Assignment Cover Sheet

Faculty of Science, Engineering and Built Environment

NAME: Satvik Sharma _____

STUDENT ID: 218595095 _____

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Research on Surgical Robots

A surgery can be defined as treating or healing of an organ or parts of a living being with a use of instrument, used for making an incision on body. On the other hand, robotics is defined as the branch of science that deals with machines resembling human and is able to replicate certain human activities. This report focuses on the use of robots in surgery, the problems which are being faced and what is going to be the next big step revolutionising surgical robots. Surgical robotics started as a way of making surgeries faster and more accurate with a minimum chance of casualty. the surgical robots are very accurate in doing surgeries, but factors like image analysis, robotic image verification, instrumentation calibration, the declaration of decreased times have not been met triumphally and, despite notable improved efficiency and workflow, set time often make robotic procedure longer than their standard coequals. The traditional method of doing surgeries was opening up the body and doing the surgery on what the surgeon can see and reach, which lead to complications. Methods are being researched for the minimally invasive surgery. These problems if solved will open the door to new possibilities.

To understand is where the technology reached where it is standing today, it should be started from the beginning, with the assistance of Arthrobot in Vancouver in year 1985 with the involvement of Geof Auchinleck, Dr. James McEwen and Dr. Brian Day and their team of science pupils. The robot was used as an assistant in an orthopaedic surgery at Vancouver's UBC Hospital and subsequently it assisted in over sixty surgeries. Advancement of the surgical robots was started with the invention of Da Vinci system and ZEUS surgical systems which was inspired from the first robotic surgery performed at the Ohio State University Medical Centre in Columbus, Ohio under the guidance of Robert E. Michler. AESOP was launched in 1994, and had the first FDA approved laparoscopic camera holder, and was occupied with voice control in 1996 and independence of seven degrees to imitate a human's hand in 1998. In 1998, ZEUS was introduced as system of robotics where the doctor sits on a console at a distance from patient and then operates via console. At Stanford Research Institute International in Menlo Park, the da Vinci surgical system was developed. It has been found out that this teleoperation robot is useful for the surgeries with very little scarring. This system senses the hand movements of surgeon and sends them into scaled down micro motions so that the small proprietary instruments can be manipulated. It also detects the tremors or shakiness in the hand of the surgeon and filters them out. It was approved by FDA in 2000 which consequently led da Vinci to become the first proper surgical robot in United States of America. Another system similar to da Vinci was founded in September 2002, known as The Sensei robotic catheter system, for accurate location, and tampering. It was developed by Hansen Medical Incorporation situated at Mountain View, California, USA. This system allows placement of a steerable catheter tip within the heart at the particular point. Furthermore, a surgical technique was documented known as transoral robotic surgery or TORS for the DA Vinci system as the only approved artificial intelligence surgical system for performing head and neck surgery. The first robotic surgeon conducted a surgery on a 34-year-old male in May 2006, without any assistance from any doctor, for the correction of

heart arrythmia and when the results came, it shook everyone since the surgery was considered than an above average human surgeon. This was possible because the machine had been encrypted with the database of thousands of such operations beforehand. A couple of years later, the first robotic paediatric neurogenic bladder reconstruction was performed by Dr. Mohan S. Gundeti. Robot should be used and in near future replace humans in medical facilities can have various reasons. Most important one is that it does much better work than humans. If given proper data, it performs really well as in the case of a surgery on a 34-year-old male. Another example is of the Renaissance which allows the surgeons to place screws in spine 9 percent higher than conventional methods. The famous da Vinci robotic surgical system, which was described in the above paragraph, performed around 2,00,000 surgeries alone in 2012, mostly including prostate removal and hysterectomy. This system is used increasingly because it makes laparoscopy easier. Earlier the surgeon had to stand on the side of patient and did all the operation from the two side cuts in inverse, meaning if the move their hands to right the surgery is performed on the left-hand side. With the arrival of da Vinci, the surgery was made much easier for patients as well as surgeons. First of all, it led to very little blood loss. Then the surgeon could sit next to the patient and perform the surgery. The hands of the robot are highly stable, providing surgeons to work in an area in a body only with long cuts if done by traditional procedure. This improves the surgeon's accuracy, flexibility and control. there was a research done comparing the cuts made on a pig skin by an experienced surgeon and a robotic system called Smart Tissue Autonomous Robot or better known as STAR. It shows that star makes more precise cuts, almost perfect and minimally damaging the surrounding tissue, better than the surgeon. But that does not mean that they are not having a negative side to them. surgical robots are not cheap. The da Vinci setup cost around 2 million American dollars, which means that not every institution can afford them or even if they do, patients might not have money to pay for high cost surgery. In a study, it was shown that robots are good at performing complex surgeries better than humans, but in a less technically challenged surgery robots take more time that human surgeon.

According to the research, the da Vinci system is considered to be the best surgical robot present now. Even though it is having some back hustles, but still it is a great help to surgeons performing surgeries on patients. But it still a midway, and there's a lot more to go on. The vision for the new robots is that they will be smaller, possibly disposable robots at a lower cost, instead of bigger and costlier robots. Nanobots or microbots that flows in the blood stream and performs surgery after attaching to the effected part may seem like a far-fetched option, but there are tiny devices such as HeartLander which tells that maybe within next 5 years, minimally invasive surgery might be possible. Carnegie Mellon University created a bot known as HeartLander as a disposable, surgical system. This device provides the entire heart with a treatment by going inside. Devices like these might be seen in the market in the near future, but before that, challenges like thrusting methods, supply of power and contacting are to be resolved. Engineers need to develop a system with which surgeon can easily interact with. Knowledge of government approved pathways, clinical studies and economics of healthcare are key to market success. Existing solutions are the expensive ones, not the commercial ones. The future might be some small, use and throw robots that can cater the healthcare economy. Some of the traditional tools used are inspired from the nature which are still used today for surgeries. Maybe future robots can be inspired from something else in nature. The ongoing research is about developing devices that the patients can swallow

without bearing any scars on the body for rest of their lives. It looks possible that big operations may be performed without cutting up the skin, and using the natural orifices as the entry points. This is only a vision which can be achieved development of tools and ensuring safe procedures.

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