SUPPLEMENTAL SYSTEM FOR ASSISTING THE KNEE JOINT USING PASCAL'S LAW

Project Reference No.:*45S_BE_2149*

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Introduction:

The knee joint is the largest joint of the human body and is designed to support the entire weight of the body, enabling us to walk, run or dance. Damage to any structure in the knee joint can impact normal knee movement. Knee pain is a common complaint affecting people of all ages, young and old. Knee pain can be a result of injury, such as a ligament tear or damage to the menisci, or can be age-related such as ortho-arthritis. It is also encountered in a myriad of other conditions, such as auto-immune disorders (rheumatoid arthritis), or as a result of accumulation of metabolic products in the joint spaces (gout). Through extensive research and survey it is found that around 25% of people around the world, who are above 50 years of age have serious problems related to knee joints. In India 15% of people are already taking treatments for knee pain, which is about 18 crore people roughly.
In the past ten years, wearable lower limb powered orthosis have been developed. Orthosis is an external medical device (such as a brace or splint) for supporting, immobilizing, or treating muscles, joints, or skeletal parts which are weak, ineffective, deformed, or injured. There are many lower limb orthosis device are developed to reduce the knee pain. Some of the devices are passive gravity balancing passive leg orthosis , Powered Leg Orthosis , Hybrid Assistive Limb (HAL), Rewalk and Ankle Foot Orthosis etc. But these devices are complex , expensive , rigid, and consume more power.
We can overcome this problem by Building an external metallic partial leg casing with adjustable range of motion knee brace material and High Torque DC Geared Motor which is connected to the hydraulic pump which can be controlled manually through mobile App using IOT concept if desired.

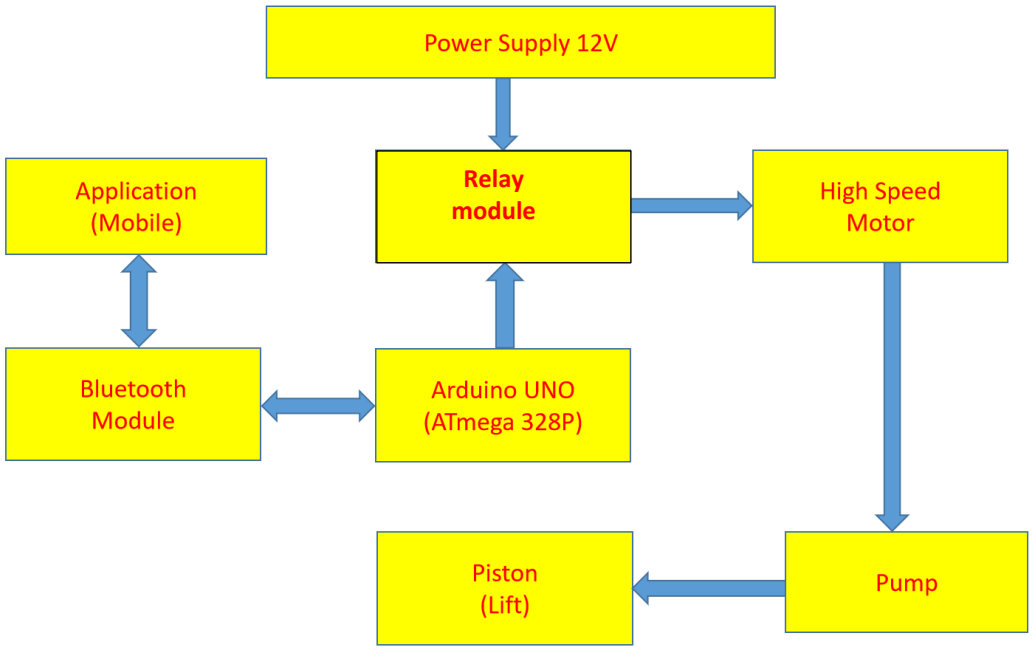
Objective:

(a) Develop a device strapped to knees which will mechanically act as a joint.

(b) Implementation of hydraulic lift to assist the action of standing and sitting.

(c) Creating an app with an user-friendly user interface to control the device.

Methodology:



(a) A partial casing of human foot with adjustable circumference is moulded using GI steel and carbon fibre with the thickness of 6mm, this is attached with the hydraulic lift.

(b) A microcontroller(ATmega328P) is assigned to control the signals from the Bluetooth module(HC-05) with range up to 100m.

(c) A pump with 6 Bar Pressure is attached to the 60 rpm BLDC motor with 12v supply.

(d) A mobile application is created to control the knee movement of the system user.

(e) Here the user can control the system at his finger tips

(f) Separate buttons are allocated for sitting and standing action.

(g) The system is also mounted with a safety value to limit the knee movement

Results and Conclusion:

Our wearable smart device assists in sitting and standing using the hydraulic lift mechanism. This is achieved by receiving input from the user through an Android app, which has been developed. The app instructs the microcontroller to actuate the motor in desired direction and speed to help in the movement of the knee.

Sitting and standing position

Scope for Future Work:

(a) Molding the exoskeleton with more user friendly material like aluminum 7075.

(b) Mounting double hydraulic lift mechanism to the exoskeleton

(c) Adding the feature of remote diagnosing to monitor the health of the motor.

(d) Implementing gyroscope for perfect balancing of the body.