**Fatima Bekmamatova**

Group: **COM-19A**

Research Topic: **Medical Engineering**

Research question: **How do tiny robots help in early detection of breast cancer in women?**

**Abstract**

Have you ever wondered about how do tiny robots help in early detection of breast cancer in women? As long as breast cancer is one of the leading killers of women, nowadays, this is one of the problematic fields, where should humankind pay attention and solve.

**Introduction:**

**“**Breast cancer is one of the leading killers of women in the world” - cited in [1] Global Trend of Cancer Mortality Rate: A 25-Year Study. Current experts working on breast cancer research at the [2] Robert W. Franz Cancer Research Center at Providence Portland Medical Center have cited that breast cancer begins as one malignant cell and grows by simple cell division. It can be felt only up to 30th cell division, though, while before that time cancer has been in your body for two to five years.

**Hypothesis:** The use of micro-robotics can do a better job of diagnosing breast cancer earlier.

When I was at 9th grade, my aunt, who looked after me when I was a child, died of the cancer. That year was saddest year in my life. My aunt died and left her four children and me at a very young age. To make worse their father had passed away earlier, so there was no one to comfort them. While my aunt was being treated, I read a lot of articles about cancer. And from that moment it was my main goal of my life was to find out whether it is possible to prevent cancer or not.

Why Breast Cancer? This type of cancer is the most frequently diagnosed cancer among women in 140 of 184 countries worldwide, as cited in Breast Cancer Statistics and Resources [3]. Nowadays, with such an advantages of highly effective technologies, the probability of solving this problem is pretty high. Why highly effective technologies? Because, as said Francesca Ciccarelli [4], a computer scientist who heads up the Cancer System Biology Lab, there is the need for high-processing computers and computational experts who can write the code that can detect marks in large datasets – 3 billion letters in human genome, by using highly effective technologies computer scientists can write code for micro-robotics and create micro-robotics, which are can do effective job than human.

Why it is important to me? It is important to me, because I want to change World for better, I want to do helpful things to the World during my life. I want to see smiling faces rather than crying ones because of this type of cancer.

**How do I plan to do? Objectives:**

1. To do deep research in breast cancer.
2. Learn writing codes on computer scientists level. (as required for biomedical engineers)
3. Find an investor for this project.

4)Make a suggestion to Medical Engineers and Computer Scientists.

5) To negotiate with top 20 Biomedical Laboratories in the World in order to make an arrangement with laboratory with all good conditions to implement our work.

**Review of the Related Literature**

**What is the present state of knowledge regarding the topic under consideration?**

According to Worldwide cancer data from World Cancer Research Fund [5] we can say that breast cancer among the women is one of the leading killers. As long as there are a lot of cases of breast cancer and deaths because of it, among the women in the world, there is a lot of researches about early detection and preventing breast cancer. There are reviewed several researches related to this field that were done before by:

1. Microsoft’s Research Labs around the World [6]:

* Programming principles and tools group in Microsoft’s Cambridge, U.K. lab.
* Genomics group at Microsoft.
* Microsoft’s Redmond, Washington, lab.
* Biological Computational Research Group.
* Radiomics Research in Microsoft’s U.K. lab.

1. MIT’s Computer Science and Artificial Intelligence Laboratory (CSAIL)

and Massachusetts General Hospital (MGH). [7]

1. Cancer Systems Biology Lab. [8]
2. In the purpose of solving one of the most complex and deadly challenges humans face: Cancer, Microsoft's research labs around the world trying to use computer science. [6] They are solving algorithms instead of testing tubes and beakers. Why Computer Science? Why algorithms instead of tubes and beakers? Because, as said Jasmin Fisher, a biologist by training who works in the programming principles and tools group in Microsoft’s Cambridge, U.K. lab [6], “the only computer can handle such big data that withdrew from cancer cells. So, we are trying to change the way research is done on a daily basis in biology.”

Researchers – computer scientists and biologists – in Microsoft’s research labs around the world, doing their bests in order to find out the solution for this current problem. [6] For instance:

One team is working on using machine learning natural language processing to help world leading oncologists figure out and treat their patients most effective. They are providing an intuitive way to sort through all the research data available.

Another team is working on pairing machine learning with computer vision. It helps radiologists a more detailed understanding of patient tumors’ progressing.

Also, another team has created powerful algorithm which help scientists to understand how cancers develop and what is the best way to fight them. [6] “The collaboration between biologists and computer scientists is actually the key to solve the problem about cancer” said Jeannette M. Wing, Microsoft’s corporate vice president in charge of the company’s basic research labs. [6]

The Francis Crick Institute mentioned that: "We have a lot of cancer researchers here – nearly half of our 1,200 scientists' research relevant to cancer. Many of them don’t wear white coats, and may never lay eyes on a tumour. Even rarely set foot in a lab at all. Who are they? The key players in the fight against cancer - our computer scientists." [8]

As said David Heckerman, a distinguished scientist and senior director of the genomics group at Microsoft, "as long as there is a huge leap between information and data, knowledge and understanding, We’re in a revolution with respect to cancer treatment. And that’s an area where computer scientists can best help the biological sciences.", the future of medicine depends on programming and computer scientists as well. [6] Because there should be handled big data. “Nowadays, cancer research would simply not be possible without data science,” says Francesca Ciccarelli, a computer scientist who heads up the Cancer Systems Biology Lab. [8]

Team of Jasmin Fisher, a senior researcher in the programming principles and tools group in Microsoft’s Cambridge, U.K., research lab and an associate professor in the biochemistry department at Cambridge University, are taking is called Bio Model Analyzer, or BMA for short. It’s a cloud-based tool that allows biologists to model how cells interact and communicate with each other, and the connections they make. [6] This system creates a computerized model that compares the biological processes of a healthy cell with the abnormal processes that occur when disease strikes. That could allow scientist to see the interactions between the millions of genes and proteins in the human body that about to lead to cancer. “Using BMA, clinicians could enter all biological information about a cancer patient, and next time it would be easy to compare that analysis with a healthy one. This kind of computation is impossible by paper and pen. To do this kind of computation you need powerful computational models, which can run through all possible abnormalities.” – s aid Fisher.

“One of the approaches to solving the cancer problem is to create a kind of molecular computer that you can put inside a cell, so that it will detect disease cell, and will response to fight it.” – said Andrew Phillips, who heads the Biological Computation Research Group. [6] But he also added that there is a big and obvious challenge - the biological systems including the human body - are much more mysterious than the hardware - computers - that we created to run the software. "We built the computer, we know how it works. We didn't build the human cell, so it remains a mystery to us. So we need to understand how the cell computes in order to program it," - Phillips said. [6]

Computer scientists and radiologists in Radiomics Research in Microsoft’s U.K. lab, working on to get the most accurate picture of what is going on patient's body. [6]

There is so much information, data from detecting cancer. In order to use these kind of information we need to learn how to use them, in other word, we should learn to listen the data. As said Brian Druker, the director of the Knight Cancer Institute:

“I’ve always believed that the data is trying to tell us what the answer is, but we need to know how to listen to it. That’s where the computation comes in.”

1. " MIT’s Computer Science and Artificial Intelligence Laboratory (CSAIL) and Massachusetts General Hospital (MGH) has created a new deep-learning model that can predict can predict the onset of breast cancer 5 years in advance. Trained on mammograms and known outcomes from over 60,000 MGH patients, the model learned the subtle patterns in breast tissue that are precursors to malignant tumors." - published in MIT News. [7]

They are detecting breast cancer by screening. While the American Cancer Society recommends starting at age 45 annual screening, the U.S. Preventative Task Force recommends starting at age 50 screening every two years. [7]

If before black women have been shown to be 42 percent more likely to die from breast cancer, the MIT/MGH model, meanwhile, is equally accurate for white and black women. [7]

“Our goal is to make these advancements a part of the standard of care, by predicting who will develop cancer in the future, we can hopefully save lives and catch cancer before symptoms ever arise.”- says Adam Yala, a Computer Science and Artificial Intelligence Lab Ph.D. student.

1. There is another group of researchers - Cancer Systems Biology Lab's researchers - are also working on early detection of cancer. [8]

Francesca Ciccarelli says, a computer scientist who heads up the Cancer Systems Biology Lab, - "there are 3 billion letters in the human genome and it is an awful lot of data to crunch. Hence, there is a need for high- processing -computers and computational experts, who can handle huge datasets. [8]

“The idea is that if we can figure out cancer’s ‘rulebook’, we can start to predict its next steps, and get one step ahead of the disease,” she says.

**How will the proposed study contribute to the existing literature?**

As we see, here, almost all researches prove that the future of medicine depends on Computer Science. So it is better to improve it and create micro-robots, as I said in my hypothesis, that can predict disease cells for advance using researches above, especially the ideas of Andrew Phillips and Jasmin Fisher. This idea will be implemented in accordance with previous studies, and with a new idea makes a contribution to this area for further development.

**Methodology**

**Design of study:**

1. As long as there is no supporting organization in Kyrgyzstan, as Health and Human Service in the USA, I should find an investor - the person who will invest during the implementation of this project.
2. In order to create the micro-robot, I should search for Computer Scientists and Biologists who are the best of their job.
3. Using previous studies and creations in the world, we should create i.e. programming the model - the tiny robot, which will detect the cancerous cell in the human body.
4. In order to realize this, we should test our tiny robot - to check whether it works accurately.
5. First of all, I should get permission from the administrator of National Oncology Center in Kyrgyzstan [9] to check the micro-robot on their patients
6. For testing, we need to collect the data from people, in exact from women who already have cancer and who are in predisposition.
7. Also, we should get consent from women who have cancer and who are in the predisposition for checking the micro-robot on them.
8. Analyze data, and make conclusions about using micro-robots to predict breast cancer among women.

**Collecting data**

**Limitations:**

Area: Only Bishkek, Kyrgyzstan

Population: Only women who already have breast cancer and who are in predisposition – the women whose mothers or grandmothers had this type of cancer.

Of course, first of all, I'll get permission from them.

Type of cancer: Breast cancer.

**How I am going to collect data?**

|  |  |  |  |
| --- | --- | --- | --- |
| **In Predisposition** | | **Who already have** | |
| Non metastasized | Metastasized | Stage I | Stage II |

There will be data from each type of group, and from five women in each group, in order to compare them after testing and get more accurate, exact results.

Collecting data from them and testing micro-robot helps future development of treating breast cancer cases and decreasing the death because of breast cancer.

**Data analyzing**

There will be collected four types of data from for type of group:

1. Women who are in predisposition and whose cells haven't metastasized yet.
2. Women who are in predisposition and whose cells already have metastasized.
3. Women who already have breast cancer and in 1st stage.
4. Women who already have breast cancer and in 2nd stage.

We will collect data from each group and compare them with each other so that the easy stages do not get complicated.

For example, we will compare the data from the first group with the second group, so that handle the patients' cells from metastasizing. Second group with third, third with fourth and so on.

If it works out as we (biologists and computer scientists) planned, it is better to recommend to other countries.

**References:**

[1] <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6745227/>

[2] <https://oregon.providence.org/forms-and-information/a/ask-an-expert-breast-cancer-growth-rate/>

[3] <https://www.bcrf.org/breast-cancer-statistics-and-resources>

[4] <https://www.crick.ac.uk/news/2019-02-04_how-computer-scientists-are-helping-beat-cancer>

[5] <https://www.wcrf.org/dietandcancer/cancer-trends/worldwide-cancer-data>

[6] <https://news.microsoft.com/stories/computingcancer/>

[7] <http://news.mit.edu/2019/using-ai-predict-breast-cancer-and-personalize-care-0507>

[8] <https://www.crick.ac.uk/news/2019-02-04_how-computer-scientists-are-helping-beat-cancer>

[9] <http://www.nco.kg/>