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MEDICO-SUPPLY CHAIN PORTAL FOR HEALTH CARE SECTOR

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ABSTRACT

Looking at the current scenario, we want to contribute to the healthcare sector through this project. When there is any shortage or disorder in a country, the effect on supply chain management impacts the most. Since this virus was not much heard of before, various theories started coming up about the effective management of medical resources. The supply of medical equipment required for the precaution and care against the COVID-19 virus saw various challenges. The supply had to be carried out economically, within the minimum possible time, and at the minimum possible cost. This challenge inspired us to come up with a Medical Supply Chain Management Portal using Blockchain.

This project is based on an organized framework for supply chain management which is powered by machine learning. There will be smart recommendations such as the prediction of cases and resources required according to the present and future situation. Here we worked upon the number of PPE kits required, region-wise where ML algorithm, SVM is used. Along with the same, Blockchain technology allows hospitals to assign access rules for their medical resources. With blockchain technology, hospitals can connect to other hospitals and collect their medical resources automatically.

Keywords—*Blockchain, Ethereum, Health Care,Hyperledger, Supply Chain, Support Vector Machine.*

1. INTRODUCTION:

1.1 Description:

The government had to supply all the necessary medical resources to each and every part of the country in the covid-19 pandemic. In general Supply chain refers to the resources required to deliver goods and services to a consumer. It is typically a complex and fragmented process managing the supply chain in healthcare. Supply chain management in Health Care involves managing supplies, obtaining resources, delivering goods and services to providers and patients. Information about medical products, physical goods usually go through a number of independent stakeholders, including manufacturers, insurance companies, hospitals, providers, group purchasing organizations, and several regulatory agencies to complete the entire process. Data security and data ownership are the two major focuses that must be addressed in healthcare today. The rise of blockchain technology as a transparent, responsible mechanism to store and distribute data is leading to new potentials of solving serious data privacy, integrity and security issues in providing healthcare services. By promoting efficiency within thehealthcare supply chain, hospitals can create substantial cost-reducing opportunities across their organization.

1.2 Problem Formulation:

Hospitals, health institutions, clinical labs and governments are finding it difficult to optimize, get well prepared, replenishing inventory of medical equipment, medicines and staff, and/or finding the right resources at the right time and price. There are no common digital platforms for manufacturers, distributors and consumers along with the highest security and transparency. As during covid, there were many transparency issues regarding the production. Organizations had to invest a lot of time to figure out the purchase. All these issues could be resolved if there would be a common secure platform where the product can be found at the best place, at the best price.

1.3 Motivation:

During this difficult time, we want to help the government and such health care organizations to come to a common platform to monitor the flow of products and inventory storage reports. After conducting a survey, speaking to a few medical professionals, we came to know about the problems and thus came up with the proposed solution.

1.4. Proposed Solution- Supply Chain Healthcare Portal:

There is a need for a digital platform where various public and private organizations can come under one roof. As the medical sector is highly authorized and sensitive, there should be transparency in the process. To make the platform highly secure, the use of blockchain will be made. The following diagram displayed the planned process of blockchain technology. Some of the goals which Medico will be trying to achieve are-

- Cost optimization - The organizations will be able to make the right decision at the right time, without paying a premium for any last-minute orders.
- Smart insights- Provide smart and useful insights, for decision making.

- Shortage prevention- To help organizations look for multiple alternative options, at the time of high demand in the market.
- Better preparedness- By providing full visibility of the current and future situation on many levels, will in turn result in better preparedness.
- New Relationships- Provide opportunity, open doors for organizations to make new relationships with potential new suppliers about which they weren't aware.
- Smart Recommendations - The more the usage of MEDICO, the smarter it will get in providing accurate results.

1.5 Scope of the Project:

It can be done for various medical products and supply of various products from various countries. It will help the user to know the current prices in various countries, availability of a product. So, this project can be expanded in various fields. It also can be used for future predictions of product availability in a particular country. And also give the nearest suggestion of import of the product. This will cause a reduction in transportation cost eventually supplying the product at less costs to organizations.

2. LITERATURE REVIEW:

Table 1: Literature Survey for Supply Chain Management

Method Category	Limitations	Technique Name	Performance
Artificial Intelligence [1]	Security and Privacy of Data, Managing data storage capacity and Interoperability.	Blockchain, Healthcare Data Gateway (HDG)	Managing Electronic health records efficiently and ensuring security and privacy.
Machine Learning [2]	Private and consortium led blockchains will address the privacy, security and scalability concerns. But these blockchains would create altogether different challenges because they run the risk of not being vendor-neutral and do not use open standards.	Blockchain	Access Control Manager to store health records. Blockchain Model for healthcare ensuring scalability, access security and data privacy. The shared data environment that is provided by Blockchain makes it easier to involve "hard-to-reach" populations and develop results that are more representative of the general public.

Artificial Intelligence. [3]	Tamperproof transmission of medical data is very substantial. Tampering problems result from the high unevenness in communication protocols and medical devices and platforms. This could be termed as a lack of standardization among IoMT manufacturers. Therefore, in protecting such variables, a standardized transmission medium is difficult in the current point of view.	Blockchain, consensus mechanisms, cryptography.	Supply Chain Management for Hospital Data and Transactions.
Artificial Intelligence [4]	Although blockchains are extremely secure, they are by nature susceptible to a type of attack known as the 51% attack. Another potential concern is the cost of implementing a blockchain system. When a transaction is requested, the user must pay for the computation.	Blockchain, cryptography, Information and Knowledge Management.	patient-centered Healthcare Medical Chain model aimed at maximizing security and accessibility.
Machine Learning [5]	Privacy Issues may arise.	Blockchain	agriBlockIOT: a blockchain-based agriculture supply chain management and traceability system.

3. ANALYSIS MODELLING:

3.1 Data Modelling:

date	Ventilators - Total Capacity	Ventilators in Use - Total	Ventilators in Use - COVID-19	Ventilators in Use - COVID-19 Patients	Ventilators in Use - COVID-19 PUI	Ventilators in Use - Non-COVID-19	Ventilators A
4/26/2020	1778	840	341	305	36	499	938
4/09/2020	1265	652	306	251	55	346	613
4/10/2020	1291	626	313	269	44	313	665
4/11/2020	1321	714	316	275	41	398	607
4/12/2020	1335	638	316	264	52	322	697
4/13/2020	1341	658	325	270	55	333	683
4/14/2020	1418	733	318	265	53	415	685
4/22/2020	1413	770	328	290	38	442	643
4/23/2020	1395	700	281	238	43	419	695
4/24/2020	1756	311	335	292	43	-24	1445
4/25/2020	1684	419	323	285	38	96	1265
4/27/2020	1943	995	345	312	33	650	948
4/28/2020	2103	1025	339	313	26	686	1078
4/29/2020	1999	1017	342	328	14	675	982
4/30/2020	1979	1050	339	320	19	711	929
5/01/2020	1937	1008	361	338	23	647	929
5/02/2020	1924	1068	342	322	20	726	856

fig 3.1.1: database snapshot of hospital capacity metrics

As seen above there are various attributes like ventilators capacity, ventilators in use, date. With the help of the table, we will come to know the number of patients and ventilators capacity because of which we will get to know the number of PPE kits required and help in our prediction.

dateRep	day	month	year	cases	deaths	countriesA	geoId	countryter	popData2(	continentE	Cumulative_number_for_14_days_of_COVID-19_cases_per_100000
########	25	9	2020	0	0	Afghanista	AF	AFG	38041757	Asia	1.571957
########	24	9	2020	25	5	Afghanista	AF	AFG	38041757	Asia	1.64556
########	23	9	2020	71	2	Afghanista	AF	AFG	38041757	Asia	1.642931
########	22	9	2020	30	3	Afghanista	AF	AFG	38041757	Asia	1.52464
########	21	9	2020	0	0	Afghanista	AF	AFG	38041757	Asia	1.698134
########	20	9	2020	125	4	Afghanista	AF	AFG	38041757	Asia	1.892657
########	19	9	2020	47	1	Afghanista	AF	AFG	38041757	Asia	1.616645
########	18	9	2020	0	0	Afghanista	AF	AFG	38041757	Asia	1.535155
########	17	9	2020	17	0	Afghanista	AF	AFG	38041757	Asia	1.653446
########	16	9	2020	40	10	Afghanista	AF	AFG	38041757	Asia	1.708649
########	15	9	2020	99	6	Afghanista	AF	AFG	38041757	Asia	1.627159
########	14	9	2020	75	0	Afghanista	AF	AFG	38041757	Asia	1.456294
########	13	9	2020	35	0	Afghanista	AF	AFG	38041757	Asia	1.309088
########	12	9	2020	34	0	Afghanista	AF	AFG	38041757	Asia	1.22497
########	11	9	2020	28	0	Afghanista	AF	AFG	38041757	Asia	1.16451
########	10	9	2020	24	2	Afghanista	AF	AFG	38041757	Asia	1.098793
9/9/2020	9	9	2020	26	3	Afghanista	AF	AFG	38041757	Asia	1.180282
9/8/2020	8	9	2020	96	3	Afghanista	AF	AFG	38041757	Asia	1.114565
9/7/2020	7	9	2020	74	2	Afghanista	AF	AFG	38041757	Asia	1.048847
9/6/2020	6	9	2020	20	0	Afghanista	AF	AFG	38041757	Asia	0.854324
9/5/2020	5	9	2020	16	0	Afghanista	AF	AFG	38041757	Asia	1.077763
9/4/2020	4	9	2020	45	1	Afghanista	AF	AFG	38041757	Asia	1.135594
9/3/2020	3	9	2020	38	3	Afghanista	AF	AFG	38041757	Asia	1.272286
9/2/2020	2	9	2020	9	0	Afghanista	AF	AFG	38041757	Asia	1.592986
9/1/2020	1	9	2020	34	4	Afghanista	AF	AFG	38041757	Asia	1.569328
########	31	8	2020	19	0	Afghanista	AF	AFG	38041757	Asia	1.487839
########	30	8	2020	3	0	Afghanista	AF	AFG	38041757	Asia	1.556185
########	29	8	2020	11	1	Afghanista	AF	AFG	38041757	Asia	1.863741
########	28	8	2020	3	0	Afghanista	AF	AFG	38041757	Asia	1.853227

fig3.1.2: database snapshot of geographic distribution of covid cases worldwide

With the help of the above table, we get the geographic location of the country for the supply of PPE kits, the requirement of PPE kits. So, with the data, we apply ML algorithm to predict cases and resources required in different countries as well as the availability of kits in various countries On the other hand, after analyzing the dataset, we have used preprocessing operations data cleaning, removal of missing values to eliminate some typos and errors in the dataset. After validation, all the missing values, typos and errors are removed from the dataset and it's completely clean and ready to use for the machine learning module.

A generalized workflow of the blockchain process:

Step 1: Transaction request made.

Step 2: Transaction broadcasted to all nodes.

Step 3: Transaction approved by all nodes.

Step 4: Transaction permanently added to chain.

4. DESIGN:

4.1 Architectural Design:

The decentralized nature of blockchain technology has extended the safety and privacy of the drug supply chain of the pharmaceutical industry. The complete system mechanism is presented with participants and a blockchain network in which users can manage and update the whole supply chain activities. The data regarding the users such as suppliers, manufacturers, distributors, pharmacies, hospitals and doctors are stored in the blockchain-based system. The assets of the systems are resources00, staple, order and record repository.

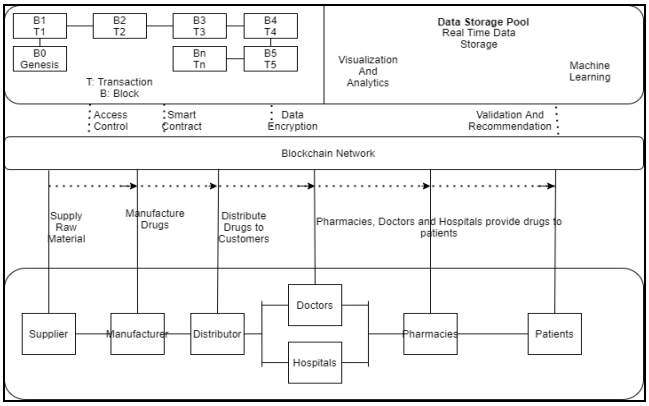

fig 4.1.1: overview of drug supply chain management system with blockchain

The important and first goal of the blockchain network is to store information in a distributed way where each block contains multiple transactions. The proposed system is a service-oriented framework for the users which provides the distributed ledger and smart contract functionalities as a service. The proposed system is split into two modules; the primary one is that the drug supply chain management system and therefore the second is that of the recommendation system.

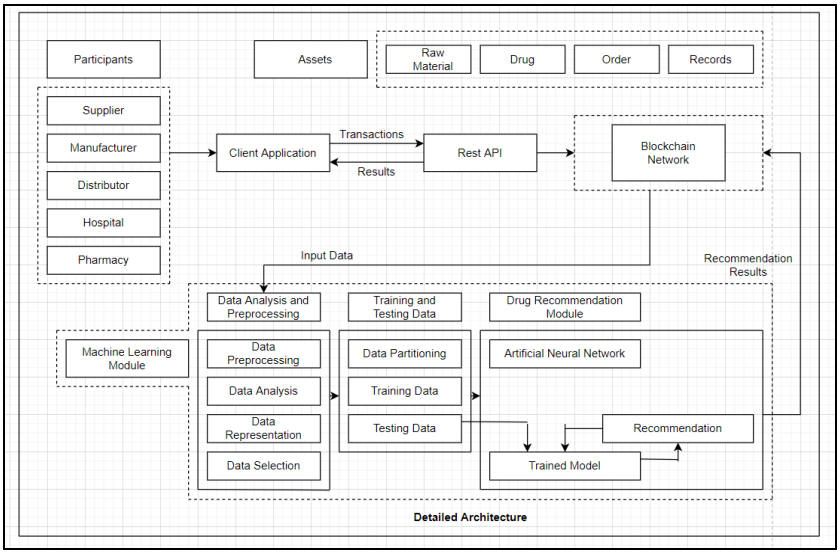

fig 4.1.2: detailed architecture of medico-supply chain

The participants, namely, Suppliers, Manufacturers, Distributors, Hospital, Pharmacy have access to their information through a client application. The Machine Learning Module of the architecture will consist of Data Analysis and Preprocessing, Training and Testing Data, and Drug Recommendation Module. In the Machine Learning Module, the input data is processed, cleaned for efficient future use. The training and testing also take place in the said module. Data related to the users of the system suppliers, distributors, hospitals, pharmacies, manufacturers and doctors are stored in a block-based system. Drug, raw-material, order and record repository are the fields of information that can be accessed. Apart from that, there will be a large data storage pool. It is a separate data library, also called a 'stored off blockchain'.

5. IMPLEMENTATION:

5.1. Algorithms / Methods Used:

5.1.1 Machine Learning-Based Kits Prediction:

Nowadays, with the growing technology and the number of software-based applications for the medical industry continuously generates a huge amount of data. Medical health care analysts and data scientists use these datasets and develop an automated system for the healthcare industry. First of all, with COVID-19_Hospital _Capacity_Metrics.csv[6], we get the information about the number of patients suffering from covid and number of ventilators occupied and the number of ventilators not in use, with this data we can predict the number of PPE kits required. And with other datasets that are COVID-19-geographic-distributionworldwide[6], we come to know the prices of PPE kits in each country, requirements of PPE kits and supply for the same, so this helps user to get knowledge about the kits' prices, quantity available in particular country and will help to know from which country they need to order PPE kits. After that, the data analysis and prepossessing module consist of two parts; data analysis and preprocessing. In the data analysis phase, we thoroughly understand and analyze the data by plotting some visualization graphs.On the opposite hand, within the second preprocessing part, we used processing

techniques to get rid of all the missing values from the dataset and make it clean for further operations. After training, our models predict the number of PPE kits. Moreover, our prediction system is able to train itself by getting current data. Finally, our system is able to recommend and predict the PPE kits in various countries and their requirements in future to the customers of the pharmaceutical industry.

5.1.2 Support vector machines:

Firstly, we collect the data and load it then we explore the data by getting to know more about features.To understand model performance, dividing the dataset into a training set and a test set.Then we split the dataset by using the functiontrain_test_split(). We have passed 3 parameters features, target, and testset-size. Then we have generated the model with SVM,by fitting our model on train set usingfit() and perform prediction on the test set using predict(), after this we got the prediction of resources and now to see accuracy,we check our model by comparing it with actual values and then we found out the accuracy was 89.47%.

5.2 Working of the project:

5.2.1 Data Set Cleaning and Preprocessing:

- As seen in the Hospital capacity dataset there are various attributes like ventilators capacity, ventilators in use, date. With the help of the table, we will come to know the number of patients and ventilators capacity cause of which we will get to know the number of PPE kits required and help in our prediction.
- In the geographic dataset,it has attributes like country name,cases,deaths,day,month,year, etc.With the help of the above table, we get the geographic location of the country for the supply of PPE kits, the requirement of PPE kits. So, with the data, we apply ML algorithm to predict cases and resources required in different countries as well as the availability of kits in various countries.

6. RESULTS AND DISCUSSION:

The forecasting of prediction of resources of PPE kits and the cases is calculated by applying the SVM and LR methods. The experimental setup of all models concludes that the SVM model gives the most accurate forecasting of the prediction resources in comparison to LR model. The following graph shows the resources of PPE kits required in future with the help of SVM model.

fig 6.1: distribution and breakdown graph of requirements of ppe kits by country, by city and by borough.

The above diagram, after the selection of the duration of days, requirements of PPE kits in a country in a particular city or even further breakdown to borough (town or district) is predicted and displayed. If a duration of 1 week = 7 days is selected, the per day requirement is mentioned in the graphs.

Even the other functionality was to display the resources available in different countries,it is like an inventory system for resources,so below is the graph that displays current rates of resources,availability of resources at various countries.

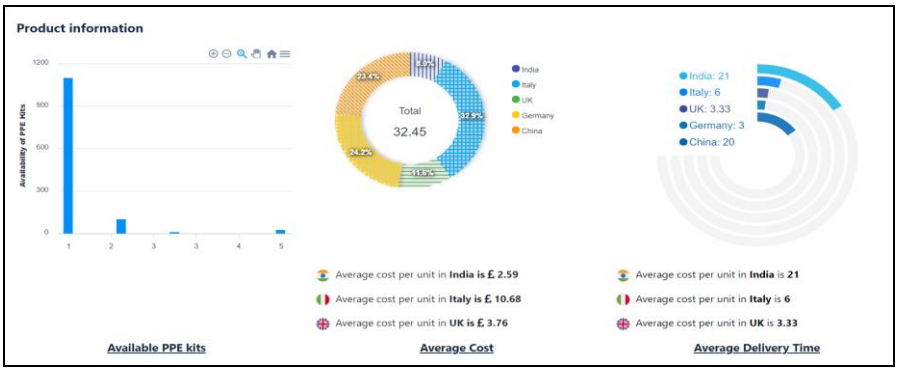

fig 6.2: graphs representing ppe kits available, their prices, and delivery time of various countries.

The above 3 graphs graphically show,

1. Available PPE kits in a particular country,

2. The second graph shows the average cost of a product (PPE kits) in other countries as well. It is shown in the form of a pie chart, in percentage of cost with respect to a country. For example, all the estimations are done with respect to. In the UK, the average cost per unit in India is 2.59 pounds.

3.In the third graph estimation of delivery time id given. With respect to. the United Kingdom, the average time per unit from India will be 21 days, from Italy will be 6 days and so on. With all these 3 estimations together, the best solution is provided. An example of it is shown below.

fig 6.3: most efficient recommendation

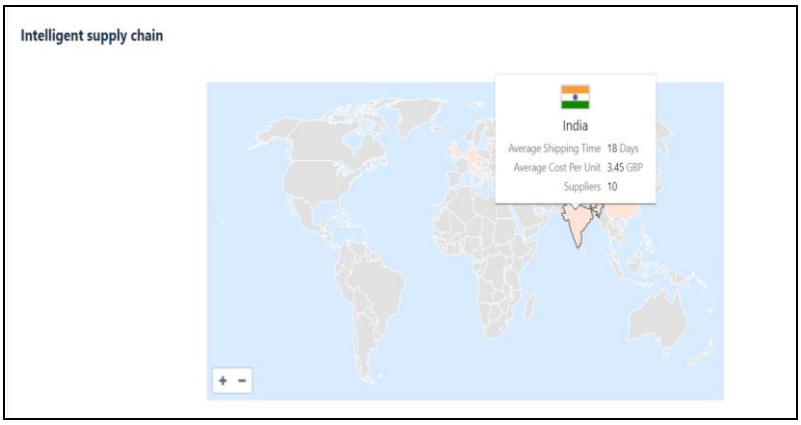

fig 6.4: world map representing country-wise data

As we hover over each country, average shipping time, average cost per unit and number of suppliers will be displaced. All this data will be given with respect to a particular country (here it is with respect to the UK).

7. CONCLUSION AND FUTURE SCOPE:

Such type of management portal can be used for various medical products and supply of various products from various countries. Medico will help the user to know the current prices in various countries and the availability of a product.So, this project can be expanded in various fields. It also can be used for future predictions of product availability in a particular country. And also give the nearest and best suggestion for better decision making. This will cause a reduction in transportation cost eventually supplying the product at less costs to organizations.

Our concerns are thatattackers might make use of 51% attacks to reverse transactions that have already taken place in a blockchain. The malicious user is able to form blocks at a faster than the rest of the network. By the longest chain rule, the network is force-switched to the attacker's desired chain. However even though these kinds of attacks are possible, the probability is very low. Thus, blockchain remains one of the most secure forms of technology.

Acknowledgement:

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REFERENCES:

[1] Asad Ali Siyal, Aisha Zahid Junejo, Muhammad Zawish, Kainat Ahmed, Aiman Khalil, Georgia Soursou, "Applications of Blockchain Technology in Medicine and Healthcare: Challenges and Future Perspectives" in the year 2019 at MDPI open journals.

[2] Blockchain for Health Data and Its Potential Use in Health ITand Health Care Related Research by Laure A. Linn and Martha B. Koo, M.D at helathit.gov.

[3] Blockchain Technology in Healthcare: A Comprehensive Review and Directions for Future Research by SeyednimaKhezr, Md Moniruzzaman, Abdulsalam Yasine, Rashid Benlamri in the year 2019 at MDPI open journals.

[4] Blockchain in Healthcare: A Patient-Centered Model by Hannah S Chen, Juliet T Jarrell, Kristy A Carpenter, David S Cohen, and Xudong Huang in 2019 at NCBI in PMC.

[5] Combining Blockchain and IoT: Food-Chain Traceability and Beyon by Jacopo Grecuccio,Edoardo Giusto,Fabio Fiori,MaurizioRebaudengoin 2020 at researchgate,Springer Conference.

[6] https://data.gov.indata for our project.