Indian Institute of Technology Kanpur
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Contact No. 6178

Intellectual Property Disclosure Form

1. Title of the invention: Portable Staircase Climber - Aarohak

2. Innovator(s) who have contributed or conceived an essential element of the invention, either independently or jointly with others during evolution of the technology concept or reduction to practice:

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*****_Inventors are requested to provide their Full Name (**without initials**), Position (**e.g Professor / Associate Professor / Assistant Professor, Post Doc / Phd / M. Tech / B. Tech Student**), Phone Number (**Personal**), Email ID (**Official along with Personal**)_

*****_Students are advised to provide their **home address** as well._

3. Non-Confidential description of the invention in layman's Language:

A. Abstract in 100 words *Aarohak is a groundbreaking portable device designed to help individuals with physical limitations navigate staircases with ease. By utilizing three DC motors, it provides smooth upward and forward movement, along with seamless rotation. The incorporation of Arduino boards allows for precise control, while proximity sensors enhance safety by detecting obstacles in real time. This report discusses the design and functionality of Aarohak, as well as its potential to significantly improve accessibility for the elderly and disabled. By offering a dependable solution for staircase navigation, Aarohak seeks to promote greater independence and mobility for those facing physical challenges.*
B. Use Case *The Aarohak portable staircase climber is ideal for individuals temporarily disabled or elderly who live in multi-story buildings without lift access. This device allows users to navigate stairs safely and independently, enhancing their mobility in everyday situations. For example, a senior resident can effortlessly move between floors to access common areas, receive visitors, or attend social activities. Similarly, someone recovering from an injury can use Aarohak to maintain their daily routine without relying on assistance. By providing a reliable means of overcoming staircases, Aarohak significantly improves quality of life for those facing physical challenges in their living environment.* *Please consult examples provided in Annexure-1 for filling this section*
C. Keywords *DC Motors + Arduino + Proximity Sensors + Robotics + Mobility Assistance + Accessibility Technology + Mechanical Design + Control Systems + Ergonomics + User Safety + Portable Design + Stair Navigation + Assistive Devices + Electromechanical Systems + Load Capacity + Transportability* *Please be noted that the above keywords will be utilized by the IPR Cell for preparing Patent Search Report*

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Note: *Please note that the above Information alone will be circulated to several agencies for technology commercialization purposes once the patent is filed. Thus the fields should be self-explanatory to highlight commercialization potential.*

4. How does this invention relate to new processes, machines, compositions of matter, etc.? Please cover the following points:

(a) Describe the invention in detail for technical evaluation. Please use additional sheets for sketches, drawing, photographs and other materials that help to illustrate the description.

Detailed description of drawings
For the purpose of illustrating the invention, the drawings show exemplary construction of the invention.

Figure 1 shows the front view of the mechanical assembly

Figure 2 shows side view of the mechanical assembly

Figure 3 shows a rendered front view of the mechanical assembly

Figure 4 shows a rendered perspective view of the mechanical assembly in expanded state (forward slide stage as mentioned in description given below)

Figure 5 shows a rendered perspective view of the mechanical assembly in compressed state (initial/repositioning stage as mentioned in the description given below)

Summary of the invention
Aarohak, the portable stair climber, is a game-changer for helping elderly or temporarily disabled people navigate stairs safely and comfortably. Weighing around 15 kilograms, it's designed to be easy to handle and carry, made from durable yet lightweight materials. This keeps it strong enough for safety but light enough for a caregiver to maneuver without hassle.

The stair-climbing machine is designed with a sequence of movements that allows it to navigate stairs smoothly and adjust to different orientations. For vertical motion, a screw jack powered by a motor controls the lifting and lowering actions. By expanding or compressing, the screw jack raises or lowers the platform, making it ideal for handling significant weight, such as a platform that supports a person. This stable, robust mechanism is essential for navigating stairs with the stability required for a safe ascent or descent.

Forward and backward movement is achieved by another motor, which is connected to a lead screw that drives the upper platform. This sliding motion allows the platform to reach the next stair step, pushing forward just before the machine's central and lower sections follow. This sequence helps the machine catch up to each step, ensuring stability while moving forward or backward on the stairs. For horizontal rotation, a third motor attached to a thrust roller bearing allows the central and upper portions to rotate around the bearing's axis. This rotation is key to aligning the platform with changes in stair direction, making the device adaptable to different stairway orientations.

The machine's structure and mechanical design support safe and stable stair-climbing. The thrust roller bearing plays a crucial role here, carrying the axial weight of the platform and improving stability while supporting rotational movement. The sliders between the upper platform and the central portion have a low-friction design to handle the platform's repeated forward and backward motions. Additionally, the lead screw design ensures precise movement.

To control and synchronize these movements, the machine uses a combination of motor control and feedback systems. Each motor's specific role means that precise timing and coordination are essential, especially as the machine navigates stairs. For this, a motor control system involving PWM (Pulse Width Modulation) and directional control through H-bridge motor drivers provides the control needed for each type of movement—vertical, forward, and rotational. Synchronization between these movements is crucial, and feedback systems ensure that each component is moving in sequence, maintaining alignment and keeping the center of gravity within safe bounds during stair climbing.

Ensuring stability and safety is also a priority in this design. As the machine moves up and down the stairs, the center of gravity will shift, so the weight distribution must remain stable during each movement. This stability is especially important when the machine rotates to align with a new stair direction. Adjustments in height and forward motion are adaptable to handle different stair dimensions. Sensors help the machine detect each step's height and depth, allowing it to adjust accordingly.

Finally, when the machine needs to change direction, the motor attached to the thrust bearing rotates the central and upper portions to align with the new stair orientation. Ensuring smooth gear-to-bearing contact is essential here to prevent any unwanted wobble, which could otherwise destabilize the machine during directional changes. This careful consideration of movement, structure, power, control, and stability makes the machine both functional and safe, able to assist users reliably across various stair configurations.

For added comfort and safety, these climbers come with adjustable straps and supports to keep the person secure, while anti-slip rubberized tracks provide grip on each stair, preventing slips or sudden movements. Many models also come with a braking mechanism that lets the caregiver stop at each step, adding control and a sense of security, especially when going down the stairs. With an adjustable handle, it's easier for caregivers of different heights to control the device comfortably, reducing strain on their arms and back.

Best of all, these climbers are often available at an affordable price, usually within 30,000 rupees, which makes them accessible for families and facilities needing a reliable solution for short-term or long-term mobility assistance. They're a practical investment that brings peace of mind and greater independence to those who need extra support on stairs.

(b) What is Novel in the invention?

The novelty of our invention lies in the integration of the components in to making a helpful device which will climb different arrangements of the staircases whether they are rounded and staircase which have brakes in between.

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Structural Overview:

1.Upper Platform: The surface where the user stands. It's designed to slide forward and backward along guided sliders.
2.Central Housing: Located directly under the upper platform, it houses the motors, control electronics, battery, and other essential components. This section enables controlled rotational and forward movements.

3.Bottom Portion with Screw Jack: This base unit is equipped with a motorized screw jack that handles vertical movement, allowing Arohak to lift or lower itself as needed. It also provides a stable foundation and weight support for the entire system.

4.Motorized Components:
Aarohak uses three motors to control its movement:
Motor 1: Controls the sliding of the upper platform using a lead screw, allowing it to move forward and backward.
Motor 2: Powers the rotational movement of the upper and central sections, enabling Arohak to turn in either direction. This rotation is facilitated by a gear-shaped thrust roller bearing, which evenly distributes the platform's load and allows smooth turning.
Motor 3: Drives the screw jack in the bottom portion, enabling Arohak to raise and lower itself, providing the necessary vertical movement for climbing steps.
Operation Sequence: Aarohak climbs stairs through a precise sequence of actions coordinated by the three motors. Here's how it operates:

Vertical Lift (Jack Expansion)
Motor 3 activates the screw jack, which lifts Aarohak vertically to match the height of the next stair. This expansion raises the platform and positions it to slide forward.

Forward Slide
Motor 1 engages the lead screw, moving the upper platform forward until it reaches the next step. This brings the user forward onto the next stair.

Vertical Descent (Jack Compression)
As the weight is shifted to the platform, motor 3 reverses to compress the screw jack, bringing the central and bottom part of Aarohak to the level of the next stair, preparing it for the next repositioning step.

Repositioning the Base
Motor 1 moves the central and bottom portions to realign them under the upper platform. This step resets Aarohak's position, making it ready for the next stair.

Direction Change
When there's a change in stair direction, Motor 2 activates to rotate the central and upper portions through the thrust roller bearing. This rotation realigns the platform with the new stair direction, allowing Aarohak to navigate turns or spirals.

Safety and Balance:
Aarohak's movement is coordinated to ensure that its center of gravity remains stable throughout each step. The design of the thrust roller bearing and sliders provides balanced support and stability during transitions between stairs, even when turning.
Sensors or limit switches are integrated to ensure precise control and stop each movement as needed, providing a safe and smooth experience for the user.

Summary

Through its carefully synchronized movements, Aarohak effectively tackles each stair by lifting, sliding forward, and repositioning itself. This cycle repeats to achieve seamless stair climbing, while the rotational mechanism allows flexibility in navigating complex staircases

(c) What is the “inventive” step in your invention? Is the step non-obvious to a person from related fields?
The inventive step in Arohak's design is the integration of three coordinated motors to handle distinct tasks: lifting via a motorized screw jack, forward movement through a lead screw, and rotational alignment using a gear and thrust roller bearing system. This combination allows Arohak to climb stairs in a controlled sequence while maintaining stability and safety. The synchronized movements of these components provide a reliable stair-climbing mechanism adaptable to a wide range of staircases and user needs

(d) What are the advantages of the present invention over comparable inventions available in patent literature? Please attach a summary of your patent search*.

The current invention has several advantages over existing aid for the staircase climbing i.e. US9278036B2 ,KR20120053490 ,KR102172954B1

1. The current invention is advanced in helping the users for transportation.
2. The invention uses different systems to ensure vertical movement while maintaining stability.
3. In this invention rotation is achieved using a thrust roller bearing, allowing the upper section to realign with different stair orientations. This is essential for navigating multi-directional staircases.
4. Your design addresses this through careful load distribution with a screw jack and a stable lead screw motion.
5. The person using this staircase only needs to stand up on it and the motion is remote controlled with turning.

NOTE: The inventors should go through the Patent Search report carefully and write the difference between his/her invention and each contents of the patent search. For Patent search please contact ipr@iitk.ac.in

(e) Has the invention been tested experimentally? Are experimental data available?

Currently going under field test

(f) Technology Readiness Levels (**TRL**) description (mention the applicable stage of TRL given below). Please Mark as Appropriate with adequate justification.

☐ **TRL-1**
Research Idea
(Potential Application/Basic Principles observed)

☐ **TRL-2**
Applied Research Idea
(Hypothesis testing and initial proof of concept is demonstrated in a limited number of trials)

☐ **TRL-3**

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Project Plan
(Device Characteristics documents & project proposal completed, Proof-of concept phase)

☑ **TRL-4**
Design and Development
(POC & Safety of device demonstrated by prototype design)

☐ **TRL-5**
Standardization
(Validating the result of the prototype by testing in simulated environment)

☐ **TRL-6**
Preclinical Evaluation
(Clinical trials of functional prototype)

☐ **TRL-7**
Technology Transfer
(Technology transfer of the developed system)

☐ **TRL-8**
Clinical Evaluation
(Evaluation of the system by clinical trials or demonstration)

☐ **TRL-9**
Commercialization
(Commercialization & Post Market Surveillance)

(g) Need and Demand
(Technology gaps addressed in domestic & international markets, pain points of Industry which are being resolved)

A portable stair climber designed for both elderly residents and cargo delivery could fill critical gaps in accessibility, versatility, and usability. Many older buildings lack elevators, making stairs a significant barrier, especially for those with mobility challenges. A lightweight, compact, and easily deployable climber could provide a safe, practical solution, helping users reach multi-story floors without requiring large, expensive equipment. Current devices are often bulky and limited to either people or cargo, but a dual-purpose climber would be invaluable not only for elderly residents but also for delivery personnel handling heavy loads in buildings without elevators. This climber could address varying stair designs by incorporating adaptive technology to handle different step heights, depths, and directions. Features like anti-slip tracks, a low center of gravity, and braking systems would ensure stability, even on narrow or uneven stairs. Additionally, energy-efficient power with longer battery life would allow multi-floor navigation without frequent recharging, crucial for both personal and commercial uses. Simple, user-friendly controls could make the climber accessible even to those with minimal technical skills, empowering elderly users to operate it independently. If designed with affordability in mind, such a climber could become widely accessible, especially for low- and middle-income households. Integrating basic IoT features for monitoring battery levels or maintenance alerts would add convenience and reliability, reducing downtime and keeping users informed. Altogether, this stair climber would be a versatile, cost-effective mobility tool,

enhancing independence and safety for elderly individuals while supporting efficient cargo transport.

(h) Market Access Information

The market for stair-climbing devices is part of the broader mobility aids and assistive devices industry, which has seen significant growth driven by aging populations, increasing numbers of individuals with mobility impairments, and a push toward inclusive, accessible living spaces. Globally, the stair lift market was valued at approximately $1.3 billion in 2023 and is projected to grow due to increased demand for home modifications and healthcare investments. In domestic markets like the U.S., Europe, and parts of Asia, the demand for advanced, independent mobility solutions is especially high.

The stair lift and stair-climbing device market is projected to grow at a Compound Annual Growth Rate (CAGR) of around 6% to 8% over the next decade. However, this estimate could increase with innovations like Arohak, which introduces more advanced functionality than traditional stair lifts. Devices that can safely navigate staircases of varying configurations without structural modifications could capture a larger segment of this market by offering enhanced flexibility and independence.

(i) Future Developments

- **Sensor Integration and AI-Driven Control**: Future developments could involve integrating sensors and AI to improve Arohak's stair-climbing ability, allowing it to adapt autonomously to different stair dimensions and automatically adjust its climbing sequence for optimal safety and efficiency.
- **Energy-Efficient Power Systems**: As battery technology advances, Arohak could incorporate more compact, energy-dense batteries to extend operational time and reduce the need for frequent recharging.
- **Weight Optimization and Material Upgrades**: Lighter, more durable materials, such as advanced alloys or composites, could be used to reduce Arohak's weight without compromising its load-bearing capabilities, making it more portable and user-friendly.
- **Enhanced Safety Mechanisms**: Newer versions could incorporate more advanced braking systems, tilt sensors, and stabilization features to increase user confidence and safety.

(j) Application/s of the invention

- **Residential and Home Care**: Arohak provides a mobility solution for elderly individuals and people with disabilities who want to navigate stairs independently at home. It's particularly valuable in multi-story homes, allowing residents to avoid costly home renovations or the need for stair lifts that require permanent installation.
- **Public Buildings and Accessibility Solutions**: In public spaces such as schools, museums, and government buildings, Arohak could offer on-demand stair-climbing solutions without requiring permanent modifications. This flexibility makes it a practical choice for historical or protected buildings where structural changes are limited.
- **Healthcare Facilities and Rehabilitation Centers**: Arohak could be used in hospitals or rehab centers to help patients safely navigate stairs as part of their physical therapy. This application would help rebuild confidence and mobility in patients while allowing caregivers to focus on guidance rather than physical support.

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5. IPR Ownership

(a) Was the intellectual property created with the significant use of funds or facilities of IITK?
Yes

(b) Please describe any source of funding for the invention (Name of the funding agency and copy of agreement, letter of intent if any, must be enclosed with this form).
N.A.

(c) What is the source of Salary/Remuneration of inventor/Co-inventor?
IIT Kanpur

(d) Have you presented in any conference, seminar, etc., if yes, please give details?
No

(e) Have you published full/part of this invention, if yes, please give copy of publications?
No

(f) Was the intellectual property created in the course of or pursuant to a sponsored/consultancy research agreement with IITK? If yes, please enclose a copy of MOU with concerned project.
N.A.

(g) Was the intellectual property created as a part of academic research leading towards a degree or otherwise?
Yes

(h) **REVENUE SHARING AMONG INVENTORS:** Please disclose the extent of contribution of each inventor in the invention in percentage terms for revenue sharing.

NAME OF THE INVENTOR	% SHARE*	SIGNATURE
1. Nachiketa tiwari		
2. Astha Punjabi		
3. Dheeraj Kumar		
4. Isha Verma		
5. Soubhagya K Dev		
6. Sumit Kumar		
7. Vivek Pal		

***** If this column is not filled and signed then it will be assumed that all inventor(s) have equal contribution

6. Commercial potential

Give brief description of potential commercialization by specifying

a) Why should the individual(s)/organization may consider procuring this innovation?

*Submission of IPDF soft copy is Mandatory at the time of Patent document submission.

The system offers an efficient solution that significantly enhances the lives of elderly residents and those with mobility challenges by enabling safe navigation of stairs. This device not only empowers individuals to maintain their independence in multi-story homes but also alleviates the physical strain on caregivers, creating a safer environment for everyone involved. Beyond personal use, the stair climber addresses pressing needs in the logistics industry, where delivery personnel often struggle with transporting goods up stairs in buildings that lack elevators. Its dual functionality for both people and cargo makes it versatile, appealing to a wide range of users, from families to healthcare facilities and delivery services. With a price point under 30,000 rupees, this affordable solution stands out in a market filled with costly alternatives like stair lifts and elevators. Furthermore, the potential for rental or subscription models opens up accessibility for short-term needs, making it a practical choice for various customers. As a result, the portable stair climber holds significant commercial potential, meeting the growing demand in elderly care, mobility assistance, and urban logistics while improving daily life for countless users.
4o mini

b) These questions are related to the question (i) above:

i. In your opinion what are the steps/processes must be undertaken by the procurer to commercialize the use of this innovation?

Currently we have designed the invention as a standalone device which uses a microcontroller and Arduino IDE is used to code the device. The procurer may have to make it compatible with their hardware and software.

ii. How long may it take to reach the commercial stage by the procurer?

6 months

c) Please give specific list of companies and contact details of concerned person who can be contacted for initiating Technology Licensing

Sr. No.	Name of Companies	Name of the contact person	Contact no.

(**Unsigned & Incomplete IPDF forms shall not be accepted*).

d) Do you want to file Patent under PCT Route in other countries?

Yes ☐ No ☑

*PCT & Foreign filing is subject to monetary support from the inventor(s) Project / Personal Account. If the above option is marked “yes”, kindly provide the Project Account Details from which the filing cost could be reimbursed.

Project Account Name:
Project Account No.:

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***The institute shall file patent under PCT route only in those cases wherein industry/company has exhibited interest for commercialization.**

Disclaimer: *I/We declare that before the submission of this disclosure form or/and during the process of filing this invention as an IPR prospect, I/We will not publish the above information in public domain.*

I/We also give consent to IIT Kanpur being the applicant of this IPR prospect, that they may use this disclosure upon their discretion, which will not be limited to publication on e-auction website, Industry meets & different portals for promotional & licensing purposes.

_____	_____
Signature of Inventor with date	Signature of Inventor with date
_____	_____
Signature of Inventor with date	Signature of Inventor with date
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Signature of Inventor with date	

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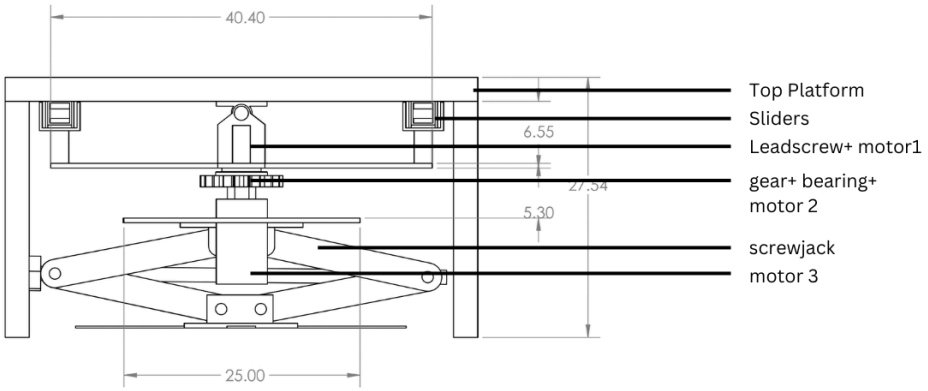

Figure 1

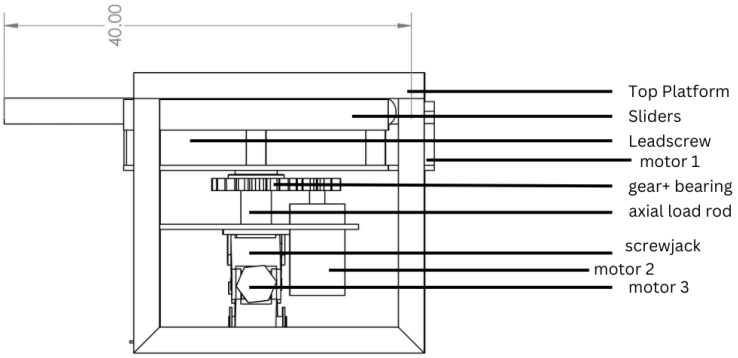

Figure 2

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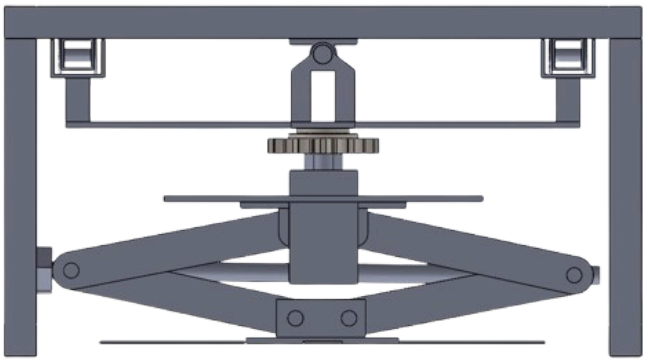

Figure 3

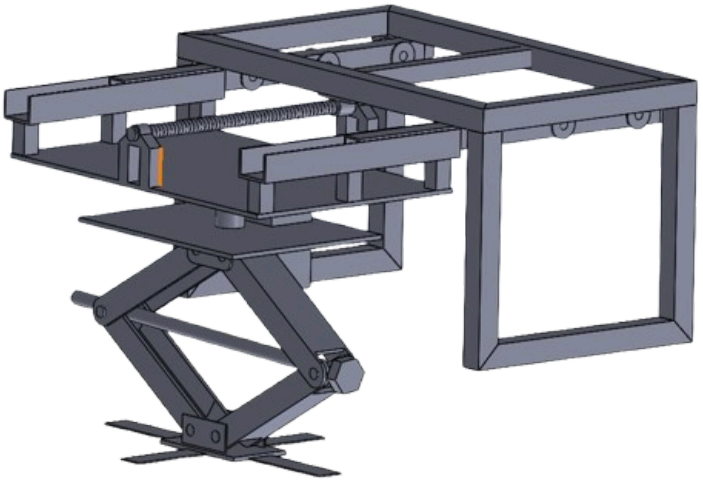

Figure 4

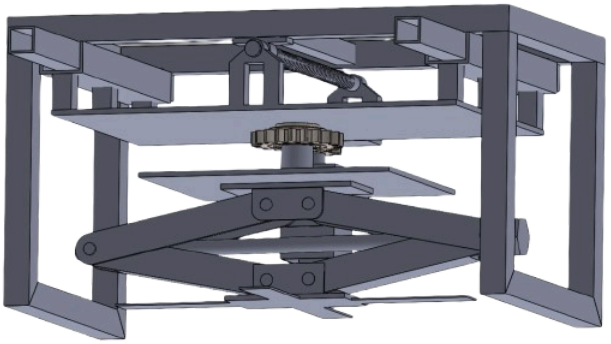

Figure 5

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Annexure- I

Illustrated examples for mentioning use case of Product/ Process

1. ***"Classification of Hard and Soft Taps on Capacitive Touch Screen" having application in below mentioned use case:***

   We all use capacitive touch screens, on a series of devices starting with smart watches, smartphones tablets laptops and desktops. The only thing you can do on the present touch screens is to indicate a location, by touching it there. It doesn't matter whether you touch it hard or lightly - the touch is definitely not 3D. iPhone X has atte mpted to introduce this feature (force touch) by including expensive special pressure-sensitive hardware. We adopt a different approach, that requires you to only install an app on the existing device. With this the same touch screen that you have been using now becomes sensitive to at least two levels of pressure, light and heavy. Every other app developer can now exploit this feature and provide more sophisticated user interfaces which can distinguish levels of touch. The possibilities are limited only by the imagination. As the technology matures, a larger number of levels of touch is likely to be supported.

2. ***"Antibacterial Nano breathing Nasal Filter" having application in***

   Many people use face mask for breathing pollution free air, but the main constraint in breathing is decrease in breathing flow rate. The innovation described herein relates to a nasal air filter, and more particularly, the invention relates to a nasal air filter based on nanotechnology for breathing by human beings that has antibacterial feature, which can mimic the natural breathing process i.e. 12-15 lpm and is comfortable to use. The nasal filter will be useful for people living in polluted cities as well persons having allergy and suffering from Asthama & Bronchitis.

3. ***"A method of measuring BMP signaling using BMP responsive reported cell line" having application in***

   Bone Morphogenetic Protein (BMP) signaling is necessary and sufficient for bone formation. It is present in several biological samples measurement of which may have diagnostic value. However, at present there is no sensitive method of detecting BMP proteins in a biological sample. In this disclosure we describe creation of a cell line based sensitive and accurate method of estimating BMP proteins in any specimen.

4. ***A unique device for plasma processing to simulating magnetospheres in the laboratory***

   The dipole plasma device would be helpful in industry for plasma processing of samples such as in the semiconductor industry, where energetic electrons (or ions) are required to impinge on a substrate and to bring about desired changes in the substrate such as plasma assisted ion doping, etching, or creation of nanostructures on metallic surfaces, the device would be helpful in understanding the physics of plasmas confined in a magnetic dipole.

5. ***Large area micro-texturing on free-form surfaces using flexible-electrode through-mask electrochemical machining***

   Surface micro-texturing deals the issues pertaining to various fields of engineering for enhancing the essential functions such as tribological, wetting, biocompatibility, sustainability, cleanliness etc. Among all the aforementioned sectors, micro-texturing of free-form large areas is getting huge attention, e.g. micro-textures on artificial biomedical implants enhances sustainability and life cycle by better implant-tissue interface, cell-adhesion and cell proliferation. Micro-textures on cylindrical surfaces (both internal and external) of bearings, piston rings, hypodermic needles assists in reducing the coefficient of friction and facilitating lubrication.

**This page is for reference purpose, no need to print this page.*

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