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Self-Balanced Walking machine for Specially Abled people controlled by brain signals.

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Abstract

The World Bank [1]reports, “One billion people, or 15% of the world’s population, experience some form of disability”. Further, it is reported that about 110 million people experience disabilities. And from the report of Research Gate [2]“Approx. Twenty percent of disabilities are related in movement” calculating 20% of 110 million we get 22 million people and living in the 21st century where technology available is Impacting Human Growth like never before. We are striving to use a part of this technology to assist those 20% percent to live their life ordinarily.

The idea for this project was realized when one of our team members was narrating an event about his uncle where his uncle was not able to walk due to a mishap and restorative treatment associated with the problem to being fit to walk again was very high which cannot be afforded by him. So we realize this won’t be the matter of that only person there will be countless more Specially abled people who cannot experience a natural life due to one or other reasons. Hence we selected to take up this project and Apply Our Engineering Knowledge to create a difference in Their Lives.

Market survey and literature

Existing Products and Techniques are costly or are country-specific such Techniques are listed below

1) Re Walk Exo Suit [3]
Fully Developed Exoskeleton Suit by a Company Named ReWalk. The drawback is it requires a Stick for balancing and is also expensive and only restricted to spinal cord injury.

2) Yoshiyuki Kumada et al. [4]
Purposed brain wave detection using electrode Mechanism. He used it to detect a disease called Alzheimer’s. Brain wave signals are detected by bringing a plurality of electrodes into contact with the scalp, but using electrodes in our project will be difficult. It is better to go with the Research of Robert Cain [5], where he detected brain signals from the part of the ear.

Hardware Requirements

1. High Torque DC Motor to move Exoskeleton Back and Forth
2. Controller Arduino/Raspy
3. EEG for Brain Wave detection
4. Motor Driver
5. Aesthetics
6. Batteries
7. Protection Circuits
8. Camera

Software Requirements

1. Arduino IDE
2. Python Compiler
3. Open CV

Implementation

- Once the machine is in position with the human body(The person is currently sitting), the machine will start working and help the person to stand.
- After proper balance is achieved, the person can start walking with the help of the machine.
- The machine has high torque motors for legs for proper movement of the legs along with the machine.
- The machine will have a metal exoskeleton on which the motors will be mounted.
- An EEG sensor will be used to take the brain signals.
- These signals are then fed to a microcontroller, and the controller will give the appropriate signals to the motor drivers.
- Motor drivers will drive the motors in different directions. For example: If the person wants to move forward, the drivers will enable the forward motion of the motors.

- The machine is also provided with a safety protection circuit. If the machine by some chance fails and there are some mishaps, the machine will automatically switch off and will go back to its original position. Also, a switch is provided when pressed the machine will shut down and will go back to its original position(when both legs are straight).
- The system is also provided with object detection using image processing to calculate the distance of the object from the person and to stop the person if the distance becomes less than a certain parameter.

This system will have the following things:

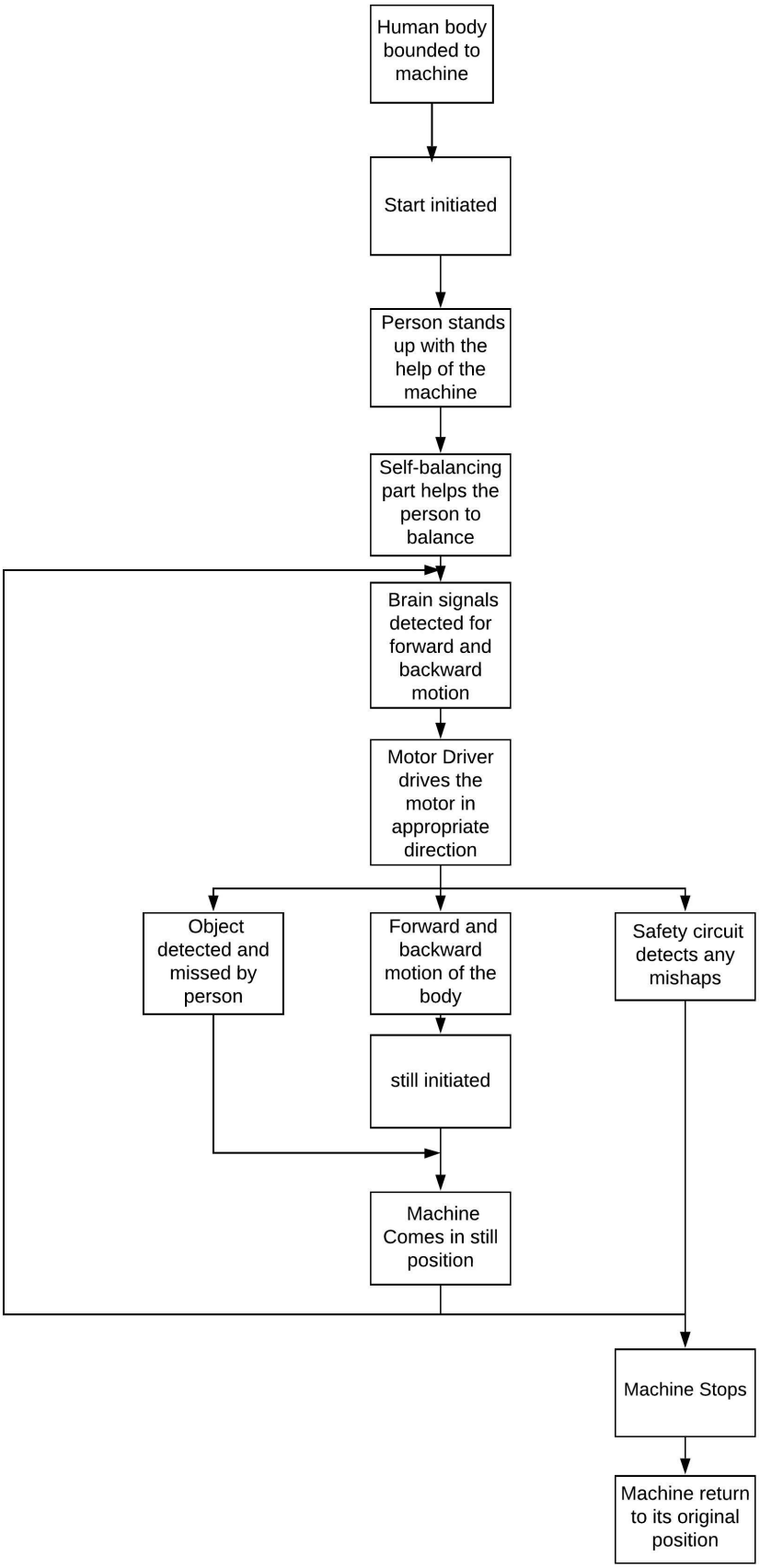
1) Brain Senor using EEG :
After measuring the signals, the sensor converts these signals into a suitable form of data, and this data is then transferred to the controller of the device. So by measuring these signals, we can automatically give the command to the machine in which direction to move and where to stop, etc.

2) High Torque motors:
The machine will have high torque motors for both the legs. After the signal from the brain is received by the controller, the controller will drive the motors accordingly. As the motors start moving, they will push the legs of the person and will help the person to walk. Proper synchronization of both the legs is mandatory and will be achieved by the controller with proper safety precautions.

3) Image processing :
Image processing is a method to perform some operations on an image in order to get an enhanced image or to extract some useful information from it. It is a type of signal processing in which input is an image, and output may be image or characteristics/features associated with that image. Nowadays, image processing is among the rapidly growing technologies. In the system, we are achieving image processing using open cv to detect the object in front of the machine.

4) Camera:
The camera will be mounted on the exoskeleton and will capture the images. Using image processing, the distance of the object will be calculated. If the object is below certain parameters, the machine will shut down so as to avoid any collision of the person and to provide safety standards.

Flowchart


Human body bounded to machine
Start initiated
Person stands up with the help of the machine
Self-balancing part helps the person to balance
Brain signals detected for forward and backward motion
Motor Driver drives the motor in appropriate direction
Object detected and missed by person
Forward and backward motion of the body
Safety circuit detects any mishaps
still initiated
Machine Comes in still position
Machine Stops
Machine return to its original position

Feasibility

Current methods are very Expensive or not reachable to All. Being in India Price matters a lot. So we are striving to provide a solution to this problem which can be in the budget and can be accessible to all. Following are some problems that can be faced by us while solving this problem and our probable solution to it.

1)Person being overweight

Problem: -

If the person is overweight, the motors may fail to push his leg in the forward direction, and he won't be able to walk.

Solution:-

Using motor of high torque i.e., considering a worst-case of person weight 100kg and reducing the weight of person having weight more than 100kg to below 100kg before using the Machine.

2) Mentally Unstable Person

Problem: -

Having a Mentally Unstable person decoding EEG signal from brain waves will be difficult.

Solution:-

Providing Joy Stick to control Exoskeleton.

3) Person may be harmed due to High Torque Motor

Problem: -

Having more than three almost 50 kg Torque motor if sny one dysfunction it may harm the person.

Solution:-

Having a Button that may reset or stop the exoskeleton.

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