A Retractive Approach for Postural Instability in Geriatric Population

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Abstract: **Stability is one of the most important human activities during walking. However, elderly people with movement disorders such as loss of muscle strength reduced the joint movement and stability have high risk of falling accidents during walking [1]. Fall is a major cause of problems in many countries. There are many existing solutions to overcome this and the statistical studies shows a better solution is needed for the same. Our work was mainly focused on the balance loss performed by the shoe which makes the stability to retain their balance.[2]. Balancing insole should be worn on both the legs, depending on the fall conditions is brought back to the normal position. . An accelerometer is used to detect the imbalance position, which is fed input to the microcontroller. The microcontroller is programmed in such a way that it runs the motor, which rotates the motion devices that are fixed to it, to retain the balance. Thus the motion devices finally move the leg to which the corresponding Insole is worn providing stability to the subject, hence overcoming the fall.**

Keywords: Accelerometer, insole, stability, Fall, Balance Recovery

I. INTRODUCTION

Falls are a major cause of mortality in elderly people aged 65 and above. Elderly people lose theirr rhythm of walking balance, because their body alignment and standing balance become less stable through aging [3]. Falls are the leading cause of injury-related visits to emergency departments. One out of every three people aged 65 and older, takes a spill. Closer to age 80, the risk affects nearly everybody, and these falls often result in hospitalization. Related healthcare costs will be very high. The mortality rate for falls increases drastically with age in both sexes. Falls are accounting for 70 percent of accidental deaths in persons 75 years of age and older. More than 90 percent of hip fractures occur as a result of falls, with most of these fractures occurring in persons over 70 years of age [3]. Risk factors for falls in the elderly include increasing age, medication use, cognitive impairment and sensory deficits. This falls also occur in people who are differently abled or partially paralyzed or who are mentally disadvantaged. Once they fall, the fear of falling again increases, which reduces their self -confidence. They always need to be assisted by someone either in person or by a supporting object. They can't even go out alone and do their work by themselves due to this reason [4]. The consequences of falling down can be very severe in few circumstances which lead to decrease in life expectancy.

This problem of falls occurs mainly due to the inability to balance themselves. Factors that may affect balance are:

- loss of muscle strength
- reduced joint movement and stability
- the side-effects of some medicines
- sudden movements, especially rising quickly from a sitting or kneeling position
- The effect of a hip or knee replacement in the short term.

Thus there is a serious need for some device to provide balance in such conditions. This project aims at reducing the rate of falls and injurious falls in people over 65.

A. Existing solution

There are many different low cost products that provide walking assistance to the elderly people.

- Standard walkers
- Heavy duty walkers
- Rolling walkers
- Crutches
- Canes
- Walkers with wheels
- Two –in-one walker-wheelchair
- Specialty walkers

But all of the above mentioned things are very big in size, and are visible to others. They need to be carried with the subject all the time. These are more like a support rather than acting only at the time of fall.

1.2. STATISTICAL ANALYSIS

From 2000 to 2014, around 14 million injury- related visits were made to emergency departments in India. Falls were the leading cause of external injury, accounting for 24 percent of these visits. Emergency department visits related to falls are more common in children less than five years of age and adults 65 years of age and older [5]. Compared with children, elderly persons who fall are 10 times more likely to be hospitalized and eight times more likely to die as the result of a fall. Trauma is the fifth leading cause of death in persons more than 65 years of age, and falls are responsible for 70 percent of accidental deaths in persons 75 years of age and older. The elderly, who represent 12 percent of the population, account for 75 percent of deaths from falls. The number of falls increases progressively with age in both the genders. The injury rate for falls is highest among persons 85 years of age and older. Annually, 1,800

falls directly result in death. Approximately 9,500 deaths in elders are associated with falls each year in fig: 1. Elderly persons who survive a fall experience significant misery. Hospital stays are almost twice as long in elderly patients who are hospitalized after a fall than in elderly patients who are admitted for any other reason. Compared with elderly persons who do not fall, those who fall experience greater functional decline in activities of daily living and in physical and social activities and they are at greater risk for subsequent institutionalization. In older patients, a fall may be a non- specific presenting sign of many acute illnesses, such as pneumonia, urinary tract infection or myocardial infarction, or it may be the sign of acute exacerbation of a chronic disease. Up to 60 percent of nursing home residents fall each year; one half of these fallers have multiple episodes. Major injuries, including head trauma, soft tissue injuries, fractures and dislocations, occur in 5 to 15 percent of falls in any given year. Fractures account for 75 percent of serious injuries, with hip fractures occurring in 1 to 2 percent of falls. In 2013, more than 250,000 elder Indians suffered fractured hips, at a cost in excess of 10 million. More than 90 percent of hip fractures are associated with falls, and most of these fractures occur in persons more than 70 years of age. Hip fracture is the leading fall- related injury that results in hospitalization, with these hospital stays being significantly prolonged and costly. It is projected that more than 340,000 hip fractures will occur in the year 2013.One fourth of elderly persons who sustain a hip fracture die within six months of the injury. Hip fracture survivors experience a 10 to 15 percent decrease in life expectancy and a meaningful decline in overall quality of life. Most falls do not end in death or result in significant physical injury. However, the psychological impact of a fall or near fall often results in a fear of falling and increasing self-restriction of activities. The fear of future falls and subsequent disorganization often leads to dependence and increasing immobility, followed by functional deficits and a greater risk of falling.

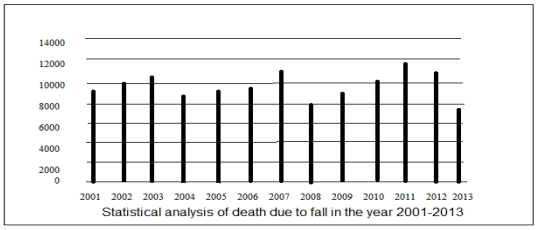


Fig: 1 Statistical analysis of death due to fall in the years 2001-2013

II. METHODOLOGY

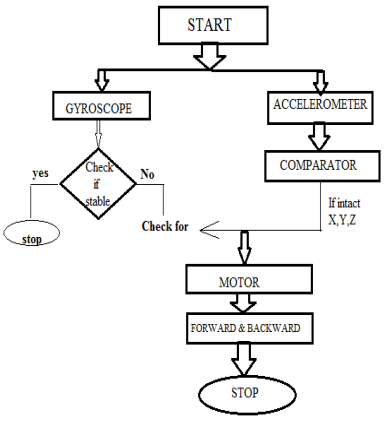
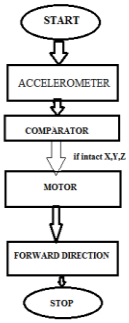


Fig 2: Flowchart of balancing insole

In this system they are two inputs one is gyroscope and accelerometer. Gyroscope measure the COG balance. If the balance is stable then stop the system, if not then go to accelerometer. By measuring the amount of static acceleration due to gravity, to find out the angle to which the foot of the subject is tilted with respect to the earth. It is used to detect imbalance position, which is fed input to the microcontroller. The microcontroller is programmed in such a way that it runs the DC motor, which rotates the motion devices that are fixed to it, to retain the balance.

III. WORKING ALGORITHM

In this design analyzed gait parameters. The analysis method of gait, to estimate the spatiotemporal measures based on gyroscope attached to the lower limb. The collected data's from this method and then analyzed the problems. In this system another input is accelerometer. It is three axis angle of accelerometer, to find out the angle to which the foot of the subject is tilted with respect to earth. This value of angle going to be calibrated was done to find the various ranges within which the balance will be achieved. This was done using in Arduino board. The program read the input from the accelerometer was written using serial monitor feature of the arduino software various output of the accelerometer for the different values were observed and value for various tilts were obtained. It is used to detect the imbalance position, which is fed input to the microcontroller. The microcontroller is programmed in such a way that it runs the Dc motor with forward and reverse condition. In forward direction, the wheel of the motor made to rotate and pull forward to retain the balance when the value of angle above zero in fig: 3



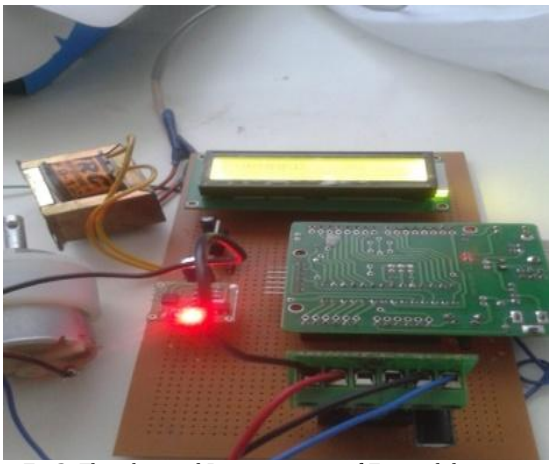
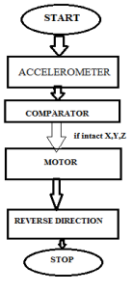


Fig 3: Flowchart and Prototype setup of Forward direction

In reverse direction, the wheel of the motor made to rotate and pull backward to retain the balance when the value of angle below zero in fig: 4



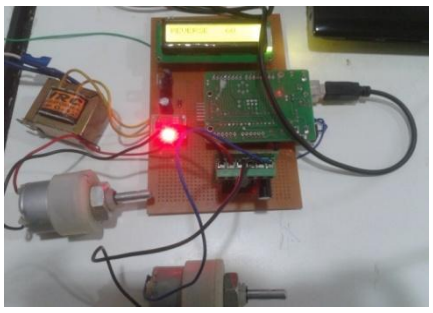


Fig 4: Flowchart and Prototype setup of Reverse direction

IV. RESULTS & DISCUSSIONS:

The result indicates that a DC motor rotates in both forward and reverse direction according to the angle of tilt. They are two conditions motion rolls .If above zero the elderly people fall in backward direction, the wheel of the motor made to rotate in forward direction and pull forward to retain the balance. If below zero the elderly people fall in forward direction, the wheel of the motor made to rotate in reverse direction and pull backward to retain the balance. This system will help the elderly people to move freely without any canes. So this method has several advantages over the other methods. It is place inside the shoe (not visible to others).So this system more comfortable and in expensive system.

VALUES	FALL DIRECTION	MOTOR ROTATION
Tilt >0 (if above zero)	Fall in backward direction	Motor rotate in Forward direction
Tilt <0 (if below zero)	Fall in forward direction	Motor rotate in Reverse direction

Fig 5: Tabulation for Motor rotation

V. CONCLUSION:

The balancing insole designed in this project is very helpful for elderly people and also much better than the present existing solutions. Elderly people can just wear it on which acts only during the fall conditions and during the other situations it is a normal shoe. Elderly people can overcome the various problems experienced by other supporting equipment available in the market.

6. FUTURE WORK:

In future propose to produce a system which will include roll axis fall during walking. This method has several advantages over other methods because the elderly people can able to balance and their body weight without any help like a walkers, canes. This method will increases the confident level of the elderly people in any ways.

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