PROJECT PROPOSAL

DIGITAL PROTOTYPE TO PREDICT MEDICAL CONDITIONS FOR ANESTHESIA BASED ON RISK FACTORS USING MACHINE LEARNING

Motivation

Before the operation or surgery, Doctors provide or inject anesthesia to reduce pain or make patients feel unconscious during surgery. It could see that sometimes anesthesia leads to the death of patients also. Why? The main reason behind this is that whenever patients come to the hospital for surgery, sometimes patients get anesthesia before knowing their previous medical background. The result could be the death of patients. To overcome this problem, there should be a preassessment system that could say about the patients, whether they should take anesthesia or not?

We are developing a model that could predict patients' risk levels based on their previous background or medical history using Machine Learning.

Using this model, users or patients can provide their medical history or give inputs like sugar, blood pressure, heart pulse, etc. This model leads to results that will tell the users or patients whether they should go for anesthesia. Whether before going for anesthesia, there must be some treatments to be done.

Directly, it would be beneficial for the Doctors to review the patient's status before surgery. Even a user or patient could also understand his or her situation.

Literature Review

In the last section, it has been seen that the essential aspects of the application of machine learning for anesthesia have been discussed. In the present section, a considerable literature review will be presented in this area. Artificial intelligence is one of the advanced technologies which is being used in the fields of medicine, including anesthesia. The application of artificial intelligence and its integration with anesthesia can be reviewed in six cases "(a) depth of anesthesia monitoring, (b) control of anesthesia, (c) event and risk prediction, (d) ultrasound guidance, (e) pain management, and (f) operating room logistics." Artificial intelligence would help the anesthesiologist in features ranging from perioperative support to critical care delivery to outpatient pain management [1]. Application in current AI and Data Science advances can see which devices and equipment would be used for anesthesia[2]. The field of machine learning advances algorithms for both parameter selection and combination. In this study, several established machine learning approaches, including a method for choosing proper signal parameters and classification algorithms, are applied to build an index that predicts anesthetized patients' responsiveness [3]. ML is an encouraging form of artificial intelligence best suited to, but also necessary for, the predictive analytics needed for clinical decision-making. It concentrates on the advancement of computer systems that can learn from big data. It identifies patterns and make selections with the least human intervention. As ML tools begin to be designed and targeted for clinical anesthesia applications, anesthesiologists will be growing pressure to clarify when and how clinicians add value versus ML can augment clinical practice and clinical decision-making.[4]. The authors suggested a study that shows the "feasibility of real-time prediction of future blood pressures, and the performance will be improved by collecting more data and finding better model structures" for anesthesia using machine learning [5].

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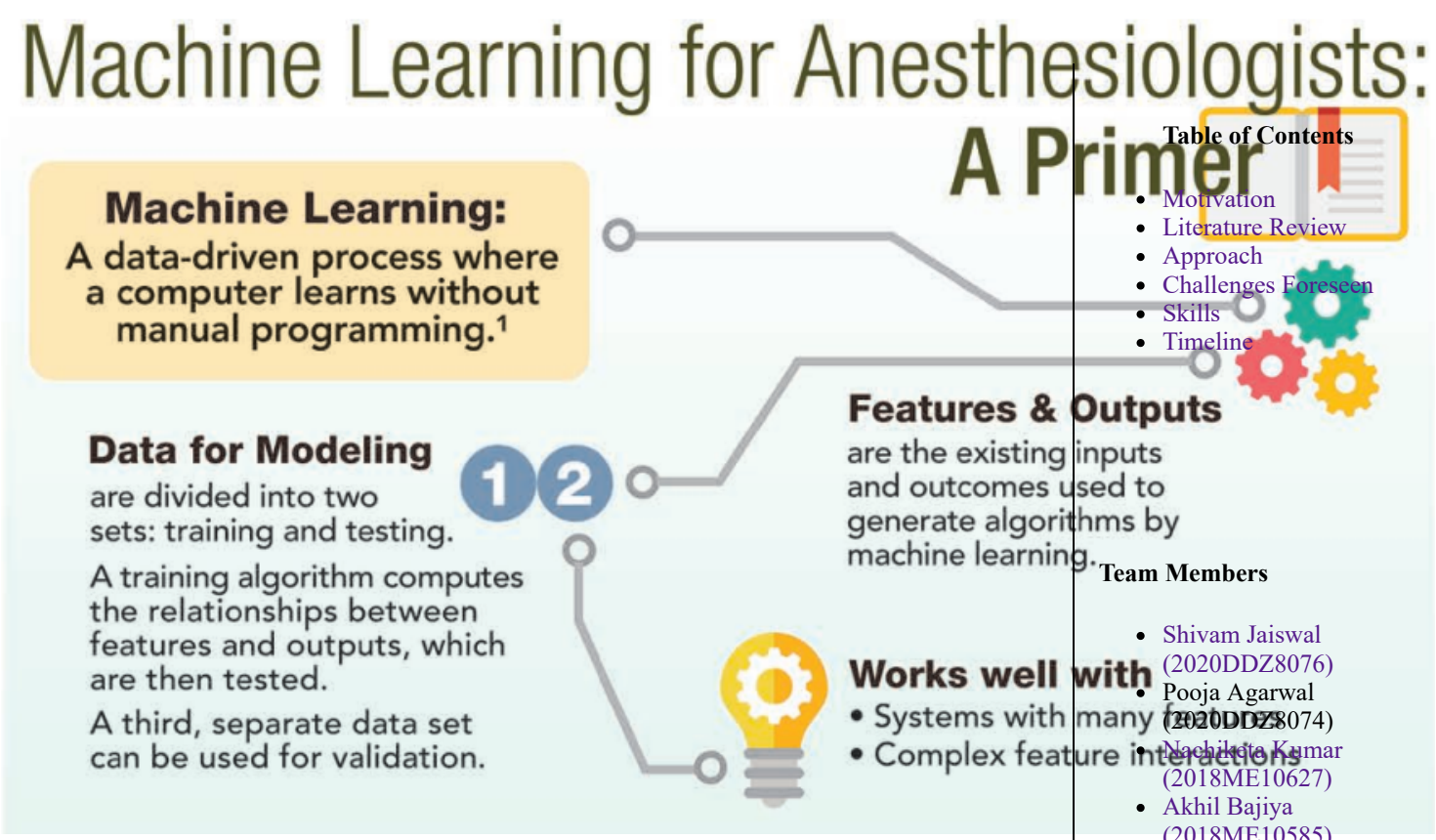
Team Members

- Shivam Jaiswal (2020DDZ8076)
- Pooja Agarwal (2020DDZ8074)
- Nachiketa Kumar (2018ME10627)
- Akhil Bajiya (2018ME10585)



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[1] D. A. Hashimoto, E. Witkowski, L. Gao, O. Meireles, and G. Rosman, “Artificial intelligence in anesthesiology: Current techniques, clinical applications, and limitations,” Anesthesiology, no. Xxx, pp. 379–394, 2020, doi: 10.1097/ALN.0000000000002960.

[2] H. Mcgrath, C. Flanagan, L. Zeng, and Y. Lei, “Anaesthesia 2020 : Impact of Artificial Intelligent & Data Analytics in the Field of Anaesthetics- Harry McGrath- University Hospital Limerick,” vol. 4, no. 2, pp. 13–14, 2020.

[3] M. Tacke, E. F. Kochs, M. Mueller, S. Kramer, D. Jordan, and G. Schneider, “Machine learning for a combined electroencephalographic anesthesia index to detect awareness under anesthesia,” PLoS One, vol. 15, no. 8 August, pp. 1–12, 2020, doi: 10.1371/journal.pone.0238249.

[4] D. S. Char and A. Burgart, “Machine-Learning Implementation in Clinical Anesthesia: Opportunities and Challenges,” Anesth. Analg., vol. 130, no. 6, pp. 1709–1712, 2020, doi: 10.1213/ANE.0000000000004656.

[5] Y. S. Jeong et al., “Prediction of blood pressure after induction of anesthesia using deep learning: A feasibility study,” Appl. Sci., vol. 9, no. 23, pp. 1–14, 2019, doi: 10.3390/app9235135.

[6] P. L. Gambus and S. Jaramillo, “Machine learning in anaesthesia: reactive, proactive… predictive!,” Br. J. Anaesth., vol. 123, no. 4, pp. 401–403, 2019, doi: 10.1016/j.bja.2019.07.009.

[7] C. W. Connor, “Artificial Intelligence and Machine Learning in Anesthesiology,” Anesthesiology, vol. 131, no. 6, pp. 1346–1359, 2019, doi: 10.1097/ALN.0000000000002694.

[8] S. Kendale, P. Kulkarni, A. D. Rosenberg, and J. Wang, “Supervised Machine-learning Predictive Analytics for Prediction of Postinduction Hypotension,” Anesthesiology, vol. 129, no. 4, pp. 675–688, 2018, doi: 10.1097/ALN.0000000000002374.

[9] A. F. Simpao, L. M. Ahumada, and M. A. Rehman, “Big data and visual analytics in anaesthesia and health care,” Br. J. Anaesth., vol. 115, no. 3, pp. 350–356, 2015, doi: 10.1093/bja/aeu552.

[10] J. P. Wanderer, J. M. Ehrenfeld, W. S. Sandberg, and J. P. Rathmell, “Infographics in Anesthesiology,” Anesthesiology, vol. 118, no. 6, pp. 1456–1456, 2013, doi:

10.1097/aln.0b013e31826f3229.

[11] D. Cumin, V. Newton-Wade, M. J. Harrison, and A. F. Merry, “Two open access, high-quality datasets from anesthetic records,” J. Am. Med. Informatics Assoc., vol. 20, no. 1, pp. 180–183, 2013, doi: 10.1136/amiajnl-2012-001087.

[12] Y. G. Weiss, S. Cotev, B. Drenger, and R. Katzenelson, “Patient data management systems in anaesthesia: an emerging technology,” Can. J. Anaesth., vol. 42, no. 10, pp. 914–921, 1995, doi: 10.1007/BF03011040.

After reviewing the above-mentioned paper, it is found how machine learning could be useful for reducing patients' risks. This project deals with the use of machine learning for anesthesia for Indian patients.

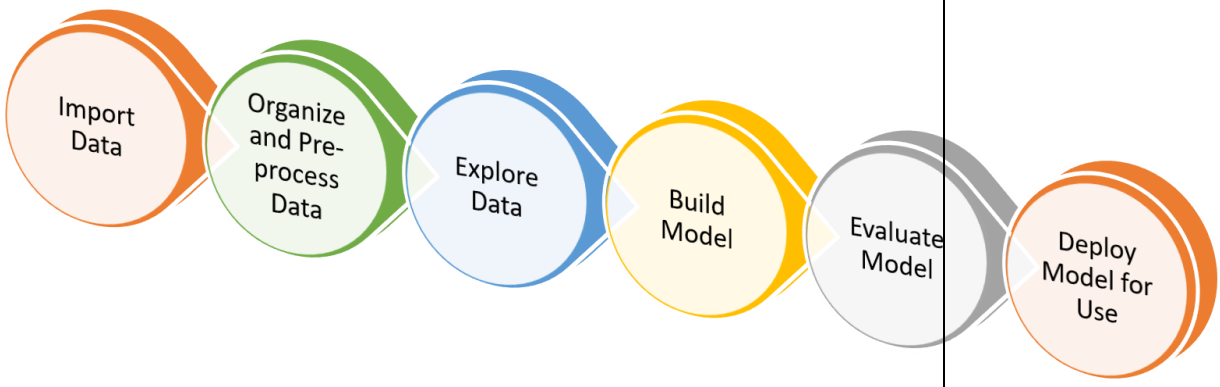
Approach

The first approach to this project would be collecting datasets and its preprocessing and visualization. Using the classification method, we would classify the data into several groups based on age, gender, types of the previous disease, etc.

Then we would apply the Regression method, which is predictive modeling techniques. It estimates the relationship between a dependent (target) and an independent variable (predictor).

In this project, we would use logistic regression, which is a type of regression method. In this type of method, results will be in binary format, which is used to predict the outcome of a categorical dependent variable.

Such as, in this project, High risk or low risk.



Challenges Foreseen

- This project's main challenge is to get datasets in the digital or editable form. If I talk about Indian scenarios, then one more challenge is to collect datasets for Indian patients.
- dealing with missing data values
- reliability of datasets

Skills

Broadly, skills would be utilized to develop this model, which is going to learn parallel in the class:-

1. **Design Thinking**

   Design thinking is an iterative, non-linear way of achieving that seeks to understand users and solve problems. It consists of five phases-empathize, define, ideate, prototype, and

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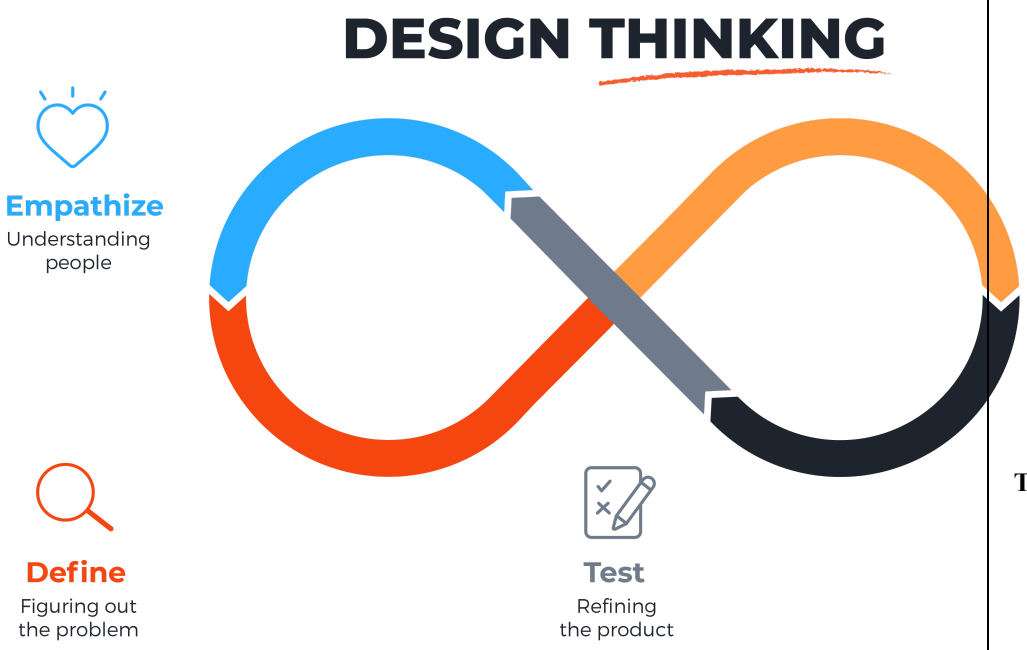
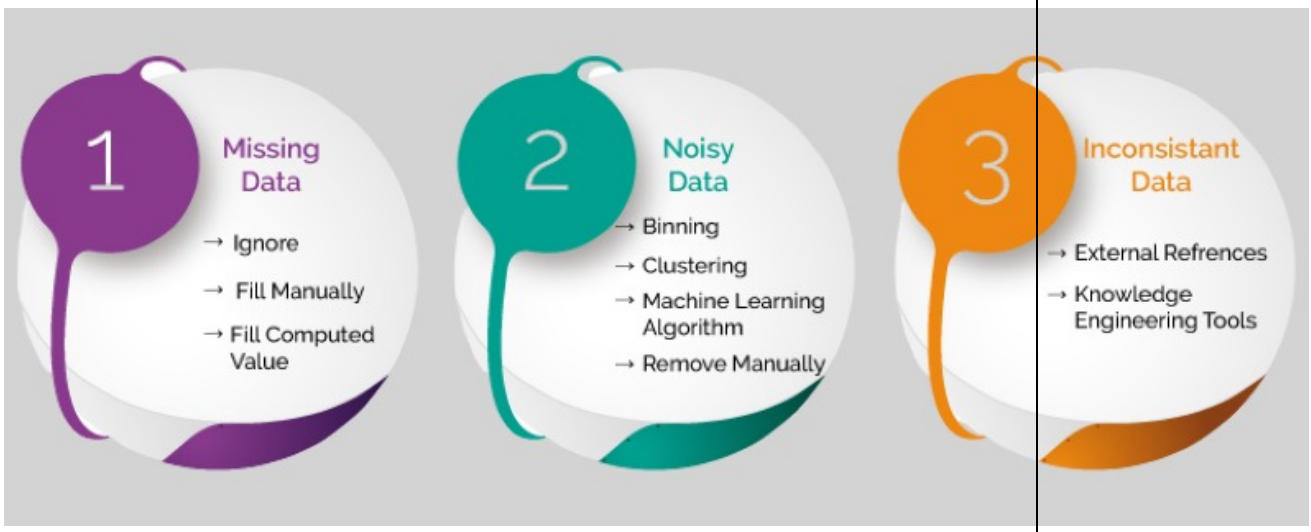
test. The process is ideal for situations where the overall challenge is not clear, or we have unknown problems.



Source:- https://www.maqe.com/insight/the-design-thinking-process-how-does-it-work/

2. **Data Pre-processing and Visualization**

During building the predictive model using Data Science, the data set is collected from various sources such as a file, database, sensors, and much more. However, the collected data cannot be used directly for performing the analysis process. Therefore, to solve this problem, Data Preparation is done. It includes two techniques that are – Data Preprocessing and Data Wrangling



Source:- https://www.xenonstack.com/blog/data-preparation/

3. **Machine Learning**

Machine learning is a course of study that allows machines(computers) to learn from data and make predictions based on the experience.

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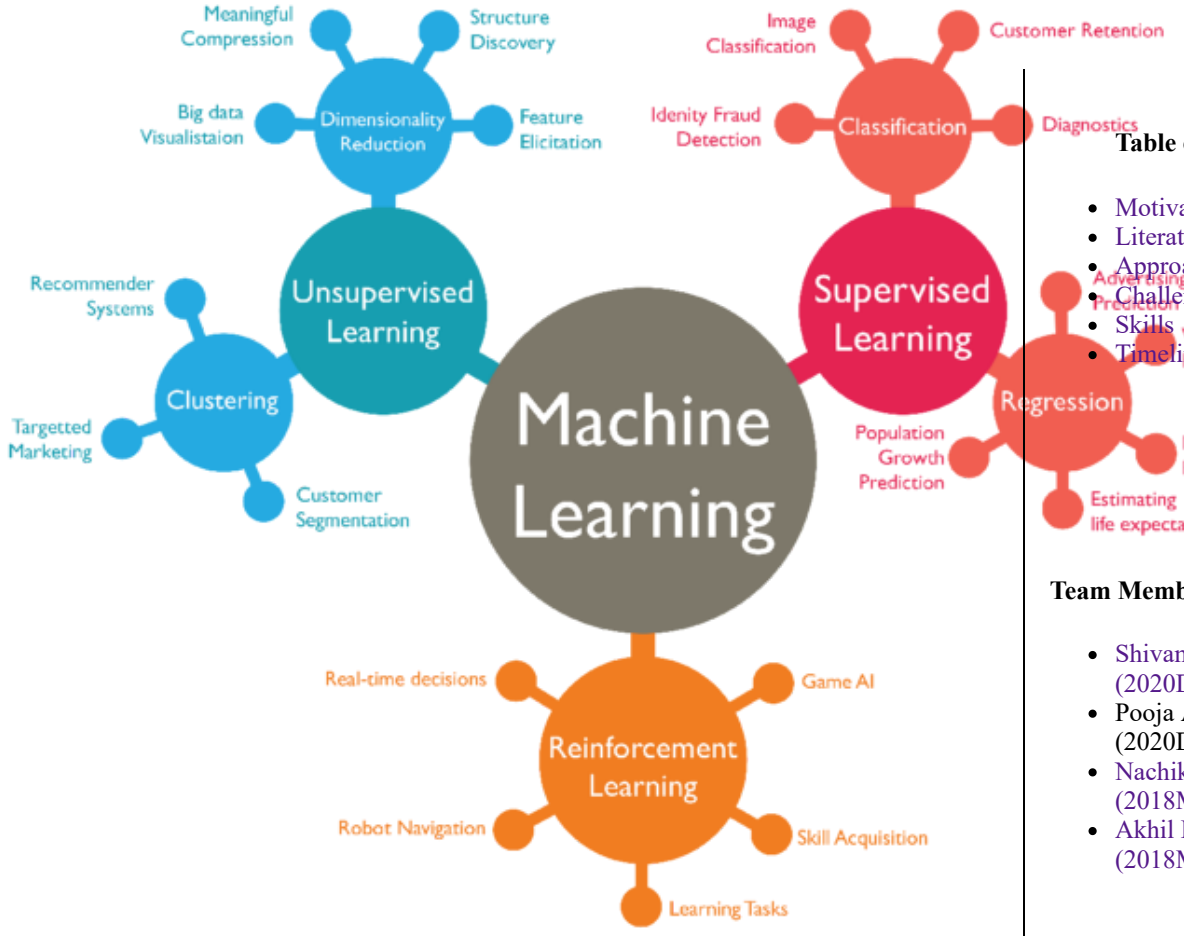
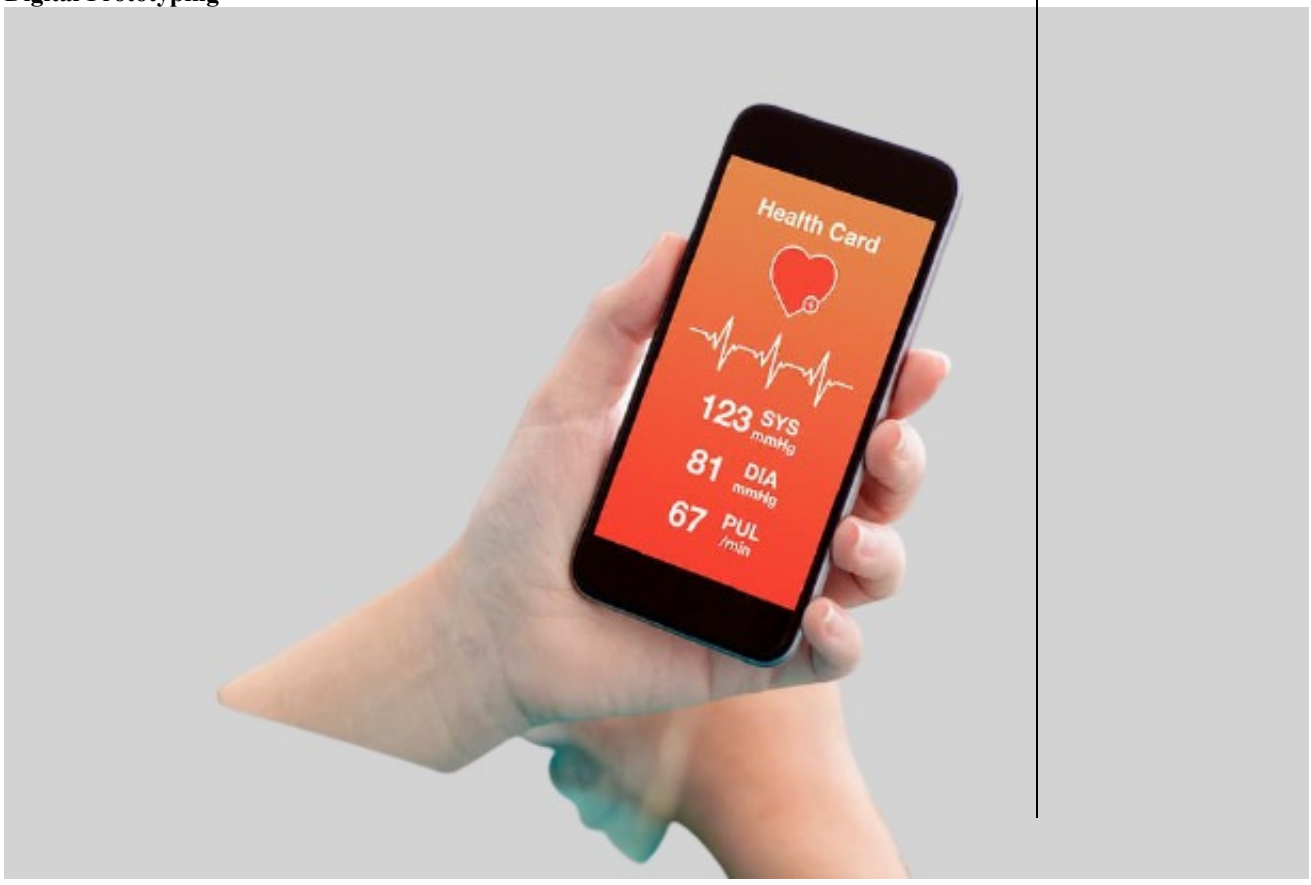


Source:- https://medium.com/@sanchittanwar75/introduction-to-machine-learning-and-deep-learning-bd25b792e488

4. **Digital Prototyping**



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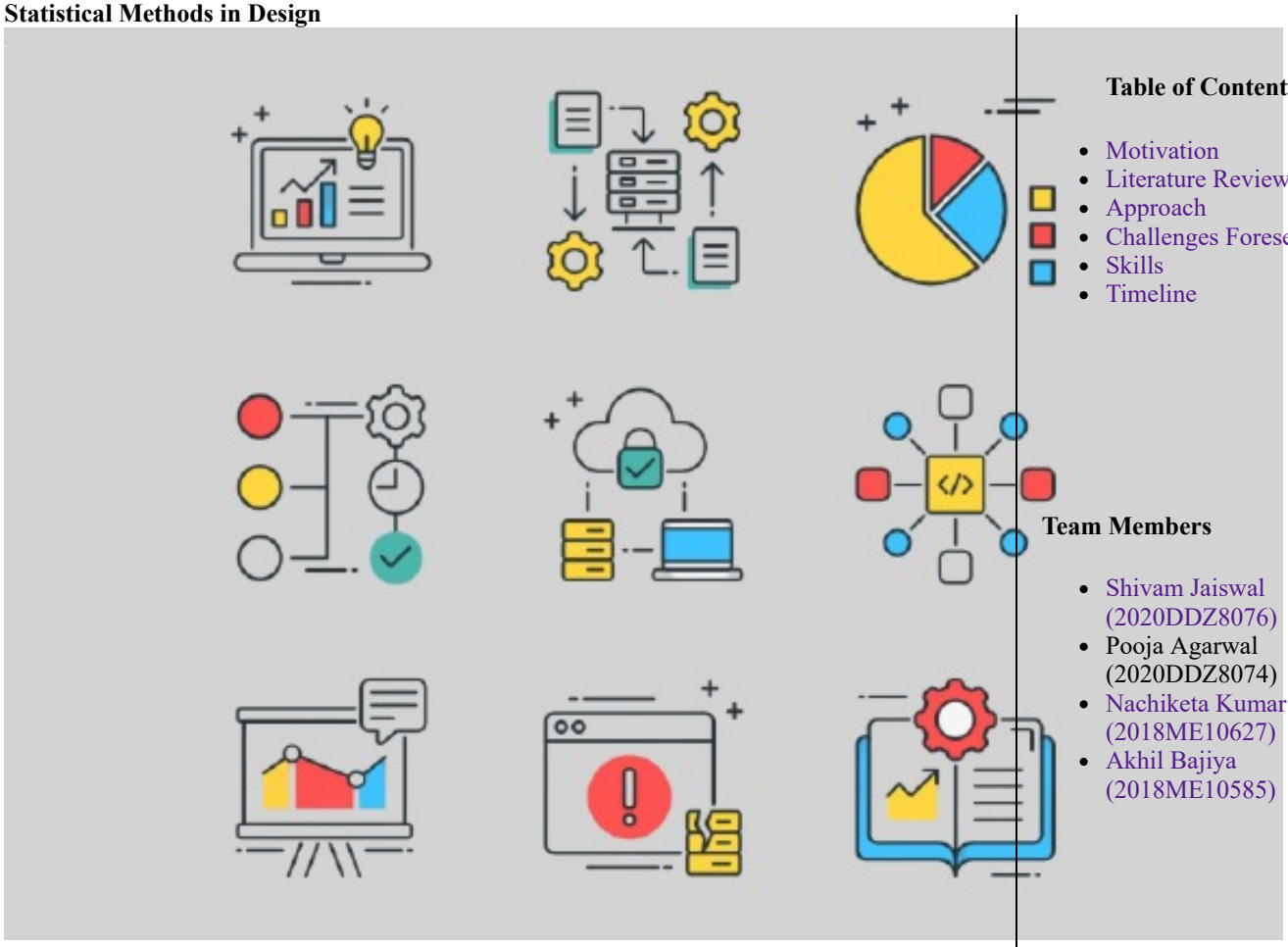
Source:- https://blog.proto.io/design-healthcare-apps-improve-patient-lives/

5. **Statistical Methods in Design**



Source:- https://www.pngkey.com/detail/u2e6y3r5r5o0a9i1_data-analytics-icon/

Timeline