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A RESEARCH VISION

Artificial intelligent device for physical and mental state monitoring in pulmonary cancer oncology: a proposal

Dispositivo inteligente artificial para monitoreo de estado físico y anímico en oncología torácica pulmonar: una propuesta

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ABSTRACT

In the world, lung cancer is a leading cause of death, and in the United States, 135.720 lung cancer deaths were estimated by 2020 without considering the global contingency of the Covid-19 pandemic. This type of cancer is more common in a few developed countries, and in Colombia, about 3.875 people die annually from lung cancer. With the advancement of technology, algorithms have been developed to detect cancer at a very early stage based on images of the x-rays. This project aims to use artificial intelligence to analyze physical and mental state in patients with lung cancer, using an intelligent device capable of obtaining vital signs and using machine learning models to analyze their current state, may be used for patients in oncology clinics or at their place of residence, the doctor may use this tool to diagnose your patient more effectively and follow up on your chemotherapy.

RESUMEN

En el mundo una de las principales causas de muertes es el cáncer pulmonar, en Estados Unidos se estimaba 135.720 muertes por cáncer pulmonar para el año 2020 sin tener en cuenta la contingencia mundial de la pandemia de Covid-19. Este tipo de cáncer se hace más frecuente en países pocos desarrollados, en Colombia mueren alrededor de 3.875 personas anualmente por cáncer pulmonar. Con el avance de la tecnología se han desarrollado algoritmos capaces de detectar cáncer en una fase muy temprana con base a radiografías. Este proyecto tiene como objetivo usar la inteligencia artificial para analizar el estado físico y anímico en pacientes con cáncer pulmonar, usando un dispositivo inteligente capaz de obtener los signos vitales y utilizar modelos de machine learning para analizar su estado actual, podrá ser de uso para pacientes en clínicas oncológicas o en su lugar de residencia, el médico encargado podrá usar esta herramienta para diagnosticar a su paciente de forma más efectiva y hacer el debido seguimiento en sus quimioterapias.

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1. Introduction

One of the leading causes of death in the world is lung cancer. In Colombia, every year, about 3.875 people die from lung cancer [1]. According to [2], it is the second leading cause of death after gastric cancer in Chile. Deaths from this type of disease have increased; few developed countries such as the United States have a low rate of lung cancer deaths as reported [3].

Figure 1. U.S. cancer death rate 2013-2017,[4].

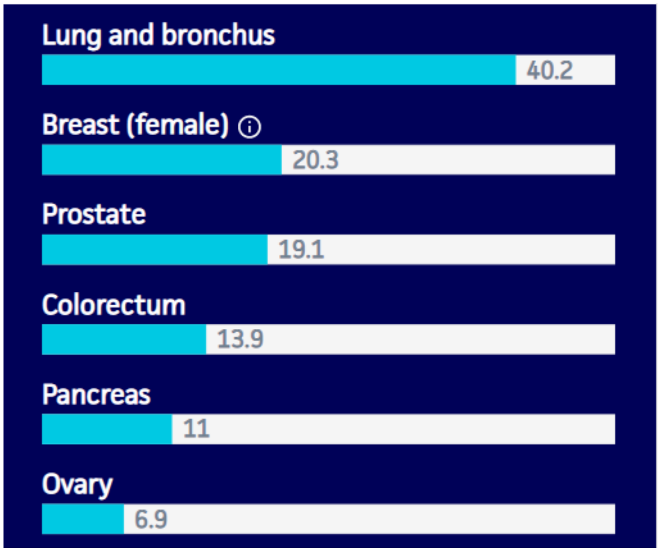
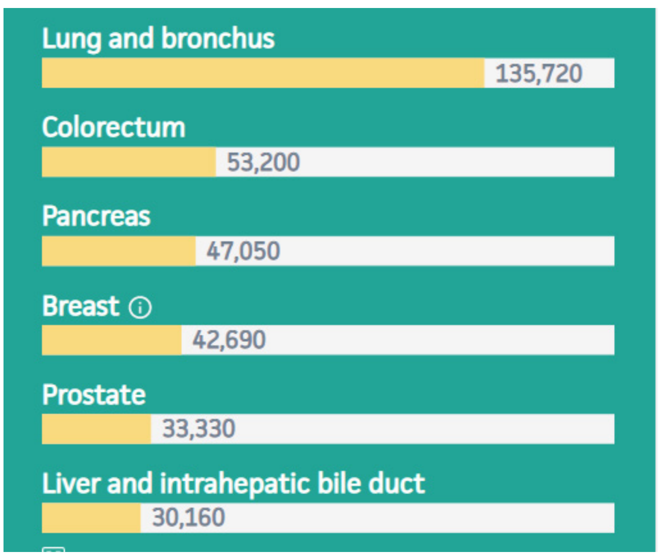


Figure 2. Estimated cancer deaths by 2020 in the United States. Man and Woman, [4].



Average annual rate per 100,000 inhabitants and age-adjusted to the standard population of The United States in 2000. Public relations rates are for 2011-2015.

Google has developed an algorithm that detects lung cancer according to [5] *"Google algorithm can distinguish between two subtypes of lung cancer with an accuracy of between 83% and 99% of times."*

No intelligent assistant devices are currently presented to guide lung cancer patients through physical activities during their day [6]. Data analysis based on small artificial smart devices is the future of oncology, with the current use of mobile devices in research in this type of cancer, describe how they can contribute an analysis of a patient's physical and emotional condition to an oncology clinic [7] and to incorporate the artificially intelligent assistant as psychological support for needs and preventions arising from distress in the experience with cancer and its treatments [8].

2. Device goals

This project's general goal is to analyze the physical and mental state in patients diagnosed with lung chest cancer by incorporating an artificial intelligent assistant device.

As specific goals: first to develop and validate the smart device for physical and mental testing in lung cancer patients [9]. Second to identify patterns in physical and mental in lung cancer patients using an artificial smart device, and third categorize respiratory abnormalities and emotional involvement in the patient and compare device use in patients for medical diagnosis at an oncology clinic.

3. Theoretical framework

Computer theory is based on logic, and mathematics give rise to computer science. The fundamental ideas are two: automaton theory and formal language theory. It is used to design and construct software and hardware and deduce if it is possible to develop a problem [10].

Artificial Intelligence is a computer science field dedicated to solving problems commonly associated with human intelligence, such as learning, problem-solving, and pattern recognition. With computing participation, machines have the power to learn and understand a situation [11].

Cancer is the malformation of cells that duplicate in an organ that can invade nearby tissues affecting organs. The name of the cancer type resides in the organ that forms [12].

According to [13], *"These are values that allow estimation of the effectiveness of circulation, respiration, and baseline neurological functions and their replication to different physiological and pathological stimuli. SV is the quantification of physiological actions, such as heart rate and rhythm (HR), breathe rate (BR), body temperature (BT), blood pressure (BP), and oximetry (OXM)."*

4. Methodology

The project's overall methodology is based on the model of requirements lifting, analysis, design, development and implementation, development testing, and pilot validation for software and hardware.

4.1. Developing the smart hardware device and mobile app

The Agile SCRUM development methodology will be applied for the mobile application and analyzer assistant [14]. The QFD (Quality for Design) methodology will be used for the hardware design based on the quality [15-16] of the bracelet; it will have a mode of synchronization via Bluetooth with the mobile device for the collection of physical state based on vital signs [17].

As a model for the design and construction of the bracelet, the Liip Smart Monitor will be used as a reference "*smart bracelet that measures real-time pulse and oxygen to a baby*" [18] and the vital sign equipment Connex® ProBPTM Digital Spigmomanometer 3400 [19].

Figure 3. Bracelet Liip Smart Monitor [20].

Figure 4. Esfigmomanómetro Digital Connex® ProBPTM 3400 [19].

- The Flutter Framework and Visual Studio Code text editor will use for mobile application development.
- The Python language is useful for the data analysis wizard.
- The models to be used for physical and mental analysis will be the classification and prediction model by implementing machine learning techniques with Python [21]

4.2. Smart device validation with lung cancer patients

With the development of the device type bracelet, mobile application, and assistant data analyst. We will validate sequentially:

- Bluetooth paired device with mobile phone and app mobile
- Data transmission to the primary server from the mobile device
- Data input from the vital signs to the server for classification and prediction
- Response to the customer informing their physical and potential status activities to carry out in his day

- Collection of model information and training for state analysis physical and mental
- Real-time analysis of lung cancer patient

4.3. Identification of patterns in physical and mental at different stages of cancer

Lung cancer has different stages: Occult stage, phase 0, stage I, stage II, and stage III. In one scene, the patient is treated differently from the others because of cancer involvement in the lung and the different organs affected [22].

By the use of machine learning, the capture of vital signs and mental data in the model, we will seek to segment patients from different stages of cancer to do their health analysis, categorize respiratory abnormalities in each lung cancer stage to generate their respective report on the progress or decline in the patient's health.

4.4 Pilot tests on lung cancer patients at the cancer hospital

The pilot test in the real-time analysis of vital signs and mental state of patients with lung cancer with the smart device will carry out in an oncology hospital where the aim will be to analyze the different stages of cancer and to generate medical reports with the recommendation of activities that the patient can perform in where the oncologist in charge of each patient checks whether the device is reporting the patient data. The machine learning models are doing their respective analyses in predicting, segmenting, and analyzing the patient [23].

5. Expected results

The expected results are presented in table 1.

Table 1. Expected results of the investigation.

Result	Description	Achievement Indicator
Generation of new knowledge	Development of an artificial smart device bracelet for real-time analysis in hospitals with lung cancer patients.	• Two scientific articles • One bracelet • One mobile applicator • Artificial assistant for vital signs analysis
Strengthening Colombia's scientific community	Training of researchers The establishment of knowledge networks Capitation in physicians specialized in oncology	• Training researchers: One undergraduate degree • Training in the use of the smart device • Interaction with doctors specializing in pulmonary chest oncology
Social appropriation of knowledge	Presentation of the results to the scientific and medical community	• One presentation at a national scientific event in the area of health
Software	Installers, source code, or installation manual.	• Mobile Application Installer • Software for Vital Signs Analysis in Lung Cancer Patients • Internal Software Patent Processing
Prototype	Bracelet plans	• Prototype Bracelet Plane • Artificial Smart Bracelet • Internal Bracelet Patent Procedure

Source: own.

6. Impacts from expected results

A second phase is expected to use the smart device in cancer hospitals to monitor lung cancer patients at regional and national levels. The device and the working wizard are required for this phase. In a third phase, incorporate it in patients outside the hospital with the pathology of lung cancer to monitor remotely by the doctor in charge.

This project will strengthen the diagnosis by oncologists in hospitals with patients with lung cancer and in the areas of health and engineering and promote the use of artificial intelligence in the Internet of things in health.

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