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Development of a Robot Roving Doctor (RoviDoc): A Telemedicine for Isolated Covid-19 Patients in the Philippines

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Abstract

RoviDoc will be used to fight the covid-19 pandemic and will deploy in a different Quarantine facility in the Provicne of Bulacan, The Philippines to help health workers minimize exposure. Using the portability and flexibility of a Remote-Controlled Vehicle (RCV) which aims to provide payloads such as prescribed medicine kits, for patients undergoing treatment, mounted tablet with a built-in camera, audio, microphone with touch-screen application to be used by physician and health workers in managing and monitoring patients with covid-19 conditions remotely via Bluetooth. RoviDoc will also facilitate collecting the Body Temperature, Pulse Rate, Oxygen Level-Oximeter (spO2) of the patient as well misting of disinfectant automatically, as a result the project got a weighted mean of 4.88 which is excellent acceptability based on the evaluation.

Keywords— Covid-19, Robotic, Telemedicine

I. INTRODUCTION

The pandemic of coronavirus disease 2019 (COVID-19) is a highly contagious variant [1] has resulted in public health measures such as physical distancing restrictions to curtail the dissemination and transmission of the novel coronavirus, which has had important consequences for the delivery of physical healthcare procedures around the world [2]. The unprecedented pandemic has ignited a surge in demand for intelligent robotic to protect health worker, around 6735 health workers in the Philippines contracted covid-19 [3], with this Telemedicine, or the idea of offering health care over the distance [4], is becoming a common method in the field of Medicine. Telepresence using robotics is increasingly being integrated into health care procedures [5] for surgical services, patient management, and this time of the pandemic. This study will provide an overview of the concepts and development of RoviDoc telemedicine amidst the covid-19 pandemic. This study will focus on the design and development of a RoviDoc for covid19 cases since Robot can function untiring and stable compare to Human that is prone to fatigue and inattention [6], This also aims to provide a robot that will replace the task of every medical worker to eliminate interaction and exposure in highly contagious virus it will also provide needed supply to the patient such as medicine and other necessary supply, it also checks the temperature and monitor pulse and oxygen spO2 level of the patient during the robot usually work at every patient.

II. METHODOLOGY

2.1 Conceptual Framework

We consider the basic system development life cycle SDLC approach for this project [7], the development of the project is divided into three phases Figure 1 shows the first phase consist of conceptualization and planning, Technical evaluation and study, Project Proposal for funding and approval the second phase of the project are the following procurement of the components needed for the development, next is the most important aspect is the development stage is assembly, functional testing, accuracy testing and connectivity testing the last part of the project development is the deployment and commissioning of the Rovidoc and training and support for the end-user.

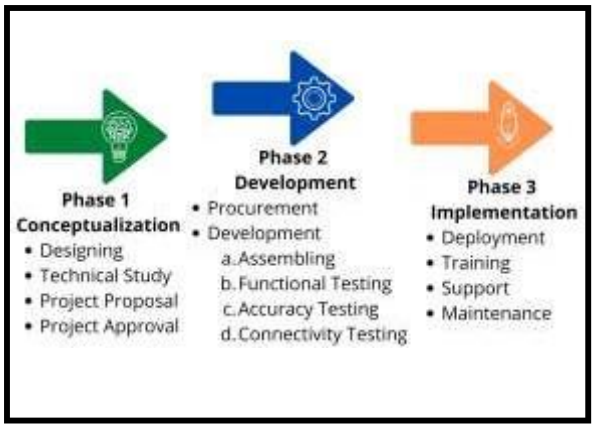

FIGURE 1. *SDLC Conceptual Framework*

Show in Figure 2 of the concept design of the project and, the second phase is the development part and testing and evaluation using ISO 9126 [8] [9] as a matrix for the evaluation of the prototype model and the third phase is the Deployment and implementation.

Figure 3 shows how RoviDoc work and function during deployment it has an HD camera for navigation of the RoviDoc as First Person View (FPV) to maneuver and control with the used of Remote Control (RC) that uses Dedicated Radio Frequency (RF). The system utilized wireless communication systems between patients, doctors and services points, Device to Device (D2D) [10] communication is the basic chain of this system to make all the connections from all sides Figure 4 and Figure 5 show the Block Diagram of the embedded component devices.

2.2 Concept Design:

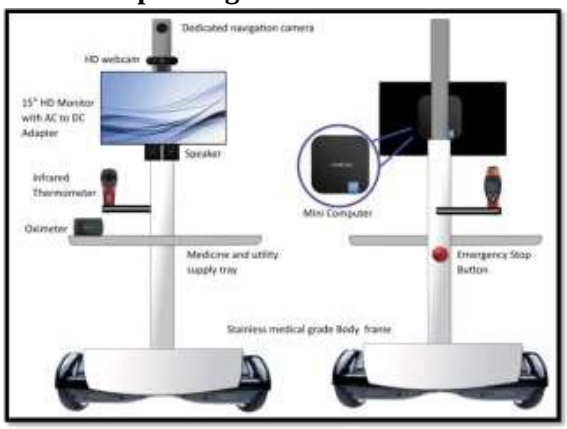

FIGURE 2*. RoviDoc Concept Design Mini CPU and Monitor*

- This device allows for audio and visual communication between medical personnel and patients. It comes equipped with a high-definition audio system to aid medical workers in communicating with patients.

Hoverboard

- A two-wheeled portable electric device that is used to move RoviDoc from one location to another.

Temperature Sensor

- An electronic gadget that monitors a patient's temperature. As a result, the medical professional can keep track of the patient's temperature.

Pulse and Oxygen SPO2

- A medical device that measures the patient's pulse rate and oxygen saturation level, or the amount of oxygen in the blood. To determine how well the heart is pumping oxygen throughout the body. Because of an illness like COVID-19, the cells in the body don't have enough oxygen to do their regular function in every cell of the body need oxygen for regular operation, medical workers can watch the patient’s oxygen levels if it is on normal range.

HD Navigational Camera

- An electronic device that assists medical personnel in navigating facilities. It captures wide-angle video that is used to plan the RoviDoc maneuvers. A video feed from a medical worker's Computer or mobile device was connected to the video feed.

Water Tank (Misting Features)

- Coronavirus transmission is reduced using misting disinfection systems (COVID-19). It aids in preventing the transmission of coronavirus as well as disinfecting a bigger area or room.

WIFI

- It is used to connect to the internet so that the patient and medical staff can communicate via video call.

Radio Frequency-RF controller

- It is used to connect and interact with Rovidoc, as well as to control Rovidoc's mobility so that it can drive around to

different locations and adjust the angle of its navigational camera.

2.3 System Configuration

Figure 3. RoviDoc will be utilized to fight the covid-19 pandemic, and it will be deployed in a separate Quarantine facility to assist health personnel in avoiding exposure. The Radio Frequency-RF controller can be used to control Rovidoc's mobility, allowing it to travel around to different places. The navigational camera can also be controlled by the Radio Frequency-RF controller to adjust its angle for a better view of its surroundings. It has a medical and utility supply tray, so it can deliver water, food, and medicine. When Rovidoc has reached with the patient. It can communicate with medical personnel since Rovidoc is equipped with a 15" monitor and a high-definition audio system, patients and medical staff can speak with one another while the medical personnel are at the nurse's station. The temperature, pulse rate, and oxygen saturation level of the patient can be checked by medical workers, and the results will be displayed on a computer or mobile device.

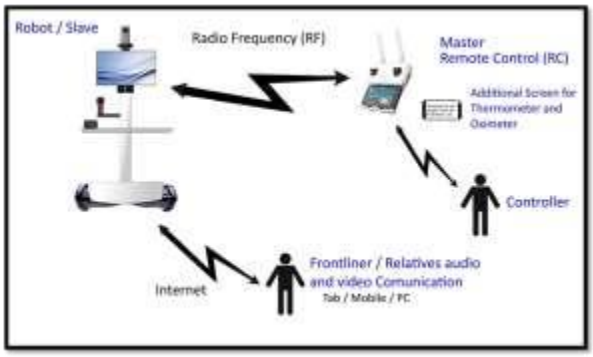

FIGURE 3. *RoviDoc Configuration*

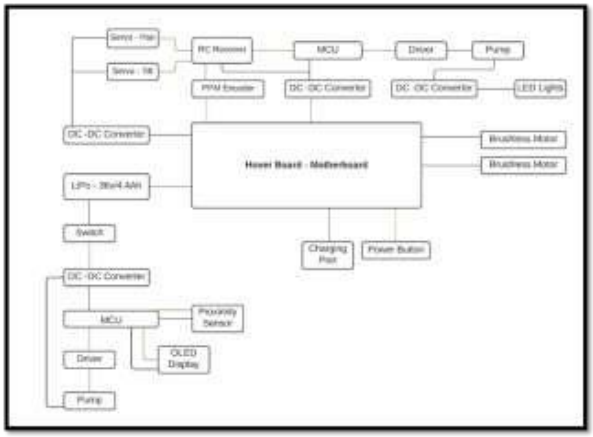

FIGURE 4. *Block Diagram of RoviDoc*

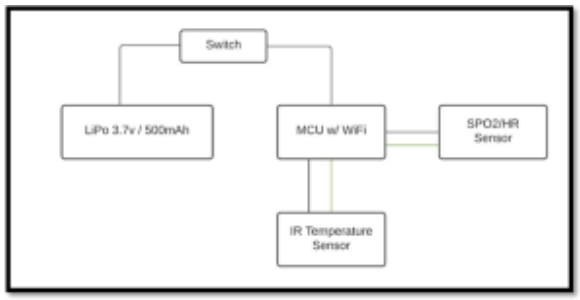

FIGURE 5. *Block Diagram of Wireless Sensor Device*

III.RESULT AND DISCUSSION:

RoviDoc was evaluated and check by a different expert in IT and medical fields as well as a safety security specialist in their fields. The researcher uses ISO 9126 to assess RoviDoc functionality, Table 1 and Table 2 shows the instrument used to evaluate and detailed result of the evaluation concerning Design, Safety, Practicality, Functionality, Accuracy, Reliability, and Usability. And with the use of the Likert Scale scoring [11] the prototype got 4.63 of the overall weighted mean quality results of Excellence. The study got a result of 4.25 of good interpretation in Accuracy aspect and the least of all the criteria while the Reliability got 4.88 of weighted mean which interpreted of Excellence the highest of all the criteria under ISO9126. It automatically stops the robot for the security and safety of the patient and others, it also embedded by the emergency protective stop button in case of an uncontrol event to stop immediately the robot operation.

TABLE 1. Likert Scale

Weighted Average	Result
1.00-1.79	Very Poor
1.80-2.59	Poor
2.60-3.39	Fair
3.40-4.29	Good
4.30-5.00	Excellence

TABLE 2. Evaluation Result

Criteria	Score	Interpretation
Design	4.69	Excellence
Safety	4.31	Excellence
Practicality	4.63	Excellence
Functionality	4.85	Excellence

Accuracy	4.25	Good
Reliability	4.88	Excellence
Usability	4.83	Excellence
Weighted Mean	4.63	Excellence

IV. CONCLUSION

Upon evaluation and review of the experts, the robot can assist the hospital staff and health workers. It is based on a D2D interaction. It is capable to provide health care servicing telemedicine robot can be more advantageous to many medical workers in the Philippines, it can be able to assist health workers in fighting covid-19 to the extent of minimizing exposure to the virus using the different features embedded on the RoviDoc. The future enhancement such as upgrading the communication devices and battery life to extend it performance and functionality this would also need to undergo evaluation since the researcher wanted the robot to be fully autonomous on the second version using Lidar technology and embed other sensors such as blood pressure monitoring in the future version of the project.

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