Intelligent Hiking Aid for Rewalk

M.Alex[1], K.Brindha[2], S.Kanimozhi[3], V.J.Janani[4]

[1, 2, 3] *Student, Department of Electronics and Communication Engineering, KGiSL Institute of Technology, Coimbatore-641035*

[4] *Assistant Professor, Department of Electronics and Communication Engineering, KGiSL Institute of Technology, Coimbatore-641035*

Abstract- **This paper presents Hip joint and knee joint motion adaption mechanism based on the movements of joints of the human body. The movement of the user is sensed by the force sensor. This device is built with four wheels, equipped with the battery power supply and the user intention is observed by the pelvic rotation. Many of the walking assist devices have been developed to support the general walking style in sagittal plane. These devices assist Flexion-Extension of the Hip and Knee joints. The invention of hiking aid proposes an algorithm to estimate human intentions related with walking in order to comfortable and safety support for a patient's walk. This device has been developed for an enhancement of walking abnormality or weakened muscle resulting from aging. It consists of devices that provides user with additional and independent limbs. In order to control additional limbs as if they were part of the user's body. The voluntary signals are independent of natural limbs motion. It is the updated version of walking aids like assistive canes, crutches and walkers.**

Index Terms- **Human intention; Hiking aid; Enhanced walking; Motion Control; Walking Support.**

I. INTRODUCTION

The technology has made day-to-day life more simplistic and less compatible. Hiking aid is one of the fundamental requisite for weakened muscle resulting from aging. Nowadays, the major challenge faced by most of the elderly person is walking inability. Until now no walking assistance have been technologically developed for comfort and safe walking. Any person who needs hiking aid has concerns about its comfort, safety and quality. It may contain other features like sensor module, servo motor and accelerometer. Our job is to make sure that the people requirements are fulfilled.

The user intention is sensed by the force sensors and accelerometer. Force sensors placed in the two feet (left and right) and Accelerometer is used to measure pelvic rotation. The left and right leg usage is decided by the pelvic rotation of the user. Forward and reverse motion is decided by the result of the force sensors. The motion is done by the four wheels equipped with the hiking aid.

These wheels are controlled by the DC servo motor and L298 IC. Experiments were conducted and the results verified the effectiveness of the developed system and control methods.

In this study, the hiking aid is developed for walking assistance, training and rehabilitation of the elderly people. The purpose of the hiking aid is to enable the operator to walk more comfortably by sensor technology. Based on recognizing the human user's motion intentions by multiple sensors, the hiking aid is aimed to provide physical support and mobility aid for the elderly person during their walking. A sensors based force measuring subsystem is designed to acquire the interaction forces between the user and the hiking aid. The user's motion intention is then estimated by analyzing the relationship between the measured interaction forces and human intention force. Furthermore, the estimated intention is used to guide the admittance-based motion control of hiking aid.

II. EXISTING SYSTEMS

A. *Independent, Voluntary Control of Extra Robotic Limbs*

This system presents a wearable robot prototype that can achieve these goals with an extremely light weight apparatus. In order to control additional robotic limbs as if they were part of the user's body, we need voluntary signals that are independent of

natural limb motions and comfortable to measure. One suitable solution explored in this study is the use of muscle activation signals generated by the torso.

Drawbacks

One disadvantage to using exoskeletons in the medical field is the specificity that each patient would require. Creating a custom exoskeleton to meet the unique needs of a patient would be very expensive. This is why one of the biggest challenges is creating an exoskeleton that could help a wide range of patients. Another tricky issue is how much assistance the exoskeleton would provide in cases where the patient has muscular atrophy or tissue damage. If the exoskeleton provides too much support the patient will never be required to use the damaged tissue and therefore won't help to rehabilitate it. On the other hand if it does not provide enough assistance then it is totally useless. The trick is finding the exact amount of work for the exoskeleton to perform. This is another issue like customization that will make it hard to create exoskeletons appropriate for unique patients.

B. *Wearable Sensing System for A Lower Extremity Exoskeleton*

Assistive type lower extremity exoskeletons (ASLEE) which serves as lower limb disabilities always operate under a customized gait to achieve the dream of walking again. With the help of this kind of exoskeletons, the patients can only complete a relatively normal walking function such as flat ground walking, climbing up and down stairs, sitting down and standing up, which greatly improve their daily living but also, they are able to return to their normal life and community.

Drawbacks

The application environment of an ASLEE is complex because it is used in daily life. In addition, many patients are complete SCIs, who cannot feel their low limb, thus it is difficult for them to confirm the motion state of the exoskeleton. Once the user losses balance, there is no way that the ASLEE provides any active protection. Therefore, the ASLEE must have the ability to sense the patient's body motion status.

C. *Powered Exoskeletons*

Powered Exoskeletons improves a person's physical capability and wellbeing. When a person attempts to move, nerve signals are sent from the brain to the muscles through nerve cells. This moves the musculoskeletal system as a consequence. Weak bio-signals can be detected on the surface of the skin and the signals through a sensor attached on the skin of the wearer. Based on the signals obtained, the power unit is then controlled to move the joint in time with the wearer's muscle movement. The system is powered by a backpack battery, and is controlled by a simple wrist-mounted remote which detects and enhances the user's movements.

Drawbacks

Exoskeleton suit problems that remain revolve around the issue of safety. Sudden involuntary or unplanned movements could result in serious injuries if safety protocols were not designed correctly. Fully mimicking the motions of the human body may prove much more difficult than the designing safety protocols. The flexibility of the spinal column may be the trickiest puzzle that requires solving.

III. PROPOSED SYSTEM

Various proposals have been made for a walking assistance device that is adapted to mount an actuator to the hip joint or knee joint of a person having a walking impediment due to injury, disease or weakened muscle resulting from aging, so that the power from the actuator can be used to assist the movement of the lower limb. Conventionally, in such a walking assistance device, it was necessary to fasten corset-like support members onto the hip, thigh and lower leg portions to securely mount rotational actuators on a side of the hip joint and knee joint and transmit the drive torque from the rotational actuators to the lower limb.

The proposed hiking aid equipped with the L298 IC motor. To interface the motor allows the human to intuitively control the system just by the pelvic rotation. It is controlled with the use of static handles equipped with the accelerometer. The movement of the user is sensed by the force sensor. The device is built with four wheels, equipped with battery power supply. The wheels are fixed in the two feet and controlled by the dc gear motor.

This invention relates to the field of assisted walking for handicapped persons. Such persons may have become paralyzed or partially paralyzed as a result of accident or physiological disorder. Early work in this field concentrated upon walking assistance for persons who were only partially disabled. This invention relates to a device which is designed to be strapped onto a person and which provides assistance in lifting the proximal leg (that is, the thigh) while taking step. This device is to be worn by a person in order to stabilize lateral support muscles to assist in overcoming pelvic sway (called "hip drop") during walking.
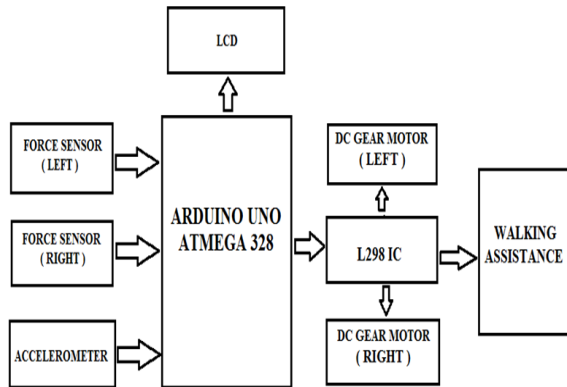
IV. SCHEMATIC REPRESENTATION

Fig.1 Block diagram

A. *Force Sensor Interface*

To the motion control of an active type walking support system, one of the vital goals of the manageability is the effective detection of the user's walking intentions. Also, the design of the human-robot interface should realize the easy and smooth operating experience. By detecting the user's intentions though physical interaction, the force sensor interface offers a naturally and intuitively way to reach that goal. Compared with other force sensor devices like joysticks or levers, the flexible type device is better in this case because this type of device is familiar to the elderly and their preconceived notion. Another problem should be taken into consideration is the stability of the human-robot interface of an active type walker. In our design the force sensors embedded in two feet offers a nature negative feedback loop of the motion control. By such a way, this interface guarantees a stable realization of the motion control.

Fig.2 Force sensor

B. *Measuring Method of Link Inclination Using Accelerometer*

As shown in Fig.2, the gravitational acceleration g[m/s2] is imposed in the vertical direction. By using the 3-axis accelerometer, we can measure gravitational acceleration decomposed in three directions under the condition of no dynamic acceleration. To measure the inclination of the link, we set the x–z plane of the accelerometer coordinate system corresponds to the $X - Z$ plane of the global coordinate system as shown in Fig.2.
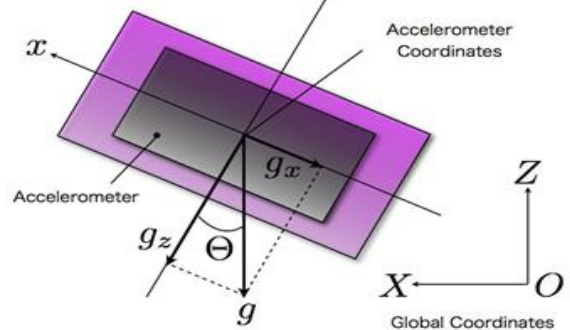

Fig.2 X-Z plane of global coordinate system

Consequently, the inclination of the accelerometer can be calculated by equation

$$\theta = \tan^{-1}(g_x/g_z)$$

Where Θ is inclination of the accelerometer with respect to the vertical direction. gx and gz are gravitational accelerations in the direction of x axis and z axis in the accelerometer coordinate system, respectively. By attaching the accelerometer to the support device, the inclination of the human links can be measured.

To accomplish the support of swing phase of the gait, it is necessary to measure the inclination of the link with respect to the vertical direction for calculating

the support knee joint moment. First introduce a method to measure the inclination of the link with an accelerometer. Then we verify the effectiveness of the method by preliminary experiments. Finally, we apply the method to the Wearable Walking Helper with an accelerometer and evaluate the reduction of the burden of the user during walk.

C. Interface of L298ic with Gear Motors

The L298IC driver module, using ST's L298IC chip can directly drive two 3-30V DC motor, and provides a 5V output interface can 5V single-chip circuitry to supply, support 3.3VMCU control, you can easily control the DC motor speed and direction. To control the motor we need a motor driver as the current drawn by the motor is large to be provided from the microcontroller. Thus a motor driver IC L298N is mounted on the shield. This IC can control two motors. An H- Bridge setup is needed to provide the sufficient power to the motor. The driver controls the motors through this H Bridge. The motors could be connected to the shield through the screw terminals which are named as MOTOR A and MOTOR B. The screw terminals in between these two motors are the dedicated power source to the motor. The MOTOR A is connected to Pin 6 and 5. The MOTOR B is connected to 10 and 11
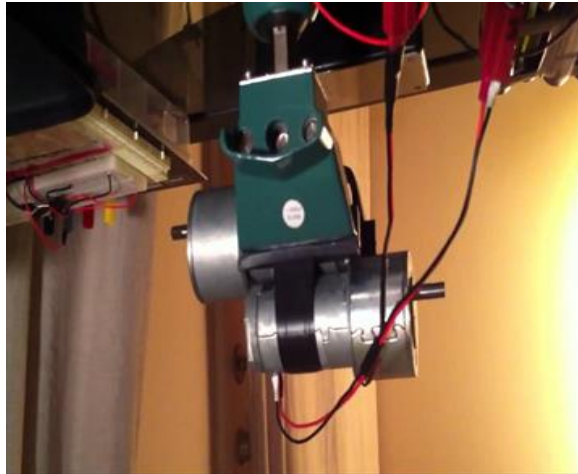

Fig.3 Gear Motor

D. Arduino Uno

Arduino is an open source devices prototyping stage in light of adaptable, simple to use hardware and programming. It's proposed for specialists, originators, specialists and anybody intrigued by making intuitive articles or situations. It's an open

source physical processing stage in light of a microcontroller board and an improvement situation for composing programming for the board. In basic words Arduino is a little microcontroller board with a USB attachment to associate with your PC and various association attachments that can be wired up to outside gadgets, for example, engines, transfers, light sensors, laser diodes, amplifiers, mouthpieces and so on. They can either be fueled through the USB Association from the PC or from a 9V battery.

The Arduino microcontroller board depends on the ATmega328P. It has 14 computerized input/yield pins (of which 6 can be utilized as PWM yields), 6 simple information sources, a 16 MHz quartz
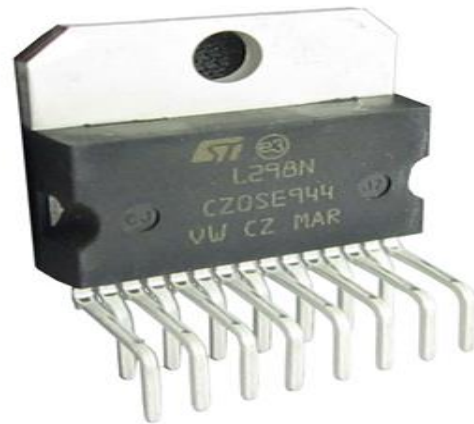

Fig.4 L298 IC

They can be controlled from the PC or modified by the PC and after that separated and permitted to work autonomously.
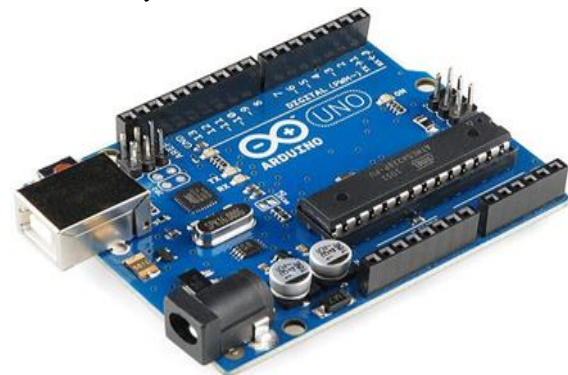

Fig.5ArduinoUNO

precious stone, a USB association, a power jack, an ICSP header and a reset catch. Fig 6.2: Layout of Arduino. It contains everything expected to strengthen the microcontroller; just associate it to a PC with a USB link or power it with an AC-to-DC connector or battery to begin.

V. CONCLUSION

The paper proposes the use of hiking aid and sensor technology to modernize the walking of aged persons. In this model the implementation is very perceptive and easy to adopt by the users. An overview of the design is according to the user's force applied to the device and pelvic rotation. The user's intention is valid and allows natural motion control of the platform. This invention is highly effective in minimizing the discomfort to the wearer. Finally, A robotic walking support system with human-robot interactive assistance is developed in this paper. A new dimension of services will be unleashed due to this confluence thereby improving the quality of livelihood.

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