## P130816

6000CEM – INDIVIDUAL PROJECT PREPARATION   
  
STUDENT ID –9912102

# Project Title and Research Question

How can an IOT dashboard help in avoiding disasters regarding extreme temperature changes in boiler and cooler systems in manufacturing industries?

“Implementing an IOT dashboard to control boiling and cooling systems in manufacturing industries.”

# Project Topic

The manufacturing industry is the backbone of the economy albeit suffers from huge losses due to a lack in the usage of technologies. Boilers and coolers are used in production for all type of industries. Boilers creates steam and hot water for production. They can also produce electricity. Besides they play an important role in transformation of products material through heating, cutting, drying, curing. Makes them consummation worthy. While boilers produce heat for industrial purposes, coolers reject any excessive heat created by that. Because overheat has negative effect on industries machines and environment. Cooler balances the temperature in industry. It also helps to control humidity level inside manufacturing warehouse. Though this is usually handled by setting appropriate temperatures. Setting temperature on correct mark and then maintain it is a harder task by itself. Despite setting the temperature on the correct mark, it can overheat or underheat and cause damage to the product. For instance, if we do not monitor the heater and if it overheats, it can burst heating tank. This can cause fatal accidents and injuries. The boiler heat is also used for shaping products. If it gets beyond ideal temperature, then it can melt the products. If the issue remains persistent, it will affect the production and in rare instances production can be halted. This can cause permanent shutdown in industries. To solve this issue, we can monitor the temperature fluctuations in a single dashboard and it’s handling along with the implementation of automation, machine learning, software development.

# Expected Outputs

The aim is to build a live data dashboard which will accumulate the results of processed data and will store data in a backend system and the frontend will fetch the data through API call. Dashboard will gather data from various sources such heating system, cutting system, drying system. They all work through the boiler. After gathering these data, machine learning algorithm will be implemented. This will train the model. The achieved output will be temperature prediction. By using those prediction, we will be able tell when extreme events will occur. ML will train the model to control the temperature through a switch board. That switch board will be controlled by AI. The switch board will be made following software engineering and web development principle. The developed system will send warning to the responsible person about potential damage. It can be done through notifications or SMS. It will turn off the system using switch to avoid the damage. Overall, this project will produce a Switch dashboard that will help to avoid industrial disasters.

# Motivation of the project

Manufacturing industry, which is the backbone of economy, should undergo modernisation periodically. Modernisation in manufacturing is about driving technology in the areas of manufacturing technology, digital factory, and automation. All distinctly different activities in your organization and may differ based on your specific industry, but the same in concept (Kurtz,2018). Modernization can reduce production cost, increase productivity and efficiency. One of sector where industry needs modernisation is in production. It has both man and machine-made error. It can hinder the industrial development of country. Due to lack of it, industries suffer from damages. That is both social and economic. When production is stopped due to machines fault, it can be expensive to fix. Also, time consuming. The downtime will be increased. Efficiency will be lost. To make sure these errors have less effect on industries efficiency the project is motivated. The errors can be avoided easily with usages of different kind of technologies. This project is one of the technologies which will be pioneer for adapting technologies in current industries

This project will be helping the manufacturing industries to take a step forward towards modernisation. By helping the manufacturer to reach their full potential. And cater to the satisfaction of the clients. Also, by controlling the damage to products yield can be maximized and shipping time can be minimized. Unnecessary downtime will be minimised.

# Primary Research Plan

We will be developing a live IOT dashboard reflecting manufacturing process. The idea is to converge all the data coming in from the different heat sources along the manufacturing lines in a single dashboard. A machine learning model will be trained using the data collected from the different heat sources. This ML model will then be used to predict extreme changes in temperature which might damage products.

With machine learning for IOT:

• Data can be ingested and transformed into a consistent format

• A machine learning model can be developed

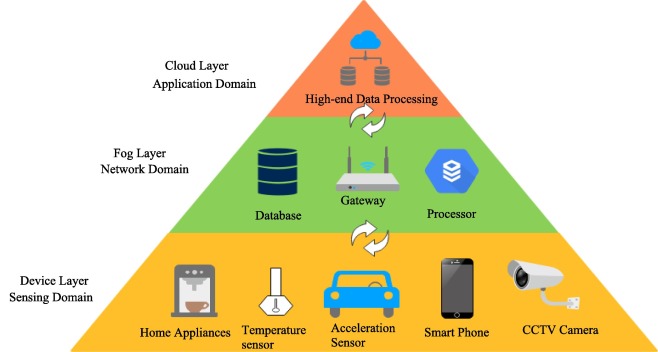
• This machine learning model can be deployed on cloud, edge, and device

Firstly, the temperature sensor system should have two distinct components: The internet enabled sensors and the software component. The sensors collect data from different heating sources that is connected to the boiling system. It also takes temperature data from cooler or cooling system. Then these internets enabled sensors will send the data to a central server or a cloud server where this data will be stored. The stored data will be pre-processed following machine learning rules. After pre-processing the data, ML algorithm will be implemented on it. And a model will be trained. The trained model will tell us about the fluctuation in temperatures. It will also tell us when the temperature of boiler is going down or up. It will be able to predict future temperatures. And when cooling system is needed, we will get to know it through the prediction. The prediction results and filtered data will be sent to the server of web or software. This server will also host a REST API. The dashboard on the frontend will display information by calling this REST API. These information are temperature of boilers and coolers in different time span. Then the dashboard will check with logic if the temperatures are dangerous or not. If it is, then it will notify the authority about the fluctuations in temperature. And if it is not it would keep showing the temperatures. Also, if the authorise person is unable to monitor or respond it will do the emergency shut down. It will automatically turn on the cooling systems to avoid the disaster.

# Literature Review

In 1999, market researcher Kevin Ashton coined the word “Internet of Things” in the sense of supply chain management ([Ashton, 2009](https://www.sciencedirect.com/science/article/pii/S1319157821003219#b0005))[1]. While the concept of “Things” has expanded as technology has progressed, the primary purpose of designing a machine sensing information without the assistance of a human remains the same. The Internet of Things (IoT) envisions the overall integration of multiple “things” while establishing a smart interface between people and nearby objects using the Internet as the backbone of the communication system. The capacity of intelligent devices to sense and assemble data from the surroundings is referred to as IoT. The evolution in IoT and its continued expansion created a broad link between “things,” i.e., sensors, actuators, and devices.

Cloud computing ([Wang et al., 2010](https://www.sciencedirect.com/science/article/pii/S1319157821003219" \l "b0010), [Botta et al., 2016](https://www.sciencedirect.com/science/article/pii/S1319157821003219" \l "b0015), [Dang, 2019](https://www.sciencedirect.com/science/article/pii/S1319157821003219" \l "b0020))[2] is used to store and analyze data. It provides a suitable utility model that offers on-request access to the application users. However, IoT devices exponentially scaled up with the growing demands, leading to a tremendous amount of data volume and processing needs, creating specific latency and bandwidth issues in solving real-time problems. All the smart things, including sensors and actuators, gathers data from the surroundings and send the data to gateways. The gateway aggregates the data transmitted by heterogeneous devices using various communication protocols and further sends it to fog or cloud data centers for high-end processing ([Sethi and Sarangi, 2017, 2017.](https://www.sciencedirect.com/science/article/pii/S1319157821003219" \l "b0040)) [3]. Thus, a gateway is a decisive part of the Internet of things. It can act as a protocol converter and build a network domain with high performance, reliability energy consumption, and low response time. The placement of the gateway in the IoT architecture is depicted in the figure below. [Fig. 1](https://www.sciencedirect.com/science/article/pii/S1319157821003219#f0005).



An ample amount of research has been done in the field of IoT ([Gubbi et al., 2013](https://www.sciencedirect.com/science/article/pii/S1319157821003219" \l "b0050), [Ray, 2018](https://www.sciencedirect.com/science/article/pii/S1319157821003219" \l "b0055), [Al-Fuqaha et al., 2015](https://www.sciencedirect.com/science/article/pii/S1319157821003219" \l "b0060)), cloud computing ([Ray, 2016](https://www.sciencedirect.com/science/article/pii/S1319157821003219" \l "b0065), [Nazari Jahantigh et al., 2020](https://www.sciencedirect.com/science/article/pii/S1319157821003219" \l "b0070), [Cavalcante et al., 2016](https://www.sciencedirect.com/science/article/pii/S1319157821003219" \l "b0075)), fog computing ([Yousefpour et al., 2019](https://www.sciencedirect.com/science/article/pii/S1319157821003219" \l "b0080), [Singh et al., 2019](https://www.sciencedirect.com/science/article/pii/S1319157821003219" \l "b0085)), edge computing ([Ai et al., 2018](https://www.sciencedirect.com/science/article/pii/S1319157821003219" \l "b0090))and is still in the emerging phase. But while investigating gateway, it has been observed that there is no systematic literature review that can elaborate the working and functionalities of IoT gateway in general.

In this fast-moving world time is everything. Vast amount of time can be saved by using this system. Now world is moving toward sustainability. Hence energy efficiency is a must. Controlling the excessive use of boiler and cooler can result in rest energy usage. Which means less carbon emission and greener environment? Estimation from predicted model will mean efficiency and less time consumption. For this work we are going to collect data IoT big date with real time database. We will be applying appropriate machine learning algorithms to get the desired model. (Wang,2020) research says this monitoring can be an effective solution to the next gen process monitoring. I think it will make automated processing easier and less hasty. Rather than buying new machine every time if can switch the connection before than it will save lots of money. Nevertheless, data driven AI applications utilizing data collected from IoT devices can help in predictive maintenance (Wang et al., 2017). The aim of this study is to develop a predictive maintenance system that produces realistic predictions of potential failures for production lines in manufacturing before occurring using machine learning methods. In order to obtain the most suitable model to address this problem, multiple algorithms were explored in detail and compared using a real-world dataset. [IoT](https://www.sciencedirect.com/topics/engineering/internet-of-things) is a significant economic way that affects all industries, and it is expected to spend $11 trillion of economic impact via IoT technologies by 2025. The circumscribe of devices availing internet services is progressive every day. According to market insights for IoT reports, the number of IoT devices is expected to grow up to 22 billion by 2025 versus 12 billion non-IoT devices (David J, Priestley A) [4]

In manufacturing, traditional maintenance strategies of production lines typically involve replacement of equipment occurring after a failure or at predetermined time periods. These maintenance plans often lead to extra costs due to early replacement of equipment. These cause economical damage. There are lots of research going on about it. But none of them are permanent. Whereas mine can be a temporal better solution. Because I am using data processing and automation along with ML approaches. The effectiveness and predictive power are evaluated through algorithms and tested with various configuration. They take live data and give results. Alerts are made as well as system will be rebooted on its own without any help. Thus it won’t be needing 24X7 monitoring. The IoT is key to control and make automated systems in industries. As we are moving forward industries are leaning towards technologies rather than the physical manpower. It operates on real time. The control production processes, and quality improvement have been improved through IoT. Through different protocols to run the production cycle economically and increase the rate of production.

# Bibliography

1. (K. Ashton, et al. That ‘internet of things’ thing RFID J., 22 (7) (2009), pp. 97-114).
2. L. Wang, G. Von Laszewski, A. Younge, X. He, L. Wang
3. Cloud Computing: A Perspective Study, 28 (2010), pp. 137-146
4. Wang, K. (2020). Migration strategy of cloud collaborative computing for delay sensitive industrial IoT applications in the context of intelligent manufacturing. *Computer Communications*, *150*, 413–420. https://doi.org/10.1016/j.comcom.2019.12.014
5. J. David, A. Priestley, S., Tan, S. Hare, The Business Value of Artificial Intelligence Worldwide from 2017-2025, USA, 2018.)
6. Kurtz, K. (2018, April 17). *Manufacturing Modernization is Bigger than Industry 4.0*. Https://Www.Linkedin.Com. https://www.linkedin.com/pulse/manufacturing-modernization-bigger-than-industry-40-kallin-kurtz/