PTO/SB/92 (11-23)
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Certificate of Mailing or Transmission under 37 CFR 1.8

I hereby certify that this correspondence is being:

1. ☑ Deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to:

   Commissioner for Patents
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   Alexandria, VA 22313-1450
   on 11/28/2023 (Date),

2. ☐ Facsimile transmitted to the United States Patent and Trademark Office, or

   OR

3. ☐ Transmitted by the USPTO patent electronic filing system.

_____	11/28/2023
Signature	Date
Team 5	
Typed or printed name	Telephone number

Note: Each paper must have its own certificate of mailing or transmission, or this certificate must identify each submitted paper:

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Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. The United States Patent and Trademark Office (USPTO) collects the information in this record under authority of 35 U.S.C. 2. The USPTO's system of records is used to manage all applicant and owner information including name, citizenship, residence, post office address, and other information with respect to inventors and their legal representatives pertaining to the applicant's/owner's activities in connection with the invention for which a patent is sought or has been granted. The applicable Privacy Act System of Records Notice for the information collected in this form is COMMERCE/PAT-TM-7 Patent Application Files, available in the Federal Register at 78 FR 19243 (March 29, 2013). https://www.govinfo.gov/content/pkg/FR-2013-03-29/pdf/2013-07341.pdf

Routine uses of the information in this record may include disclosure to:

1) law enforcement, in the event that the system of records indicates a violation or potential violation of law;

2) a federal, state, local, or international agency, in response to its request;

3) a contractor of the USPTO having need for the information in order to perform a contract;

4) the Department of Justice for determination of whether the Freedom of Information Act (FOIA) requires disclosure of the record;

5) a Member of Congress submitting a request involving an individual to whom the record pertains, when the individual has requested the Member's assistance with respect to the subject matter of the record;

6) a court, magistrate, or administrative tribunal, in the course of presenting evidence, including disclosures to opposing counsel in the course of settlement negotiations;

7) the Administrator, General Services Administration (GSA), or their designee, during an inspection of records conducted by GSA under authority of 44 U.S.C. 2904 and 2906, in accordance with the GSA regulations and any other relevant (i.e., GSA or Commerce) directive, where such disclosure shall not be used to make determinations about individuals;

8) another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c));

9) the Office of Personnel Management (OPM) for personnel research purposes; and

10) the Office of Management and Budget (OMB) for legislative coordination and clearance.

If you do not furnish the information requested on this form, the USPTO may not be able to process and/or examine your submission, which may result in termination of proceedings, abandonment of the application, and/or expiration of the patent.

PTO/AIA/15 (10-17)
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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.	
First Named Inventor	
Title	
Priority Mail Express® Label No.	

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

1. ☑ **Fee Transmittal Form** (PTO/SB/17 or equivalent)
2. ☑ **Applicant asserts small entity status.** See 37 CFR 1.27
3. ☐ **Applicant certifies micro entity status.** See 37 CFR 1.29. Applicant must attach form PTO/SB/15A or B or equivalent.
4. ☑ **Specification** [*Total Pages* <100] Both the claims and abstract must start on a new page. *(See MPEP § 608.01(a) for information on the preferred arrangement)*
5. ☑ **Drawing(s)** (35 U.S.C. 113) [*Total Sheets* 3]
6. **Inventor's Oath or Declaration** [*Total Pages* ____] *(including substitute statements under 37 CFR 1.64 and assignments serving as an oath or declaration under 37 CFR 1.63(e))*
   a. ☑ Newly executed (original or copy)
   b. ☐ A copy from a prior application (37 CFR 1.63(d))
7. ☑ **Application Data Sheet** ** See note below.* See 37 CFR 1.76 (PTO/AIA/14 or equivalent)
8. **CD-ROM or CD-R** in duplicate, large table, or Computer Program (*Appendix*)
   ☐ Landscape Table on CD
9. **Nucleotide and/or Amino Acid Sequence Submission** (*if applicable, items a. – c. are required*)
   a. ☐ Computer Readable Form (CRF)
   b. ☐ Specification Sequence Listing on:
      i. ☐ CD-ROM or CD-R (2 copies); or
      ii. ☑ Paper
   c. ☑ Statements verifying identity of above copies

ADDRESS TO:

Commissioner for Patents
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Alexandria, VA 22313-1450

ACCOMPANYING APPLICATION PAPERS

10. ☑ **Assignment Papers** (cover sheet & document(s))
    Name of Assignee _____
11. ☑ **37 CFR 3.73(c) Statement** (*when there is an assignee*) ☐ **Power of Attorney**
12. ☐ **English Translation Document** (*if applicable*)
13. ☐ **Information Disclosure Statement** (PTO/SB/08 or PTO-1449)
    ☐ Copies of citations attached
14. ☐ **Preliminary Amendment**
15. ☐ **Return Receipt Postcard** (*MPEP § 503*) (*Should be specifically itemized*)
16. ☑ **Certified Copy of Priority Document(s)** (*if foreign priority is claimed*)
17. ☐ **Nonpublication Request** Under 35 U.S.C. 122(b)(2)(B)(i). Applicant must attach form PTO/SB/35 or equivalent.
18. ☐ **Other:** _____

***Note**: (1) Benefit claims under 37 CFR 1.78 and foreign priority claims under 1.55 **must** be included in an Application Data Sheet (ADS).
(2) For applications filed under 35 U.S.C. 111, the application must contain an ADS specifying the applicant if the applicant is an assignee, person to whom the inventor is under an obligation to assign, or person who otherwise shows sufficient proprietary interest in the matter. See 37 CFR 1.46(b).

19. CORRESPONDENCE ADDRESS

☑ The address associated with Customer Number: 1386438931 **OR** ☐ Correspondence address below

Name					
Address					
City		State		Zip Code	
Country		Telephone		Email	

Signature	Group 5 patent	Date	19 Nov 2023
Name (Print/Type)	Group 5 patent	Registration No. (Attorney/Agent)	

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. The United States Patent and Trademark Office (USPTO) collects the information in this record under authority of 35 U.S.C. 2. The USPTO's system of records is used to manage all applicant and owner information including name, citizenship, residence, post office address, and other information with respect to inventors and their legal representatives pertaining to the applicant's/owner's activities in connection with the invention for which a patent is sought or has been granted. The applicable Privacy Act System of Records Notice for the information collected in this form is COMMERCE/PAT-TM-7 Patent Application Files, available in the Federal Register at 78 FR 19243 (March 29, 2013). https://www.govinfo.gov/content/pkg/FR-2013-03-29/pdf/2013-07341.pdf

Routine uses of the information in this record may include disclosure to: 1) law enforcement, in the event that the system of records indicates a violation or potential violation of law; 2) a Federal, state, local, or international agency, in response to its request; 3) a contractor of the USPTO having need for the information in order to perform a contract; 4) the Department of Justice for determination of whether the Freedom of Information Act (FOIA) requires disclosure of the record; 5) a Member of Congress submitting a request involving an individual to whom the record pertains, when the individual has requested the Member's assistance with respect to the subject matter of the record; 6) a court, magistrate, or administrative tribunal, in the course of presenting evidence, including disclosures to opposing counsel in the course of settlement negotiations; 7) the Administrator, General Services Administration (GSA), or their designee, during an inspection of records conducted by GSA under authority of 44 U.S.C. 2904 and 2906, in accordance with the GSA regulations and any other relevant (i.e., GSA or Commerce) directive, where such disclosure shall not be used to make determinations about individuals; 8) another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)); 9) the Office of Personnel Management (OPM) for personnel research purposes; and 9) the Office of Management and Budget (OMB) for legislative coordination and clearance.

If you do not furnish the information requested on this form, the USPTO may not be able to process and/or examine your submission, which may result in termination of proceedings, abandonment of the application, and/or expiration of the patent.

Additional Uses

Additional USPTO uses of the information in this record may include disclosure to: 1) the International Bureau of the World Intellectual Property Organization, if the record is related to an international application filed under the Patent Cooperation Treaty; 2) the public i) after publication of the application pursuant to 35 U.S.C. 122(b), ii) after issuance of a patent pursuant to 35 U.S.C. 151, iii) if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections, or an issued patent, or iv) without publication of the application or patent under the specific circumstances provided for by 37 CFR 1.14(a)(1)(v)-(vii); and/or 3) the National Archives and Records Administration, for inspection of records.

PTO/AIA/01 (06-12)
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DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	Bendable Pliable Interactive Screen Device

As the below named inventor, I hereby declare that:

This declaration is directed to:

- [■] The attached application, or
- [ ] United States application or PCT international application number _____

filed on _____.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

LEGAL NAME OF INVENTOR

Inventor: M. K. Zimmerman, E.Rodriguez, E.Hamilton, P.I Date (Optional) :_____

Signature: Team 5

Note: An application data sheet (PTO/AIA/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. The United States Patent and Trademark Office (USPTO) collects the information in this record under authority of 35 U.S.C. 2. The USPTO's system of records is used to manage all applicant and owner information including name, citizenship, residence, post office address, and other information with respect to inventors and their legal representatives pertaining to the applicant's/owner's activities in connection with the invention for which a patent is sought or has been granted. The applicable Privacy Act System of Records Notice for the information collected in this form is COMMERCE/PAT-TM-7 Patent Application Files, available in the Federal Register at 78 FR 19243 (March 29, 2013). https://www.govinfo.gov/content/pkg/FR-2013-03-29/pdf/2013-07341.pdf

Routine uses of the information in this record may include disclosure to: 1) law enforcement, in the event that the system of records indicates a violation or potential violation of law; 2) a Federal, state, local, or international agency, in response to its request; 3) a contractor of the USPTO having need for the information in order to perform a contract; 4) the Department of Justice for determination of whether the Freedom of Information Act (FOIA) requires disclosure of the record; 5) a Member of Congress submitting a request involving an individual to whom the record pertains, when the individual has requested the Member's assistance with respect to the subject matter of the record; 6) a court, magistrate, or administrative tribunal, in the course of presenting evidence, including disclosures to opposing counsel in the course of settlement negotiations; 7) the Administrator, General Services Administration (GSA), or their designee, during an inspection of records conducted by GSA under authority of 44 U.S.C. 2904 and 2906, in accordance with the GSA regulations and any other relevant (i.e., GSA or Commerce) directive, where such disclosure shall not be used to make determinations about individuals; 8) another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)); 9) the Office of Personnel Management (OPM) for personnel research purposes; and 9) the Office of Management and Budget (OMB) for legislative coordination and clearance.

If you do not furnish the information requested on this form, the USPTO may not be able to process and/or examine your submission, which may result in termination of proceedings, abandonment of the application, and/or expiration of the patent.

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PTO/AIA/14 (01-22)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	
	Application Number	
Title of Invention	Bendable Pliable Interactive Screen Divice	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2:

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1 Remove

Legal Name

Prefix	**Given Name**	**Middle Name**	**Family Name**	**Suffix**
	Team		5	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	UCCS	**State/Province**	CO	**Country of Residence** i	US

Mailing Address of Inventor:

Address 1	1420 Austin Bluffs Pkwy		
Address 2			
City	Colorado Springs	**State/Province**	Co
Postal Code	80918	**Country** i	US

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	000000000		
Email Address		Add Email	Remove Email

Application Information:

Title of the Invention	Bendable Pliable Interactive Screen Divice		
Attorney Docket Number		**Small Entity Status Claimed**	☒
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)		**Suggested Figure for Publication (if any)**	

PTO/AIA/14 (01-22)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	
	Application Number	
Title of Invention	Bendable Pliable Interactive Screen Divice	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	◉ Customer Number	◯ US Patent Practitioner	◯ Limited Recognition (37 CFR 11.9)
Customer Number	000000000		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
000000000000000	Continuation in part of	00000000000000000	

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	
	Application Number	
Title of Invention	Bendable Pliable Interactive Screen Divice	

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)[i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Remove

Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button.

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

PTO/AIA/14 (01-22)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	
	Application Number	
Title of Invention	Bendable Pliable Interactive Screen Divice	

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	
	Application Number	
Title of Invention	Bendable Pliable Interactive Screen Divice	

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

◯ Assignee	◯ Legal Representative under 35 U.S.C. 117	◯ Joint Inventor
◯ Person to whom the inventor is obligated to assign.	◯ Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. ☐

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

Mailing Address Information For Applicant:

Address 1			
Address 2			
City		**State/Province**	
Country		Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button.

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	
	Application Number	
Title of Invention	Bendable Pliable Interactive Screen Divice	

Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

If the Assignee or Non-Applicant Assignee is an Organization check here. ☐

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1			
Address 2			
City		**State/Province**	
Country i		Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button.

Signature:

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). **However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).**

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	TEAM 5			Date (YYYY-MM-DD)	2023-11-28
First Name	TEAM	Last Name	5	Registration Number	

Additional Signature may be generated within this form by selecting the Add button.

PTO/AIA/14 (01-22)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	
	Application Number	
Title of Invention	Bendable Pliable Interactive Screen Divice	

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BENDABLE PLIABLE INTERACTIVE SCREEN DEVICE

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] This application claims the benefit of An electronic device may have a rollable display that can be added to various surfaces to create a smartphone interface.

Description of Related Art Including Information Disclosed Under 37 CFR 1.97 and 37 CFR 1.98

[0002] This relates generally to pliable electronic devices, and more particularly, to electronic devices with displays.

[0003] US Patent 9,504,170 issued Nov. 22, 2016, by Janis, Dabov for Flexible Display Device discloses Electronic devices may be provided that contain multiple housing portions. The housing portions may be coupled together using hinges. The hinges may include hinges based on a three-bar linkage, hinges based on a four-bar linkage, hives with slotted members, hinges formed from flexible support structures, and hinges based on flexible housing structures. Flexible displays may be mounted to the housing portions overlapping the hinges. When the housing portions in a device are rotated relative to each other, the flexible display may bend. The hinge may be configured to allow the flexible display to be placed in a front-to-front configuration in which an active side of the display faces itself or a back-to-back configuration. Engagement structures may be used to help the housing grip external objects and to hold the housing portions together. The hinges may be provided with rotational detents to help hold the flexible display in desired positions.

[0004] US Patent Publication 2023/0221766 published Jul. 13,2023, by Nguyen, Jones for Electronic Devices with Rollable Displays discloses An electronic device may have a rollable display. The display may be moved between an unrolled state in which the display is planar and a rolled state in which a rollable portion of the display is rolled up for storage. The display may

have a display panel with a pixel array that produces images and a transparent protective layer that overlaps the pixel array. The transparent protective layer may contain a layer of glass. The glass layer may be locally thinned in the rollable portion to facilitate the rolling of the display. The display may be configured to apply compressive stress to the outwardly facing-surface of the glass layer when the display is rolled up. Compressive stress in the outwardly facing glass surface may help prevent damage to the display when the display is bent during rolling operations.

BRIEF SUMMARY OF THE INVENTION

[0005] An electronic device may have a rollable display. The display may be moved between an unrolled state in which the display is unrolled for viewing and a rolled state in which a rollable portion of the display may be planar. In the rolled state, the rollable portion bends about an axis as it is rolled onto a roller for storage.

[0006] The display may have a display panel with a pixel array that produces images and a transparent protective layer that overlaps the pixel array. The transparent protective layer may contain a layer of glass. The glass layer may be locally thinned in the rollable portion to facilitate bending.

[0007] During the use of the device, the outward-facing surface of the transparent protective layer may be exposed to objects that can create scratches, whereas the inwardly-facing surface of the transparent protective layer may be protected and thereby have fewer surface irregularities. To help prevent cracking in the glass layer, the display may be configured to roll so that its outward facing-surface receives compressive stress. Compressive stress in the outwardly facing glass surface may help prevent any scratches in the outwardly facing display from causing cracking or any other damage to the display when the display is bent during rolling operations.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING(S)

[0008] **FIG. 1** is an illustrative electronic device that adheres to any surface it is applied to.

[0009] **FIG. 2** is an illustrative electronic device that is pliable to multi-edged surfaces as an illustrated flexible display in accordance with an embodiment.

[0010] **FIG. 3** is an illustrative electronic device that is a cylindrical portion application of an illustrative electronic device in accordance with an embodiment.

[0011] **FIG. 4** is a cross-imposed view of an illustrative electronic device in which an outwardly facing surface of the display has a transparent appearance so as to match the surface it rests on.

List of Reference Numerals

[0012] Electronic devices may be provided with displays. Displays may be used for displaying images for users. Displays may be formed from arrays of light-emitting diode pixels or other pixels. For example, a device may have an organic light-emitting diode display or a display formed from an array of micro-light-emitting diodes (e.g., light- emitting diodes formed from crystalline semiconductor dies).

[0013] A schematic diagram of an illustrative electronic device having a display is shown in FIG. 1. Device 10 may be a cellular telephone, tablet computer, laptop computer, wristwatch device or other wearable device, a television, a stand-alone computer display or other monitor, a computer display with an embedded computer (e.g., a desktop computer), a system embedded in a vehicle, kiosk, or other embedded electronic device, a media player, or other electronic equipment. Configurations in which device 10 is a cellular telephone, tablet computer, or other portable electronic device may sometimes be described herein as an example. This is illustrative. Device 10 may, in general, be any suitable electronic device with a display.

[0014] Device 10 may include control circuitry 20. Control circuitry 20 may include storage and processing circuitry for supporting the operation of device 10. The storage and processing circuitry may include storage such as non- volatile memory (e.g., flash memory or other electrically- programmable-read-only memory configured to form a solid state drive), volatile

memory (e.g., static or dynamic random-access-memory), etc. Processing circuitry in control circuitry 20 may be used to gather input from sensors and other input devices and may be used to control output devices. The processing circuitry may be based on one or more microprocessors, microcontrollers, digital signal processors, baseband processors and other wireless communications circuits, power management units, audio chips, application specific integrated circuits, etc. During operation, control circuitry 20 may use a display and other output devices in providing a user with visual output and other output.

[0015] To support communications between device 10 and external equipment, control circuitry 20 may communicate using communications circuitry 22. Circuitry 22 may include antennas, radio-frequency transceiver circuitry (wireless transceiver circuitry), and other wireless communications circuitry and/or wired communications circuitry. Circuitry 22, which may sometimes be referred to as control circuitry and/or control and communications circuitry, may support bidirectional wireless communications between device 10 and external equipment over wired and/or wireless links (e.g., circuitry 22 may include radio-frequency transceiver circuitry such as wireless local area network transceiver circuitry configured to support communications over a wireless local area network link, near-field communications transceiver circuitry configured to support communications over a near-field communications link, cellular telephone transceiver circuitry configured to support communications over a cellular telephone link, or transceiver circuitry configured to support communications over any other suitable wired or wireless communications link). Wireless communications may, for example, be supported over a Bluetooth® link, a WiFi® link, a wireless link operating at a frequency between 6 GHz and 300 GHz, a 60 GHz link, or other millimeter wave link, cellular telephone link, wireless local area network link, personal area network communications link, or other wireless communications link. Device 10 may, if desired, include power circuits for transmitting and/or receiving wired and/or wireless power and may include batteries or other energy storage devices. For example, device 10

may include a coil and rectifier to receive wireless power that is provided to circuitry in device 10.

[0016] Device 10 may include input-output devices such as devices 24. Input-output devices 24 may be used in gathering user input, in gathering information on the environment surrounding the user, and/or in providing a user with output. Devices 24 may include one or more displays such as display 14. Display 14 may be an organic light- emitting diode display, a liquid crystal display, an electrophoretic display, an electrowetting display, a plasma display, a microelectromechanical systems display, a display having a pixel array formed from crystalline semiconductor light-emitting diode dies (sometimes referred to as microLEDs), and/or other display. Configurations in which display 14 is an organic light-emitting diode display or microLED display are sometimes described herein as an example.

[0017] Display 14 may have an array of pixels configured to display images for a user. The pixels may be formed as part of a display panel that is bendable. This allows device 10 to be bent about a bend axis. For example, a flexible (bendable) display in device 10 may be partly or completely rolled up so that device 10 may be placed in a compact shape for storage and may be rolled out when it is desired to view images on the display. Displays with rollable structures may sometimes be referred to herein as rollable displays, scrol-lable displays, flexible displays, or bendable displays. A rollable display may be completely rollable (e.g., flexible over its entire area) or may be partly rollable (e.g., one or more edge portions of a display may be provided with sufficient flexibility to be rolled whereas one or more other portions of the display may be less flexible and/or may be fixed in a planar state).

[0018] Sensors 16 in input-output devices 24 may include force sensors (e.g., strain gauges, capacitive force sensors, resistive force sensors, etc.), audio sensors such as microphones, touch and/or proximity sensors such as capacitive sensors (e.g., a two-dimensional capacitive touch

sensor integrated into display 14, a two-dimensional capacitive touch sensor overlapping display 14, and/or a touch sensor that forms a button, trackpad, or other input device not associated with a display), and other sensors. If desired, sensors 16 may include optical sensors such as optical sensors that emit and detect light, ultrasonic sensors, optical touch sensors, optical proximity sensors, and/or other touch sensors and/or proximity sensors, monochromatic and color ambient light sensors, image sensors, fingerprint sensors, temperature sensors, sensors for measuring three-dimensional non-contact gestures ("air gestures"), pressure sensors, sensors for detecting position, orientation, and/or motion (e.g., accelerometers, magnetic sensors such as compass sensors, gyroscopes, and/or inertial measurement units that contain some or all of these sensors), health sensors, radio-frequency sensors, depth sensors (e.g., structured light sensors and/or depth sensors based on stereo imaging devices that capture three-dimensional images), optical sensors such as self-mixing sensors and light detection and ranging (lidar) sensors that gather time-of-flight measurements, humidity sensors, moisture sensors, gaze tracking sensors, and/or other sensors. In some arrangements, device 10 may use sensors 16 and/or other input-output devices to gather user input. For example, buttons may be used to gather button press input, touch sensors overlapping displays can be used for gathering user touch screen input, touch pads may be used in gathering touch input, microphones may be used for gathering audio input, accelerometers may be used in monitoring when a finger contacts an input surface and may therefore be used to gather finger press input, etc.

[0019] If desired, electronic device 10 may include additional components (see, e.g., other devices 18 in input- output devices 24). The additional components may include haptic output devices, audio output devices such as speakers, light-emitting diodes for status indicators, light sources such as light-emitting diodes that illuminate portions of a housing and/or display structure, other optical output devices, and/or other circuitry for gathering input and/or providing output. Device 10 may also include a battery or other energy storage device, connector ports for

supporting wired communication with ancillary equipment and for receiving wired power, and other circuitry.

[0020] FIG. 2 is a side view of an illustrative display for electronic device 10. As shown in FIG. 2, display 14 may have a rear side B and a front side OF. Front side F may face a user of the electronic device during use and may sometimes be referred to as an outward facing side or surface of display 14. Rear side B may face away from the user and may sometimes be referred to as an inwardly facing side or surface of display 14. The outline of display 14 when viewed by the user may be rectangular or may have other suitable shapes.

[0021] Display panel 14P of display 14 may have a pixel array such as an array of light-emitting pixels (e.g., a rectangular array of light-emitting diodes). During operation, the pixel array of panel 14P may produce images that pass through transparent protective layer 14T and that are viewable by the user on front side F. Protective layer 14T may include clear polymer, clear glass, and/or other transparent structures that allow images to be viewed while providing support (e.g., rigidity) and protection (e.g., protection from scratches and other damage) for display panel 14P. As an example, a layer of glass that is attached to the outer (front-facing) surface of panel 14P may be used to prevent display panel 14P from deforming and becoming damaged when a user's finger, computer stylus, or other external object contacts front side F of display 14. Protective polymer layers and/or other protective layers may be formed as coatings on the glass layer help prevent scratching of the glass layer. The substrate used in forming panel 14P may be flexible (e.g., display panel 14P may have a pixel array formed on a flexible polymer substrate or other flexible substrate). Protective layer 14T may also be formed from flexible structures. As a result, some or all of the area of display 14 may be flexible, which allows some or all of display 14 to be rolled up for storage.

[0022] Consider, as an example, the side view of display 14 that is shown in FIG. 3. In this example, display 14 has a planar portion such as planar portion 30 and a rolled portion 26, which has been rolled up around axis 28. When it is desired to store display 14, some or all of display 14 may be rolled up as shown by portion 26. When it is desired to increase the amount of display surface area that is viewable to the user, some or all of rolled portion 26 may be unrolled (e.g., display 14 may be unrolled so that more or all of display 14 is planar as shown by portion 30).

[0023] During rolling and/or other bending operations, the glass of layer 14T experiences compressive and tensile stress. For example, in the example of FIG. 3, the surface of the glass layer in layer 14T that faces front side F (the outwardly facing surface of the glass layer) experiences compressive stress and the surface of the glass layer in layer 14T that faces rear side R (the inwardly facing surface of the glass layer) experiences tensile stress. In general, display 14 may be rolled inwardly on its front surface (as shown in FIG. 3) or may be rolled outward about its rear surface (as shown in the illustrative configuration of FIG. 4).

[0024] During manufacturing, small surface irregularities (e.g., pits, grooves, or other recesses with dimensions on the orders of hundreds of nanometers) may be formed on the front and rear surfaces of the glass layer in layer 14T. During use of display 14 by a user, contact with a user's fingers, computer styluses, and/or other external objects may give rise to deeper surface irregularities (e.g., pits, grooves, and/or other recesses from scratches with dimensions on the order of one micron or more). The presence of these micron--sized surface irregularities may make the glass layer susceptible to cracking if excessive tensile stress is imposed (e.g., by rolling layer 14T so that layer 14T and the glass layer of layer 14T are characterized by an excessively small bend radius). To help ensure that the glass layer does not crack, it may be advantageous to roll display 14 inwardly towards front side F as shown in FIG. 3, rather than outwardly towards rear side B as shown in FIG. 4. In this way, the surface of the glass layer that is less susceptible to cracking (i.e., the unscratched surface of the glass layer that faces rear side B and that has smaller

surface irregularities) is subjected to tensile stress during rolling about axis 28, whereas the surface of the glass layer that is more susceptible to cracking (i.e The surface of the glass layer that faces the user and is therefore subjected to scratches from the user and has larger surface irregularities) is subjected to compressive stress during rolling about axis 28. Placing the more vulnerable surface of the glass layer in display 14T under compressive stress helps ensure that display 14 will be free from any undesired cracks or other damage.

[0025] In the examples of FIGS. 3 and 4, one edge of display 14 is being rolled. If desired, two opposing edges may be rolled for storage. This type of arrangement is shown in FIG. 5. As shown in FIG. 5, the left edge of display 14 may be sufficiently flexible to be rolled for storage and unrolled to deploy the display for use in displaying images and the right edge of the same display 14 may be sufficiently flexible to be rolled up when stored and unrolled for use.

[0026] Electronic device 10 may include rigid and flexible housing structures. FIG. 6 is a cross-sectional side view of an illustrative electronic device with a housing. As shown in FIG. 6, housing 12 may have a portion forming a rear housing wall. Interior region 32 of device 10 may contain electrical components 36 mounted on substrates such a printed circuit 34. Interior region 32 may be separated from the exterior region surrounding device 10 by a rear housing wall (housing 12) and by display 14.

[0027] Display panel 14P has an array of pixels that form an image under an inwardly facing surface of protective layer 14T. Display panel 14P may be, for example, a flexible organic light-emitting diode display or a microLED display in which light-emitting pixels are formed on a flexible substrate layer (e.g., a flexible layer of polyimide or a sheet of other flexible polymer). Flexible support layer(s) for display 14 may also be formed from flexible glass, flexible metal, and/or other flexible structures. If desired, device 10 may have a support layer formed from slates such as slats 38 (e.g., slates that are each attached to left and right adjacent slats by hinge

structures). Slats 38 may help maintain desired support for display 14 as display 14 is wrapped around axis 28 (of FIGS. 3, 4, and 5). Slats 38 may be formed from elongated strips of metal or other material and may extend along axes parallel to axis 28. Backside display panel support layers formed from flexible metal and/or polymer layers may also be used. In addition, layer 14T may use a flexible glass layer to help provide display panel 14P with structural support.

[0028] Layer 14T may be formed from polymer layers, one or more layers of glass, crystalline materials such as sapphire, other materials, and/or combinations of these materials. To locally increase flexibility, a portion of a glass layer in layer 14T that corresponds to the rollable portion of display 14 may be locally thinned (e.g., this portion may be thinned relative to portions of the glass layer that are not to be rolled about axis 28). The thickness of the glass layer of layer 14T (e.g., the non-thinned portions of the glass layer) may be 50-200 microns, 70-150 microns, 100-200 microns,

[0029] 100-400 microns, 100-600 microns, at least 100 microns, at least 200 microns, less than 600 microns, less than 400 microns, less than 250 microns, less than 150 microns, less than 100 microns, at least 50 microns, or other suitable thickness. The thickness of the locally thinned portions of the glass layer of layer 14T may be 30-150 microns, less than 200 microns, less than 150 microns, less than 100 microns, less than 75 microns, less than 40 microns, at least 15 microns, or other suitable thickness that is thinner than the thickness of the non-thinned portions of the glass layer. Thicker glass tends to be less bendable than thinner glass, but may provide display panel 14P with more rigidity and therefore enhanced protection for panel 14P. Thinner glass allows display 14 to be rolled up tightly (with a small bend radius). The bend radius of the rolled portion of display 14 be lm l=, lea 3=, least6=, least 15 =, less than 30 =, less than 20 =, less than 10 =, less than 5 =, or other suitable value.

[0030] FIG. 7 is a cross-sectional side view of device 10 in an illustrative configuration in which housing 12 of device 10 has a planar portion that supports planar portion 30 of display 14 and a rolled display storage portion that supports rolled portion 26 of display 14. The outwardly facing surface of display 14 on upper side U of device 10 presents images to a user. Under planar portion 30 of display 14, housing 12 may have interdigitated fingers and/or other structures that allow the lateral size of housing 12 to be adjusted. When it is desired to extend display 14, housing 12 may be extended leftward (in the -X direction) to help support an enlarged area of portion 30 as rolled portion 26 is unrolled by being pulled out of the rolled display storage portion of housing

[0031] 12. When it is desired to contract display 14, housing 12 may be contracted (left edge TP of housing 12 and display 14 may be moved to the right in the +X direction). As the planar portion of housing 12 is reduced in size in this way, spring-loaded roller 42 may rotate counterclockwise about roller axis 28 so that portion 26 of display 14 is retracted and rolled up about roller 42 for storage within the rolled display storage portion of housing 12. The diameter of the rolled display storage portion of housing 12 (Hl+H2) and associated diameter of roller 42 are sufficiently large to accommodate rolled portion 26 of display 14 while maintaining a desired minimum bend radius to prevent damage to display 14.

[0032] To help minimize the distance that housing 12 protrudes above the plane of planar display portion 30, reverse bend portion RB of display 14 may be provided with a bend in the opposite direction from the bend of portion 26 and housing 12 may be shaped to conform to the bends in display 14. In the example of FIG. 7, rolled portion 26 of display 14 is wrapped upwardly around roller 42 and axis 28, whereas reverse bend portion RB is characterized by a bend in the opposite direction (e.g., display 14 is bent downwardly away from the user). As a result of the presence of the reverse bend portion RB, axis 28 is moved to a lower height (lower Z position in the orientation of FIG. 7). This lowers the value of Hl (the amount of housing 12 that

protrudes above the plane of planar portion 30 of display 14) and increases the value of H2 (the amount of housing 12 at the back of device 10 that extends below the plane of planar portion 30 of display 14). In reverse bend portion RB, the outer surface of the glass layer of display 14 is exposed to tension, whereas the inner surface of this glass layer is exposed to compression. The outer surface may be more sensitive to fractures due to surface damage than the inner surface, but the bend radius of display 14 in reverse bend portion RB is greater than the bend radius of display 14 in rolled portion 26, which helps reduce the tension of the outer surface to satisfactory levels. The bend radius of portion RB may be, as an example, at least two times, at least five times, or at least ten times greater than the bend radius of portion 26 (as examples). The use of a housing and display configuration for device 10 that forms a reverse bend in display 14 in this way helps reduce the visible protrusion in housing 12 that is used for rolled display storage and may thereby enhance the appearance of device 10. Configurations in which reverse bend portion RB of display 14 is omitted (e.g., configurations in which display 14 is planar except where forming rolled portion 26) may also be used.

[0033] Housing 12 may form housing walls, sidewall structures, and/or internal supporting structures (e.g., a frame, an optional midplate member, etc.) for device 10. The portions of housing 12 on the sidewalls and rear wall of device 10 may be formed from glass or other transparent structures and/or opaque structures such as metal, opaque polymer, etc.

[0034] FIG. 8 is a cross-sectional side view of display 14. In the illustrative configuration of FIG. 8, display 14 includes a flexible display panel (panel 14P) that is attached to the rear surface of transparent protective layer 14T. Layer 14T may include glass layer 48. In display portion BP, glass layer 48 may have a first thickness Tl, whereas in display portion LP, glass layer 48 may be locally thinned and may be characterized by a second thickness T2 that is less than Tl. The value of Tl may be 50-200 microns, 70-150 microns, 100-200 microns, 100-400 microns, 100-600 microns, at least 100 microns, at least 200 microns, less than 600 microns, less than 400 microns,

less than 250 microns, less than 150 microns, less than 100 microns, at least 50 microns, or other suitable thickness that helps protect display panel 14P from damage when the surface of display 14 is contacted by an external object. The value of T2, which is sufficiently small to allow display 14 to bend, may be 30-150 microns, less than 200 microns, less than 150 microns, less than 100 microns, less than 75 microns, less than 40 microns, at least 15 microns, or other suitable thickness that allows display 14 to be rolled up while still providing rigidity that helps protect display 14. If desired, transitions between areas of different thickness in the cross- sectional profile of layer 48 may be provided with curved cross-sectional profiles or other profiles with smoothly changing thicknesses. These curved profile shapes may help avoid stress concentrations due to abrupt thickness changes and can therefore help enhance the strength of layer 48.

[0035] Protective rear coating layer 50 may be located between the rear (inwardly facing) surface of glass layer 48 and the opposing front (outwardly facing surface) of display panel 14P. Layer 50 may be formed from a flexible polymer. The presence of layer 50 may help protect the inner surface of glass layer 48 and may help planarize the inner surface of glass layer 48 to facilitate mounting of display panel 14P against this inner surface (e.g., with an additional layer of adhesive and/or using the adhesive properties of layer 50). Polymer 50 may be sufficiently flexible to bend in portion

[0036] The refractive index of polymer 50 may be matched to that of glass layer 48 to help minimize light reflections (e.g., by incorporating inorganic nanoparticles in the polymer material of layer 50). For example, at a wavelength of 500 nm, the refractive index of polymer 50 may differ from that of layer 48 by less than 0.15, less than 0.1, or less than 0.05 (as examples).

[0037] To help protect the front (outwardly facing) surface of display 14 from damage during use (e.g., to help prevent scratching of glass layer 48, which could weaken glass layer 48), layer 48 may be provided with a protective coating such as protective coating layer 40. Layer 40 may

have one or more separate layers of material (e.g., polymer such as polyimide, etc.). As an example, layer 40 may have an inner layer (e.g., a polyimide layer or other polymer layer 46 with a thickness of 50 microns, 10-100 microns, 20-80 microns, or other suitable thickness) and an outer layer that is thinner than the inner layer (e.g., a polymer layer such as polymer layer 44 with a thickness of a few microns, at least 0.5 microns, at least 1 micron, at least 2 microns 2-10 microns, 2-8 microns, less than 15 microns, less than 7 microns, or other suitable thickness). In this type of arrangement, layer 46 may help prevent relatively deep scratches in layer 40 from penetrating to the outer surface of glass layer 48, whereas layer 44, which may be formed from a harder polymer than layer 46, may help protect the surface of layer 46 from scratching that could create haze or other visible changes to layer 40. Layer 40 faces outwardly from layer 14T and may therefore sometimes be referred to as a top coating or top coat for layer 14T, whereas layer 50 faces inwardly from layer 14T and may sometimes be referred to as a back coating, rear coating, back coating, or back coat for layer 14T.

[0038] Optional coatings may be formed on the outer surface of layer 40. These optional coatings may include, for example, anti-smudge layers, anti-fog layers, antireflection layers, anti-static layers, and/or other coatings. In some configurations, each of these functions may be implemented using a separate respective coating layer. In other configurations, a single layer may serve multiple functions.

[0039] As described above, one aspect of the present technology is the gathering and use of information such as information from input-output devices. The present disclosure contemplates that in some instances, data may be gathered that includes personal information data that uniquely identifies or can be used to contact or locate a specific person. Such personal information data can include demographic data, location-based data, telephone numbers, email addresses, twitter ID's, home addresses, data or records relating to a user's health or level of fitness (e.g., vital signs

measurements, medication information, exercise information), date of birth, username, password, biometric information, or any other identifying or personal information.

[0040] The present disclosure recognizes that the use of such personal information, in the present technology, can be used to the benefit of users. For example, the personal information data can be used to deliver targeted content that is of greater interest to the user. Accordingly, use of such personal information data enables users to calculate control of the delivered content. Further, other uses for personal information data that benefit the user are also contemplated by the present disclosure. For instance, health and fitness data may be used to provide insights into a user's general wellness, or may be used as positive feedback to individuals using technology to pursue wellness goals.

[0041] The present disclosure contemplates that the entities responsible for the collection, analysis, disclosure, transfer, storage, or other use of such personal information data will comply with well-established privacy policies and/or privacy practices. In particular, such entities should implement and consistently use privacy policies and practices that are generally recognized as meeting or exceeding industry or governmental requirements for maintaining personal information data private and secure. Such policies should be easily accessible by users, and should be updated as the collection and/or use of data changes. Personal information from users should be collected for legitimate and reasonable uses of the entity and not shared or sold outside of those legitimate uses. Further, such collection/sharing should occur after receiving the informed consent of the users. Additionally, such entities should consider taking any needed steps for safeguarding and securing access to such personal information data and ensuring that others with access to the personal information data adhere to their privacy policies and procedures. Further, such entities can subject themselves to evaluation by third parties to certify their adherence to widely accepted privacy policies and practices. In addition, policies and practices should be adapted for the particular types of personal information data being collected and/or

accessed and adapted to applicable laws and standards, including jurisdiction-specific considerations. For instance, in the United States, collection of or access to certain health data may be governed by federal and/or state laws, such as the Health Insurance Portability and Accountability Act (HIPAA), whereas health data in other countries may be subject to other regulations and policies and should be handled accordingly. Hence different privacy practices should be maintained for different personal data types in each country.

[0042] Despite the foregoing, the present disclosure also contemplates embodiments in which users selectively block the use of, or access to, personal information data. That is, the present disclosure contemplates that hardware and/or software elements can be provided to prevent or block access to such personal information data. For example, the present technology can be configured to allow users to select to "opt in" or "opt out" of participation in the collection of personal information data during registration for services or anytime thereafter. In another example, users can select not to provide certain types of user data. In yet another example, users can select to limit the length of time user-specific data is maintained. In addition to providing "opt in" and "opt out" options, the present disclosure contemplates providing notifications relating to the access or use of personal information. For instance, a user may be notified upon downloading an application ("app") that their personal information data will be accessed and then reminded again just before per- sonal information data is accessed by the app.

[0043] Moreover, it is the intent of the present disclosure that personal information data should be managed and handled in a way to minimize risks of unintentional or unauthorized access or use. Risk can be minimized by limiting the collection of data and deleting data once it is no longer needed. In addition, and when applicable, including in certain health related applications, data de-identification can be used to protect a user's privacy. De-identification may be facilitated, when appropriate, by removing specific identifiers (e.g., date of birth, etc.), controlling the amount or specificity of data stored (e.g., collecting location data at a city level rather than at an

address level), controlling how data is stored (e.g., aggregating data across users), and/or other methods.

[0044] Therefore, although the present disclosure broadly covers use of information that may include personal information data to implement one or more various disclosed embodiments, the present disclosure also contemplates that the various embodiments can also be implemented without the need for accessing personal information data. That is, the various embodiments of the present technology are not rendered inoperable due to the lack of all or a portion of such personal information data.

[0045] The foregoing is merely illustrative and various modifications can be made to the described embodiments. The foregoing embodiments may be implemented individually or in any combination.

[0046] What is claimed is:

[0047] 1. An electronic device, comprising:

[0048] a housing;

[0049] a display coupled to the housing, wherein the display has a rollable portion configured to operate in an unrolled state and in a rolled state, wherein the display com- pri• ses:

[0050] a pixel array configured to display an image; and

[0051] a transparent protective layer that overlaps the pixel array, wherein the image is viewable through the transparent protective layer, wherein the transparent protective layer includes a glass layer having an inwardly facing surface that faces the pixel array and having an opposing outwardly facing surface, and wherein the outwardly facing surface of the glass layer in the rollable portion is compressively stressed in the rolled stated

DETAILED DESCRIPTION OF THE INVENTION

[0052] Electronic devices may be provided with displays. Displays may be used for displaying images for users. Displays may be formed from arrays of light-emitting diode pixels or other pixels. For example, a device may have an organic light-emitting diode display or a display formed from an array of micro-light-emitting diodes (e.g., light emitting diodes formed from crystalline semiconductor dies).

[0053] A schematic diagram of an illustrative electronic device having a display is shown in FIG. 1. Device 10 may be a cellular telephone, tablet computer, laptop computer, wristwatch device or other wearable device, a television, a stand-alone computer display or other monitor, a computer display with an embedded computer (e.g., a desktop com-puter), a system embedded in a vehicle, kiosk, or other embedded electronic device, a media player, or other elec-tronic equipment. Configurations in which device 10 is a cellular telephone, tablet computer, or other portable elec-tronic device may sometimes be described herein as an example. This is illustrative. Device 10 may, in general, be any suitable electronic device with a display.

[0054] Device 10 may include control circuitry 20. Con-trol circuitry 20 may include storage and processing cir-cuitry for supporting the operation of device 10. The storage and processing circuitry may include storage such as non-volatile memory (e.g., flash memory or other electrically programmable-read-only memory configured to form a solid state drive), volatile memory (e.g., static or dynamic ran-dom-access-memory), etc. Processing circuitry in control circuitry 20 may be used to gather input from sensors and other input devices and may be used to control output devices. The processing circuitry may be based on one or more microprocessors, microcontrollers, digital signal pro-cessors, baseband processors and other wireless communi-cations circuits, power management units, audio chips, application specific integrated circuits, etc. During opera-tion, control circuitry 20 may use a display and other output devices in providing a user with visual output and other output.

[0055] To support communications between device 10 and external equipment, control circuitry 20 may communicate using communications circuitry 22. Circuitry 22 may include antennas, radio-frequency transceiver circuitry (wireless transceiver circuitry), and other wireless commu-nications circuitry and/or wired communications circuitry. Circuitry 22, which may sometimes be referred to as control circuitry and/or control and communications circuitry, may support bidirectional wireless communications between device 10 and external equipment over wired and/or wireless links (e.g., circuitry 22 may include radio-frequency trans-ceiver circuitry such as wireless local area network trans-ceiver circuitry configured to support communications over a wireless local area network link, near-field communica-tions transceiver circuitry configured to support communi-cations over a near-field communications link, cellular tele-phone transceiver circuitry configured to support communications over a cellular telephone link, or trans-ceiver circuitry configured to support communications over any other suitable wired or wireless communications link). Wireless communications may, for example, be supported over a Bluetooth® link, a WiFi® link, a wireless link operating at a frequency between 6 GHz and 300 GHz, a 60 GHz link, or other millimeter wave link, cellular telephone link, wireless local area network link, personal area network communications link, or other wireless communications link. Device 10 may, if desired, include power circuits for transmitting and/or receiving wired and/or wireless power and may include batteries or other energy storage devices. For example, device 10 may include a coil and rectifier to receive wireless power that is provided to circuitry in device 10.

[0056] Device 10 may include input-output devices such as devices 24. Input-output devices 24 may be used in gathering user input, in gathering information on the envi-ronment surrounding the user, and/or in providing a user with output. Devices 24 may include one or more displays such as display 14. Display 14 may be an organic light emitting diode display, a liquid crystal display, an electro-phoretic display, an electrowetting display, a plasma display, a microelectromechanical systems display, a display having a pixel array formed from crystalline

semiconductor light emitting diode dies (sometimes referred to as microLEDs), and/or other display. Configurations in which display 14 is an organic light-emitting diode display or microLED display are sometimes described herein as an example.

[0057] Display 14 may have an array of pixels configured to display images for a user. The pixels may be formed as part of a display panel that is bendable. This allows device 10 to be bent about a bend axis. For example, a flexible (bendable) display in device 10 may be partly or completely rolled up so that device 10 may be placed in a compact shape for storage and may be rolled out when it is desired to view images on the display. Displays with rollable structures may sometimes be referred to herein as rollable displays, scrol-lable displays, flexible displays, or bendable displays. A rollable display may be completely rollable (e.g., flexible over its entire area) or may be partly rollable (e.g., one or more edge portions of a display may be provided with sufficient flexibility to be rolled whereas one or more other portions of the display may be less flexible and/or may be fixed in a planar state).

[0058] Sensors 16 in input-output devices 24 may include force sensors (e.g., strain gauges, capacitive force sensors, resistive force sensors, etc.), audio sensors such as micro-phones, touch and/or proximity sensors such as capacitive sensors (e.g., a two-dimensional capacitive touch sensor integrated into display 14, a two-dimensional capacitive touch sensor overlapping display 14, and/or a touch sensor that forms a button, trackpad, or other input device not associated with a display), and other sensors. If desired, sensors 16 may include optical sensors such as optical sensors that emit and detect light, ultrasonic sensors, optical touch sensors, optical proximity sensors, and/or other touch sensors and/or proximity sensors, monochromatic and color ambient light sensors, image sensors, fingerprint sensors, temperature sensors, sensors for measuring three-dimen-sional non-contact gestures ("air gestures"), pressure sen-sors, sensors for detecting position, orientation, and/or motion (e.g., accelerometers, magnetic sensors such as com-pass sensors, gyroscopes, and/or inertial measurement units that contain some or all of these sensors), health sensors, radio-frequency sensors, depth sensors (e.g., structured light sensors and/or depth

sensors based on stereo imaging devices that capture three-dimensional images), optical sen-sors such as self-mixing sensors and light detection and ranging (lidar) sensors that gather time-of-flight measure-ments, humidity sensors, moisture sensors, gaze tracking sensors, and/or other sensors. In some arrangements, device 10 may use sensors 16 and/or other input-output devices to gather user input. For example, buttons may be used to gather button press input, touch sensors overlapping dis-plays can be used for gathering user touch screen input, touch pads may be used in gathering touch input, micro-phones may be used for gathering audio input, accelerom-eters may be used in monitoring when a finger contacts an input surface and may therefore be used to gather finger press input, etc.

[0059] If desired, electronic device 10 may include addi-tional components (see, e.g., other devices 18 in input output devices 24). The additional components may include haptic output devices, audio output devices such as speakers, light-emitting diodes for status indicators, light sources such as light-emitting diodes that illuminate portions of a housing and/or display structure, other optical output devices, and/or other circuitry for gathering input and/or providing output. Device 10 may also include a battery or other energy storage device, connector ports for supporting wired communication with ancillary equipment and for receiving wired power, and other circuitry.

[0060] FIG. 2 is a side view of an illustrative display for electronic device 10. As shown in FIG. 2, display 14 may have a rear side B and a front side F. Front side F may face a user of the electronic device during use and may some-times be referred to as an outward facing side or surface of display 14. Rear side B may face away from the user and may sometimes be referred to as an inwardly facing side or surface of display 14. The outline of display 14 when viewed by the user may be rectangular or may have other suitable shapes.

[0061] Display panel 14P of display 14 may have a pixel array such as an array of light-emitting pixels (e.g., a rectangular array of light-emitting diodes). During opera-tion, the pixel array of

panel 14P may produce images that pass through transparent protective layer 14T and that are viewable by the user on front side F. Protective layer 14T may include clear polymer, clear glass, and/or other trans-parent structures that allow images to be viewed while providing support (e.g., rigidity) and protection (e.g., pro-tection from scratches and other damage) for display panel 14P. As an example, a layer of glass that is attached to the outer (front-facing) surface of panel 14P may be used to prevent display panel 14P from deforming and becoming damaged when a user's finger, computer stylus, or other external object contacts front side F of display 14. Protective polymer layers and/or other protective layers may be formed as coatings on the glass layer help prevent scratching of the glass layer. The substrate used in forming panel 14P may be flexible (e.g., display panel 14P may have a pixel array formed on a flexible polymer substrate or other flexible substrate). Protective layer 14T may also be formed from flexible structures. As a result, some or all of the area of display 14 may be flexible, which allows some or all of display 14 to be rolled up for storage.

[0062] Consider, as an example, the side view of display 14 that is shown in FIG. 3. In this example, display 14 has a planar portion such as planar portion 30 and a rolled portion 26, which has been rolled up around axis 28. When it is desired to store display 14, some or all of display 14 may be rolled up as shown by portion 26. When it is desired to increase the amount of display surface area that is viewable to the user, some or all of rolled portion 26 may be unrolled(e.g., display 14 may be unrolled so that more or all of display 14 is planar as shown by portion 30).

[0063] During rolling and/or other bending operations, the glass of layer 14T experiences compressive and tensile stress. For example, in the example of FIG. 3, the surface of the glass layer in layer 14T that faces front side F (the outwardly facing surface of the glass layer) experiences compressive stress and the surface of the glass layer in layer 14T that faces rear side R (the inwardly facing surface of the glass layer) experiences tensile stress. In general, display 14 may be rolled inwardly on its front surface (as shown in FIG. 3) or may be rolled outward about its rear surface (as shown in the illustrative configuration of FIG. 4).

[0064] During manufacturing, small surface irregularities (e.g., pits, grooves, or other recesses with dimensions on the orders of hundreds of nanometers) may be formed on the front and rear surfaces of the glass layer in layer 14T. During use of display 14 by a user, contact with a user's fingers, computer styluses, and/or other external objects may give rise to deeper surface irregularities (e.g., pits, grooves, and/or other recesses from scratches with dimensions on the order of one micron or more). The presence of these micron sized surface irregularities may make the glass layer sus-ceptible to cracking if excessive tensile stress is imposed (e.g., by rolling layer 14T so that layer 14T and the glass layer of layer 14T are characterized by an excessively small bend radius). To help ensure that the glass layer does not crack, it may be advantageous to roll display 14 inwardly towards front side F as shown in FIG. 3, rather than outwardly towards rear side B as shown in FIG. 4. In this way, the surface of the glass layer that is less susceptible to cracking (i.e., the unscratched surface of the glass layer that faces rear side B and that has smaller surface irregularities) is subjected to tensile stress during rolling about axis 28, whereas the surface of the glass layer that is more suscep-tible to cracking (i.e., the surface of the glass layer that faces the user and is therefore subjected to scratches from the user and has larger surface irregularities) is subjected to com-pressive stress during rolling about axis 28. Placing the more vulnerable surface of the glass layer in display 14T under compressive stress helps ensure that display 14 will be free from any undesired cracks or other damage.

[0065] In the examples of FIGS. 3 and 4, one edge of display 14 is being rolled. If desired, two opposing edges may be rolled for storage. This type of arrangement is shown in FIG. 5. As shown in FIG. 5, the left edge of display 14 may be sufficiently flexible to be rolled for storage and unrolled to deploy the display for use in displaying images and the right edge of the same display 14 may be sufficiently flexible to be rolled up when stored and unrolled for use.[0027] Electronic device 10 may include rigid and flexible housing structures. FIG. 6 is a cross-sectional side view of an illustrative electronic device with a housing. As shown in FIG. 6, housing 12 may have a portion forming a rear housing wall. Interior region 32 of device 10 may contain electrical

components 36 mounted on substrates such a printed circuit 34. Interior region 32 may be separated from the exterior region surrounding device 10 by a rear housing wall (housing 12) and by display 14.

[0066] Display panel 14P has an array of pixels that form an image under an inwardly facing surface of protective layer 14T. Display panel 14P may be, for example, a flexible organic light-emitting diode display or a microLED display in which light-emitting pixels are formed on a flexible substrate layer (e.g., a flexible layer of polyimide or a sheet of other flexible polymer). Flexible support layer(s) for display 14 may also be formed from flexible glass, flexible metal, and/or other flexible structures. If desired, device 10 may have a support layer formed from slats such as slats 38 (e.g., slates that are each attached to left and right adjacent slats by hinge structures). Slats 38 may help maintain desired support for display 14 as display 14 is wrapped around axis 28 (of FIGS. 3, 4, and 5). Slats 38 may be formed from elongated strips of metal or other material and may extend along axes parallel to axis 28. Backside display panel support layers formed from flexible metal and/or polymer layers may also be used. In addition, layer 14T may use a flexible glass layer to help provide display panel 14P with structural support.

[0067] Layer 14T may be formed from polymer layers, one or more layers of glass, crystalline materials such as sapphire, other materials, and/or combinations of these materials. To locally increase flexibility, a portion of a glass layer in layer 14T that corresponds to the rollable portion of display 14 may be locally thinned (e.g., this portion may be thinned relative to portions of the glass layer that are not to be rolled about axis 28). The thickness of the glass layer of layer 14T (e.g., the non-thinned portions of the glass layer) may be 50-200 microns, 70-150 microns, 100-200 microns, 100-400 microns, 100-600 microns, at least 100 microns, at least 200 microns, less than 600 microns, less than 400 microns, less than 250 microns, less than 150 microns, less than 100 microns, at least 50 microns, or other suitable thickness. The thickness of the locally thinned portions of the glass layer of layer 14T may be 30-150 microns, less than 200 microns, less than 150 microns, less than 100 microns, less than 75 microns, less than 40 microns, at least 15

microns, or other suitable thickness that is thinner than the thickness of the non-thinned portions of the glass layer. Thicker glass tends to be less bendable than thinner glass, but may provide display panel 14P with more rigidity and therefore enhanced protection for panel 14P. Thinner glass allows display 14 to be rolled up tightly (with a small bend radius). The bend radius of the rolled portion of display 14 □□□□1□□□3□□□6□□□ 15 mm, less than 30 mm, less than 20 mm, less than 10 mm, less than 5 mm, or other suitable value.

[0068] FIG. 7 is a cross-sectional side view of device 10 in an illustrative configuration in which housing 12 of device 10 has a planar portion that supports planar portion 30 of display 14 and a rolled display storage portion that supports rolled portion 26 of display 14. The outwardly facing surface of display 14 on upper side U of device 10 presents images to a user. Under planar portion 30 of display 14, housing 12 may have interdigitated fingers and/or other structures that allow the lateral size of housing 12 to be adjusted. When it is desired to extend display 14, housing 12 may be extended leftward (in the -X direction) to help support an enlarged area of portion 30 as rolled portion 26 is unrolled by being pulled out of the rolled display storage portion of housing 12. When it is desired to contract display 14, housing 12 may be contracted (left edge TP of housing 12 and display 14 may be moved to the right in the +X direction). As the planar portion of housing 12 is reduced in size in this way, spring-loaded roller 42 may rotate counterclockwise about roller axis 28 so that portion 26 of display 14 is retracted and rolled up about roller 42 for storage within the rolled display storage portion of housing 12. The diameter of the rolleddisplay storage portion of housing 12 (Hl+H2) and associ-ated diameter of roller 42 are sufficiently large to accom-modate rolled portion 26 of display 14 while maintaining a desired minimum bend radius to prevent damage to display 14.

[0069] To help minimize the distance that housing 12 protrudes above the plane of planar display portion 30, reverse bend portion RB of display 14 may be provided with a bend in the opposite direction from the bend of portion 26 and housing 12 may be shaped to conform to the bends in display 14. In the example of FIG. 7, rolled portion 26 of display 14 is wrapped

upwardly around roller 42 and axis 28, whereas reverse bend portion RB is characterized by a bend in the opposite direction (e.g., display 14 is bent downwardly away from the user). As a result of the presence of reverse bend portion RB, axis 28 is moved to a lower height (lower Z position in the orientation of FIG. 7). This lowers the value of Hl (the amount of housing 12 that protrudes above the plane of planar portion 30 of display 14) and increases the value of H2 (the amount of housing 12 at the back of device 10 that extends below the plane of planar portion 30 of display 14). In reverse bend portion RB, the outer surface of the glass layer of display 14 is exposed to tension, whereas the inner surface of this glass layer is exposed to compression. The outer surface may be more sensitive to fractures due to surface damage than the inner surface, but the bend radius of display 14 in reverse bend portion RB is greater than the bend radius of display 14 in rolled portion 26, which helps reduce the tension of the outer surface to satisfactory levels. The bend radius of portion RB may be, as an example, at least two times, at least five times, or at least ten times greater than the bend radius of portion 26 (as examples). The use of a housing and display con-figuration for device 10 that forms a reverse bend in display 14 in this way helps reduce the visible protrusion in housing 12 that is used for rolled display storage and may thereby enhance the appearance of device 10. Configurations in which reverse bend portion RB of display 14 is omitted (e.g., configurations in which display 14 is planar except where forming rolled portion 26) may also be used.

[0070] Housing 12 may form housing walls, sidewall structures, and/or internal supporting structures (e.g., a frame, an optional midplate member, etc.) for device 10. The portions of housing 12 on the sidewalls and rear wall of device 10 may be formed from glass or other transparent structures and/or opaque structures such as metal, opaque polymer, etc.

[0071] FIG. 8 is a cross-sectional side view of display 14. In the illustrative configuration of FIG. 8, display 14 includes a flexible display panel (panel 14P) that is attached to the rear surface of transparent protective layer 14T. Layer 14T may include glass layer 48. In display portion BP, glass layer 48 may have a first thickness Tl, whereas in display portion LP, glass layer 48 may be

locally thinned and may be characterized by a second thickness T2 that is less than Tl. The value of Tl may be 50-200 microns, 70-150 microns, 100-200 microns, 100-400 microns, 100-600 microns, at least 100 microns, at least 200 microns, less than 600 microns, less than 400 microns, less than 250 microns, less than 150 microns, less than 100 microns, at least 50 microns, or other suitable thickness that helps protect dis-play panel 14P from damage when the surface of display 14 is contacted by an external object. The value of T2, which is sufficiently small to allow display 14 to bend, may be30-150 microns, less than 200 microns, less than 150 microns, less than 100 microns, less than 75 microns, less than 40 microns, at least 15 microns, or other suitable thickness that allows display 14 to be rolled up while still providing rigidity that helps protect display 14. If desired, transitions between areas of different thickness in the cross-sectional profile of layer 48 may be provided with curved cross-sectional profiles or other profiles with smoothly changing thicknesses. These curved profile shapes may help avoid stress concentrations due to abrupt thickness changes and can therefore help enhance the strength of layer 48.

[0072] Protective rear coating layer 50 may be located between the rear (inwardly facing) surface of glass layer 48 and the opposing front (outwardly facing surface) of display panel 14P. Layer 50 may be formed from a flexible polymer. The presence of layer 50 may help protect the inner surface of glass layer 48 and may help planarize the inner surface of glass layer 48 to facilitate mounting of display panel 14P against this inner surface (e.g., with an additional layer of adhesive and/or using the adhesive properties of layer 50). Polymer 50 may be sufficiently flexible to bend in portion 26. The refractive index of polymer 50 may be matched to that of glass layer 48 to help minimize light reflections (e.g., by incorporating inorganic nanoparticles in the polymer material of layer 50). For example, at a wavelength of 500 nm, the refractive index of polymer 50 may differ from that oflayer 48 by less than 0.15, less than 0.1, or less than 0.05 (as examples).

[0073] To help protect the front (outwardly facing) surface of display 14 from damage during use (e.g., to help prevent scratching of glass layer 48, which could weaken glass layer 48), layer

48 may be provided with a protective coating such as protective coating layer 40. Layer 40 may have one or more separate layers of material (e.g., polymer such as polyimide, etc.). As an example, layer 40 may have an inner layer (e.g., a polyimide layer or other polymer layer 46 with a thickness of 50 microns, 10-100 microns, 20-80 microns, or other suitable thickness) and an outer layer that is thinner than the inner layer (e.g., a polymer layer such as polymer layer 44 with a thickness of a few microns, at least 0.5 microns, at least 1 micron, at least 2 microns 2-10 microns, 2-8 microns, less than 15 microns, less than 7 microns, or other suitable thickness). In this type of arrangement, layer 46 may help prevent relatively deep scratches in layer 40 from penetrating to the outer surface of glass layer 48, whereas layer 44, which may be formed from a harder polymer than layer 46, may help protect the surface of layer 46 from scratching that could create haze or other visible changes to layer 40. Layer 40 faces outwardly from layer 14T and may therefore sometimes be referred to as a top coating or top coat for layer 14T, whereas layer 50 faces inwardly from layer 14T and may sometimes be referred to as a back coating, rear coating, back coating, or back coat for layer 14T.

[0074] Optional coatings may be formed on the outer surface oflayer 40. These optional coatings may include, for example, anti-smudge layers, anti-fog layers, antireflection layers, anti-static layers, and/or other coatings. In some configurations, each of these functions may be implemented using a separate respective coating layer. In other configu-rations, a single layer may serve multiple functions.

[0075] As described above, one aspect of the present technology is the gathering and use of information such as information from input-output devices. The present disclosure contemplates that in some instances, data may be gathered that includes personal information data that uniquely identifies or can be used to contact or locate a specific person. Such personal information data can include demographic data, location-based data, telephone numbers, email addresses, twitter ID's, home addresses, data or records relating to a user's health or level of fitness (e.g., vital signs

measurements, medication information, exercise information), date of birth, username, password, biometric information, or any other identifying or personal informa-tion.

[0076] The present disclosure recognizes that the use of such personal information, in the present technology, can be used to the benefit of users. For example, the personal information data can be used to deliver targeted content that is of greater interest to the user. Accordingly, use of such personal information data enables users to calculated control of the delivered content. Further, other uses for personal information data that benefit the user are also contemplated by the present disclosure. For instance, health and fitness data may be used to provide insights into a user's general wellness, or may be used as positive feedback to individuals using technology to pursue wellness goals.

[0077] The present disclosure contemplates that the enti-ties responsible for the collection, analysis, disclosure, trans-fer, storage, or other use of such personal information data will comply with well-established privacy policies and/or privacy practices. In particular, such entities should imple-ment and consistently use privacy policies and practices that are generally recognized as meeting or exceeding industry or governmental requirements for maintaining personal infor-mation data private and secure. Such policies should be easily accessible by users, and should be updated as the collection and/or use of data changes. Personal information from users should be collected for legitimate and reasonable uses of the entity and not shared or sold outside of those legitimate uses. Further, such collection/sharing should occur after receiving the informed consent of the users. Additionally, such entities should consider taking any needed steps for safeguarding and securing access to such personal information data and ensuring that others with access to the personal information data adhere to their privacy policies and procedures. Further, such entities can subject themselves to evaluation by third parties to certify their adherence to widely accepted privacy policies and practices. In addition, policies and practices should be adapted for the particular types of personal information data being collected and/or accessed and adapted to applicable laws and standards, including jurisdiction-specific

consid-erations. For instance, in the United States, collection of or access to certain health data may be governed by federal and/or state laws, such as the Health Insurance Portability and Accountability Act (HIPAA), whereas health data in other countries may be subject to other regulations and policies and should be handled accordingly. Hence different privacy practices should be maintained for different personal data types in each country.

[0078] Despite the foregoing, the present disclosure also contemplates embodiments in which users selectively block the use of, or access to, personal information data. That is, the present disclosure contemplates that hardware and/or software elements can be provided to prevent or block access to such personal information data. For example, the present technology can be configured to allow users to selectto "opt in" or "opt out" of participation in the collection of personal information data during registration for services or anytime thereafter. In another example, users can select not to provide certain types of user data. In yet another example, users can select to limit the length of time user-specific data is maintained. In addition to providing "opt in" and "opt out" options, the present disclosure contemplates providing noti-fications relating to the access or use of personal informa-tion. For instance, a user may be notified upon downloading an application ("app") that their personal information data will be accessed and then reminded again just before per-sonal information data is accessed by the app.

[0079] Moreover, it is the intent of the present disclosure that personal information data should be managed and handled in a way to minimize risks of unintentional or unauthorized access or use. Risk can be minimized by limiting the collection of data and deleting data once it is no longer needed. In addition, and when applicable, including in certain health related applications, data de-identification can be used to protect a user's privacy. De-identification may be facilitated, when appropriate, by removing specific identifiers (e.g., date of birth, etc.), controlling the amount or specificity of data stored (e.g., collecting location data at a city level rather than at an address level), controlling how data is stored (e.g., aggregating data across users), and/or other methods.

[0080] Therefore, although the present disclosure broadly covers use of information that may include personal infor-mation data to implement one or more various disclosed embodiments, the present disclosure also contemplates that the various embodiments can also be implemented without the need for accessing personal information data. That is, the various embodiments of the present technology are not rendered inoperable due to the lack of all or a portion of such personal information data.

[0081] The foregoing is merely illustrative and various modifications can be made to the described embodiments. The foregoing embodiments may be implemented individu-ally or in any combination.

[0082]

[0083] Although the present invention has been described with reference to specific embodiments, it is understood that modifications and variations of the present invention are possible without departing from the scope of the invention, which is defined by the claims set forth below. Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by one of the ordinary skills in the art to which this invention belongs. Any methods and materials similar or equivalent to those described herein can also be used in the practice or testing of the present invention; however, the preferred methods and materials are now described.

CLAIMS

The invention claimed is:

1. A rollable electronic device comprising:

a flexible Organic Light Emitting Diode Display panel housing;

a bendable circuit board integrated with said flexible Organic Light Emitting Diode Display panel;

a power source for providing electrical power to said flexible Organic Light Emitting Diode Display panel and said, bendable circuit board;

a bendable housing encapsulating said flexible Organic Light Emitting Diode display panel, the bendable circuit board, and the power source;

a transparent protective layer that overlaps the pixel array, wherein the viewable through the transparent protective layer, wherein the transparent protective layer includes a glass layer having an inwardly facing surface that faces the pixel array and having an opposing outwardly facing surface of the glass layer in the rollable portion is compressively stressed in the rolled state.

and a sticky film affixed to the back surface of said bendable housing, wherein said sticky film allows the smart device to adhere to various surfaces.

2. **2.** The rollable electronic device of claim **1**, wherein, further comprising a touch-sensitive interface integrated with the flexible Organic Light Emitting Diode Display panel housing for user interaction.

3. The rollable smart device of claim 1, further comprising a touch-sensitive interface integrated with the flexible Organic Light Emitting Diode Display panel for user interaction.

Dependent Claim 3: The rollable smart device of claim 1, wherein the flexible Organic Light Emitting Diode Display panel is constructed using organic light-emitting diodes.

4: The rollable smart device of claim 1, wherein the bendable circuit board further comprises flexible interconnects for facilitating electrical communication between components.

5: The rollable smart device of claim 1, wherein the power source is a rechargeable lithium-ion battery.

Dependent Claim 6: The rollable smart device of claim 1, wherein the bendable housing further comprises a protective coating to enhance durability.

7: The rollable smart device of claim 1, wherein the sticky film is composed of a silicone-based adhesive.

8: The rollable smart device of claim 1, wherein the sticky film is removable and repositionable for multiple applications.

9: The rollable smart device of claim 1, wherein the bendable housing further comprises a mechanism for adjusting the degree of curvature of the smart device.

10: The electronic device defined in claim 2 wherein, in the rolled state, the rollable portion of the glass layer is characterized by a first bend radius and the bent portion is characterized by a second bend radius that is greater than the first bend radius.

11:The electronic device defined in claim 3 wherein, in the rolled state, the second bend radius is at least two times the first bend radius.

12. The electronic device defined in claim 4 wherein the glass layer is locally thinned.

13. The electronic device defined in claim 4 wherein the glass layer has a non-rollable portion that is planar in the rolled state.

14. The electronic device defined in claim 6 wherein the glass layer has a first thickness in the non-rollable portion and a second thickness that is less than the first thickness in the rollable portion.

15. The electronic device defined in claim 1 wherein the transparent protective layer includes a layer of polymer between the glass layer and the pixel array.

16. The electronic device defined in claim 8 further com-prising a protective coating layer that includes a first layer of polymer on an outwardly facing surface of the glass layer and a second layer of polymer on the first layer of polymer, wherein the second layer of polymer is harder than the first layer of polymer, and wherein the second layer of polymer is thinner than the first layer of polymer.

17. The electronic device defined in claim 9 wherein the pixel array comprises a display panel with an array of light-emitting diodes.

18. The electronic device defined in claim 9 wherein the display panel comprises an organic light-emitting diode display panel.

19. An electronic device, comprising:

a housing; and

a rollable display that is coupled to the housing, wherein the rollable display is configured to operate in an unrolled state in which the rollable display is planar and displays images and a rolled state in which at least one rollable portion of the rollable display is rolled up, wherein the rollable display has a flexible display panel overlapped by a glass layer, and wherein the glass layer has a surface that faces away from the flexible display panel and that is under compressive stress in the rollable portion in the rolled state.

13. The electronic device defined in claim 12 wherein the rollable display has first and second opposing edges and first and second corresponding opposing rollable portions at the first and second edges.

14. The electronic device defined in claim 12 wherein the glass layer has a first region with a first thickness and a second region with a second thickness that is less than the first thickness.

15. The electronic device defined in claim 14 further comprising a layer of polymer between the glass layer and the flexible display panel, wherein the layer of polymer has a refractive index that differs from a refractive index of the glass layer by less than 0.1

16. The electronic device defined in claim 14 wherein, in the rollable portion of the rollable display, the glass layer has the second thickness.

17. The electronic device defined in claim 16 wherein, in the rolled state, a region of the surface of the glass layer that faces away from the flexible display panel is under tensile stress.

18. An electronic device, comprising:

a housing; and

a display coupled to the housing that is configured to transition between an unrolled configuration in which the display is planar and a rolled configuration in which a first portion of the display is planar and second portion of the display is rolled up, wherein the display has a display panel overlapped by a transparent protective layer containing a glass layer, wherein the glass layer has a first surface facing the display panel and a second surface facing away from the display panel, and wherein in the rolled configuration, the first surface of the glass layer in the second portion receives tensile stress from being rolled up and the second surface of the glass layer in the second portion receives compressive stress from being rolled up.

19. The electronic device defined in claim 18 wherein the glass layer is thinner in the second portion of the display than in the first portion of the display.

20. The electronic device defined in claim 19 wherein at least some of the second surface of the glass layer is under tensile stress in the rolled configuration.

* * * * *

ABSTRACT

A patent is claimed for a rollable electronic device with a flexible Organic Light light-emitting diode (OLED) display. The device includes a bendable circuit board, a power source, and a bendable housing encapsulating the display, circuit board, and power source. A transparent protective layer overlaps the pixel array, allowing for viewability while providing compressive stress in the rolled state. Additionally, a sticky film on the back allows the device to adhere to various surfaces. Further claims include a touch-sensitive interface, the use of organic light-emitting diodes in the display, flexible interconnects in the circuit board, a rechargeable lithium-ion battery, a protective coating for durability, a silicone-based adhesive for the sticky film, repositionable film, and a mechanism for adjusting the device's curvature. This invention combines flexibility and adhesive properties for versatile applications in electronic devices.

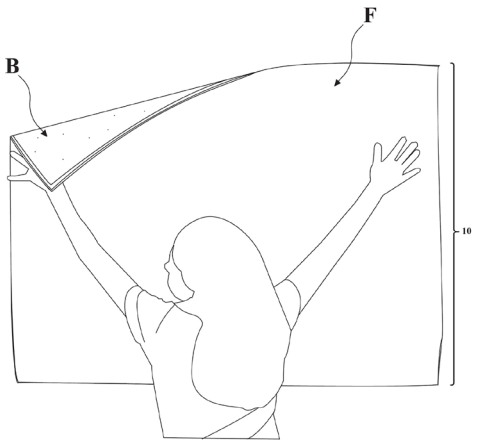

FIG. 1

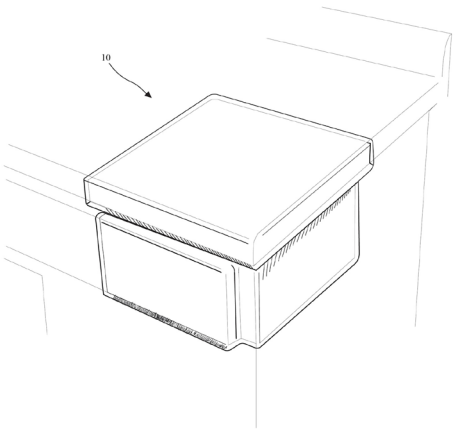

FIG. 2

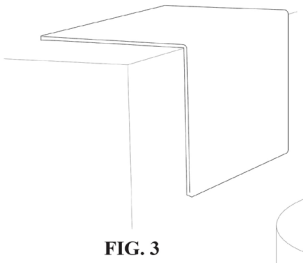

FIG. 3

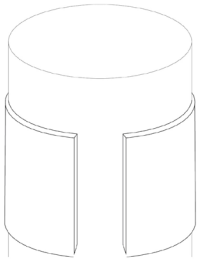

FIG. 4

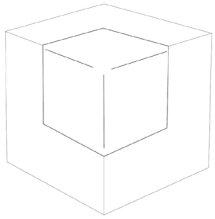

FIG. 5

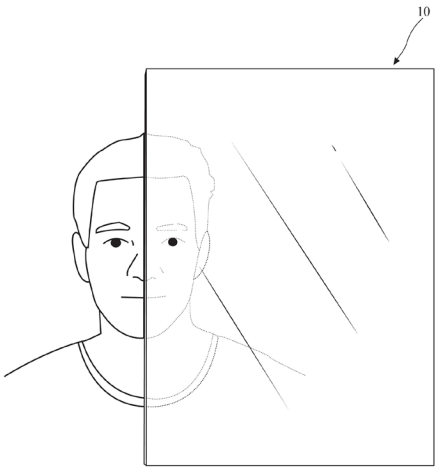

FIG. 6

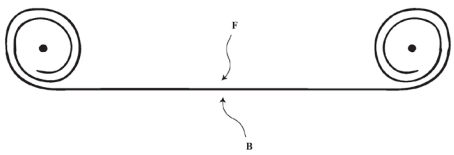

FIG. 7

PTO/AIA/01 (06-12)
Approved for use through 05/31/2024. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	Bendable Pliable Interactive Screen Device

As the below named inventor, I hereby declare that:

This declaration is directed to:

- [■] The attached application, or
- [ ] United States application or PCT international application number _____

  filed on _____.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

WARNING:

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LEGAL NAME OF INVENTOR

Inventor: M. K. Zimmerman, E.Rodriguez, E.Hamilton, P.I Date (Optional) :_____

Signature: Team 5

Note: An application data sheet (PTO/AIA/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

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Name: Erick R, Mary Z, Meredith E. Aurora W, Eden H
Address: 9 Mountain Lion Way
City, Zip State: Colorado Springs, 80918

#324

DATE 11/17/2023

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Nine Hundred Twenty Eight and 00/100 **DOLLARS**

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FOR Utility Patent Application Team 5

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PTO/SB/17 (12-22)
Approved for use through 05/31/2024. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995 no persons are required to respond to a collection of information unless it displays a valid OMB control number

FEE TRANSMITTAL

Complete if known	
Application Number	
Filing Date	
First Named Inventor	Eden H, Mary Z, Eric R, Per
Examiner Name	Rory Lewis
Art Unit	
Practitioner Docket No.	

- [x] Applicant asserts small entity status. See 37 CFR 1.27.
- [ ] Applicant certifies micro entity status. See 37 CFR 1.29. Form PTO/SB/15A or B or equivalent must either be enclosed or have been submitted previously.

TOTAL AMOUNT OF PAYMENT ($) $928

METHOD OF PAYMENT (check all that apply)

- [x] Check [ ] Credit Card [ ] Money Order [ ] None [ ] Other (please identify): _____
- [x] Deposit Account Deposit Account Number: 04190322 Deposit Account Name: Group 5 Patent

For the above-identified deposit account, the Director is hereby authorized to (check all that apply):

- [x] Charge fee(s) indicated below
- [ ] Charge fee(s) indicated below, **except for the filing fee**
- [ ] Charge any additional fee(s) or underpayment of fee(s) under 37 CFR 1.16 and 1.17
- [ ] Credit any overpayment of fee(s)

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FEE CALCULATION

1. BASIC FILING, SEARCH, AND EXAMINATION FEES (U = undiscounted fee; S = small entity fee; M = micro entity fee)

	FILING FEES			SEARCH FEES			EXAMINATION FEES			
Application Type	**U ($)**	**S ($)**	**M ($)**	**U ($)**	**S ($)**	**M ($)**	**U ($)**	**S ($)**	**M ($)**	**Fees Paid ($)**
Utility	320	128*	64	700	280	140	800	320	160	280
Design	220	88	44	160	64	32	640	256	128	64
Plant	220	88	44	440	176	88	660	264	132	176
Reissue	320	128	64	700	280	140	2,320	928	464	280
Provisional	300	120	60	0	0	0	0	0	0	0

* The $128 small entity filing fee for a utility application is further reduced to $64 for a small entity applicant who files the application via Patent Center or EFS-Web.

2. EXCESS CLAIM FEES

Fee Description	**Undiscounted Fee ($)**	**Small Entity Fee ($)**	**Micro Entity Fee ($)**
Each claim over 20 (including Reissues)	100	40	20
Each independent claim over 3 (including Reissues)	480	192	96
Multiple dependent claims	860	344	172

Total Claims		**Extra Claims**		**Fee ($)**		**Fee Paid ($)**
20	-20 or HP =	0	x	0	=	0

HP = highest number of total claims paid for, if greater than 20.

Indep. Claims		**Extra Claims**		**Fee ($)**		**Fee Paid ($)**
3	-3 or HP =	0	x	0	=	0

HP = highest number of independent claims paid for, if greater than 3.

Multiple Dependent Claims	**Fee ($)**	**Fee Paid ($)**

3. APPLICATION SIZE FEE

If the specification and drawings exceed 100 sheets of paper (excluding electronically filed sequence or computer listings under 37 CFR 1.52(e)), the application size fee due is $420 ($168 for small entity) ($84 for micro entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).

Total Sheets		**Extra Sheets**		**Number of each additional 50 or fraction thereof**		**Fee ($)**		**Fee Paid ($)**
100	- 100 =	0	/ 50 =	0 (round **up** to a whole number)	x	0	=	0

4. OTHER FEE(S)

	Fees Paid ($)
Non-English specification, $140 fee ($56 for small entity) ($28 for micro entity)	0
Non-electronic filing fee under 37 CFR 1.16(t) for a utility application, $400 fee ($200 small or micro entity)	200
Other (e.g., late filing surcharge): _____	

SUBMITTED BY

Signature	Team 5 Patent	Registration No. (Attorney/Agent)	Telephone
Name (Print/Type)	Team 5 Patent group	Date	19 Nov 2023

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Doc Code: WFEE
Document Description: Fee Worksheet (SB06)

PTO/SB/06 (12-22)
Approved for use through 05/31/2024. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number

APPLICATION AS FILED – PART I LARGE ENTITY

MICRO ENTITY

SMALL ENTITY

	(Column 1) FOR NUMBER FILED	(Column 2) NUMBER EXTRA	RATE ($)	FEE ($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A
TOTAL CLAIMS minus 20 = * (37 CFR 1.16(i))		x	=	
INDEPENDENT CLAIMS minus 3 = * (37 CFR 1.16(h))		x	=	

APPLICATION SIZE FEE (37 CFR 1.16(s))

If the specification and drawings exceed 100 sheets of paper, the application size fee due is $420 ($168 for small entity or $84 for micro entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).

MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j)) N/A

* If the difference in column 1 is less than zero, enter "0" in column 2. TOTAL

APPLICATION AS AMENDED – PART II LARGE ENTITY MICRO ENTITY

SMALL ENTITY

AMENDMENT	(Column 1) CLAIMS REMAINING AFTER AMENDMENT	(Column 2) HIGHEST NUMBER PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
TOTAL (37 CFR 1.16(i))	* Minus ** =			x =	
INDEPENDENT (37 CFR 1.16(h))	* Minus *** =			x =	
APPLICATION SIZE FEE (37 CFR 1.16(s))					

FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))

N/A

TOT!L !DD'L FEE

(Column 1) (Column 2) (Column 3)
CLAIMS HIGHEST
REMAINING NUMBER PRESENT

ADDITIONAL RATE ($) FEE ($)

AFTER PREVIOUSLY EXTRA
AMENDMENT PAID FOR

TOTAL * Minus ** = (37 CFR 1.16(i))

x =

INDEPENDENT * Minus *** = (37 CFR 1.16(h))

x =

APPLICATION SIZE FEE (37 CFR 1.16(s))

FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))

N/A

TOT!L !DD'L FEE

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SP!CE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SP!CE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

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Doc Code: MES.GIB

Document Description: Certification of Micro Entity Status (Gross Income Basis) PTO/SB/15A (07-14)

CERTIFICATION OF MICRO ENTITY STATUS
(GROSS INCOME BASIS)

Application Number or Control Number (if applicable):	Patent Number (if applicable):
First Named Inventor: Mary Kate Zimmerman, Erick Rodriguez, Eden Hamilton, Percy Eaves, Aurora Weaver	Title of Invention: BENDABLE PLIABLE INTERACTIVE SCREEN DEVICE

The applicant hereby certifies the following—

(1) **SMALL ENTITY REQUIREMENT –** The applicant qualifies as a small entity as defined in 37 CFR 1.27.

(2) **APPLICATION FILING LIMIT –** Neither the applicant nor the inventor nor a joint inventor has been named as the inventor or a joint inventor on more than four previously filed U.S. patent applications, excluding provisional applications and international applications under the Patent Cooperation Treaty (PCT) for which the basic national fee under 37 CFR 1.492(a) was not paid, and also excluding patent applications for which the applicant has assigned all ownership rights, or is obligated to assign all ownership rights, as a result of the applicant's previous employment.

(3) **GROSS INCOME LIMIT ON APPLICANTS AND INVENTORS –** Neither the applicant nor the inventor nor a joint inventor, in the calendar year preceding the calendar year in which the applicable fee is being paid, had a gross income, as defined in section 61(a) of the Internal Revenue Code of 1986 (26 U.S.C. 61(a)), exceeding the "Maximum Qualifying Gross Income" reported on the USPTO Web site at http://www.uspto.gov/patents/law/micro_entity.jsp which is equal to three times the median household income for that preceding calendar year, as most recently reported by the Bureau of the Census.

(4) **GROSS INCOME LIMIT ON PARTIES WITH AN "OWNERSHIP INTEREST" –** Neither the applicant nor the inventor nor a joint inventor has assigned, granted, or conveyed, nor is under an obligation by contract or law to assign, grant, or convey, a license or other ownership interest in the application concerned to an entity that, in the calendar year preceding the calendar year in which the applicable fee is being paid, had a gross income, as defined in section 61(a) of the Internal Revenue Code of 1986, exceeding the "Maximum Qualifying Gross Income" reported on the USPTO Web site at http://www.uspto.gov/patents/law/micro_entity.jsp which is equal to three times the median household income for that preceding calendar year, as most recently reported by the Bureau of the Census.

SIGNATURE by an authorized party set forth in 37 CFR 1.33(b)

Signature	

Name					
Date		Telephone		Registration No.	
✔	There is more than one inventor and I am one of the inventors who are jointly identified as the applicant. The required additional certification form(s) signed by the other joint inventor(s) are included with this form.				

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