Interactive Isolation Care System for COVID-19 IICS

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Abstract:

Due to the outbreak of the coronavirus and its transformation from a disease in a limited area into a pandemic that has led to the death of thousands, resulting in growing fears and concerns of the medical staff about infection, whether they are doctors or nurses. In direct explicit terms, it is the question of how to isolate patients to prevent infection, while still under medical supervision, without exposing the medical team to the danger of catching the infection? In other words, the suggested system combines three strategies in one integrated system: allows the doctor to deal with the patient without worrying about infection, provides the appropriate atmosphere for the patient to support his recovery rate without external contact with any person, and reduces further infection and limits the spreading of the virus.

Since there are 5 stages of the disease, it is observed that the cure rates in the initial stages are substantial, whereas the last two stages are very low in terms of recovery.

Among the challenges faced by medical skills and technology is the fear of further infection, even with the presence of the current isolation procedures. Therefore, the main problem lies in how to build an optimal isolation system for the patient and his surroundings, from the medical staff, and at the same time achieve the highest levels of unity and team-work spirit among the medical staff. Henceforth, the new system should guarantee their safety from the risk of infection.

The main principle (of the proposed system) has not been discussed in previous studies fulfilling systems of protection, isolation and prevention adopted in other diseases in which the Incubator functions with its environment of temperature, humidity and breathing organization with the Ventilator Gas Control devices, intensive care devices, Pulse Monitoring, Lung Sound and other relevant control and monitoring devices.

The suggested design fulfills the above objectives, and facilitates their rapid production and counteracts the active movement of the virus.

One of the main advantages of the recommended system is the high accessibility and ease of patient-medical-staff communication when found inside the system. Furthermore, it provides enhanced cleansing and sterilizing procedures. In addition, the system enables self-sterilization to achieve double-benefit criterion of ensuring staff's safety and maintain the used devices.

The IICS succeeds to meet the current needs between a numbers of directionally-opposing elements:

- Interface points (staff & patients)
- Suitable Environment for the patient
- Medical isolation of those infected with the virus
- Improved Skill level of user
- Interaction between:
  - Human-to-human

- Hardware element
- Software element

I attempt to develop a model that performs certain tasks whereby the human beings who are fighting the emerging coronavirus manage to do so through a productively ergonomic design.

Keywords:

IICS Unit - Ideal Isolation - Improved Medical Efficiency – Ideal Contact Means

ملخص البحث:

بسبب انتشار فيروس كورونا وتحوله من مرض في منطقة محدودة إلى وباء عالمي أدى إلى وفاة مليون ومئات الآلاف (1)، أدى ذلك إلى تخوف الكادر الطبي وقلقهم من الإصابة ، سواء كانوا هم أطباء أو ممرضات ، لذلك كان التفكير الأول والأهم هو كيفية عزل المريض بالفيروس للوقاية من العدوى سواء كان ذلك من الطاقم الطبي أو لأي شخص آخر وعلى النقيض فهو يحتاج للمتابعة مستمرة للمريض أكثرحسب حالته و كانت الفكرة عبارة عن تصميم منظومة مدمجة في نظام يتيح للطبيب التعامل مع المريض دون القلق من الإصابة أو خوف من العدوى منه وتوفير الدعم المناسب للمريض للمساعدة في تعافيه مع الشفاء دون احتكاك خارجي مع أي شخص. لتقليل العدوى وانتشار الفيروس .

إذا تم تقسيم مراحل المرض إلى 5 مستويات . ، يُلاحظ أن معدلات الشفاء في المراحل الأولى عالية جدًا (1,2,3) مستوى، لكن المستويان (4,5) الأخيرين منخفضة جدًا. واقع مبنى على الملاحظة والأستبيان ,

من أهم أسباب تدني معدلات الشفاء يرجع الى أنخفاض كفائة التكنولوجيا الطبية المقدمة للمريض الناتج من الخوف من الإصابة (العدوى) مع وجود العزل الحالي التقليدى بحيث تصبح المشكلة الرئيسية في كيفية إجراء عزل كامل للمريض وبيئته عن البيئة الطبية ويحقق المخالطون في نفس الوقت أعلى مستويات التداخل للطاقم الطبي وهم في مأمن من مخاطر الإصابة,

آتيت الفكرة الرئيسية بعد مرحلة الدراسات التي استوفت أنظمة الحماية والعزل والوقاية المتبعة في أمراض أخرى ودراسة فكرة الحضّانة وتحقيق بيئتها من درجة الحرارة والرطوبة والتنفس وتنظيمها المتكامل مع أجهزة التنفس الصناعي وأجهزة العناية المركزة. ومراقبة النبض وصوت الرئة وأجهزة التحكم والمراقبة الأخرى,

يفي التصميم بالأهداف المذكورة أعلاه ، ويسهل إنتاجه السريع ويقاوم الحركة النشطة للفيروس,

من أهم مميزات الجهاز سهولة التواصل بين المريض داخل الجهاز والطاقم الطبي بأسهل الطرق الممكنة ، وكذلك سهولة تنظيف الجهاز وتعقيمه من قبل وبعض من استخدامه للكل من المريض و الطبيب معا وهي ميزة تتيح التعقيم الذاتي للجهاز لحد من نشر الفيروس,

نجح نظام العزل والتفاعل الطبى IICS(المقترح) فى الوصول إلى ما نحتاجة من عمليات متناقضة فى وتيرة عملها: نظام العزل و نظام التواصل مع المتعاملين,

- التعامل (الطاقم الطبى والمريض)
- البيئة المناسبة للمريض
- العزل الطبي للمصابين بالفيروس
- تحسين مستوى مهارة المستخدمين
- التفاعل والتعامل بين:

o التعامل بين الأفراد o التعامل مع الأجهزة o التعامل مع البرامج

هذا النموذج يقوم بمهام من شأنها مراعاة الجانب الإنساني ومكافحة فيروس كورونا باستخدام تصميمًا إرجنوميا فعالا يحد من إنتشاره.

الكلمات المفتاحية :-

وحدة العزل والتفاعل IICS – العزل المثالى - رفع مستوى الكفائة الطبية -الوصل المثالى

Scientific Concepts about the Corona Virus.[1]

What is Corona virus?

Coronaviruses are a broad family of viruses that may cause disease in animals and humans. It is known that a number of corona viruses in humans cause respiratory diseases ranging in severity from common cold to more severe diseases such as Middle East respiratory syndrome (MERS) and severe acute respiratory syndrome (SARS). The recently discovered Coronavirus causes Covid-19 disease.is the disease caused by a new coronavirus called SARS-CoV-2. WHO first learned of this new virus on 31 December 2019, following a report of a cluster of cases of 'viral pneumonia' in Wuhan, People's Republic of China,

What is Covid-19 disease?

Covid-19 is an infectious disease caused by the last discovered virus of the Coronavirus strain. There was no knowledge of the existence of this new virus and its disease before the outbreak began in the Chinese city of Wuhan in December 2019. Covid-19 has now turned into a pandemic affecting many countries in the world.

What are the symptoms of Covid-19 disease?

The most common symptoms of COVID-19 are fever, fatigue and a dry cough. Other symptoms that are less common but which some patients may develop include: pains and aches, nasal congestion, headache, conjunctivitis, sore throat, diarrhea, loss of sense of taste or smell, and the appearance of a rash or discoloration of the fingers or toes. These symptoms are usually mild and start gradually. Some people become infected with only very mild symptoms**.**

Most people (about 80%) recover from the disease without the need to special treatment. However, symptoms worsen in approximately one out of every 5 people who have Covid-19 disease, and he suffers from difficulty breathing. The risk of developing severe complications increases among the elderly and people with other health problems such as high blood pressure, heart and lung disease, diabetes or cancer. All persons of any age should seek medical attention immediately if they develop a fever and / or cough accompanied by difficulty breathing / shortness of breath, pain or pressure in the chest, or loss of speech or movement. It is recommended, as much as possible, to contact the physician or the health care facility in advance, in order to direct the patient to the appropriate clinic.

Introduction Based on the statistics of the World Health Organization (2020) the number of injuries as on the date of the conference[2], the traditional use of medical cures and devices only had weak cure effectiveness and the rate of infection increased at the beginning of the pandemic. The poor precaution procedures led to worsen the situation, in addition to the

emergence of psychological troubles and the exhaustion of the both patient and the contacts .This is confirmed by the study of that exposure to high noise and vibration levels emanating from (medical) tools and devices which in turn increase the level of fatigue and affect the health and psychological aspects of those exposed to it as well as affecting the quality of performance[3].This is confirmed by the study of that exposure to high noise and vibration levels emanating from (medical) tools and devices increases the level of fatigue and affects the health and psychological aspects of those exposed to it as well as affects the quality of performance[4].

Figure 1. Epidemic curve of confirmed COVID-19, by date of report & WHO region through[5] 23 /3/ 2020

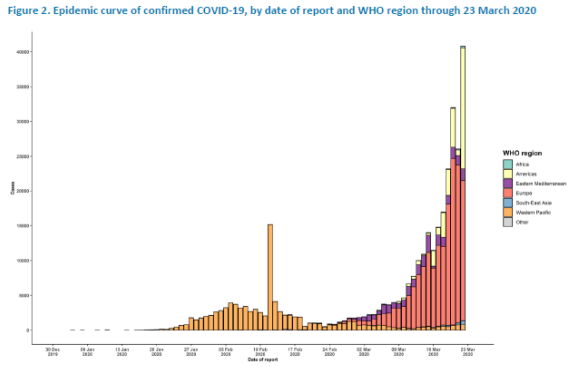


Figure 1 Coronavirus disease 2019 (COVID-19): WHO Situation Report - 63-World Health Organization

of Applied Physics, 2020, Volume 16, Issue 1, pages 27-36

And since the quality of performance is the basic part to increase the efficiency of the medical line-up in order to boost care while decreasing the possibility of face-to-face interaction with the patients, thus this becomes the heart of the problem and the need that mothers invention.

The patient and the first person (the contact) have the primary role in identifying the risks and taking the necessary measures to limit the confrontation of infection. The idea of the proposed research centers on how to enhance the evaluation of individuals using the proposed medical system: System of Isolation and Medical Care for COVID-19 (IICS), increase effective communication and decrease unnecessary contact, develop better isolation, reduce infection risks, and increase efficiency of care.

Problems of the Research

From the above, it will be crystallized in answering the following questions:

1. How to establish a system that achieves communication and also confirms increased isolation for patients?
2. How acceptable is the IICS medical system by doctors and users to reduce the risk of infection and increase the efficiency of care?
3. Are there differences in acceptance of the IICS assumed model to reduce infection risk and increase efficiency of care? Regarding the previous (traditional) system, according to the difference between each of the individuals (doctors - patients - contacts) in terms of (health, age, duration of previous illness, level of education,)?

Hypothesis of the Research

1. There are statistically significant assumptions regarding user reception of and reaction to of the IICS proposed medical system to reduce the risk of infection and raise the efficiency of care.
2. There is a statistically significant variance in receiving the assumed model to reduce the risk of infection and raise the efficiency of care. Regarding the previous (traditional) system, according to the difference between each individual in terms of (health, age, duration of previous illness, level of education,
3. If a system was built to verify communication and also confirm increased isolation for patients, safety would be granted for patients, and doctors 'confidence would rise to increase service.

It is assumed that if we provide the medical staff with the appropriate environment for the patient with the emerging coronavirus, death rate decreases and the recovery rates increases using protocols, guidelines and guidelines for design sciences and human engineering sciences (agronomics).

The proposed scientific contribution: System of Isolation and Medical Care for covid-19 integrates industrial design and biomedical engineering activities.

Research Methods & Description:

In this study, the descriptive and analytical approach is used to analyze the assumed model to reduce the risk of infection for the users of the proposed IICS medical system, while determining the extent of its effect on the variables.

The experimental Method:

In this study, the experimental method, with one group, is used, whereby a pre- and post-measurement (hypothetically) is used for the same group to identify differences in the level of reception and reaction of individuals using the IICS hypothetical model to reduce the risk of infection.

The Research Sample

a. The basic study sample: consisted of (100) physicians, medical engineers and designers, who were randomly selected and conditional on fulfilling the sample diversity requirement to standardize the general data form, and the measure of limiting acceptance by individuals using the IICS hypothetical model to reduce the risk of infection.

b. The experimental study sample: consisting of (50) specialists, and that is from the basic study sample of acceptance of doctors and users of the IICS hypothetical model to reduce the risk of infection.

Search tools[6]:

General data form:

- The measure of reducing contracting the disease among doctors using the hypothetical model to reduce the risk of infection: the researcher
- The first design in different stages.
- These Ideas reflect need the needs
- Design Process and guidelines

- Concept Stage
- Concept Refinement
- Possible directions for form and function

- **The adequacy scale of the IICS hypothetical model to reduce infection risk**

This scale was developed in order to identify the methods followed by doctors to reduce the risk of infection by using the IICS hypothetical model. It is included in its final form (20) news statements distributed on four axes representing four interaction and methods of use. The response to it is determined according to three options (yes-to some extent-no) on a continuous scale (1,2,3) for positively worded expressions (1,2,1) for negatively formulated expressions. Thus, the highest score obtained by the user is (60) and the lowest score.(20)

- **The measurement axes are as follows:**
- The first axis: accepting the use of the assumed model IICS and defining the elements of the system.
- The second axis: compatibility of the use of the IICS assumed model and methods of interacting with it.
- The third axis: Presenting the opinion of the jury for the supposed design (IICS) and evaluating the elements of the system.

Research Study & Method Studies

A. Isolation

Everything related to the concept of insulation and the types and methods of its establishment were researched and studied in more than one use and field[7].

1. Contact isolation 2.Airborne 3.Droplet4.Protective[8]

Prevents particulate (biological and radiological) cross-contamination between the patient and the external environment.

Infant incubator & isolation Types

F2 Research study - Isolation Figure 2 Figure 3 isolation Types

FIGURE4 ISOLATION TYPES

Figure53 incubator Types

Figure 4 HEAD & isolation Types

Inventor Yazan Al-Qaisi designed an isolation helmet for use on the November 17 subway. 2020 NE-1 ", which is more like a motorcycle helmet. The helmet is equipped with a powered air purification system, speakers and a Bluetooth audio system, enabling you to make a phone call."[9]

B.Incubator

Its idea is to isolate the child from the external environment because the infection is not transmitted from the outside to the inside, in contrast to the idea of the device is to isolate the patient from the external environment to not transmit the infection from the inside to the outside while providing the same appropriate environment for the incubator to suit the situation resulting from the outbreak of the Corona virus emerging

C. Ventilator machine

FIGURE 7 VENTILATOR TYPES

D. ICU Monitor

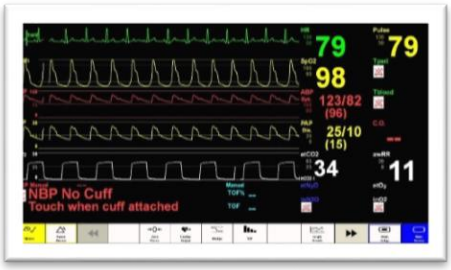


FIGURE 8 ICU MONITOR

E.Interactive

It means reaching the safest and most effective way to deal with the patient without exposure to infection with mutual confidence and satisfaction between the two parties

Interaction between:

- Human element & Human Human
- Hardware element
- Software element

- **Interface**

Reaching the best design helps ease the use of the device's medical staff, ease of handling and speed of learning about it

Method : Through previous studies and polls, the results of which were taken through social networking sites, the number of affected cases, recovery cases and deaths, and through the general design 10 phases [10]

Stage 1: To approach the subject with the correct mindset
Stage 2: To comprehend the subject fully
Stage 3: To recognize the problems connected to the subject
Stage 4: To comprehend the overall nature of the problem
Stage 5: To break the problem down into its constituent parts
Stage 6: To study and analyses the elements of the product
Stage 7: In light of the previous findings, to improve upon the definition of the problem, and the details involved in it.
Stage 8: To classify and analyses all relevant data
Stage 9: (consisting of three separate steps):

- to propose possible solutions
- to evaluate and assess these solutions
- to arrive at final solution

Stage 10: To give a presentation on the findings above.

From the World Health Data, research began with the total number of deceased (54) and the number of injured (576) and recovered (9) When the research was completed 1/4/2020 the number of deceased (52855) and the injured (1000000-million) and those recovering (211900)

The scientific reason on which the idea of the device was built is divided into four main important axes which are (conclusion - analysis - deduction - a questionnaire) at first. Lack of understanding of the increase in the number of deaths in the last stage, and it resulted from questions answered by specialists across the communication sites, which led to a quick questionnaire on The path of communication sites is its main components. Questions of specialized doctors and some elements inside and outside Egypt. From the results of the questionnaire, it was concluded that there are problems in isolating the patient and interacting with him, and the last stage comes, which is the extraction of the idea of the device through the questionnaire, analysis and conclusion, which is a defect in the required isolation but the idea of a For a device that is not complete isolation as it is in isolation rooms, but it is an integrated system that is simple, complete and complete production that helps medical staff interact and provide care to the patient as required.

A. Design Process and guidelines

Phase 1: Research/Schematics:

The project began by researching various products on the market. Then various component schemes that would fit within the parameters of the Industrial Design objective have been composed. LCD placement, control panel location and proper balance of weight were all addressed. Next, the development activities have begun.

Phase 2:

We start to establish possible directions for form, function, ergonomics, component schematics, manufacturing and assembly of the product. These ideas are illustrated through the following concept drawings.

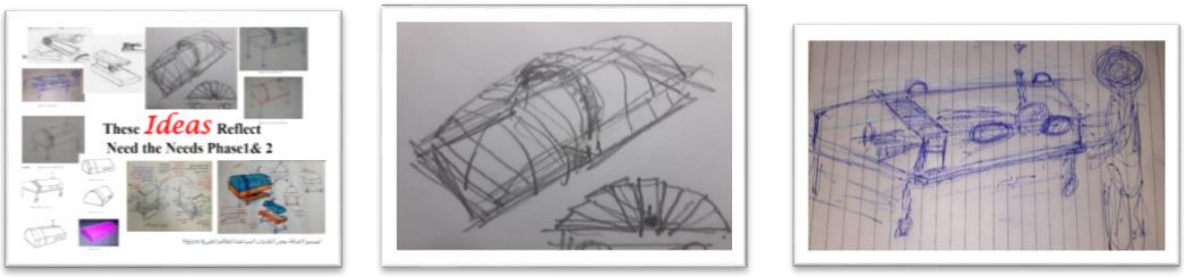


FIGURE9 HAND SKETCH PHASE

Hand sketch phase Figure 9& 1 Hand sketch free**FIGURE 9 HAND SKETCH PHASE**

FIGURE 11 HAND SKETCH PHASE

FIGURE 2 HAND SKETCH PHASE

Figure 3 Hand sketch geometry

Figure 4 Hand sketch geometry2

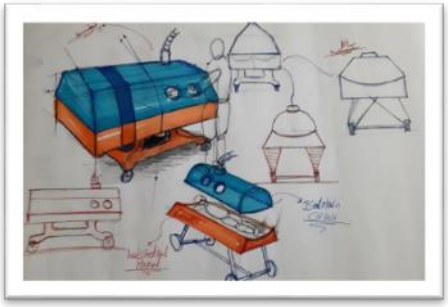


Figure 145 Hand sketch geometry& cylinder

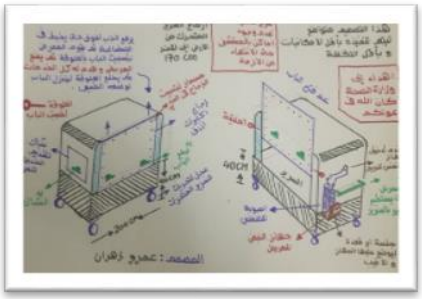
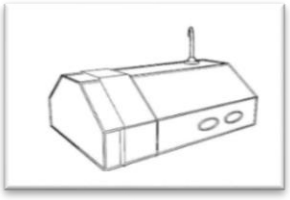


Figure 15 Hand sketch geometry paramedic

FIGURE 14&156 HAND SKETCH GEOMETRY EXPLODED

Figure 14 &15 Hand sketch geometry proposed design by[11]

CAD PHASE FIGURE 16-19



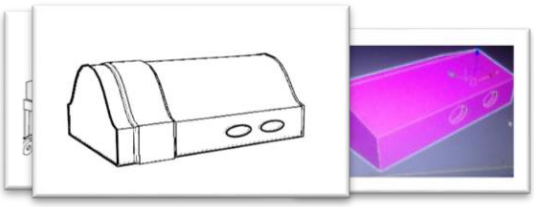


FIGURE 167 DESIGN GEOMETRY FIGURE 178 DESIGN GEOMETRY FIGURE18 DESIGN GEOMETRY FIGURE 19 DESIGN GEOMETRY

FIGURE 20 CONCEPT REALITY STAGE

FIGURE 209 CONCEPT STAGE

POSSIBLE DIRECTIONS FOR THE FORM AND FUNCTION FIGURE 20 CONCEPT STAGE REALITY SIMULATION

DEVELOPMENT: THROUGH PRELIMINARY ERGONOMIC RESEARCH, CONCEPT IDEATION AND THE CREATION OF SKETCH MODELS, WE DEVELOPED TO ALLOW POSSIBLE LATER CHANGES IN DIRECTION.

PHASE 3: D MODELS

PHASE 4: CONCEPT REFINEMENT - REALITY SIMULATION

FEEDBACK NOTED FROM PHASE 1 IS INCORPORATED INTO THE FINAL DESIGN. THE GOAL IS TO SET THE DIRECTION FOR ALL OF THE ELEMENTS OF THE DESIGN, INCLUDING FORM, GRAPHICS, ASSEMBLY AND MANUFACTURING. THIS PHASE SOMETIMES REQUIRES MULTIPLE ITERATIONS, DEPENDING ON THE COMPLEXITY OF THE PROJECT.

CAD: WE SECTIONED OUR FINAL FORM MODEL TO BE MEASURED FOR COMPLETE ACCURACY WHILE CREATING THE CAD MODEL REALITY SIMULATION.

WE USED 3D MAX PACKAGE TO ACHIEVE THE DESIRED RESULTS.

ALL OF THE SNAP FITS AND INTERLOCKING COMPONENTS WERE DESIGNED STEEL-SAFE FOR FUTURE REFINEMENT.

FOR THE SAKE OF THIS RESEARCH, WE DID NOT COMPLETE ALL THE PHASES, SUCH AS MECHANICAL LAYOUT, ID CONTROL DRAWING OR PROTOTYPES.

VALIDATING INQUIRY.

VALIDITY OF SCALE: LEGALIZATION OF STUDY TOOLS: WITH THE AIM OF MEASURING THE VALIDITY AND RELIABILITY OF THE SCALE.

I. Authenticity Of The Content: By Presenting The IICS Use Acceptance Scale And Determining The System's Elements To The Specialized Professors, Their Number (5), To Express An Opinion On The Appropriateness Of The Scale's Expressions And Their Formulation For What They Aim To Collect From Information And Data (This Was Done And An Approval Rate Of 80% Was Expressed And Some Phrases Were Modified And Deleted In Some Axes. Adjustment).

Ii. Formation Validity: The Validity Of The Formation Was Calculated With The Sincerity Of The Internal Consistency By Finding The Correlation Coefficient Using The Pearson Coefficient, And The Value Of The Correlation Coefficients Ranged Between Expressions And Axes (.31 -.97), Which Are The Values Of A Statistical Function At The Level Of 01, Which Indicates The Homogeneity Of The Expressions And Axes Of The Scale And The Total Degree For Him.

The Reliability Coefficient: The Accuracy Of The Measurement In The Test And The Observation And Its Non-Contradiction With Itself, Its Consistency With Itself, And Its Consistency In What It Provides Us With Information About The Subject's Behavior[12]. For All Scale Axes Shown Table (1).

Table No. (1) The Values Of The Reliability Coefficient For The IICS Use Acceptance Scale And Determining The System Elements

Table 1 Validating

Scale stability	coefficients	Cronbach ALPH	GUTMAN
Acceptance of Use of the IICS Assumed Model and Identification of System Elements		.85	.91
compatibility of the use of the IICS assumed model and methods of interacting with it		.81	.84
Opinion of the jury for the supposed design IICS		.80	.78

It is clear from the table that the values of the stability coefficients for the scale are high, which indicates its stability and suitability for application.

Table 1 Validating

Figure 21: - first 40-days experience and clinical outcomes in the management of coronavirus covid-19 crisis.Single centerpreliminarystudy[13]

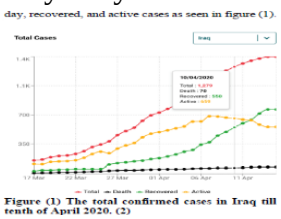


Figure (1) The total confirmed cases in Iraq till tenth of April 2020. (2)

Figure 21: - coronavirus covid-19 crisis. Single center preliminary study

Figure 22:26 Concept Stage Reality simulation the supposed design **IICS**

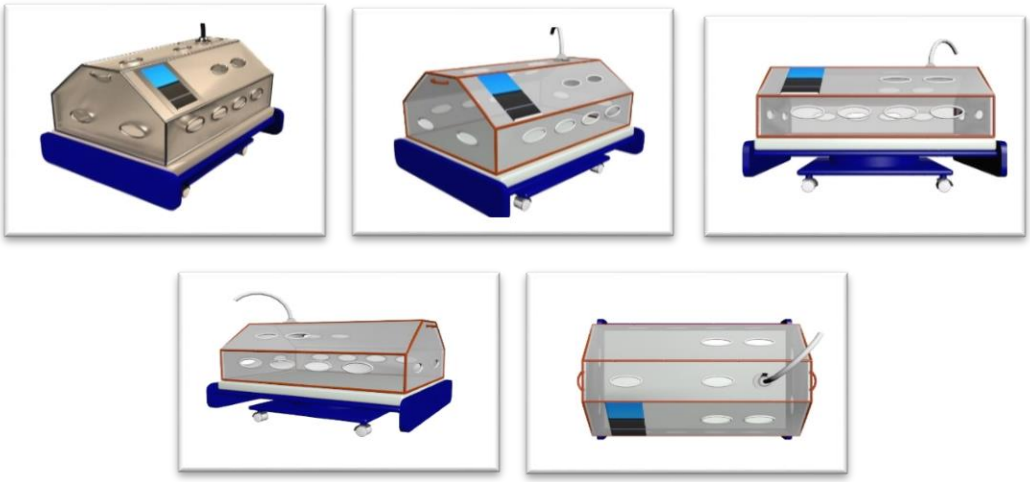


Figure 22:26 Stage Reality simulation the supposed design **IICS**

FIGURE 27: 29 STAGE REALITY SIMULATION THE SUPPOSED DESIGN IICS DESIGN GROPE AXA

FIGURE27:29DESIGN GEOMETRY GROPE BXA DESIGN GEOMETRY GROPE BXA DESIGN GEOMETRY GROPE BXA

FIGURE 30: 33 STAGE REALITY SIMULATION THE SUPPOSED DESIGN IICS DESIGN GROPE BXA

FIGURE 30: 33 DESIGN GEOMETRY GROPE BXA INTEGRATION DESIGN GROPE BXA & AXA& CXC

FEEDBACK NOTED FROM PHASES IS INCORPORATED INTO THE FINAL DESIGN. THE GOAL IS TO SET THE DIRECTION FOR ALL OF THE ELEMENTS OF THE DESIGN, INCLUDING FORM, GRAPHICS, ASSEMBLY AND MANUFACTURING. THIS STAGE SOMETIMES REQUIRES MULTIPLE ITERATIONS, DEPENDING ON THE COMPLEXITY OF THE PROJECT.

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RESULTS/ PROCEDURE / EXPERIMENT AND ANALYSIS

THE OUTCOME OF THIS WORK IS A PROPOSED PLAN TO ESTABLISH A NEW SYSTEM THAT INTEGRATES A SET OF DEVICES AND INSTRUMENTS.

THE PLAN MERGES THE TECHNIQUES AND THE METHODS OF DESIGNING PROCESS KEEPING INTO CONSIDERATION THE DIFFERENCES BETWEEN THE STEPS OF IMPLEMENTING THE SUITABLE TECHNIQUES AND APPLYING THEIR CORRESPONDING METHODS. THE RESULTS ARE REPRESENTED IN THE MENTIONED STAGES AND MODEL IICS. INTEGRATION DESIGN GROPE BXA & AXA& CXC

CONCLUSIONS

KEEPING IN MIND THE ABOVE MENTIONED, ANALYSIS OF THE EXAMPLE, THE LONG EXPERIENCE (ACADEMIC AND PRACTICAL IN BIOMEDICAL EQUIPMENT DESIGNS) AND SUPERVISING THE BIOMEDICAL EQUIPMENT DESIGN GRADUATION PROJECTS AS WELL THE MAJOR DESIGN CRITERIA OF BIOMEDICAL EQUIPMENT DESIGNS:(SYSTEM PERFORMANCE, PHYSICAL CONSTRUCTION AND QUALITY, RELIABILITY, MAINTAINABILITY, SAFETY AND HUMAN FACTORS), IT IS SAFE TO CONCLUDE THAT THE FOLLOWING 10 STAGES ARE THE BEST TO TACKLE THE BIOMEDICAL EQUIPMENT DESIGN PROBLEMS WITH A FINAL SAFE AND OBJECTIVE PRODUCT IICS INTERACTIVE ISOLATION CARE SYSTEM FOR COVID-19 .

LIST OF REFERENCES

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