

# A Review on Humanoid Robotics

Shreyas G.K<sup>1</sup>, Tapan Endla<sup>2</sup>, Dr. Hanumantharayagouda M B<sup>3</sup>

U.G. Student, Department of Mechanical Engineering, Sir M Visvesvaraya Institute of Technology, Bangalore, India<sup>1,2</sup>

Assistant Professor, Department of Mechanical Engineering, Sir M Visvesvaraya Institute of Technology,  
Bangalore, India<sup>3</sup>

**ABSTRACT:**Recent advances in the area of artificial intelligence, machine learning has led to widespread research of integration of these new fields onto humanoid robotics. For integration of these elements, we need to know the basics of humanoid robotics. This is being addressed in this review paper. Tedious jobs are soon to be eliminated by widespread use of robots in daily life. I think humanoid robots are a great advancement in the field of technology. Consensus shows that the development of humanoid robots is slowly progressing. In order to present these advancements, the author has referred to many sources. The paper reviews evolution, elements and future scope in the area of humanoid robotics. The purpose of this study is to present a review concerning the question: are humanoid robots the next friends of humans that can be used in daily life? It is hoped that this study will inform students, engineers and researchers about the advancements, applications and future scope of humanoid robotics.

**KEYWORDS:** Artificial Intelligence, Machine Learning, Evolution, Future.

## I. INTRODUCTION

A Human like autonomous robot that is worthy of adjusting itself with the change in its surroundings and continues to fulfill its requirements is called a Humanoid Robot. The popularity for human characteristics in robots is increasing in area of humanoid robotics. Groups worldwide are working on issues like Bipedal Locomotion, perception of sound and sight, interaction between robots and humans, Adaptive Control in Humanoid Robotics. The human body can perform with ease daily applications like walking on stairs, opening and closing of door handles and so on. If the robot has body of human, daily tasks can be done with ease. The new applications will require humans and robots to interact efficiently. Communication with humans will be easier if robot is able to gauge speech, gestures and body language. Lastly, Human intelligence can be studied using the concept of humanoid robotics.

Paper is organized as follows. Section II describes the history of Humanoid Robotics and how these machines have evolved through time. Section III explains basic features of a Humanoid Robot and how they work. There are various applications of Humanoid Robots that is explained in Section IV. The future of Humanoid Robots seems to be promising and is explained in Section V. Finally, Section VI represents conclusion.

## II. LITERATURE SURVEY

The concept of human like automation grows from the past. In the second century BC, statues were constructed that were operated by air or steam.

In 1495, Leonardo Da Vinci constructed a mechanism device that looked like an armored knight [3]. The armored knight could open and close its jaw via a movable neck and wave its arms. In 1921, the word ROBOT was coined by Karel Capek in his play. In 1952, there was a breakthrough in the field of humanoid robots when Ozumu Tezuku created Astroboy, the first Japanese sci-fi robot [5].

In 1989, Pacific Northwestern Laboratory constructed a full-scale android body called Manny shown in Fig. 1 (a). In 1996, Tokyo University built Saika shown in Fig. 1 (b), a light weight and low-cost humanoid robot.

In 2000, Honda made a breakthrough by building a bipedal robot, ASIMO shown in Fig. 1 (c) which stands for advanced step in innovative mobility. In present day, ASIMO can climb stairs, recognize faces, and understand commands, open doors, carry objects. It can also perform complex operations like playing football and jumping [4].

In modern day world, a robot by Boston dynamics "Atlas" can do parkour stunts. There are some humanoid robots that can perform surgeries and are approved by the FDA. Exoskeletons have been coming up that are soft and wearable. These exoskeletons would prove very useful for protection in the workplace, help people walk again and boost the endurance of soldiers.

There are robots called co-bots that stands for collaboration bots that work alongside humans and also learn from humans. Universal robotics has been doing great work in this field. Soft robotics is one of the growing technologies in today's world. Research is going on about smart materials being used on robots. Shape shifting materials can be used as

artificial muscles with material being liquid crystal elastomers.

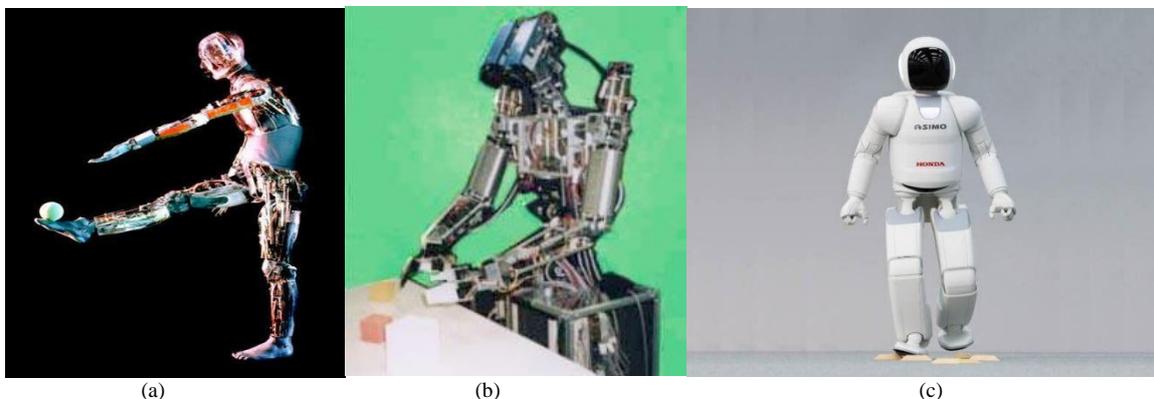


Fig. 1. Evolution of Humanoid Robots (a) Manny (b) Saika (c) ASIMO

### III. FEATURES OF A HUMANOID ROBOT

Although, from the above, the control and construction of humanoid robots might seem simple, there are a few problems and capabilities of humanoid robots are limited. The features are:

#### 1) Bipedal locomotion:

Bipedal locomotion is an important feature of humanoid robotics. For a robot, making it to learn to coordinate its lower body is the toughest job in the field of robotics. Human hands have 30 degrees of freedom. It is difficult for robots to get the same flexibility and strength of humans [6].

#### 2) Perception:

For successful function, robot must understand their environment efficiently. For perception, robots measure their state using decoder, force sensor, potentiometer etc. The robots should be able to judge changes in environment, should be able to perceive the different emotions of people and react accordingly. These functions of a humanoid robot can be fulfilled by the booming technology that is Artificial Intelligence [15].

#### 3) Human robot interaction:

Interaction between humans and robots is the primary area of study in many research organizations. Robots should be able to interpret speech, eye gaze, facial expressions, body language. Since we learn all these functions from birth, it might not seem difficult. But for a robot, it is difficult to interpret these signs in a short time. Hence robots use anthropomorphic hands for gestures [14]. Androids and Gynoids have an almost photorealistic human like appearance.

#### 4) Proprioception:

It refers to the parts that sense the orientation, position and speed of a human. The otoliths and semicircular canals are used to maintain position in the human body. Humanoid robots use acceleration is calculated by accelerometers, integrating which gives velocity, inclination is measured by tilt sensors [11].

### IV. APPLICATIONS

#### 1) Space missions:

Humanoid robots can be used in space missions because there is a danger for a human to go to space. Since humanoid robots perform the same work as humans, they can be used for navigating terrains, analyzing rock samples, checking existence of water on other planets etc. NASA is building a robot called ROBONAUT as shown in Fig. 2. (a) which measured how air moves in a station, cleans the handrails in a station. It has a camera for vision [1].

#### 2) Robot competitions:

The best visual of a robot competition is shown in the movie “Real Steel”. Although robots have not been developed to that level, they are used to play football competitions. The robots have the ability to regain their position after they have fallen and continue playing. The competitions for humanoid robot soccer include RoboCup [13] as shown in Fig. 2. (b).

### 3) Household Application:

The purpose of these robots is to help the elderly or the disabled. Robots help them by serving dishes, moving an item from one place to another etc. These robots can also be used for security when the house is uninhabited. The robots can serve as sensors and trigger alarms, call the police, etc. Although, this latest application is yet to be made [16].

### 4) Defense applications:

These robots can be used in defense applications. They can be used to fire guns after detecting an enemy, they can serve as watchdogs, they can be used for bomb defusal etc. The example for this is a robot called BigDog as shown in Fig. 2. (c) which is a dynamically stable four-legged military robot created by Boston Dynamics [2]. It was supposed to accompany and carry soldiers in difficult areas not suited for normal vehicles. The project was dropped off since the gas-powered engines were deemed too noisy for combat.

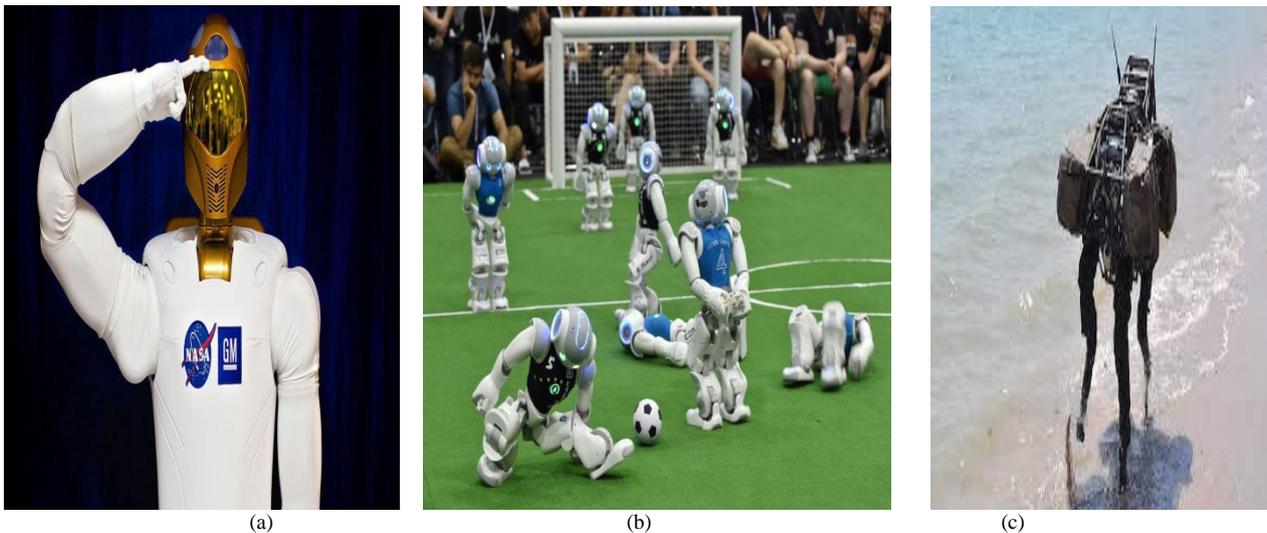


Fig. 2. Applications (a) ROBONAUT (b) Robocup (c) BigDog

## V. FUTURE SCOPE FOR HUMANOID ROBOTS

- Humanoid robots have a large scope in the future. Humanoid robots can be made complete by integrating it with many other fields like artificial intelligence, machine vision, machine learning, internet of things etc.
- Advances are expected from mechanical side. The actuators and sensors are to be made of higher stiffness for robots to operate safely. The parts of the robots must be made more heat resistant and waterproof for it to be used in high temperature terrains and use in disaster management like fires, floods etc.
- Many lives can be saved using humanoid robots integrated with drones for easy and safe movement of robots in a dangerous situation. Another important aspect to be considered is the compliance of robots with humans.
- Insights from biophysics and neuroscience can be used for enhancing compliance of robots with humans. Humanoid robots are not meeting daily users because of two reasons, high cost and high complexity.
- If the cost is reduced and process is made simple, then the scope of using humanoid robots in daily life will increase. Humanoid robots can also be used in manufacturing processes which are too tedious for men.
- This increases productivity and quality of the product. In the coming years, robots will replace humans in manufacturing and production jobs.

## VI. CONCLUSION

The field of humanoid robotics is extensively interdisciplinary which includes various disciplines like mechanical engineering, electronics engineering, computer science engineering and biophysics. Various integration with other fields is necessary for the future of humanoid robotics. Now the applications are limited. But in the near future, robots are going to change the way we live. They are going to be used in daily life. This will raise many questions about the safety of humans. In science fiction, it is shown that robots become more intelligent and decide to take over the world. This is not possible because robots that are manufactured should follow Asimov's three laws of robotics. Humanoid robots also serve as a medium to learn more about humans. Still many perceptions of humans are yet to be seen on robots. There are still things to learn from humans in the field of biophysics like mechanics, control and intelligence. At

last, I would like to conclude that although humanoid robots might imitate humans to maximum extent, they cannot equal the greatest creation of nature, humans.

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