Introduction:

Coronavirus disease 2019 (**COVID-19**) is already created in an alarming situation. The panic of coronavirus infection is grappling the world day by day. After evolving from seafood and/or poultry market in China, Coronavirus outbreak has extended to almost all the countries around the world and the infected people are increasing day by day. Like, other countries are building especial hospitals for coronavirus that ensures a negative pressure room and having intensive care units (ICUs) equipped with ventilators. So, In Bangladesh, we also need to build this kind of hospital. For that purpose, we have designed a floor plan of a temporary-built hospital that has all those necessary things, and so on.

Selected Topic & Group Members:

Selected Topic: Facility design (floor plan) of COVID-19 patient hospital.

Group Members:

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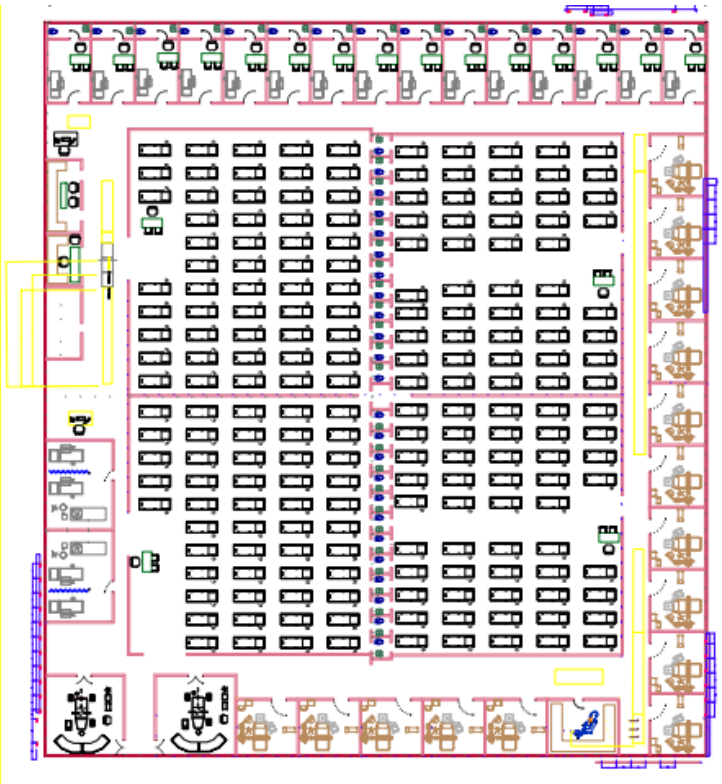
Paper Review:

Qingxian et al. describe in their paper that in a designated hospital outside Hubei Province, COVID-2019 patients could be effectively managed by properly using the existing hospital system

with some urgent modifications [1]. However, mortality may be lowered when cases are relatively mild, but having or availing sufficient medical resources to care and treat the disease could be lifesaving with that kind of hospital.

Methodology (Working Principles):

Hospital architecture is a quite spacious and full of amenities and can be built using maps and plans of design with proper architecture floor plan. Mainly, a hospital having different units are a multistory building with complex architecture layout. We have designed a model using AutoCAD which gives 2D architectural visualizations designed to interact with architectural design. Cabin rooms are designed with different tools and commands such as an array, mirror, trim, copy command. We used an array to repeat different designed blocks like beds, doors, and washroom for cabin room planning and some of them are also be included as an external reference. ICU units are placed in the main diagram as a block and then using an array, we setup 10 ICUs. In the model, we also placed negative pressure rooms for emergency patents who needs negative airflow on their lung. We have placed 2 lab rooms for testing the samples having a computer and different machine PCR facilities. We have set up restrooms for all staff of the hospital on the top side of the picture. We have created



our plan having different layers indicating different works as a Gas layer has the gas architecture, water layer has the water supply line, electric layer, and underground electric layer has the electric construction. As it is a temporary hospital plan that's why we set up the electric lines through the underground. It will minimize the construction cost and time. Doors and other building items are still a type of material built.

Moreover, different layers are used for developing and simplify the main floor overview which will cover with a shell around as building and finalize as the building of the hospital. Here is our CAD floor plan of the diagram of a hospital mainly for those patients who are affected form COVID-19.

Importance:

Like a contagious virus, it's too difficult for giving treatment to normal patients and covet-19 positive patients in the same hospital. And Covit-19 positive patients need oxygen in severe cases. So, they need ICU and ventilation for their treatment. For providing all of those facilities, constructing different hospitals is more efficient.

Normal Cabin:

All of the covet-19 positive cases people don't need ICU and ventilation for their treatment. In that case, these patients need to be treated as normal flu patients. So, those patients don't need a special cabin with having ventilation and ICU facilities. The normal cabin is enough for treating those patients.

ICU:

Those covet-19 patients are suffering from very low or very high blood pressure, or those that have just had a heart attack or are suffering from an unstable heart rhythm, often need constant observation. To monitor those patient's conditions, ICU is needed.

Negative Pressure Room:

Like a contagious virus, COVID-19 positive patients need to be separated from normal people. To ensure this separation negative pressure room is needed for isolating those covet-19 positive patients.

Doctor's Chamber:

Covit-19 positive patient's condition would worsen at any time. So they need extra care all day long. That's why the doctor's chamber is much needed in a covet-19 special hospital.

Washroom:

Not only covet-19 patients, but all kinds of patients also need a washroom facility in a hospital. And covet-19 hospital there would be needed two types of hospital. One is for patients and another is for doctors.

Rest Room:

To keep your staff productivity high, make sure they feel important by giving them a clean and healthy working (and restroom) environment. And in a covet-19 hospital restroom is needed for the doctors. Doctors are always busy in COVID-19 hospital. As a human being, they also need rest. So, a restroom is much needed with having all facilities in a covet-19 hospital.

Generator Cabin:

All-time electricity service is much needed in a covet-19 hospital. Cause, in-hospital there needs proper electricity facilities for maintaining all stuff. So, the generator cabin is also needed for getting electric facilities continuously.

Underground Water Tank:

In a hospital, proper water supply is needed for patients and doctors. To store water underground water tank is needed.

Design Parameters & Costing:

The hospital can be funded by the government itself or any private group. Here, we are planned for the govt. funded temporary hospital plans on emergency conditions like COVID-19. This a 300 patient hospital design having 250 normal cabins based bed, 10 ICU and, 2 testing lab, 15 doctors chamber, and restroom. The 4 big cabins are separated as different types of patients need to separate. Two of the cabins are having the facility of negative pressure.

We assume the electric and gas costing is bearing by the government, that's why we don't estimate it, but the other costing like foods, accessories, and medical equipment will cost a good amount. It will cost on average 20laks taka for a month including all ambulance, doctors, patient's food, and transport facility.

Electric Power & Gas Load:

This kind of hospital needs a high electric load every time. We have a plan for a total 10 ICU which consume the most power. One transformer needs to be dedicated to the full hospital. A backup generator needs to be set up for emergency power cut-off. The input voltage of the hospital will be 220V~240V. Power consumption can be measured using the standard formula, P = Vt. Eclectic load can be forecast using this procedure [2].

Algorithm 1 PCA-based algorithm for electrical load forecast.

Input: $\boldsymbol{y}$

1: Reshape $\boldsymbol{y}$ into an $M \times N$ matrix $\boldsymbol{X}$, where $M = (24 \times 4 \times 7)$ and N is the number of data weeks.
2: Mean-center the matrix $\boldsymbol{X}$ into $\tilde{\boldsymbol{X}}$, such that $\boldsymbol{X} = \tilde{\boldsymbol{X}} + \bar{\boldsymbol{X}}$.
3: Compute $\boldsymbol{U}, \boldsymbol{S},$ and $\boldsymbol{V}$ such that $\tilde{\boldsymbol{X}} = \boldsymbol{U}\boldsymbol{S}\boldsymbol{V}^T$ (perform SVD).
4: Determine P most significant singular values or principal components.
5: Identify the linear trend and the periodic means by solving Equation (3).
6: Forecast coefficients $\hat{\boldsymbol{V}}_r = [\hat{\boldsymbol{v}}_1, \boldsymbol{v}_2, ..., \boldsymbol{v}_P]$ according to Equation (5).
7: Compute the approximation $\hat{\boldsymbol{X}} = \bar{\boldsymbol{X}} + \boldsymbol{U}_r \boldsymbol{S}_r \hat{\boldsymbol{V}}_r^T$.
8: Set the PCA prediction as $\hat{\boldsymbol{y}}_{PCA} = \text{vec}(\hat{\boldsymbol{X}})$.

Output: $\hat{\boldsymbol{y}}_{PCA}$, and $\boldsymbol{U}$.

Figure: procedure to perform the PCA-based electrical load forecasting

Item	Description	Max. load (kW)
1	300 RT chiller × 3 (220 kW × 3), chilled water pump × 3 (30 kW × 3), cooling tower fan × 3 (22 kW × 3)	816
2	Zone water pumps × 7 (55*3+45*2+19*2) kW = 293 kW	293
3	Air handling unit 50 sets	212
4	Fan coil unit 300 sets	40
5	Exhaust fan, 40 sets	78
6	Supply fan, ventilating fan, 33 sets	161
7	Packaged air-conditioning, 5 sets	78
8	Lab	100
9	Lighting	500
10	Pressurizing pump	77
11	Gas	70
12	Computer	48
13	Medical equipment	600
14	Other equipment	100

Table 2: The major energy consumption items (monthly)

A Gas chamber is set up for ensuring central gas availability. The gas generator can make different pressure loads.

Covid-19 Patient Management:

Covid-19 hospital mainly needs the emergency medicine, personal protective equipment, mask, hand gloves, face mask, etc. This model hospital needs in a total of 20 MBBS doctors, 30 nurses, and other workers. There are different types of a patient such as normal COVID-19 patients, ICU needed patient, and negative pressure facility needed patients. The doctor will confirm the condition of the patent and separate them with their condition that's how we design 4 different large cabins, isolation unit, and negative pressure room and incentive care unit. Older people and children who affected by coronavirus are the most vulnerable, that's why doctors and nurses need to be attentive with their cabin.

On the other hand, one hospital needs to have lab facilities for the test. So, we also draw some lab rooms for the test. It is also needed that doctors, nurses and other workers need to rest, that's why we draw a setup for a restroom. Besides, our drawing has a doctor's chamber for routine check-ups for every patient.

ICU is the most important place if one patient cannot breathe properly or other serious injuries by the virus, he/she needs to be urgently shifted to ICU for Oxygen support and ventilator support. Different instruments are needed for a life support patient, that's why we designed a simple electric and gas line connected to ICU.

For ambulance facility, we drew a place for Gurage outside of the hospital.

Conclusion:

COVID-19 is an infectious disease caused by a newly discovered coronavirus. Most people who fall sick with COVID-19 will experience mild to moderate symptoms and recover without special treatment. 'WHO' also said that corona-virus never has gone from the world. So, we need to survive from this novel coronavirus. We need to give proper treatment to the patient for that purpose. Though this virus is contagious, that's why we need to make a specialized hospital for coronavirus patients. That's why we make this proposed model of coronavirus patient's hospital, which is full of ICU, ventilator, and so on.

References

[1] D. H. P. O. Qingxian Cai, "COVID-19 in a designated infectious diseases hospital outside Hubei Province, China," *Wiley,* no. 02 April 2020, 2020.

[2] 2. I., L. M. L.-R. Rodolfo Gordillo-Orquera 1, "Analyzing and Forecasting Electrical Load Consumption in Healthcare Buildings," *www.mdpi.com,* no. 26 February 2018, 28 January 2018.