GNG2101

Design Project User and Product Manual

SnapCane – One-Handed Telescopic Cane

Submitted by:

SnapCane AND F1.4

Ethan Leung, 300160832

Julien Kapro, 300173066

Matthew Rispoli, 300309987

Rashad Nesar, 300372555

Faran Rashid, 300453866

2025-04-04

University of Ottawa

Table of Contents

Table of Contents ii
List of Figures iii
List of Tables iv
List of Acronyms and Glossary v
1 Introduction 1
2 Overview 2
2.1 Conventions 4
2.2 Cautions & Warnings 4
3 Getting started 5
Configuration Considerations 5
3.1 5
3.2 User Access Considerations 5
3.3 Accessing/setting up the System 6
System Organization & Navigation 6
3.4 6
3.5 Exiting the System 6
4 Using the System 7
Extending/Collapsing 7
4.1 7
4.1.1 Extending 7
4.1.2 Collapsing 7
5 Troubleshooting & Support 7
5.1 Error Messages or Behaviors 7
5.2 Special Considerations 7
5.3 Maintenance 8
Support 8
5.4 8
6 Product Documentation 9
6.1 Subsystem 1: Outer Shell 9
6.1.1 Bill of Materials 9
6.1.2 Equipment List 9
6.1.3 Instructions 9
6.2 Subsystem 2: Inner Rods 10
6.2.1 Bill of Materials 10
6.2.2 Equipment List 10
6.2.3 Instructions 11
6.3 Subsystem 3: Handle & Button 11
6.3.1 Bill of Materials 11
6.3.2 Equipment List 12
6.3.3 Instructions 12
6.4 Testing & Validation 12
6.4.1 Prototype 1 12
6.4.2 Prototype 2 13
6.4.3 Prototype 3 (Final Prototype) 15
7 Conclusions and Recommendations for Future Work 17
8 Bibliography 18
APPENDICES 19
9 APPENDIX I: Design Files 19
10 APPENDIX II: Other Appendices 20

List of Figures

Figure 1: Disassembled Final Prototype Extended 2
Figure 2: Disassembled Final Prototype Collapsed 3
Figure 3: Assembled Final Prototype Extended 3
Figure 4: SnapCane Detailed CAD Model 5
Figure 5: Prototype 1 Fully Extended 13
Figure 6: Prototype 1 Collapsed 13
Figure 7: Prototype 2 Full CAD 14
Figure 8: CAD Model of Prototype 2 Part 2 14
Figure 9: Structural Buckling Test of Inner Rod at F=1000N 15
Figure 10: Final Prototype 16

List of Tables

Table 1. Acronyms v
Table 2. Glossary v
Table 3: BOM - Outer Shell 9
Table 4: Equipment List for Subsystem 1 9
Table 5: BOM - Inner Rods 10
Table 6: Equipment List for Subsystem 2 10
Table 7: BOM - Handle & Button 11
Table 8: Equipment List for Subsystem 3 12
Table 9. Referenced Documents 19
Table 10: Miscellaneous Files 20

List of Acronyms and Glossary

Table 1. Acronyms

Acronym	Definition
PLA	Polylactic Acid
BOM	Bill of Materials

Table 2. Glossary

Term	Acronym	Definition
User Product Manual	UPM	A document that provides directions of use of a product for customers.

1 Introduction

This User and Product Manual (UPM) provides the information necessary for any user to effectively use the SnapCane and for prototype documentation. The UPM provides insight into configuring the device, utilizing the device effectively, troubleshooting any potential issues arisen, as well as additional documentation necessary for the product.

Configuring the device remains at a minimal level, with the prototype requiring no assembly upon utilization. Operating the device is detailed in Section 4, where extension and collapsing functionality is described. Troubleshooting instructions are also included in the case of malfunction.

Additional documentation included is the detailed BOM for each subsystem, as well as all design files, both related to design and validation.

In terms of security, safety, and/or privacy concerns regarding the use of the UPM, there are no special concerns that must be noted.

2 Overview

A problem exists for a user that experiences limited mobility on one side of the body with full operation of one hand, thus requiring a cane for support. An example situation can be provided for when the user has issues commuting. The user has 1 fully functioning hand which needs to be held on to the railing during transit, but still requires a cane to walk. This creates an issue where the user has nowhere to put the cane down while standing on the bus/train.

The fundamental needs for the user would be for a cane to be able to fold and unfold quickly, keeping in mind the use of 1 fully functional hand. Where a natural grip and walking motion of a walking stick is more comfortable, compared to a traditional cane. The user is implied that they do not carry a backpack, so it would be ideal for to be stored the cane in another method. A lightweight option remains a high priority. An extension grip will be utilized rather than a firm grasp.

Thus, a need exists for a cane/walking stick that provides support and stability for people with mobility impairments on one side of their body. This cane will be lightweight, quick and easy to fold with the use of only one hand, as well as durable across variable weather conditions. It will be simple to operate and be suitable for everyday usage.

Figure 1: Disassembled Final Prototype Extended

Figure 2: Disassembled Final Prototype Collapsed

Figure 3: Assembled Final Prototype Extended

The product presented in the user manual, dubbed ‘SnapCane’, is fully operable with one-hand, thus promoting independence of those who suffer from mobility impairments. It can be stored away due to its small collapsed size, making it convenient when needed, and out of the way when not required. The key differentiator between SnapCane and other market products is the operability with one-hand, and the intuitive method of extending the cane when needed and storing when not in use.

The key features of the product are the segmented structural tubing that offers a significantly reduced size when collapsed, allowing easy storage. Additionally, the simple operability with the button found on the handle allows quick reduction and extension when needed, with the segment’s extension utilizing gravity as its triggering mechanism. Key safety features are implemented as well on the system, where a ball bearing mechanism is utilized to eliminate accidental engagement of the collapsibility component via the rotating rods in the telescoping system.

The construction of the product utilizes aluminium structural tubing for the segmented structure. The internal telescoping system utilizes steel rods, whilst the support is within the structure is created with screws inserted into the aluminium structure. Additional guide pieces and handle subsystem are created with 3D printing, thus created with a PLA filament

2.1 Conventions

No applicable conventions have been applied in the user manual.

2.2 Cautions & Warnings

If applicable, identify any cautions or warnings that the user should know about before using the prototype. If waiver use or copy permissions need to be obtained, describe the process.

Utilizing the prototype involves risk of accidental collapsibility of the cane, as a result of the telescoping rods within the structure misplacing themselves on the support ridge. It is not recommended to use the prototype for real support in a real application. The prototype has demonstrated its ability to support weight, though it is not recommended to use the prototype as intended. For a final refined product, no cautions or warnings would be issued with extensive testing of the product, thus ensuring safe operation.

3 Getting started

3.1 Configuration Considerations

The Snap Cane is comprised of 3 collapsing aluminum tubes as shown in Figure 3. Each tube has a smaller diameter than the one above it, allowing them all to collapse into itself.

Figure 4: SnapCane Detailed CAD Model

At the top of the cane is a handle with a button built in it. You will grip the cane with the handle, and use the button to operate the extending and collapsing mechanism.

At the bottom of the cane is the tip. The tip is what is touching the ground when in use, and is replaceable.

The physical prototype will come fully made. No user assembly is required.

3.2 User Access Considerations

The Snap Cane would be used by people with that use a mobility aid, both long and short term. Long term user being people with a disability that inhibits their ability to walk, and short-term users being people with an injury that inhibits their ability to walk. Of those people, if they only have 1 fully functioning hand the SnapCane is perfect for them, and they will have no issues using the cane, but the cane has a convenient and intuitive design so it could be used by anyone. The cane could be used by the visually impaired, but was not designed for that specifically, so it may not be of ideal height or weight.

3.3 Accessing/setting up the System

The product comes fully assembled and does not require setting up.

3.4 System Organization & Navigation

The product ships with different tip attachments that can be swapped out depending on weather conditions. All the tips are threaded so twist to attach or detach.

3.5 Exiting the System

See Section 4.1.2 for instructions on how to collapse the cane.

4 Using the System

The following sub-sections provide detailed step-by-step instructions on how to use the various functions or features of the SnapCane.

4.1 Extending/Collapsing

4.1.1 Extending

To extend the cane, hold the handle in an upside-down position (button should be near the top of the handle) and press and hold down the button that is on the handle. While the button is held down, turn the handle 180 degrees so that the button is now near the bottom of the handle and wait for the cane to extend. Once the cane has fully extended, release the button to lock the cane in place.

4.1.2 Collapsing

To collapse the cane, press and hold down the button that is on the handle, turn the cane upside down and wait for all the sections of the cane to collapse. Once the cane is fully collapsed, release the button to lock the cane in its collapsed position.

5 Troubleshooting & Support

5.1 Error Messages or Behaviors

There is always a small possibility of failure when using the SnapCane. To understand how to handle such failures, consult the following documentation:

1. If when holding down the button and the SnapCane fails to completely extend, keep the button held down and shake the cane rapidly until it fully extends.
2. Likewise, if when holding down the button and SnapCane fails to completely collapse, keep the button held down and shake the cane rapidly until it fully collapses.
3. If the button on the handle of the cane gets stuck, spray WD-40 around it and wiggle the button with our thumb.

Failures like this can happen due to poor maintenance of the product. See Section 5.3 to ensure that failures are minimized.

5.2 Special Considerations

If you encounter any problems with the SnapCane that are not addressed in this document, please contact the support team and they will be happy to assist you. For the support team contact information, see Section 5.4.

5.3 Maintenance

As mentioned in Section 5.1, it is important to keep the product maintained to avoid any extension and/or collapsing failure. Perform the following maintenance instructions:

1. Ensure to lubricate the inner sections of the cane with WD-40 every three months to avoid any unwanted friction and to ensure that the extending and collapsing of the cane remains smooth.
2. Also, lubricate the button on the handle by spraying WD-40 around it every three months.
3. Although the cane is weather resistant, avoid keeping it outdoors when not in use. This will significantly lengthen the life of the cane.

5.4 Support

To reach the customer support team, please Faran, the head designer of the SnapCane. Faran can be reached at his email address: frash071@uottawa.ca

6 Product Documentation

6.1 Subsystem 1: Outer Shell

6.1.1 Bill of Materials

Table 3: BOM - Outer Shell

Product	Description	Quantity	Unit Cost	Full Cost	Link
Telescopic Pole	Telescopic pole	1	$35.99	$40.67	https://www.amazon.ca/SANLIKE-Telescopic
PLA	3D Printing	1	$2.00	$2.00	Makerstore

6.1.2 Equipment List

Table 4: Equipment List for Subsystem 1

Electric Sander
Hand Drill
Hand Saw
Pliers
Exacto Knife

6.1.3 Instructions

The initial phase of manufacturing was acquiring the materials for the cane. The outer aluminum shell was taken from an extendable hook for docking a boat. Aluminum was best for the shell because of the light weight and durability. Initially, the plan was to manufacture this shell, but during a design review, the reviewer recommended purchasing a premade telescopic shell because it would be difficult to adjust the rods if the sizing was wrong. The plastic connectors connecting the rods together were cut off so the rods could freely open and close. The bottom section had a small thick rod with a thread for the tip of the hook which had to be removed because of the weight. After the connectors were removed, the black plastic ends on each rod were drilled into and pried off with pliers. After this, the plastic handle was cut vertically up the seam and pried off. The rods

were now clear of all obstructions and could telescope freely. To secure them in place and prevent them from turning, two 3D prints were designed in CAD which stopped the middle rod from falling from the top rod, and the bottom rod from falling from the middle one. There are dowels that were in the shell initially, which are what stop the rods from falling out.

6.2 Subsystem 2: Inner Rods

6.2.1 Bill of Materials

Table 5: BOM - Inner Rods

Product	Description	Quantity	Unit Cost	Full Cost	Link
Steel Round Rod	3/16 x 36"	1	$11.20	$12.66	https://www.homedepot.ca/product/
C-Clip	To keep the rod on the bearing from sliding	1	$13.99	$15.81	https://www.amazon.ca/Hilitchi
Bearings	Thrust bearings to allow steel rod to pivot	1	$13.29	$15.02	https://www.amazon.ca/

6.2.2 Equipment List

Table 6: Equipment List for Subsystem 2

Electric Sander
Hand Drill
Welder

Metal Grinder
Lathe

6.2.3 Instructions

Next, the inner rods were manufactured. The material is taken from a 36-inch steel rod which was cut into two pieces. The next step was welding small tabs perpendicular to the rod at the end, so the rod would catch the dowel, and it would be load bearing. We chose steel for this because it had to be strong with a resistance to buckling, while being small. The next step was creating the mechanism to turn the rods so the cane could fold. Purchased bearings would be used so the rods could turn without moving horizontally in the cane. These bearings were fitted into 3D prints, which fit over sections of the rods of the cane. These 3D prints would be attached to the shell with glue. We considered using methods like dowels to secure the prints, but we decided against it because it would be much more difficult. Another factor was the fact that these connecting pieces were not load bearing, so a more robust mechanical connection was not needed. Also, adding metal dowels would increase the weight of the cane, which is a negative.

6.3 Subsystem 3: Handle & Button

6.3.1 Bill of Materials

Table 7: BOM - Handle & Button

Product	Description	Quantity	Unit Cost	Full Cost	Link
Spring	Return spring for button	1	$12.21	$13.80	https://www.amazon.ca/Stainless-Torsional
PLA	3D Printing	1	$2.00	$2.00	Makerstore

6.3.2 Equipment List

Table 8: Equipment List for Subsystem 3

3D Printer
Welder
Metal Grinder
Glue

6.3.3 Instructions

For the handle, the full design was not implemented because it was not a necessary requirement for the cane to function. For the final prototype, a rudimentary button was made using a piece of metal sheet welded onto the top rod. It functioned the same to how the designed button would function, but without the safety mechanism with the bearing. A 3D printed piece with a hole for the rod and a section for a bearing was printed and fitted over the top of the top outer rod. In the full design for the handle, this would be the bottom component, with the rest of the handle and button being printed on top of it. For the prototype, a second piece of metal was glued to the side of the 3D printed piece and a spring was glued to both pieces of metal for the button push back after pressed.

6.4 Testing & Validation

6.4.1 Prototype 1

Prototype 1 consisted of a CAD design of the outer shell of the cane. This was done to test the length of the cane and used an outer shell that would potentially be bought as a reference for the measurements. It was found that the outer shell was too long and did not fold down enough, so the telescoping rod that was planned to be purchased was changed for a shorter rod.

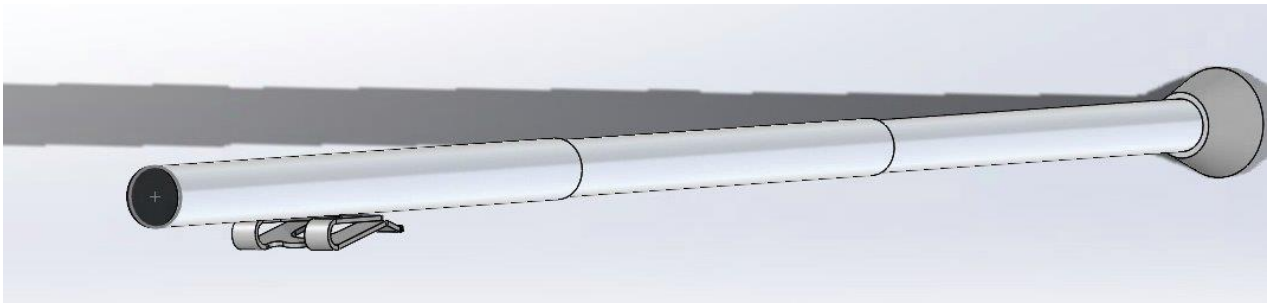

Figure 5: Prototype 1 Fully Extended

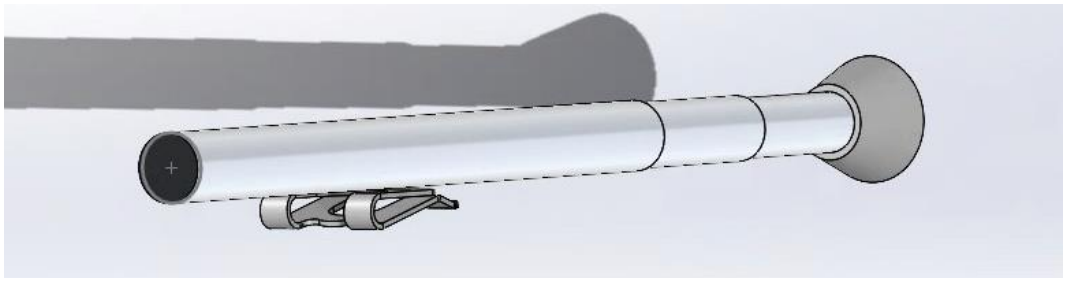

Figure 6: Prototype 1 Collapsed

6.4.2 Prototype 2

Prototype 2 consisted of three parts, the first of which was a full CAD design of the outer shell, the inner rods, and the button and handle. This was done to test the functionality of the design and was found to be successful. The second part was a physical model of the outer shell and one of the inner rods, which were 3D printed. This was done to show the how the inner rod functioned sitting on a lip at the top of the second rod. The final part of the prototype was a structural buckling analysis of one of the inner rods which was done in Ansys. This was done to test the strength of the inner rod, and it was successful. One of the ends was fixed and the other had a force of 1000 Newtons, which is equivalent to around 225 pounds. The results showed that the inner rod would have around 0.1mm of buckling at its worst point with this amount of force, which is an insignificant amount of buckling.

Figure 7: Prototype 2 Full CAD

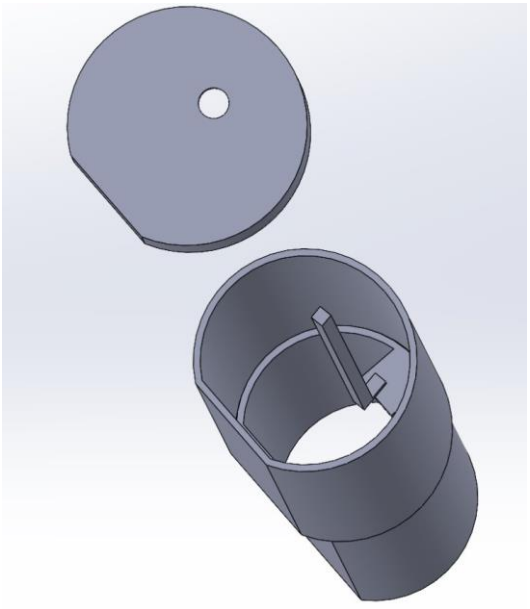

Figure 8: CAD Model of Prototype 2 Part 2

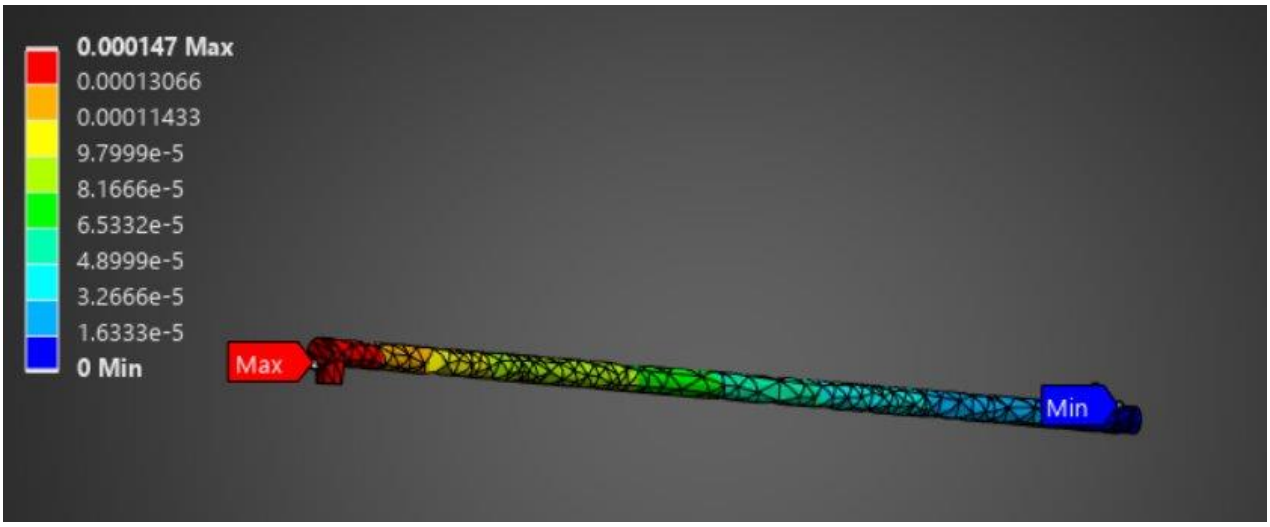

Figure 9: Structural Buckling Test of Inner Rod at F=1000N

6.4.3 Prototype 3 (Final Prototype)

The final prototype was not completed as intended, but it showed a design flaw that can be resolved in future iterations of the project. Prototype 3 was a full physical implementation of the cane, with all three subsystems working and functioning together. This was a functional test, and if it had worked, a load bearing test. The top mechanism (the rod holding the second outer segment open) functioned as expected and was weight bearing, but the bottom mechanism (the second rod holding the third segment open) did not function correctly because the first rod did not turn the second rod correctly. This is what caused the prototype to fail and is what needs to be improved going forward. Overall, this prototype did not meet the project expectations, but it gave clarity into what design changes were needed and showed a partial proof of concept with the top mechanism.

Figure 10: Final Prototype

7 Conclusions and Recommendations for Future Work

With the final prototype being implemented with the conceptual design of the telescoping mechanism, unforeseen issues regarding the initial design were found and unable to be fixed prior to the final due date. With more prototyping in between, the design flaws could have been identified early on and could have resulted in the design concept to be changed. This could have provided the prototype with a better chance of success. Due to a difficult time constraint, the team initially didn't see it feasible to construct multiple physical prototypes, though more thought could have been utilized to forgo this obstacle.

Implications regarding the final project state solely lie in the functionality of the second rod of the telescoping system, as well as full implementation of the handle subsystem. The team focused primarily on the telescoping system and opted to forego the construction of other pieces of the prototype in efforts to have a functioning prototype. A design concept flaw resulted in the second telescoping rod getting stuck upon support by the first rod, which prevented the cane's collapse when fully extended. It is notable that the first rod functions as intended, providing load bearing support, and the ability to collapse and retract the structural tubes.
Next steps include modifications to the connecting pieces between the first and seconds rods. A gearing system can be used to engage the second rod, thus preventing the second rod from over-rotating and getting stuck in a position past the first rod, as previously discussed. The design files for the handle have already been created and simply need to be 3D-printed and attached to the top of the cane for the completion of the handle subsystem.

With more time to work and complete the project, several things would be revised to have a fully functioning prototype. The first revision will be the addition of a gearing system to help guide the first and second rod of the telescoping system to lie on top of each other, thus eliminating the possibility of the second rod becoming stuck due to over rotation. With a fully functional extension and collapsing system, the team can finish with the manufacturing of the handle, the side clipping mechanism, and the removable cane tip. The handle manufacturing is straight forward, with majority of the components being 3D-printed. The files have already been created and are ready for print. The clipping mechanism allows the cane to be hung on articles of clothing. A pre-made clip can be modified to fit snugly on the cane, allowing the cane to be hung. The removable cane tip is a tip that can be threaded onto the bottom of the cane, thus exchanging tips based on the environmental conditions. The tip of the cane structure would need to be machined to a thread, and the resultant sets of tips can be 3D-printed with variable features to tackle any conditions.

8 Bibliography

N/A

APPENDICES

9 APPENDIX I: Design Files

This UPM is intended to be used coincidently with the deliverable content of the course GNG2101, which can be found in the MakerRepo under the SnapCane classification. The UPM serves as a summary of the operation of the prototype. Detailed processes can be found in the deliverables.

All design files and previous deliverable content can be found in the MakerRepo.

https://makerepo.com/JulienKapro/2431

Table 9. Referenced Documents

Document Name	Document Location and/or URL	Issuance Date
F1.4_PD_B-D	https://makerepo.com/JulienKapro/2431	2025-04-02
F1.4_PD_E-I	https://makerepo.com/JulienKapro/2431	2025-04-02

10 APPENDIX II: Other Appendices

Table 10: Miscellaneous Files

File Name	Location and/or URL	Issuance Date
Cane.SLDASM	https://makerepo.com/JulienKapro/2431.snapcane	2025-03-04
Strucure.zip	https://makerepo.com/JulienKapro/2431.snapcane	2025-03-04
Internal.zip	https://makerepo.com/JulienKapro/2431.snapcane	2025-03-04
Handle.zip	https://makerepo.com/JulienKapro/2431.snapcane	2025-03-04
STL.zip	https://makerepo.com/JulienKapro/2431.snapcane	2025-03-04