

A Modern View into Robotic Assistance

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ABSTRACT

Robotics, How are robots represented in our modern world? Will robots dominate the workforce? Where would robots fit into our current society? What is the norm preconception for an acceptable robot? What type of robotic are developers trying to manufacture? These questions pose serious issues within the field of robotic assistance which is slowly becoming more popular within various fields such as the commercial and research societies, the key factor that needs to be taking into consideration when developing new appliances is that, developers create something useful and innovative, which is also accepted by the norm of society. With this paper a look into the innovation of robotics will be previewed, followed by reviews through current research that is being undertaken and recent studies about human preconception towards robots and their desired behavioral pattern will be thoroughly examined. The main factor that will be covered for discussions about robotic assistance will be to first consider the type of robots that can match both the expectations of society and the dream of what developers are striving to achieve. Introduction of robotic tools that is currently being developed to assist humans in various situations shall be reviewed and its impact in society shall also be presented, this will in turn show the capability and progress that robotics has achieved in our current world.

INTRODUCTION

In the early 70's mankind had an early vision which visualized what the future would be, many of this conceptual ideas were portrayed in science fiction shows, from blockbuster movies to television series even to cartoons, some famous example would include Star Wars, Terminator, Star Trek, The Jetsons and many other shows which have a massive cult following even until today. In those films futuristic concept that were introduced included flying cars, human characterized robot, weird outfits and many other bizarre notations. The topic of interest for this would be the conception of robots that were displayed in those early 70's movie. During that time line, the main feature that a robot should possess was intelligence, human movement, and human characteri-

stics, famous robots that would fit this criteria was C3PO from Star Wars, Data from Star Trek, and even T101 from Terminator. Another interesting point from movies are whether robots will dominate human kind one day, in shows like Terminator and The Matrix, robots are portrayed in a distant future where they have taken over the world, this could be translated into a more pressing issue which worries the majority of people, and that is whether robots will replace them from their work. In the early 19th century when Joseph Marie Jacquard refined the weaving machine that was invented by Jean Falcon, it created a huge gap in the economy infrastructure by forcing many weavers out of a living, where the machine was able to produce higher quality fabric at a consistent and rapid rate. To reflect on this, with robots being more precise and focus on any given task than a human, and its integration into society becoming more of a reality, will we be seeing a repeat of history where the introduction of robotics forces human out of their work. All this concept and ideas from movies poses interesting questions that will be essential for the future development of robotics.

Even though the idea of robots had been a dream of mankind for over the last few decades, the field of robotics is still a fairly new ground. Today, robotics is slowly gaining momentum in our everyday life, even with the many skeptics about robotics, the field of robotics is slowly becoming more popular, and with the current direction we are progressing robots will very soon become an essential part of our everyday life in the foreseeable future. The topics following this will discuss behavioral patterns that are acceptable for a robot by both society and developers, the main focus on society will be the expected behavior that a robot should possess and on the developers side a focus on a robot's practical use and design functionality shall be further explored.

SOCIETY

In robotics for assistance purposes, there is a common question of how a robot's personality should be, this is severely important if robotics are to be accepted by the general consumers, this is similar to the following principle where you do not let a stranger into your house, and the same reasoning will be applied to robots. Through studies (Dautenhahn et. al. 2005) provided a list of typical triads a robot could possess, where a robot could act as a companion or act as a household tool, and through a survey it is shown that majority of the subjects would be more willing to accept it as a household tool, and less of the subjects would accept it as a companion. Also during the research another survey on ac-

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ceptable behavior pattern for robots was conducted, and it shows that one of the key behaviors that subjects are more keen into accepting within a robot, is that when it possess the following criteria, which is in no particular order a robot has to be able to be easily controlled, its action should be predictable, and it has to be always loyal to its owner. This result prove to be a fairly surprising factor, by just seeing the response from the subjects, it shows that the typical behavior of a robot that is desired by the vast majority of the subjects, is to have total dominance over the robots functionality. This shows that human have a psychological need to be in control of a robot, thus creating a typical persona that we want in a robot, which is in term similar to that of a loyal pet dog, or maybe a hired servant or butler, and to push it into a more extreme view, it shows that we want robots to emulate the personality of a personal slave with no free will.

Another study done by (Jennifer & Sara, 2002) presented two different personalities for their robots, one had an extraverted and playful approach towards people, and the other had a serious and concerned attitude towards people. Then test subjects were introduced into a isolated room to initiate interaction with the robots, from here observers would record down the subjects behavior and attitude towards the robot and also gather the emotion that was displayed towards the robots. After the study most of the test subjects that interacted with the extraverted and playful personality for a robot got a highly positive rating for interaction than compared to subjects with robots that have a serious and concern attitude which got a lower rating. So besides being controllable and loyal which was one of the conditions lay out in the earlier study, humans would rather a robot have a cheerful personality for a robot over a serious personality. When the results were finally gathered, an analysis of the test subjects interaction with the robots, shows that subjects tend to first find the robots to possess a degree of intelligence, but after a period of time, the test subjects loses interest in interacting with the robot and realize the robot is pretty repetitive and lacks any real intelligence. The most interesting fact that was assembled from the collection of data during the interaction with the serious personality for a robot was that subjects actually performed the provided task better, and the robot managed to gather the attention span of the subjects for a longer period of time compared to the playful personality. This fact actually creates an interesting paradox with the current research presented by both the two previously discussed research about what we as human want, over what we as human really need. It proves ironic that the test subjects wanted a controllable, fun, loving robot, but in reality a serious and concern personality had better impact on the subjects, a common analogy that could be made is that all human really want is someone to lead and guide us, like a flock of sheep.

With the various type of personalities that a robot could adept, (Jodi, 2005) undertaken a research in how beneficial robotics assistance to the elderly would be. During the author's research, a test robot was deployed into a hospital environment, to see the reaction of people when confronting with a robot. From the gathered results, it was shown that engineers and male administrator treated the robot as a tool

which is easily controlled, female administrator and lower level staff treated the robot with anthropomorphism, while nurses saw the robot as nothing but a technological tool with little use. Through the research, it is shown that the way engineers and male administrator treated the robots were exactly how they were envisioned through the survey done by (Dautenhahn et. al., 2005) where they are portrayed as nothing but controllable tools, while the reaction of female administrator and lower level staff proved to be really interesting and unique, as this would show that robots are not an alien concept and may be easily integrated into society. Of all the displayed reaction of the hospital staff, the behavior of the nurses were by far the most interesting, these reaction could be simulated by the fear of either being replaced which makes the robot a rival to the nurses, or they really believe that the robots are annoying and inadequate to handle the given task they it was provided to do, this shows that further inquiry on this matter should be properly investigated to gain a better insight of the nurses reaction.

From the given research accomplished by various authors, it proves that robots can be accepted into our society as (Jodi, 2005) shows how a robot was integrated into a hospital environment with mixed reaction, and that the behavior pattern of a robots personality if should it be accepted by society needs to be both controllable and loyal to its owner. There will be a degree of resistance against robotics being accepted by society but with work and understanding, hopefully this will be a problem that can be overcome in the near future.

DEVELOPERS

On the developer side, the type of robots that are being brought into realization requires careful preparation, a degree of purpose and motivation is needed to create something practical that can be accepted by the general population, and this is an issue that must be solved by developers if robots are to make it into our society. A research (Frdric, 2005) introduces four types of robots that can be introduced into a normal household, and that is:

- The fashionable clothes - its usefulness is only for a short period in the beginning
- The computer -its usefulness will increase overtime but after some time start to decrease
- The cockscrews - its usefulness is always consistent
- The notebook -its usefulness increase overtime and remains useful

By following the work done by the author, the best robot that would fit for assistance purpose into a household would be the notebook model. This is because a robot needs to have good historical capacity, versatile functionality and an orientation towards social interactions, and these three qualities were deemed to be the most important factors when developing a robot that would have a lasting impact towards our society and be able to withstand the test of time. Looking at the given models that were discussed, the notebook model for a

robot far outshines the other models making it the obvious candidate that developers should strive for when creating a robot.

Aside from focusing on the type of robots developers should center their design on, a robot should adopt a list of user centered design (Aaron, 2008), it uses the basic user center design principles from Human Computer Interaction and revise it to fit the needs of robotics. Besides revision, the author added a few unique principles solely to fit the needs of robotics, thus creating the Human Robotic Interaction principle. Based on the basic principle of Human Computer Interaction, the author developed the following list of principles that should be incorporated into robotics:

- Required information should be present and clear
- Prevent errors if possible, if not, help users diagnose and recover
- Use metaphors and language the user already know
- Make it efficient to use
- Design should be aesthetic and minimalist
- Make the architecture scalable and support multiple platforms
- Simplify task through autonomy
- Allow precise control
- Create a positive brand image
- Strive for human-human interaction

These following principles recommended by the author are only guidelines that have been propose for Human Robot Interaction. For it to work there will be need for further refinement and improvement so that it would generate a better model that would suit the requirements of robotics better. As robotics advances into our society, and the market for robotics expand into our lives, it will open a different sort of interaction and developers must be prepare to face the challenge beforehand.

Besides creating new criteria and models for robots, developers should also pay attention to its entertainment value (Ryohei, 2006). Entertainment value is vital in marketing robots into society and that alone is an important commodity that developers must be aware of. Through entertainment, it is important to see what features of a robot would provide the best fit into the given criteria, and the author claims that 3 factors are required to improve a robots entertainment value, and that is:

- Appearance - robots have an actual physical appearance which can give us a sense of reality which 2 dimensional images lack.
- Interaction - robots can achieve physical interaction which gives us a sense of presence which telecommunication lacks.

- New Experience - base on the following two features provided, a robot can provide us with new experience we never had before.

Even though entertainment has always been considered a waste of time, it is demonstrated as an essential part of our society, the entertainment industry is one of the largest profit generators, and if developers are striving to break into the market, it would be beneficial to aim for the most lucrative industry there is. Also for developers, the behavior that a robot portrays is a serious issue that must be handled, because if a consumer is not pleased with the end product, it will not be sold. That is why research conducted by (Dautenhahn et. al., 2005) and (Jennifer & Sara, 2002) shows that deep consideration needs to be taken into account when creating robots for household situation.

In the movie I, Robot, robots where programmed with three fundamental rules which dictates the action of a robot, to extend this fact, it can be applied to what (Aaron, 2008) was trying to introduce with his set of principles. By applying a set of fundamental principle that developers should undertake, it can be crucial in order to avoid any problem and confusions that may occur in the future, and this should be achieve while the field of robotics is still young. This shows that a degree of careful planning and preparation is required on the developer's side in order to propel the field of robotics into the future which was discussed by both (Frdric, 2005) and (Ryohei, 2006).

CURRENT DEVELOPMENT

After discussing the type of personality, behavior, and even principles that a robot should possess, it is important to see the latest development in the field of robotic assistance that is being undertaken. (Takahashi et.al., 1998) four types of robots designed to assist the elderly were introduced in the authors' research, the first two robots were designed to assist people in walking and climbing stairs. The first robot introduced was a biped robot, where a pair of robotic legs is attached to a handrail with a balancing mechanism for support, it uses a potentiometer attached to the waist of the robotic legs, and the legs are controlled by a personal computer with A/D and D/A boards. To use the biped robot for walking assistance, a person would step onto the leg platform and the robotic legs will assist you in walking around an area defined by the handrail. The other robot used for walking assistance, is a stick robot where like the biped it uses a handrail to control the robots movement, from the handrail it extends a rod that acts as a support bar for user to lean their weight against, another rod that acts as the main support stretches towards the floor and is attached to a motorized wheel that can increase or decrease its velocity which is controlled by a personal computer that uses a voice instruction system. To be able to climb stairs, its main rod features a foldable section, so when it meets a stair, it will bend its wheel towards the wall. This stick support robot is a simplistic design when compared to the biped model which uses a complex system that assist with actual movement and can be better for elderly who have very weak legs, but the stick design is less bulky and will be more appropriate for a small house with

narrow surrounding. The next two robots that were introduced by the author were design to assist people by serving tea while they are in bed. The first robot is a floor based tea serving robot that requires a small installation area, the idea of this robot was simulated from a drip transfusion stand used in hospitals. It incorporates a main rod that has three directional drive mechanisms. The robot also includes a hand to grasp the cup, and also a personal computer which controls the system via a voice instruction system. The other robot is a ceiling version which utilizes a laser sensor to detect a thin lightweight plate attach to wires that uses a guide rail on the ceiling, the laser is used to determine the inclination of the wires which is used to reduce vibration so that the tea will not be spilled when being carried by the robot hand. The ceiling version is shown to require less space than the floor counterpart, but the ceiling version may be more costly requiring a special laser sensor to avoid spilling where the floor version is steadier than the ceiling model. The robots that were created by the author are mainly voice activated, and follow a strict guideline of action to perform. This gives a user full control of the robot which is important as demonstrated in (Dautenhahn et. al., 2005), and the simplistic design that mainly uses a long stick confines to the principles that was introduced by (Aaron, 2008), unfortunately the design would fall under the cockscrew category which was not the ideal make for a robot (Frdric, 2005).

Another robot that has been recently developed was used for assisting people in wheelchairs that either lost the function of their legs or have really weak leg muscle by transferring them from the wheelchair to another surface and vice versa (Takahashi, Manabe, Takahashi, & Hatakeyama, 2003). The robots uses a robotic arm where the user will lean his body weight against and the arm will extend to support your body, then the base will rotate to the new angle you wish to be at, and finally the arm will return to its original state allowing the user to sit back down on the new location. During construction, the main robotic arm was the most important feature, where the author had to find the perfect length to reduce the burden on a user. It was shown that a short arm would cause too much stress on the user and a long arm increases the burden on the robot, so the author decided that it is better to reduce the users burden as that is more important as a robot should be assisting the human and not the other way. This final design of the robot was created with an extendable arm which would be better for commercial purposes which would conform to (Aaron, 2008) principles of robotic, sadly the design define by (Frdric, 2005) would classify this as a cockscrew robot where it has only one functionality and would not improve over time.

Robotic assistance was also applied to movement therapy (Cozens, 1999), the robots goal is to help patient who have neurologically impaired joints recover from the discomfort and regain joint movements. The author gathered a group of ten subjects, where each had problems with their elbow movement. Each user was equipped to the assisting robot and a basic exercise routine was performed. During the middle of the experiment the author would randomly turn off the robot to stop assisting the subject without the subject's knowled-

ge. Before the assistance of the robot, all the subjects were unable to complete the set of exercises provided by the author, but with the assistance of the robot, all the subjects were able to complete the exercise even when the robot was deactivated without sensing any discomfort. The results showed here means that robotic assistance is capable of improving the movement of the subject and hopefully with further assistance, the joint will be fully recovered. (Reinkensmeyer, Galvez, Marchal, Wolbrecht, & Bobrow, 2007) had some critical problems with robotic assistance for movement therapy, as listed this are the key problems that the author claims:

- It has not been demonstrated yet that robots are necessary to achieve observed therapeutic benefits.
- Therapeutic benefits of robotic therapy are small.
- We do not understand how motor learning during neuro-rehabilitation works at a level of detail sufficient to dictate robotic therapy device design.

To overcome this problem the author tried to address the issues by undertaking more research to improve movement therapy robots:

- Research Direction: Identify motor learning tasks that can be enhanced with robotic assistance.
- Research Direction. Develop non-robotic therapy technology when appropriate.
- Research Direction: Optimize robotic assistance to promote engagement and effort and allow some error.

The movement therapy assistance robot should be fun and entertaining to encourage users to rehabilitate their joints, this feature is important and it coincide with the points made by both (Jennifer & Sara, 2002) and (Ryohei, 2006). The robot also seem to be a cockscrew model from (Frdric, 2005) which shows that most assistance robot are currently introduced into society are focused onto solving a single issue, which may prove to be a downside for the future, but for now, at least robotic assistance are getting noticed and slowly integrating itself into our society.

CONCLUSION

So to conclude things, robotics assistance is approaching fast and it is very real indeed. In the near future, I expect robots to be a common part of our society, this means research for understanding the behavioral pattern so that it may entice society to better accept robots and allow it to slowly integrate into our society is important, and also dictating a set of fundamental rules and principles that robots should possess will help ease developers into creating tools that are efficient and effective for consumers to use. Will robots become the new slave of the future? It may be so and we should be prepared for it.

FUTURE WORK

More work into creating a dynamic multi-purpose robot should be done rather than robots with a single minded mentality which would allow robots to become more versatile

and useful unlike the robots from (Takahashi et. al., 1998) and (Takahashi, Manabe, Takahashi, & Hatakeyama, 2003). Another point of research that will be important would be to increase the amount of survey into current robots and the success or failure of the outcome should be recorded to try and refine the situation like (Reinkensmeyer, Galvez, Marchal, Wolbrecht, & Bobrow, 2007).

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