Engenharia Moderna: Soluções para Problemas da Sociedade e da Indústria

Filipe Alves Coelho
Iara Lúcia Tescarollo
Vicente Idalberto Becerra Sablon
(Organizadores)

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APRESENTAÇÃO

Enquanto esta obra era produzida, a humanidade via-se diante de uma de suas maiores crises recentes: a pandemia do novo coronavírus. Este cenário escancarou a importância da ciência como ferramenta e um dos pilares da evolução da sociedade. Ao lado da ciência, a engenharia implementa o conhecimento desenvolvido na forma de produtos e serviços, tornando real e sustentável o conhecimento científico.

Sem dúvida, o que tornou possível verdadeiras revoluções na ciência e na engenharia foram os conhecimentos desenvolvidos na interface entre distintas áreas do conhecimento. As ciências biológicas e a engenharia ambiental produziram equipamentos para tratamento de efluentes empregando microrganismos. A computação e a engenharia de processos permitem que um funcionário monitore e controle uma fábrica mesmo estando a quilômetros de distância. A medicina, física e engenharia elétrica produzem equipamentos que enxergam o interior do corpo humano em alta resolução.

Neste sentido, esta obra é uma coletânea de trabalhos de professores cientistas e engenheiros, com vasto conhecimento em suas áreas de atuação, que destaca como a ciência e a tecnologia são empregadas para resolver problemas da sociedade. Em comum, além dos esforços para tornar a sociedade e a indústria mais sustentáveis, está o fato de todos os trabalhos terem sido desenvolvidos na cidade de Campinas ou em cidades próximas.

A multidisciplinaridade presente nesta obra é reflexo de um trabalho em construção no sentido de agregar o conhecimento acumulado e condensá-lo em produtos e serviços ou mesmo um fim em si, visando informar a sociedade de que temos pesquisa de boa qualidade sendo feita no Brasil.

Com o compromisso de incentivar a pesquisa acadêmica, divulgar e disseminar o conhecimento, a Editora Atena, através dessa obra, traz um rico material pelo qual será possível atender aos anseios daqueles que buscam ampliar seus estudos nas temáticas aqui abordadas. Boa leitura!

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SUMÁRIO

CAPÍTULO 1

GENERAL ASPECTS OF TELEMEDICINE: FROM EMERGENCE TO USE IN THE COVID PANDEMIC 19

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ABSTRACT: In a world increasingly globalized and surrounded by artificial intelligence techniques, medical areas have undergone constant changes and improvements. In the early days, access to health was meant for a few people, nowadays with the implementation of telemedicine, barriers have been broken and patients and doctors have been united despite the distance and fears of contamination during the COVID-19 pandemic. Considering that telemedicine is an interdisciplinary area subdivided into many fields of application, the present study aims to carry out a study on an operation, applicability, and research that can assist in the development and improvement of this technology. To this end, data on the topic will be collected in 45 periodic articles dated 2016 to 2020. Only, through quick, effective methodologies and those who break barriers, is it possible to make health in the world more egalitarian and more humanitarian.

KEYWORDS: Telemedicine, Health, Telecommunications, COVID - 19.

1 | INTRODUCTION

The term Telemedicine originates from the Greek word 'tele', which means distance. Thus, Telemedicine is a telehealth area that offers remote diagnostic support, allowing the interpretation of exams and the issuance of medical reports at a distance. This interdisciplinary branch is formed by the union of Information and Communication Technologies with medical areas (WOOTTON; CRAIG; PATTERSON, 2017).

The context of Telemedicine is communication. It is the discovery of electricity,

electronics, the use of computers, the use of networks, especially the Internet. Telemedicine is related to the evolution of computers and networks. Some historical facts must be highlighted, as they culminated in the current communication system that exists today. With the evolution of computers, personal computers appeared, from 1960 to 1970, which began to be commercialized in 1977. Over the years, computers have been improved concerning memory, programs, and accessories (ARTHUR, 2007; ARTHUR, 2012; BASHSHUR; SHANNON,2009; TEOLI, 2018).

The first networks were used for military purposes (related to radars). The first network developed was the ARPANET (Advanced Research Projects Agency Network), which had the function of connecting the University of Los Angeles with Stanford (California) and military centers. It was a secure network, had no center, and was created for the purpose of protecting American defense interests, at the time of the Cold War with the Soviet Union. Tim Berners Lee, an Englishman who worked at the European Nuclear Research Center in Switzerland, invented the Internet, based on ideas from ARPANET (PATIDAR *et al*, 2020).

With the emergence of the computer and the Internet, Telemedicine appears; Two areas give Telemedicine a big boost: space exploration (NASA) and all defense ministries (military areas of the world). The 60s and 70s are the milestones of progress in Telemedicine. In 1967, Massachusetts General Hospital was linked to Boston City Airport, with the aim of handling any emergency that occurred at the airport from the Hospital. On the other hand, the Hospital would receive basic information from an individual who had a serious problem at the airport and needed to be taken by ambulance. This is an important milestone in the history of Telemedicine. From that fact, other isolated experiences occurred (BASHSHUR; SHANNON,2009; TEOLI, 2018)

Telemedicine was the fastest-growing medical specialty in the world. Although Telemedicine has deep roots, its reality is just over 20 years old and is changing the daily lives of healthcare professionals and patients. It is important to note that the applicability of telemedicine is the result of the interaction of various techniques of computing, technology, and communication. In this way, the application of Artificial Intelligence (Machine Learning and Deep Learning), internet of things, fog computing, cloud computing, digital image processing, telecommunications, and academic research always go hand in hand, in order to optimize the existing processes (PALACIOS-MOYA *et a*l, 2019).

In this context, Deep Learning consists of a Machine Learning technique that uses deep neural networks for information processing and learning. Unlike other existing techniques, Deep Learning is able to work with the analysis of raw data, which allows a broader field of action compared to other techniques, and can classify information contained in different formats, such as audios, texts, images,

sensors, and databases. The development of AI encompasses several techniques and methods, in addition to algorithms that make software or hardware intelligent (ALPAYDIN,2020; GOODFELLOW, BENGIO; COURVILLE, 2016; JACKSON, 2019).

With the junction of the internet of things (IoT), which is the internet that makes the connection between people and electronic devices and also, between the devices themselves, and cloud computing, which is a service that provides the storage of files and data on servers which can be accessed on any device with internet, enabling the application of deep learning as a way of improving artificial intelligence. Based on this, the objective of this study is to present the functioning, applicability, and research that can assist in the development and improvement of this technology (BHATT; DEY; ASHOUR, 2017; MISRA; SARKAR; CHATTERJEE, 2019).

2 | METHODOLOGY

This study was developed based on the data collection of **45** scientific articles present in bases such as Scielo, Scholar Google, and PubMed, with the works dated from 2016 to 2020.

3 | HISTORY AND APPLICATION OF TELEMEDICINE IN BRAZIL

In Brazil, the telemedicine service, mainly applied to issuing online reports, is growing and consolidating. The beginning was in the 90's - precisely with the expansion of the internet -, following a worldwide trend in medical care and the generation of remote reports. In 2005, CNPq/Ministry of Science and Technology (MCT), through the Instituto do Milênio Program, inserted Telemedicine as one of the thematic sets of induction of the public notice. With that, several consortia of institutions that participated with projects were formed, and in October 2005, the result was announced. The winner was the consortium coordinated by the Faculty of Medicine of USP, with the project entitled Estação Digital Médica - a strategy for the implementation and expansion of Telemedicine in Brazil, covering 2005 - 2008, bringing together several institutions, including the State University of Amazonas. The axes related to primary care were the conceptual basis to support the first project related to the use of Telemedicine in primary care by the Ministry of Health, which began to be implemented in 2007 (MALDONADO; MARQUES; CRUZ,2016).

In December 2005, the Ministry of Health, through a meeting with the participation of several institutions, supported the development of a pilot project called the Telematics and Telemedicine Project in support of primary health care in Brazil. After several agreements, carried out throughout 2006, the nine participating universities began to implement it in their respective States, in 2007. With the

evolution of the works, this first project became what is now known as the National Program Telehealth Brazil Networks from the Ministry of Health, focusing on primary care, telemergency, telediagnosis, and tele-education (COMBI; POZZANI; POZZI, 2016; SIMOES *et al*, 2016).

In 2006, the discussion started to form the University Telemedicine Network (Rute), which brings together high-performance university hospitals, led by the National Teaching and Research Network (RNP) - MCT/MEC. In the first phase, the initiative involved the structuring of videoconferencing rooms for educational activities and clinical meetings between hospitals, using the RNP network. Over the years, there was an approximation and partnership between Rute and Telehealth, which became projects with complementary actions (DELEVIDOVE, 2019).

In 2010, in order to provide new means to increase the updating capacity of SUS professionals, the Ministry of Health created Unasus. The initiative was composed of a collaborative network of higher education institutions, with the creation of a collection of educational resources in health (HARZHEIM,2017).

In 2011, the Ministry of Health established the National Telehealth Brazil Network Program, based on the Telehealth Brazil Program (2009-2011), which encouraged the formation of Telehealth Centers, based on regional consortia of municipalities (DE MELO *et al*, 2018).

The following year, the Ministry of Health launched the Telemergencies and Teleurgencies Program. The pilot project was in charge of the Instituto do Coração do HC, USP Medical School (Fmusp). Concomitantly, several state and regional initiatives emerged, which also began to develop activities related to Telemedicine and Telehealth (PENTEADO; BENTO, 2011).

Since the year 2017, research by França *et al* has aimed at the development of a telecommunications channel for the transmission of medical data based on discrete event techniques. This model is called CBEDE (Bit Coding for Entities through Discrete Events). This methodology aims to model concepts of a high level of abstraction present in a system, such as patients, nurses, doctors. Besides, it can be applied from exchanging e-mails on a clinical server to transmitting packet data between devices connected to a hospital network. Another function is the management of patient data, emergency services, intensive care units, surgical and outpatient procedures (PADILHA et al, 2017; PADILHA,2018; FRANÇA et al, 2019; FRANÇA et al,2020).

All simulations are developed in a simulation environment (Simulink) contained in the Matlab software. The improvement in data transmission is the result of a bit pre-coding process, where discrete events are applied to the signal before the modulation process. Through simulations, the model without the proposal consumed 55.5 MB. The CBEDE methodology consumed 28.82 MB Megabytes).

Also, the results have shown improvements in performance in memory usage and information compression, showing an improvement of 92.6% (PADILHA et al, 2017; PADILHA,2018; FRANÇA et al, 2019; FRANÇA et al,2020).

4 | TELEMEDICINE APPLICATIONS

Telemedicine can be subdivided into a few branches: telecare, teleconsultation, tele-education, and the issuing of reports at a distance. All can be inserted into eHealth (ALAMI *et al*,2018).

In telecare, the focus of communication is on the patient and his well-being. Through it, the patient is monitored at his own home or at a local health center by a doctor or any other health professional who communicates with other professionals at a distance. In order to increase the efficiency of the system and ensure an accurate medical investigation, various equipment is used to assess clinical parameters and send this data, usually via the internet, to specialists at a distance (HASLWANTER, 2018).

Teleconsultation can be done between doctors, when a general practitioner seeks assistance from a specialist, such as a second opinion on the diagnosis, a more suitable medication, or even live guidance on how to perform a procedure. Another way is the online consultation, made directly between doctors and patients. In Brazil, the practice of teleconsultation between doctor and patient is still being made possible (DAVID,2020).

Teleducation is already applied in different sectors, but in the case of medicine, the focus is on training health professionals who are far from large centers, seeking to update and prepare them for different situations in medical practice. To achieve this goal, tele-education focused on telemedicine uses videoconferences, classes, lectures, e-learning, and recycling programs. It is a way of bringing knowledge to improve the performance of exams and to provide quality care to patients (BARBOSA, 2017).

Besides, telemedicine can be used to: Consult and exchange information between health institutions; Information on results of laboratory tests and images, Discussion of clinical cases, mainly related to rare diseases; Robotic surgery; Assistance to chronic patients, high-risk pregnant women and the elderly (BAKER; STANLEY,2018).

5 | ISSUANCE OF REMOTE REPORTS

Issuing remote reports is one of the fastest-growing branches in Brazil. Through this technology, the exam can be performed anywhere and reported by specialists connected to the internet. Thus, it is possible to have easy access to

the best doctors in the country. One of the strengths of the use of telemedicine is the provision of online reports at a distance, without the need for the clinic or hospital to have full-time specialist doctors, attending on their premises. A series of tests, such as Electrocardiogram (ECG), Spirometry, Electroencephalogram, Visual Acuity, Mammography, X-rays, among others, can be performed by the health team (technicians and nurses) and sent in real-time to the telemedicine company (ALKMIM, 2019).

Through technology, the result is sent via the internet to medical teams, composed of specialists working in major medical centers in Brazil. They are professionals qualified to remotely report examinations performed at any time and place in the country. It is possible to deliver reports on the same day or, in an emergency, minutes after the exam is issued (DE MELO et al 2018).

Many devices used for the procedures are already digital and provide the results directly to telemedicine services. If the devices are analog, some companies, such as Telemedicine Portal, allow quick integration of the devices with the digital system through IoT (Internet of Things) protocols. The Telemedicine Portal is able to connect to more than 90% of the park of medical devices currently installed in Brazil (STRADOLINI *et al*, 2018).

The entire process is done in appropriate and secure information and image management system. If clinics or hospitals do not have the equipment to perform the exams, Portal allows the rental of these devices. Based on this, research has been done to improve the transmission of medical data and consequently positively impact the efficiency of telemedicine STRADOLINI *et al*, 2018).

6 | DISCUSSION

Telemedicine is therefore a way to speed up and also qualify the procedure and the delivery of reports of various tests. In a short time, the examination is carried out and the report is delivered to the patient, enabling the diagnosis and the beginning of treatment more quickly.

There are several advantages to the adoption of Telemedicine. One is the possibility of reducing distances. For patients, this technology allows them to have access to quality medicine and also to reference professionals, even though they are far from urban centers.

For the health system, there is a decentralization of care, reducing the demand for specialists and hospitals right at the beginning of care. With telemedicine, it is possible to take special care to more locations and at reduced costs. Resources can be allocated for disease prevention and treatment. Also, the greater exchange of information between health services contributes to the integration of clinical

research, expanding the knowledge of professionals working in the sector.

For doctors and other health professionals, there is a chance to participate in educational programs from anywhere in the country, in addition to the possibility of having the support of other professional colleagues when making decisions.

We highlight some of the benefits of telemedicine: Expands the contact between doctors and patients; Access to specialists and reference professionals; Facilitates the exchange of information between health services; Decreases the movement of patients to hospitals and large urban centers; Facilitates examinations, which can be done at clinics and health posts; Improves the quality of the reports issued and speeds up the delivery.

Especially because several specialties can be attended via telemedicine, including those with specificities of occupational health and occupational medicine. Examination and delivery of reports are carried out and interpreted at:

- Cardiology - electrocardiogram, Blood Pressure MAP, Holter Records;
- Neurology - occupational electroencephalogram; electroencephalogram with brain mapping;
- Pulmonology - spirometry exam, bronchodilation test;
- General Radiology - exams such as standard X-rays, mammograms; tomography; bone densitometry, magnetic resonances;
- Ophthalmology - Visual Acuity Exam to assess possible vision impairments and the ability to see clearly;
- Dermatology - following a specific protocol and the use of cameras, photographs are made possible injuries and skin disease patients.
- Hematology: Works carried out by Monteiro et al, using digital image processing and deep learning techniques in order to recognize and count blood cells, as is already done by conventional hematological equipment that is commonly based on cytometry techniques. flow, impedance, laser, among others. This study has performed blood cell counts employing digital blood smear images, which can be processed by computers and cell phones, eliminating the use of high-cost conventional equipment. Considering the practicality of cell phones, the exams can be transmitted to hematology professionals from remote locations, as well as to specialized centers and also directly to patients (MONTEIRO et al, 2017; MONTEIRO et al, 2018; MONTEIRO et al, 2019; BORGES MONTEIRO et al, 2019; MONTEIRO et al, 2020).

7 | THE REGULATION OF TELEMEDICINE

The application of telemedicine is regulated by the rules of the American Telemedicine Association (American Telemedicine Association), being recognized by the Federal Council of Medicine (CFM) and by Brazilian laws.

Initially, the Brazilian market initially adopted standards of ethics and service standards defined by international organizations, but from 2002, with the expansion and consolidation of services, national standards and resolutions were created to guide this type of work. In the country, the laws require that the company providing the service have a doctor in charge and also be registered with the Regional Council of Medicine, such as CREMESP in São Paulo. Law 1,643 of 2002 from CFM regulates telemedicine services as a medical modality in the country (LOPES; OLIVEIRA; MAIA, 2019).

The legislation says that services provided via telemedicine must have the appropriate technological infrastructure and comply with the CFM technical rules pertaining to the safekeeping, handling, data transmission, confidentiality, privacy, and a guarantee of professional secrecy. Besides, Law No. 12,842/2013, which includes the issuing of examination reports, reinforces that only doctors can issue the report at a distance (SAADE,2019; LOPES; OLIVEIRA; MAIA, 2019).

There are also other standards related to telemedicine services in Brazil, which deal with the storage of images and patient data. One is Resolution RDC/ ANVISA No. 302 of 2005, of the National Health Surveillance Agency (Anvisa), which defines the custody of medical reports for five years, by the units that carry out the procedures. The legislation, added to CFM Resolution No. 1,821/07, implies that companies providing the telemedicine service have secure technological means for online storage of patient information (SAADE,2019; LOPES; OLIVEIRA; MAIA, 2019).

8 | TELEMEDICINE AND THE CORONAVIRUS (COVID-19) PANDEMIC

Today the world has experienced its newest pandemic. The new coronavirus (SARS-Cov-2) causes the disease called COVID-19, which started in China in December 2019. The disease is called COVID-19 (meaning Coronavirus Disease, number 19 referring to the year 2019, year of the onset of the disease). This is present in the saliva and human secretions of infected people, and can be transmitted even in the asymptomatic phase of the disease. Easy transmission occurs because this virus replicates in the nasal mucosa (SOHRABI *et al*, 2020).

Given its easy transmission, absence of effective pharmacological treatment, no vaccine, and low adherence to social isolation by some underdeveloped and developing countries, this virus has become a major threat to people with

immunosuppression, the elderly, and people with comorbidities, such as diabetes and hypertension. However, there are reports of patients affected by COVID-19 and without prerequisites for classification in a risk group, progressing to severe symptoms of the disease, and eventually dying (SOHRABI *et al*, 2020; SINGHAL,2020).

In this context, one of the populations most affected by this pandemic is the health professionals themselves, who, due to long working hours, and in some cases due to the lack of adequate personal protective equipment, have been affected by this pathology. In addition, patients who undergo continuous monitoring with doctors due to chronic diseases are often absent from periodic consultations, as they are afraid to attend hospital environments (SINGHAL,2020).

Another important point is that social isolation is an important tool against COVID-19, because, without the circulation of people in public environments and without the presence of agglomerations, the virus substantially loses its ability to infect a large number of people. However, social isolation has increased the number of people with the panic syndrome, anxiety, and depression (ARMITAGE, NELLUMS,2020).

We must also consider that patients affected by COVID-19 should be isolated from their families within their own homes. In addition, in more severe cases, where there is severe breathing difficulty, individuals are taken to intensive care units, where they remain in isolation, without the sight of family members. The isolation of patients often makes treatment difficult, as emotional factors always help in the recovery from illness (ARMITAGE, NELLUMS,2020).

Faced with all these scenarios, the key tool to solve all these difficulties has been telemedicine. Through telemedicine, patients with chronic diseases can be analyzed by their doctors through video conferences and sending exams through communication systems. In addition, individuals in social isolation who are experiencing symptoms of anxiety, depression, or panic syndrome, can go into remote consultations with qualified medical professionals and receive the most appropriate diagnosis and treatment (ZHOU et al, 2020).

In the case of people contaminated and kept in isolation inside their own homes or hospitals, they can talk to their family and friends using tablets and cell phones. This equipment has been distributed by health professionals and receives the correct sanitizations before and after its use (HOLLANDER; CARR, 2020).

Thus, telemedicine, which until a few years ago was so much discussed and even feared, became commonplace (ARTHUR et al, 2010; ARTHUR, 2011; ARTHUR, 2016; ARTHUR, 2017; MONTEIRO et al, 2018; BORGES MONTEIRO et al, 2019; MONTEIRO et al, 2020). In addition, we must consider that after the coronavirus pandemic, the public health system in Brazil and the world may suffer an overload. This is because people will no longer fear the disease and will seek medical

resources more often. Thus, to avoid overcrowding, telemedicine can continue to be used mainly to solve less severe cases.

9 | CONCLUSIONS

Despite all the advantages, many people are still afraid that telemedicine will become the norm and that all medical services will be provided remotely, without any direct contact with the patient. However, the idea is not to replace but to complement medical care, and help it overcome the obstacles created by the physical distance between the doctor and the patient.

In addition to aspects related to technologies, ethics, bioethics, clinical standards, etc., it is necessary to start and move forward in discussions regarding civil responsibilities for health services provided through interactive technologies, quality monitoring criteria, and professional remuneration.

Thus, telemedicine presents itself as a way to overcome cultural, socioeconomic, and mainly, geographical barriers, so that health services and information reach the entire population, whether in times of pandemic, or to serve less favored populations and with access difficulties. the medicine.

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REFERENCES

[1] WOOTTON, Richard; CRAIG, John; PATTERSON, Victor. **Introduction to telemedicine**. CRC Press, 2017.

[2] BASHSHUR, Rashid; SHANNON, Gary William. **History of telemedicine: evolution, context, and transformation**. New Rochelle, NY: Mary Ann Liebert, 2009.

[3] TEOLI, Dac; AEDDULA, Narothama R. **Telemedicine**. 2018.

[4] PATIDAR, Harshit et al. **History and Future Scope of Arpanet**. Tathapi with ISSN 2320-0693 is a UGC CARE Journal, v. 19, n. 22, p. 137-142, 2020.

[5] PALACIOS-MOYA, Lucia et al. **Trends and Evolution of Telemedicine Research: A Bibliometric Approach**. Indian Journal of Public Health Research & Development, v. 10, n. 12, p. 598-603, 2019.

[6] ALPAYDIN, Ethem. **Introduction to machine learning**. MIT Press, 2020.

[7] GOODFELLOW, Ian; BENGIO, Yoshua; COURVILLE, Aaron. **Deep learning**. MIT Press, 2016.

[8] JACKSON, Philip C. **Introduction to artificial intelligence**. Courier Dover Publications, 2019.

[9] BHATT, Chintan; DEY, Nilanjan; ASHOUR, Amira S. (Ed.). **Internet of things and big data technologies for next-generation healthcare**. 2017.

[10] MISRA, Sudip; SARKAR, Subhadeep; CHATTERJEE, Subarna. **Sensors, Cloud, and Fog: The Enabling Technologies for the Internet of Things**. CRC Press, 2019.

[11] MALDONADO, Jose Manuel Santos de Varge; MARQUES, Alexandre Barbosa; CRUZ, Antonio. **Telemedicine: challenges to dissemination in Brazil**. Cadernos de saude publica, v. 32, p. e00155615, 2016.

[12] COMBI, Carlo; POZZANI, Gabriele; POZZI, Giuseppe. **Telemedicine for developing countries**. Applied clinical informatics, v. 7, n. 04, p. 1025-1050, 2016.

[13] SIMOES, N. et al. **National Research and Education Networks to support telemedicine and telehealth**. Journal of the International Society for Telemedicine and eHealth, v. 4, p. e8 (1-6), 2016.

[14] DELEVIDOVE DE LIMA VERDE BRITO, Thiago et al. **Collaboration between medical professionals: special interest groups in the Brazilian Telemedicine University Network (RUTE)**. Telemedicine and e-Health, v. 25, n. 10, p. 902-910, 2019.

[15] HARZHEIM, Erno et al. **Guia de avaliação, implantação e monitoramento de programas e serviços em telemedicina e telessaúde**. Porto Alegre: Universidade Federal do Rio Grande do Sul, Hospital Alemão Oswaldo Cruz, 2017.

[16] DE MELO, Maria do Carmo Barros et al. **Belo Horizonte telehealth: incorporation of teleconsultations in a health primary care system**. Telemedicine and e-Health, v. 24, n. 8, p. 631-638, 2018.

[17] PENTEADO, Silvio Pires; BENTO, Ricardo Ferreira. **Hearing rehabilitation through telemedicine to enhance public policies in Brazil**. Einstein (São Paulo), v. 9, n. 1, p. 102-104, 2011.

[18] FRANÇA, Reinaldo Padilha et al. **Potential proposal to improve data transmission in healthcare systems**. In: Deep Learning Techniques for Biomedical and Health Informatics. Academic Press, 2020. p. 267-283.

[19] FRANÇA, Reinaldo Padilha et al. **Potential Proposal to Improvement of the Data Transmission in Healthcare Systems**. 2019.

[20] FRANÇA, Reinaldo Padilha et al. **A Methodology for Improving Efficiency in Data Transmission in Healthcare Systems. In: Internet of Things for Healthcare Technologies**. Springer, Singapore. p. 49-70, 2020.

[21] FRANÇA, Reinaldo Padilha et al. **Lower Memory Consumption for Data Transmission in Smart Cloud Environments With CBEDE Methodology**. In: Smart Systems Design, Applications, and Challenges. IGI Global, 2020. p. 216-237.

[22] PADILHA, Reinaldo et al. **Computational Performance of an Model for Wireless Telecommunication Systems with Discrete Events and Multipath Rayleigh**. In: Brazilian Technology Symposium. Springer, Cham, 2017. p. 193-203.

[23] PADILHA, Reinaldo França et al. **Proposta de um método complementar de compressão de dados por meio da metodologia de eventos discretos aplicada em um baixo nível de abstração=** Proposal of a complementary method of data compression by discrete event methodology applied at a low level of abstraction. 2018.

[24] ALAMI, H. et al. **Telemedicine System and Network**. Telemedicine System and Network, p. 312, 2018.

[26] HASLWANTER, Jean D. Hallewell. **Review of Telecare Technologies for Older People.** In: International Conference on Computers Helping People with Special Needs. Springer, Cham, 2018. p. 407-415.

[27] DAVID, Yadin. **Telehealth, telemedicine, and telecare**. In: Clinical Engineering Handbook. Academic Press, 2020. p. 550-555.

[28] BARBOSA, Diogo Jacintho. **Using Tele-Education for Professional Training in Mental Health Primary Care in Brazil**. Journal of the International Society for Telemedicine and eHealth, v. 5, p. (GKR); e4:(1-3), 2017.

[29] BAKER, John; STANLEY, Anthony. **Telemedicine technology: a review of services, equipment, and other aspects**. Current Allergy and asthma reports, v. 18, n. 11, p. 60, 2018.

[30] ALKMIM, Maria Beatriz et al. **Brazilian National Service of Telediagnosis in Electrocardiography. Studies in health technology and informatics**, v. 264, p. 1635-1636, 2019.

[31] STRADOLINI, Francesca et al. **IoT for telemedicine practices enabled by an Android™ application with cloud system integration**. In: 2018 IEEE international symposium on circuits and systems (ISCAS). IEEE, 2018. p. 1-5.

[32] Monteiro, A. C. B., Iano, Y., & França, R. P. (2017, December). **Detecting and counting of blood cells using watershed transform: an improved methodology**. In Brazilian Technology Symposium (pp. 301-310). Springer, Cham.

[33] MONTEIRO, Ana Carolina Borges; IANO, Yuzo; FRANÇA, Reinaldo Padilha. **An improved and fast methodology for automatic detecting and counting of red and white blood cells using watershed transform**. VIII Simpósio de Instrumentação e Imagens Médicas (SIIM)/VII Simpósio de Processamento de Sinais da UNICAMP, 2017.

[34] MONTEIRO, Ana Carolina Borges et al. **A Comparative Study Between Methodologies Based on the Hough Transform and Watershed Transform on the Blood Cell Count**. In: Brazilian Technology Symposium. Springer, Cham, 2018. p. 65-78.

[35] MONTEIRO, Ana Carolina Borges et al. **Development of a laboratory medical algorithm for simultaneous detection and counting of erythrocytes and leukocytes in digital images of a blood smear**. In: Deep Learning Techniques for Biomedical and Health Informatics. Academic Press, 2020. p. 165-186.

[36] MONTEIRO, Ana Carolina Borges et al. **Applied Medical Informatics in the Detection and Counting of Erythrocytes and Leukocytes through an Image Segmentation Algorithm**. SET INTERNATIONAL JOURNAL OF BROADCAST ENGINEERING, v. 5, p. 7, 2020.

[37] BORGES MONTEIRO, Ana Carolina et al. **Medical-Laboratory Algorithm WTH-MO For Segmentation of Digital Images of Blood Cells: A New Methodology for Making Hemograms**. International Journal of Simulation--Systems, Science & Technology, v. 20, 2019.

[38] MONTEIRO, Ana Carolina Borges et al. **Proposta de uma metodologia de segmentação de imagens para detecção e contagem de hemácias e leucócitos através do algoritmo WT-MO**. 2019.

[39] LOPES, Marcelo Antônio Cartaxo Queiroga; OLIVEIRA, Gláucia Maria Moraes de; MAIA, Luciano Mariz. **Saúde digital, direito de todos, dever do Estado?**. Arquivos Brasileiros de Cardiologia, v. 113, n. 3, p. 429-434, 2019.

[40] SAADE, Débora Christina Muchaluat. **Telemedicina no Brasil: Nova Regulamentação Incentiva Pesquisa e Inovação em Soluções Seguras para Saúde Digital**. Journal of Health Informatics, v. 11, n. 1, 2019.

[41] SOHRABI, Catrin et al. **World Health Organization declares global emergency: A review of the 2019 novel coronavirus (COVID-19)**. International Journal of Surgery, 2020.

[42] SINGHAL, Tanu. **A review of coronavirus disease-2019 (COVID-19)**. The Indian Journal of Pediatrics, p. 1-6, 2020.

[43] ARMITAGE, Richard; NELLUMS, Laura B. **COVID-19 and the consequences of isolating the elderly**. The Lancet Public Health, v. 5, n. 5, p. e256, 2020.

[44] ZHOU, Xiaoyun et al. **The role of telehealth in reducing the mental health burden from COVID-19**. Telemedicine and e-Health, v. 26, n. 4, p. 377-379, 2020.

[45] HOLLANDER, Judd E.; CARR, Brendan G. **Virtually perfect? Telemedicine for COVID-19**. New England Journal of Medicine, v. 382, n. 18, p. 1679-1681, 2020.

[46] ARTHUR, A. M., Vanini, T. M., Lima, N. M., Iano, Y., & Arthur, R. (2010). **Tratamentos fisioterapêuticos em pacientes pós-AVC: uma revisão do papel da neuroimagem no estudo da plasticidade neural**. Ensaios e Ciência: Ciências Biológicas, Agrárias e da Saúde, 14(1), 187-208.

[47] ARTHUR, R. (2007). **Novas propostas para otimização de receptores de TV digital baseados em OFDM em ambientes de redes de frequência única regionais**.

[48] ARTHUR, A. M. (2012). **Contribuições para segmentação e análise de características de imagens de alta resolução da retina humana**.

[49] ARTHUR, A. M., Iano, Y., Turuda, P. D., Larico, R. F., & Arthur, R. (2011). **Técnicas de análise da retina humana: revisão breve sobre os recursos e as renovações propedêuticas disponíveis à prevenção e o diagnóstico precoce das complicações vasculares da retina associadas às doenças sistêmicas**. Ensaios e Ciência, 15(4).

[50] ARTHUR, A. M., Arthur, R., Silva, A. G., Fouto, M. S., Iano, Y., & Faria, J. M. L. D. (2017). **Algorithm for predicting macular dysfunction based on moment invariants classification of the foveal avascular zone in functional retinal images**. Research on Biomedical Engineering, 33(4), 344-351.

[51] ARTHUR, A. M. (2016). **Contribuições para medidas de eficiência de protocolos fisioterapêuticos e exercícios físico e diagnóstico automático de patologias usando imagens de alta resolução da retina humana**.

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