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IOT BASED SAFE FOOTWEAR RECOMMENDATION SYSTEM

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ABSTRACT

An IOT based safe footwear recommendation system including a body divided into a first (1), second (2) and third (3) section, where first section has rotatable arrangement (8) with multiple racks (9) for storing footwear belonging to different user(s), a platform (4) with multiple sensors attached to second portion for detecting properties of the user's feet skin, an IOT based display unit (5) linked to a microcontroller for providing footwear recommendation helping said user in deciding an appropriate footwear; multiple AI (artificial intelligence) cameras (6a, 6b) installed in the second section and racks for detecting location of footwear in the racks, a sortation conveyer assembled on the racks that rotates based on the location of footwear in order to slide out the footwear from the racks towards a collection compartment (7) attached to the third section for providing appropriate footwear to user, thereby preventing risk of severe feet diseases.

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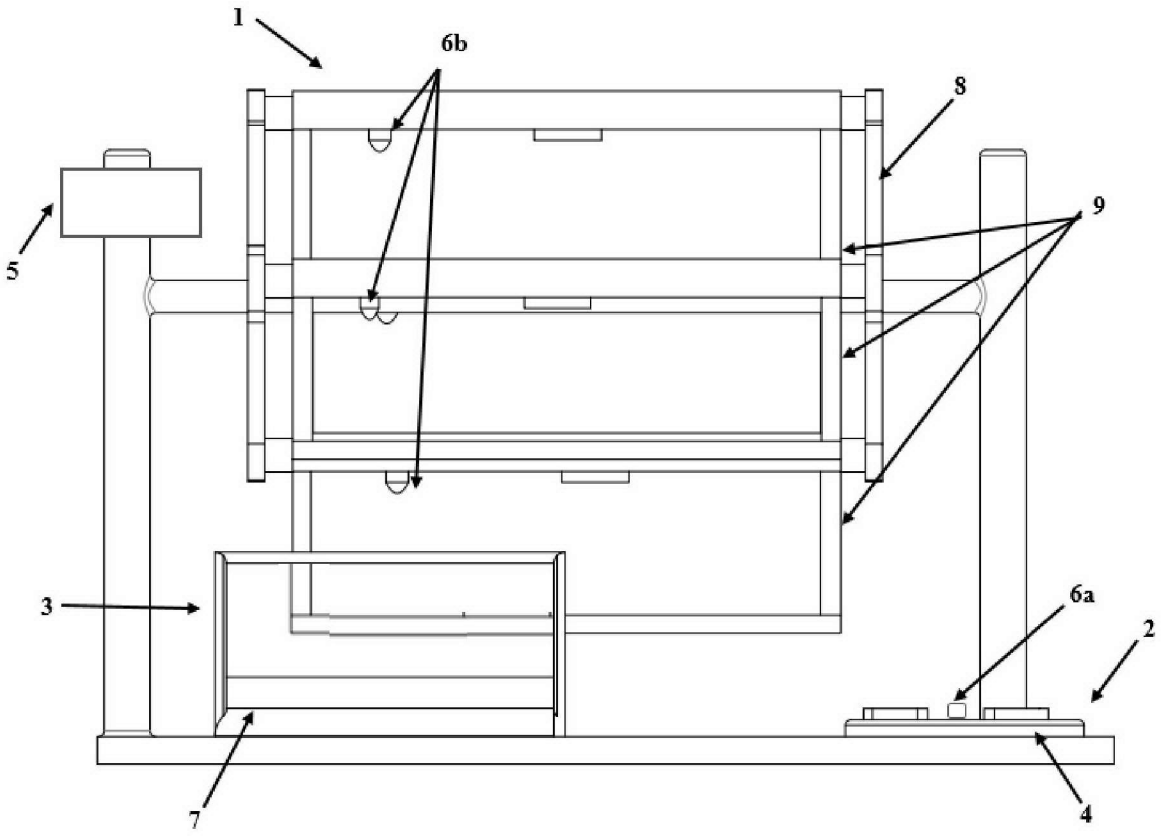

Figure 1

IOT BASED FOOTWEAR RECOMMENDATION SYSTEM

FIELD OF THE INVENTION

[0001] The present invention relates to a footwear recommendation system, and in particular to an IOT based footwear recommendation system that helps user(s) in deciding appropriate footwear for preventing discomfort and foot diseases.

BACKGROUND OF THE INVENTION

[0002] A footwear is a piece of garment usually worn on feet for preventing foot injuries, providing protection against adverse weather conditions and helping in comfortable movement over different ground textures. The advancements in footwear industry has led development of footwear design and fashion adornment keeping a balance of comfort and practical usability. However, the footwear fashion has taken over the usability aspect and people have been wearing unsuitable and misfit shoes leading to several feet diseases. Both men and women generally face problems associated with foot pain, which generally occurs by wearing ill-fitting shoes for longer time period. Women usually wear narrow and constrictive shoes making their feet prone to injuries and diseases. Tight shoes generally cause overcrowding of toes that may lead to structural defects. The defects and traumatic injuries caused by wearing extremely tight shoes, lead to foot diseases.

[0003] There have been several other effects of wearing inappropriate shoes which are focused on feet skin and nails. Wearing uncomfortable shoes leads to alterations in feet vital parameters such as humidity, temperature, production of odor and sweat. Improper footwear along with disease onset such as diabetes especially in old age lead to severe foot problems. Presence of odor is usually attributed to fungal growth inside the shoes which progresses towards feet skin causing significant discomfort, pain and itching. These infection in severe form

lead to cracking, blistering and peeling of feet skin which is transmissible from one body part to another. Therefore it is necessary to keep the footwear including shoes and socks clean and contamination free. Further, to avoid skin alterations and bone deformities in feet, it is necessary to maintain a cautious understanding of appropriate footwear according to feet conditions.

[0004] **US7478732B2**discloses about a modular footwear display system including a display module having a display surface for storing different footwear items and a divider for identifying boxed footwear associated with the displayed item of footwear. The display module has at least one mounting fixture for slidably suspending the display surface from a track. A plurality of display modules may be provided in a cabinet and adjusted to accommodate varying quantities of boxed footwear for efficient use of retail space. The invention provides an essential arrangement for storing and displaying different footwear but lacks a mechanism to recommend footwear type according to foot conditions of user(s).

[0005] **WO2016185400A3**discloses about a method and system for recommending fitting footwear. The method includes receiving multiple images of one of the foot associated with a user. At least one of the images provides information of an object placed as reference in proximity to the user's foot. A digital geometric profile is generated by processing of the images, representing dimensions of at least one foot of the user. Set of foot measurements is extracted from the digital geometric profile to classify the digital geometric profile into foot type data. A foot geometric profile is created as storage based on the digital geometric profile and the foot type data together. The foot geometric profile is then used for determining at least one fitting footwear which is displayed on the user device. The invention helps in recommending footwear based on geometric dimensions of foot but does not help in analyzing biological characteristics of foot skin for providing an appropriate footwear accordingly.

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[0006] As per disclosed prior art, the inventions are based on providing a display arrangement for storing multiple footwear items and recommending appropriately fitting footwear by analyzing feet dimensions, but lack a mechanism to analyze feet conditions and accordingly provide most suitable footwear for maintaining comfort and feet health.

[0007] In order to overcome the aforementioned drawbacks, there is a need to develop an IOT based footwear recommendation system that helps user(s) in storing different types of footwear and detects foot conditions for recommending a suitable footwear option for preventing severe feet diseases.

OBJECTS OF THE INVENTION

[0008] The principal object of the present invention is to overcome the disadvantages of the prior art.

[0009] An object of the present invention is to develop a system for storing multiple footwear pairs belonging to different user(s).

[0010] Another object of the present invention is to develop a system for detecting properties of foot skin in terms of humidity, pH, odor and microbial contamination.

[0011] Another object of the present invention is to develop a system for recommending different footwear options to user(s) based on foot properties to provide most suitable footwear.

[0012] Yet, another object of the present invention is todevelop a system for providing a suitable footwear to user(s) for preventing severe feet diseases.

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[0013] The foregoing and other objects, features, and advantages of the present invention will become readily apparent upon further review of the following detailed description of the preferred embodiment as illustrated in the accompanying drawings.

SUMMARY OF THE INVENTION

[0014] The present invention relates to an IOT based footwear recommendation system that helps user(s) in identifying most suitable footwear according to skin conditions of the user's feet and providing an appropriate footwear for maintaining comfort and prevention of feet diseases.

[0015] According to an embodiment of the present invention, the system includes a body divided into three sections – a first section for storage of footwear in multiple racks , a second section having a platform fabricated with multiple sensors for detecting feet skin parameters while a user stands on the platform, a third section in continuation with the first section for collecting footwear dispensed by sortation conveyer, multiple AI (artificial intelligence) based cameras installed in the racks and body for detecting footwear belonging to the user and location of footwear in the racks, a collection compartment configured in the third section for providing selected footwear to the user and an IOT based display unit for displaying footwear recommendations based on the user's feet parameters for providing comfortable footwear to the user.

[0016] While the invention has been described and shown with particular reference to the preferred embodiment, it will be apparent that variations might be possible that would fall within the scope of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] These and other features, aspects, and advantages of the present invention

will become better understood with regard to the following description, appended claims, and accompanying drawings where:

Figure 1 illustrates an exploded front view of a body in association with an IOT based safe footwear recommendation system according to an embodiment of the present invention;

Figure 2 illustrates an exploded perspective view of a body in association with an IOT based footwear recommendation system according to an embodiment of the present invention; and

Figure 3 illustrates a side view of a rotatable assembly according to an embodiment of the present invention; and

Figure 4 illustrates an exploded view of a lead screw arrangement according to an embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0018] The following description includes the preferred best mode of one embodiment of the present invention. It will be clear from this description of the invention that the invention is not limited to these illustrated embodiments but that the invention also includes a variety of modifications and embodiments thereto. Therefore, the present description should be seen as illustrative and not limiting. While the invention is susceptible to various modifications and alternative constructions, it should be understood, that there is no intention to limit the invention to the specific form disclosed, but, on the contrary, the invention is to cover all modifications, alternative constructions, and equivalents falling within the spirit and scope of the invention as defined in the claims.

[0019] In any embodiment described herein, the open-ended terms "comprising," "comprises," and the like (which are synonymous with "including," "having"and "characterized by") may be replaced by the respective partially closed phrases "consisting essentially of," consists essentially of," and the like or the respective closed phrases "consisting of," "consists of, the like.

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[0020] As used herein, the singular forms "a," "an," and "the" designate both the singular and the plural, unless expressly stated to designate the singular only.

[0021] As used herein the term "IOT" refers to `internet of things which is based on network of physical objects embedded with software and sensors for establishing connection and exchanging data with other devices and systems through internet.

[0022] As used herein the term "AI" refers to artificial intelligence which is inculcated machine intelligence programmed to think and perform like cognitive human brain associated to learning and problem solving.

[0023] The present invention relates to an IOT based footwear recommendation system that helps user(s) in maintaining their footwear items stored in an organized manner and provides footwear recommendation based on feet skin conditions analyzed using multiple sensors. The system includes footwear storage arrangement specifically designed for keeping footwear belonging to different user(s). The system analyzes feet skin parameters such as pH, humidity, odor and presence of contaminants to detect feet problems encountered by the user and utilizes machine learning protocol for identifying suitable footwear that helps in providing comfort and prevents feet diseases.

[0024] The system helps the user in selecting footwear by providing a rank-based recommendation list of footwear according to the user's feet parameters. The system identifies suitable footwear based on alignment of footwear characteristic and the user's feet conditions through machine learning and internet of things (IOT) based protocol and automatically provides the selected footwear without requiring manual intervention. The system utilizes a wireless communication module which is capable of being connected to the server for retrieving information regarding characteristics of footwear that are associated with different

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feet problems for analyzing footwear stored in the arrangement and providing the recommendation accordingly.

[0025] The system involves a set of footwear arrangement for storing different footwear in an organized manner. The arrangement is linked with multiple sensors that recognize different feet conditions and further the feet conditions are aligned with footwear kept in the arrangement through data processing. After the feet analysis, the footwear recommendations are provided to the user(s) through display panel. The user selects the required footwear, which is provided to the user by automatic movement of footwear from the arrangement, towards a collection compartment which is accessed by the user.

[0026] Referring to Figure 1 and 2, an exploded front view and an exploded perspective view of a body in association with an IOT basedfootwear recommendation system according to an embodiment of the present invention is illustrated wherein, a body is divided into three sections – first section **1** having footwear storage assembly **8**, second section **2** having a standing platform **4**and third section **3** having a collection compartment **7,** where the standing platform **4** is fabricated with multiple sensors in connection with a microcontroller, multiple AI (artificial intelligence) cameras **6a, 6b** attached to the body and linked to the microcontroller, multiple racks **9** arranged in the footwear storage assembly **8** where each of the racks **9** are equipped with separate AI cameras **6b** and nozzles, a sorting conveyer arranged in the racks **9** in continuation towards the collection compartment **3** which is linked with a display unit **5** through which the user(s) selects a suitable footwear for having a comfortable walking experience.

[0027] When a footwear is required from the collection stored in multiple racks **9** of the storage assembly**8**, the user stands on the platform **4** present in second section **2** of the body. The platform is fabricated with multiple sensors i.e. a pressure sensor, pH sensor, sweat sensor, odor sensor and chemical sensor for determining foot skin conditions. As the user steps onto the platform, the pressure

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sensor detects the user's presence and activates pH sensor for detecting skin pH of the user's feet. The pressure sensor is configured with a sensing element, fluid and diaphragm associated transducer. The force applied on the sensing element of constant area creates a response towards pressure applied by a fluid on the same area. The applied force deflects a diaphragm, and the deflection is analyzed by the transducer to generate an electrical signal.

[0028] As the user stand on the platform **4**, the pressure applied by the user's feet deflects diaphragm which creates an electrical output via transducer of the sensor. The generated output is transmitted towards a microcontroller which generates a command for activation of pH sensor, sweat sensor, odor sensor and chemical sensor. The pH sensor includes a hydrogen ion sensing electrode, a reference electrode and electrolyte. The presence of hydrogen ions on the user's feet skin are detected by the pH sensor fabricated on the platform and the hydrogen ions are exchanged with metal ions creating potential difference with respect to the reference electrode. The potential difference is analyzed by the microcontroller and converted to pH value analyzed by the microcontroller and displayed over the display unit**5**.

[0029] The platform also includes an odor sensor which is made up of three elements – an olfactory receptor, detector and transducer. The receptor detects volatile molecules responsible for creating an odor and detector undergoes reaction in terms of change in electrical properties of the detection element. The molecules are either charged positively or negatively which alters electrical field created inside the sensors. Accordingly, the transducer generates an electrical output which is received by the microcontroller.

[0030] The presence of sweat in the user's feet is detected through a sweat sensor attached to the platform **4**. The sweat sensor are biochemical sensors which utilize a molecular chemical receptor and a physico-chemical detector (transducer) to collect information regarding presence of chemical constituents corresponding to

onset of a disease. The sensor performs recognition reactions in response to chemical behavior of an analyte and detects measurable change in the chemical reaction. Based on the type of transducer these sensors are classified as – optical, impedance-based and piezoelectric sensors. For example, electrolytes such as sodium, potassium and chloride present in sweat are utilized for detecting electrolyte imbalance and hydration properties of the feet skin.

[0031] Accordingly, the electrical output generated by the transducer is transmitted towards the microcontroller for detecting presence of sweat constituents related to health status of feet skin. The chemical receptor is capable of being improvised for detecting presence of microbial metabolites present in the feet skin. These metabolites mark the onset of microbial growth such as bacterial or fungal infection. The output generated by the sensor is aligned with information provided by the odor sensor for identifying type of microbial infection present in the user's feet.

[0032] The output generated by all the sensors – pH, odor and sweat sensor is analyzed by the microcontroller in a coordinated manner by utilizing machine learning protocol. The microcontroller is programmed for conducting comparison of information generated through the sensors with feet disease information available on the server. The microcontroller retrieves standard information regarding feet disease and role of footwear in those diseases through a communication module connected to the server. The information retrieved form the server is taken as reference and accordingly, the user's feet status is analyzed to control further functions of the body.

[0033] The microcontroller (MCU) as the name explains is a small unit that executes dedicated tasks assigned or programmed by a user. The task may be related to normal calculations like addition, subtraction, division and floating point math. The microcontroller controls, processes and stores the information in memory received from the camera module. The memory size of the

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microcontroller varies for different microcontroller families.

[0034] The basic architecture of the microcontroller comprises of a central processing unit (CPU), clock, crystal oscillator, memory and hardware peripherals connected internally with each other. The CPU is basically the brain of the microcontroller that follows out an action stated by the user in the form of programs. The motor-controller contain data collection and data logging abilities as well as application specific control logic. The mentioned data are generally received by a microcontroller that is electronically paired with the motor controller. The motor controller correlates the data received by the microcontroller with motors attached to the mechanical elements and controls further functioning of the body.

[0035] The body also includes multiple AI (artificial intelligence) based cameras **6a, 6b** for associating footwear kept in the racks with their owners. The camera **6a** is configured with the body to capture image of the user and accordingly identify the footwear belonging to the user. The racks **9** also contain multiple AI cameras **6b** for detecting footwear kept in the racks. The camera used herein is basically structured of three elements: an optical element i.e. the lens, a chemical element comprising of a film and a mechanical element i.e. camera body. These components work in synchronization to each other to capture images in the surroundings. The lens is a simple curved piece of gals that takes beams of light bouncing off of on an object and redirects them in such a manner that they form a real image. This is done by deflecting or changing the path of the incident light by slowing down it into the air. Thus, one of the cameras visually examines the association of footwear with the user and another camera detects location of footwear in the racks.

[0036] Referring to Figure 3, a side view of a storage assembly according to an embodiment of the present invention is illustrated, wherein the racks **9** are attached around a frame rotating in an upright manner holding multiple racks

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along the circumference. The racks **9** are arranged around the frame such that as the frame rotates, the racks remain upright by the influence of gravity. The gravitational force helps in maintaining the racks'**9** orientation parallel to the ground. The frame is mounted on a motorized shaft **10** holding the assembly attached to first section of the body.

[0037] Referring to Figure 2, an exploded perspective view of a body in association with an IOT based safe footwear recommendation system according to an embodiment of the present invention is illustrated, wherein as the user's feet skin properties are analyzed, the microcontroller provides electrical signal towards a display panel **5** attached to the body. According to the feet information detected through the sensors, the microcontroller provides different footwear options available in the racks**9** through the display unit**5**. Each of the footwear options are presented with a recommendation score which is evaluated on the basis of footwear material and feet skin parameters of the user. The display unit **5** is inbuilt with a keypad through which the user selects a suitable footwear based on the recommendations score. The signal generated by the keypad is transferred to the microcontroller which operates the rack assembly **8** according to the user's input.

[0038] Referring to Figure 4, an exploded view of a lead screw arrangement according to an embodiment of the present invention is illustrated, wherein the AI camera **6b** attached to the racks **9** scans the location of selected footwear and provides an output towards the microcontroller. The camera is capable of moving along a lead screw arrangement. The arrangement includes two screw threads attached to each other in plus-shaped manner such that the camera **6b** is mounted on a motorized nut directly contacting the screw thread. The lead screw assembly converts turning motion to liner motion of the nut. The nut and screw thread have male and female members aligned to each other for movement of nut over the screw thread.

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[0039] According to command provided by the microcontroller, the camera **6b** mounted on a primary nut moves along a primary screw thread **12** via operation of the motor, providing a linear movement to the camera in x-direction. The primary screw thread is attached to a secondary screw thread **13** through a secondary nut attached to another motor. The camera **6b** mounted to the primary nut attains movement in y-direction by movement of primary screw thread **12** over the secondary screw thread **13** via motorized secondary nut. Thus, the assembly helps the camera to visualize footwear kept in racks in both directions. The movement helps in identifying location of the selected footwear which is transmitted towards the microcontroller.

[0040] The microcontroller provides electrical signal towards the motor attached to the shaft **10**, leading to rotation of shaft **10**. As the shaft rotates, the racks **9** attached to the shaft **10** change their positions until the rack containing selected footwear is present at front portion of the body. The racks **9** are equipped with sortation conveyer where footwear are kept. The sorter conveyer functions in response to output provided by the microcontroller for moving selected footwear towards the collection compartment provided in third section of the body.

[0041] The sortation conveyer includes multiple omnidirectional wheels on the surface establishing contact with the footwear. The microcontroller provides signal towards different wheels tracing the path from selected footwear to the collection compartment. The output provided by the microcontroller, operates the wheels in a synchronized manner such that selected footwear moves over the wheels, transitioning form one wheel to another in the path towards the collection compartment. The conveyer finally releases footwear towards the collection compartment (third section) where the footwear is manually picked and worn by the user.

[0042] In an embodiment of the present invention, referring to Figure 4, the camera attached to the racks also detect cracks, wear and tear caused to polish and

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upper lining of the footwear. The lead screw assembly further includes another nut where multiple nozzles **11** are attached on an element in a combined manner. The element is capable of moving in x and y direction through mechanism similar to that of the camera. These nozzles **11** are attached to multiple chambers containing fillers and shoe polish fluids according to different footwear material. As the camera **6b** visually spans footwear placed in different racks and analyzes presence of surface deformities, the signal is transmitted towards the microcontroller. The microcontroller analyzes the combination of footwear material to polish fluids and provides signal towards electrical valves attached to respective chamber for dispensing the fluid towards the nozzle via pipe connecting nozzles**11** to the chambers. The nozzles **11** provide the polish fluids towards the footwear surface and help in footwear maintenance.

[0043] In an embodiment of the present invention, one of the racks **9** associate with the footwear storage assembly **9** is utilized as socks storage rack where different socks owned by the user(s) are stored. The camera associated with the rack detects material of socks transmitting information towards the microcontroller. The feet skin parameters detected through the sensors and socks fabric data analyzed by the camera are compared through machine learning protocol for providing socks recommendation to the user(s) for preventing skin diseases.

[0044] In an alternative embodiment of the present invention, the racks and platform associated with the body may include radiation sterilization unit preferably ultraviolet-C unit operated through said microcontroller for sterilizing feet of user(s) standing on the platform for feet skin parameters detection. The unit may be included in the racks for sterilization of footwear and socks, ensuring contamination free footwear management.

[0045] Although the field of the invention has been described herein with limited reference to specific embodiments, this description is not meant to be construed in

a limiting sense. Various modifications of the disclosed embodiments, as well as alternate embodiments of the invention, will become apparent to persons skilled in the art upon reference to the description of the invention.

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CLAIMS:

1. An IOT based footwear recommendation system, comprising;
   i) a body segregated into a first, second and third section, wherein a rotatable arrangement having multiple racks is installed in said first section for storing footwear belonging of different user(s);
   ii) a platform configured in said second section to allow said user to stand thereon, wherein said platform is fabricated with plurality of sensors for detecting properties of user's feet skin;
   iii) an IOT based display unit attached on said body and linked to a microcontroller for providing footwear recommendation to said user based on output provided by said sensors, wherein said user selects a footwear among recommended options through said display unit;
   iv) plurality of AI (artificial intelligence) based cameras installed in said second section and racks connected to said microcontroller for identifying said user and location of said selected footwear in said racks;
   v) a sortation conveyer assembled on said racks and connected to said microcontroller, wherein said sortation conveyer rotates based on the location of footwear in order to slide out said footwear from said racks;
   vi) a collection compartment attached to said third section, positioned in proximity to said racks for collecting the dropped footwear from said conveyer in order to provide an appropriate feet care based comfortable footwear to said user.

2. The system as claimed in claim 1, wherein said sensors include but not limted to a pressure sensor, pH sensor, sweat biochemical sensor and odor sensor connected to said microcontroller for detecting foot problems encountered by said user.

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3. The system as claimed in claim 1, wherein said arrangement functions in coordination with said AI (artificial intelligence) cameras, wherein said microcontroller rotates said racks after detecting said user and footwear via said cameras to provide an appropriate footwear to said user.

4. The system as claimed in claim 1, wherein said platform is capable of detecting sweat and odor present in socks through said sensors, accordingly socks owned by said user are sorted in one of said racks and recommendations are provided to said user.

5. The system as claimed in claim 1, wherein said racks include a lead screw arrangement for installing said cameras and plurality of nozzles operated through said microcontroller for providing repairing solution towards said footwear as per wear and tear based footwear information detected through said cameras.

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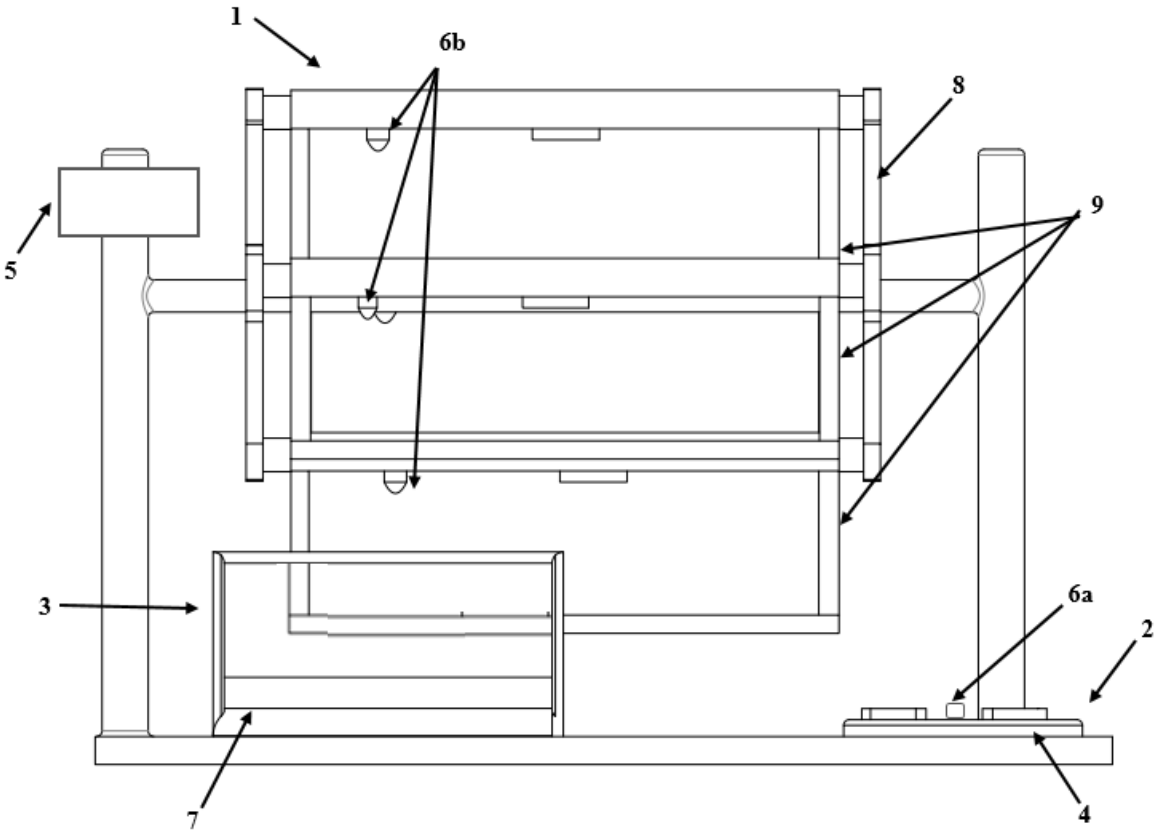

Figure 1

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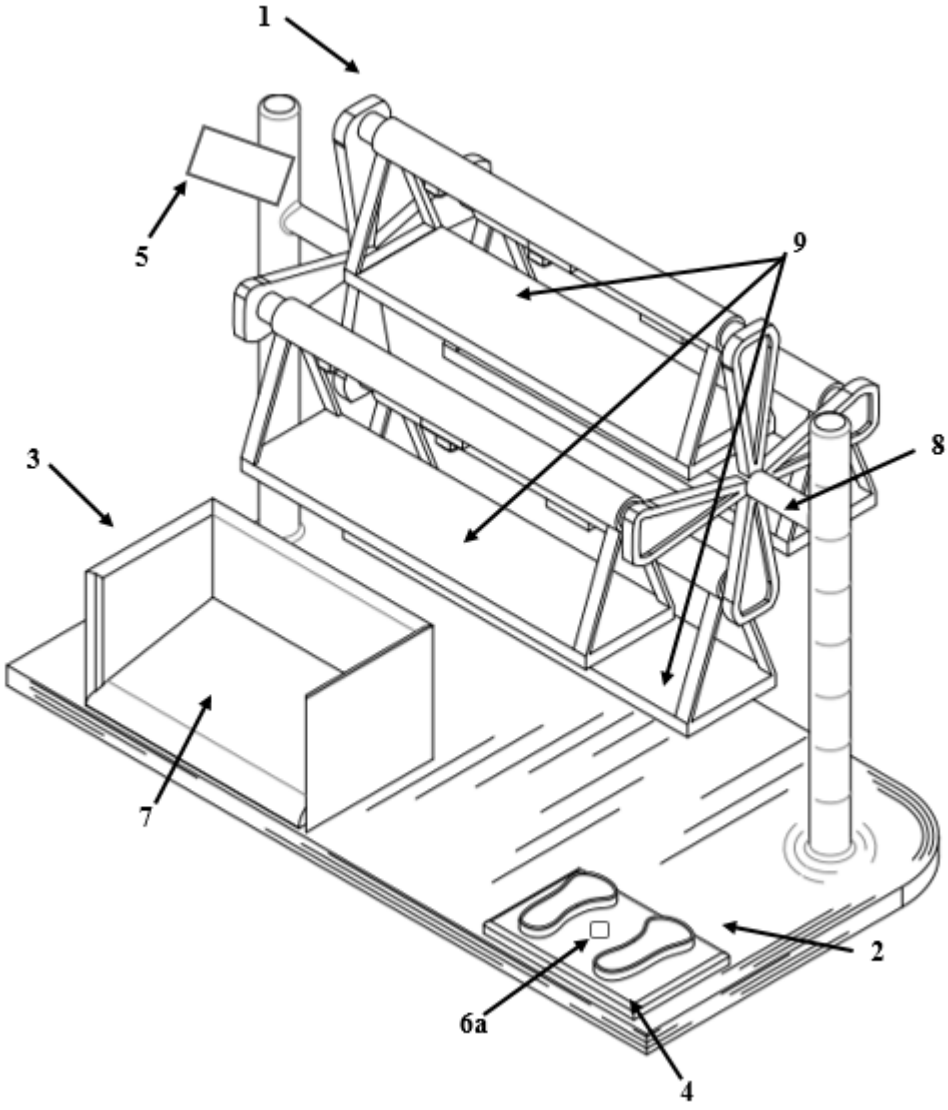

Figure 2

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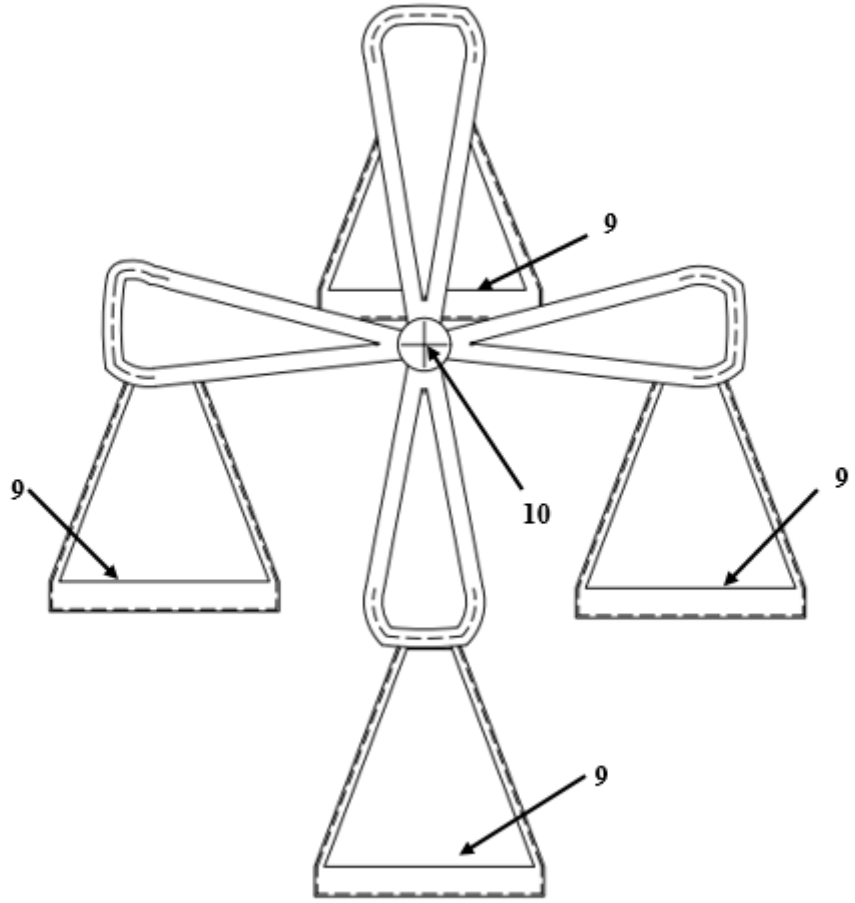

Figure 3

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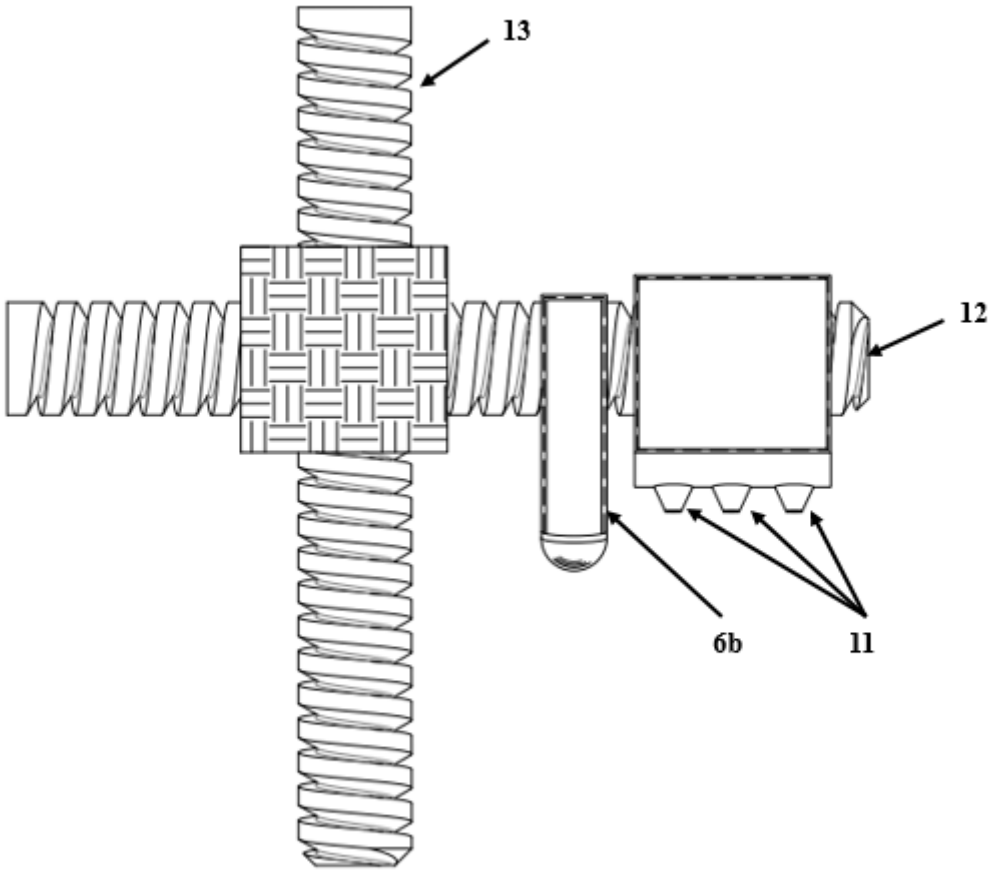

Figure 4