Microcontroller based automatic food feeder for physically challenged people- a study

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ABSTRACT

Today the world is moving faster. In this there is no time to serve the loving disabled in their family. Even though any care taker stays with them to help, they could not serve them heartily, especially during eating. During eating everyone will take their own time to chew the food. Someone might chew it faster and someone may consume more time. The care taker cannot serve them by spending their time with them. For providing freedom of eating to the disabled, a feeding system is designed for them. This research paper deals with the proposal to facilitate the feeding problem for physically challenged person. The "Automatic Food Feeder" has a conveyor belt with attached spoon to take the food from the parabolic bowl. It is in turn connected to an AC servo motor controlled by ATMEGA32 microcontroller. The user gives the instruction through the microcontroller and the servo motor rotates at a particular angle which is preset and hence the spoon takes the food from the bowl and comes to a position perpendicular to the user, so that the user can have their food at ease. This system gives freedom of eating to the disabled. Indeed this system will help the physically challenged person to rely on themselves instead of depending on others. Moreover the physically challenged can have food with their family members in dining table as like normal person.

Introduction

A disability may be physical, cognitive, mental, sensory, emotional and developmental or any combination of these. A physically challenged, who does not have hands or fingers has to depend on others for everything, even for taking food [1] [4]. Disability is classified into five types seeing, speech, hearing, movement (locomotors) and mental [4]. According to census of July 2002 to December 2002 1.8% of Indian population are disabled, the number of persons were estimated to be 18.49 million from the total population. About 10.63 percent from the total disabled population are suffering more than one type of disability. According to a survey, for every 100000 people in India 1755 are mentally or physically disabled. Among the different type of disability the prevalence of locomotors disability is high in our country. About 69 persons per 100000 were born disabled or become disabled of some reason for every year. And 13% were observed that they could not take self-care even with aid/appliance [2]. This paper proposes an eating system that would help the physically challenged to have food on their own. The controlled conveyor belt with spoon that would take the food from the parabolic bowl and feed to the user at the touch of a button at their wish [15][16]. This "Automatic Food Feeder" would enable the users to rely on their own for their needs. This paper is mainly developed for solving at least a single basic problem of the people with locomotive disability [4]. Inspiration for this project was from our society. The status of the differently abled in our society and their sufferings intended to do something useful for rectifying their problem. This proposal will partly reduce the need of relying on others.
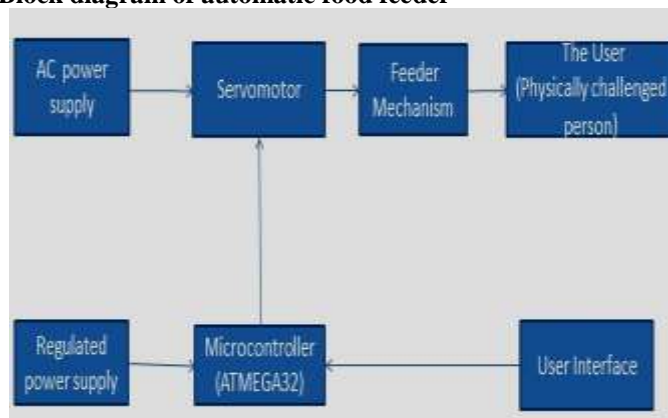
Block diagram of automatic food feeder

Figure: 1 Automatic Food Feeder Function

In this system DC source is connected with microcontroller and a separate single phase ac supply is given to main winding of servomotor [5] [13]. The system operation is discrete and not continuous. In this system servomotor operates in discrete rotation. The instruction is given to the microcontroller from the user module. Based on the instruction, the servomotor rotates to an angle and remains in the same position until the next instruction is received. The feeder spoon system collects the food from the parabolic bowl and gives to the user. The user will take the food from the spoon. For the next instruction the same operation is repeated. The operation of the food feeder system is shown in fig: 1.

Design model of food feeder system

This proposed automatic feeder model is designed by using SOLIDWORKS software is shown in fig:2 [9] [16]. The whole system is placed on the base layer. A vertical column is constructed on the base layer, which consists of two shaft .The upper shaft is coupled with servomotor and bottom shaft is just fit with bearing for rotation.The conveyor belt is mounted over the two shaft and the removable spoon is fit in the conveyor with eventual gap [15] [16]. The holder is fixed on the belt with the help of two holes in it. The spoon is fit into holder. The spoon does not rotate inside the holder. It only moves along the direction of belt movement. A parabolic bowl is placed below the bottom shaft. A small vertical cylinderical hollow space is provided to place water bottle with straw.
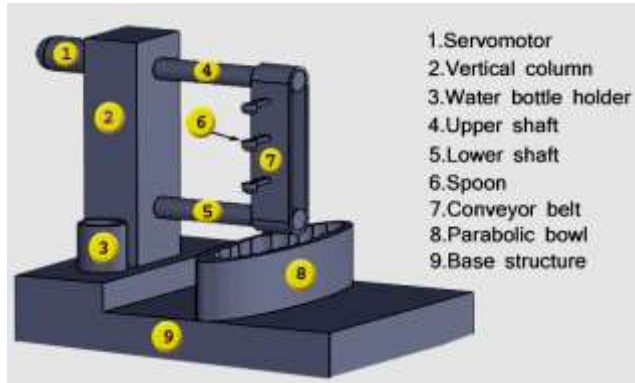

1.Servomotor
2.Vertical column
3.Water bottle holder
4.Upper shaft
5.Lower shaft
6.Spoon
7.Conveyor belt
8.Parabolic bowl
9.Base structure

Figure: 2 Design Model Of Food Feeder System

In making ready for operation,every time the system should be filled with food and water in the concerned places before getting into the operation. The overall system is incorporated with three major section namely conveyor belt,servomotor and microcontroller [6] [14] . The advanced microcontroller is the heart of the proposed system and the servomotor is used for precise position control [13]. Based on the command signal from the user, control signal goes to motor in such a way to make the spoon straight by rotating certain angle by the servomotor. In this system, for example, for the first instruction motor rotates to $90^0$and stops, this makes the conveyor belt to rotate correspondingly, which moves the spoon attached to the belt downwards to upward. Due to the motor rotation, food is collected from the bowl and stays straight towards the users mouth and for the next consequent instruction from user, the same operation is repeated[5][8]. The conveyor belt rotates periodically and collects food with the help of spoon. This operation is repeated for every users' instruction. The user interface switch is connected through long extendable wires and it can be placed near any movable part of the user. The user could control "The Automatic Food Feeder". when the user touches the switch the signal is given to microcontroller.

When the user likes to take food, first someone has to fix the spoon in the belt and fill the bowl with food. In this system the servomotor is used for periodical belt movement[6]. Thus servomotor is controlled by interfacing it with advanced microcontroller ATMEGA32 and triggering can be done by the user by touching the button with leg or any momentry part , based on the users comand signal to microcontroller [18] [13]. The control voltage is produced by the controller and given to the control winding of servomotor [5] [14]. The angle of rotation of servomotor is set in such a way that makes the spoon straight to mouth. Then the user has to take food from the spoon. After eating , user can give another signal to the controller so that motor will rotate to the same preset angle and again the spoon

will stay straight to users mouth and performs the same mechanism again. After user eats, the spoon can be removed and cleaned by the helpers.

While eating, the user may feel thirsty and at times may get hiccups. Since they are disabled they cannot take water bottle with their hand to quench their thirst. So a circular hollow surface is provided in this model to place the water bottle. That water bottle will be provided with straw to drink whenever they feel thirsty.

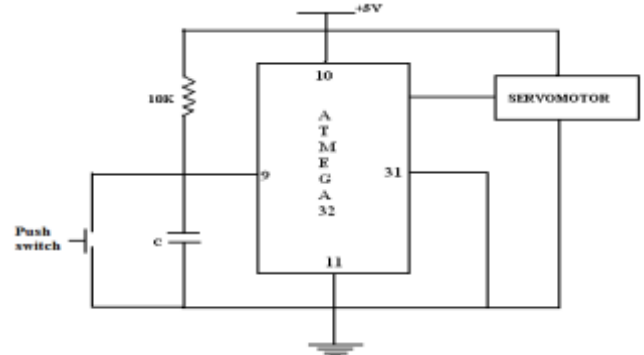**Microcontroller interface with servo motor:**

Figure: 3 Servomotor Interface with ATMEGA32

In this research work, the hardware system uses two phase AC servo motor for precise position control and the single phase AC supply is given to the main winding. Based on the user instruction given to the input port, control voltage is produced at the output port and which is finally given to the servomotor as shown in fig: 3.The rotation of the motor is controlled by the phase difference between the main winding and the control winding [8].

Flow chart:
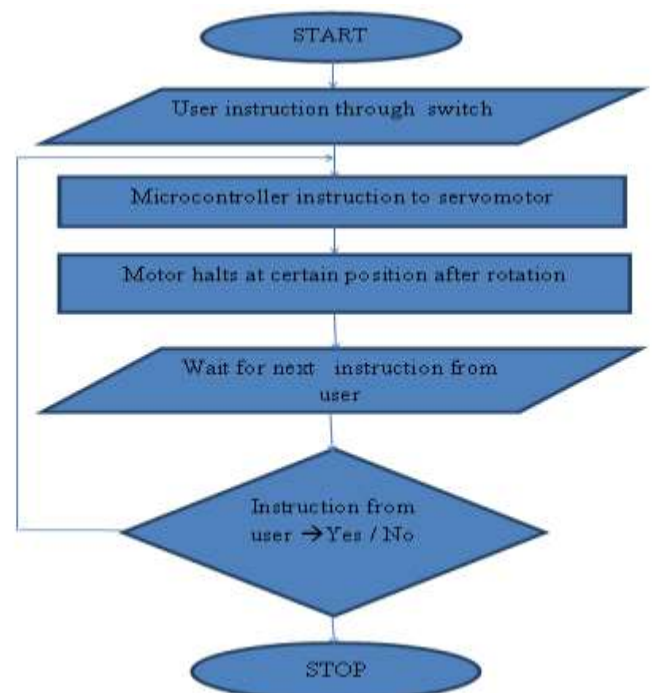
Algorithm
1. START
2. Input signal from user to microcontroller.
3. Read signal and alter motor position to move the conveyor.
4. Motor halts at particular prefixed position.
5. Wait for next instruction.
6. If input signal is received, repeat from step 3, else stay halt.
7. Stop the program.

Conveyor Belt

Figure: 4 Rubber Conveyor Belt

The conveyer belt is mounted over the two top and bottom shaft, with a continuous loop of belt material. The conveyer belt is powered at the upper shaft [15] [16]. A model of the belt is shown in fig: 4.In this system rubber belt is chosen for smooth and convenience operation [17]. When belt rotates according to the user command the spoon which is attached with the belt will move up. By that time some food will spill on the belt and that will create stain on the belt. Since it is unavoidable in this system, to keep the belt clean and safe we use rubber belt. The advantageous features of rubber belt are its lightweight, portability, assembling process is easy and stains can be cleaned with mild soap oil [17].
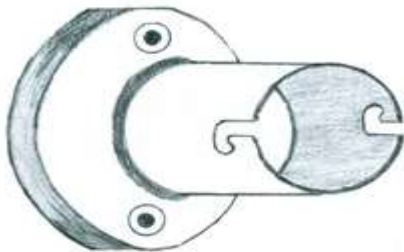
Design of Holder and Spoon

Figure: 5 Spoon Holder

Holder is fixed in the vertical conveyor belt by the help of two holes in the holder. Spoon is fixed in the holder. So that it can be removed and cleaned after eating. A model of the spoon holder is shown in fig: 5.This holder is similar to that of lamp holder. Two studs of the spoon are screwed into the holder.

Figure: 6 Spoon

Here the normal spoon is designed to use for this system. In this,the studs of the two spoons are attached at one end of the spoon as shown in fig:6 , with the help of that stud the spoon can be fixed into the holder. Mouth of the spoon can be changed to make the system suitable foreating from small size to large pieces of food.

Eating Bowl

Figure: 7 Parabolic Bowl

This eating bowl design is very important in this system [9] [10]. We cannot employ a round bowl or any other design. It should be designed in parabolic shape (i.e. like fishing boat). Its inner surface should be curved because in each rotation food will get settled at the center of the bowl by parabolic design the food will focus at center place of the bowl. So the spoon can easily collect the food from bowl. fig: 7 projects the model of parabolic bowl. But when the food becomes dry the food gets settled at the corners without moving down.

Solution to eat food at the corner of the bowl

Sometimes disable may eat dry food. While eating dry foods, it is difficult to take food at corner of the bowl. There are two different ways to take the food at the corner of the bowl. Either of these mechanisms can be used for eating dry foods.

1. By placing the spoon at various places of belt.
2. By tilting the bowl

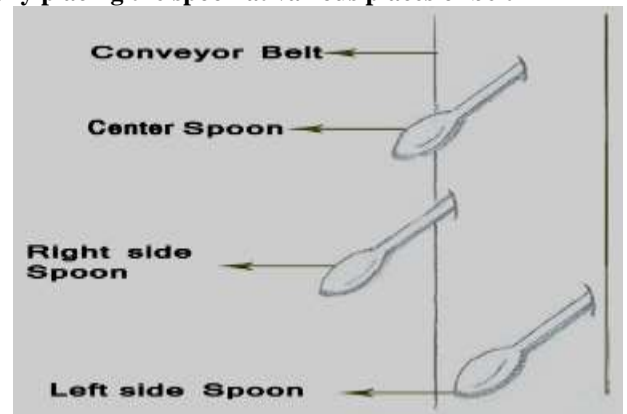**(i).By placing the spoon at various places of belt**

Figure: 8 Spoon on various places of belt

Three spoons are placed at different places. One at the center of the belt the other at the right corner of the belt and the third one at the left corner of the belt. All spoons are placed perpendicular to the belt. The center spoon is projected at an inch more than the other two side spoons to reach the bottom of the parabolic bowl. The right side spoon takes the food from the right corner of the bowl and the left side spoon takes the food from the left corner of the bowl. The user gives the instruction based on the instruction the center spoon takes the food from the bowl and the right and left spoon takes the food for the next consecutive instructions. So the food in the bowl can be eaten completely by the user.
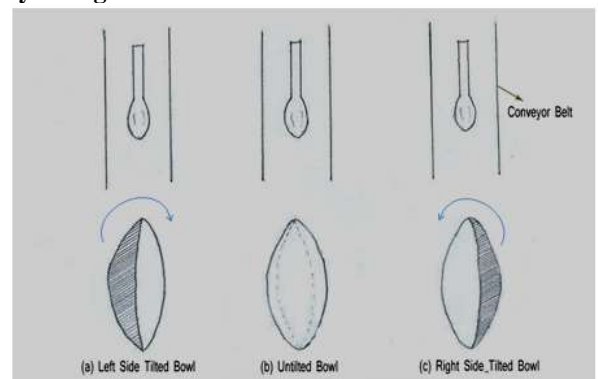
(ii). By tilting the bowl

Figure: 9 Bowl tilting methods

In this method the middle spoon is enough. Instead of placing the spoons at different places of belt the bowl is tilted towards right and left for 10° to 20° for collecting the food at two corners of bowl. In the same way figure (a) shows the bowl

tilted towards left side for 10° to 20° to take food at right corner of the bowl (the direction of inclination is shown through arrow mark). The figure (b) shows the bowl at normal operating condition. The figure (c) shows the bowl is tilted towards right side for 10° to 20° take food at left corner of the bowl (the direction of inclination is shown through arrow mark). The proposed system is enough to eat the food in semi-solid state. Only for dry foods either of these mechanisms is used.

Conclusion:

The "Automatic Food Feeder" will serve the humanity in a wide range. Having food is essential for the survival of the living being. Every human needs full freedom to enjoy the taste of food at any time. Normally for eating, the disabled have to depend on others. So when user feels hungry he/she has to depend upon their family members or friends. Some times their care takers may not understand their situation and help them [3] [4]. This will psychologically affect their mind. In that way this proposal will help them more. Moreover it provides the physically challenged to have their food on their own which provides a sense of independence [3]. It will give confidence to live and compete with others and also it makes the user to take their own time while eating.

Future enhancement:

Technology is developing dramatically. In future this paper will get implemented and make a huge impact among the differently abled people. Now in this proposal, they can eat only one dish at a time. In order to make the disabled person more comfortable, in future, it is planned to design the model to be suitable for eating two or more dishes. More over this whole system is planned to control through voice.

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