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Chapter

Tiny Blind Assistive Humanoid Robot

Amrita Ganguly and Bijan Paul

Abstract

In today's world, individuals show more enthusiasm for robotics and aim to depend upon humanoid robots for multiple purposes. It has implementations in a wide range of sectors such as- in atomic plants, house management, government foundations and even astro stations. Our research-based project is elucidating robotics with a tiny humanoid robot following the human structure to make gestures like strolling, dancing, and detecting objects near it. It has been achieved using Arduino Nano (Atmega 328P), Servo motors SG90 working on the conception of servo-mechanism and the Ultrasonic sensor to identify obstacles and restrain the Robot from going ahead. The aim is to fabricate a bigger humanoid robot that will serve our general public and make our life simpler. The Robot has eventual utilize in marketing, entertainment and helping the visually impaired to move from one place to another. This project can also be a great apparatus for future research works and alteration.

Keywords: bipedal Robot, Servo Mechanism, Object Detection, Ultrasonic sensor, Servo motor, Blind Assistive/Visually Impaired, entertainment, humanoid robot, notifier, rotation impact, navigation

1. Introduction

Individuals are finding robots charming and interesting day by day. In this changing climate humanoid robots have a more imperative capacity to outlive. One can without much of a stretch expect that in the coming future the utilization of robots will extend in our general public. It is only our little activity towards the development of a tiny humanoid to make the copy of human in the future. **Figure 1** shows the structure of the tiny humanoid strolling and moving Robot.

This Arduino-based bipedal Robot (**Figure 1**) follows an algorithm to stroll by turning the servo horns [1] and an ultrasonic sensor that can distinguish any items close to it [2]. At whatever point the humanoid identifies any item before it, it quits strolling and illuminates the LED on its top as an informer. This informer can be supplanted by any kind of informer like a buzzer [3]. A microcontroller ATmega328P is working as the memory storage of the Robot. Using its legs which are made of servo motors, the Robot can likewise move in a few stages.

Regions engaged in achieving this target which is elaborated here examine the servo motors, analyzing its turning effects, supportive system arrangement adjustment, generate dancing and walking algorithm, picking the extent of the ultrasonic sensor and impact on the servo horns close by the LED. This humanoid Robot (**Figure 1**) is about 17 cm in length and is very lightweight.

The coming segments are organized as follows: segment 2 depicts related works; segment 3 delineates Application. Segment 4 inspires working mechanism,

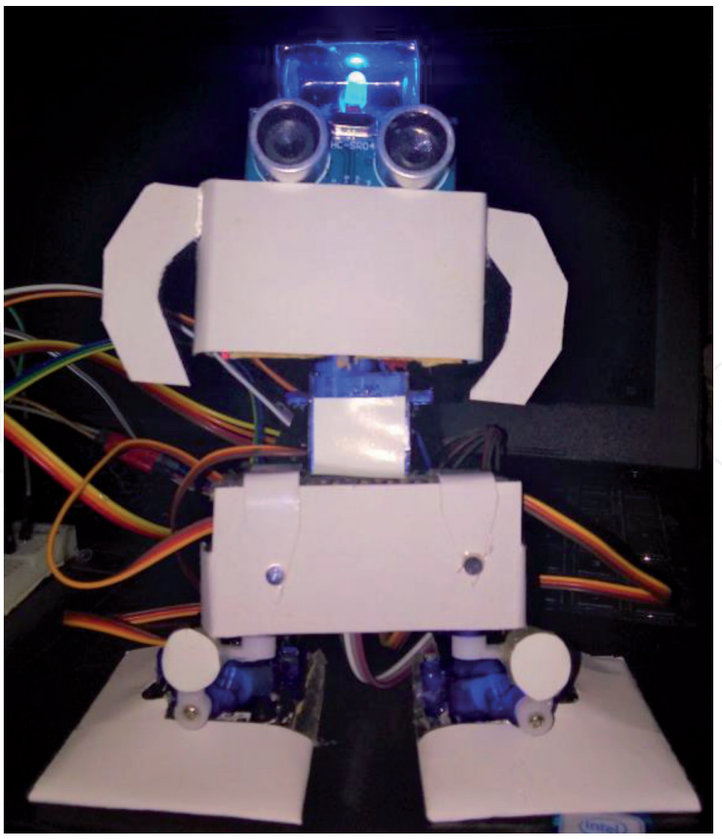


Figure 1.
Tiny humanoid strolling and moving robot.

area 5 shows programming mechanism and segment 6 illustrates Human-Robot Collaboration, Section 7 portrays hardware and financial requirement analysis and user opinion. Section 8 concludes this paper and references have been added towards the end of this paper.

2. Related works

Biped robots are the essential bit of humanoid robots, walking development examination is prioritized. Numerous explores happening on the creation of humanoid biped robot which is indistinguishable from an individual. Likewise, the robot relationship with individuals and headway of collaborative task are crucial perspectives that the humanoids are confronting. In these particular conditions, in the latest years, robot interactivity transformed into an essential area of examination.

Prakash Chandran, Mohit Jaswal, Dr. T.V.U Kiran Kumar and Mrs. Raji Pandurangan have introduced a biped humanoid (**Figure 2**) utilizing a microcontroller in their work distributed on International Journal of Science, Engineering and Technology Research (IJSETR). Here, the biped robot can detect sound and range distance. In this research work, they have referenced two different ways of designing humanoid robots. First is the regular spot technique where the Robot strolls in the course of action where the focal point of mass of Robot keeps moving to settle the position of the robot body. Another technique for implementing the change is using an accelerometer and gyro sensors. They chose the first strategy to adjust the structure. A sound sensor makes the Robot accept directions as voice orders. Such compound activities show utilization of open-source tasks, for example, Arduino [4].

Self-guided humanoid robot-Adhvik presented by Aditya Mishra, Ashutosh Shrivastav, Neha Maurya, S. Vamshi Krishna can perceive any red-shaded article before

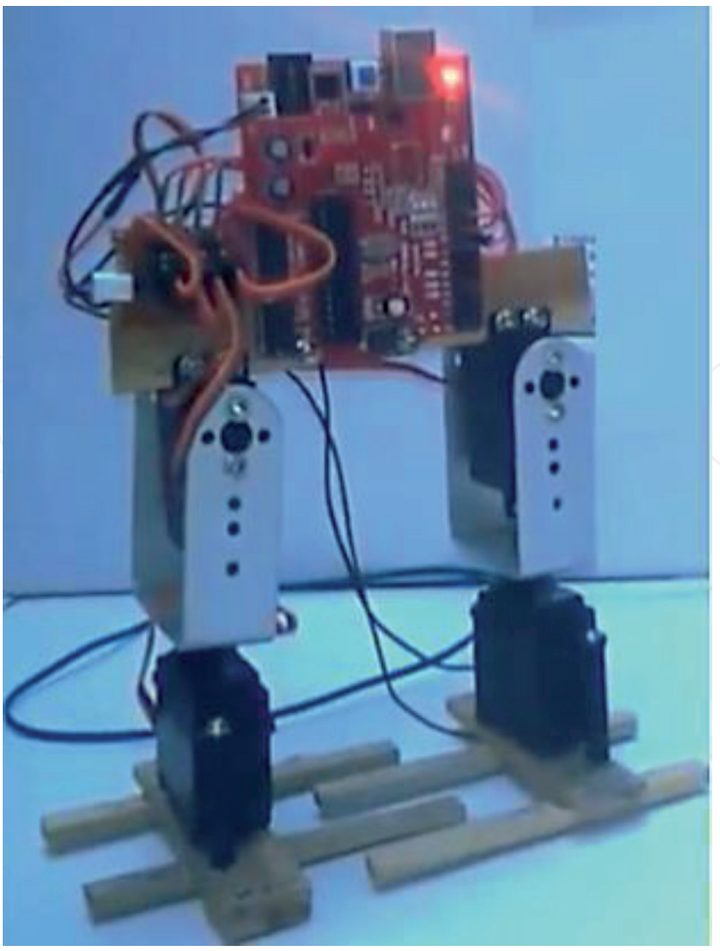


Figure 2.
Humanoid robot (autonomous) using Arduino.

it alongside strolling and different functionalities. The Robot is fundamentally utilized for object location and wayfinding. This functionality has been refined using a remote camera. The camera divides the red object into multiple parts. The humanoid can explore three directions: Left, Right and Straight as indicated by the position of the ball. At the point when the camera catches the picture of the ball, it partitions the casing into three and afterward humanoid moves appropriately. MATLAB programming has been done to handle the picture. It includes the contribution of the remote module [5].

Numerous scientists are working and have designed visually impaired assistive gadgets and robots to give autonomous route facilities to the visually impaired. For instance, a smart way direction robot to help blinds portrayed in the paper of M F Razali, S F Toha and Z ZAbidin distributed on IEEE International Symposium on Robotics and Intelligent Sensors (IRIS 2015) utilizes a Fuzzy Logic Controller. A sensible, quick, and trustworthy arrangement is offered by the fuzzy logic approach, which is an advantage over the ordinary controller. The straightforward "IF-THEN" rule is expected to impact the activity in Fuzzy Logic [6].

Another tiny human structured robot that is distantly controlled by means of Bluetooth is represented in the research work of Ahmet Aksoz, Salim Engin, and Mahir Dursun in the Journal of Automation and Control Engineering Vol. 4, No. 3, June 2016. Their Robot utilizes the remote correspondence innovation that empowers it to be constrained by an Android application. In a far-off area, the Robot can move freely [7].

There are numerous kinds of exploration equipped for obliging and actualizing complex theories and algorithms for dynamic strolling, human interaction, navigation, human conduct simulation, artificial intelligence, visual recognition utilizing Image recognition [8]. Biped robots using these algorithms and techniques

Features	Other mentioned robots	Tiny Humanoid
Uses only four servos for strolling	3 robots among 5 have used four servos. Other 2 have used 6 or more.	Yes.
Detects obstacle and stops strolling	2 robots among 5 does this. Other 3 not defined.	Yes.
Gives notification using buzzer	None of the mentioned have used.	Yes.
Detects obstacle in 180 degree view	Detects only in front view.	Yes.
Can dance in several steps to entertain	None of the mentioned have done this.	Yes.
Gives notification using LED	None of the mentioned have done this.	Yes.

Table 1.
Comparison table of tiny humanoid with other robots.

are further developed and effective henceforth more costly and confounded. Our project likewise expects to actualize such controlling frameworks and complicated calculations in our humanoid in the forthcoming future. **Table 1** shows the comparison between Tiny Humanoid with other robots.

3. Application

Advancement of impelled humanoids is used in implementation in a tremendous extent of areas, for instance, the development industry, home applications, incitement, social protection, sport, space, education. Our small walking biped robot has features; for example, it can recognize article close to it and quit strolling movement illuminating the LED as an identifier at its top. The following situations describe the incredible use of the features.

The Robot can add to bioengineering by helping the outwardly disabled patient. Outwardly impeded individual faces troubles in exploring starting with one spot then onto the next evading object. The Robot can function as a visually impaired assistive robot all things considered. This Robot can identify objects before it utilizes the ultrasonic sensor and stops strolling by initializing the servo motors' turning estimations to its primary value alarming the visually impaired individual that there is an article close by.

The Robot additionally has features that can accelerate commercialization. People these days show more fascination towards robots. As the Robot is able to dance in a few steps, it very well may be used before amusement parks and restaurants to invite and welcome individuals with fascinating movements. Thus they can have more customers attracted to their place and accelerate business.

Children and kids are turning into the Smartphone focused step by step. It is damaging to their eyesight as they are consistently playing with a Smartphone. For them, the Robot can be an incredible apparatus to play with as it can dance and entertain them, distracting them from Smartphone.

The Robot's object recognition capacity can be utilized to guarantee a specific spot or item's safety ensures that not even a solitary item draws close to it.

Nonetheless, there are multiple purposes and utilization of this sort of humanoid Robot. The humanoid can be upgraded with different highlights, for example, talking, ignoring objects, tuning in to voice order that will without a doubt improve its Application.

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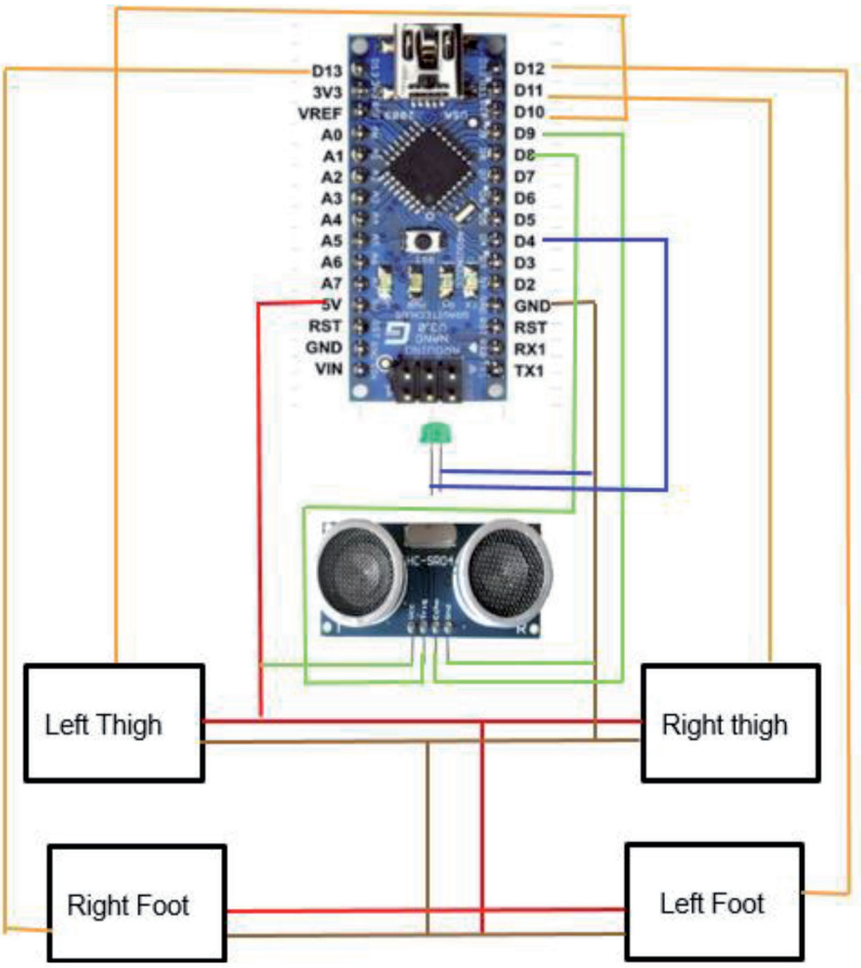


Figure 3.
Connection structure of tiny humanoid.

4. Working mechanism

From **Figure 3** we can without much of a stretch comprehend the Robot's association anatomy and how the ultrasonic sensor, servo motors [1] and the LED are associated with the Arduino board (Atmega 328P).

Each leg has been utilized using two servos. Servos are joined in a position, that the thigh servo's movement will influence the direction of the foot servo; however, the thigh servo motors are attached to the structure and are not influenced by the foot servo motor's movement. As the thigh servos are connected to the body, when the foot servo moves, it makes the route of the entire robot body alongside the thigh servo. The LED functions by coworking with the sensor through code.

As the appropriate strolling of the Robot relies upon the turning estimations of the servo motor horns, it is must be cautious while connecting the servos realizing the underlying pivoting values. In this way, a legitimate comprehension of servo motor rotation impact on its strolling is likewise significant. Paths need to be connected in a cautious manner, such as in servos, wiring positives to voltage and negatives to the ground; otherwise, it may damage the equipment.

Biped's strolling and objects recognizing steps:

- The servo of the right foot ascents up and the servo motor right thigh turns to make the servos of the foot to approach.

- Similarly, the servo of the leftmost thigh will pivot to the contrary side a piece to help the rightmost servo motors go ahead.
- After the right servo motors is put ahead, the leftmost foot servo motor raises and the leftmost thigh servo turns more prominent than the right foot servo and pushes a stride forward.
- Same time the right thigh servo motor does likewise as the leftmost thigh servo motor did.
- In that case, if an item is identified by the ultrasonic sensor, the drove lights and the humanoid set the servo motors to the initial state.
- This step is recalled while the microcontroller is controlled.

In this cycle, the Robot explores starting with one spot then onto the next.

5. Programming technique

Our methodology towards the coding began with investigating the impact of rotating values on servo motors. The left thigh and right thigh were at first set to 90 degrees. The left foot was set to 0 and the right foot was placed to 180 degrees as shown in **Figure 4**.

Programming steps:

1. Define four servo objects to operate the legs.

```
#include <Servo.h>
Servo rightfoot;
Servo rightthigh;
Servo leftfoot;
Servo leftthigh;
```

2. Initialize ports to the defined objects.

3. Mention the primary position of the servo motors.

```
rightfoot.attach(10);
rightthigh.attach(7);
leftfoot.attach(5);
leftthigh.attach(11);

leftfoot.write(0);
leftthigh.write(90);
rightthigh.write(90);
rightfoot.write(180);
```

4. Stroll by turning the servo horns in estimated angles.

```
rightfoot.write(170);
rightfoot.write(160);
```

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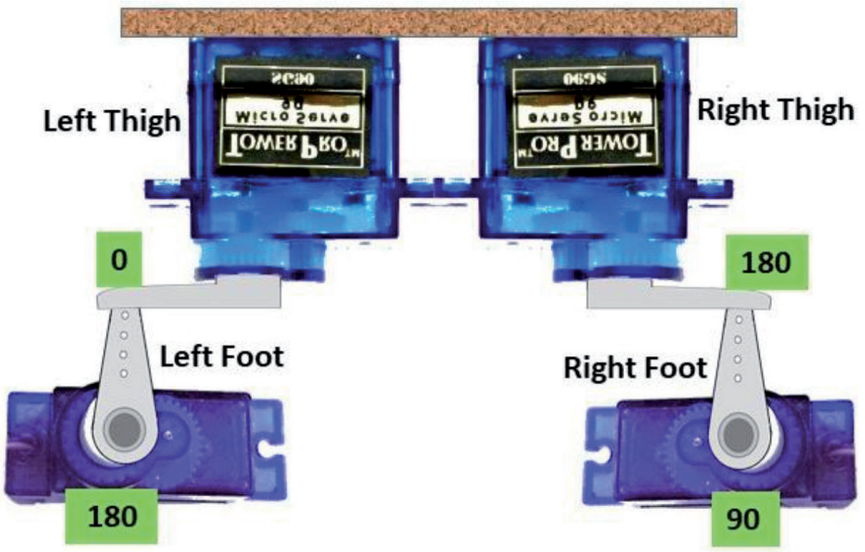


Figure 4.
Turning values of servo horns.

5. Identify if there is an obstacle found within a distance of less than 30.

```
if ((distance <= 30))
{
  digitalWrite(led, HIGH);
  leftfoot.write(0);
  leftthigh.write(90);
  rightthigh.write(90);
  rightfoot.write(180);
}
else if (distance > 30)
{
  digitalWrite(led, LOW);
}
```

6. If found, initialize servo horns to their initial position and illuminate LED.

```
digitalWrite(trigPin, HIGH);
 delayMicroseconds(1000);
 digitalWrite(trigPin, LOW);
```

7. If not found, repeat step 4, keeping the LED low.

Few lines are shown here as an example, this is not the complete code. One will need to generate the full code by understanding the algorithm appropriately. A suggestion is not to copy the above code but to understand it.

The above steps are programmed on the Arduino integrated development environment (IDE). It is a cross-stage application written in the Java programming language [9].

6. Human-robot collaboration

In human-robot cooperation, Both contribute their particular capacities. The robots play out the actual work. The human operator controls and screens. The Robot

helps the visually impaired and hard of hearing human to move securely. This implies Robot does not supplant the human, however supplements his abilities and soothes him of difficult errands. They uphold a user as a partner on account of seeing obstacles close to them. Using the Bluetooth module, the user will be able to connect to the Robot and control its walking and view with the help of a mobile platform. The human operator will be able to move the Robot's head to the left and right using the platform.

7. Apparatus and monetary requirement analysis and user feedback

In this project, we did not add AA cells, yet it is important to add AA cells to control the microcontroller instead of fueling it with USB so the humanoid can stroll freely. **Figure 5** shows the wiring outline of utilizing the AA cells.

The Robot can be designed using Arduino UNO too. In that case, one can attach the Arduino UNO to the card body of the Robot. A smaller breadboard can also be attached at the back of the robot body. Attaching Arduino UNO and a small

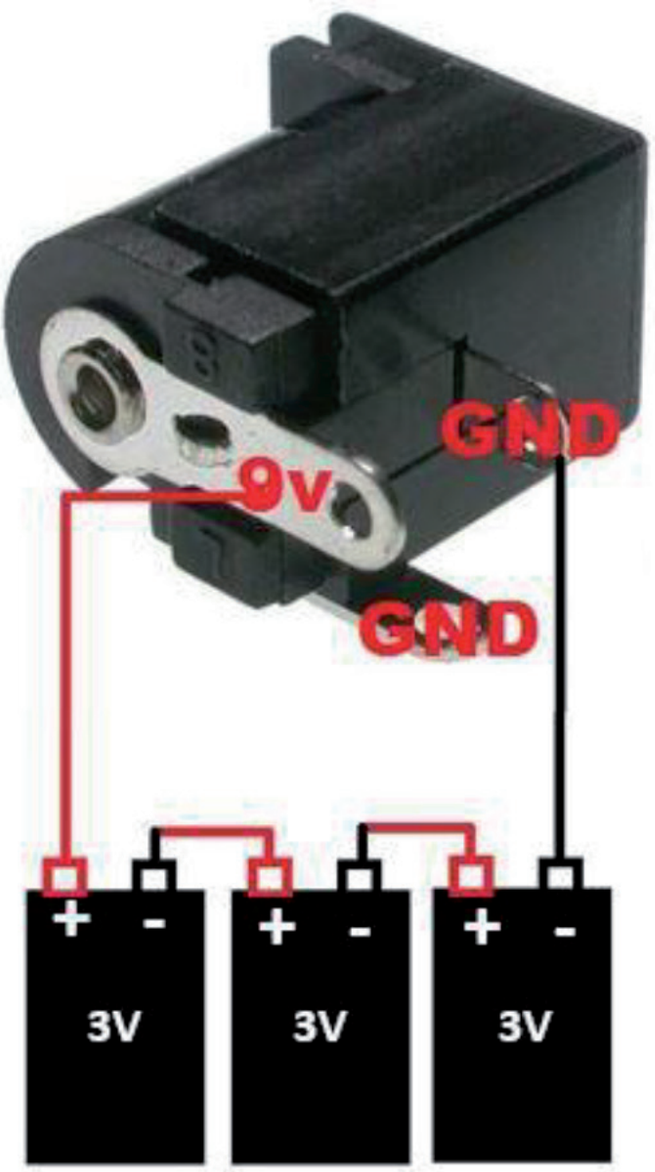


Figure 5.
Wiring diagram of AA cells.

Apparatus	Quantity	Price (BDT)
Arduino Nano V (3.0)	1	350
Micro servo (SG90)	4	135 * 4
Ultrasonic Sonar sensor (HC-SR04)	1	100
LED	1	2
Bread board	1	85
AA cells (Optional)	1	~60
Jumper wires	3 sets	20*3
Total: 1,197		

Table 2.
Apparatus with quantity and price.

breadboard to the robot body may restrict the Robot from walking properly. As it will increase the weight of the Robot, it is wise to use Arduino nano.

The Arduino Nano is an Arduino UNO contracted into a little profile, making it advantageous for restricted spaces and tasks that may have to reduce weight at every possible opportunities. Often, Arduino Nano is the least expensive choice accessible making the projects cost-effective. One should aim to decrease the use of long wires and reduce the weight of the Robot for better performance. Using a Bluetooth module will make it easier to achieve less weight.

Table 2 shows the significant apparatus and their price. Some other necessary apparatus incorporates glue gun, knife, and slices of cardboard to make the anatomy of the tiny humanoid.

As the Robot is grown mainly for outwardly weakened individuals, we went to Bangladesh Visually Impaired People's Society (BVIPS) [10] and Green Disabled Foundation (GDF) [11] to get user opinion. BVIPS is a deliberate association of visually impaired individuals in Bangladesh. The important opinion for this Robot is gathered from multiple association individuals mentioned in **Table 3**.

As the humanoid is developed mainly for apparently debilitated people, we have looked into Bangladesh Visually Impaired People's Society (BVIPS) [10] and Green

Institution	Participants
IER Dept, Dhaka University	22
BVIPS	35
GDF	19

Table 3.
Number of participants from different institution.

Benchmark	Compensation
Blind assistant	61
Amusement	43
Obstacle awareness	70

Table 4.
Blind people feedback.

Disabled Foundation (GDF) [11] to get client input. In Bangladesh, BVIPS is a purposeful relationship of outwardly disabled people.

Table 4 presents the feedback of the Robot that we have gotten from outwardly weakened individuals dependent on robot associate conduct, Entertainment and impediment location highlight.

8. Conclusion

In this chapter, we depicted the component to develop a simple humanoid robot to convert it to a gadget for future exploration and adjustment. This cost-effective tiny humanoid Robot can be used to assist visually impaired and hard of hearing at the same time. It can also be a source of entertainment and can provide security. Future researchers can contribute to the advancement of this Robot by adding features like voice recognition, control system from smartphones, decision-making capabilities using AI.

Regardless, the point is to manufacture a more extraordinary humanoid robot that will serve our overall population and make our life easier.

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