Crisis-Critical Intellectual Property Findings From the COVID-19 Pandemic

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Abstract— *A pandemic calls for large-scale action across national and international innovation systems in order to mobilize resources for developing and manufacturing crisis-critical products efficiently and in the huge quantities needed. Nowadays, these products also include a wide range of digital innovations. Given that many responses to the pandemic are technology driven, stakeholders involved in the development and manufacturing of crisis-critical products are likely to face intellectual property (IP)- related challenges Innovation systems in order to mobilize resources for developing and manufacturing crisis-critical products efficiently and in the huge quantities needed. We provide a reasoning why intellectual property (IP)- needs to be considered earlier rather than too late in a global health crisis. Major stakeholders we identify include 1) governments; 2) manufacturing firms owning existing crisis-critical IP (incumbents in crisis-critical sectors); 3) manufacturing firms normally not producing crisis-critical products suddenly rushing into crisis-critical sectors to support the manufacturing of crisis-critical products in the quantities that far exceed incumbents' production capacities; and 4) voluntary grassroot initiatives that form during a pandemic, often by highly skilled engineers and scientists in order to contribute to the development and dissemination of crisis-critical products.*

I. INTRODUCTION

1.1 Data Mining

Data mining is a process used by companies to turn raw data into useful information. By using software to look for patterns in large batches of data, businesses can learn more about their customers to develop more effective marketing strategies, increase sales and decrease costs. Data mining depends on effective data collection, warehousing, and computer processing.

1.2 HOW DATA MINING WORKS

Data mining involves exploring and analysing large blocks of information to glean meaningful patterns and trends. It can be used in a variety of ways, such as database marketing, credit risk management, fraud detection, spam Email filtering, or even to discern the sentiment or opinion of users.

The data mining process breaks down into five steps. First, organizations collect data and load it into their data warehouses. Next, they store and manage the data, either on in-house servers or the cloud. Business analysts, management teams and information technology professionals access the data and determine how they want to organize it. Then, application software sorts the data based on the user's results, and finally, the end-user presents the data in an easy-to-share format, such as a graph or table.

1.3 COVID -19 ANALYSIS

In DECEMBER 2019, an outbreak of a novel coronavirus in Wuhan, Hubei province, China, manifested itself as a global health tragedy. The World Health Organization (WHO) announced it as a public health emergency of international concern on January 30, 2020 and as a pandemic on March 11, 2020. The virus, later named SARS-CoV-2, can cause mild flu-like symptoms (or even be asymptotic) but can progress to acute pneumonia-like respiratory illness called novel coronavirus-infected pneumonia (NCIP). The overall clinical syndrome is known as COVID-19. Until today, there are no vaccines or medical cure for the disease yet , and the disease has a fatality rate that is unconfirmed due to lack of testing data for many countries but is likely to be around or above 1%. In just less than six months since its emergence, the virus is affecting more than 212 countries, with more than 4 million confirmed cases worldwide. The virus has a stronger transmission capacity than the "conventional" annually recurring flu.

The current COVID-19 pandemic creates enormous demand surges for products that are crisis relevant as well as a need for rapidly developing innovations to address crisis-specific problems. The current pandemic spreads so much faster than the global health crises studied in prior literature. However, two general conclusions can be drawn from prior literature focusing on IP in the context of crises that are very much in line with what is known from extensive economic research on IP and

innovation. We identify relevant stakeholders and describe associated IP challenges they face related to the development and manufacturing of technologies and products for prevention (of spread), diagnosis of infected patients, and the development of treatments summarized in an adopted IP roadmap.

1.4 Innovation Stakeholders

Major innovation stakeholders we identify include the following:

1) governments;
2) manufacturing firms owning existing crisis-critical intellectual property (CC-IP) [incumbents in crisis-critical sectors (CC-S)];
3) manufacturing firms normally not producing CC-P suddenly rushing into CC-S to support the manufacturing of CC-P in the quantities that far exceed incumbents' production capacities;
4) voluntary grassroot initiatives that form during a pandemic, often by highly skilled engineers and scientists in order to contribute to the development and dissemination of CC-P.

Obviously, our findings result only from observations of one ongoing pandemic and thus need to be verified further and interpreted with care.

II. LITERATURE SURVEY

1. Author: L. Aristodemou and F. Tietze,

Title: "The state-of-the-art on intellectual property analytics (IPA):

Description: A literature review on artificial intelligence, machine learning and deep learning methods for analysing intellectual property (IP) data, " .Big data is increasingly available in all areas of manufacturing and operations, which presents an opportunity for better decision making and discovery of the next generation of innovative technologies. Recently, there have been substantial developments in the field of patent analytics, which describes the science of analysing large amounts of patent information to discover trends. We define Intellectual Property Analytics (IPA) as the data science of analysing large amount of IP information, to discover relationships, trends and patterns for decision making.

2. Author: N. Warthmann,

Title:"WHO asked to create voluntary intellectual property pool for COVID-19 work".

Description:Seeking to widen access to medical products for combating Covid-19, the Costa Rican government has asked the World Health Organization to create a voluntary pool to collect patent rights, regulatory test data and other information that could be shared for developing drugs, vaccines and diagnostics. The move comes amid a worldwide race to fight the novel coronavirus, but also mounting concerns that some products may not be accessible for poorer populations. By establishing a voluntary mechanism under the auspices of the WHO, Costa Rican officials are hoping to create a pathway that will attract numerous governments, as well as industry, universities and non-profit organizations.

3. Author: Qing Lina and Shawn WON Gb

Title: A Study of Intellectual Property Protection for Mass Innovation Spaces.

Description: Intellectual property is inextricably linked to the innovative development of mass innovation spaces. The synthetic development of intellectual property and mass innovation spaces will fundamentally support the new economic model of "mass entrepreneurship and innovation". As such, it is critical to explore intellectual property service standards for mass innovation spaces and to steer mass innovation spaces to the creation of an intellectual property service system catering to "makers". In addition, it is crucial to explore intellectual cluster management innovations for mass innovation spaces.

4. Author: K. L. Cox

Title:"The medicines patent pool: Promoting access and innovation for life-saving medicines through voluntary licenses,"

Description: Monopolies over many life-saving drugs have led to high prices that remain out of reach for patients in the developing world, leading to a crisis of access over these essential medicines. High intellectual property barriers harm not only access to medicines, but can also impact future innovation. In order to address this problem, a proposal for a "patent

pool" emerged that would rely on voluntary licenses by patent holder to enable the production of more affordable generic medicines. This article briefly describes the history of patent pools before focusing specifically on the UNITAID-supported Medicines Patent Pool. In addition to identifying areas for improvement, this article explores the mechanisms, including those that de-link innovation from monopoly pricing, that can be used to achieve these goals and encourage greater participation in the Medicines Patent Pool.

5. Author: Johns Hopkins 2020

Title: Coronavirus Resource Centre Accessed

Description: The COVID-19 crisis has created an unprecedented need for contact tracing across the country, requiring thousands of people to learn key skills quickly. The job qualifications for contact tracing positions differ throughout the country and the world, with some new positions open to individuals with a high school diploma or equivalent.

In this introductory course, students will learn about the science of SARS-CoV-2 , including the infectious period, the clinical presentation of COVID-19, and the evidence for how SARS-CoV-2 is transmitted from person-to-person and why contact tracing can be such an effective public health intervention. Students will learn about how contact tracing is done, including how to build rapport with cases, identify their contacts, and support both cases and their contacts to stop transmission in their communities. The course will also cover several important ethical considerations around contact tracing, isolation, and quarantine. Finally, the course will identify some of the most common barriers to contact tracing efforts -- along with strategies to overcome them.

2.1 Existing System

Adopting this strategy, new entrants would essentially develop novel CC-IP. However, if not carrying out careful freedom to operate analysis, they may infringe on existing background CC-IP owned by incumbents. A third strategy is to access CC-IP through teaming up with incumbents to produce some existing CC-P manufactured prior to the pandemic by the incumbents only. Suddenly, incumbents may find themselves confronted with new entrants in “their” sector which infringe their CC-IP, which they find difficult to enforce during a pandemic, with new entrants developing subsequently their own CC-IP. Not for the particular coronavirus type SARS-CoV-2 that causes the COVID-19 disease. It appears evident that there is a time lag between outbreaks and the materialization of patents and a number of references to NPL, which shows the urgency of scientists for open data to put the information in the public domain. Any patent analysis is historic, thus limited to existing IP, even with a delay as patent applications get published 18 months after filing.

2.2 Disadvantages:

1. There is no for the particular coronavirus type SARS-CoV-2 that causes the COVID-19 disease in not prediction.
2. If the patient getting the applications very delayed after the filling.

2.3 Input Design:

The input design is the link between the information system and the user. It comprises the developing specification and procedures for data preparation and those steps are necessary to put transaction data in to a usable form for processing can be achieved by inspecting the computer to read data from a written or printed document or it can occur by having people keying the data directly into the system. The design of input focuses on controlling the amount of input required, controlling the errors, avoiding delay, avoiding extra steps and keeping the process simple. The input is designed in such a way so that it provides security and ease of use with retaining the privacy. Input Design considered the following things:

- What data should be given as input?
- How the data should be arranged or coded?
- The dialog to guide the operating personnel in providing input.
- Methods for preparing input validations and steps to follow when error occur.

2.4 Objectives

1) Input Design is the process of converting a user-oriented description of the input into a computer-based system. This design is important to avoid errors in the data input process and show the correct direction to the management for getting correct information from the computerized system.

2) It is achieved by creating user-friendly screens for the data entry to handle large volume of data. The goal of designing input is to make data entry easier and to be free from errors. The data entry screen is designed in such a way that all the data manipulates can be performed. It also provides record viewing facilities.

3) When the data is entered it will check for its validity. Data can be entered with the help of screens. Appropriate messages are provided as when needed so that the user will not be in maize of instant. Thus, the objective of input design is to create an input layout that is easy to follow

2.5 Output Design

A quality output is one, which meets the requirements of the end user and presents the information clearly. In any system results of processing are communicated to the users and to other system through outputs. In output design it is determined how the information is to be displaced for immediate need and also the hard copy output. It is the most important and direct source information to the user. Efficient and intelligent output design improves the system's relationship to help user decision-making.

1) Designing computer output should proceed in an organized, well thought out manner; the right output must be developed while ensuring that each output element is designed so that people will find the system can use easily and effectively. When analysis design computer output, they should Identify the specific output that is needed to meet the requirements.

2) Select methods for presenting information.

3) Create document, report, or other formats that contain information produced by the system.

The output form of an information system should accomplish one or more of the following objectives.

- Convey information about past activities, current status or projections of the
- Future.
- Signal important events, opportunities, problems, or warnings.
- Trigger an action.
- Confirm an action.

III. DESIGN PROCESS

We provide a structure, framework, and language for those concerned with steering clear of IP challenges to avoid delays in fighting a pandemic. We provide a reasoning why IP needs to be considered earlier rather than too late in a global health crisis. Major stakeholders we identify include

1) governments;

2) manufacturing firms owning existing crisis-critical IP (incumbents in crisis-critical sectors);

3) manufacturing firms normally not producing crisis-critical products suddenly rushing into crisis-critical sectors to support the manufacturing of crisis-critical products in the quantities that far exceed incumbents' production capacities; and

4) voluntary grassroot initiatives that form during a pandemic, often by highly skilled engineers and scientists in order to contribute to the development and dissemination of crisis-critical products.

For these major stakeholders, we draw up three scenarios, from which we identify associated IP challenges they face related to the development and manufacturing of technologies and products for

1) prevention (of spread);

2) diagnosis of infected patients; and

3) the development of treatments.

This article provides a terminology to help policy and other decision makers to discuss IP considerations during pandemics. We propose a framework that visualizes changing industrial organizations and IP-associated challenges during a pandemic and derive initial principles to guide innovation and IP policy making during a pandemic. Obviously, our findings result only from observations of one ongoing pandemic and thus need to be verified further and interpreted with care.

3.1 Advantages:

- Non-Repudiation
- Strong Authentication
- Accountability

Algorithms:

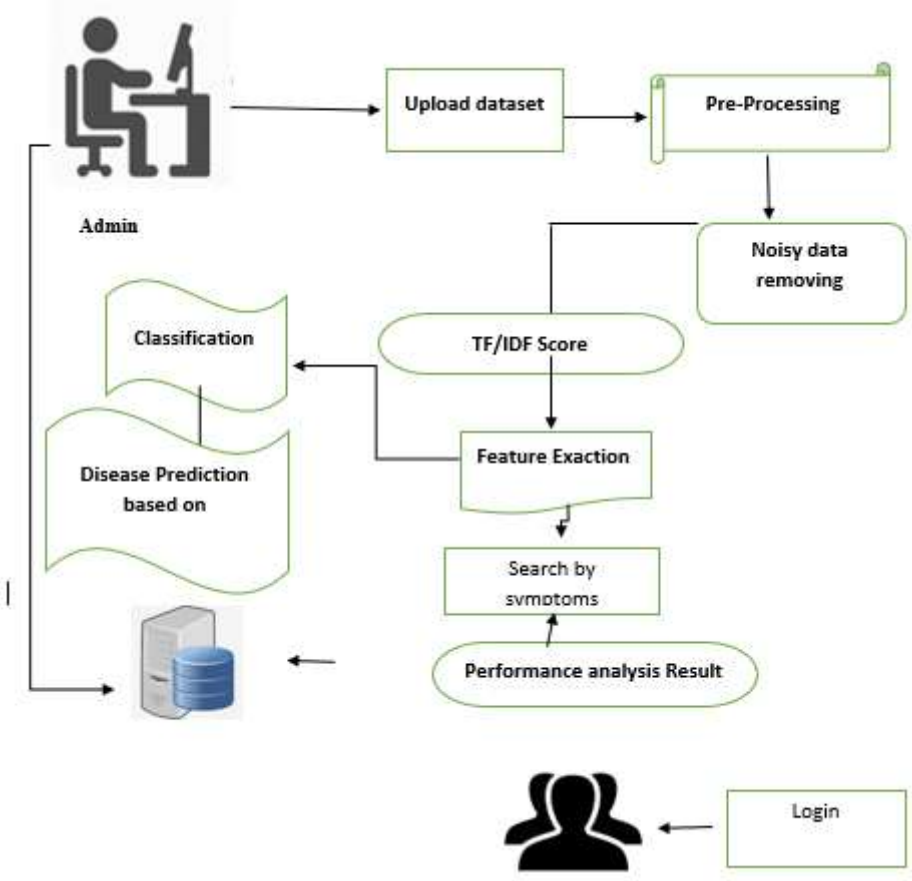
3.2 Collaborative filtering:

Collaborative filtering (CF) is a technique used by recommender system. Collaborative filtering has two senses, a narrow one and a more general one**.**

3.3 Ciphertext:

Ciphertext is also known as encrypted or encoded information because it contains a form of the original plaintext that is unreadable by a human or computer without the proper cipher to decrypt it. Decryption, the inverse of encryption, is the process of turning ciphertext into readable plaintext.

IV. SYSTEM ARCHITECTURE

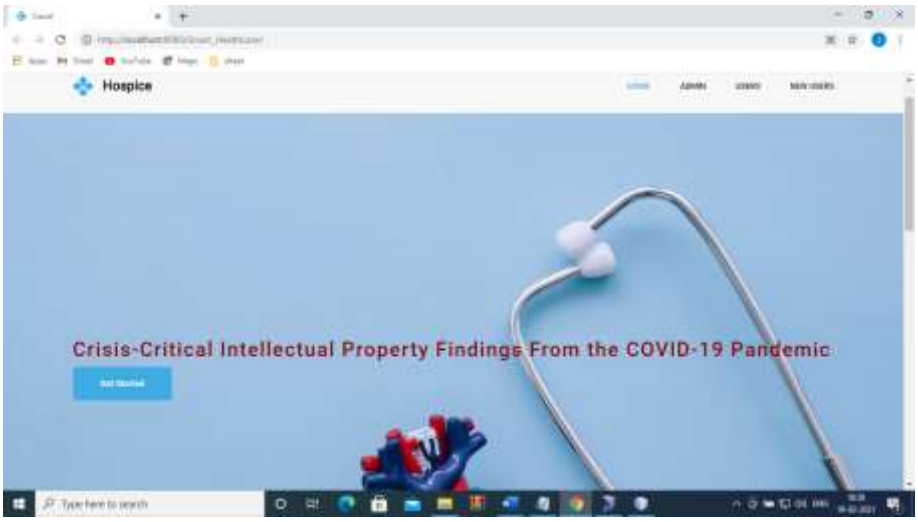


V. APPLICATION AND THE FUTURE WORK

This method has been implemented in all critical situations such as cyclone, storm beach, thunder storm and anticyclone.

In fact, currently, we lack systematically collected evidence documenting the extent to which IP issues actually present a barrier or are a perceived possible future problem (risk) and to what extent for different actors. Evidence for this could be created for instance through a survey to those developing and manufacturing CC-P. This would provide a sounder basis for conversations with decision makers about the importance of IP issues during a pandemic.

Home



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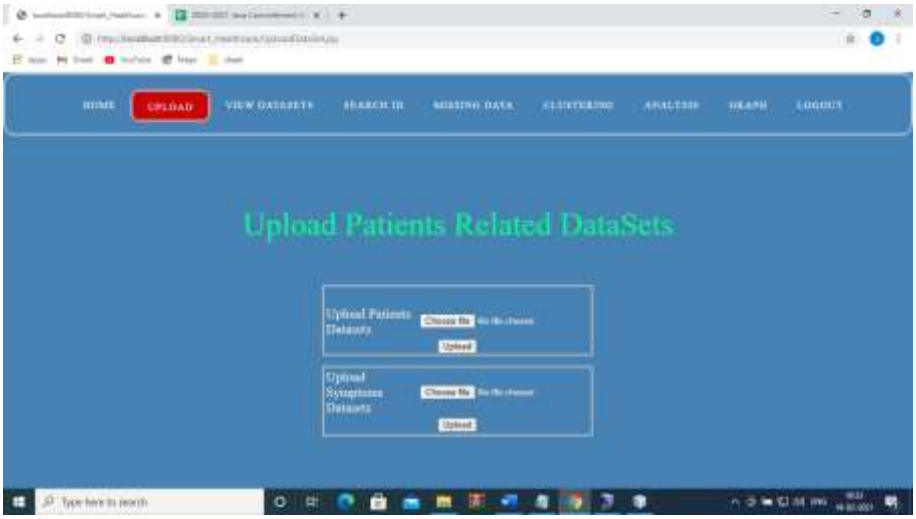


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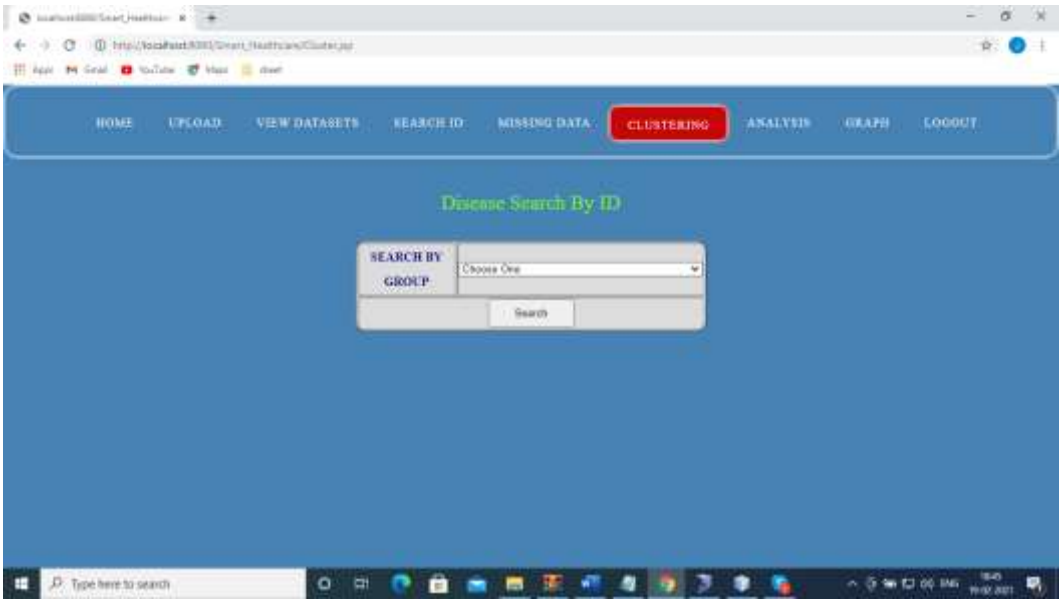
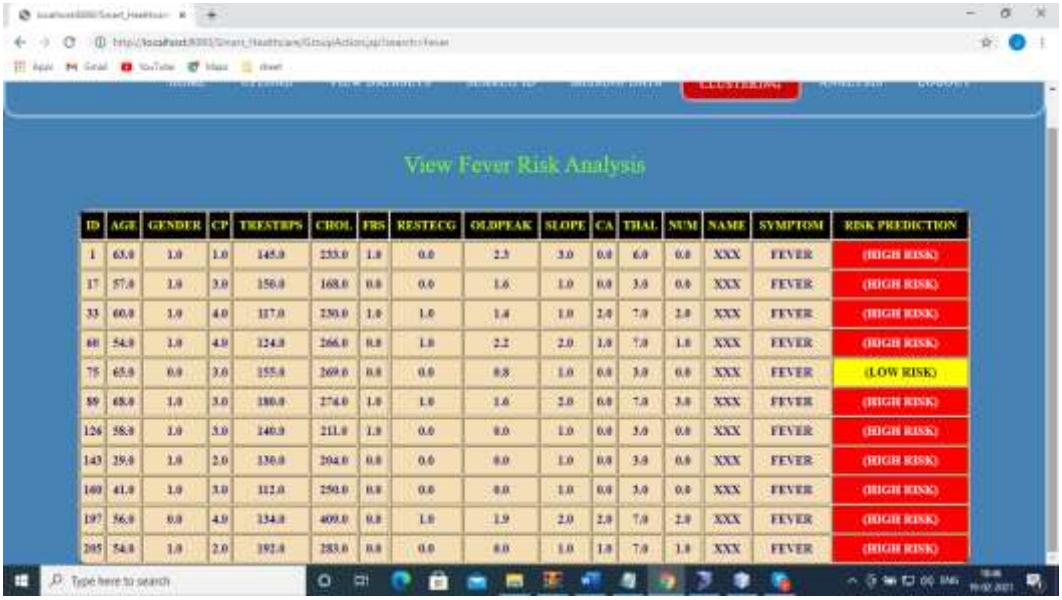
1 63.0 1.0 1.0 145.0 233.0 1.0 2.0 2.3 3.0 0.0 6.0 0.0 XXX FEVER
2 67.0 1.0 4.0 160.0 286.0 0.0 2.0 1.5 2.0 3.0 3.0 2.0 XXX DRY COUGH
3 67.0 1.0 4.0 120.0 229.0 0.0 2.0 2.6 2.0 2.0 7.0 1.0 XXX TIREDNESS
4 37.0 1.0 3.0 130.0 250.0 0.0 0.0 3.5 3.0 0.0 3.0 0.0 XXX ACHES AND PAINS
6 41.0 0.0 2.0 130.0 204.0 0.0 2.0 1.4 3.0 0.0 3.0 0.0 XXX SORE THROAT
7 56.0 1.0 2.0 120.0 236.0 0.0 0.0 0.8 3.0 0.0 3.0 0.0 XXX DIARRHOEA
8 62.0 0.0 4.0 140.0 268.0 0.0 2.0 3.6 3.0 2.0 3.0 3.0 XXX CONJUNCTIVITIS
9 57.0 0.0 4.0 120.0 354.0 0.0 0.0 0.6 3.0 0.0 3.0 0.0 XXX SEEK
10 63.0 1.0 4.0 130.0 254.0 0.0 2.0 1.4 2.0 1.0 7.0 2.0 XXX DRY COUGH
11 53.0 1.0 4.0 140.0 203.0 1.0 2.0 3.1 3.0 0.0 7.0 1.0 XXX TIREDNESS
12 57.0 1.0 4.0 140.0 192.0 0.0 0.0 0.4 2.0 0.0 6.0 0.0 XXX CONJUNCTIVITIS

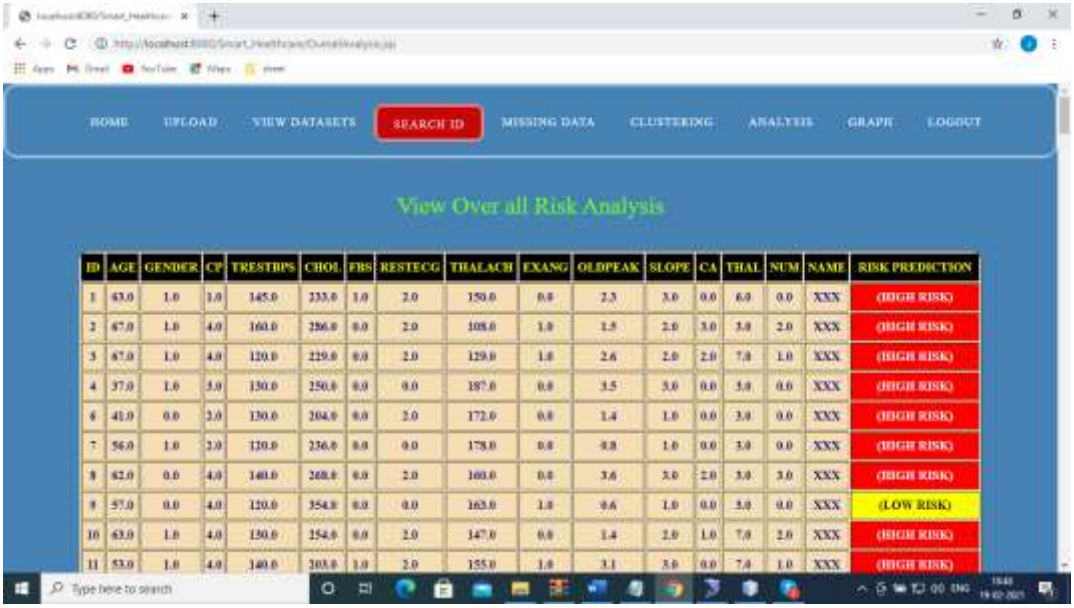

Disease Search Result By ID
ID 1
AGE 67.0
GENDER 1.0
CP 4.0
TEMPERATURE 160.0
CHOL 286.0
FBS 0.0
RESTECG 2.0
THALACH 108.0
EXANG 1.0
OLDPEAK 1.5
SLOPE 2.0
CA 3.0
THAL 3.0


HOME UPLOAD VIEW DATASETS SEARCH ID MISSING DATA CLUSTERING ANALYSIS LOGOUT
Risk Based on Structured / UnStructured Data
STRUCTURED DATA RISK
RISK BASED ON (GENDER, AGE, NAME)
ID 1 —
AGE 67.0 HIGH LEVEL
GENDER 1.0 HIGH LEVEL
NAME XXX —
Check Over all Risk
UNSTRUCTURED DATA RISK
CP 4.0 HIGH LEVEL
TEMPERATURE 160.0 HIGH LEVEL
CHOL 286.0 HIGH LEVEL
FBS 0.0 LOW LEVEL
RESTECG 2.0 HIGH LEVEL
THALACH 108.0 NORMAL LEVEL
EXANG 1.0 HIGH LEVEL
OLDPEAK 1.5 HIGH LEVEL
SLOPE 2.0 HIGH LEVEL



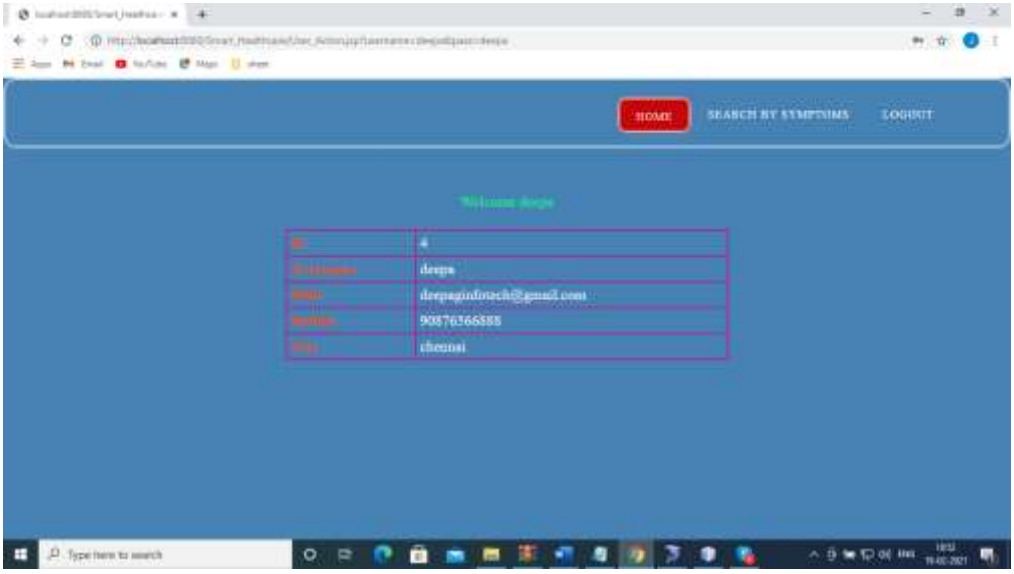


ID	AGE	GENDER	CP	TRESTBPS	CHOL	FBS	RESTECG	OLDPEAK	SLOPE	CA	THAL	NUM	NAME	SYMPTOM	RISK PREDICTION
1	63.0	1.0	1.0	145.0	233.0	1.0	0.0	2.3	3.0	0.0	6.0	0.0	XXX	FEVER	(HIGH RISK)
17	57.0	1.0	3.0	150.0	168.0	0.0	0.0	1.6	1.0	0.0	3.0	0.0	XXX	FEVER	(HIGH RISK)
33	60.0	1.0	4.0	117.0	230.0	1.0	1.0	1.4	1.0	2.0	7.0	2.0	XXX	FEVER	(HIGH RISK)
60	54.0	1.0	4.0	124.0	266.0	0.0	1.0	2.2	2.0	1.0	7.0	1.0	XXX	FEVER	(HIGH RISK)
75	65.0	0.0	3.0	155.0	269.0	0.0	0.0	0.8	1.0	0.0	3.0	0.0	XXX	FEVER	(LOW RISK)
99	68.0	1.0	3.0	180.0	274.0	1.0	1.0	1.6	2.0	0.0	7.0	3.0	XXX	FEVER	(HIGH RISK)
126	58.0	1.0	3.0	140.0	211.0	1.0	0.0	0.0	1.0	0.0	3.0	0.0	XXX	FEVER	(HIGH RISK)
143	29.0	1.0	2.0	130.0	204.0	0.0	0.0	0.0	1.0	0.0	3.0	0.0	XXX	FEVER	(HIGH RISK)
169	41.0	1.0	3.0	112.0	250.0	0.0	0.0	0.0	1.0	0.0	3.0	0.0	XXX	FEVER	(HIGH RISK)
197	56.0	0.0	4.0	134.0	409.0	0.0	1.0	1.9	2.0	2.0	7.0	2.0	XXX	FEVER	(HIGH RISK)
205	54.0	1.0	2.0	192.0	283.0	0.0	0.0	0.0	1.0	1.0	7.0	1.0	XXX	FEVER	(HIGH RISK)



ID	AGE	GENDER	CP	TRESTBPS	CHOL	FBS	RESTECG	THALACH	EXANG	OLDPEAK	SLOPE	CA	THAL	NUM	NAME	RISK PREDICTION
1	63.0	1.0	1.0	145.0	233.0	1.0	2.0	150.0	0.0	2.3	3.0	0.0	6.0	0.0	XXX	(HIGH RISK)
2	67.0	1.0	4.0	160.0	286.0	0.0	2.0	108.0	1.0	1.5	2.0	3.0	3.0	2.0	XXX	(HIGH RISK)
3	67.0	1.0	4.0	120.0	229.0	0.0	2.0	129.0	1.0	2.6	2.0	2.0	7.0	1.0	XXX	(HIGH RISK)
4	37.0	1.0	3.0	130.0	250.0	0.0	0.0	187.0	0.0	3.5	3.0	0.0	3.0	0.0	XXX	(HIGH RISK)
6	41.0	0.0	2.0	130.0	204.0	0.0	2.0	172.0	0.0	1.4	1.0	0.0	3.0	0.0	XXX	(HIGH RISK)
7	56.0	1.0	2.0	120.0	236.0	0.0	0.0	178.0	0.0	0.8	1.0	0.0	3.0	0.0	XXX	(HIGH RISK)
8	62.0	0.0	4.0	140.0	268.0	0.0	2.0	160.0	0.0	3.6	3.0	2.0	3.0	3.0	XXX	(HIGH RISK)
9	57.0	0.0	4.0	120.0	354.0	0.0	0.0	163.0	1.0	0.6	1.0	0.0	3.0	0.0	XXX	(LOW RISK)
10	63.0	1.0	4.0	130.0	254.0	0.0	2.0	147.0	0.0	1.4	2.0	1.0	7.0	2.0	XXX	(HIGH RISK)
11	53.0	1.0	4.0	140.0	203.0	1.0	2.0	155.0	1.0	3.1	3.0	0.0	7.0	1.0	XXX	(HIGH RISK)

User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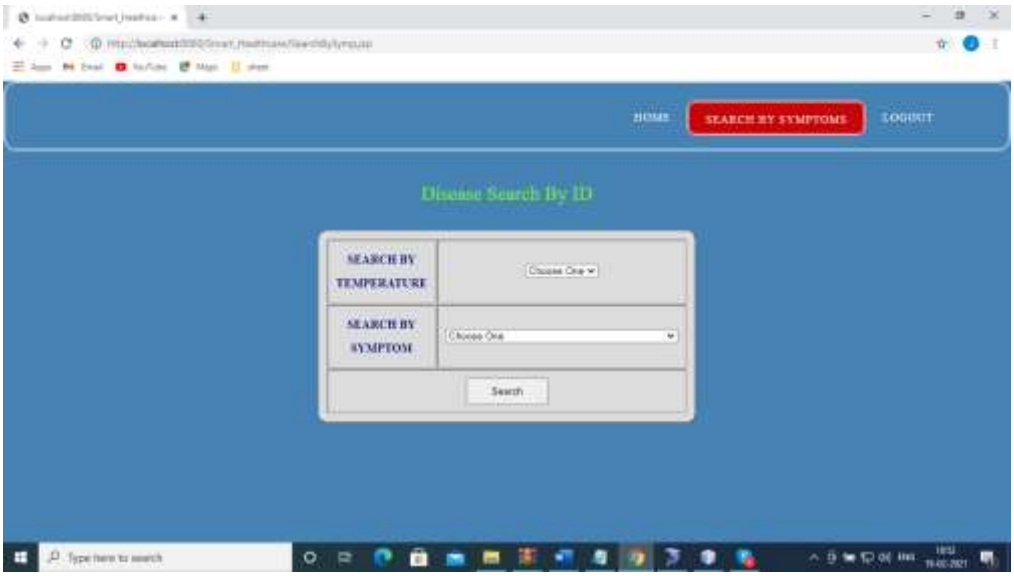
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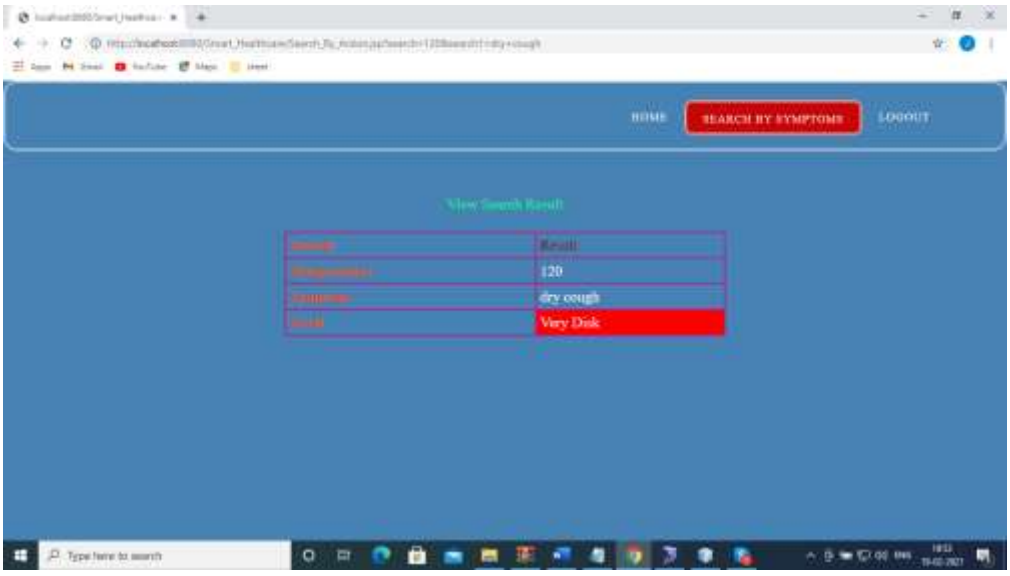
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120
dry cough
Very Disk

VI. CONCLUSION

From an IP and innovation perspective, this article contributed to the scarce literature about the role of and challenges associated with IP during pandemics. Our findings were derived from analysing, synthesizing, and interpreting secondary data from the COVID-19 pandemic from two major sources: 1) publicly available documents, such as newspaper articles, industry specific outlets, government reports, and announcements and

2) patent data.

Obviously, our findings result only from observations of one ongoing pandemic and thus need to be verified further and interpreted with care.

We find that what makes it difficult for IP to be given its required considerations during the early stage of a pandemic is the enormous sense of urgency, which draws decision makers' attention to huge and undoubtedly urgent operational challenges. With this article, we hopefully contribute a set of arguments to raise awareness why IP needs to be dealt with earlier rather than later during a pandemic in order to avoid that IP-associated risks delay the mobilization of the resources so urgently needed for the research, development, and mass manufacturing of CC-P. This is particularly important as various responses to the pandemic are somehow technology related, which typically involves IP rights in some form.

This article offered a set of contributions. We summarized IP-related issues currently surfacing during the COVID-19 pandemic in a CC-IP roadmap. We identified four major groups of stakeholders that are mostly concerned with IP considerations. These include governments (and intergovernmental organizations, such as the WHO and WIPO) who are called upon to orchestrate pandemic responses, incumbent manufacturing firms in CC-S, as well as new entrants that enter CC-S to assist incumbents. New entrants include manufacturing firms that did not produce CC-P prior to a pandemic (Type 1 entrants), as well as voluntary grassroot initiatives, start-ups, entrepreneurial scientists, etc. (Type 2 entrants). This article then identified and analysed three scenarios in which different IP considerations emerge for the different stakeholder groups. This article provided a terminology that helped to conceptualize IP considerations in times of pandemics or global health crises that call for urgent and large-scale actions from various innovation stakeholders that suddenly find themselves engaged in new relationships that are associated with various IP associated uncertainties, not the least related to the use and sharing of IP with the particular problem that negotiating licensing agreements is typically time consuming. We also provided a language for policy makers and other decision makers to articulate and discuss IP challenges during pandemics, which might evolve further with specific terms being added gradually or notions being revised as we go along. We proposed a framework that visualizes how industrial organization could change throughout pandemics. That can serve as an analytical framework for others and particularly follow up studies. Results from our patent analysis show that research and IP protection for coronavirus-related inventions is not new. Patent protection for different forms of coronavirus already exists, but not for the particular coronavirus type SARS-CoV-2 that causes the COVID-19 disease. It appears evident that there is a time lag between outbreaks and the materialization of patents and a number of references to NPL, which shows the urgency of scientists for open data to put the information in the public domain.

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