# SMART HEALTHCARE MODEL FOR HUMAN MONITORING IN THE COVID-19 ZONE USING IoT TECHNOLOGY APPROACH: A SYSTEMATIC LITERATURE REVIEW

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**ABSTRACT**

Today, there are still various obstacles faced by the community in protecting themselves from COVID-19 infection and providing valid health services. The purpose of this paper is to explain how healthcare systems interact with IoT technology to provide warnings to users when they are on COVID-19 zoning and provide information on the implementation of health protocols according to zones. The research method used is the SLR (Systematic Literature Review) method, where the data collection process is carried out by documenting all research articles that match the criteria, search string from 2000 to 2020. The results of the discussion of this paper are how to design a framework for improving health information services as an early prevention effort against the dangers of COVID-19. The conclusion from the healthcare system framework can be used as a reference for building IoT-based applications in self-monitoring of the dangers of COVID-19

***Keywords:*** Covid-19, Smart Healthcare, Healthcare System, Internet of Things

## INTRODUCTION

Based on research conducted[1], mitigation of the COVID-19 pandemic has required the role of health services to support the presentation of information related to COVID-19 based on zoning and level of spread in each region, so that protection for the wider community can be carried out. Healthcare systems are complex database networks and can share data in one network connection to provide health services to the public [2], thus smart health services are one solution to help the public increase awareness and protect themselves against infection and reduce the level of spread COVID-19. Healthcare is a response to information driven by data linkages between one another [3]. The presence of healthcare is faced with the availability of large amounts of data and connectivity with data sources so that it can be used to make informed and personalized decisions with IoT support to solve health-related problems [4]. Healthcare provides a new way for users to monitor and provide health services and provides preventive measures against other health problems [2]. Data in healthcare systems is a valuable asset that has significance and usefulness for users [5]. The advantage of using healthcare is getting information services related to preventing and handling health problems and protecting users' privacy [2]. Advances in hardware technology have made it possible to communicate with the Internet of Things (IoT) and decision making in real-time [6]. Improving healthcare services' quality is expected to be developed through the Internet of Things [7]. Internet of Things is used to connect data availability effectively with different healthcare users [8]. The Internet of Things can provide easy data access to build a competitive healthcare model to present information to users [2]. IoT can connect several hardware devices to the internet, such as sensors, which allow users to receive data and information or other related resources [9]. Healthcare services by utilizing IoT technology have provided fast data responses that help reduce pressure on medical resources widely [10], so this research aims to develop an IoT-based intelligent health service system that can provide alternative solutions to overcome the spread and break the chain of COVD- 19. The flexibility of IoT can improve data accessibility, increase resource use, and improve data communication efficiency across multiple sources to improve overall data integrity [9], making it possible in this research to integrate various features of IoT technology to be able to develop service models intelligent health for the wider community in producing accurate information. In the current situation, it is essential for healthcare systems to make technological innovations in providing medical information for users to create innovative services [11].

Application of the Acceptance Model Technology predicts the possible interaction paths between healthcare service users and smart healthcare for the desired medical information [12]. Despite the importance of the current health service system, there are still various obstacles faced by the community in protecting themselves from Covid-19 infection in providing valid health services and information to break the chain of spread of Covid-19. This research aims to develop a smart health service model based on IoT technology by utilizing the Technology Acceptance Model theory to explain and predict user acceptance of a technology and predict user acceptance of the technology that will be used. This research also includes a framework for a comprehensive framework model that utilizes IoT technology for monitoring and designing a framework for improving health information services as an early prevention effort against the dangers of Covid-19, with the aim of making it easier for health service system users to carry out personal monitoring to break the chain. transmission of Covid-19.

## LITERATURE REVIEW

A. Healthcare System

Healthcare includes several patient log information, various diagnoses of the patient's condition, and the management of resources needed [13]. Healthcare allows a person/user to be able to access information correctly and get the correct and appropriate solution, can minimize medical care and can increase efficiency in obtaining and processing information in the medical field [14]. One of Healthcare's implementations of the Internet of Things is the personal side, which includes devices or tools used to track activities carried out by healthcare users in self-monitoring [15]. The application of healthcare in general can be used to track user movements/activities, provide information about infected people in an area/zone, and increase self-

monitoring of the risk of COVID-19 through warning alarms given to the healthcare system [16]. The healthcare system also adopts health services with various perspectives, including (1) life time monitoring, (2) more convenient and easy access to medical information quickly and cost-effectively to health services, (3) good management of personal medical service information, connected with medical data sources so that they can be accessed anytime and anywhere [17]. The ability to create smart health services is a challenge for the health care system in general with the aim of protecting everyone's health and not bringing viruses into the family environment and ensuring everyone's mental health[18]. The psychological burden of long-term effects has led to increased awareness of the importance of smart health services to reduce high levels of fatigue, psychological stress, high rates of infection and death, as well as fear of uncertainty regarding the subsequent impacts that will occur[19].

B. IoT Technology

The rapid and widespread development of Internet of Things technology has been used in the medical world to increase the effectiveness and accuracy of data in self-monitoring systems [13]. Internet of Things is a connected interconnection of various physical objects that are used to record and observe an event on an ongoing basis [13]. IoT is a set of uniquely identifiable networks which each object can be connected to the server to provide appropriate services and be able to communicate with each other in communicating data [20]. IoT is also a set of dynamic network infrastructure which is equipped with its own configuration based on interoperable communication with standard data communication protocols [14]. With these advantages, IoT is able to create an integrated educational environment from a device to various platforms that are connected both online and physically [21]. The use of IoT technology empowers healthcare users to be able to follow self-monitoring guidelines that lead to cost-effectiveness of health services and be able to improve self-management in implementing health programs [20]. The use of IoT sensor-based technology has had a significant impact in reducing the risk of increasing transmission of COVID-19, where the role of IoT is to help detect various COVID-19 cases precisely so that it can make the work of medical personnel easier[22]. The use of Internet of Things (IoT) technology in the health care industry has experienced a very significant increase, both before and after the COVID-19 pandemic occurred, this is because providing for community needs, such as an IoT-based intelligent health service system is very important which makes it possible more precise diagnosis, treatment and patient care and monitoring processes[23].

C. Technology Acceptance Model

The use of TAM as a research model for application modeling has been widely used to be able to access and define technology acceptance by the user which will be implemented [24]. The Technology Acceptance Model is a tool used to investigate the factors that influence the acceptance of technology use [25]. The Technology Acceptance Model is used to predict the adoption of the use of information technology in an organization or community of application users [26]. According to [25] that The Technology Acceptance Model assumes that user acceptance of technology is divided into 2 variables, namely ease of use and usability of use in relation to system characteristics and potential use of the system. It is further explained that TAM is a simple model used in software development from the ground up or advanced software development which is based on the user ease of use and the usefulness of the application being developed [27]. Technology Acceptance Model is part of innovation by adopting technology to fulfill a technology acceptance process. In Figure 1, it is explained how the variables of attitude and perceived usefulness directly influence attitudes towards acceptance of the technology used [28]. The application of the TAM model has been carried out in validity testing in the health care system, the results can provide a better understanding of how a user uses IoT technology-based health care devices, so that the TAM model is able to provide detailed guidance in using the system and increase user acceptance of health devices based on IoT technology[29]. In general, the application of applications based on IoT technology by users towards the use of health services is very low, this is because the application of IoT-based technology is only limited to the factors of usability, ease of use, system performance results, and expectations regarding the final results achieved but the level of application security is a factor. not yet thought about, so the use of the TAM model is expected to provide a detailed picture of the perception of health risks in the application that will be implemented[30]. The TAM model describes the user acceptance process of

technology will be applied in two perceptions, namely perceived usefulness (PU) and perceived ease of use (PEOU), which are the user's emotional beliefs that affect the user's acceptance of technology [24]. Perceived Ease Of Use (PEOU) is an important factor in software development and planned technology utilization so that it can significantly influence user behavior in application use [31]. TAM is a model developed for modeling application design to explain the use and usability of applications so that users have confidence that using the system can improve job performance [32]. The TAM model has developed into a frame of mind in analyzing technology acceptance for application users based on the usefulness factor of the implemented system [33].

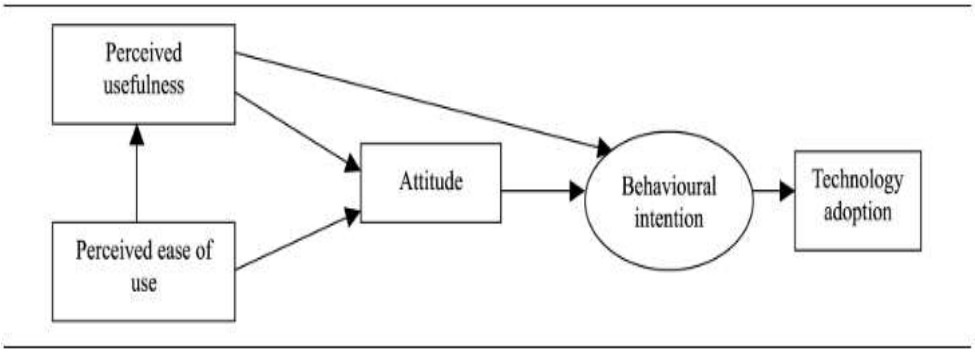



**Figure 1:** The Technology Acceptance Model

Based on the results of the literature review, it shows that the use of IoT technology combined with the TAM model can provide increased acceptance of the use of smart health service models and can improve the quality of health provision services based on IoT technology.

## METHODOLOGY

The completion of this paper involves several processes including conducting a comprehensive literature review based on the topic in this paper, the method that will be carried out is a systematic literature review methodology [34]. The discussion in the paper by conducting a review on the keyword aspects of each data source that matches the topic, determines the criteria inclusion and exclusion, finding the suitability of journals with appropriate topics and categorizing them as selected studies.

1. Data Source

In this paper, the process of searching for data sources is carried out on five data source journals with Scopus indexed reputation. This paper also uses SLRs to design a smart healthcare framework that can be used easily by users. With these five data sources, it is hoped that you will find information sources that can support the design of a smart healthcare framework. The initial stage is to determine the data source that will be used in this paper, namely:

1. IEEE Xplore Digital Library
2. Sciencedirect
3. Springer link

To support the research results in this paper, a search process will be carried out from all data sources that have been determined with the following strings:

1. (Smart Healthcare OR Healthcare OR Healthcare System) AND (Framework OR Modelling OR Architecture Process) AND (Self-Monitoring)
2. (Systematic Literature Review OR Systematic Review) AND (Smart Healthcare OR Healthcare OR Healthcare System) AND (Covid-19 OR Corona Virus Diseases)

3. (Smart Healthcare OR Healthcare OR Healthcare System) AND (Covid-19 OR Corona Virus Diseases) AND (Self-Monitoring)
4. (Internet of Things OR IoT OR IoMT) AND (Smart Healthcare OR Healthcare OR Healthcare System) AND (Covid-19 OR Corona Virus Diseases)
5. (Technology Acceptance Models OR TAM) AND (Smart Healthcare OR Healthcare OR Healthcare System) AND (Self-Monitoring)

2. Criteria Selected

The process of validating the search results on each data source that is suitable and relevant to the research topic will be grouped into "Studies Found". The final result of data collection in the "Studies Found" group data source will be filtered again by looking at the suitability of the paper with the research topic. The 75% similarity in the discussion of the paper will be taken as the main reference to be classified as "Candidate Studies". The final step is to filter the data sources in the "Candidate Studies" group to find the relevance and relevance of the paper discussion to the research that will be conducted. The similarity with the percentage of 91% will be used as "Selected Studies". In order to ensure that the papers are in the "Selected Studies" group, it is necessary to make criteria to select and filter the papers. The criteria selected are as follows:

1. Publication year between 2000 - 2022
2. Duplicate articles from different sources will be delete
3. The complete paper structure, which means all identities (journal/conference, author's identity, etc.) are mentioned on paper.
4. Duplicate paper from the same study will not be included and removed from the SLR Data Extractions
5. Articles mainly explaining about healthcare, Internet of Things, and Technology Acceptance Models.
6. Articles written in English Indexed Scopus

3. Data Extraction

After the data grouping process, it is found the number of papers that will be the references in the paper. In the initial stage, there were 102 relevant journals which were grouped into "Studies Found". The evaluation process of the paper was carried out again and there were 73 journals which had 75% similarities and were classified as "Candidate Studies". The final evaluation process was carried out by looking at the relevant level of paper discussion at 91% and found as many as 38 journals and classified as "Selected Studies". The results of the evaluation can be seen in table 1.

**Table 1:** Data Extraction in Inclusion Criteria

| Source | Studies Found | Candidate Studies | Selected Studies |
|---|---|---|---|
| IEEE Explore | 48 | 37 | 24 |
| Sciencedirect | 30 | 24 | 9 |
| Springer Link | 24 | 12 | 5 |
| Total | 102 | 73 | 38 |

4. Research Design

**Figure 2:** Flowchart Research Diagram

In this study, design research is specifically described as a series of processes in finding papers that match the topic to be discussed. The series of processes is detailed in a flowchart scheme which in detail describes each stage and method of selecting papers in order to find papers that match the research topic to be discussed. The description of the process flow is depicted in Figure 1.

5. Conceptual Model & Hypotheses

Based on the results of the literature review described in the previous discussion, this paper will describe the smart healthcare framework as shown in the figure 3 below.

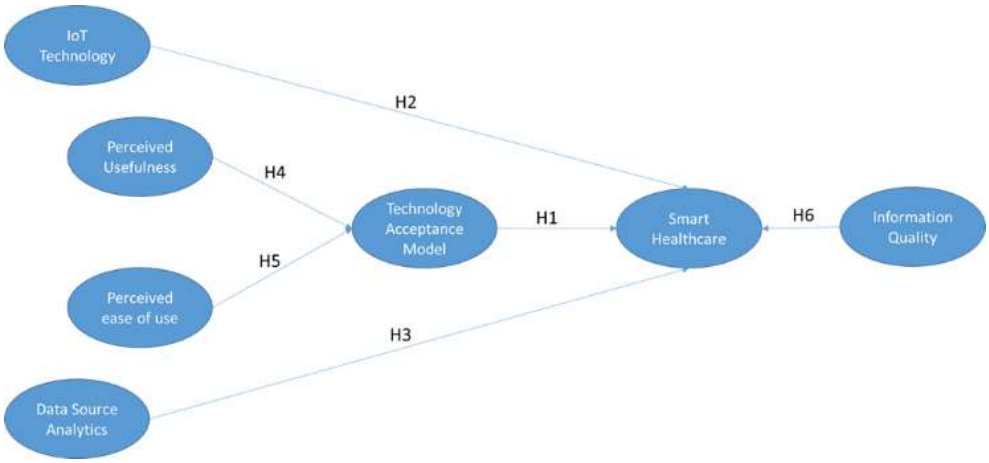



**Figure 3:** Concept Model

H1 : Technology Acceptance Model affects attitudes in using smart healthcare

H2 : IoT technology factors affect smart healthcare performance

H3 : The ability to analyze data sources affects the performance and validation of smart healthcare information

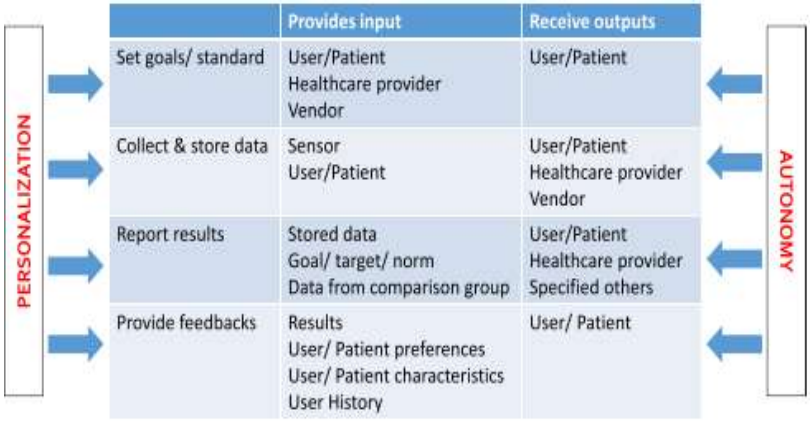
H4 : Perceived usefulness factors influence user confidence in utilizing smart healthcare

H5 : Perceived ease of use factor affects the ease of operating smart healthcare

H6 : Information quality factors affect the confidence of data availability in smart healthcare

## DISCUSSION

1. Publication Journal Smart Healthcare Framework




| | Provides input | Receive outputs |
|---|---|---|
| Set goals/ standard | User/Patient<br>Healthcare provider<br>Vendor | User/Patient |
| Collect & store data | Sensor<br>User/Patient | User/Patient<br>Healthcare provider<br>Vendor |
| Report results | Stored data<br>Goal/ target/ norm<br>Data from comparison group | User/Patient<br>Healthcare provider<br>Specified others |
| Provide feedbacks | Results<br>User/ Patient preferences<br>User/ Patient characteristics<br>User History | User/ Patient |

**Figure 4:** Personalization and autonomy of health data

The healthcare system is a set of resources related to the provision of health information, health services, and health measures which are a series of activities with the aim of maintaining health [35]. The Healthcare system refers to the concept of a system that has complexity as an information service needed to anticipate health problems, has procedures for the goals to be achieved [36]. In healthcare implementation, the focus is on the medical data domain (see Figure 1) which is collected, stored, and accessible by users at any time so that users can determine the information services needed [8]. Internet of Things technology makes a major contribution to improving health information services and healthcare development in providing access to information without geographic barriers [8].

2. Integration IoT and Healthcare

The concept of the Internet of Things (IoT) is to make it easier for devices to communicate and share information with users through network devices, communication protocols, sensors, internet networks that are integrated with healthcare applications [37]. In the health sector, IoT provides real-time services and provides an easy and effective way to live healthy at low costs so that users can monitor independently using medical devices that are integrated with IoT [38]. IoT has had a huge influence in the development of Healthcare applications, namely by providing health care management through tracking facilities for environmental conditions that are directly connected to smart healthcare devices [39]. One of the uses of IoT in the health sector is healthcare, which changes the traditional medical care process that focuses on hospital services into a focus on patient care through personalizing IoT towards the development of the health care system, where this scenario can be seen in Figure 4 below [40].


**Figure 5:** Transforming healthcare scenario with IoT

3. Analysis of key findings use of TAM and Healthcare

The approach model used to design a smart healthcare framework is the Davis TAM model. The Technology Acceptance Model (TAM) claims that acceptance of information technology adoption depends on 2 aspects, namely ease of use and usefulness of technology where perceived ease of use has a significant positive effect on perceptions of system usability [41]. Based on the definition of TAM, the PEOU aspect can affect the expected acceptance through its effect on PU, this is because PEOU is directly related to the main results expected from the use of Information Technology [42]. TAM is one of the models used for acceptance of new technology that applies Fishbein and Ajzen's Theory of Reasoned Action (TRA) to define a scheme for the utilization of information systems at the user level by using 2 aspects of acceptance, namely Perceived Usefulness (PU) and Perceived Ease-Of-Use (PEOU) as the main factor to describe the success level of acceptance of technology designed with the aim of encouraging users of their applications to do so according to the services required [43]. TAM makes it easy for users to be able to understand the concept of implementation of the application by using the theory of reasoned action (TRA), where TRA uses a psychological approach to describe how users can be sure of the system to be used through behavior towards application usage [44]. The implementation of the TAM model has had a broad impact on the acceptance of the use of technology in smart health services, this provides a better understanding of the use and acceptance of systems in supporting smart health services for users[29].

4. Hypotheses Verification

Based on the results of a literature review [33], it is shown that the results of the hypothesis show that the smart healthcare framework is based on the TAM theory where the successful use of smart health care is based on two hypotheses, namely perceived usefulness (H4) and perceived ease of use (H5) have a positive effect on improvement that user belief in smart healthcare. IoT technology (H2) and Data Source (H3) also have an influence on the level of service confidence and the speed of information in smart healthcare.

5. Publishing outlets

Sources of data from this paper can be seen in the table below which is categorized by title, year, and type (T) of paper and year of publication.

**Table 3:** Source of Publication

| Title | Year | T | Title | Year | T |
|---|---|---|---|---|---|
| Smart Healthcare | 2020 | J | Technology acceptance mod | 2015 | J |
| Cloud-based healthcare | 2018 | J | TAM In Healthcare | 2010 | J |
| Healthcare 4.0 | 2019 | J | Frameworks success in TAM | 2009 | J |
| Personalized Healthcare | 2020 | J | TAM Innovation | 2004 | J |
| Issues in Healthcare | 2020 | J | TAM for e-Health | 2012 | J |
| IoT-Enabled Healthcare | 2020 | J | TAM Implementation | 2018 | J |
| Enabled Healthcare Sys | 2019 | J | Systematic review process | 2013 | J |
| IoT Healthcare System | 2019 | J | capacity in healthcare | 2019 | J |
| IoT-based healthcare | 2020 | J | IoT Based in Healthcare | 2018 | J |
| Processing in Healthcare | 2020 | J | Cloud-centric IoT | 2018 | J |
| TAM Healthcare | 2017 | J | Development of Smarthealthcare | 2020 | J |
| TAM Model Healthcare | 1999 | J | Review Human Healthcare | 2020 | J |
| A Healthcare Monitoring | 2020 | J | User Acceptance | 2002 | J |
| 5G-based smart healthcare | 2019 | J | The importance of TAM | 2003 | J |
| A Survey of Healthcare | 2019 | J | health information | 2007 | J |
| Smart solution for COVID-19 | 2020 | J | Technology Acceptance | 2020 | J |
| Framework for Data Sharing | 2020 | J | addictiveness of the healthcare | 2020 | J |
| IoT for Healthcare | 2020 | J | TAM Validation SI | 2010 | J |
| IoT-Based Healthcare | 2018 | J | SLR Methodology | 2013 | J |
| **Total** | | | | | **38** |

6. Source of Publication

Keywords are the main points to find information that fits the topic of discussion. Sources of information about keywords in supporting the results of the literature review can be seen in the table below.

**Table 4:** Source of Publisher

| Keywords | IEEE | Elsevier | Springer |
|---|---|---|---|
| Framework | √ | √ | √ |
| Healthcare | √ | √ | √ |
| IoT | √ | √ | √ |
| TAM | √ | - | √ |
| Self-Monitoring | - | √ | √ |

7. Author's Demography

Based on the total data sources displayed, there are 105 participating authors. The demographics below illustrate that MOOCs can be applied in various multidisciplinary disciplines.

**Table 5:** Author's Demography

| Field Of Study | Total | % |
|---|---|---|
| Computer Science | 43 | 41% |
| Information Systems | 21 | 20% |
| Educational Sciences | 17 | 16% |
| Information Science | 12 | 11% |
| Information Technology | 9 | 9% |
| Social Science | 3 | 3% |
| **Total** | **105** | |

## CONCLUSION AND RECOMMENDATION

System healthcare is an interaction between users and the system that makes it possible to get medical information services and store data on the activity of users of the Healthcare system. Healthcare system integration with IoT is expected to improve self-protection and the implementation of health protocols properly. TAM's support for the Healthcare system framework also provides support for the level of user confidence in the application both in terms of the benefits of using it or the ease of implementing existing applications. The framework contained in this paper can be used as a reference for building IoT-based applications for self-monitoring of the dangers of Covid-19 through providing notifications as initial protection against the dangers of Covid-19 and also storing information related to user activity stored in the database while outside the home. Apart from that, the model produced in this research can provide insight and a general picture that can be developed and implemented to help provide smart health services based on IoT technology

by increasing user involvement more effectively in complying with health protocols. Although the results in this research can provide an overview of the application of IoT-based technology with a combination of the TAM model in producing an individual monitoring system model in preventing COVID 19, further research needs to be carried out by conducting a wider exploration of the effectiveness and implementation models that will be applied next, as well Pay attention to the readiness of data that will be used as a reference in decision making.

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