Design And Development Of Assistive Feeding Device For Physically Challenged Persons

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Abstract: The ultimate aim of this proposed methodology is to assist the persons with movement disorder who need the help of someone to feed themselves. The proposed methodology comprises of six servo motors, one arduino controller and one power window motor. By closing the switch which is near to the feet of the user, the required height will be obtained through the rotation of power window motor. Arduino nano is programmed in such a way to co-ordinate the required movements of the arm. The desirable robotic arm position is accomplished by the rotation of servo motors. The assistive feeding device has a spoon clamped on the top shaft which is mounted for rotation adjustments. The top shaft will rotate in clockwise direction to take the meals. The user will get the food at an angle of 120 degree. Switches are provided near the feet of the person so that the person can control the arm movement by pressing the switch.

Index Terms: Arduino, Assistive feeding mechanism, Differently Able Persons, Feeding Device People with different disability, Physically challenged Persons.

1. INTRODUCTION

INdia is a country with large number of disabilities, according to recent survey nearly 2.21% of India's total population has severe disabilities which nearly 2.68 crore in number. Among those nearly 85 lakhs of people are affected by the disability in movements in which nearly 70% of people belongs to rural area and other 30% belongs to urban. People in rural are mostly illiterate and cannot afford for a caretaker. In such cases feeding the people with disability in movement of hand is a great challenge. The proposed methodology focuses on feeding of meals to the person with disability using a robotic arm. The existing methods have some cons like to appoint a care taker to operate the device and in countries like United States, United kingdom an automata robot is there but it is too costly. The proposed work mainly focuses on feeding meals to the person with disability without the help of caretakers and at affordable price. Existing techniques are quite costly which cannot be afford by the rural people of India and other few existing methods are quite based on technologies which cannot be understand by the people of rural India. Technologies that are used in this method are quite easy and understandable and cost is quite low compared to other devices available in the market.

2 LITERATURE REVIEW

There were several papers published to overcome this difficulty in which paper published by Won-Kyung Song, Won-Jin Song, Yale Kim, and Jongbae Kim which had a major impact on developing idea for feeding the people without the arm but the major drawback of this paper was that it only suits for the Korean food like sticky rice and in the cost factor it was very high and the technique used here was quite complex[1].

There was an idea developed by Bulmaro A. Vald'es, Mahta Khoshnam, Jason L. Neva, and Carlo Menon to feed the armless people during current year in this project they use the 3D technique to accomplish the feeding operation but the major disadvantage of this project is technology used here is quite complex, and the cost of this would be quite high but as of now it was just an idea proposed there was no development of prototype for this idea [2]. There was an idea proposed by Shotaro Gushi, HirokiHiga, Hideyuki Uehara, Takashi Soken to feed the armless people the main disadvantage of this idea was that this arm can be used only for the transformation of water and soup, with this idea we cannot feed the food(solid items) to the people and till date this was only a proposed idea there was no development of prototype in this idea only experimental setup was done for this idea and this idea act based the movement of eyes which means the command is based on the movement of eyes which is difficult to understand by the users and the components used here are quite costly which became a great barrier in development of the prototype[3]. Nguyen Truong Thinh, La Hoang Thang, Tran Tan Thanh published a paper to feed the armless people at an IEEE conference the idea proposed was Feed-Bot combines the best of available technology including a 2 D.O.F. lightweight manipulator and an index tray. It operates with a food tray and a manipulator to bring the foods from the tray and feed to disabled people as Parkinson patients the main disadvantage is that is semi-automated in nature and is generally high in cost, and it requires internet facility for the operation which cannot be provided in all rural areas[4]. Isira Naotunna, Chamika Janith Perera, Chameera Sandaruwan, R.A.R.C. Gopura, and Thilina Dulantha Lalitharatne proposed the current scenario of the technologies which is used to feed the armless people and the challenges in the present technologies in that they spoke that the main challenges faced was the command given to the robotic arm by the person there was nearly a decade of research was going on to overcome it but till now there was not an efficient way to give command, and another main disadvantage was that in existing methods there were only limited safety measures which may contaminate the food and harm the people and in the current system we need to train the people to use the robotic arm in which the training time is quite high[5]. Feeding the people without the arm is the major need because the rate of disability is increasing in world day by day in order to overcome this issue many countries are working on it to develop an automatic robot for feeding in this way they discovered a robot

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named as iEat in which user needs to fix the mouth distance for the first time which requires a caretaker. Another robot was Obi, which was too costly, which cost around three lakhs, which can't be afforded by the rural peoples of India. In order to overcome this problem students of IIT-Delhi came with an idea of feeding the people without arm using voice command through Google assistant which cannot be understood by the rural peoples of India

3 PROPOSED SOLUTION

The designed methodology comprises of a robotic arm and a mechanical setup. The arm is controlled by arduino nano by PWM (Pulse Width Modulation) signal. Initially height adjustment is done by the power window motor based on switching. If the switch is moved ahead means the motor will be rotated in clockwise direction, if the switch is moved towards rear position means the motor will be rotated in counter-clockwise direction. Thus through clockwise and counter- clockwise action of the motor the desirable height will be obtained. The locomotion of robotic arm is accomplished by the servo motors. Based on users need the arduino is programmed and the servo motors are rotated on desired angle to feed the food. There will be a switch near to the user's feet. If the user need any pause or if he feels the food is enough then he can stop the robotic arm moment by pressing the switch.

4 BLOCK DIAGRAM

The various components present in the assistive feeding device are shown in the figure 1. It incorporates a battery which acts as an energy source for providing electricity to the device. Arduino Nano controller is used to controlling the rotation of the servo motors by sending the PWM (Pulse Width Modulation). The robotic arm is rotated based upon the revolution of servomotors. The converter used here is buck converter which regulates the voltage to 5V. After regulating the voltage to 5V the power will be fed to the controller and the switch.

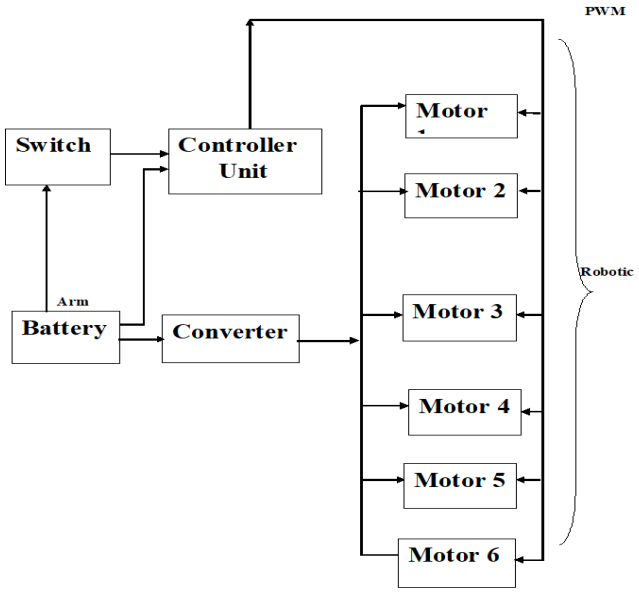

***Fig. 1**. Block diagram of the feeding device*

5 ALGORITHM

The flow chart of the feeding device is shown in figure 2. The various steps involved is highlighted and the each step is explained in a lucid manner.

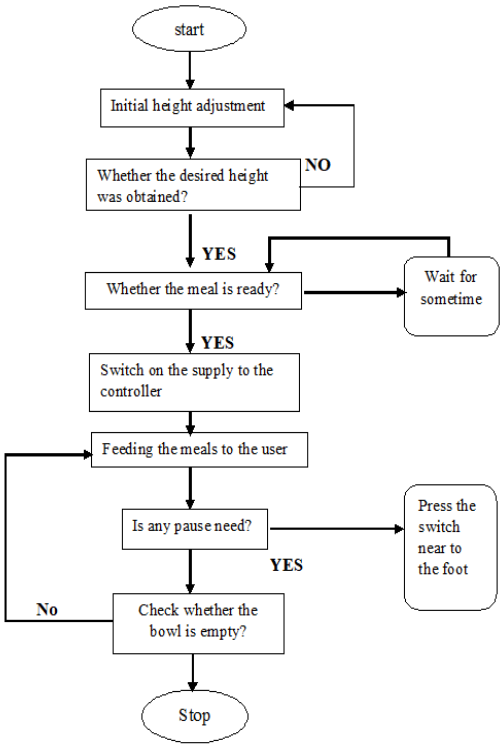

***Fig. 2**. Flowchart of the Assistive Feeding Device.*

5.1 Steps

Step 1: Start the process.
Step 2: Adjust the height according to the users need.
Step 3: Check whether the meal is ready. If it is ready means pursue the next process, if not means wait for some time.
Step 4: Now the food will be feed to the user by robotic arm.
Step 5: If the user need some gap to have food means press the button nearer to the foot. If not means continue the process.
Step 6: Check whether the bowl is empty. If it was empty means switch off the device.
Step 7: If the bowl was not empty means then go to step4.
Step 8: Stop.

6 HARDWARE IMPLEMENTATION

The complete hardware setup of the proposed methodology of the proposed methodology is shown in the fig 3.

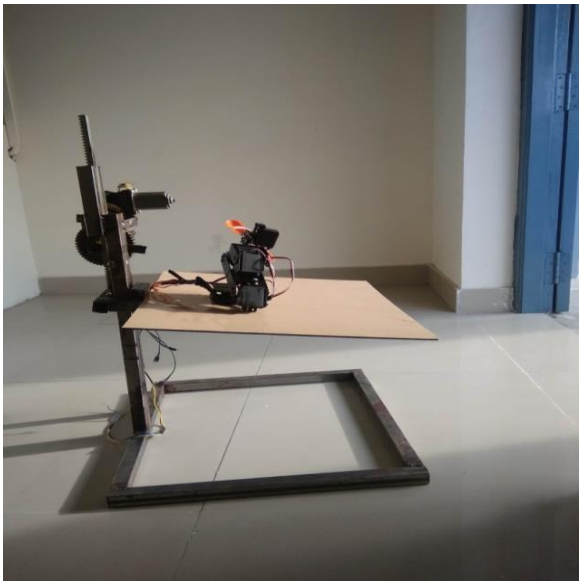

***Fig. 3**. Complete hardware setup*

STEP 1:

The fig 4 shows the initial position of arm where it standstill until a trigger from a button is given so that the person can initially fix the required height he/she needed.

***Fig. 4**. Robotic arm initial position*

STEP 2:

As shown in the fig 5 the robotic arm is rotated about 85° from the initial position along the axis of bowl and height of arm is reduced because when the arm is at maximum height the motors draw maximum current.

***Fig. 5**. Robotic arm second position*

STEP 3:

The fig 6 shows the arm holding the spoon bends closer to the bowl and it is done by reducing the angle of servo motor 2, 3, 4 according to our need.

***Fig. 6**. Robotic arm third position*

STEP 4:

In this step the gripper holding the spoon rotates about 90° to 200° to pick the food from bowl and it goes to its original position.

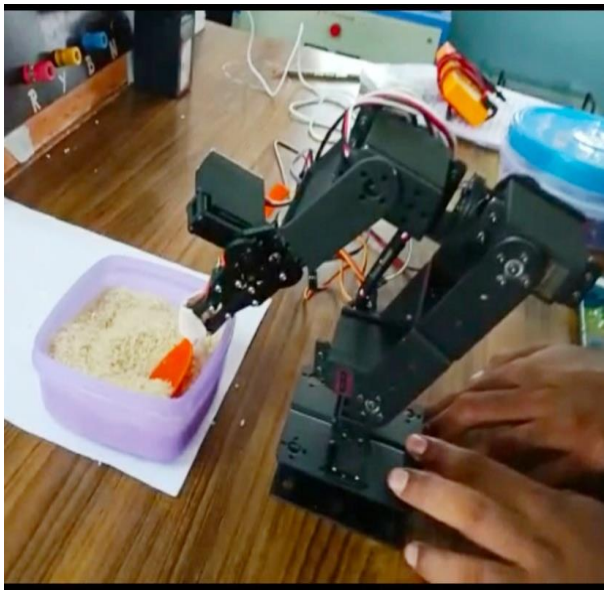

***Fig. 7**. Robotic arm when it takes the meals*

STEP 5:

As shown in the fig 8 the arm lifts the spoon holding food away from the bowl slowly so that the food does not spill out.

Fig. 8*. Robotic arm after taking the meals*

STEP 6:
In this position the arm is rotated about 85° along the axis of bowl and height of arm is reduced because when the arm is at maximum height the motors draw maximum current.

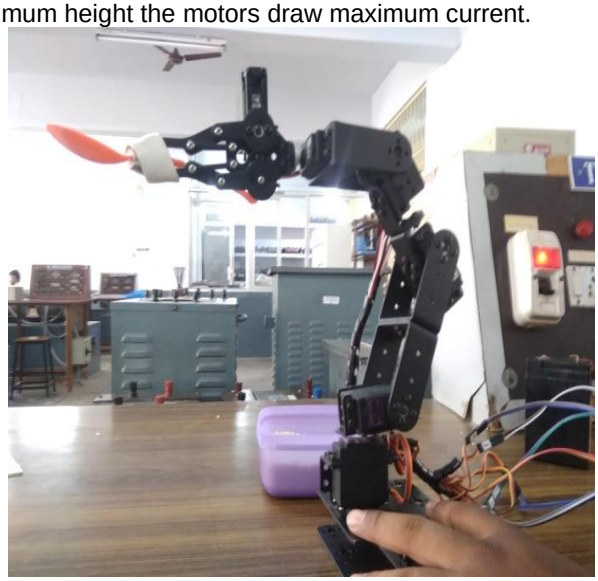

Fig. 9*. Robotic arm during feeding*

In this step the arm lifts the gripper slightly so that it makes the person easy to eat the food from spoon and it standstill until an input is given from the person.

7 OUTPUT

The assistive feeding device takes around 22seconds to complete one rotation (from taking food to feeding the disabled). Its further movement depends upon the input using the push button (manual input).It feeds 200 grams of food in 20 minutes.

8 RESULTS AND ANALYSIS

This project report has investigated the design of a assistive feeding device for the developing world and presented a novel solution to the problem. The design incorporates the following features,

- Helps the persons with disabled upper limbs to take meals by themselves.
- It allows the user to adjust the height at the required level.
- This assistive feeding device has a switch near to the user's feet to pause the movement of the arm at any condition.
- It helps the user (differently able) to have their food comfortably.

The self-feeding device feeds the food properly with enough time. It assists physically challenged peoples to have their food on their own. This device enabled the design of a efficient, affordable robotic arm for feeding the food.

9 FUTURE SCOPE

In future the proposed methodology can be developed to sense the position of the user's feeding position using electronic compass module so that the arm can move automatically.

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