# Artificial Intelligence: The Significance of Tesla Bot

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**Abstract.** The rising humanoid robot industry has brought significant interest from the public and treasure seekers who see this industry as the future. Tesla, a leading motor manufacturer and artificial intelligence company, has also joined the competition of humanoid robots by introducing “Optimus.” The service robotics industry, which “Optimus” focuses on, is fast-growing, with approximately 119% growth over the last four years. Compared with its competitors, Tesla has a few advantages. First of all, it has abundant experience in the field as it has accumulated countless data on human behavior through the beta that its Tesla cars have provided over the years. In addition, Tesla has more capital than its competitors. As of September 10th, 2021, Tesla has a market capital of 939 billion dollars. However, Tesla is also known for its overconfidence in its products, as it usually exaggerates the delivery date and the capability of its products. Another obstacle that Tesla faces comes from the industry itself. Admittedly, it is not a mature industry without much experience that Tesla can learn from. As a result, like many of its competitors, Tesla has to develop all of its technologies in-house, leading to the high prices of humanoid robots on the market. However, suppose Tesla is able to develop a complete version of “Optimus” faster and better than its competitors. In that case, it is very likely for Tesla to become the leader in the humanoid robot industry.

**Keywords:** Tesla; Robots; Artificial Intelligence.

## 1. Introduction

Humanoid robotics is an emerging and challenging research field that has received significant attention during the past years and will continue to play a central role in robotics research and many applications of the 21st century [2]. The research on humanoid robots can be traced back to Leonardo da Vinci at the end of the 15th century when he drew a "humanoid robot design sketch" and thus triggered research on "humanoid robots" until the modern day. Humanoid robots are robots built to resemble humans. Typically, humanoid robots have a torso, head, two arms, and two legs, although some forms of humanoid robots may only model a portion of the body, such as from the waist up. Some humanoid robots also have heads designed to replicate human facial features, such as eyes and mouths. Humanoid robots should be able to "work in the environment where people work and live, operate tools and equipment designed for people, and communicate with people." Therefore, the two basic elements for humanoid robots are control and sensing. Since the 21st century, research on humanoid robots has made remarkable achievements [3]. The first ever humanoid robot was invented in 1927, named “Televox.” It was not able to walk but could make simple gestures and motions. The first full-sized humanoid robot was developed in 1972, named “WABOT-1”. Then, Honda developed the first ever humanoid robot with two functioning legs in 1986. Since then, humanoid robots have been more advanced and capable of performing more tasks. However, a big challenge still confronted by scientists and developers is the future of humanoid robots. Currently, the general society is not even close to accepting humanoid robots as part of their lives. It is not uncommon for people to see humanoid robots in hospitals and hotels for guidance. Nevertheless, it is rare for people to interact with them because they are so less effective than humans. Furthermore, many people in society prefer in-person interactions. They want to communicate with a person instead of a computer. They believe it goes against humanity and nature to replace humans with robots. However, they only represent a small portion of the entire society. The main reason that humanoids are not successfully commercialized is simply because they are not good enough. For instance, a patient wants to see a doctor in a hospital. It is easier to communicate with a nurse than with a robot. One can explain the

exact symptom he/she has, and the nurse is more capable of directing the patient to the appropriate doctor than a humanoid robot. Furthermore, it is tough to cope with people's ever-changing needs. Thus, it significantly raises the difficulty of implementing humanoid robots into the hospitality industry. For example, in a hotel setting, some customers want to check in, some want to check out, and some may want the hotel to arrange a birthday party for their kids. It is hard for humanoid robots at the current stage to cope with all these requests.

However, this case study is significant because its target, a major player in the technology and artificial intelligence industry, Tesla, has joined the humanoid robot's field. Tesla is unquestionably one of the most successful business ventures of the 20th century. Its founder, Elon Musk, is known for his innovative business ideas. For example, SpaceX, the space transportation and aerospace manufacturing company Elon Musk founded, has been successful. Starlink, a telecommunication maverick, has also been a hugely successful venture with mature commercialization. This case study will focus on introducing "Optimus," the Tesla bot, and how it compares to its competitors. The case study will also discuss how Tesla may differentiate itself from its competitors to outcompete its competitors in commercialization.

## 2. Main Body

### 2.1 Case Description

Tesla introduced its humanoid robot prototype, "Optimus," on September 30th, 2021. As it claimed on its website, it is "to develop the next generation of automation, including a general purpose, bi-pedal, humanoid robot capable of performing unsafe, repetitive or boring tasks." As the leading company in autopilot technology, Tesla has the right to declare a "seemed" outlandish goal to the public due to its abundance of data on human behaviors, autopilot calculations, experience in artificial intelligence, and its developed supply chain and manufacturing ability. Undoubtedly, as a successful entrepreneur and businessman, Elon Musk certainly understands the potential of artificial intelligence and the Robotics field. In 2021, the global market size for robots is 41 billion dollars. This is still an immature industry during the initial development period. It is expected to undergo heavy growth in the future. Currently, robotics is mainly consumed by businesses and is for industrial usage. Its settings are currently only valuable in factories and the world of medicine and biotechnology [4] and for demonstrating the up-and-coming technologies [5]. What Tesla focuses on is service robots, which will have a much broader application since it focuses on interactions with people. While the service robot's industry is still under initial development, it has grew119% over the past four years, with global revenue of around 12 billion dollars. While it may sound that Tesla has a promising future, "Optimus" ability to commercialize and be utilized in a daily setting can be a significant obstacle.

### 2.2 Analysis

In order to assess "Optimus"' opportunities in the robotics industry, The SWOT analysis will be used to analyze Tesla.

#### 2.2.1 Strengths

Tesla has an abundance of experience in artificial intelligence. As claimed by musk, it will be using the neural system of the optical neural network on the bot to auto-manage the desired tasks. For instance, Tesla's autonomous driving solution is based on the perception network, which outputs a three-dimensional space established from the real world and uses a hybrid planning system that combines traditional planning methods and neural algorithms to plan the behavior and trajectory of the car. It is expected that the algorithm will be used in humanoid robots, which will advance the autonomy of humanoid robots to make more accurate decisions. With large-scale original data sets and sufficient computing power, Tesla's core algorithms for autonomous driving perception and regulation can be fully utilized by "Optimus." In addition, separate from other startups, Tesla is already a successful company with plenty of capital to spend on researching and developing the

"Optimus." Tesla's sales revenue was 53.8 billion dollars, with 936,172 cars delivered to customers in the fiscal year 2021, with a profit of 5.6 billion dollars. As of September 10th2021, Tesla has a market capital of 939 billion dollars, surpassing the market capitalization of the top 5 automakers (Toyota, Volkswagen, Daimler, Ford, and General Motors) combined. Furthermore, Tesla has an annual budget of 2.883 billion dollars (in 2022) [6]. In addition, Tesla is a great employer offering good welfare and substantial salary for its employees, as it was featured in the Forbes "America's best employers" [7].

### 2.2.2 Weaknesses

However, Tesla is also a company with weaknesses. It is known for its overconfidence. For instance, The Washington Post argued that "Tesla has a history of exaggerating timelines and overpromising at its product unveilings and investor presentations." [8]. As a result, it is inarguably true that "Optimus" was just a prototype with no real-world application in its pockets to be presented to its potential users in the near future.

### 2.2.3 Opportunities

Nevertheless, the robotics and AI industry are fast-growing with vast potential. If we still select major countries in America, Europe, and Asia and make a mid-term demand calculation based on the number of employees in the service industry and manufacturing industry. 8%, 7%, and 6% will be their relative penetration rate, and the total number of units in demand is 54.46 million. Assuming a unit price of 28,000 dollars, the total market size in the commercial service scenario is 1.59 trillion dollars. The demand in the superimposed housework scenario is 2 trillion dollars, and the total market size in the medium-term dimension is about 3.59 trillion dollars. In addition, with the advancement of AI technology, human-computer interaction capabilities will be gradually strengthened, and eventually, humanoid robots can meet emotional/accompanying needs. Thus, we can make a long-term demand calculation. We take one-person households as the primary target group and divide the number of households in core countries in America, Europe, and Asia into one-person households and non-one-person households. One-person households are mainly based on emotional/ accompanying needs and have a high penetration rate. (35%, 28%, and 20% in the United States, Europe, and Asia, respectively); non-one-person households are mainly based on the needs of housework scenarios, and the penetration rate is estimated (at 16%, 12%, and 8% in the United States, Europe, and Asia, respectively). The final calculation shows that the total demand for humanoid robots in the housework + emotion/accompaniment scenario is 101.07 million units. According to the unit price of 28,000 dollars, the market size is about 2.89 trillion dollars. In the long run, humanoid robots are expected to realize the resonance of the three scenarios of housework + emotion/ accompaniment + business/industrial, and the total market size is expected to reach 4.4 trillion dollars.

Other companies have also realized the massive potential hidden in the robotics industry and thus became significant competitors of Tesla. For example, one of the major competitors of "Optimus" is the Honda "Asimo" robot, launched in 2000. After a decade of updates and developments, it was able to run, jump and even climb stairs. It had a price tag of 2.5 million dollars. However, it was not commercialized, and Honda stopped the project in July 2018. Another major competitor of Honda is Boston Dynamics, which gained much popularity in recent years through the internet. Boston Dynamics launched its robot "Atlas" in 2013. It has the highest sports control ability, which allows it to do some heavy parkour actions. However, it has a price tag of 2 million dollars and has not yet been commercialized. Another major competitor of "Optimus" is Ubitech's "Walker." It was prototyped in 2016. Through multiple updates, it can play piano, pour water, and walk and is still on its way to commercialization. Other representative products include Softbank's "Pepper," Engineered Arts' "Ameca," and Agility Robotics' "Digit," all of which have high costs. "Digit" focuses on vertical logistics application scenarios and has the best commercialization effect. "Digit" is sold at 250 thousand dollars per unit and shipped around 40 to 60 units in 2021.

### 2.2.4 Threats

Comparing the core parameters of those humanoid robots, they usually have a height between 120-185cm, weight between 40-80kg, and driving speed between 3-5km/h, which is similar to humans. The three core technologies of humanoid robots are human-computer interaction + scene perception, and motion control. The scene perception technology progresses rapidly over time. Most motion control uses hydraulic or pure motor drive, and there is still much room for improvement in the operation control algorithm. There have been breakthroughs in human-computer interaction, but there is still a big void in autonomous decision-making. However, because the robot has not provided effective and accessible solutions to real-world problems, and the price is high, the commercialization process is relatively slow.

### 2.3 Suggestions

Through the SWOT analysis of Tesla and comparisons with its competitors. It was clear that for Tesla to successfully commercialize its "Optimus," it must accurately position itself in a setting that is susceptible to AI and profitable in the future. When it is challenging to develop a general-purpose robot suitable for all scenarios, the more vertical and deeper the demand scenario, the easier it is to achieve commercial success.

The growth rate of robots in personal/family scenarios is relatively fast as well, and they still have significant growth potential. In the personal/family scenario, the sales volume of robots in 2022 will reach 9.1 billion dollars, which is nearly double the growth compared to 4.6 billion dollars in 2018; robots used in housework scenarios and emotional interaction scenarios account for 82% and 18%, respectively. Compared with the commercial scenario, it has more substantial growth potential and broader market space, which is what "Optimus" focuses on. In terms of scenario entry sequence, "Optimus" should be applied to personal/family scenarios in the short term, commercial service scenarios in the medium term, and long-term expectations that further breakthroughs in interactive technology are expected to meet the needs of emotion and companionship since it is in accordance with the level of difficulty of development.

Thus, Tesla should focus on developing its product to out-compete its competitors and reveal a product that is accessible to the public earlier than other companies. Just like the path that Tesla took in electric cars. Looking back at Tesla's sales in the past ten years, Tesla's global sales in 2011 were less than 300 vehicles, and after ten years of rapid growth to 936,000 vehicles in 2021. Tesla can do that because it revealed an attractive and accessible product before anyone else. Thus, Tesla should use its leading electric technology, intelligent technology, business model & marketing strategy to develop a competitive product. Due to the many similarities between humanoid robots and electric vehicles, in the field of humanoid robots, Tesla still has a comparative advantage over other manufacturers, and "Optimus" has a high potential for commercial success and can take the lead in the market.

## 3. Conclusion

In a nutshell, the market for humanoid robots is set for rapid expansion. There is a significant number of competitors for Tesla with abundant capital. For example, Ameca, developed by Engineered Arts, is now able to have full conversations. However, they all lack the accumulated experience and technology that Tesla possesses. In the field of humanoid robots for commercial use. It is already a mature industry with some leading companies such as ABB and Epson. However, there has not been a leader in the service robot industry, so it allows Tesla to use its existing technology to potentially dominate a vast industry with a significant market capitalization in the future. Consequently, the most important step for Tesla now is development. For it to be the leader in the humanoid robot industry, it must deliver an accessible and useful product before all its competitors to the consumers to take over the market, and Tesla has more advantages in doing so than its competitors. This case study gives prospective researchers a general overview of "Optimus" and the

humanoid robot field. In the future, more studies should focus on the technical side of the humanoid robot industry and whether this industry will truly become accessible, as predicted by this study. If so, when? Furthermore, more research should be done on which field the humanoid robot will access first and how the development of humanoid robots would affect humans and society as a whole.

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