purpose of the safety device in the first place [8]

List any references from the statements you came up with as a team in the space below.

[1] M. Pierce, "9 common problems with baby gates and how to solve them," *Baby Gates Expert*, 21-Nov-2021. [Online]. Available: https://babygatesexpert.com/common-problems-baby-gates/. [Accessed: 14-Jan-2022].

[2] "Home Safety," *Parachute*, 29-Nov-2021. [Online]. Available: https://parachute.ca/en/injury-topic/home-safety/. [Accessed: 17-Jan-2022].

[3] "Children and Falls," *World Health Organization*, 2008. [Online]. Available: https://www.who.int/violence_injury_prevention/child/injury/world_report/Falls_english.pdf?ua=1. [Accessed: 17-Jan-2022].

[4] P. H. A. of Canada, "Government of Canada," *Canada.ca*, 01-Mar-2016. [Online]. Available: https://www.canada.ca/en/public-health/services/reports-publications/leading-causes-death-hospitalization-canada/2009-10-males-females-combined-counts-specific-hospitalization-rate.html. [Accessed: 18-Jan-2022].

[5] T. L. Holbrook, D. B. Hoyt, R. Coimbra, B. Potenza, M. J. Sise, D. I. Sack, and J. P. Anderson, "Trauma in adolescents causes long-term marked deficits in quality of life: Adolescent children do not recover preinjury quality of life or function up to two years Postinjury compared to national norms," *Journal of Trauma: Injury, Infection & Critical Care*, vol. 62, no. 3, pp. 577–583, 2007.

[6] P. H. A. of Canada, "Government of Canada," *Canada.ca*, 01-Mar-2016. [Online]. Available: https://www.canada.ca/en/public-health/services/reports-publications/leading-causes-death-hospitalization-canada/2008-males-females-combined-counts-specific-death-rate.html. [Accessed: 18-Jan-2022].

[7] "Medical Devices in home health care - ncbi.nlm.nih.gov." [Online]. Available: https://www.ncbi.nlm.nih.gov/books/NBK210047/. [Accessed: 18-Jan-2022].

[8] "New Study finds number of children treated in U.S. emergency departments for baby gate-related injuries nearly quadrupled since 1990," Nationwide Children's Hospital, 15-May-2014. [Online]. Available: https://www.nationwidechildrens.org/newsroom/news-releases/2014/05/new-study-finds-number-of-children-treated-in-us-emergency-departments-for-baby-gate-related. [Accessed: 18-Jan-2022].

MILESTONE 1 (STAGE 3) – LIST OF CRITERIA

Team Number: 35

As a team, develop a list of criteria that your device is required to meet. List your criteria in the space below. These criteria are akin to *customer requirements*. As such, you should indicate whether each criterion is an objective, function, or constraint. As a reminder, requirements ***can be*** *more than one* of the three.

List your criteria in this field. Bullet-point format is acceptable. For each criterion, indicate (in parentheses) whether it is an objective, function, or constraint.

Constraints:

- Must conform to safety standards
- Must be easily adjustable
- Must be affordable for the average family

Functions:

- Prevents injury
- Indicates trespassing/signals to parents

Objectives:

- Should not prevent parents/older children from going about their lives
- Should have a life span of at least 3 years
- Should adhere to different surfaces

MILESTONE 1 (STAGE 4) – NEED STATEMENT

Team Number: 35

Write your Need Statement in the space below. Recall that your need statement should:

- Have a clearly defined problem (what is the need?)
- Indicate your end-user (who has the need?)
- Have a clearly defined outcome (what do you hope to solve and why is it important?)

NEED STATEMENT:	Design a device for use by parents that automates household child safety to prevent falls in unsupervised children, which result in over 10,000 injuries per year in Canada.

MILESTONE 2 – COVER PAGE

Team Number: 35

Please list full names and MacID's of all *present* Team Members

Full Name:	MacID:
Andrea Siroen	siroena
Alexis Moutafis-Tymcio	moutafia
Declan Yorke	yorked1
Eli Taylor	tayloe26

Any student that is ***not*** present for Design Studio will not be given credit for completion of the worksheet and may be subject to a 10% deduction to their DP-3 grade.

MILESTONE 2 (STAGE 1) – PRELIMINARY CONCEPTS

Team Number: 35

You should have already completed this task individually *prior* to Design Studio.

1. Copy-and-paste each team member's preliminary concept sketches on the following pages (1 sketch per page)
    - Be sure to indicate each team member's Name and MacID
1. Copy-and-paste each team member's description of their chosen input and output devices on the following pages (1 description per page)
    - Be sure to indicate each team member's Name and MacID

We are asking that you submit your work on both worksheets. It does seem redundant, but there are valid reasons for this:

- Each team member needs to submit their preliminary concept sketches and description of their chosen input and output devices with the **Milestone Two Individual Worksheets** document so that it can be ***graded***
- Compiling your individual work into this **Milestone Two Team Worksheets** document allows you to readily access your team member's work
    - This will be especially helpful when completing ***Stage 2*** of the milestone

Name: Andrea Siroen	**MacID**: siroena
Preliminary Concept Solution **#1**	
Insert screenshot(s) of your preliminary sketches below	

Name: *Andrea Siroen*	**MacID**: siroena
Preliminary Concept Solution **#1**	

Type of information input from the physical environment

Applied force from child (i.e., touch, grasp, climb); must touch anywhere on surface pad to activate force sensor. May include a second sensor found at a distance from the sensor pad to allow for the system to be temporarily disabled and distinguish between user and child interaction.

Type of sensor required

Force Sensitive Resistor.

Type of output device(s) used for communication

To communicate that a child is near a potential hazard, an alarm will sound to alert the user when the sensor pad is contacted. The alarm will be projected through a speaker. This aims to reduce the potential risk of the child's compromised safety and consequently avoid any related injuries.

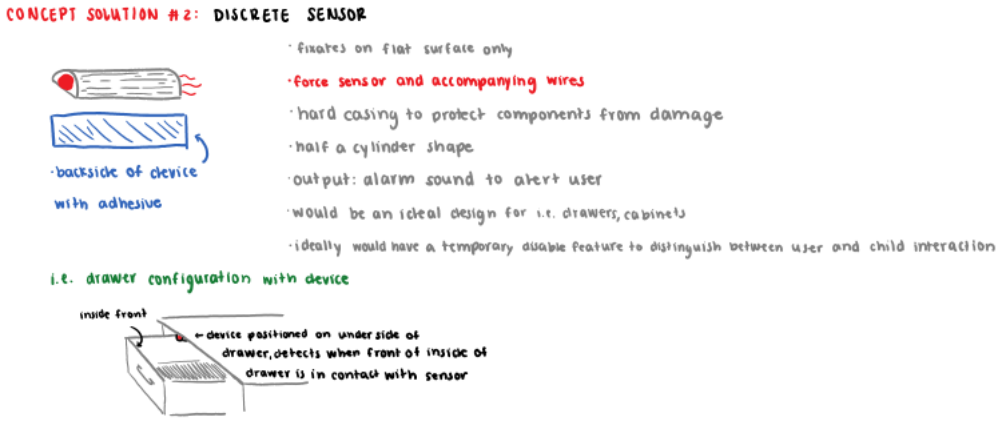
How output devices will be implemented

The output device will be contained within the Pi housing unit. However, since the sensor pad device cannot store the Pi, the Pi will need to be mounted close enough to the sensor pad. As mentioned above, the speaker would ideally be paired with another alert system, such as a messaging system for mobile devices or notification through a mobile application (to ensure the alert is always received).

Name: *Andrea Siroen*	**MacID**: siroena

Preliminary Concept Solution **#2**

Insert screenshot(s) of your preliminary sketches below



Type of information input from the physical environment

Applied force from i.e. drawer, cabinet, indicating that the appliance is either closed or adjacent. May include a second sensor to allow for the system to be temporarily disabled and distinguish between user and child interaction.

Type of sensor required

Force Sensitive Resistor.

Type of output device(s) used for communication

An alarm will sound to alert the user when the sensor pad is not in contact. A speaker will be used as the output device for the alarm, and possible use of a mobile application or SMS to further alert user if not within range to hear alarm.

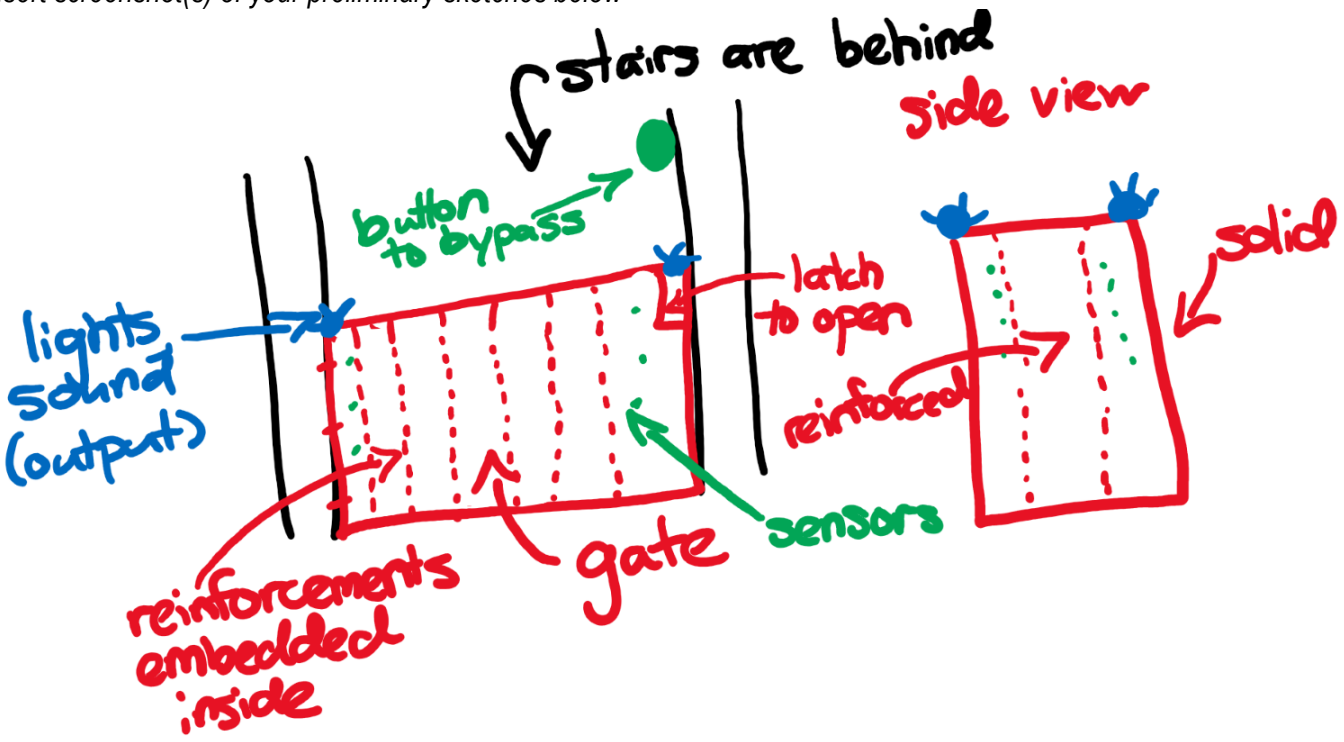
How output devices will be implemented

The output device will be included in the housing for the Pi. As mentioned above, the speaker would ideally be paired with another alert system, such as a messaging system for mobile devices or notification through a mobile application (to ensure the alert is always received).

Name: *Alexis Moutafis-Tymcio*	**MacID**: moutafia

Preliminary Concept Solution **#3**

Insert screenshot(s) of your preliminary sketches below



Type of information input from the physical environment

Forces when someone tries to open the gate, someone pressing a button to bypass the gate (adults, older children)

Type of sensor required

Force sensor

Type of output device(s) used for communication

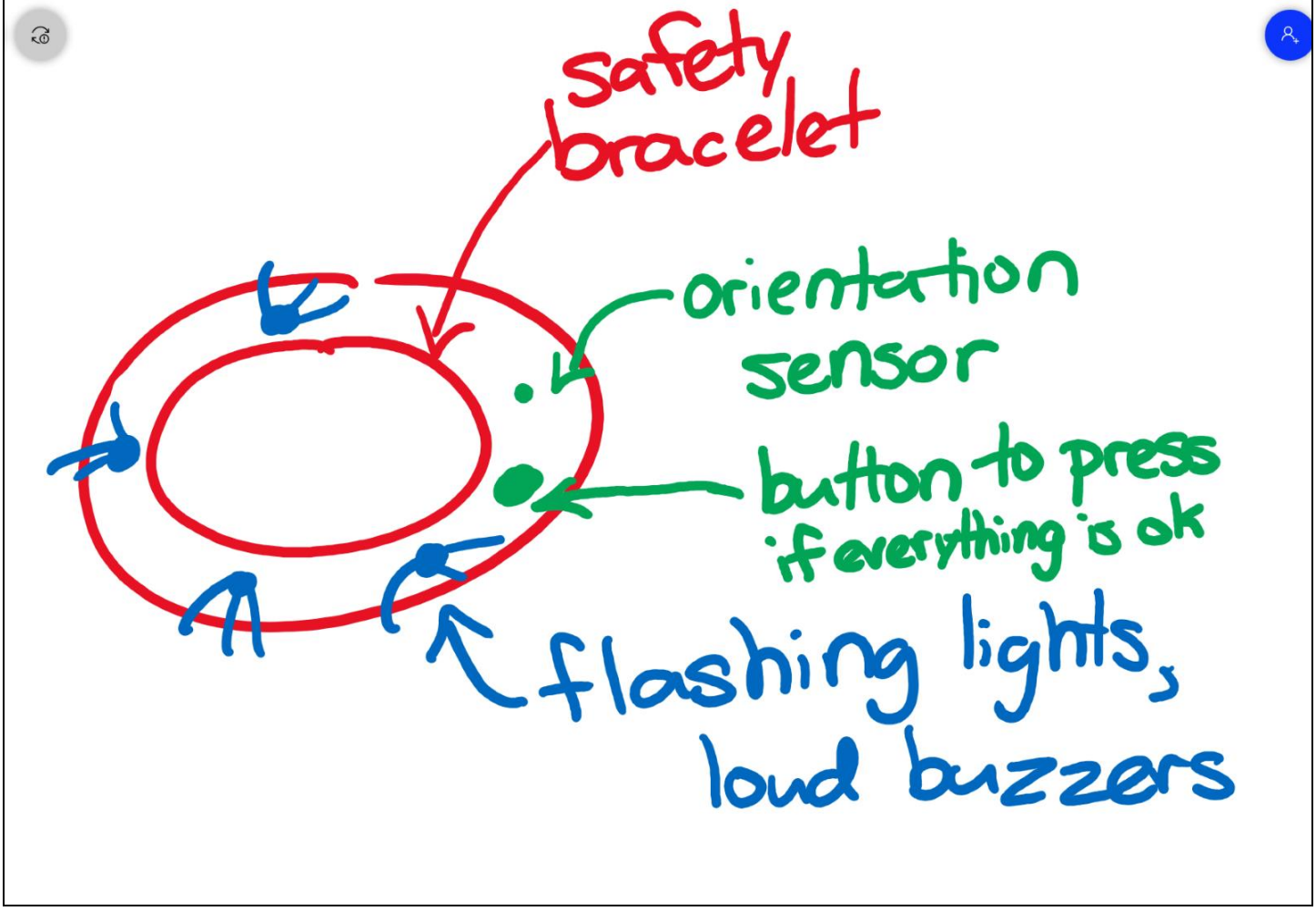
Flashing lights, some device that creates sound (i.e. buzzer), gate acts as an output device in itself by locking when pressure/force is detected

How output devices will be implemented

Buzzer/sound creating device is embedded in the gate, flashing lights are put on top so they're visible. When the force sensor detects pressure on the gate, they are activated

Name: *Alexis Moutafis-Tymcio*	**MacID**:
Preliminary Concept Solution **#4**	

Insert screenshot(s) of your preliminary sketches below



Name: *Alexis Moutafis-Tymcio*	**MacID**: moutafia
Preliminary Concept Solution **#4**	

Type of information input from the physical environment

Acceleration, direction (sudden movement that you would see in a fall), button on the bracelet that can be pressed in the event that the bracelet detects something but the child isn't hurt

Type of sensor required

Orientation sensor

Type of output device(s) used for communication

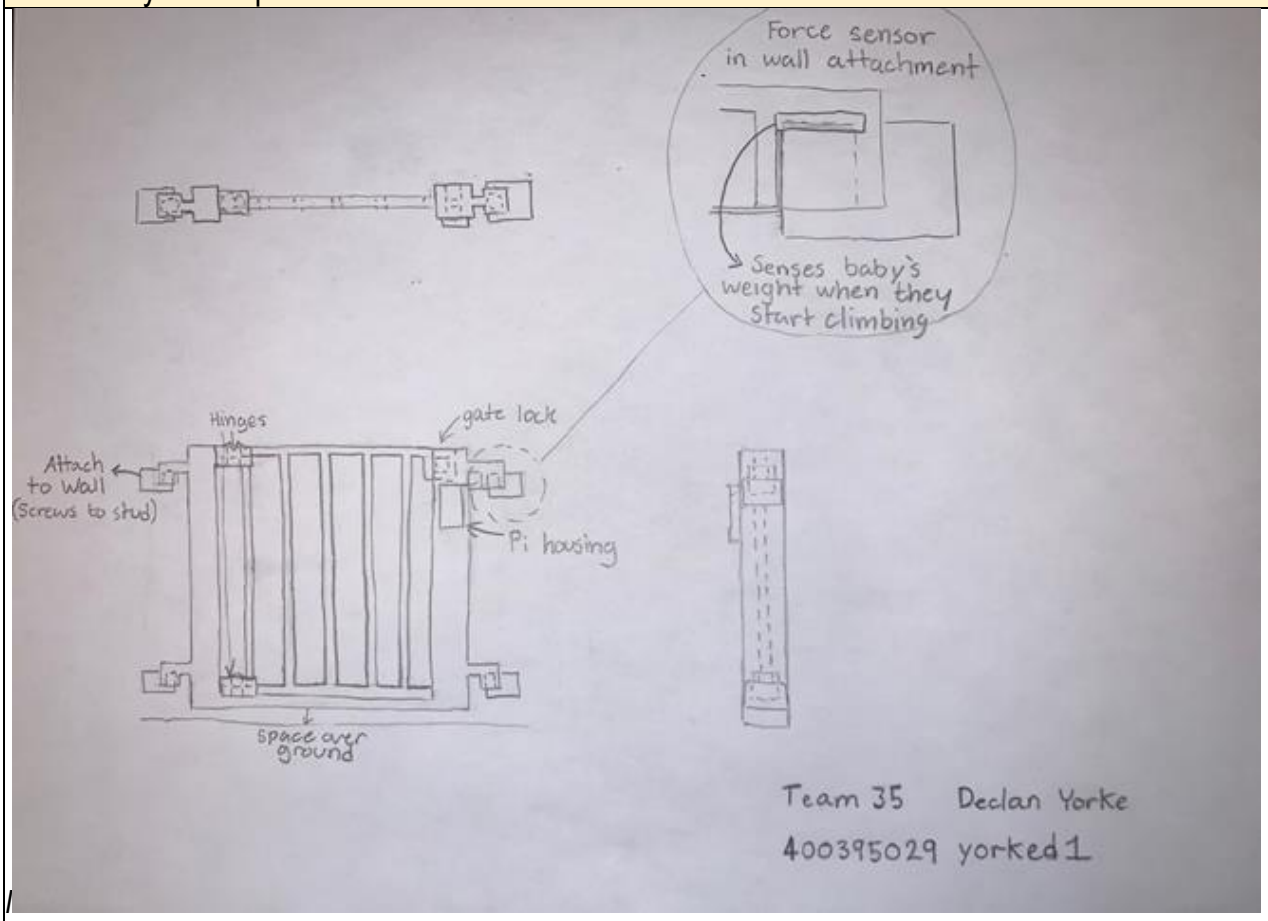
Buzzers (have to be loud), lights, text messages

How output devices will be implemented

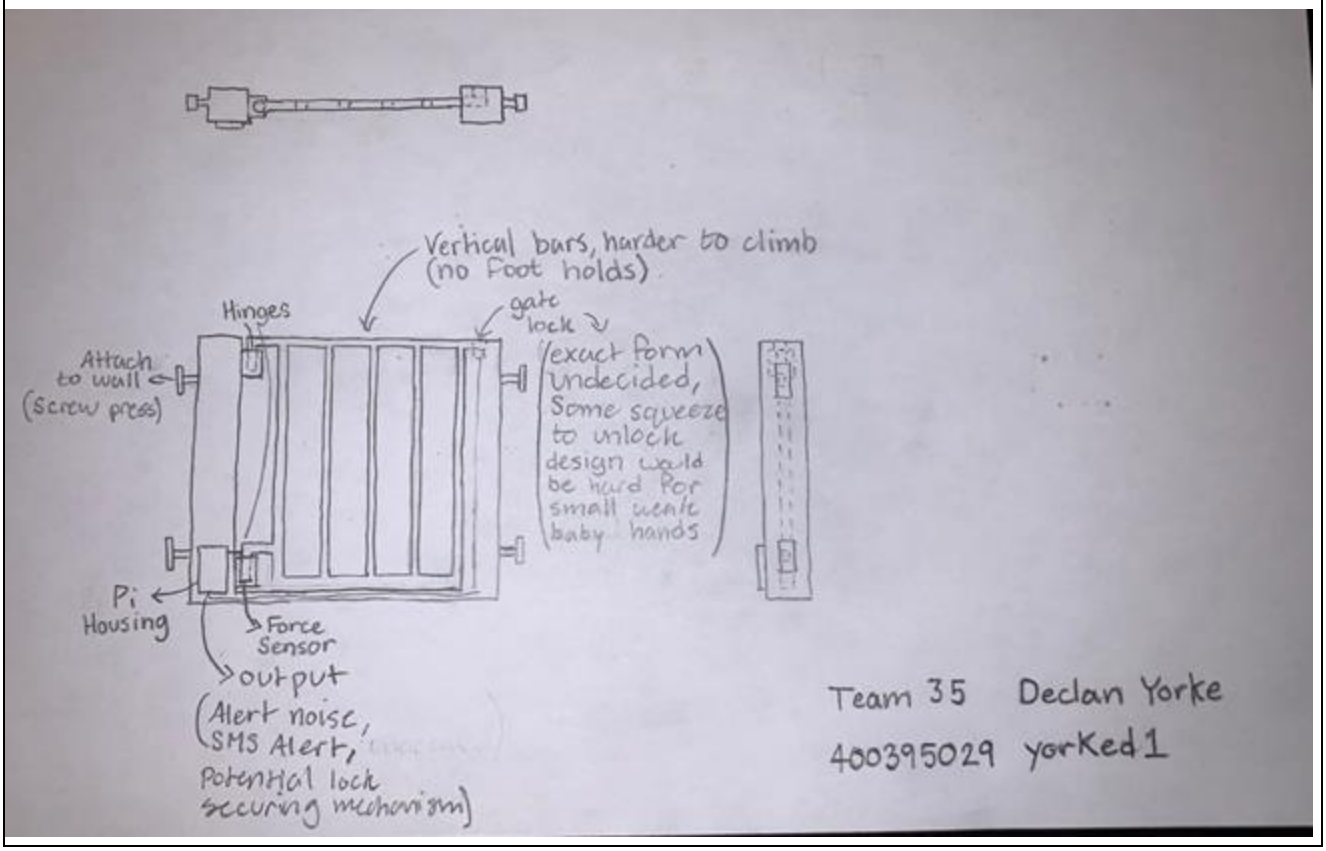
Buzzers embedded in the bracelet, lights on the outside of the bracelet

Name: Declan Yorke	**MacID**: yorked1

Preliminary Concept Solution **#5**



Name: Declan Yorke	**MacID**: yorked1
Preliminary Concept Solution **#6**	



Type of information input from the physical environment

Downwards force from baby's weight climbing gate

Type of sensor required

Force sensor

Type of output device(s) used for communication

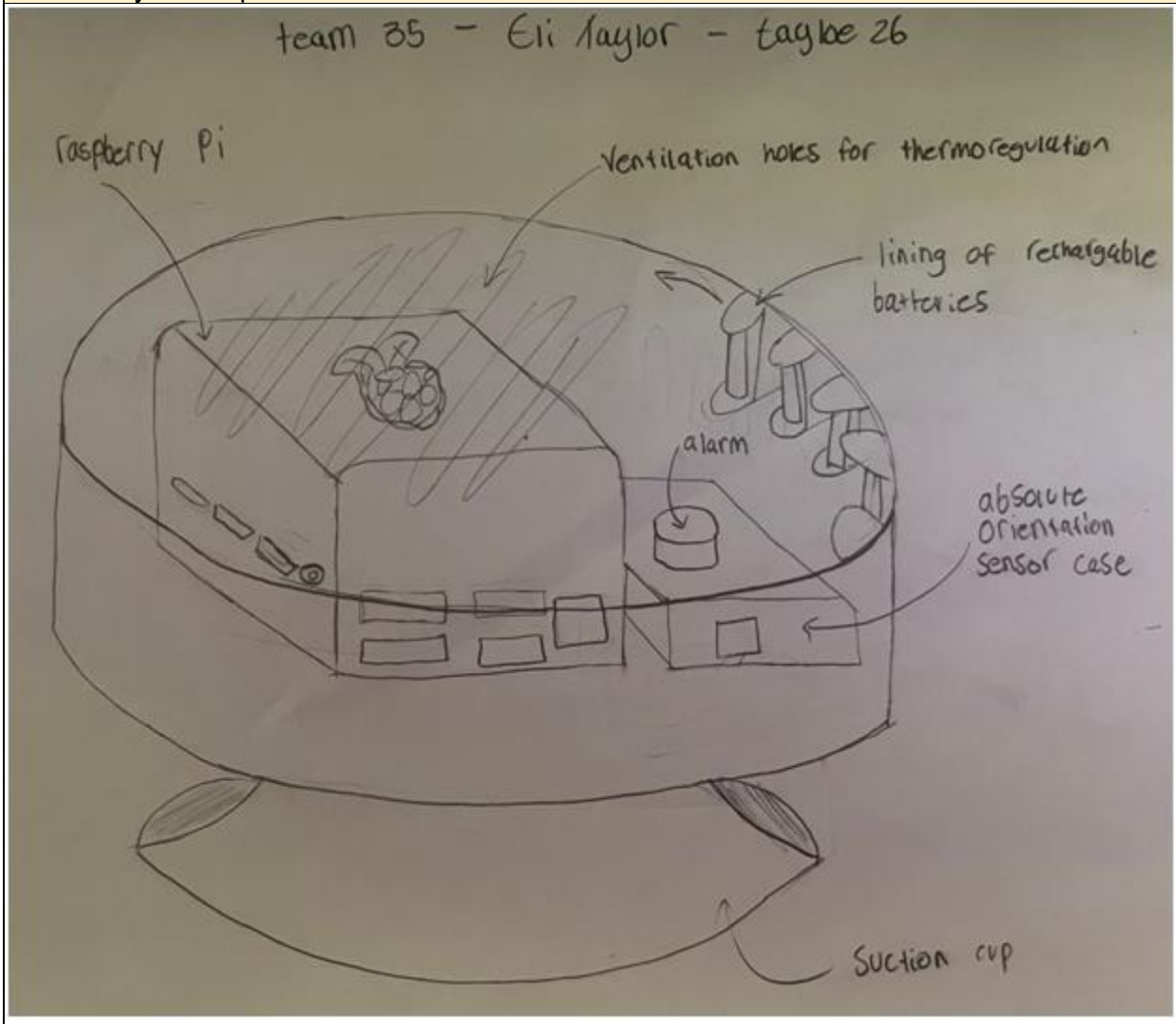
Speaker (for alert noise), SMS alert for more range/less annoying

How output devices will be implemented

Output devices would be integrated into the housing of the Pi on the device. Could also implement a device that makes the gate completely unlockable if baby is sensed. Noise alert would last a second and be activated when the force sensor senses a baby trying to climb the device (200-600N). SMS would also be sent (to phone number or whatever is programable) when baby's weight is sensed.

Name: *Eli Taylor*	**MacID**: tayloe26

Preliminary Concept Solution **#7**



This device attaches to an existing child gate via the suction cup and alerts parents when the gate is unintentionally disturbed. It helps automate supervision and protects children from areas they're not supposed to enter.

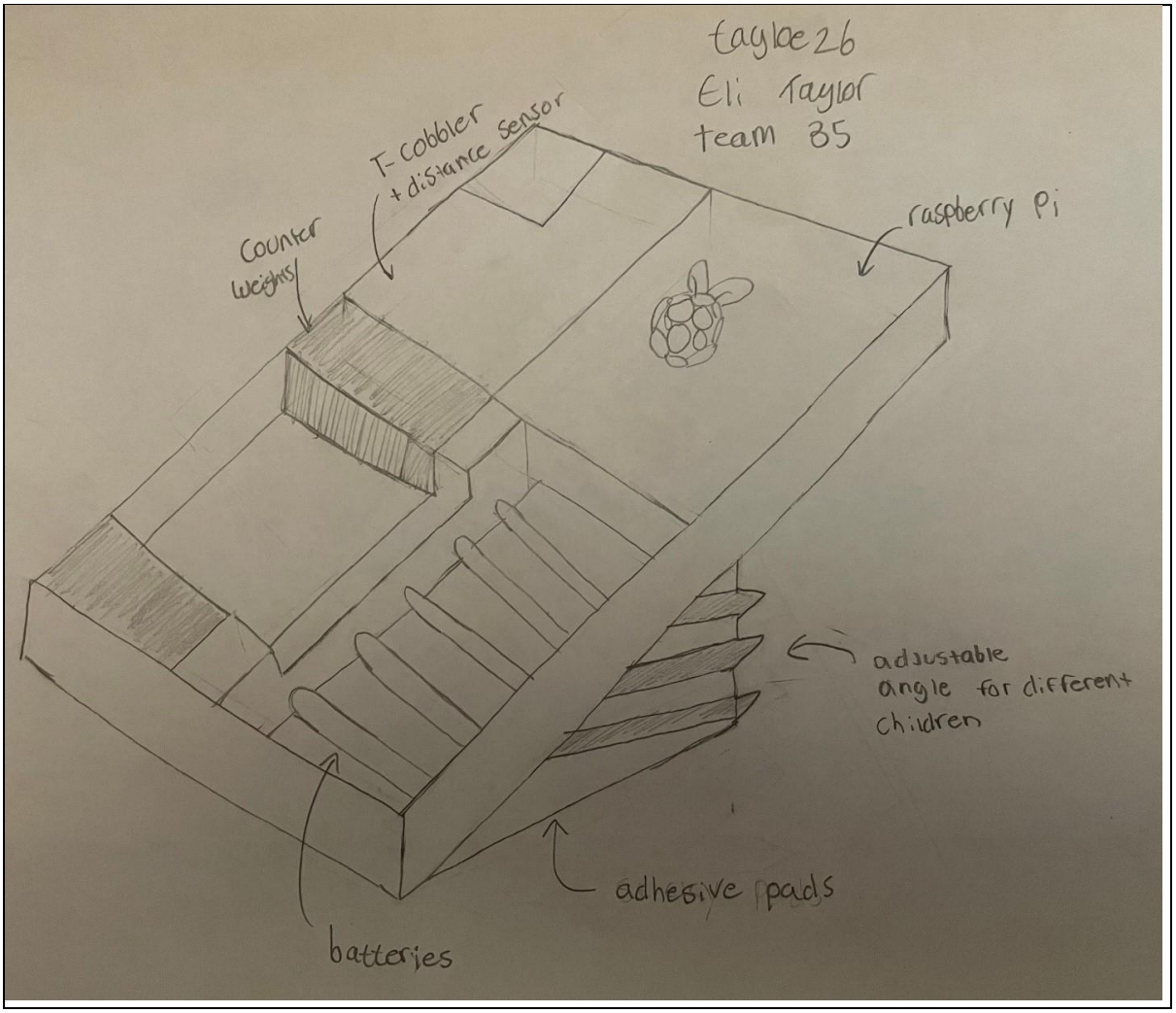
Name: *Eli Taylor*	**MacID**: tayloe26
Preliminary Concept Solution **#7**	

Type of information input from the physical environment
Acceleration

Type of sensor required
Absolute orientation sensor BNO055

Type of output device(s) used for communication
Audio alarm/downloadable app

How output devices will be implemented
The alarm can be connected through the T-cobbler and the app could receive inputs from a special python file downloaded onto the raspberry pi. A signal is passed when the acceleration exceeds 1m/s.



This device attaches to a stair gate through the use of adhesive pads. It automatically lights the area when a child enters to help prevent them from tripping near the stairs, a common source of injury and death.

Type of information input from the physical environment

Distance of child from stairs

Type of sensor required

VL53LOX distance sensor

Type of output device(s) used for communication

Either attached LED or the remote activation of a light switch.

How output devices will be implemented

The necessary parts would be added to the otherwise empty counterweight section. For the LED it would involve a bulb attached to the T-Cobbler, while the light switch would require a Bluetooth transmitter and compatible switch. The device would activate when the child is within 0.5m and last until they move further away.

MILESTONE 2 (STAGE 2) – PUGH MATRIX

Team Number: 35

1. As a team, evaluate your concept solutions in the table below
   - List your Criteria in the first column
     - You should include a minimum of 5 criteria
   - Fill out the table below, comparing your designs against a baseline concept (the decision of a baseline concept is arbitrary and entirely up to your team to decide)
     - Replace "Concept 1", "Concept 2", etc. with more descriptive labels (e.g., a distinguishing feature or the name of student author)
     - Indicate a "+" if a concept is better than the baseline, a "–" if a concept is worse, or a "S" if a concept is the same

	Baby Monitor	***Andrea 1***	***Andrea 2***	***Alexis 1***	***Alexis 2***	***Declan 1***	***Declan 2***	**Eli - 1**	**Eli - 2**

Prevents Injury	D	+1	0	+1	-1	+1	+1	0	+1
Alerts Parents	A	+1	+1	+1	+1	+1	+1	+1	0
Blocks Unsafe Areas	T	0	+1	+1	0	+1	+1	+1	0
Doesn't Obstruct Parents	U	-1	0	0	0	-1	-1	-1	0
Has a Long Lifespan	M	+1	+1	+1	+1	+1	0	+1	+1
Versatile applications		+1	0	-1	0	-1	0	0	+1
Affordable		0	0	0	0	0	0	+1	+1
Total +		4	3	4	2	4	3	4	4
Total –		1	0	1	1	2	1	1	0
Total Score		3	3	3	1	2	2	3	4

*For a team of 5, click the top-right corner of the table to "Add a New Column"

1. Indicate the concept(s) you have selected to pursue for further development and testing, include **justification**

The first and most prominent design to pursue is a combination of Alexis-1 and Declan-1, taking advantage of the structure described in the first example and the sensor set-up described in the second. This combination helps improve the obstruction of parents (bringing the –1 from Declan-1 to a 0) and gives a clear direction on how to house the raspberry pi and sensors (somewhat missing in Alexis-1).

Our two secondary designs that remain in consideration are Andrea-1 and Eli-2. They are sufficiently unique from the above design to warrant further investigation. They seem to be more versatile and affordable solutions compared to existing products, although they have minor issues that still need to be resolved.

*** It's perfectly acceptable to consider more than one design at this point.**

1. Briefly describe any **design refinements** that your team will consider for the selected concept. Design refinements include any changes or modifications that deviate from the initial design. These changes or modifications may be based on *other* designs that were proposed but not selected, or they may be derived from discussions during your team's concept evaluation.

- Improve versatility (e.g., adjust to different widths)
- Improve possible structural weak points (e.g., hinges)
- Undergo a materials selection process
- Make product more affordable/accessible
- Invent ways to distinguish parents/children (secondary designs)

MILESTONE 3 – COVER PAGE

Team Number: 35

Please list full names and MacID's of all *present* Team Members

Full Name:	MacID:
Andrea Siroen	siroena
Alexis Moutafis-Tymcio	moutafia
Declan Yorke	yorked1
Eli Taylor	tayloe26

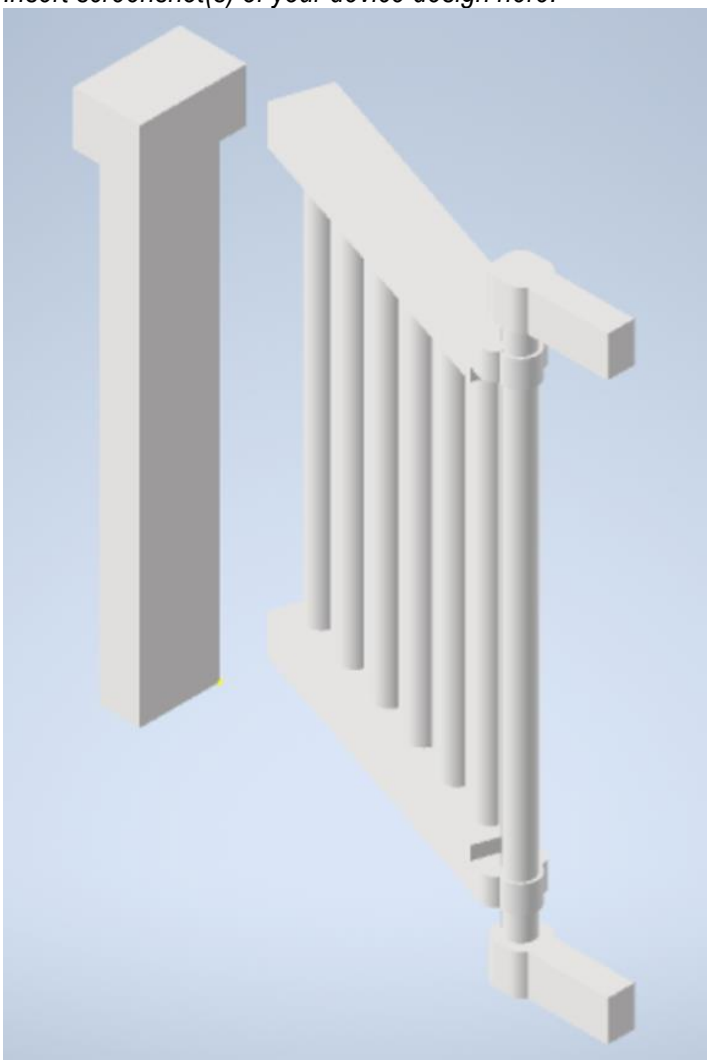
Any student that is ***not*** present for Design Studio will not be given credit for completion of the worksheet and may be subject to a 10% deduction to their DP-3 grade.

MILESTONE 3 (STAGE 1) – PRELIMINARY DESIGN OF DEVICE

Team Number: 35

As a team, create a preliminary presentation of your device, documenting your design via screenshots in the space below.

Insert screenshot(s) of your device design here.

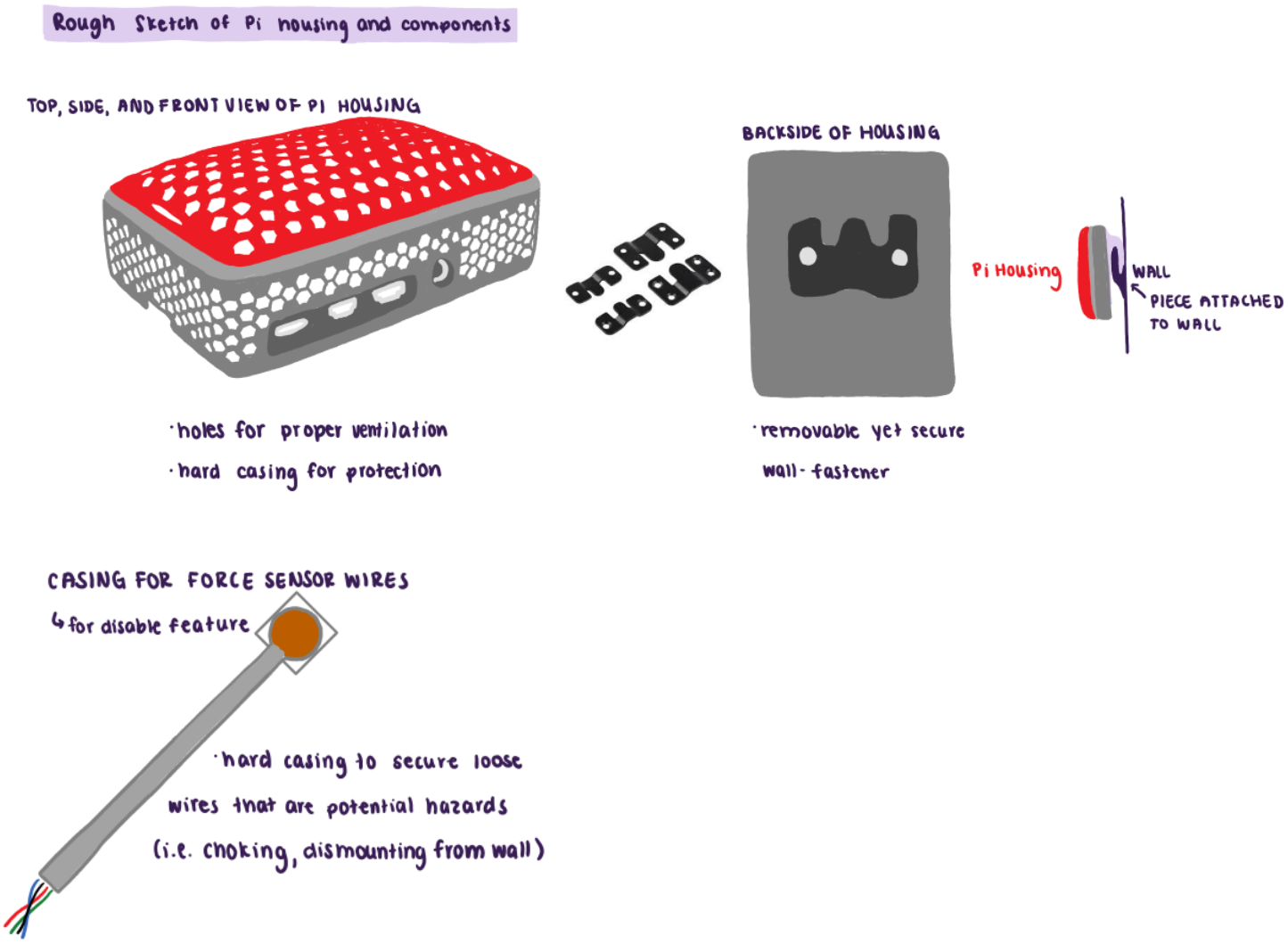


MILESTONE 3 (STAGE 2) – PRELIMINARY SKETCH (MODELLING SUB-TEAM)

Team Number: 35

As a sub-team, create a preliminary sketch of your Raspberry Pi housing, documenting your housing via screenshots in the space below.

Insert screenshot(s) of your device design here.



Page Break

MILESTONE 3 (STAGE 3) – PROCESSING INPUT AND COMMUNICATING OUTPUT (COMPUTATION SUB-TEAM)

Team Number: 35

As a sub-team, complete your pseudocode or flowcharts in the space below. Alternatively, copy-and-paste screenshots of your pseudocode or flowchart below (1 screenshot per page)

Name: Declan Yorke	**MacID**: yorked1
Sub-task: Pseudocode for the button/switch operated locking mechanism on the baby gate. The gate checks for a user input from the button and unlocks or relocks depending on its locked status when the button is pressed. (Process = checking lock status and registering input. Output = changing lock status via the output	

device which is a piston or some other simple mechanical device that can be moved to lock and unlock the door)

Program start
Import necessary libraries, time, button
Initialise boolean lock _status
Initialise boolean button_pressed to false
Connect button_pressed to pi input
Connect lock_status to pi output (don't know exactly what form this will take yet)
Start infinite loop
If lock_status == true
Gate is locked
else
Gate is unlocked
if button_pressed == true
If lock_status == true
lock_status == false
Else
lock_status == true
Sleep 1 second
End infinite loop

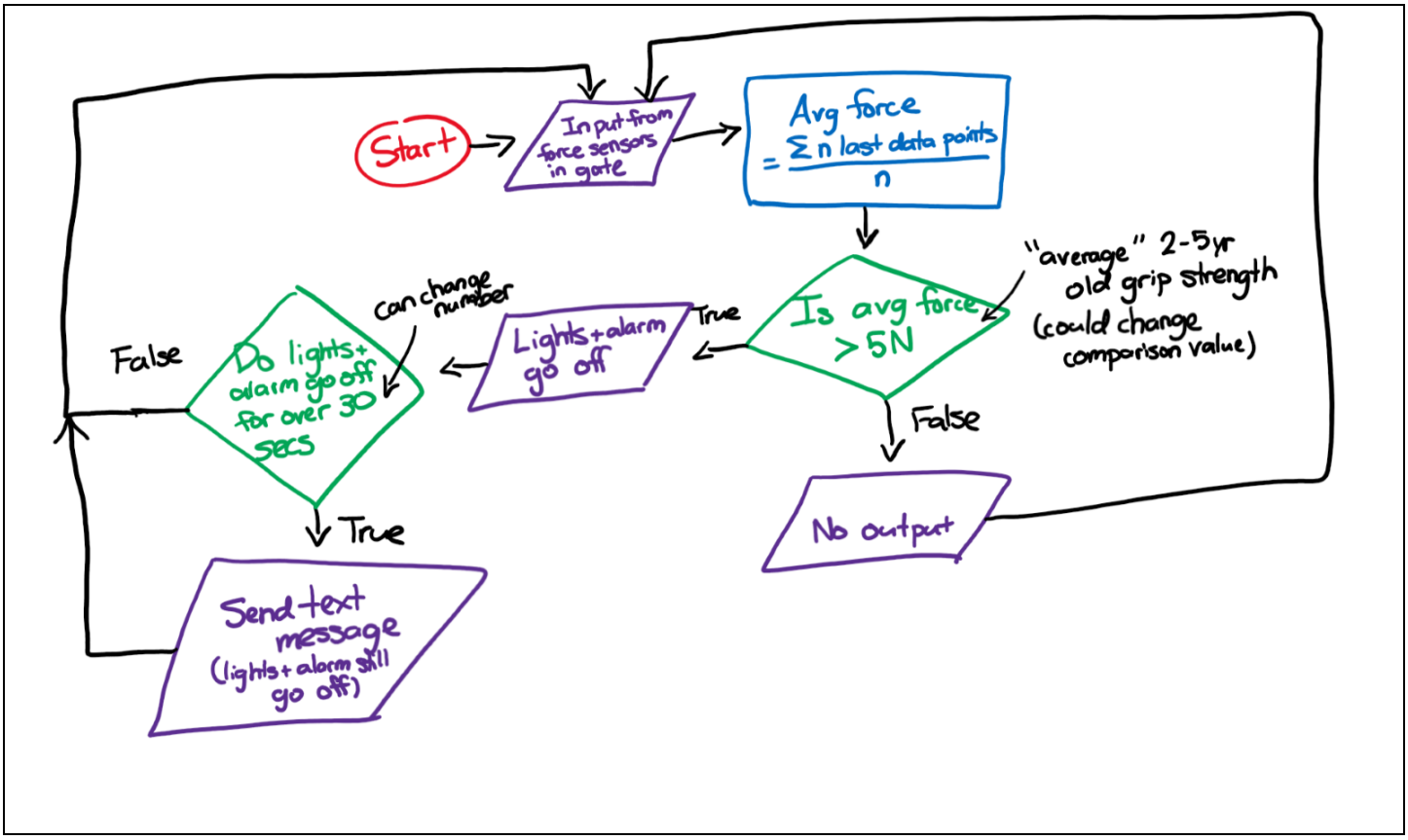
* For each process (remember, there are 2!), please copy-and-paste the above to a new page

MILESTONE 3 (STAGE 3) – PROCESSING INPUT AND COMMUNICATING OUTPUT (COMPUTATION SUB-TEAM)

Team Number: 35

As a sub-team, complete your pseudocode or flowcharts in the space below. Alternatively, copy-and-paste screenshots of your pseudocode or flowchart below (1 screenshot per page)

Name: *Alexis Moutafis-Tymcio*	**MacID**: moutafia
Sub-task: Flowchart showing the process for determining if pressure is being put on the gate and if it should lock. Input: force sensors in the gate. Process: Calculating average force and comparing to benchmark. Output: Alarm, lights, text messages	
Insert a screenshot of your pseudocode or flowchart here.	



MILESTONE 3 (STAGE 4) – DESIGN REVIEW FEEDBACK

Use the space below to document mentor feedback for your design.

- Where would it be ideal to put the force sensors? (to test if the child is pushing on the gate)
  - We can keep them on the hinge as long as the sensors aren't damaged/affected
- Where would it be best to mount the Pi housing? On the exterior? Or embed it in the banister-like attachment?
  - Put it somewhere where it's inaccessible to the children
  - Can detach it from the gate completely (i.e. in the same room out of reach of the child, but not physically attached to the gate)
- Is it feasible to have an SMS message as output?
  - It's feasible, just make it as a print statement to the shell
  - Could be redundant
  - What if the parent doesn't have the phone on them?
- Consider older siblings who might be stronger
- Challenge is creating unique ideas, but we need to be able to justify them

Use the space below to propose design refinements based on the feedback.

- Make text messaging an optional feature
- Look into if Raspberry Pis can be wireless/need to be attached to the device
- Toddler-proof the gate so older siblings learn how to use it responsibly and as an intended user
- Think of ways to protect the force sensors from damage

MILESTONE 4 – COVER PAGE

Team Number: 35

Please list full names and MacID's of all *present* Team Members

Full Name:	MacID:
Alexis Moutafis-Tymcio	moutafia
Declan Yorke	yorked1
Andrea Siroen	siroena
Eli Taylor	tayloe26

Any student that is ***not*** present for Design Studio will not be given credit for completion of the worksheet and may be subject to a 10% deduction to their DP-3 grade.

MILESTONE 4 (STAGE 1) – DETAILED SKETCHES (MODELLING SUB-TEAM)

You should have already completed this task individually *prior* to Design Studio.

1. Copy-and-paste each team member's detailed sketch of their housing assembly on the following pages (1 team member per page)
    - Be sure to clearly indicate who each sketch belongs to

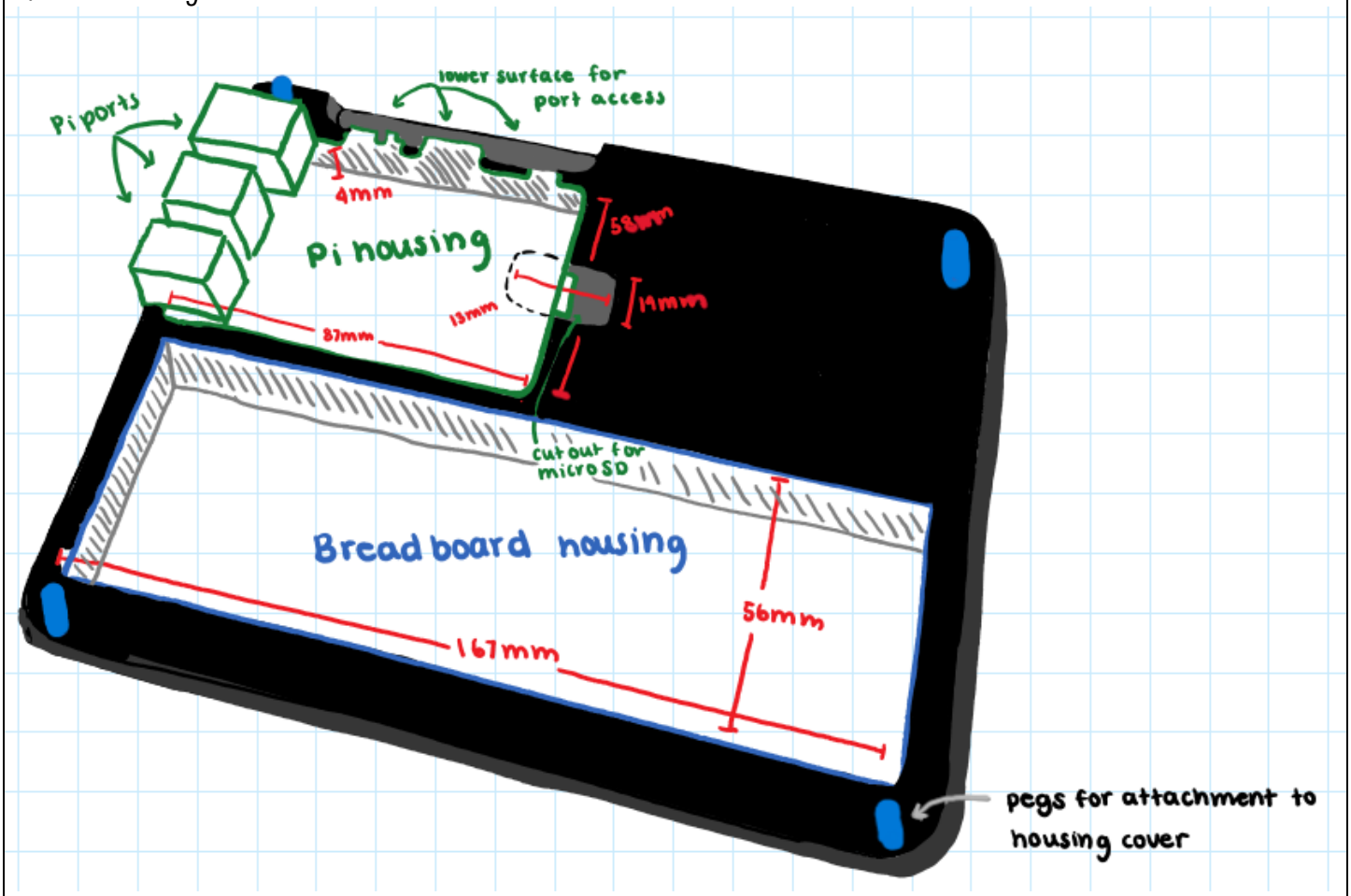
We are asking that you submit your work on both worksheets. It does seem redundant, but there are valid reasons for this:

- Each team member needs to submit their detailed sketch screenshots with the **Milestone Four Individual Worksheets** document so that it can be ***graded***
- Compiling your individual work into this **Milestone Four Team Worksheets** document allows you to readily access your team member's work
  - This will be especially helpful when completing ***Stage 3*** of the milestone

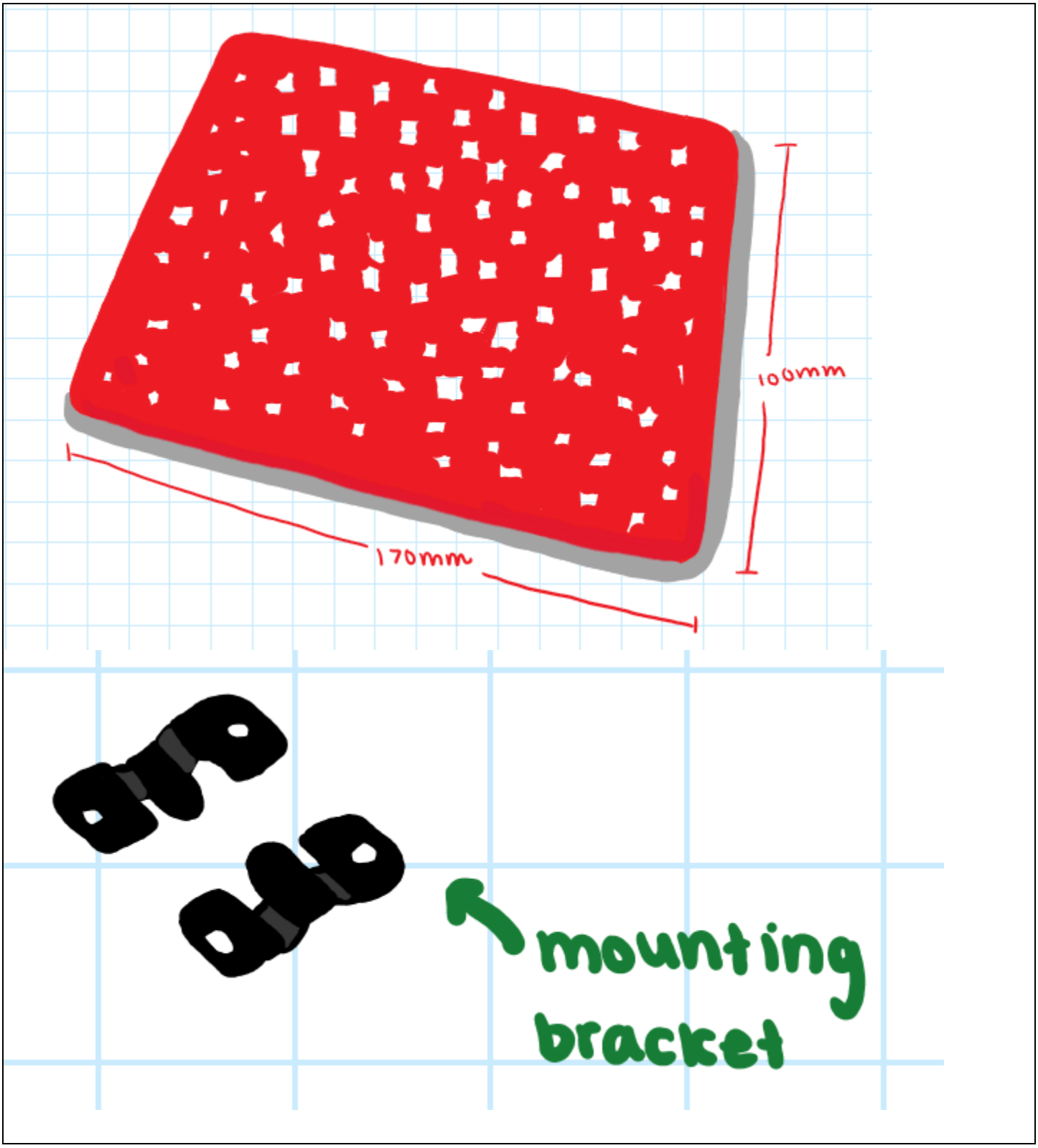
Name: Andrea Siroen	**MacID**: siroena

Insert a screenshot of your detailed sketch below

Base for Housing

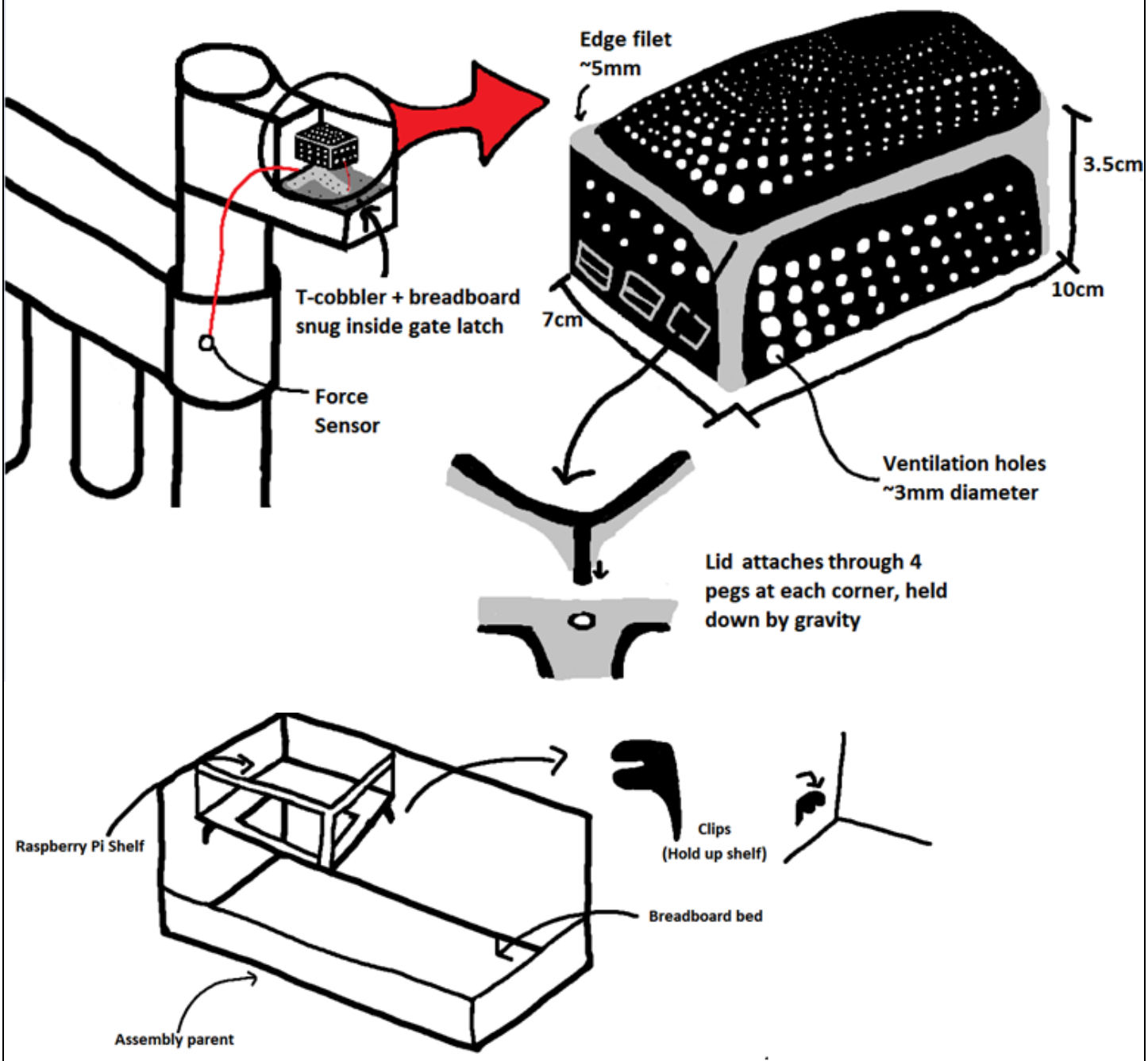


Lid for Housing


100mm
170mm
mounting bracket

Name: Eli Taylor	**MacID**: tayloe26

Insert a screenshot of your detailed sketch below



*Note: the unit is fully enclosed, just shown to be open for presentation of device idea

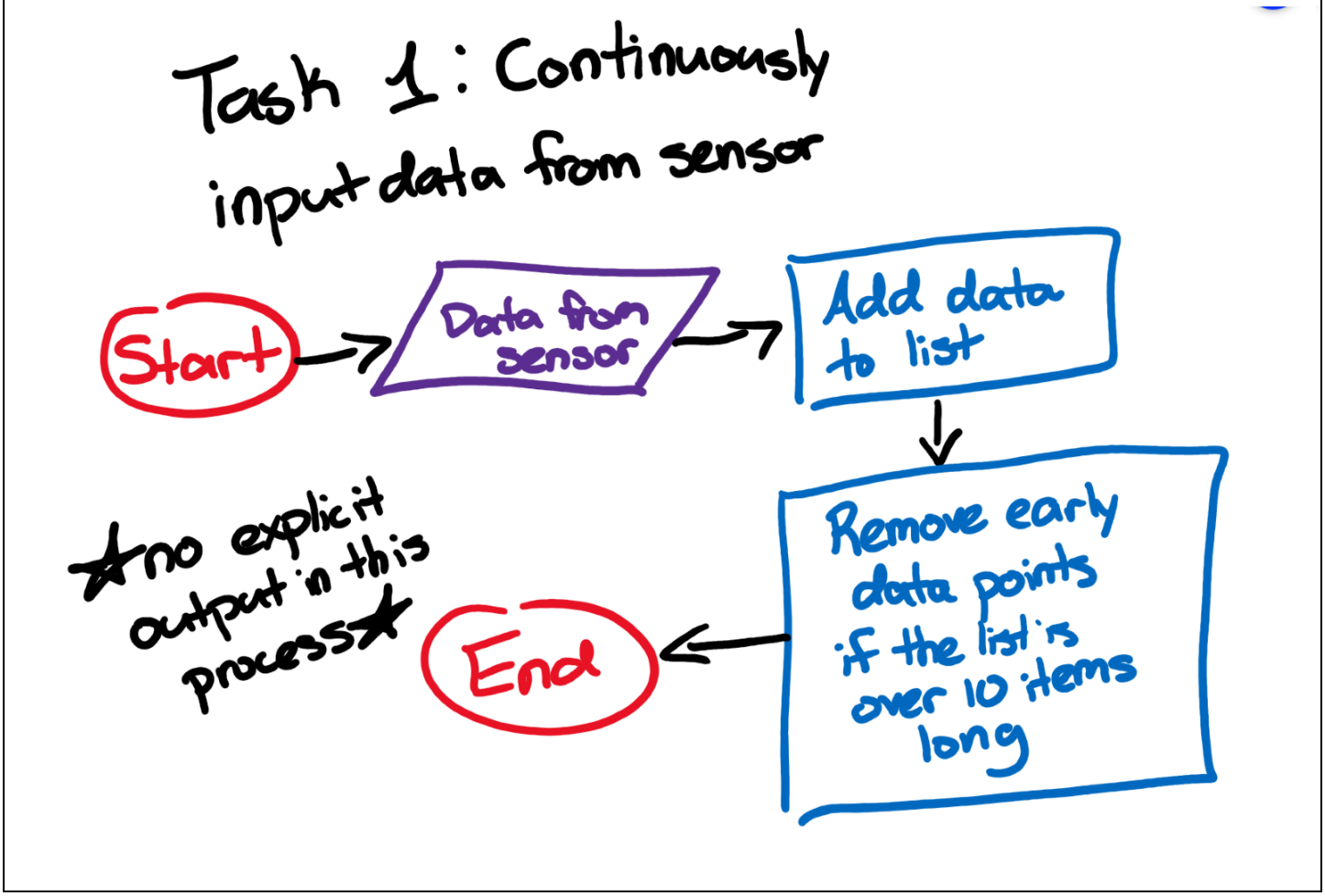
MILESTONE 4 (STAGE 2) – COMPUTER PROGRAM WORKFLOW (COMPUTATION SUB-TEAM)

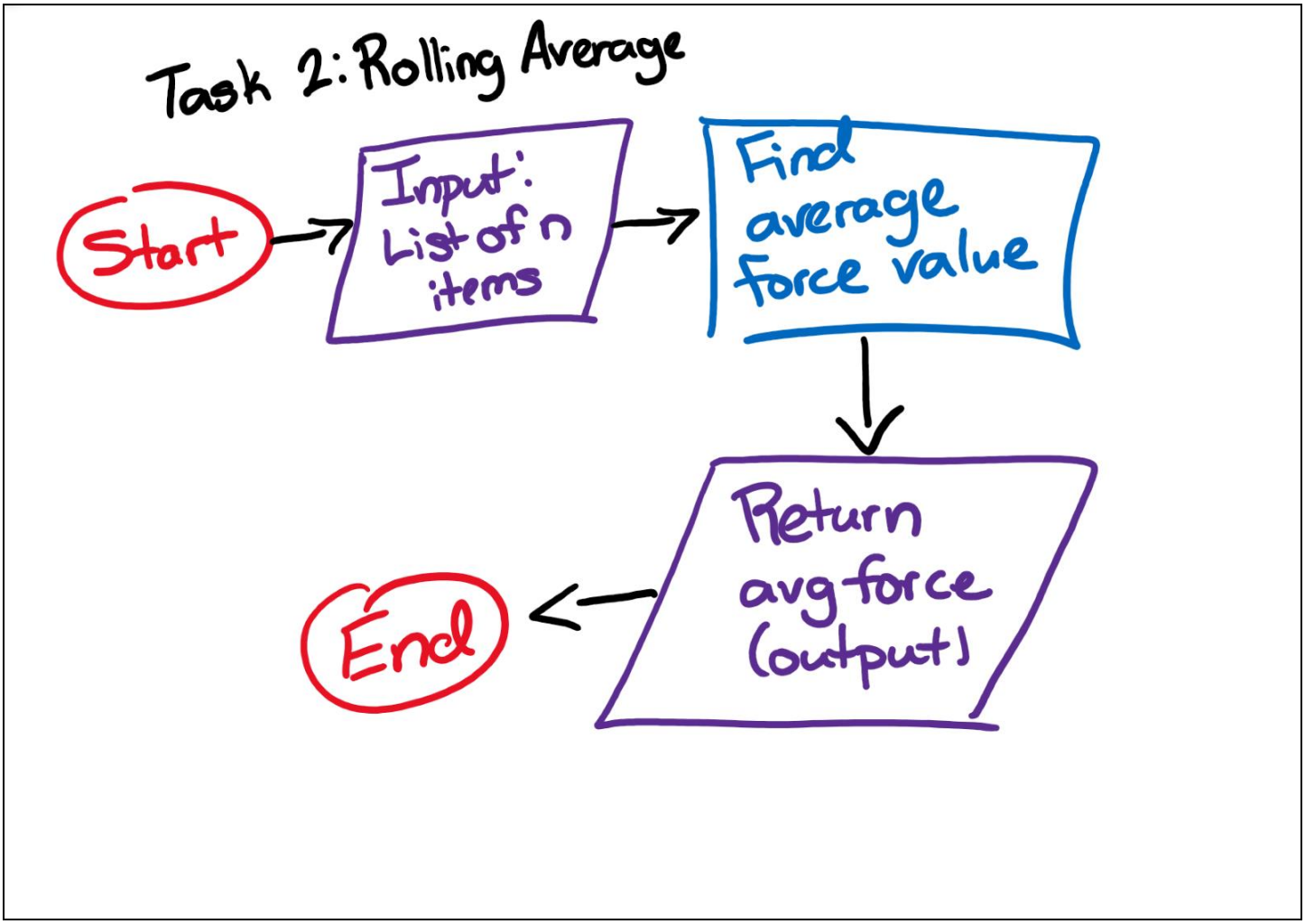
Team Number: 35

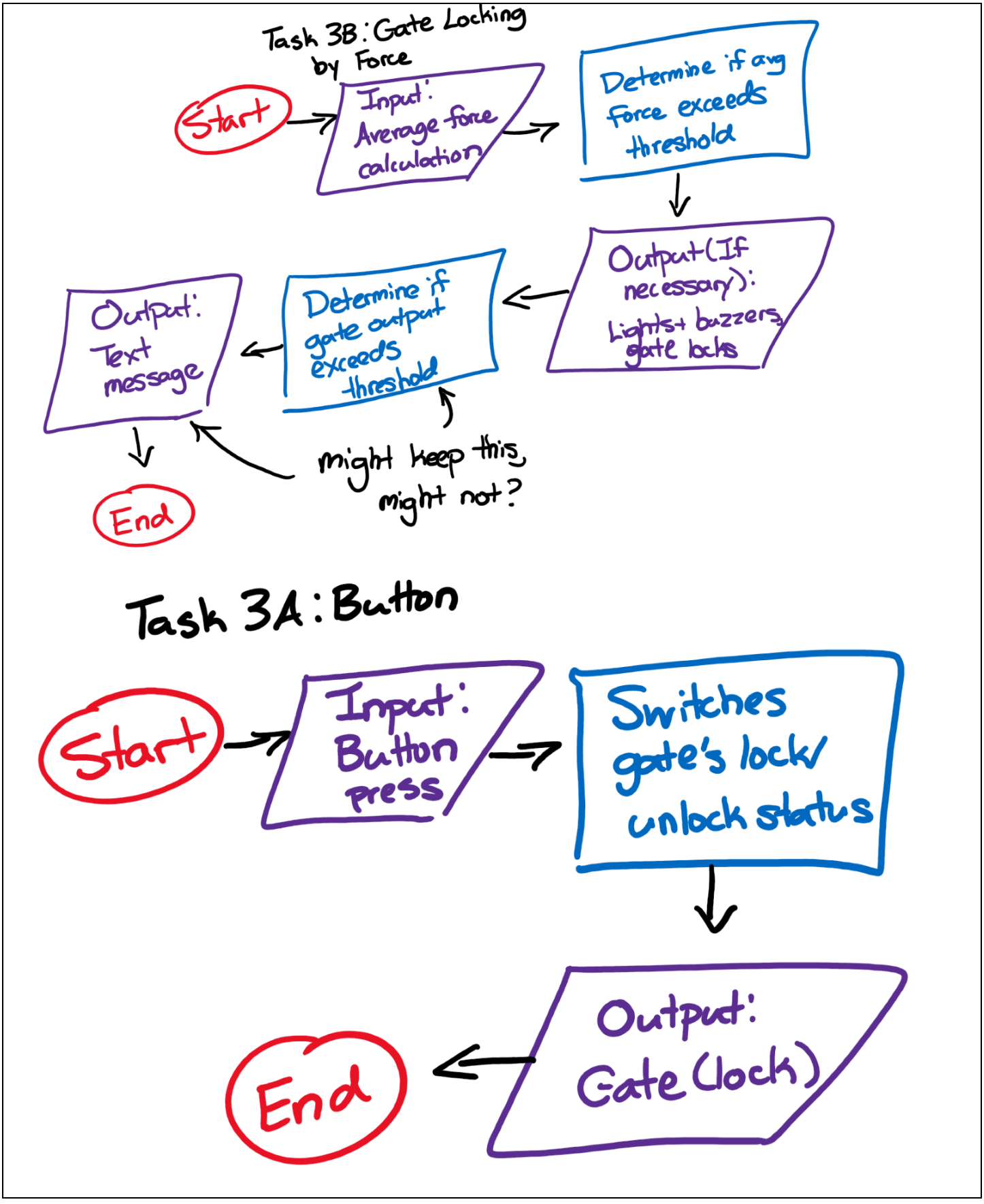
You should have already completed this task individually *prior* to Design Studio.

1. Copy-and-paste each team member's screenshots of their flowchart on the following pages (1 sub-team member per page)
    - Be sure to indicate each team member's Name and MacID

Name: *Alexis Moutafis-Tymcio*	**MacID**: moutafia

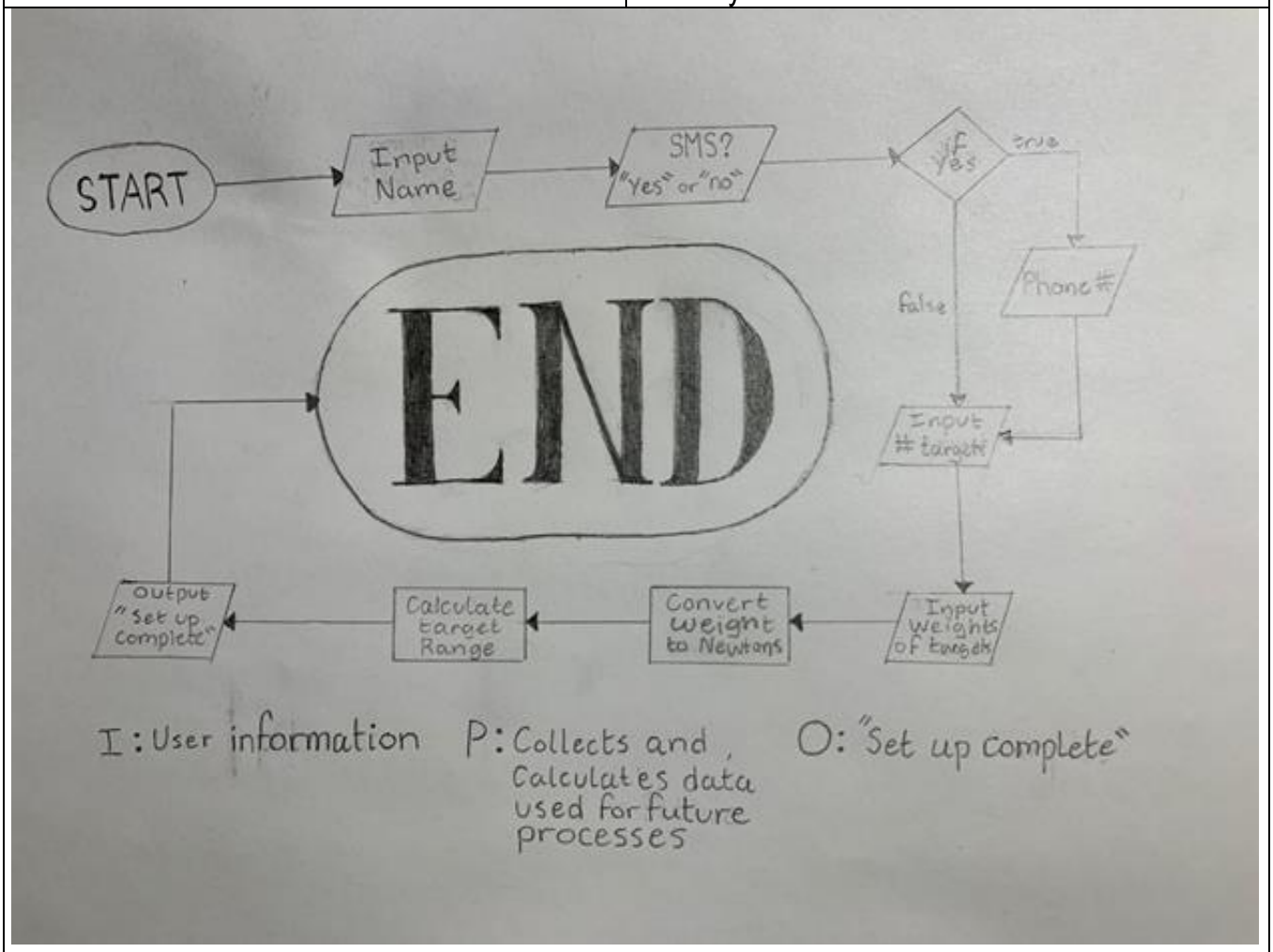


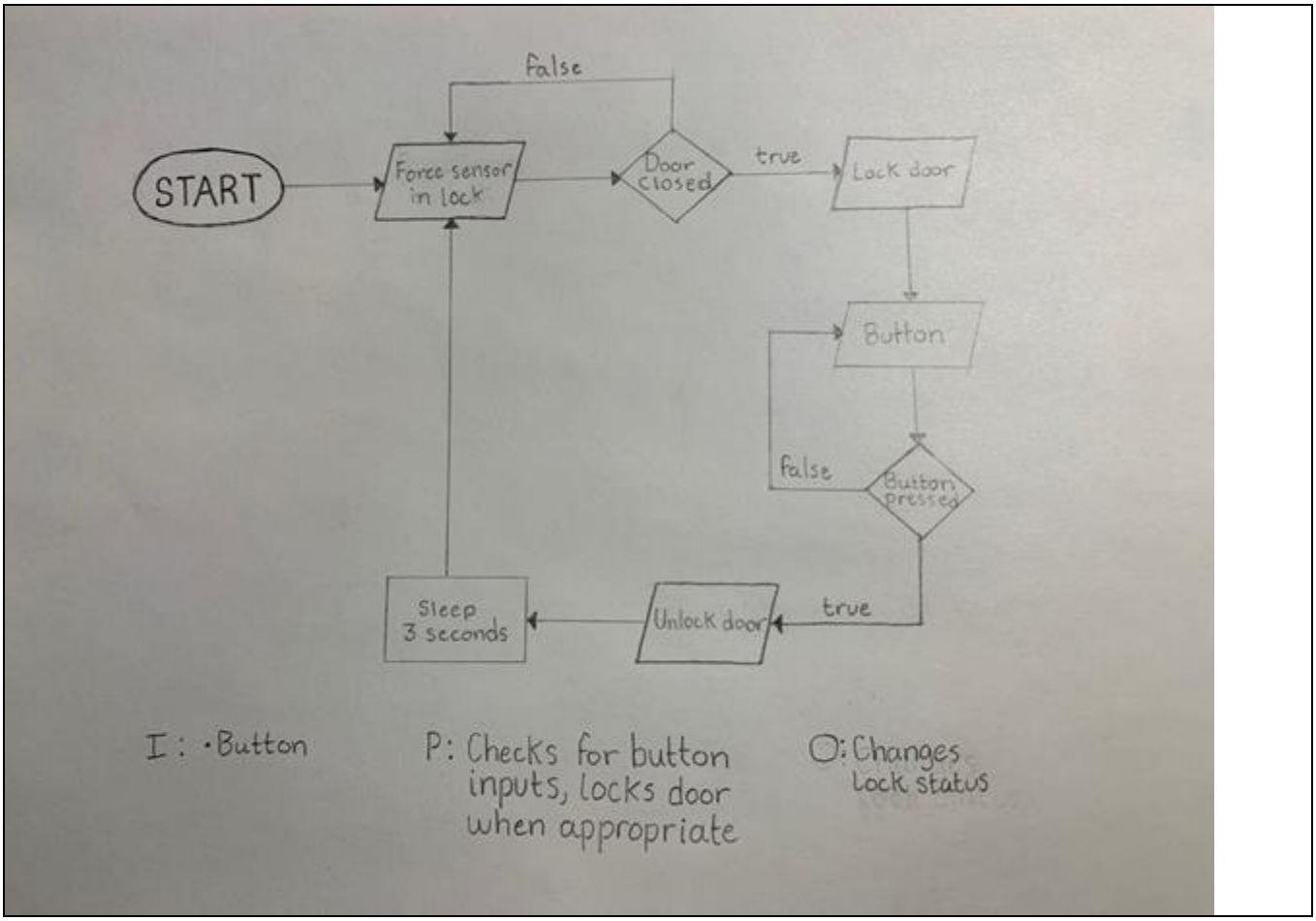

Task 2: Rolling Average
Start
Input: List of n items
Find average force value
Return avg force (output)
End

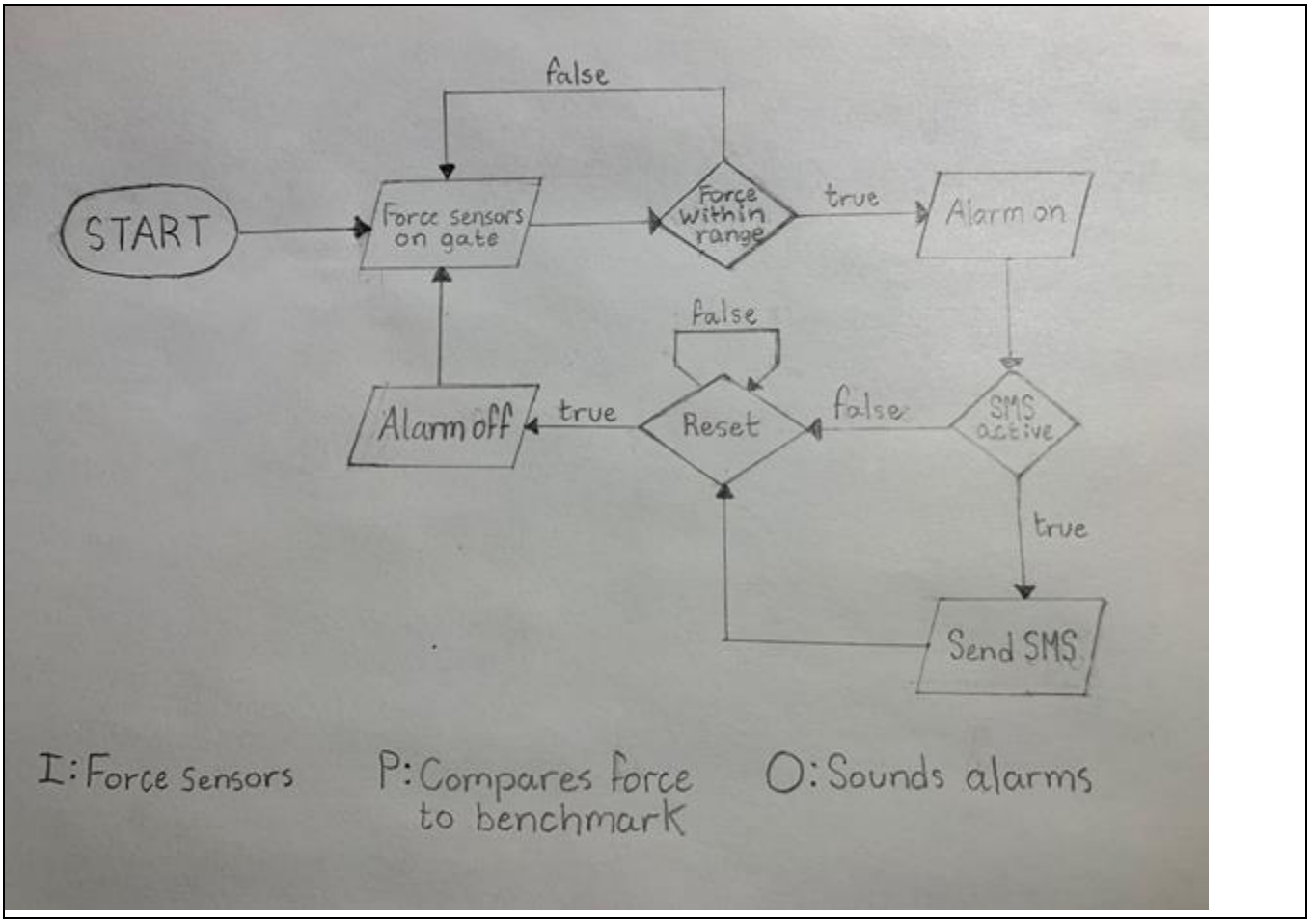

Task 3B: Gate Locking by Force
Start
Input: Average force calculation
Determine if avg force exceeds threshold
Output (If necessary): Lights + buzzers, gate locks
Determine if gate output exceeds threshold
might keep this, might not?
Output: Text message
End
Task 3A: Button
Start
Input: Button press
Switches gate's lock/unlock status
Output: Gate (lock)
End

Team Number: 35

Name: *Declan Yorke*	**MacID**: yorked1




False
START
Force sensor in lock
Door closed
true
Lock door
Button
False
Button pressed
Sleep 3 seconds
Unlock door
true
I: ·Button
P: Checks for button inputs, locks door when appropriate
O: Changes Lock status


false
START
Force sensors on gate
Force within range
true
Alarm on
false
Alarm off
true
Reset
false
SMS active
true
Send SMS
I: Force sensors
P: Compares force to benchmark
O: Sounds alarms

MILESTONE 4 (STAGE 3A) – HOUSING ASSEMBLY OBSERVATIONS AND EVALUATION (MODELLING SUB-TEAM)

Team Number: 35

As a team, **document your observations**, specifically any **similarities and differences** between each team member's detailed sketch in the space below.

Document your observations for each detailed sketch here.

Observations

- *Generally, same design for housing*
- *Use of clips*
- *Consider the t-cobbler connection more*
- *Not a wireless design*

Similarities

- *Breadboard bed*
- *General shape (rectangular prism)*
- *Utilize supports for the Pi housing*

Differences

- *Eli's design*
- *Custom pi casing*
- *Lid for pi casing attached with pegs found on each corner*
- *Shelving unit: inclusion of parent unit to then attach to safety gate "banister"*
- *Pi elevated from breadboard, allowing for wires to freely dangle from raised Pi to breadboard for T-cobbler*

- *Andrea's design*
- *No pi casing*
- *Pi bed*
- *Cut outs for Pi components, i.e., SD card, ports.*
- *Attachment location not specific*
- *Pi on same level, adjacent to breadboard for T-cobbler wires to attach*

As a team, **document the outcome of your design evaluation**, including a **justification** for your decision, in the space below.

Document the outcome / justification here.

We plan on moving forwards with a general version of Eli's design, with additional considerations made as to the relationships between the Pi Casing/assembly parent as well as specific measurements. We chose this design since it is more space-efficient and allows for an easier connection from the casing to the main baby gate.

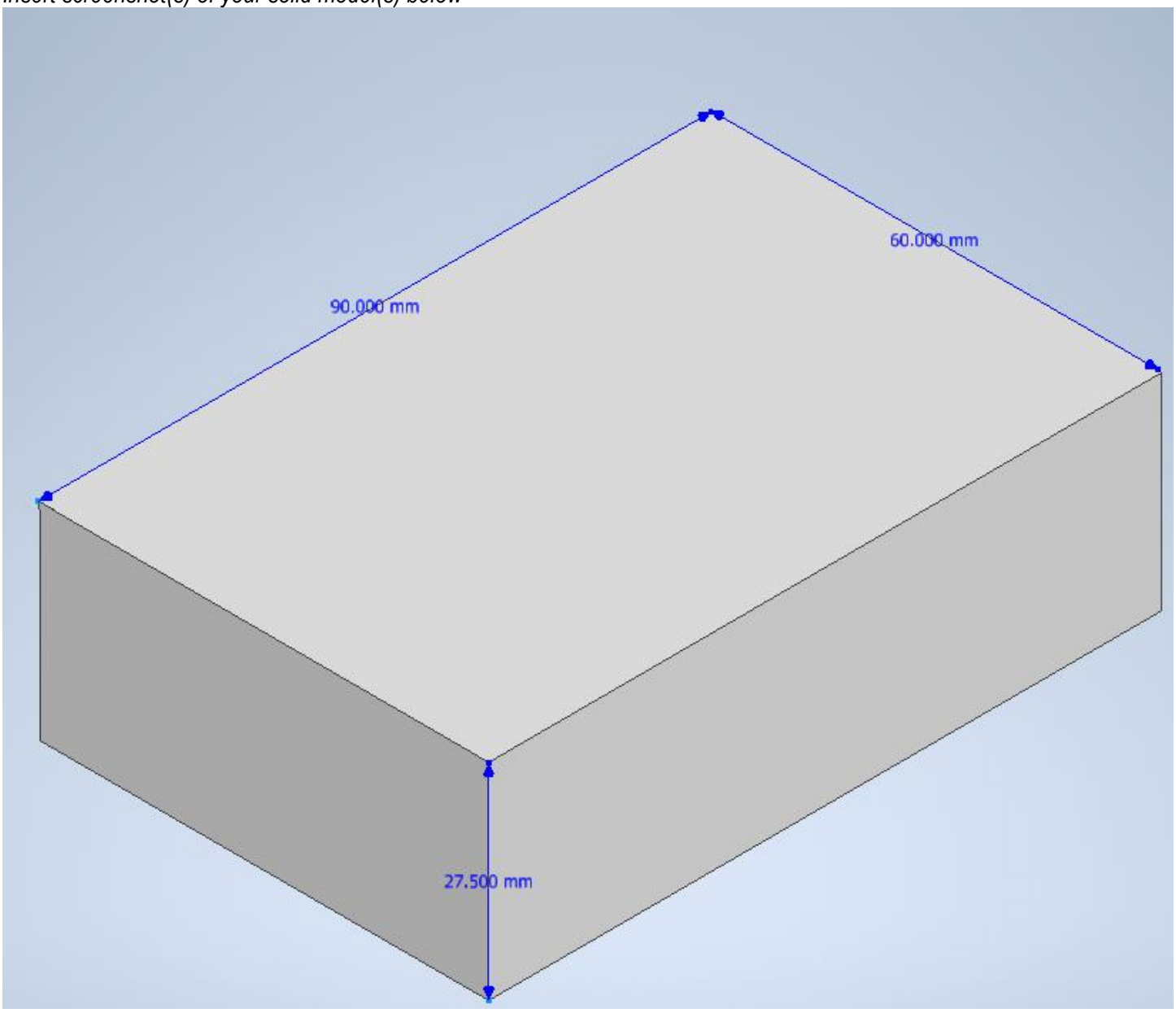
*You do ***not*** need to document the process of your design evaluation!

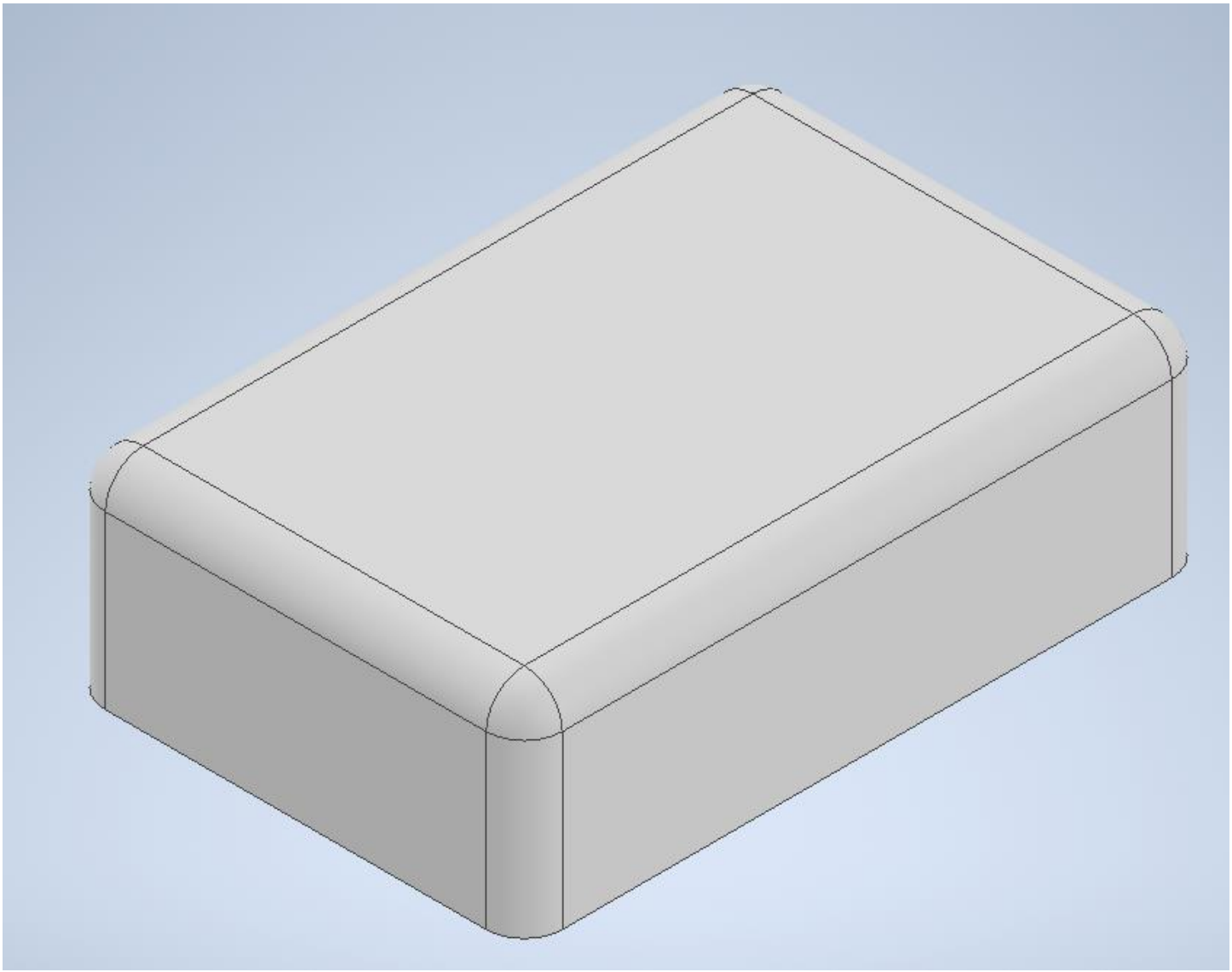
MILESTONE 4 (STAGE 3B) – PRELIMINARY MODELLING (MODELLING SUB-TEAM)

Team Number: 35

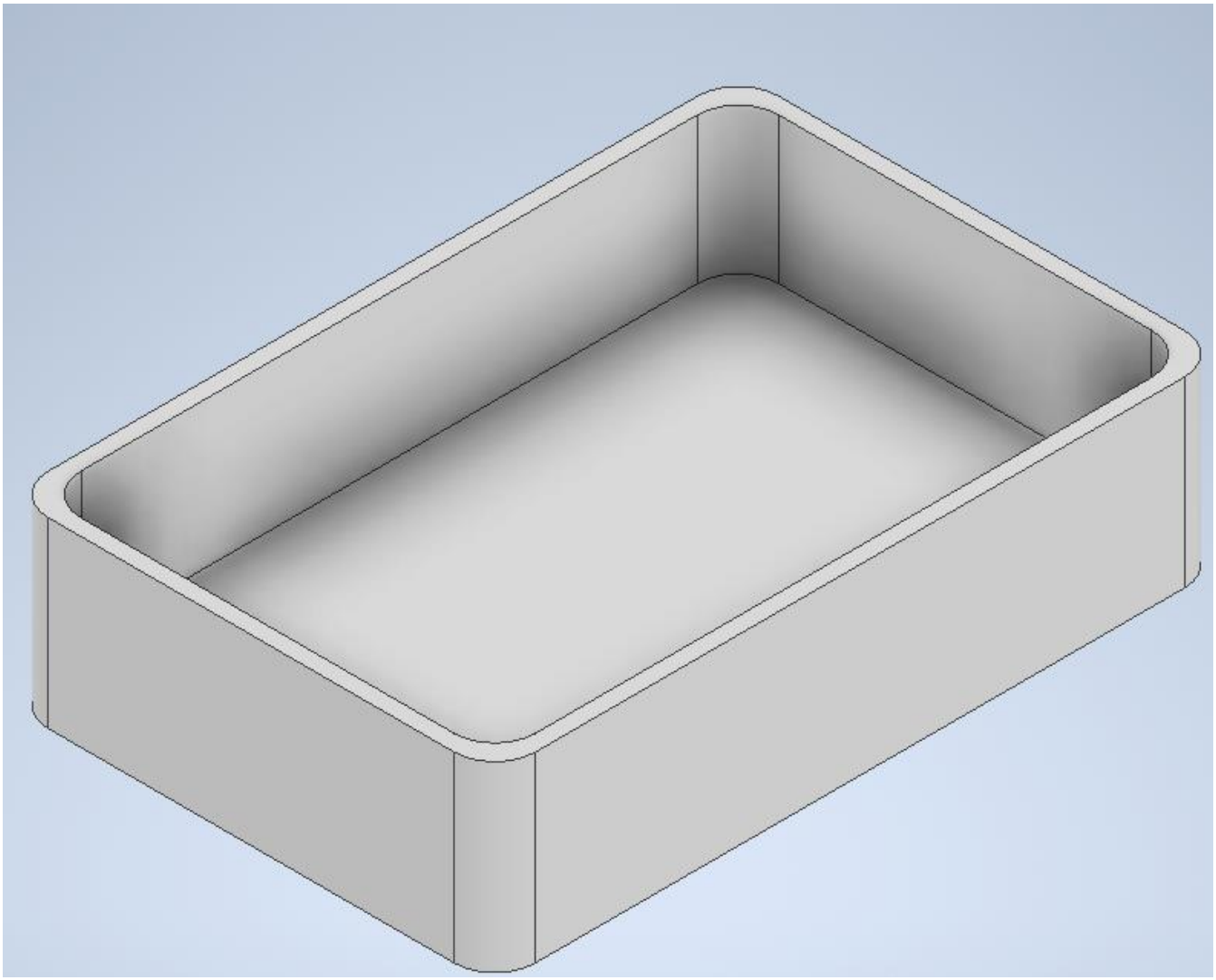
As a team, **begin modelling your Raspberry Pi Housing components** in Autodesk Inventor, documenting your progress via screenshots in the space below.

Insert screenshot(s) of your solid model(s) below

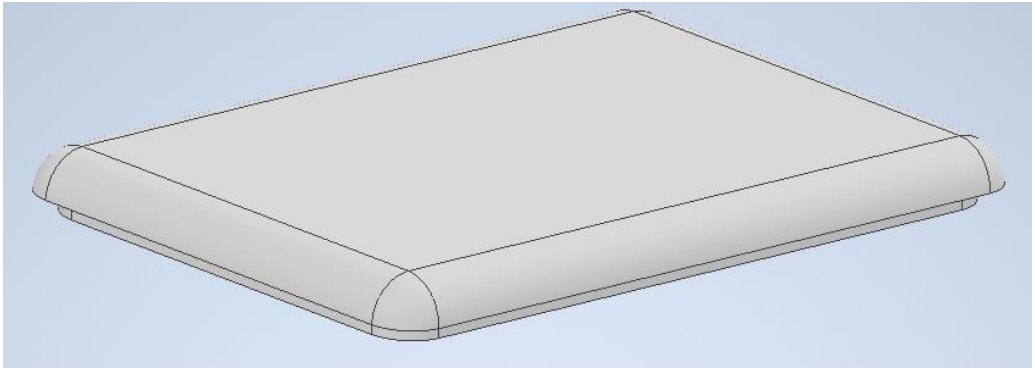




(5mm filet)



(2mm thickness) Pi Casing Bottom



(2mm thickness) Pi Casing Top

MILESTONE 4 (STAGE 4A) – WORKFLOW PEER-REVIEW (COMPUTATION SUB-TEAM)

Team Number: 35

As a team, **document your observations**, specifically any **similarities and differences** between each team member's flowchart in the space below.

Document your observations for each flowchart here.

Similarities:

- Mechanisms for button: infinite loop and output (locking, unlocking door)
- Gate force sensor loop: comparing input to range, alarm output, SMS feature

Differences:

- *Force sensor sensing closed door + auto lock feature in button design*
- *Rolling average from force sensors*
- *Reset button for alarm*
- *Sett-up feature*

As a team, **write out a pseudocode** outlining the *high-level workflow* of your computer program in the space below.

```
Import necessary libraries: time, gpiozero, math
##Task 1: Setup
Def  setup():
username = Input(Name:)
sms  = Input(SMS alert?, "yes" or "no")
If  (sms == "yes"):
    phonenumber = input(Phonenumber: )
targets =  int(input(how many children would you like to be alerted for?))
Initialize list weights []
For n in range(targets):
    weight = int(input(weight in kg of child n))
    Append weight to weights
Initialize list newton weight []
For n in range(targets):
    newtonweight = 9.81*weight(n)
Ranges = []
For n in range(targets):
    Append [newtonweight[n]-15, newtonweight[n]+15] to ranges
Range = []
For n in range(targets):
    Calculate range []
Print("setup complete")

##Task 2: Rolling average
Define rolling average function (arguments: average_list, num_items, target force sensor):
```

```
  Force = input from force sensor
  Append force to average_list
  If length(average_list) > num_items:
    Remove first item from average_list
  Sum = 0
  For item in average_list:
    Sum += item
  Average = sum / length(average_list)
  Return average, average_list

##Task 3: Button loop
Define button function (arguments: force_sensor)
  Average_button_force = rolling_average_function (average_list (define this in main), 10, force_sensor)
  If 98 <= average_button_force <= 147: ##avg baby gate weighs 14 kilos→convert 10-15kg to newtons
    Door_Locked = True
    ##some output/method locks the door, or we express as print statement
    If button_press = True (there's an existing method to check this)
      Door_Locked = False
      ##door unlocks using some output/method/print statement
    Time.sleep(3)


##Task 4: Force sensor loop
While true:
    If  average is within range:
        Alarm turns on
        If sms == "yes" && sent ==false:
            Print ("send text to: ", phonenumber , " SmartGate alert")
             sent = true
        If reset button pressed == true:
            Alarm turns off
            sent = false

##Task 5: Main function (bringing everything together)
Define main():
    setup()
    while True:
    button_loop(button_sensor)
    force_sensor_loop(force_sensor)

main()
```

Appendix D: Comprehensive List of Sources

Preliminary Research-Milestone One

[1] T. L. Holbrook, D. B. Hoyt, R. Coimbra, B. Potenza, M. J. Sise, D. I. Sack, and J. P. Anderson, "Trauma in adolescents causes long-term marked deficits in quality of life: Adolescent children do not recover preinjury quality of life or function up to two years Postinjury compared to national norms," *Journal of Trauma: Injury, Infection & Critical Care*, vol. 62, no. 3, pp. 577–583, 2007.

[2] P. H. A. of Canada, "Government of Canada," *Canada.ca*, 01-Mar-2016. [Online]. Available: https://www.canada.ca/en/public-health/services/reports-publications/leading-causes-death-hospitalization-canada/2008-males-females-combined-counts-specific-death-rate.html. [Accessed: 18-Jan-2022].

[3] "Medical Devices in home health care - ncbi.nlm.nih.gov." [Online]. Available: https://www.ncbi.nlm.nih.gov/books/NBK210047/. [Accessed: 18-Jan-2022].

[4] "New Study finds number of children treated in U.S. emergency departments for baby gate-related injuries nearly quadrupled since 1990," Nationwide Children's Hospital, 15-May-2014. [Online]. Available: https://www.nationwidechildrens.org/newsroom/news-releases/2014/05/new-study-finds-number-of-children-treated-in-us-emergency-departments-for-baby-gate-related. [Accessed: 18-Jan-2022].

[5] M. Pierce, "9 common problems with baby gates and how to solve them," *Baby Gates Expert*, 21-Nov-2021. [Online]. Available: https://babygatesexpert.com/common-problems-baby-gates/. [Accessed: 14-Jan-2022].

[6] "Home Safety," *Parachute*, 29-Nov-2021. [Online]. Available: https://parachute.ca/en/injury-topic/home-safety/. [Accessed: 17-Jan-2022].

[7] "Children and Falls," *World Health Organization*, 2008. [Online]. Available: https://www.who.int/violence_injury_prevention/child/injury/world_report/Falls_english.pdf?ua=1. [Accessed: 17-Jan-2022].

Executive Summary

[8] S. Levy, "Baby gate-related injuries send nearly 2,000 children to Emergency," *Healthline*, 02-Sep-2014. [Online]. Available: https://www.healthline.com/health-news/baby-gates-injuries-emergency-room-050514.
[Accessed: 06-Mar-2022].

[9] T. L. Holbrook, D. B. Hoyt, R. Coimbra, B. Potenza, M. J. Sise, D. I. Sack, and J. P. Anderson, "Trauma in adolescents causes long-term marked deficits in quality of life: Adolescent children do not recover preinjury quality of life or function up to two years Postinjury compared to national norms," *Journal of Trauma: Injury, Infection & Critical Care*, vol. 62, no. 3, pp. 577–583, 2007

[10] "New Study finds number of children treated in U.S. emergency departments for baby gate-related injuries nearly quadrupled since 1990," Nationwide Children's Hospital, 15-May-2014. [Online]. Available: https://www.nationwidechildrens.org/newsroom/news-releases/2014/05/new-study-finds-number-of-children-treated-in-us-emergency-departments-for-baby-gate-related.
[Accessed: 18-Jan-2022].

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Market Analysis

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Design Critique, Discussion, and Recommendations

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Appendix E: Computer Program

Note: We pasted the code directly because some lines were too wide to screenshot.

```
#Team 35 DP3
#Computing Team: Alexis Moutafis-Tymcio, Declan Yorke
#MacIDs: moutafia, yorked1
#Student numbers: 400371000, 400395029

#import statements
from gpiozero import Buzzer, Button, LED
import time
import sys
import math
from sensor_library import *
#function 1: starts the setup process
def setup():
  sms = input("Input 'yes'if you want to enable SMS notifications: ")
  send = False
  if (sms=='yes'):
    send = True
    phonenumber = ''
    while phonenumber == '':
      phonenumber = input("Phone number: ")
      try:
        phonenumber = int(phonenumber)
        if len(str(phonenumber)) != 10:
          print("Please enter a valid phone number.")
          phonenumber = ''
      except ValueError:
        print("Please enter a valid phone number.")
```

```
        phonenumber = ''
  else:
    send = False
    phonenumber = None
  upper = ''
  lower = ''
  while upper == '':
    try:
      upper = int(input("Input weight of oldest child (kg): "))
    except ValueError:
      print("Error. Please enter integer")
  while lower == '':
    try:
      lower = int(input("Input weight of youngest child (kg): "))
    except ValueError:
      print("Error. Please enter integer")
  upperweight = upper * 9.81 * 1.25
  lowerweight = lower * 9.81 * 0.75 #determines target range
  print('Setup complete')
  return send, phonenumber, upperweight, lowerweight
#function 2: inputs data and calculates the rolling average
def rolling_average(avg_list, num_items, sensor):
  global force
  force = sensor.force_raw()
  avg_list.append(force)
  avg_list.pop(0)
  sum = 0
  for item in avg_list:
    sum += item
```

```
  avg = sum/len(avg_list)
  avg = round(avg, 2)
  return avg, avg_list, force
#function 3: locks/unlocks the gate, shows this with a light
def button_force(light, locked):
  if locked == False:
    locked = True
    actuator = "forward"
    actuator_start = time.time()
    light.on()
  else:
    locked = False
    actuator = "reverse"
    actuator_start = time.time()
    light.off()
  time.sleep(0.2)
  return locked, actuator, actuator_start
#function 4: determines if force is in range of inputted child weight and
sends an alert if it is
def force_alert(buzzer, average, sms, phonenumber, upperweight,
lowerweight, avg_list, locked, actuator, light, actuator_start, force):
  #orig_sms = the original value of sms derived from input
  orig_sms = sms
  if actuator == "off    ":
    actuator_start = 0
  if (lowerweight <= average <= upperweight):
    buzzer.on()
    print("Buzzer ON")
    if locked == False:
      locked = True
```

```
      light.on()
      actuator = "forward"
      actuator_start = time.time()
      print(print_statements(force, average, light, buzzer, locked,
actuator, actuator_start))
    if sms == True:
      print('Send message to ', phonenumber, ': SmartGate alert')
      sms = False
    input("Type any key to reset: ")
    average, avg_list, sms = reset(buzzer, sms, average, avg_list,
orig_sms)
    print(avg_list)
  return average, avg_list, locked, actuator, actuator_start
#function 5: resets the average and average list so the buzzer resets
properly
def reset(buzzer, sms, average, avg_list, orig_sms):
  buzzer.off()
  sms = orig_sms
  average = 0
  avg_list = [0]*10
  return average, avg_list, sms
#function 6: formats data sent to shell
def print_statements(force, avg, light, buzzer, locked, actuator,
actuator_start):
  currant = time.time()
  if light.is_lit == True:
    l_status = "on "
  else:
    l_status = "off"
  if locked == True:
    lock = "locked  "
```

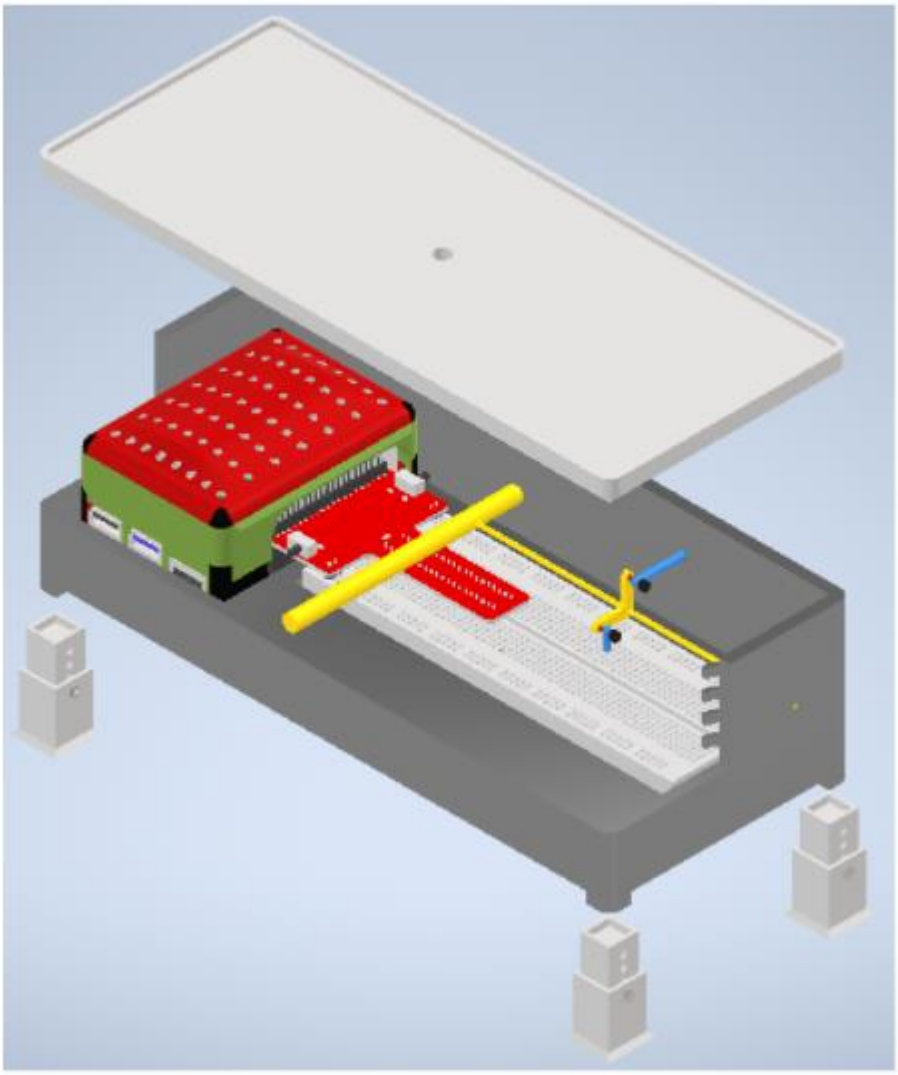
```
  else:
    lock = "unlocked"
  if currant - actuator_start >= 4:
    actuator = "off    "
  print(force,"\t    \t",avg,"\t \t",lock,"\t",l_status,"\t
",actuator,"\t  off")


#main
def main():
  sms_status, phonenumber, upperweight, lowerweight = setup()
  buzzer = Buzzer(17)
  avg_list = [0]*10
  sensor = Force_Sensing_Resistor(1)
  push_button = Button(23)
  yellow = LED(26)
  yellow.on()
  locked = True
  actuator = "off    "
  actuator_start = 0
  print("Force(raw) \t Force(avg) \t Lock Status \t Yellow LED \t
Actuator\t Buzzer")
  #infinite loop which calls functions continuously and when appropriate
to operate device/outputs
  while True:
    average, avg_list, force = rolling_average(avg_list, 10, sensor)
    average, avg_list,locked, actuator, actuator_start =
force_alert(buzzer, average, sms_status, phonenumber, upperweight,
lowerweight, avg_list, locked, actuator, yellow, actuator_start, force)
    if push_button.is_pressed:
      locked, actuator, actuator_start = button_force(yellow, locked)
```

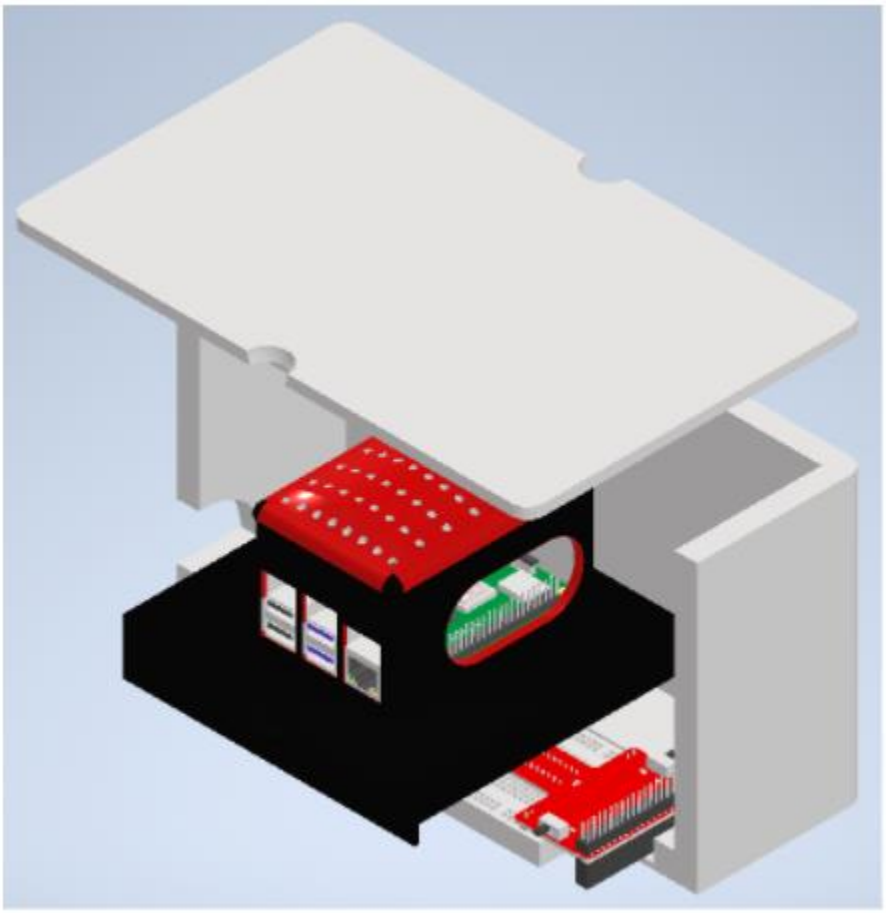
```
    print_statements(force, average, yellow, buzzer, locked, actuator,
actuator_start)
    time.sleep(0.5)


main()
```

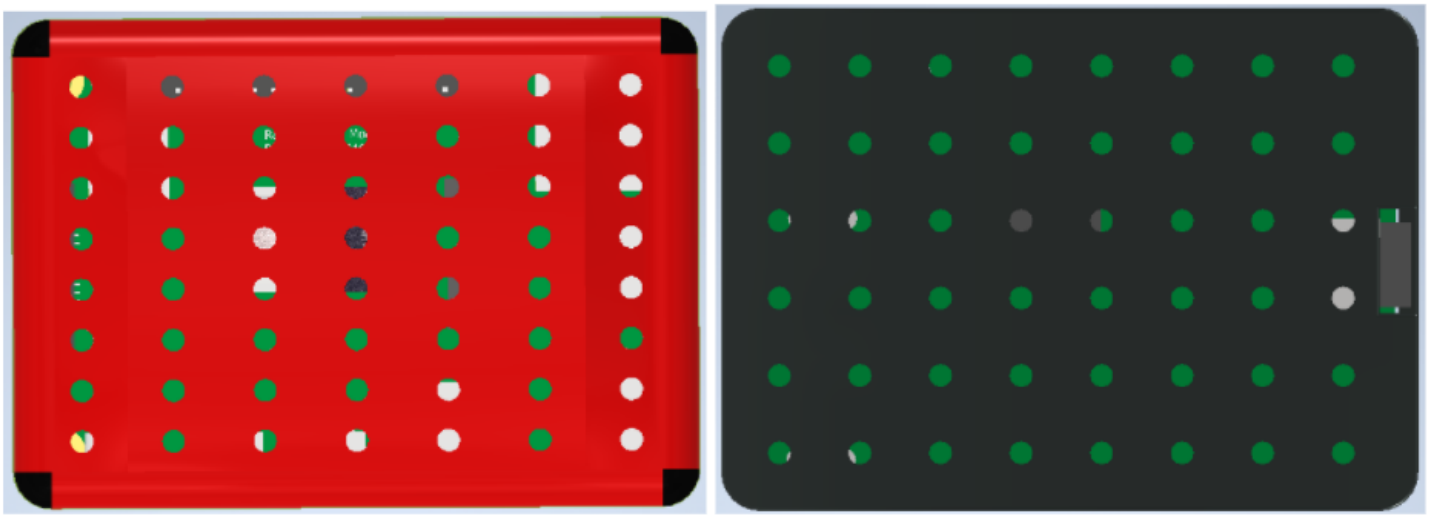
Appendix F: CAD Models



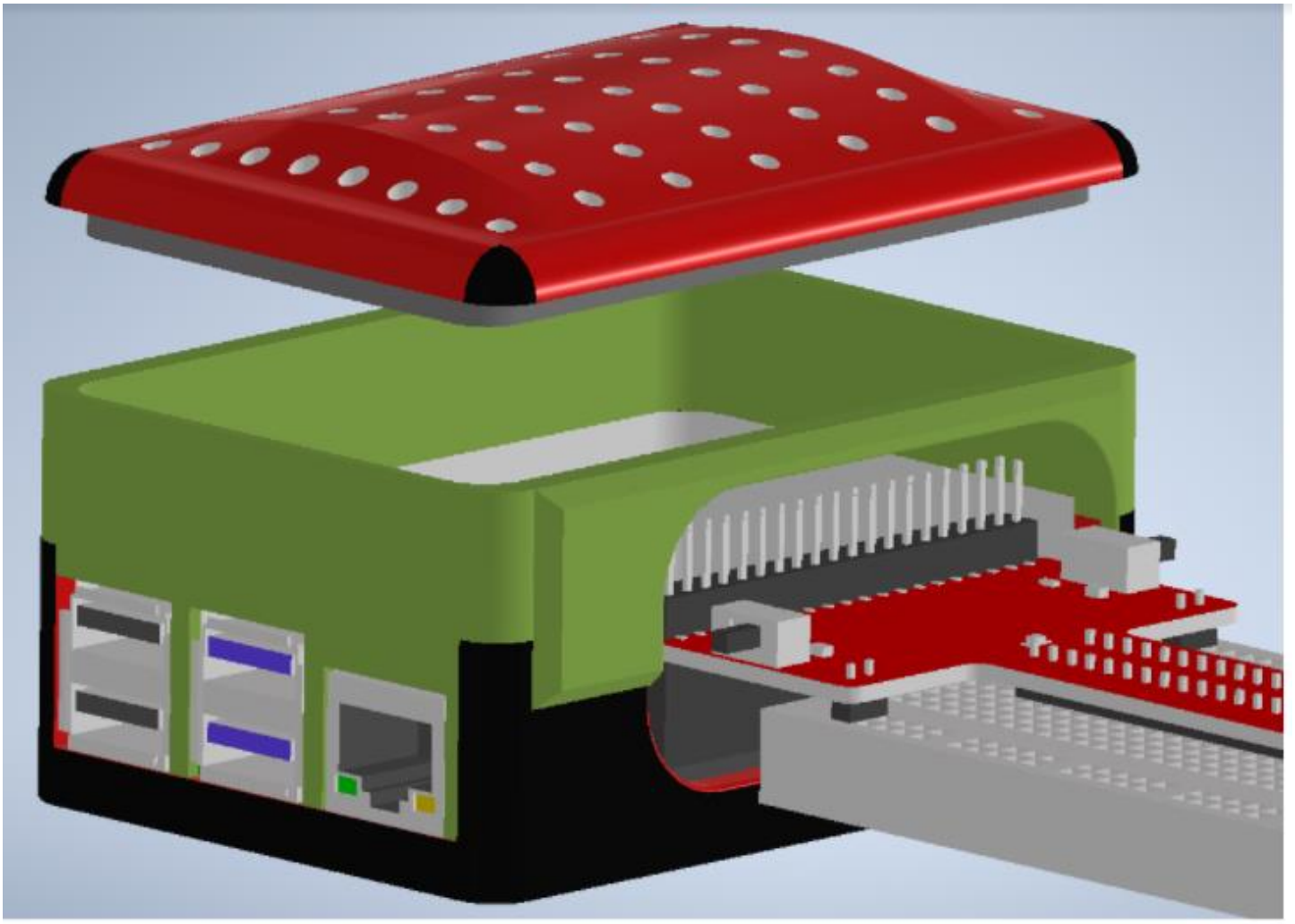
[Figure F.1] A cutaway view of the kit version of the Smart Gate used in the short term. The kit will also include a mat for the force sensor that is not depicted here. It is placed below an existing baby gate and activates when pressure is sensed along its top.



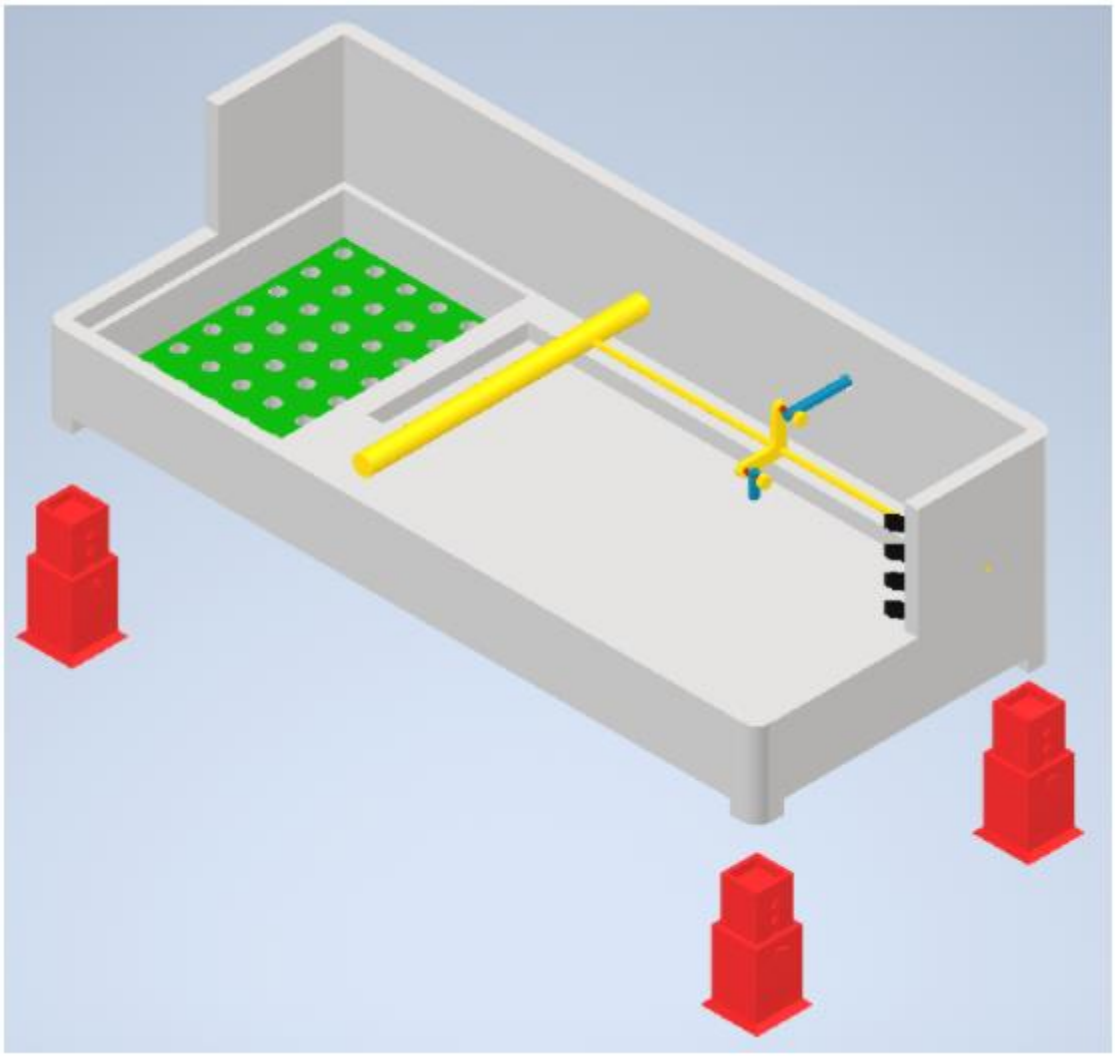
[Figure F.2] A cutaway view of the integrated Smart Gate used in the long term. This assembly sits in the lower right-hand corner of a customized baby gate.



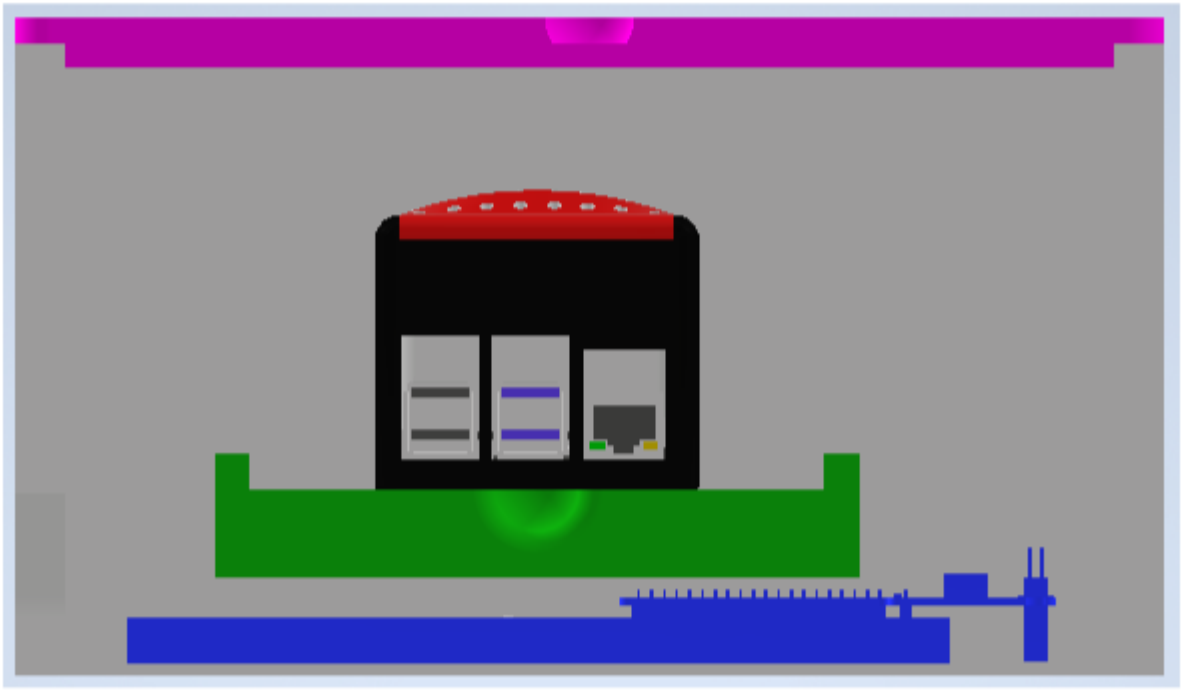
[Figure F.3] An image depicting the pattern of ventilation holes found on the lid (left) and base (right) of the Pi's immediate housing.



[Figure F.4] An image depicting the relationship between the lid and body of the Pi housing. The dark gray inside of the lid secures it against horizontal disturbances while the lack of a locking mechanism ensures it is easy to remove from the top.



[Figure F.5] An image highlighting unique design features of the exterior and interior of the Pi casing. The adjustable feet are highlighted in red, the bell crank system for activating the button is highlighted in yellow and blue, the wire tunnel is highlighted in black, and the ventilation holes are highlighted in green.



[Figure F.6] An image depicting the layered design for the long-term Smart Gate. The breadboard (in blue) sits below the shelf (in green) which holds up the Raspberry Pi. The lid (in pink) offers protection while leaving the rest of the components easily accessible.

[Figure F.7] This image depicts the location of the long-term assembly, highlighted in red, relative to the larger gate. It is attached to the wall on the outwards-facing right side.

Appendix G: Engineering Drawings

Gate Components with Latch – G.1

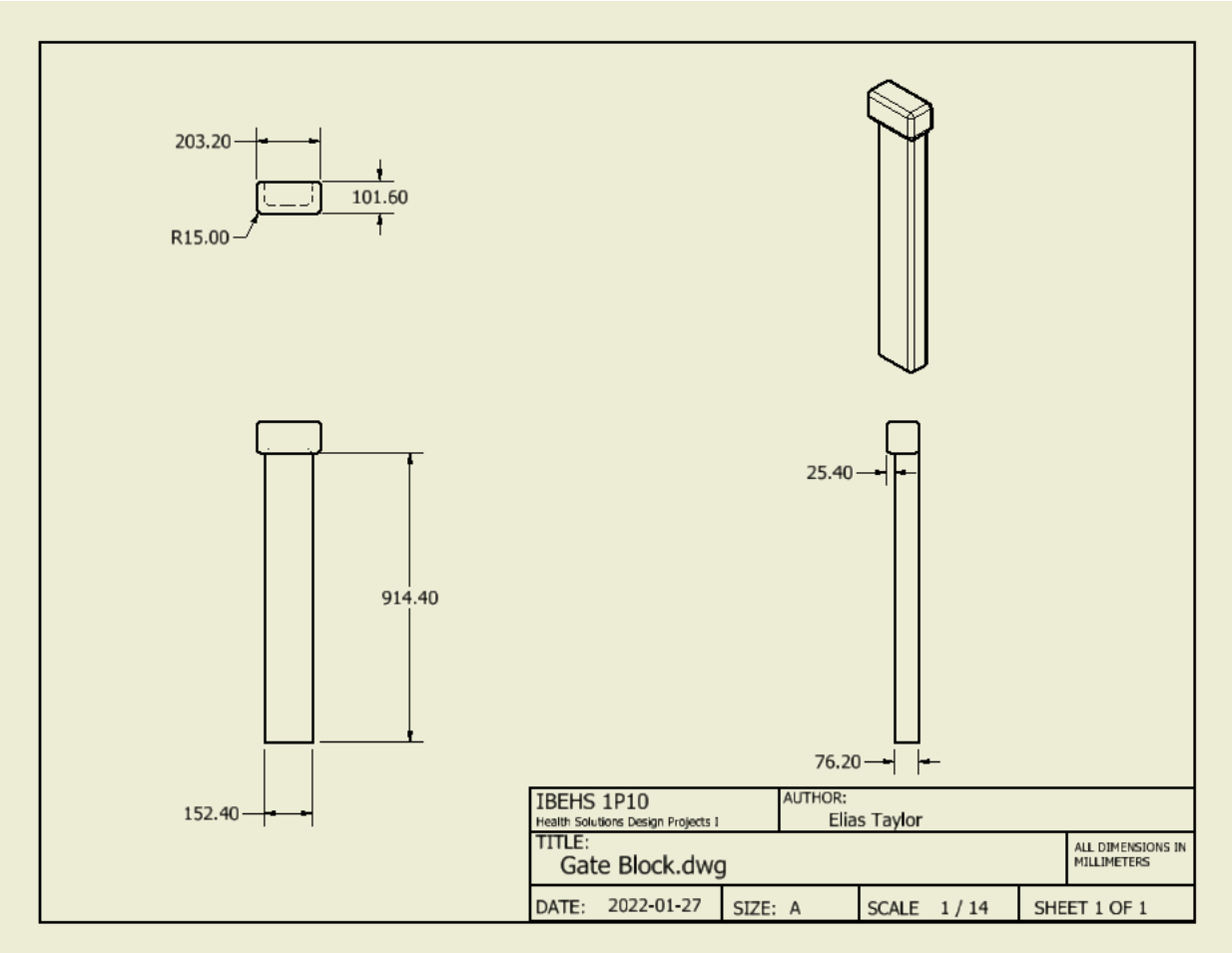


Figure G.1.1: Banister for gate to lock to; would attach to wall or stair banister

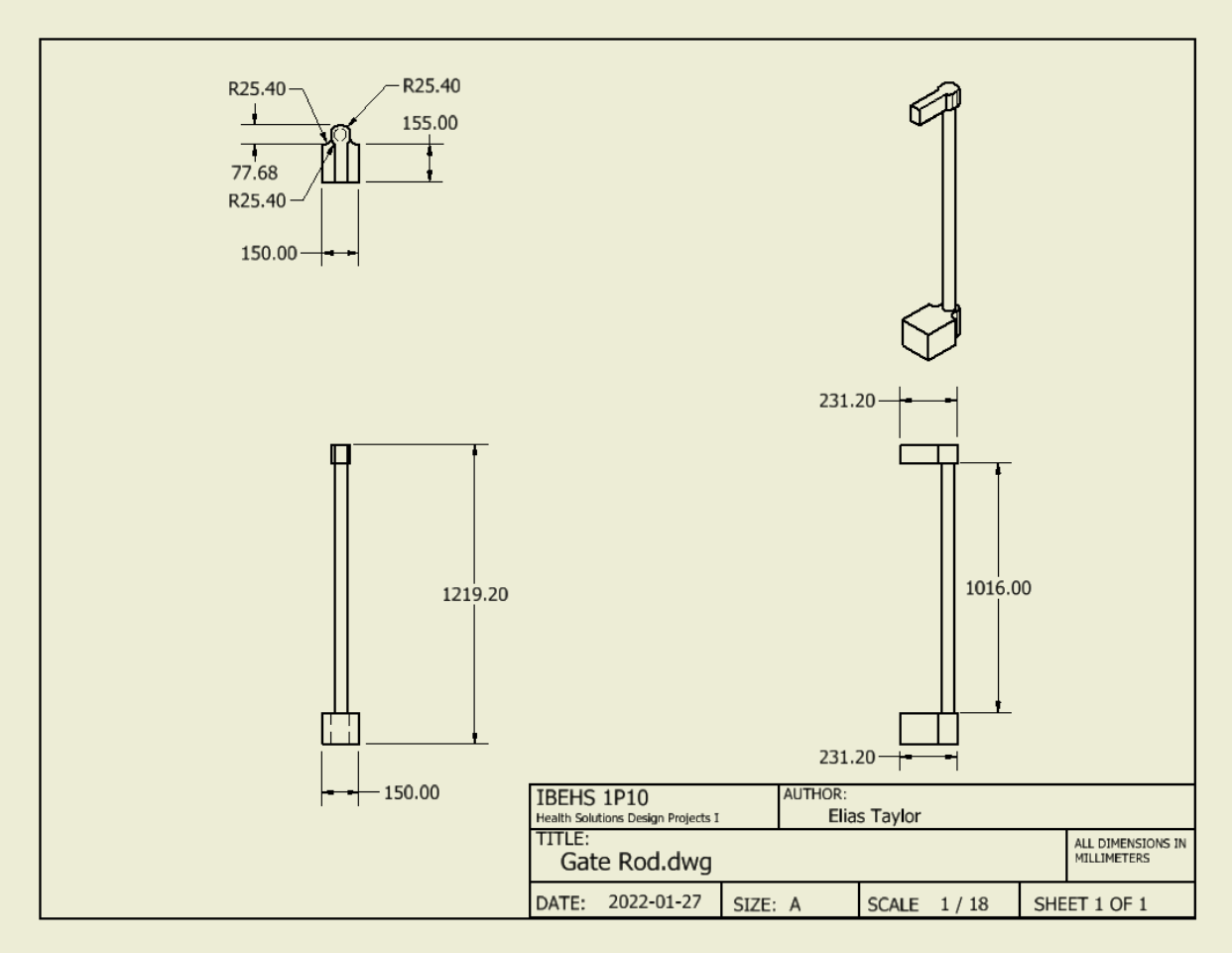


Figure G.1.2: Post for main gate component to attach to; parent housing for Pi located at base

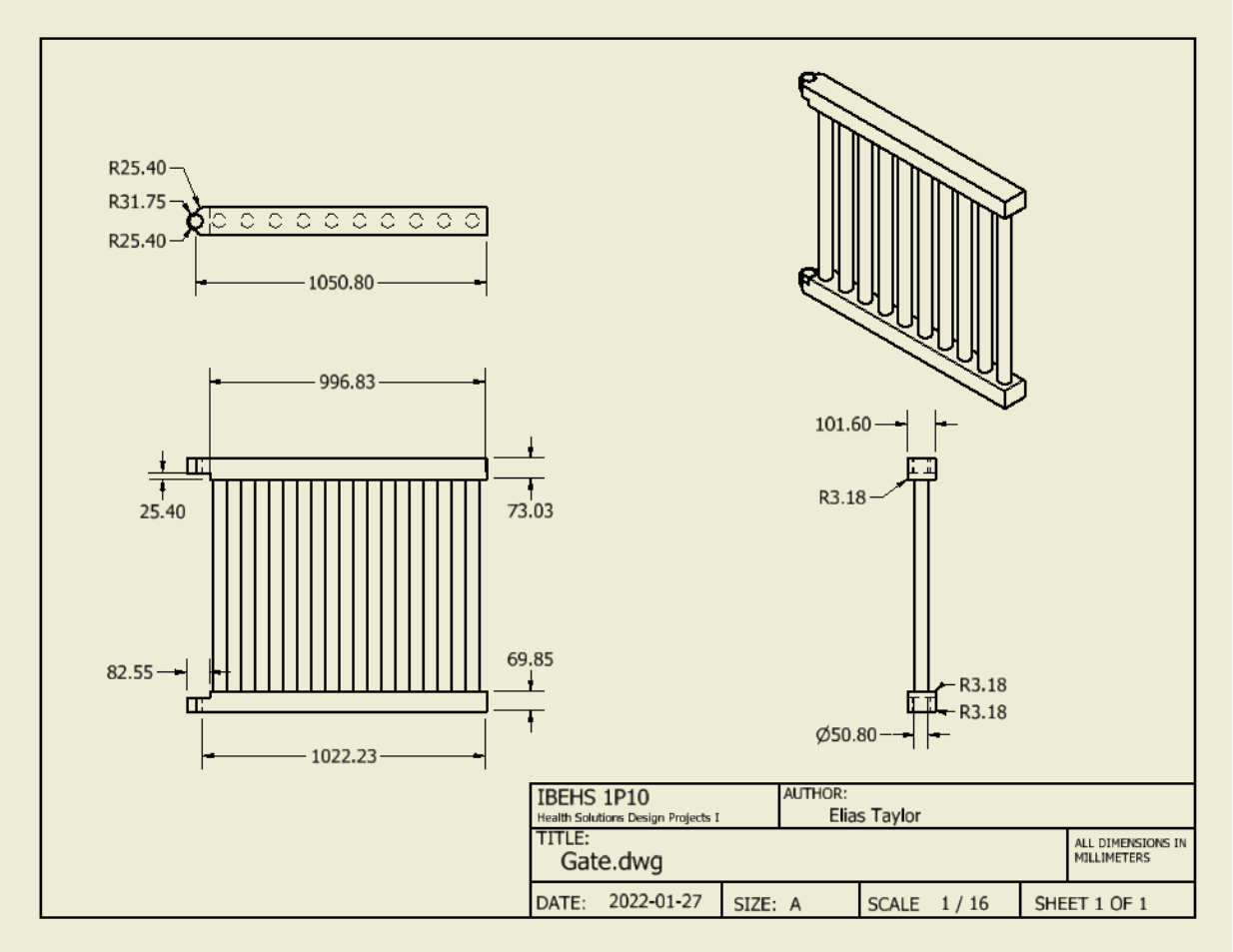


Figure G.1.3: Main gate component

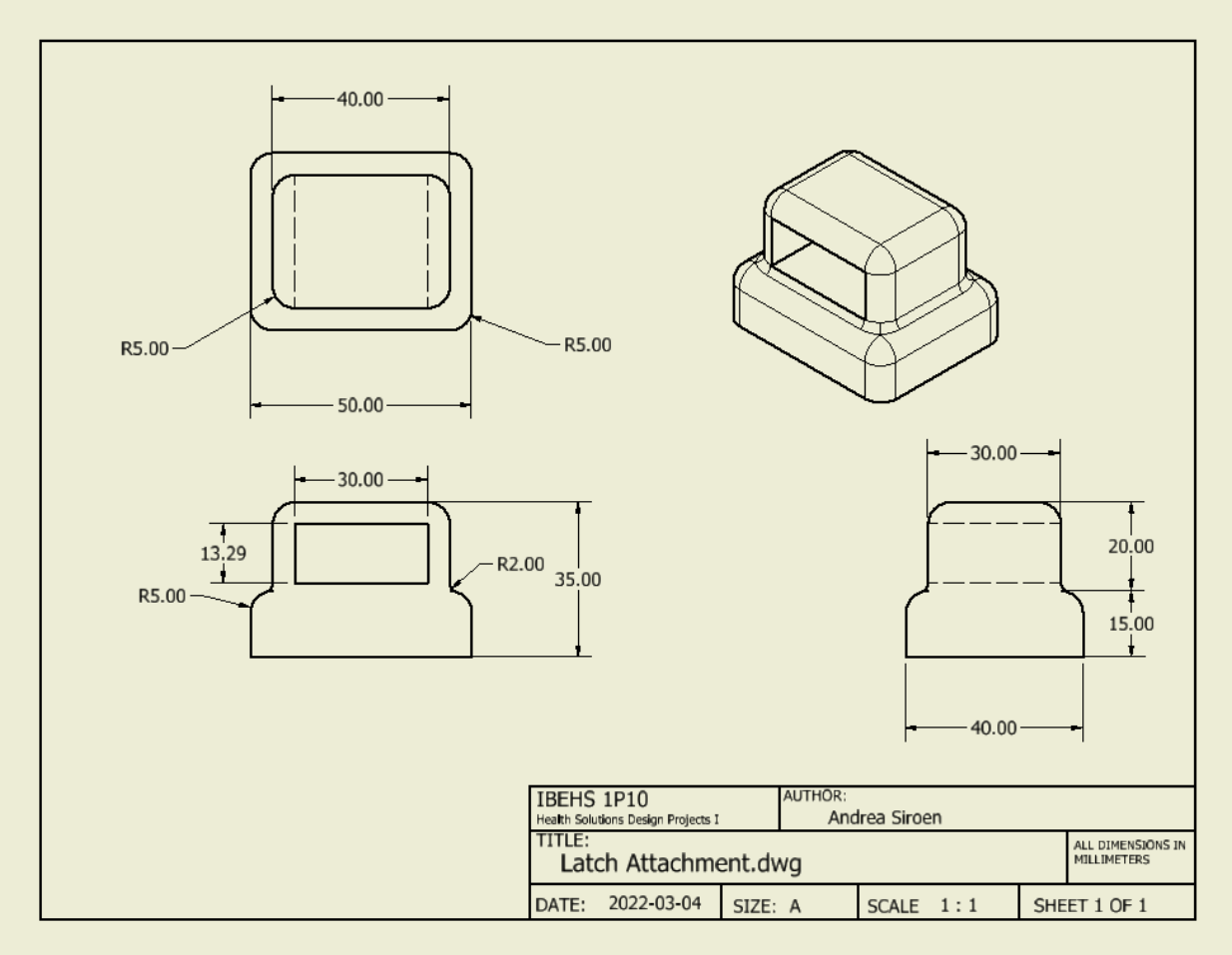


Figure G.1.4: Latch component for latch rod to lock into when in extended position; is fixed to gate banister

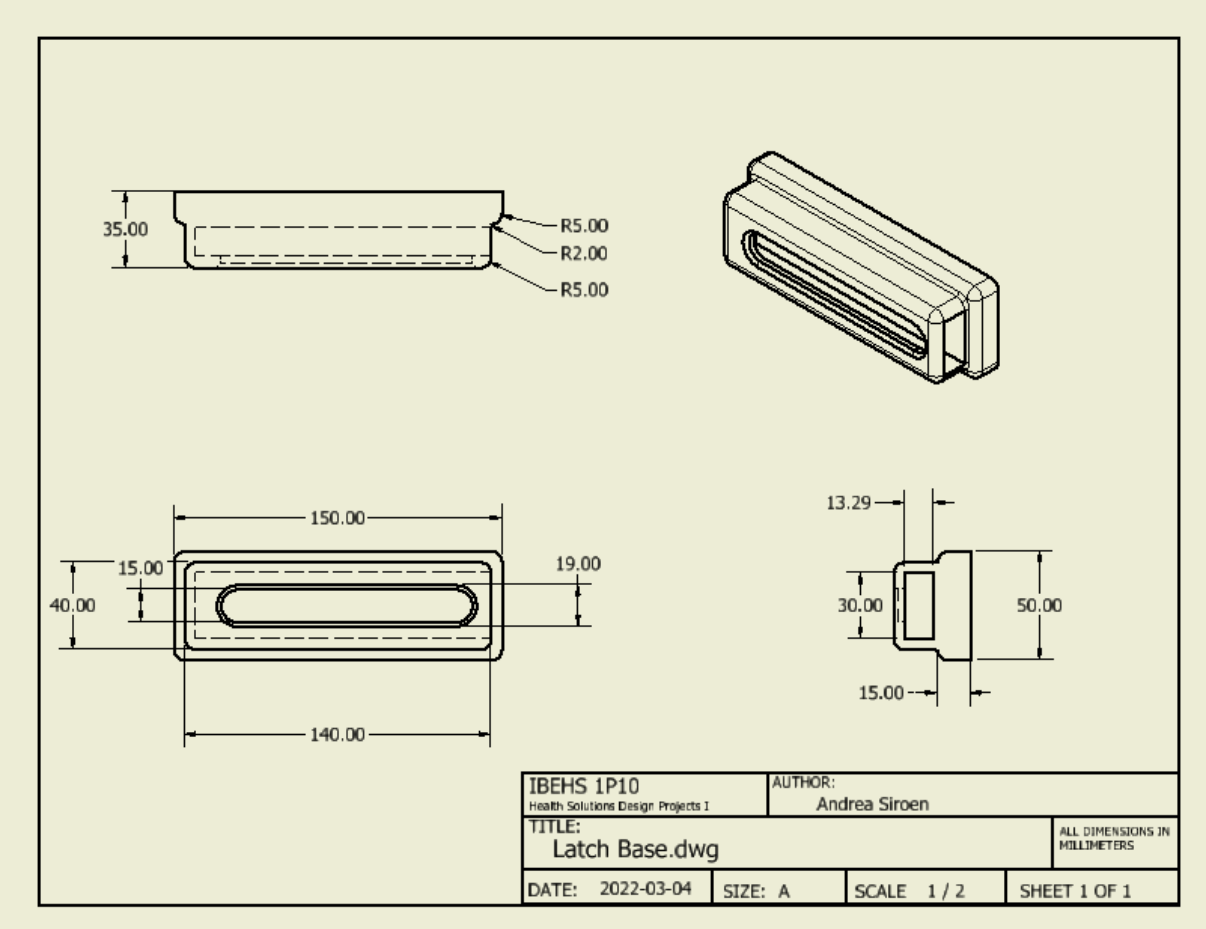


Figure G.1.5: Latch base; secures latch rod and actuator

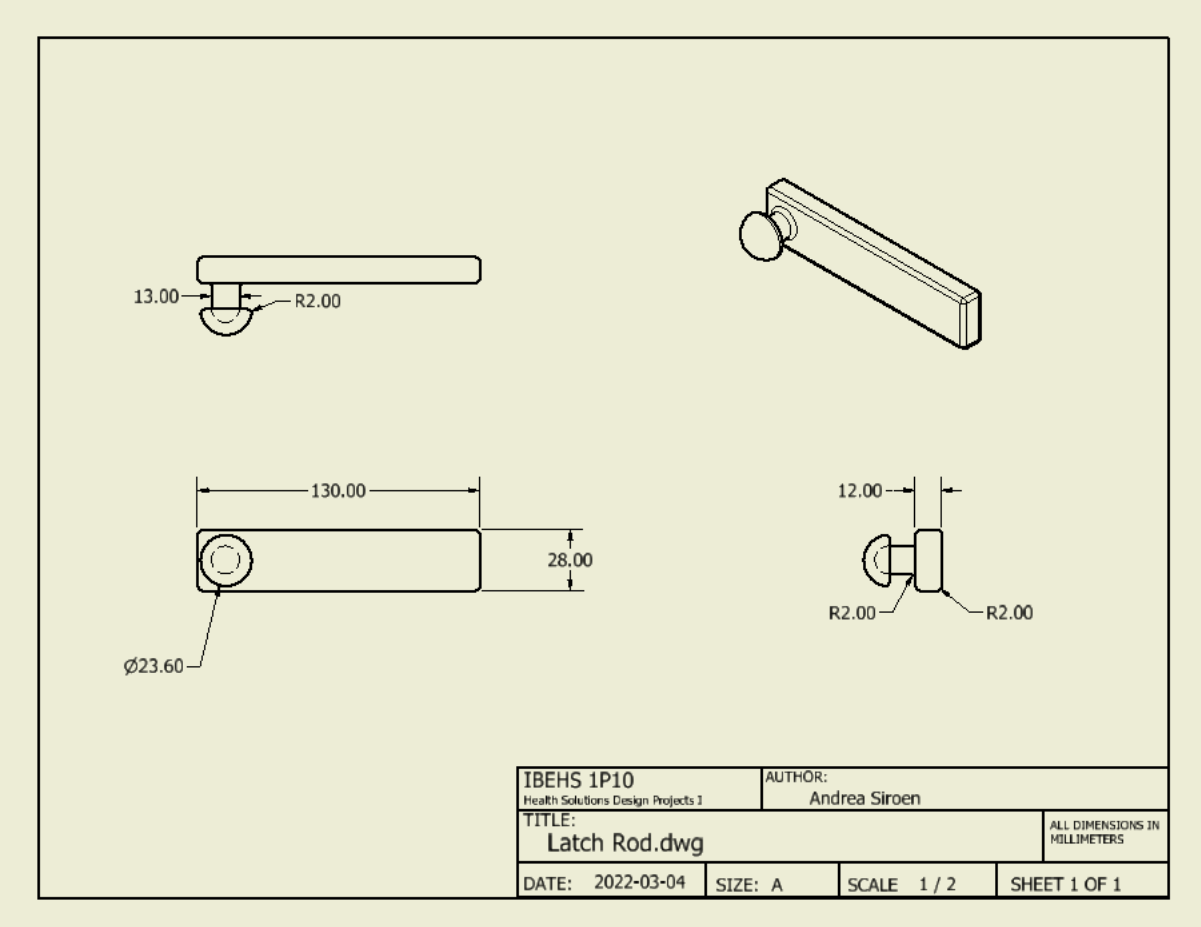


Figure G.1.6: Latch rod for latch assembly

Long-Term Assembly – G.2

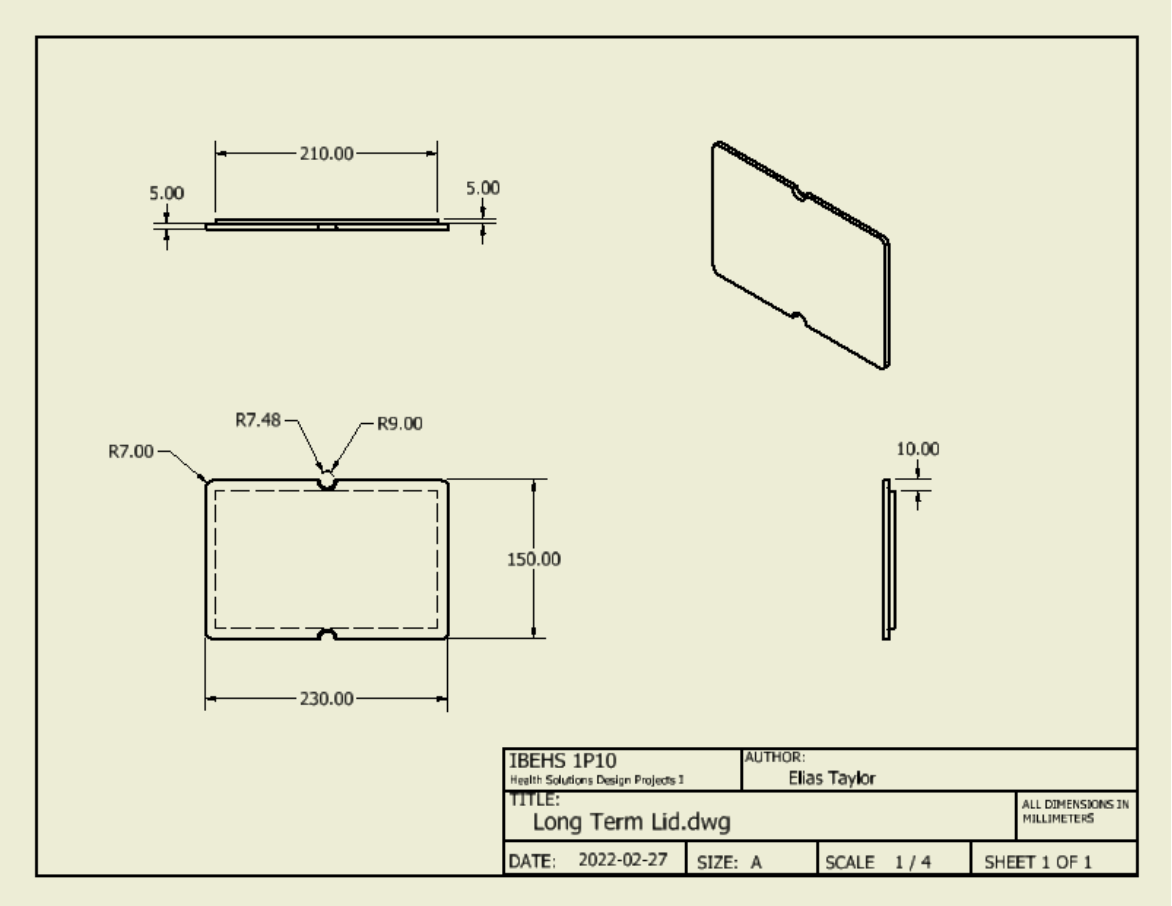


Figure G.2.1: Long-term lid for parent base

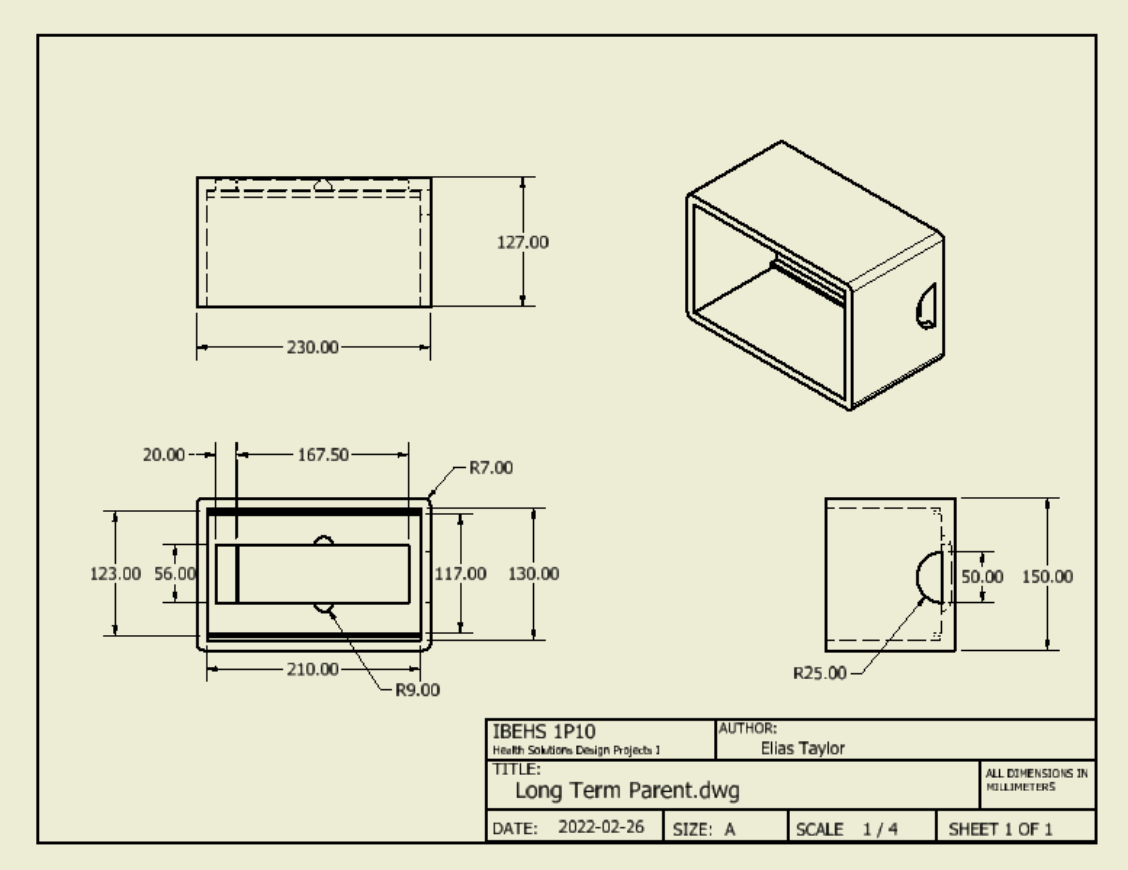


Figure G.2.2: Long-term parent base

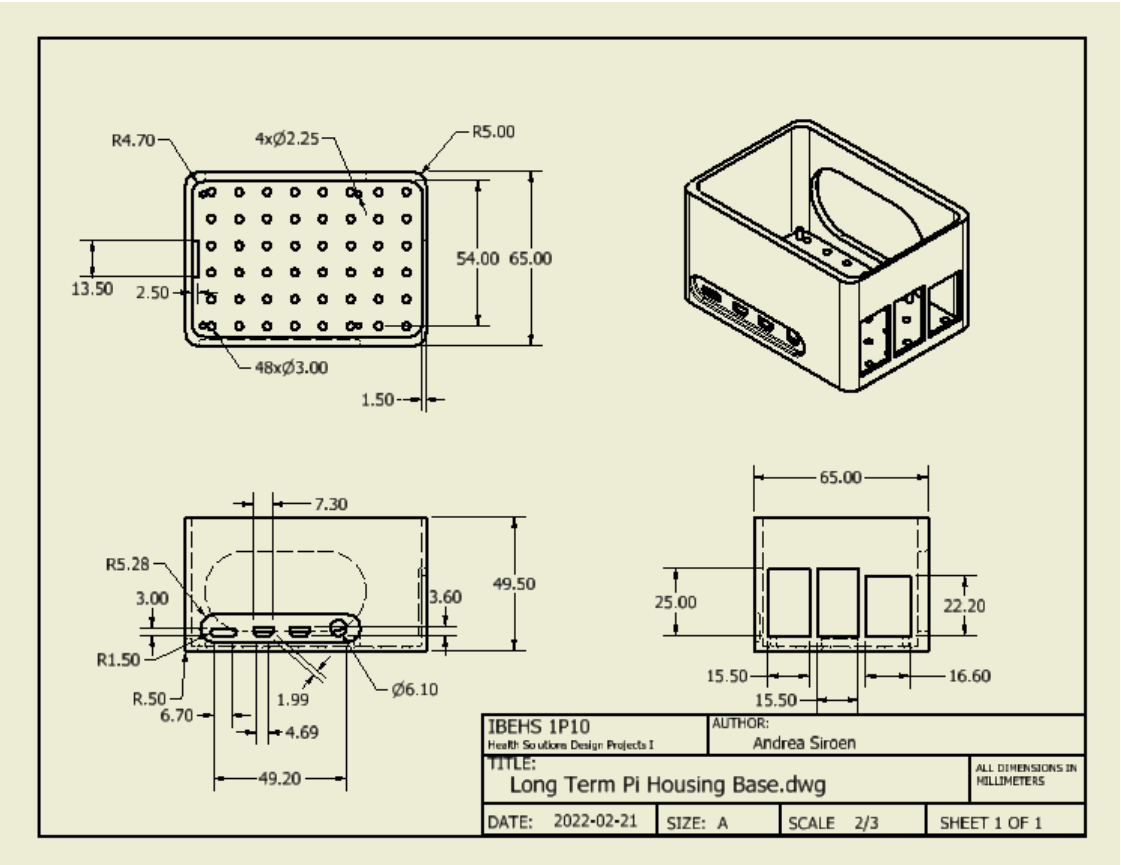


Figure G.2.3: Long-term Pi housing base

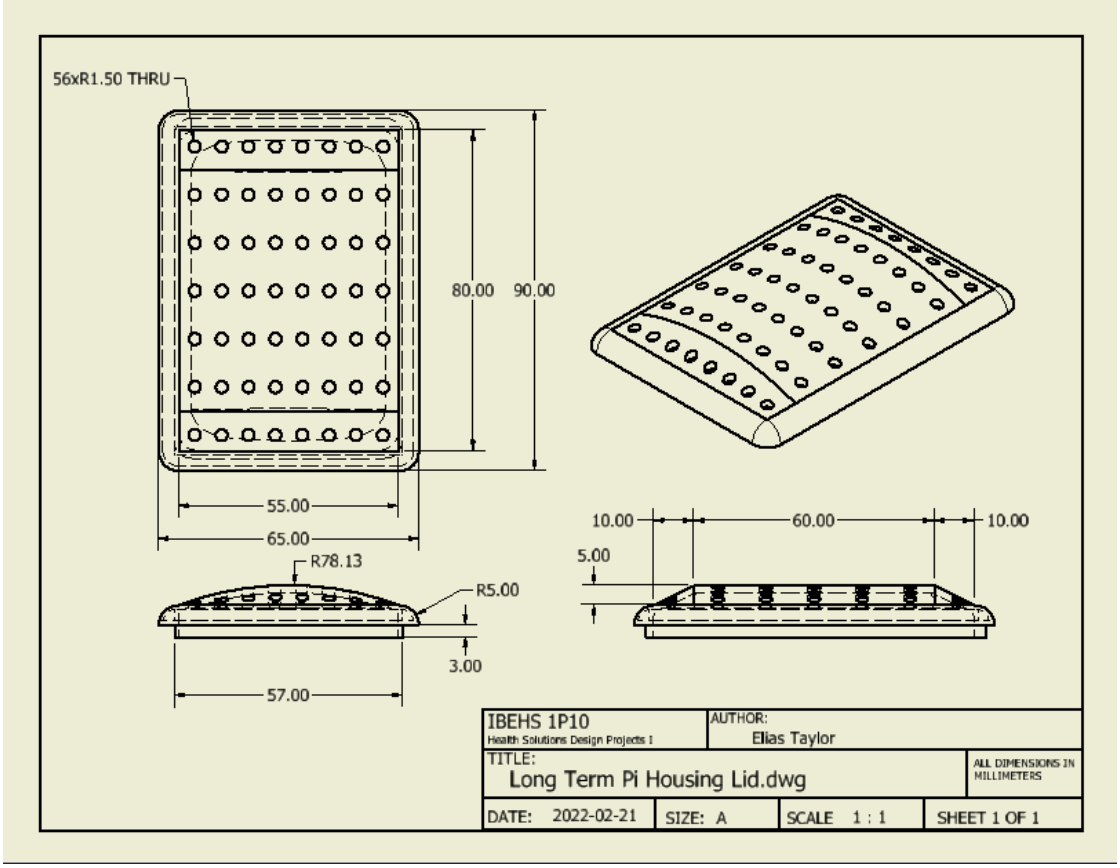


Figure G.2.4: Long-term Pi housing lid

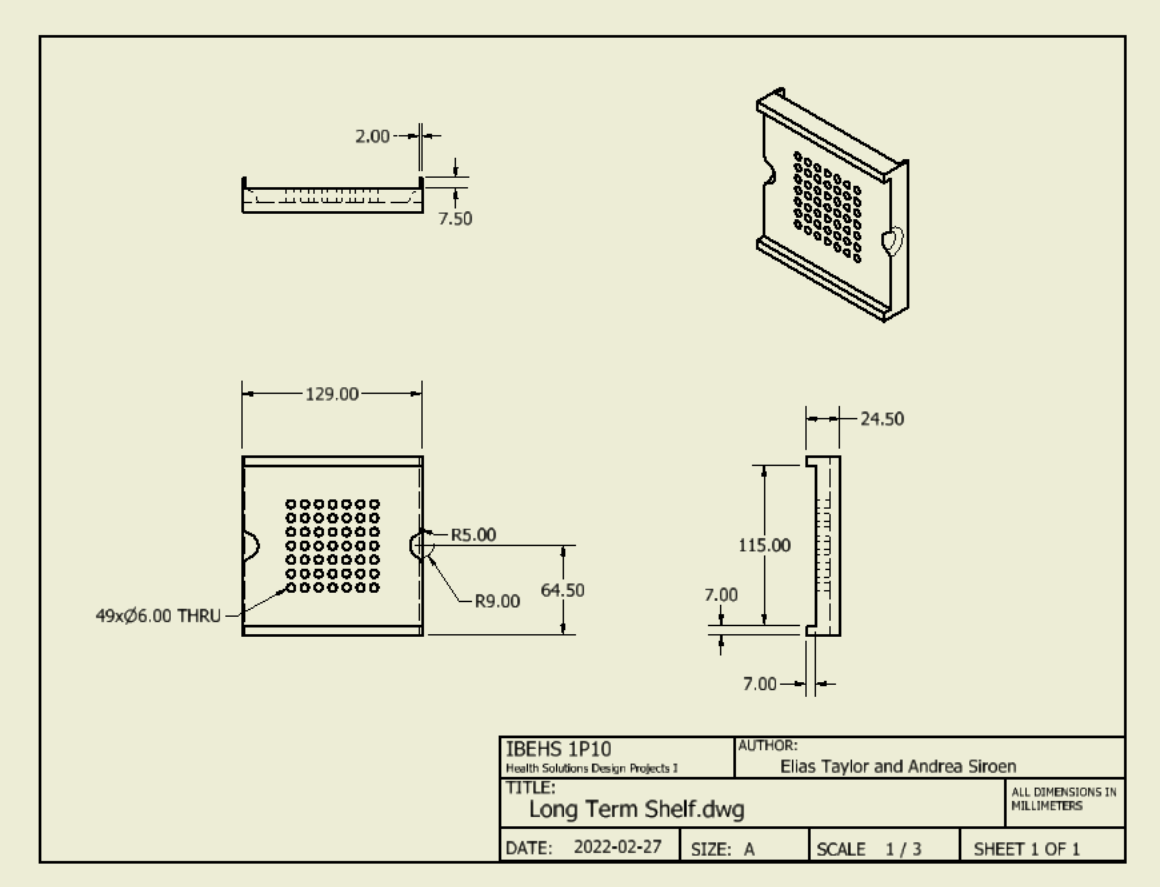


Figure G.2.5: Long-term self to hold Pi housing; rests in parent base

Short-Term Assembly – G.3

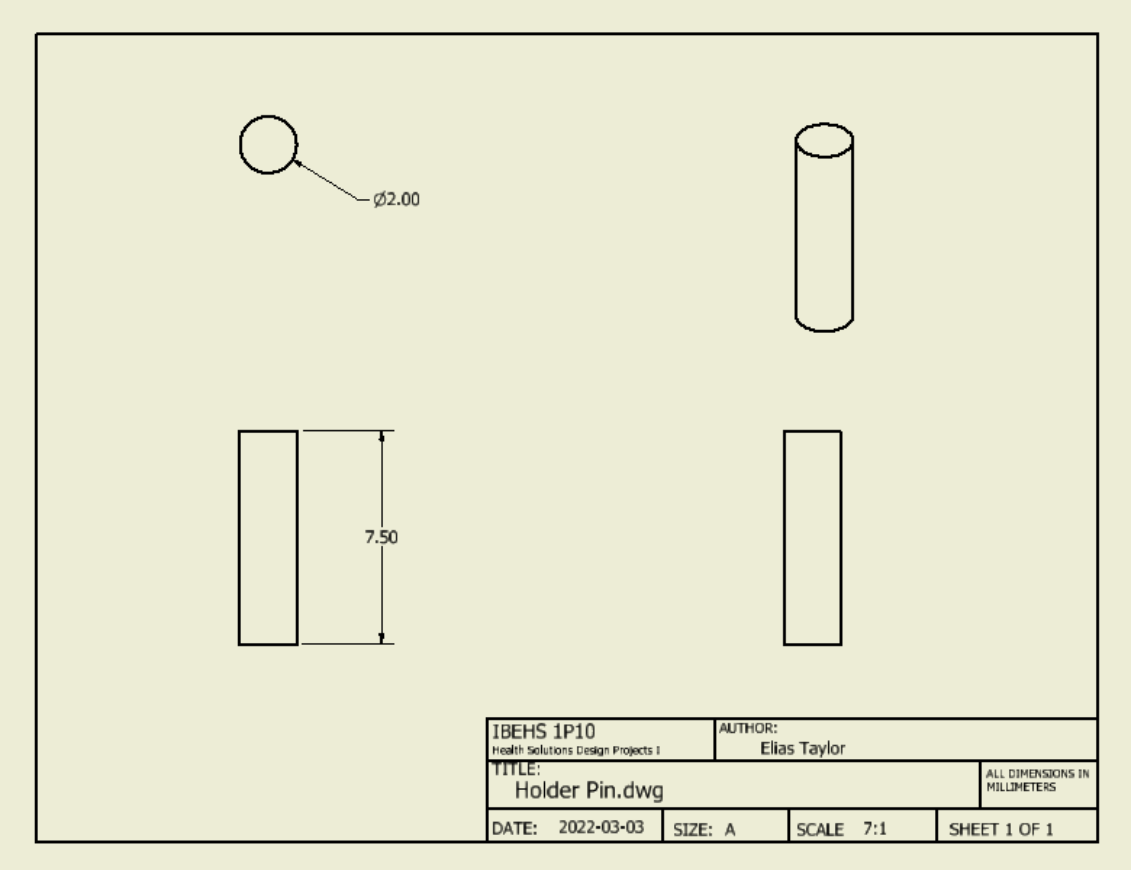


Figure G.3.1: Holder pin for bell crank (x2)

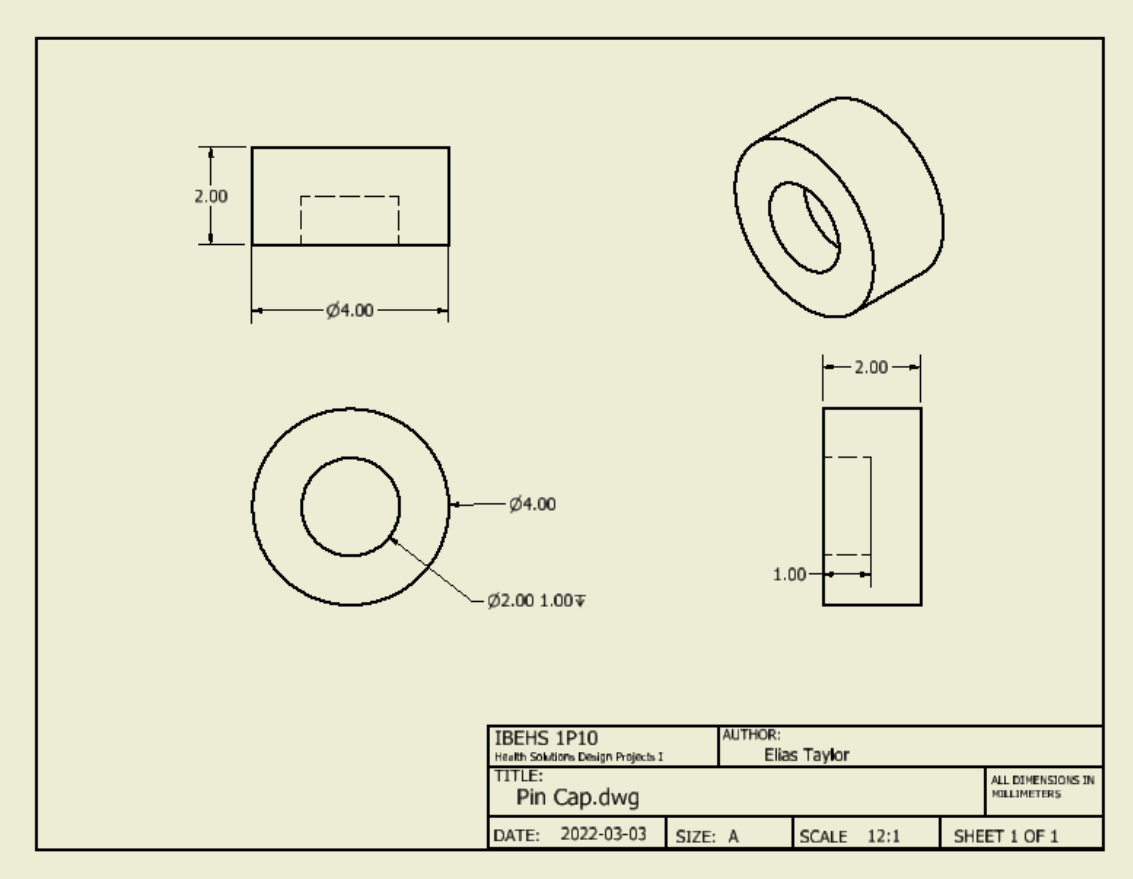


Figure G.3.2: Pin cap for bell crank (x2)

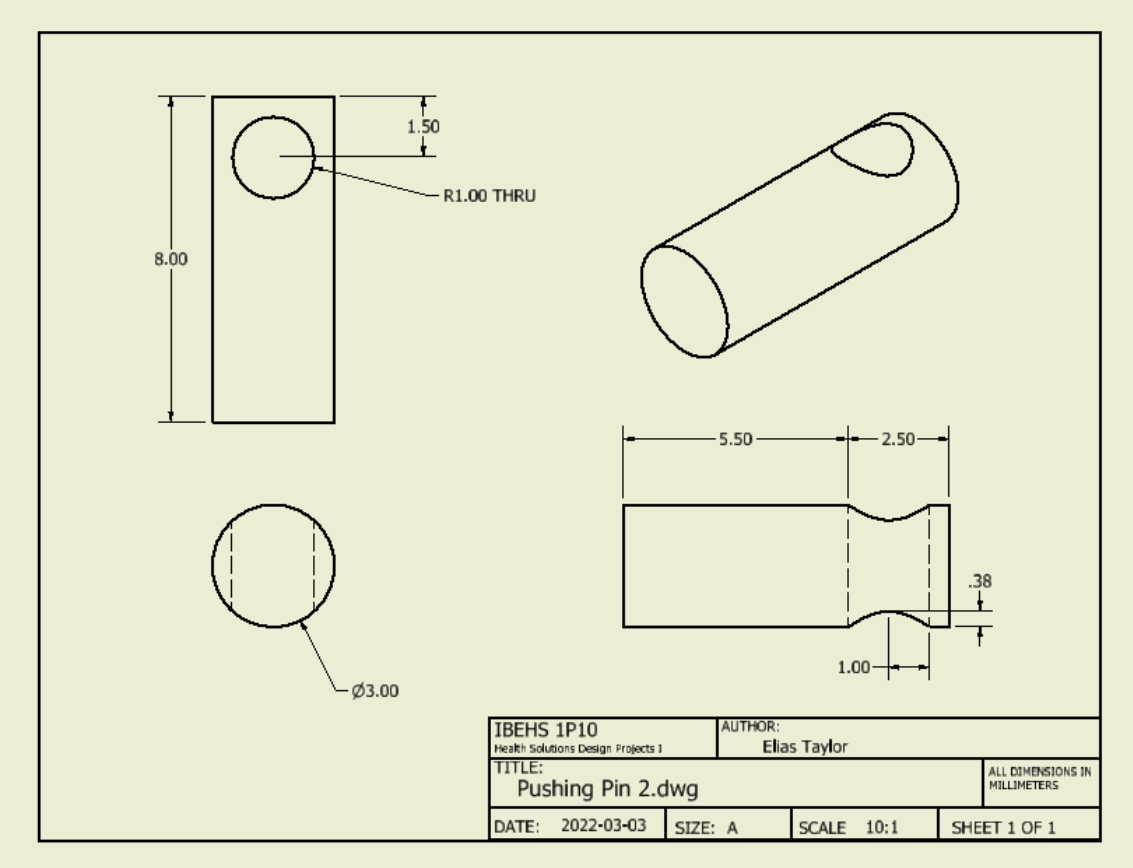


Figure G.3.3: Short pushing pin for bell crank

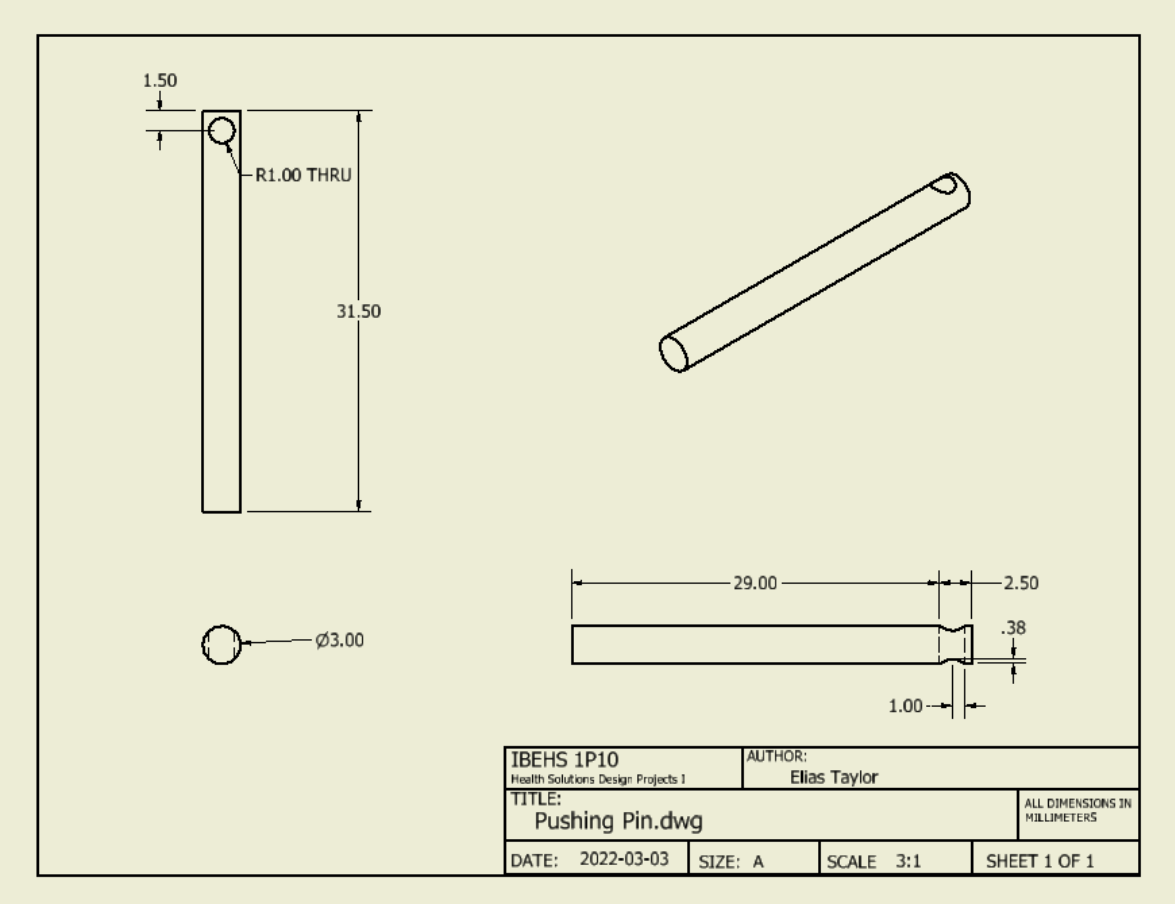


Figure G.3.4: Long pushing pin for bell crank

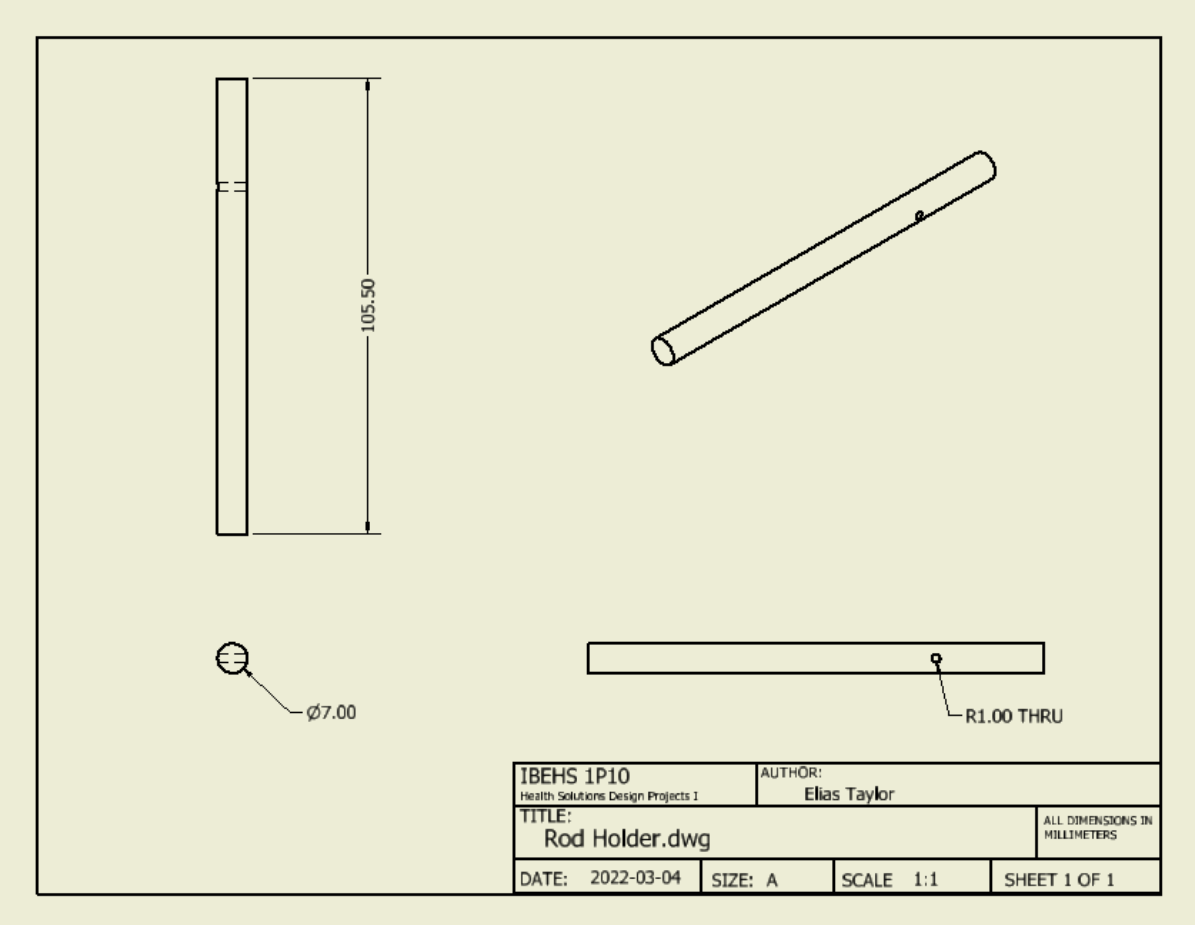


Figure G.3.5: Rod holder for bell crank

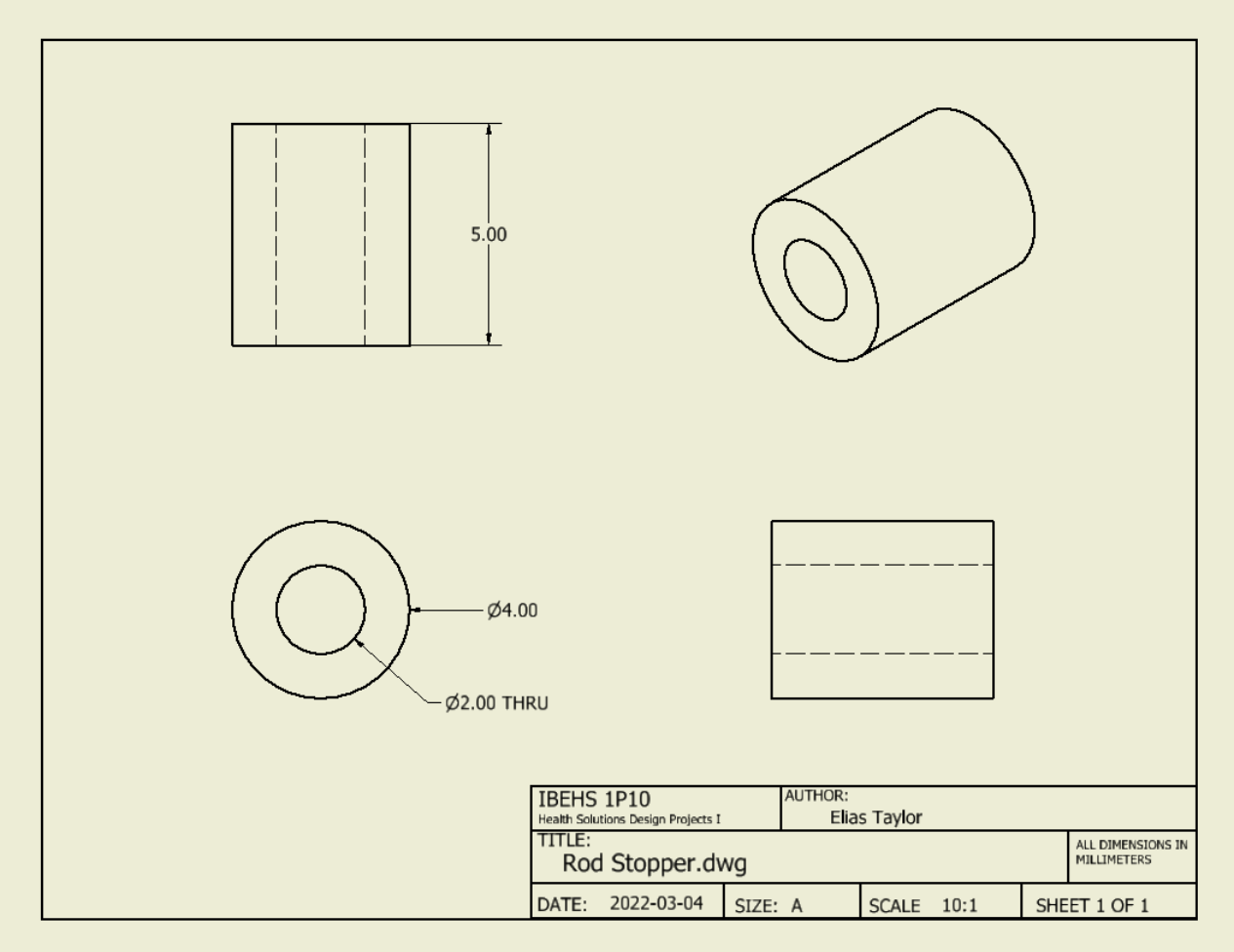


Figure G.3.6: Rod stopper for bell crank

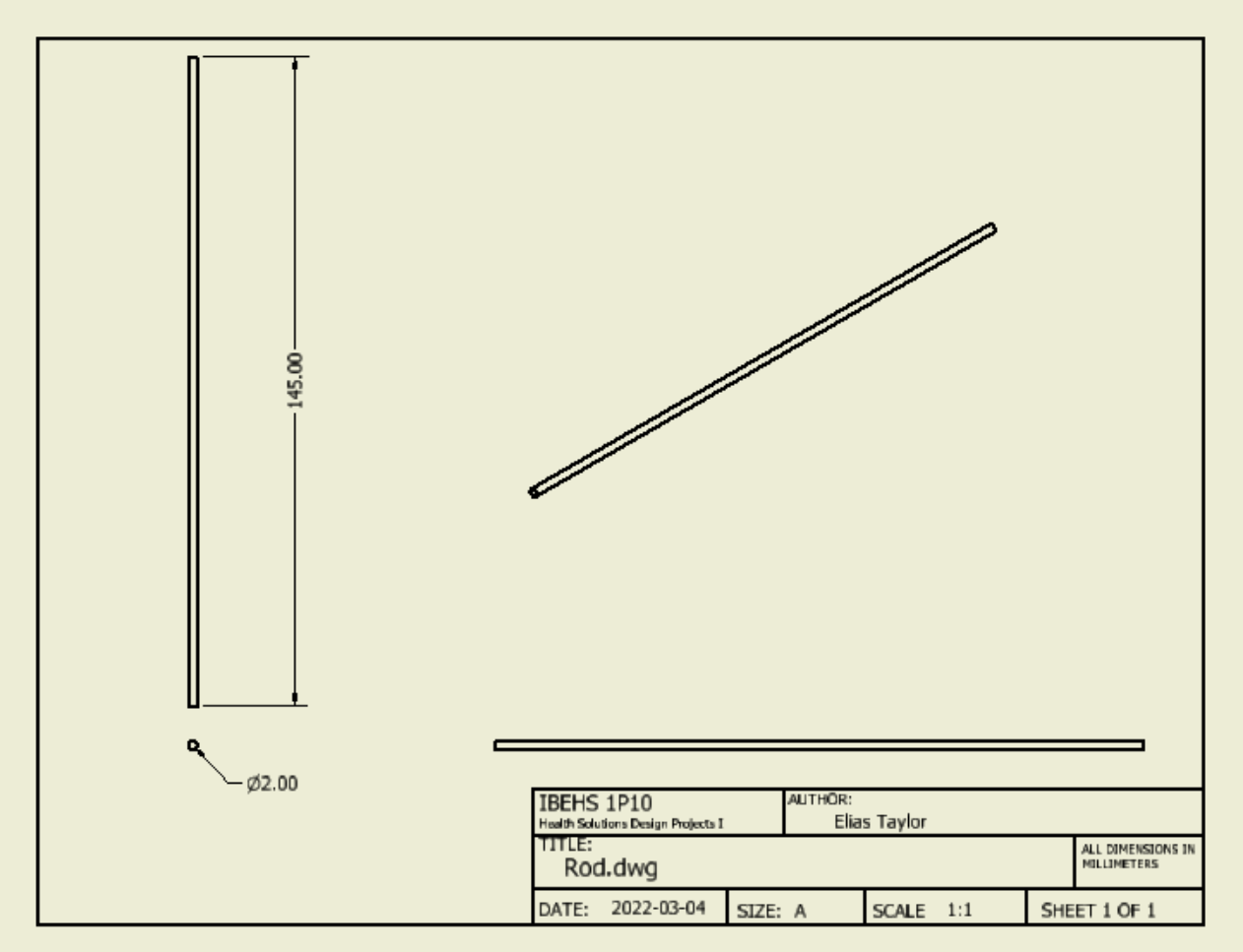


Figure G.3.7: Main rotating rod for bell crank

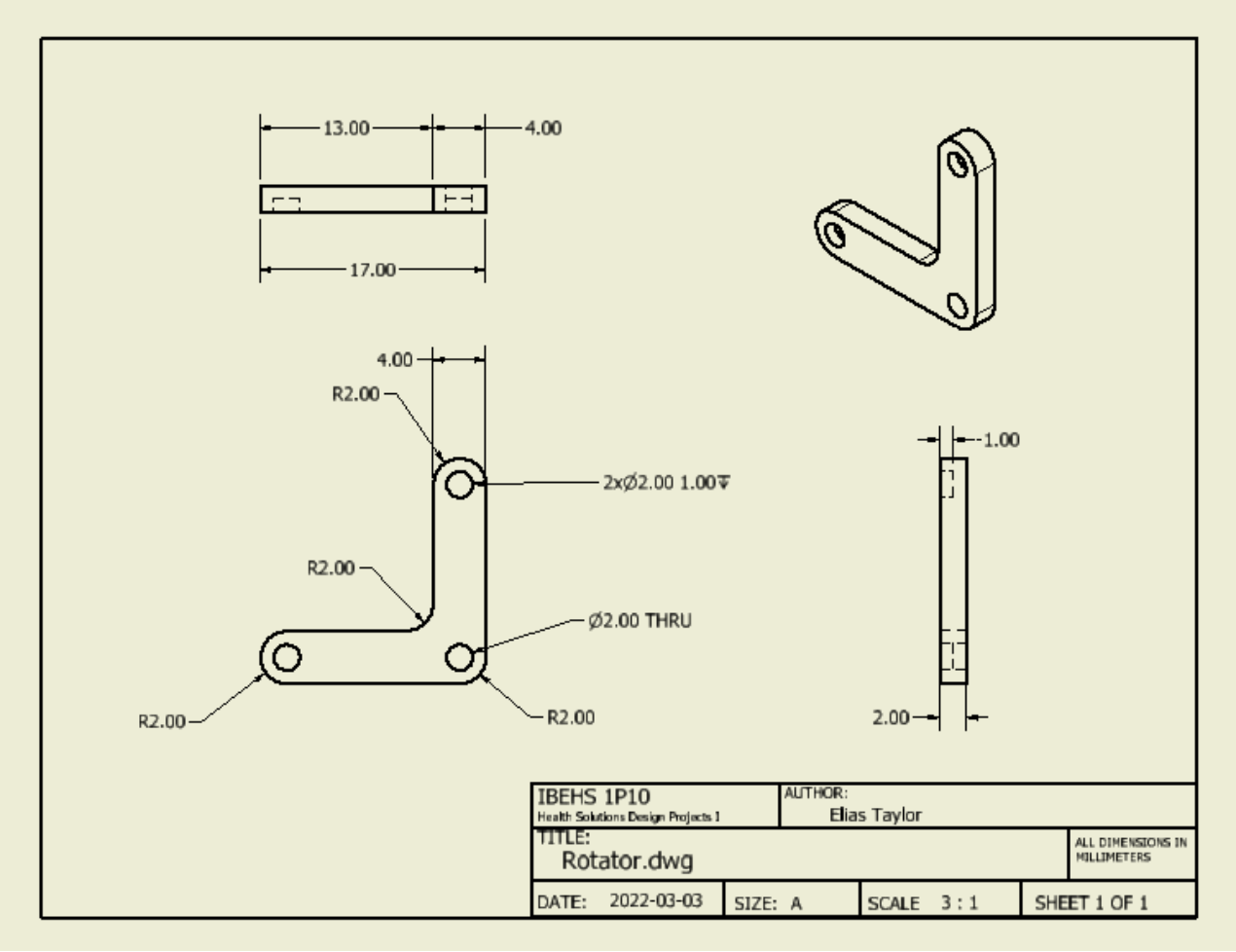


Figure G.3.8: Rotating L-shape piece for bell crank; interfaces with all associated rod components

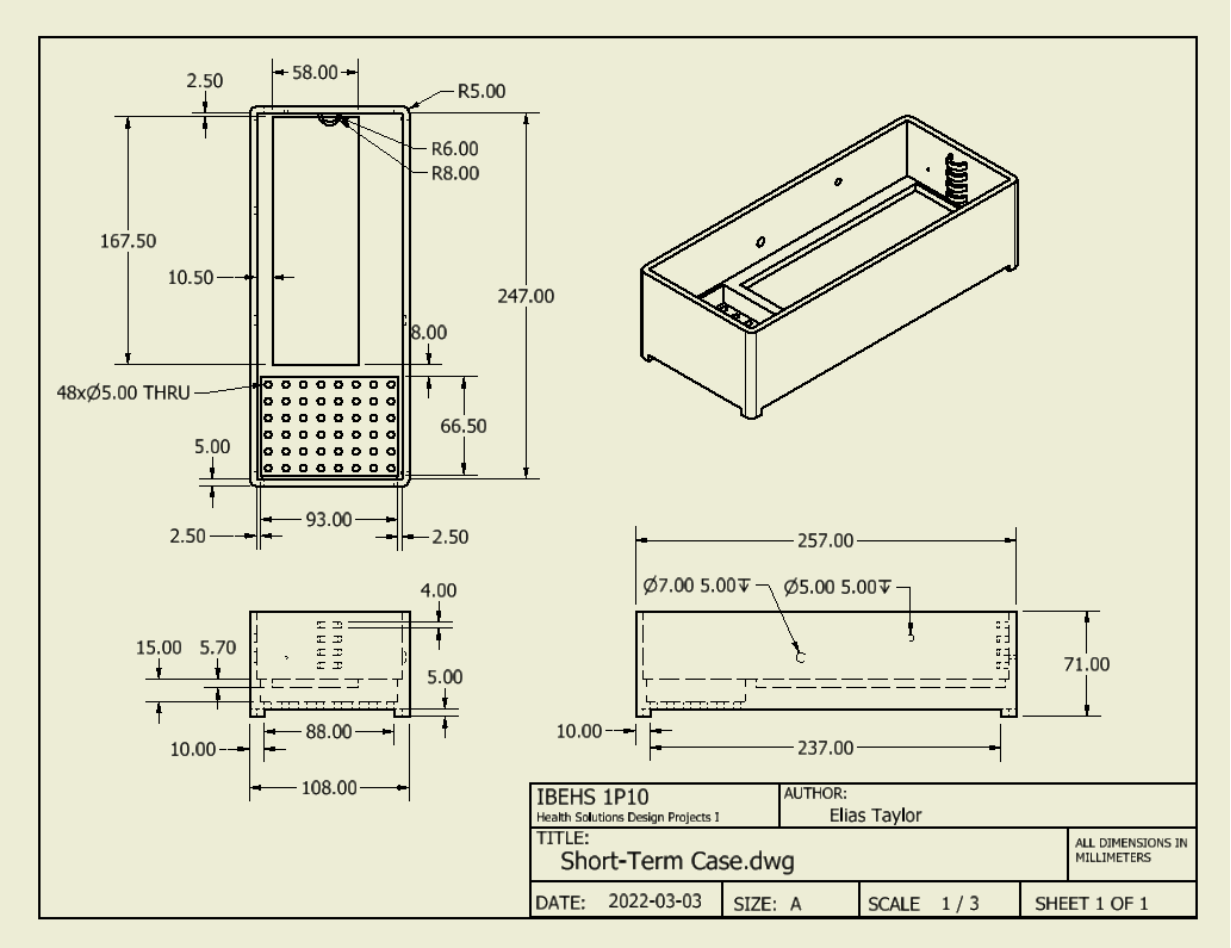


Figure G.3.9: Short-term parent base

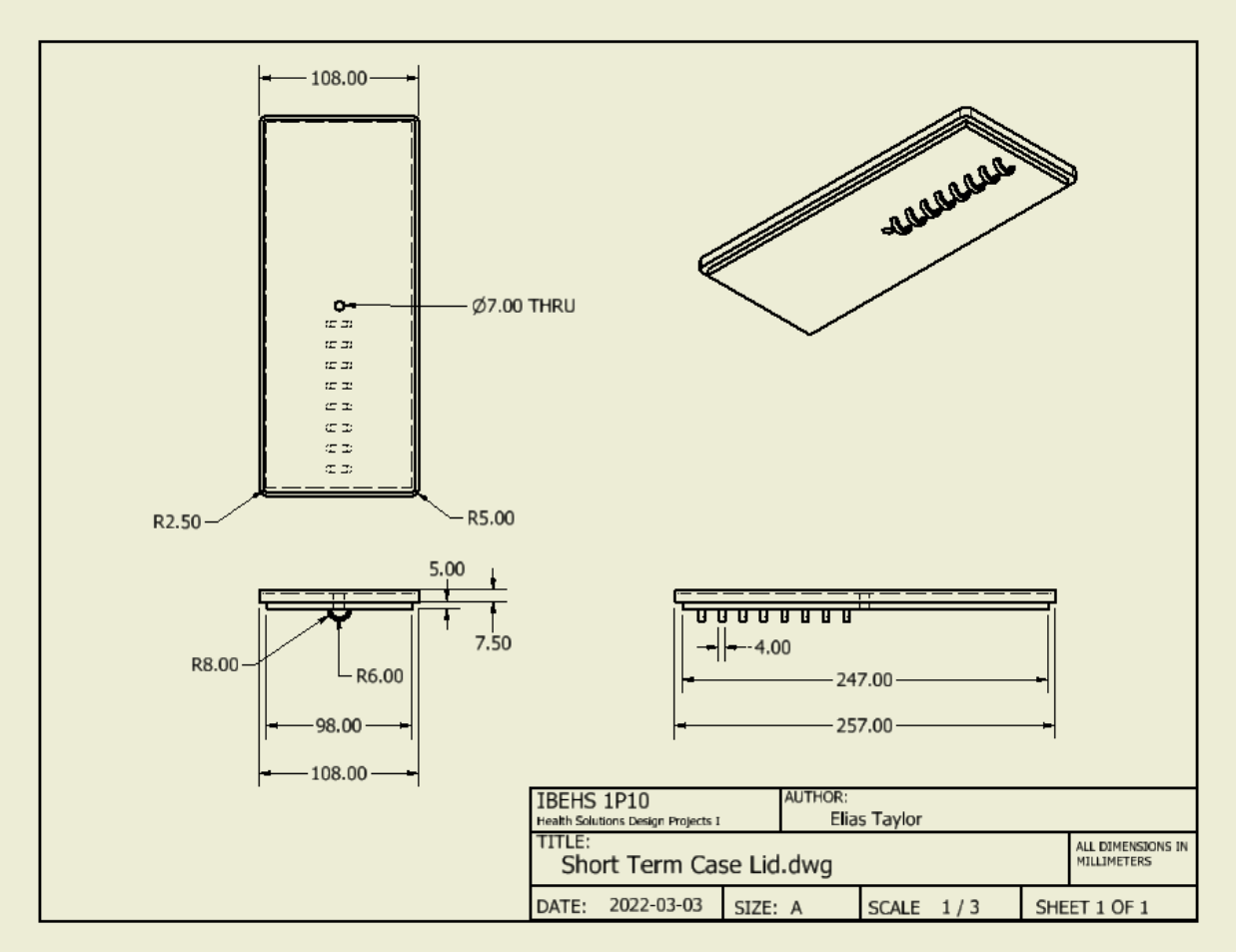


Figure G.3.10: Short-term lid for parent base

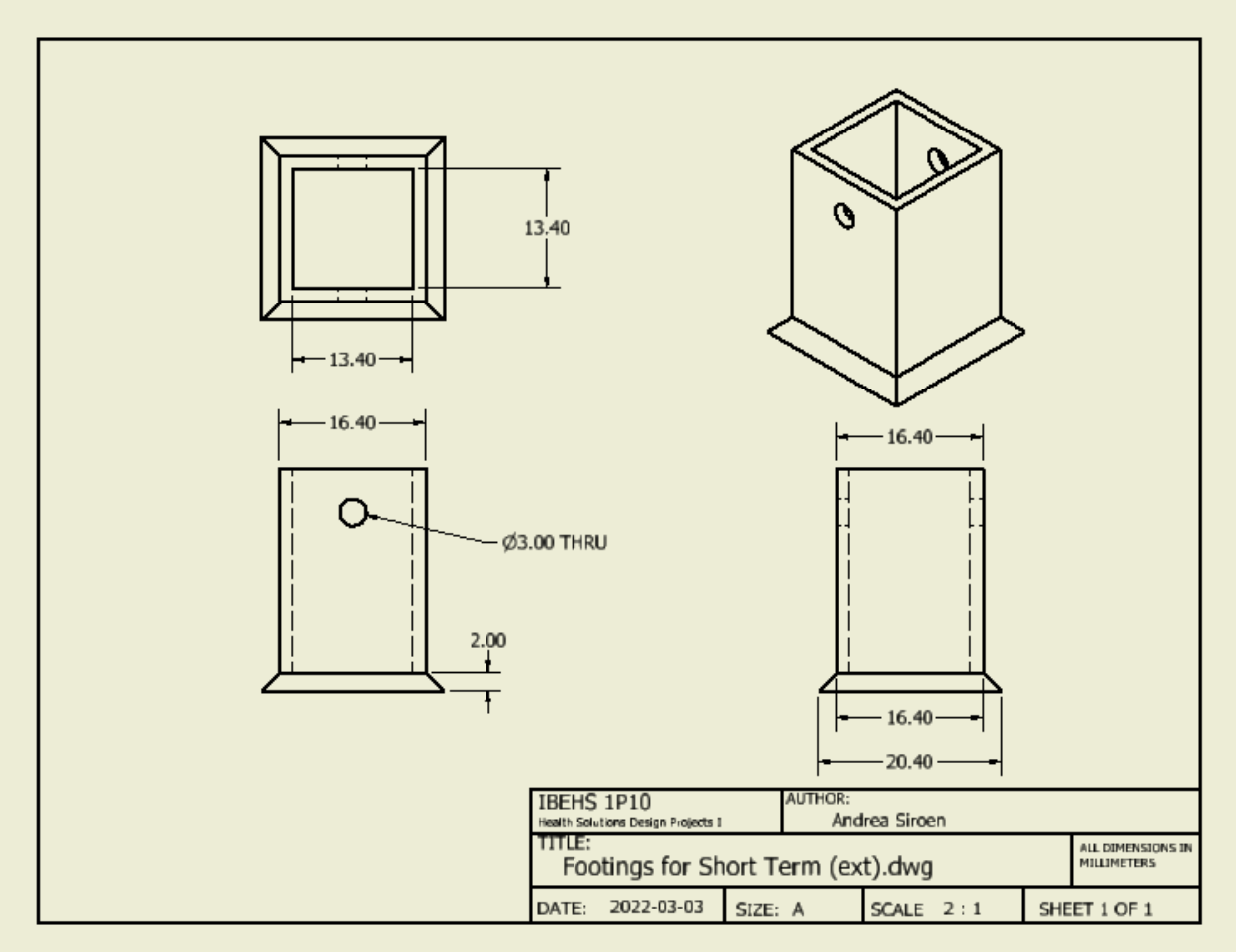


Figure G.3.11: Adjustable footings for short-term parent (exterior component)

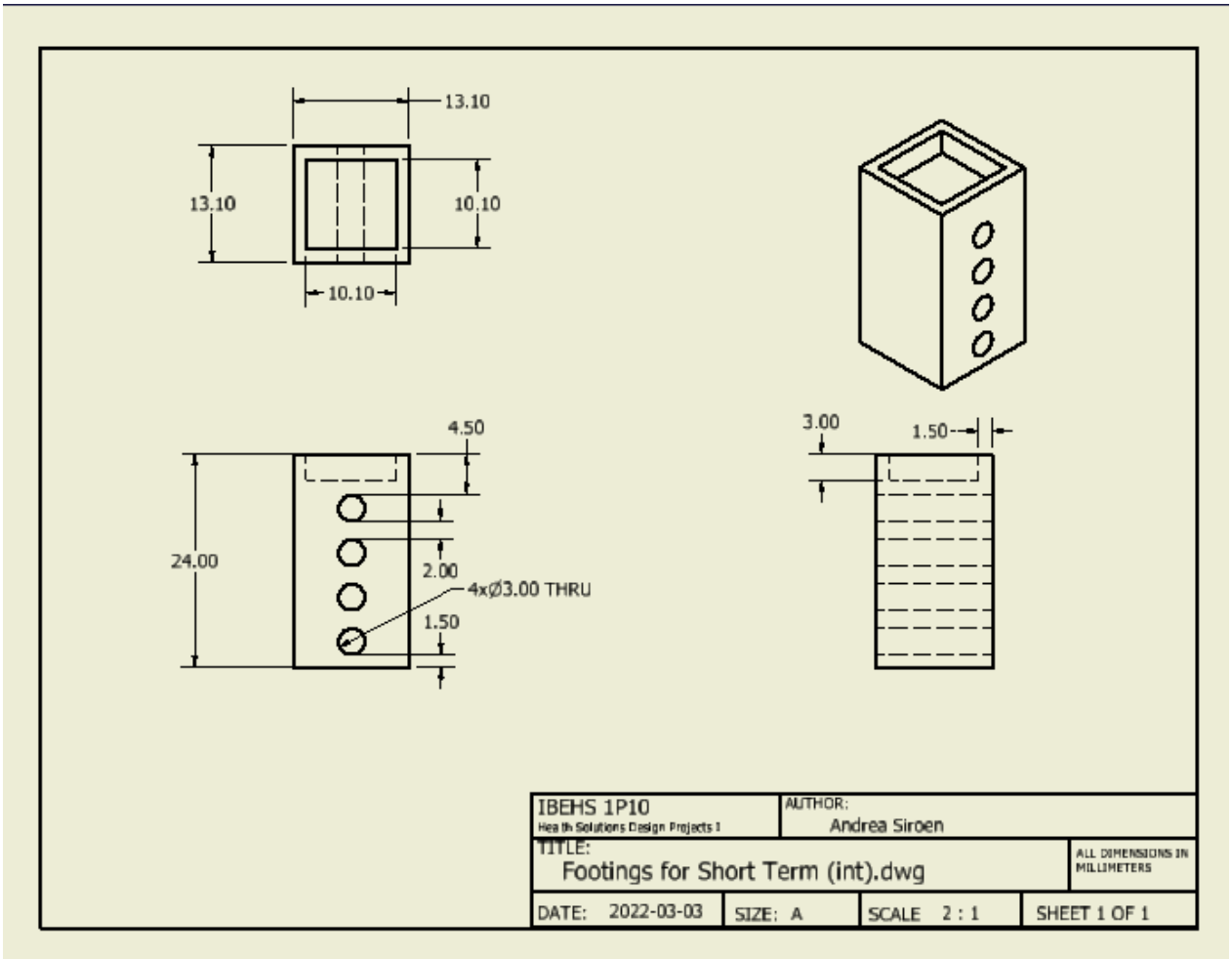


Figure G.3.12: Adjustable footings for short term parent (interior component)

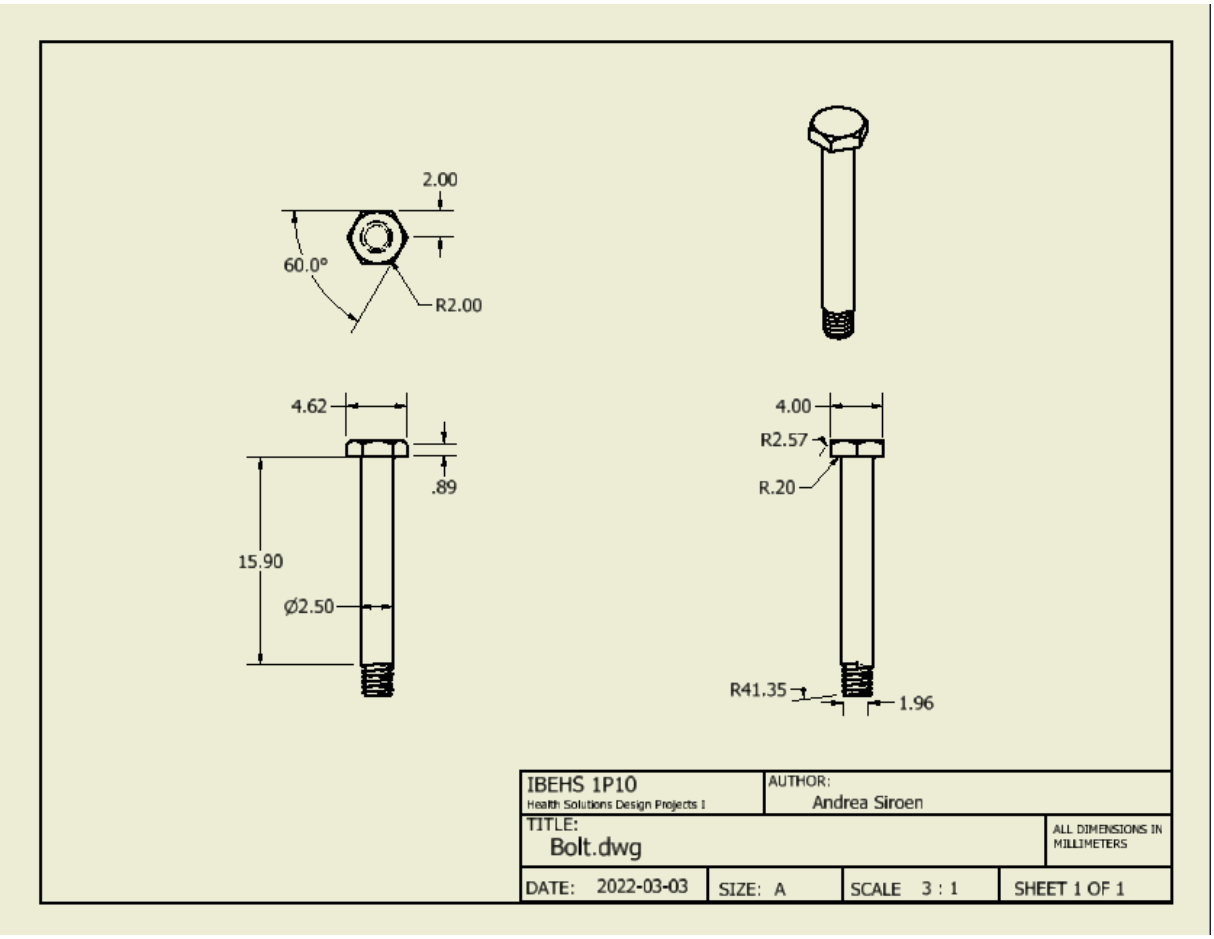


Figure G.3.13: Bolt for adjustable footings

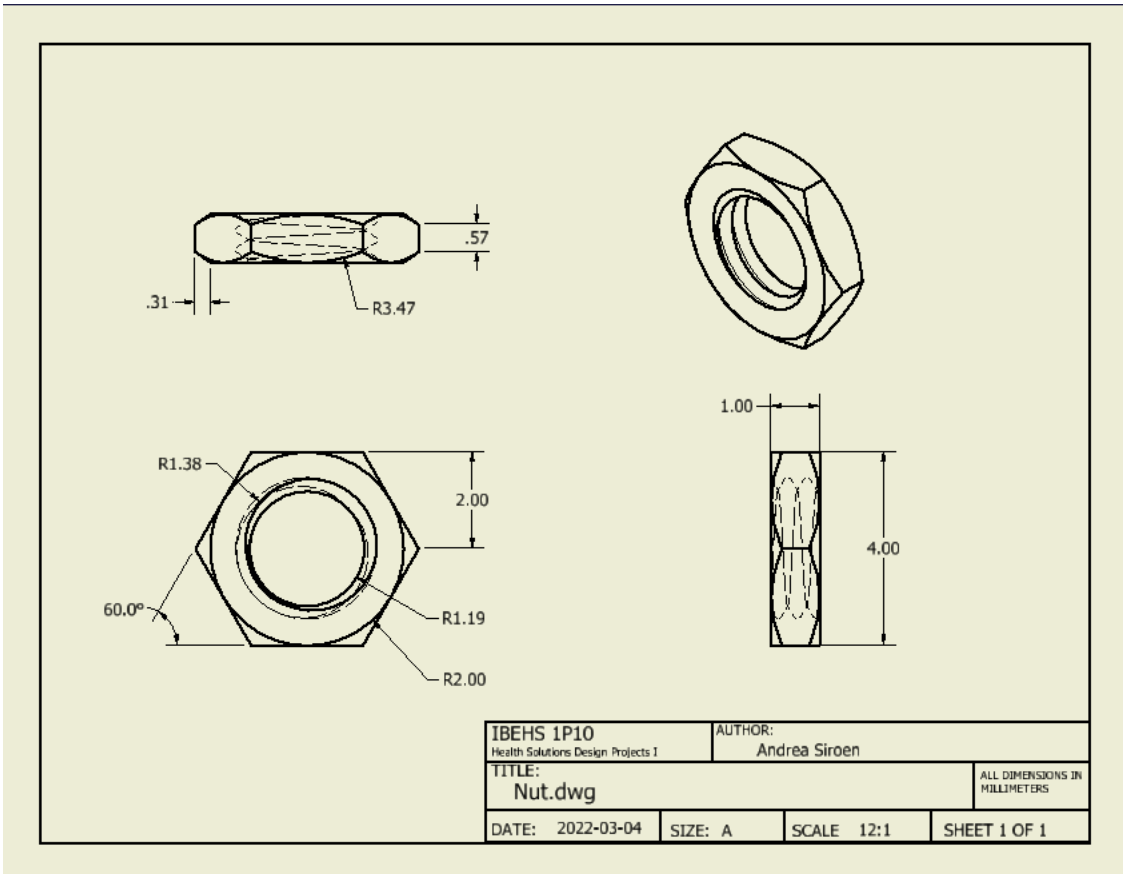


Figure G.3.14: Nut which interfaces with bolt for adjustable footings

Appendix H: CAD Model Iterations

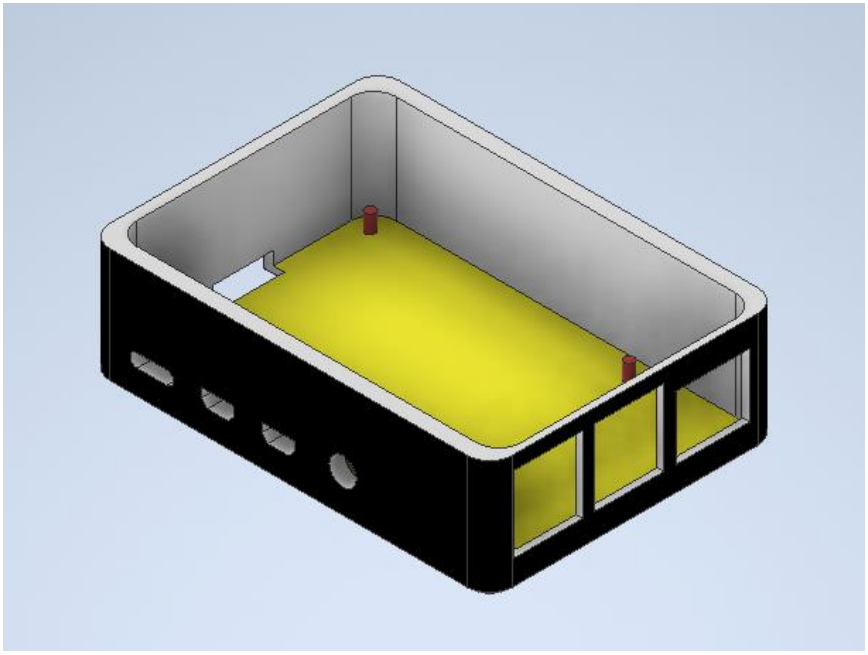


Figure H.1: First Pi housing base iteration

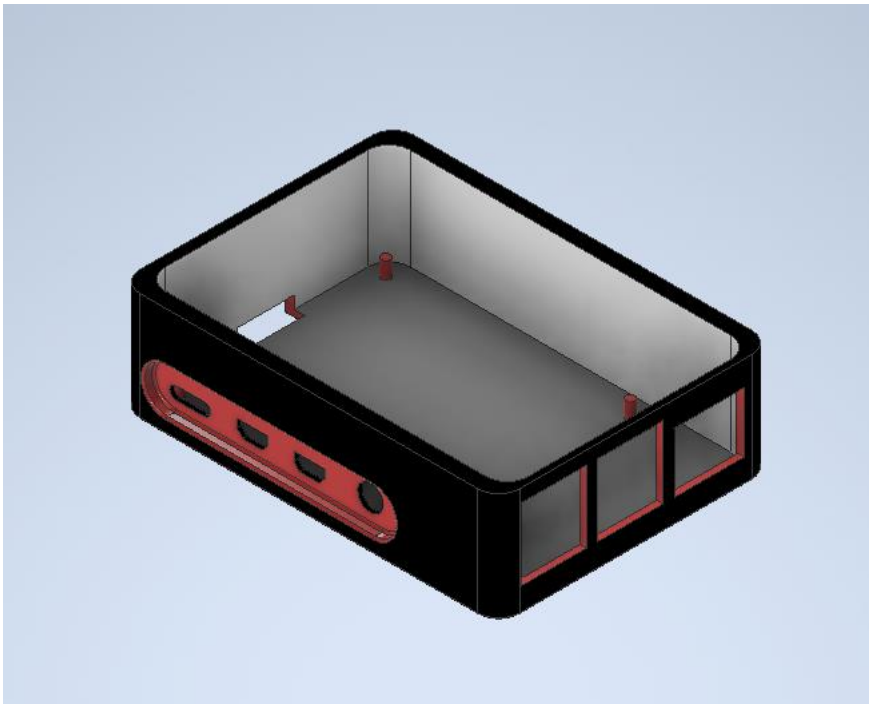


Figure H.2: Second Pi housing base iteration

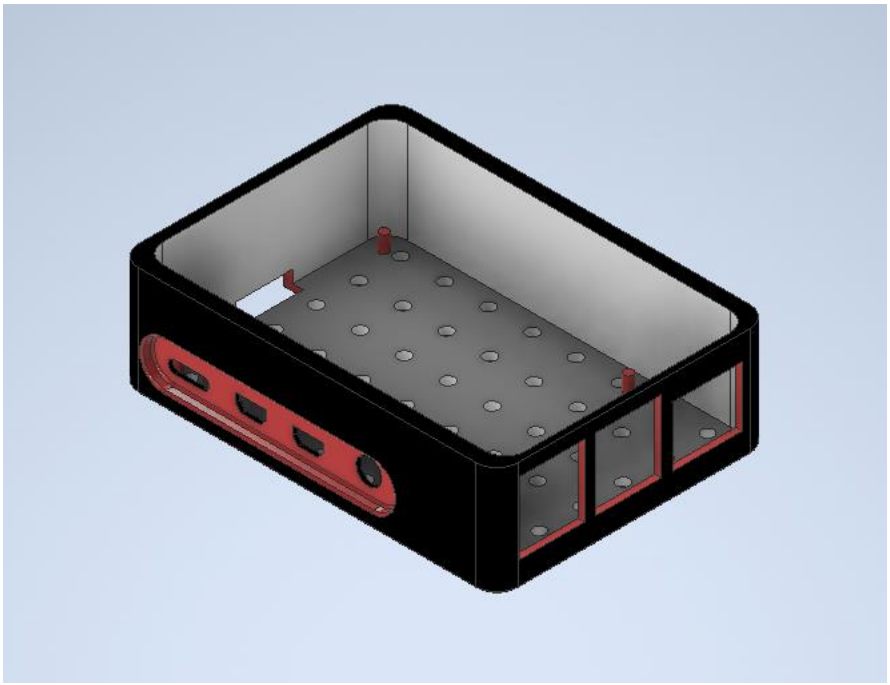


Figure H.3: Third Pi housing base iteration

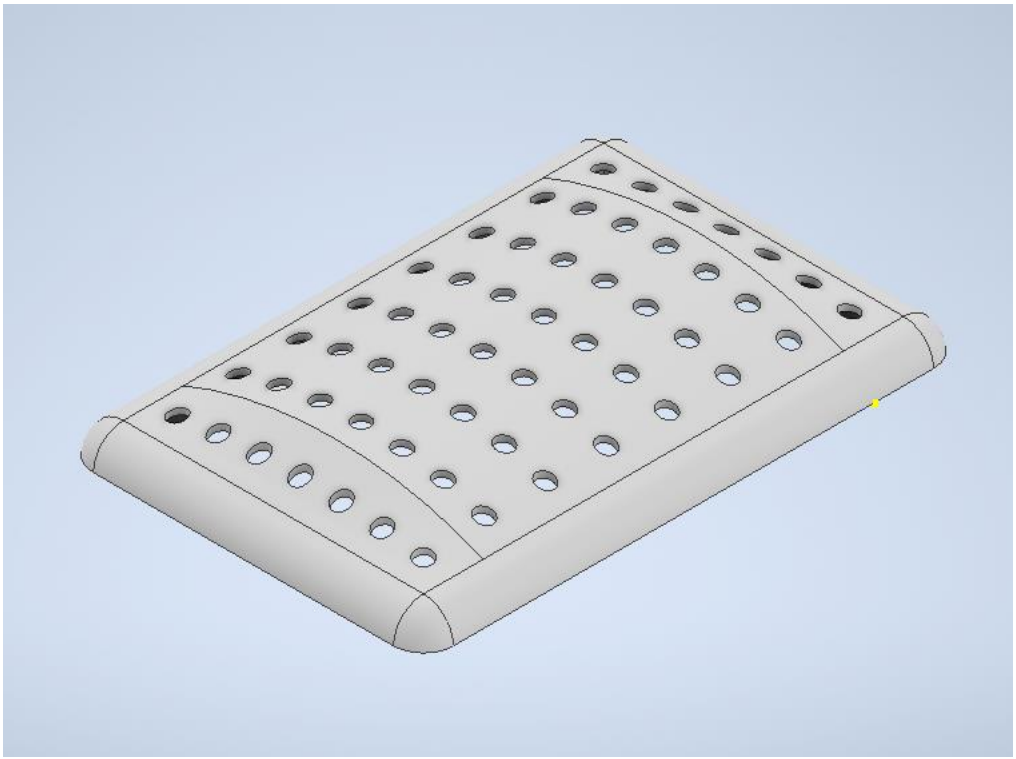


Figure H.4: First Pi housing lid iteration

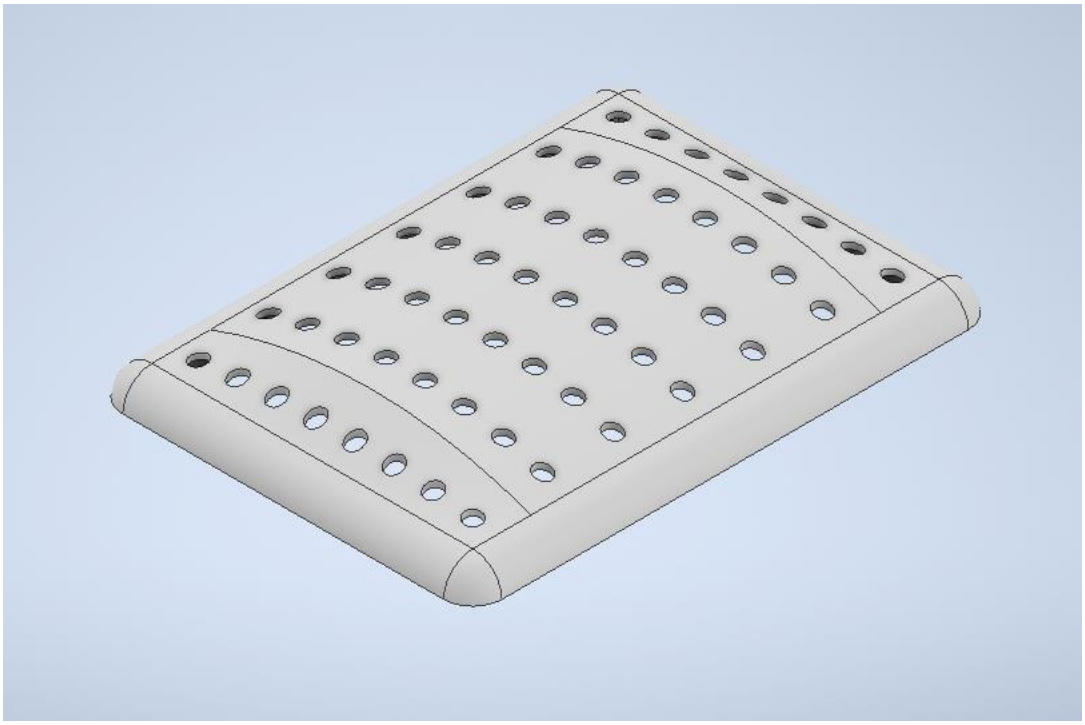


Figure H.5: Second Pi housing lid iteration

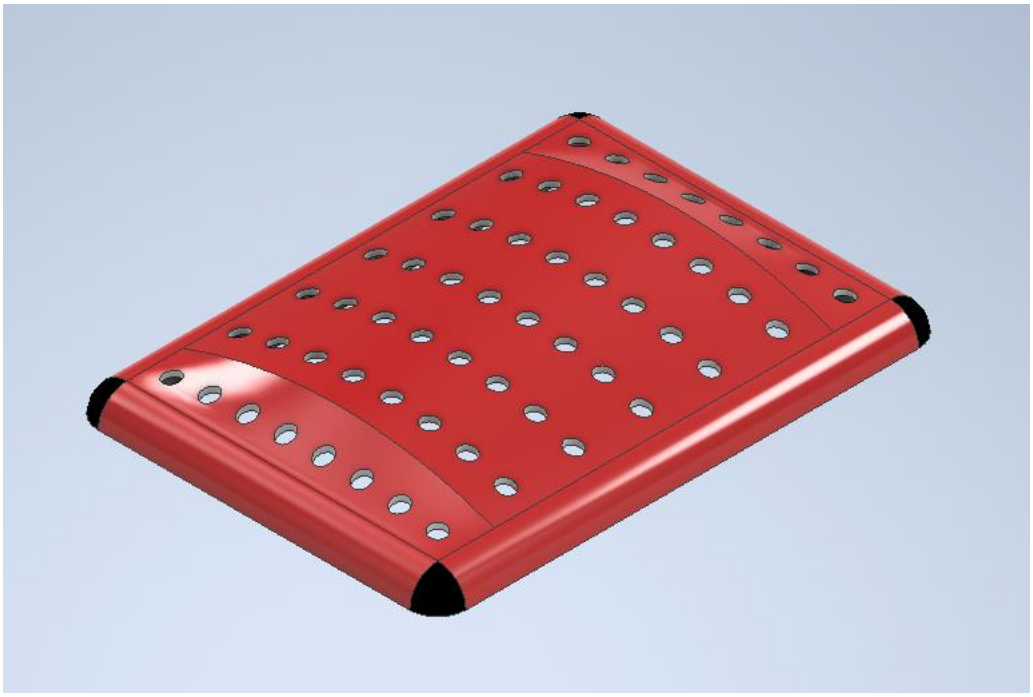


Figure H.6: Third Pi housing lid iteration

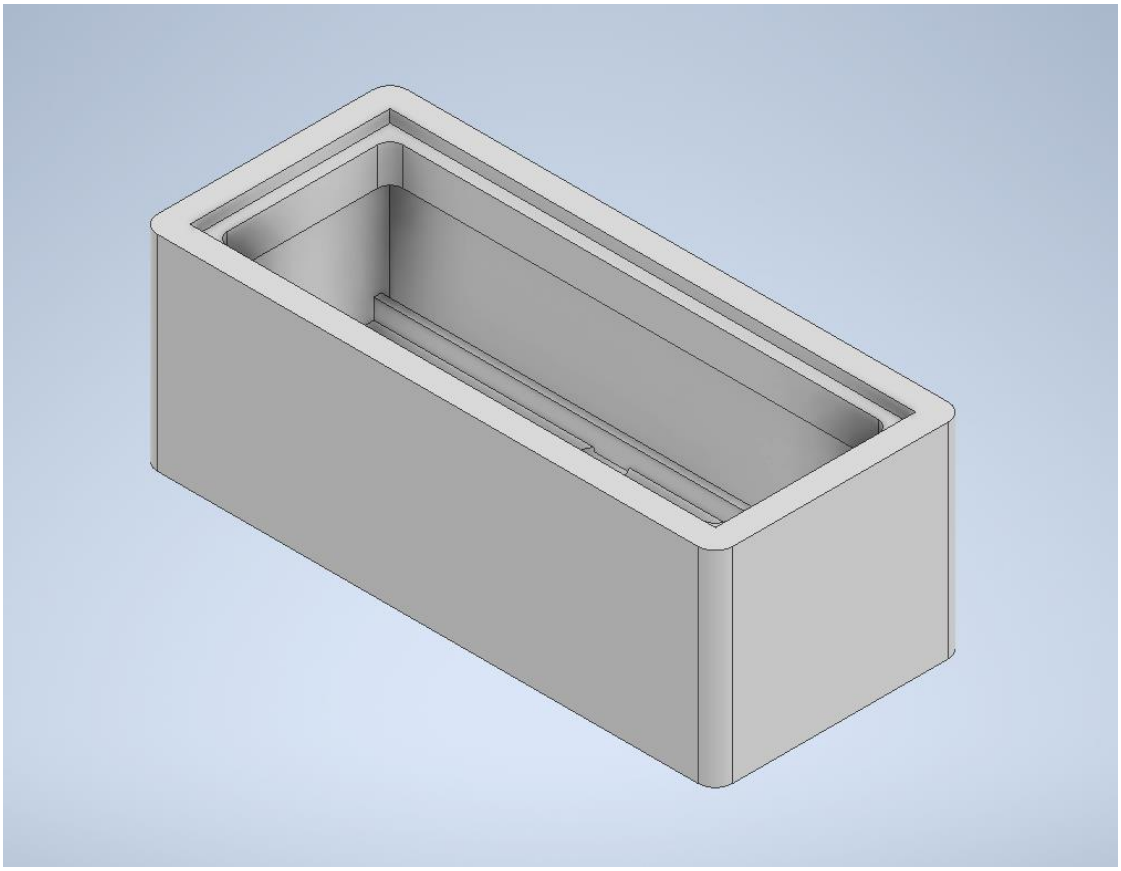


Figure H.7: First short-term parent base iteration

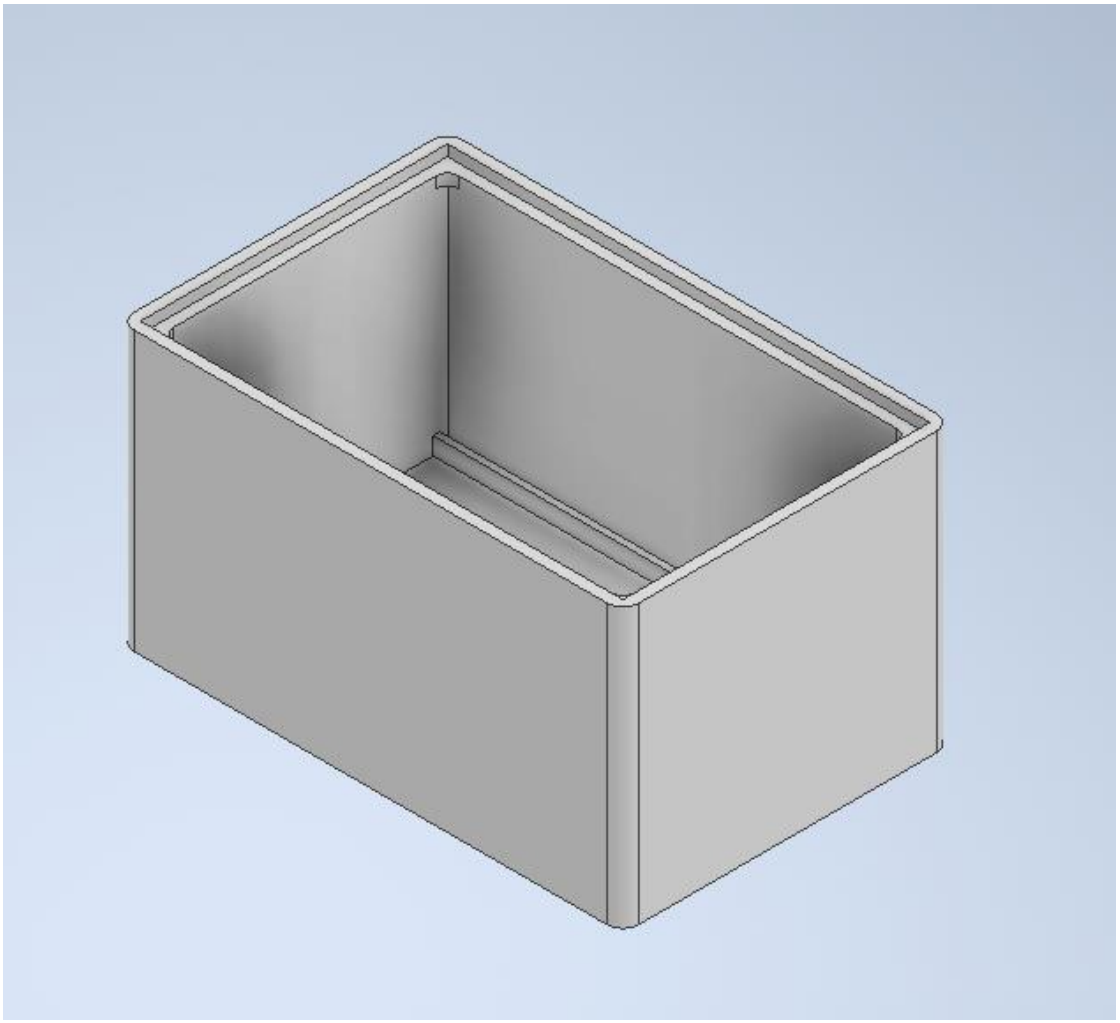


Figure H.8: Second short-term parent base iteration

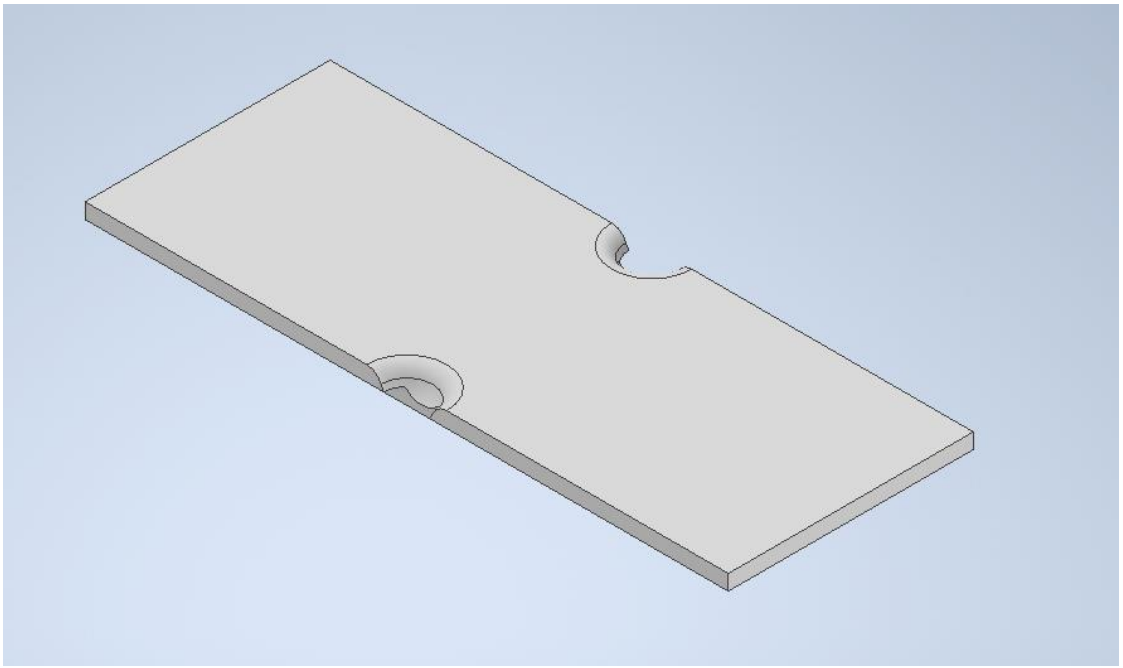


Figure H.9: First short-term parent lid iteration

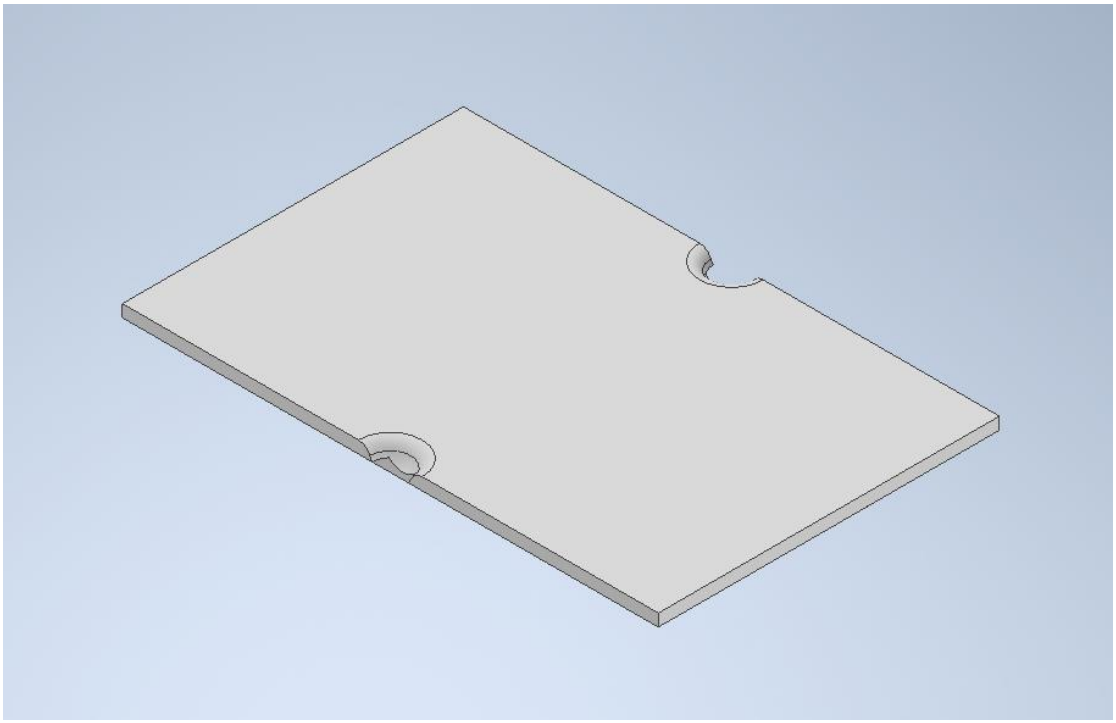


Figure H.10: Second short-term parent lid iteration