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Self-Health Examination Pavilion (APKM) for Health Consultation

Billy Montolalu [1], Ahmad Wali Satria Bahari Johan [*2], Susijanto T. Rasmana [3], Ardian Yusuf Wicaksono [4], Muhammad Dzulfikar Fauzi [5]

[1] Teknik Komputer, Fakultas Teknologi Elektro dan Industri Cerdas,
Institut Teknologi Telkom Surabaya, Surabaya, Indonesia
[2, 4, 5] Informatika, Fakultas Teknologi Informasi dan Bisnis,
Institut Teknologi Telkom Surabaya, Surabaya, Indonesia
[3] Teknik Elektro, Fakultas Teknologi Elektro dan Industri Cerdas,
Institut Teknologi Telkom Surabaya, Surabaya, Indonesia
Email : billy@ittelkom-sby.ac.id [1], ahmadsatria13@ittelkomsby.ac.id [2], susijanto@ittelkom-sby.ac.id [3], ardian@ittelkom-sby.ac.id [4], muhammad.dzulfikar.f@ittelkomsby.ac.id [5]

Abstract

The Independent Health Examination Platform (APKM) aims to assist medical personnel in reducing the usual initial examination procedures so that further examinations or consultations can be carried out immediately. The usual initial examinations include measuring body weight, height, body temperature, blood pressure, oxygen levels in the blood, heart rate per minute, respiratory rate per minute, and an electrocardiogram to record heart activity. All measurements are carried out in one station and are equipped with an audio-visual guide. The measuring devices use equipment with a high level of precision and work automatically so that they can be used by ordinary people. The equipment used in APKM includes scales and LIDAR sensors to measure weight and height. Additionally, equipment such as oximeters, thermometers, and blood pressure monitors are used to measure heart rate, body temperature, and blood pressure. The examination results obtained from these devices need to be consulted with a doctor. This research proposes the development of APKM for telemedicine so that patients who have conducted independent examinations can directly consult with a doctor regarding their examination results.

Keywords: *APKM, consultation, doctor*

1. Introduction

The Covid-19 pandemic has changed the daily behavior of mankind a lot (Drury et al. 2021)(Corpuz 2021). Worries about contracting Corona disease and the government's policy of limiting going out of the house are forcing people to change old habits into new behaviors. Shopping behavior, teaching and learning, work, and many other activities are carried out online. The spread of the Covid-19 virus has also made people very careful about visiting health centers such as polyclinics or hospitals. Besides that, queues at hospitals also create crowds of sick people who have the potential to spread the virus. To get health services at a hospital or health clinic, patients must patiently wait for several hours. The large number of patients that must be served and several examination procedures that must be carried out by doctors, this is what makes the service time at the hospital long. Before consulting a doctor, a patient first carries out an initial examination by medical personnel to obtain data on blood pressure, heart rate, oxygen in the blood, weight and height. Queues at this initial inspection stage must of course be avoided, because crowds have a great potential for spreading the Covid-19 virus. According to the results of a scientific publication at Wuhan University, the Covid-19 virus can float in the air in the form of an aerosol, so it can be spread when a carrier coughs. sneezing, screaming, and talking (Liu et al. 2020)(Ong et al. 2020). Apart from being related to preventing the transmission of the virus during a pandemic, currently patient medical data is still in the form of manual recording data written by medical staff on a card which is then handed over to the doctor when consulting. This manual examination by medical personnel certainly takes a relatively long time because officers must take measurements and record each patient one by one. This can lead to queues and buildup of patients(Queen Elizabeth Enahoro et al. 2023).

This queuing problem can be accelerated in patient handling without reducing examination procedures. With the development of medical device technology, it is easy for patients to check their health independently. Various sensors related to medical measurements have been produced, including blood pressure sensors, temperature sensors, weight sensors, and sensors for measuring height. When connected to the Internet of Things (IoT) technology, the data from each of these sensors will be something extraordinary. IoT prioritizes the speed of data from connected equipment then stores and processes this data on the hospital database server which can also be accessed by patient smartphone applications. Several companies have developed self-examination equipment including POD(Lupton 2017).

Currently, medical electronic sensor technology supported by IoT makes it possible to reduce queues for manual checks carried out by medical personnel. According to Skyttberg, the use of automatic machines can increase the speed of serving patients (Skyttberg, Chen, and Koch 2018). For this reason, the Telkom Institute of Technology (IT Telkom) Surabaya in collaboration with Airlangga University Hospital (RSUA) in 2021 has made a prototype of the Independent Health Pavilion (APKM). This pavilion has facilities for checking vital signs of health (health vital signs). Patients can carry out examinations at the independent health examination platform (APKM) provided in the hospital waiting room. The pavilion has the features of an initial examination which are generally carried out by a doctor which actually can be carried out independently by a patient with a non-severe illness. Equipped with an audio-visual user guide facility, it makes it easier for patients to carry out independent examinations (Rusdianawati et al. 2021). This equipment is also connected to the hospital database server so that it can store examination results immediately and can be accessed by doctors.

The APKM development proposed in this study is the addition of communication facilities so that patients can carry out remote consultations with doctors. With this facility, patients do not have to come to a health center or hospital and meet a doctor in person. Patients only need to come to the health pavilion near their home to do a health check and consult with a doctor. For doctors, this facility can make it easier because they can serve patients anywhere with internet access. In addition, this can reduce direct contact between patients and doctors and health workers so as to prevent the spread of infectious diseases.

2. Methods

This study used an object-oriented approach in the development of Independent Medical Examination Platforms (APKM). There are several stages that must be passed, including needs analysis, design, implementation and testing. Each stage is carried out in order to produce a product that suits the needs of patients in medical examinations. Figure 1 illustrates the research methodology utilized in this study. The process commences with an in-depth analysis of requirements, followed by detailed system design. Subsequently, the system is realized through practical implementation. The next stage involves integrating various necessary devices and conducting comprehensive testing to ensure optimal system performance prior to the final phase.

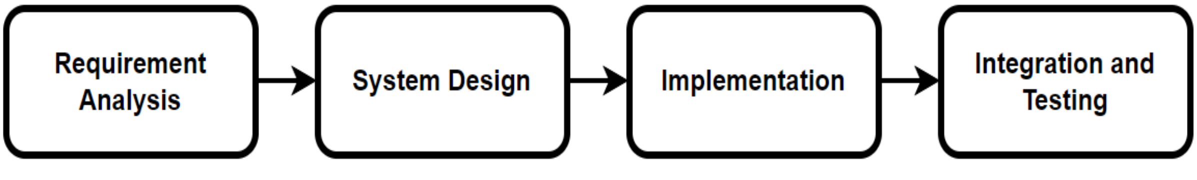

Figure 1. Research methodology

2.1 Requirements Analysis

The initial stage of the construction of the Independent Health Examination Platform (APKM) is the requirements analysis stage. A requirements analysis is carried out to find out every detail of the

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requirement that must be provided in APKM. The requirement analysis consists of the definition of the requirement along with the specification of the requirements. The definition of requirements is a definition of the needs that must be provided in APKM. While the requirements specification is a detailed specification or what must be provided and done from the definition of requirement (Tukur, Umar, and Hassine 2021)(Arora and Bhatia 2018). The process of requirement analysis entails a comprehensive sequence of actions, commencing with extensive interviews and firsthand observations that actively engage both doctors and medical staff. Table 1 describes the definition and specification of the requirements that must be provided in the APKM.

Table 1. Requirement Analysis

No	Requirement Definition	No	Requirement Specification
D001	Patients can access APKM by attaching patient cards and facial recognition	S0101	The system performs data matching between the RFID reader and the patient's face
		S0102	APKM system performs facial recognition of patients
		S0103	The camera sensor captures an image of the patient's face
		S0104	RFID reader reads affixed patient card
D002	Patients can check weight and height	S0201	Sensor load cell converts weight into an analog electrical signal which will be converted into a digital value using an analog to digital converter (ADC)
		S0202	Sensor Light Detection and Ranging (LIDAR) will detect the distance between the patient's head and the sensor
		S0203	The system displays the results of checking the patient's weight and height on the display
D003	Patients can check body temperature	S0301	Thermal cameras send patient's body temperature after logging in
		S0301	The system displays the results of body temperature checks on the display
D004	The patient can check oxygen saturation and heart rate	S0401	The patient places one finger on the Oximeter
		S0402	Oximeter Sensor sends test results
		S0403	The system displays the results of oxygen saturation and heart rate checks
D005	The patient can check blood pressure	S0501	The patient places his arm on the blood pressure meter
		S0502	The blood pressure meter sends the patient's systolic and diastolic values
		S0503	System displays systolic and diastolic values
D006	The system provides guidance to patients during the use of APKM	S0601	The system displays videos on the use of each examination tool
		S0602	The system issues an APKM usage guide sound for each type of examination

No	Requirement Definition	No	Requirement Specification
D007	The system can store the results of all patient examinations	S0701	The system provides a database of examination results
		S0702	Every patient examination result can be accessed by doctors and medical personnel
D008	The system provides a teleconference between the patient and the doctor	S0801	The patient is provided with a video call button with the doctor on duty
		S0802	The doctor gets a call notification from the patient

2.2 Use Case Diagram

Use Case Diagrams are used to describe interactions between system users (actors) and use cases that are adapted to predetermined steps (scenarios) (Sills, Ranade, and Mittal 2020). Figure 2 shows the use case diagram on the APKM system. The use case diagram explains who the actors are in the APKM system and the work that can be done. In the first stage, the patient actor is required to place the patient card on the RFID reader sensor. Then the camera will capture the patient's face and identify the patient and match the facial data with the data stored on the patient card. The first examination that can be done by the patient is a height and weight check. The patient stands in the recommended position, then the load cell sensor detects the patient's weight and the LIDAR sensor detects the patient's height. The second examination is a body temperature check, where the thermal camera sensor sends the patient's body detection results to the system. The third examination is checking oxygen saturation and heart rate. The patient attaches one of his fingers to the oximeter sensor, then the oximeter sensor sends the examination results to the system. The fourth examination is checking blood pressure. The patient places his arm on the sphygmomanometer, then the sphygmomanometer sends systolic and diastolic values to the system. The system can display the entire inspection results. Examination results can be accessed by medical staff and doctors on duty. After the patient has completed the examination, the final stage is a consultation with the doctor by pressing the consultation button provided. Doctors will receive calls from patients using APKM.

2.3 Sequence Diagram

Sequence diagrams describe the interactions between objects in and around the system (including users, displays/forms) in the form of messages depicted against time (Morikawa, Omori, and Ohnishi 2018)(Sajeev and Wibowo 2003). There are 6 sequence diagrams created. Sequence diagrams are made to explain interactions between objects contained in the APKM system. Figure 3(a) shows a sequence diagram of the patient login process. Where there are patient actors, RFID reader sensors and camera sensors. This sequence shows that the patient can successfully log in if there is a match between the patient's ID card and the patient's face. Figure 3(b) shows a sequence diagram of the process of checking height and weight. The sequence diagram starts with the patient actor who checks the height and weight, then the load cell sensor sends the patient's weight and the LIDAR sensor sends the patient's height. This sequence produces objects in the form of the patient's height and weight. Figure 3(c) shows the sequence diagram of checking the patient's body temperature. The thermal camera sends the patient's body temperature data to the system. This sequence produces body temperature objects. Figure 3(d) shows a sequence diagram of checking oxygen saturation and heart rate. The oximeter produces the 2 objects needed, namely the oxygen saturation and the patient's heart rate. Figure 3(e) shows a sequence diagram of a blood pressure check. There is a tension meter sensor that sends 2 objects, namely systolic and diastolic. Figure 3(f) shows a sequence diagram of the process of consulting a patient with a doctor. There are 2 actors, namely the patient and the doctor. In this sequence, there are objects in the form of consultation results.

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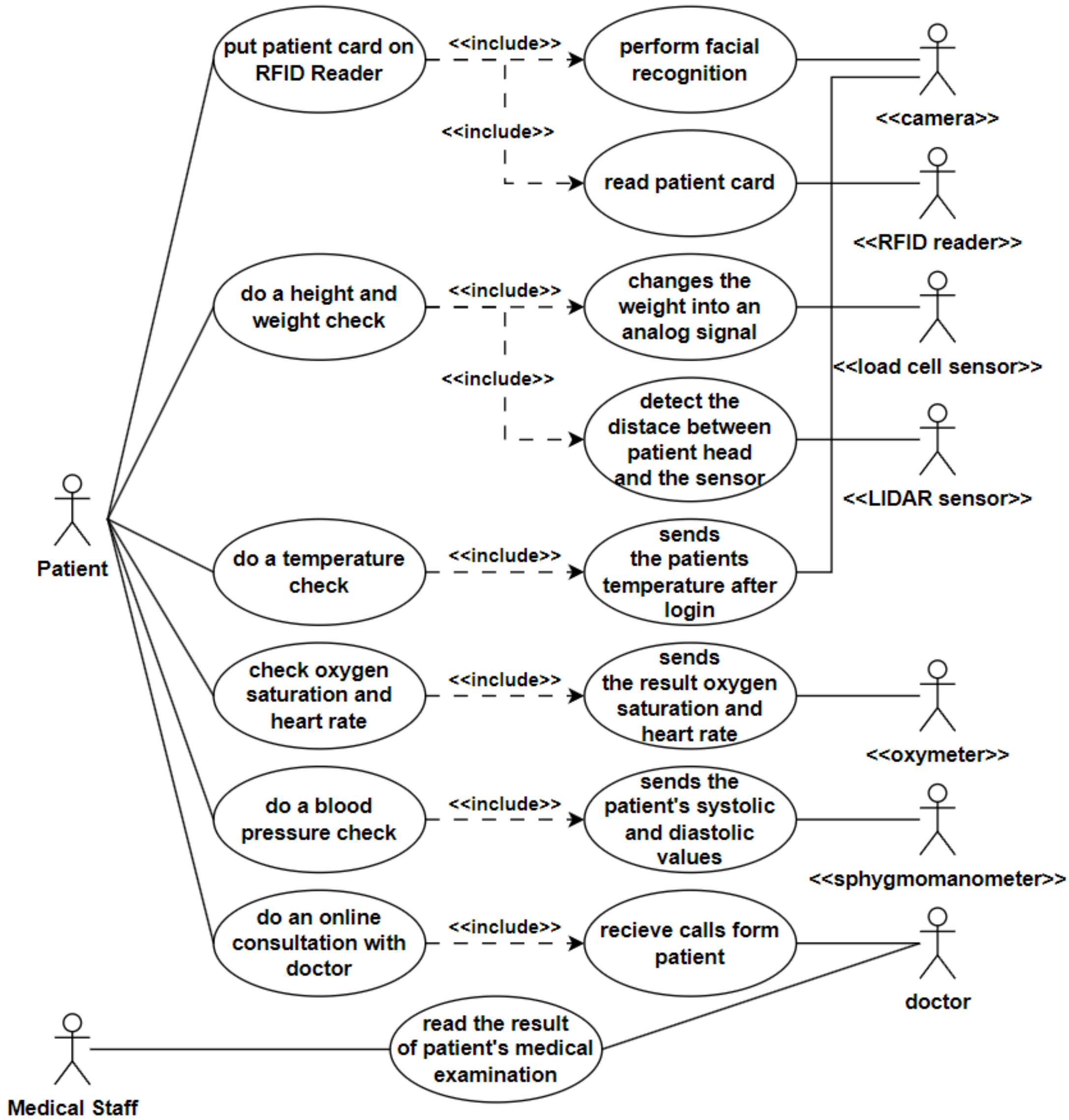
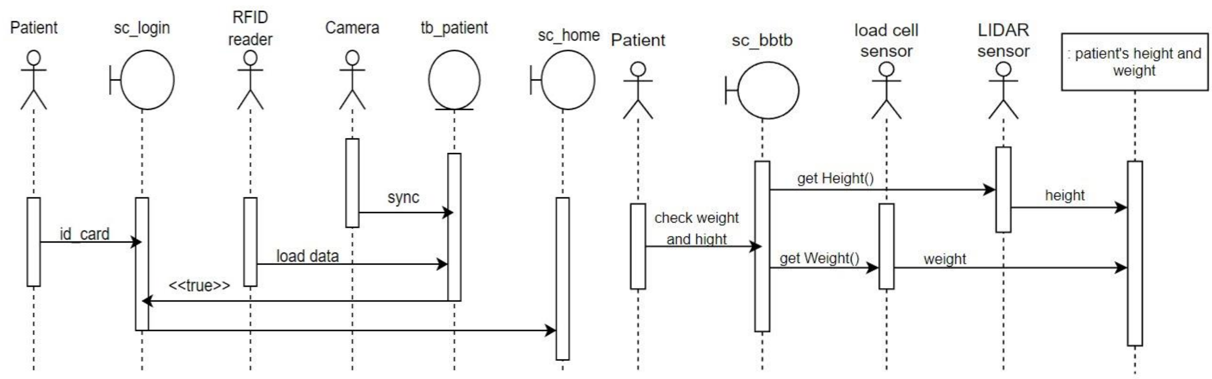
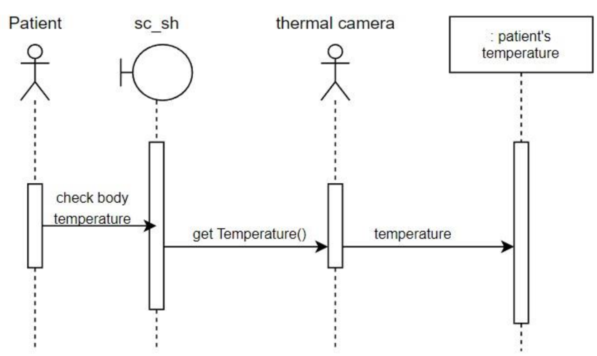
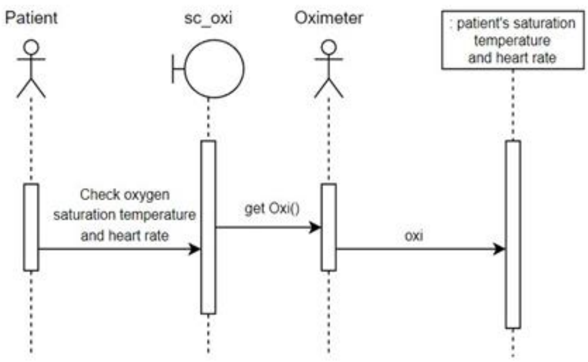


Figure 2. Use case Diagram

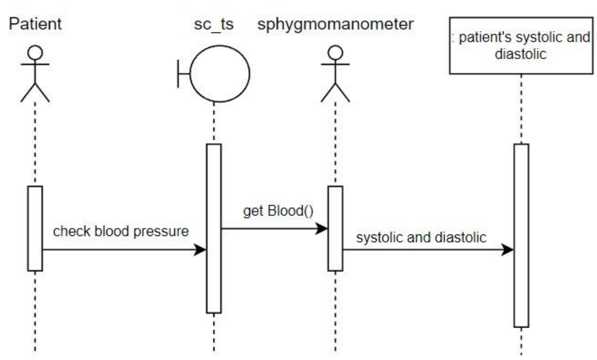


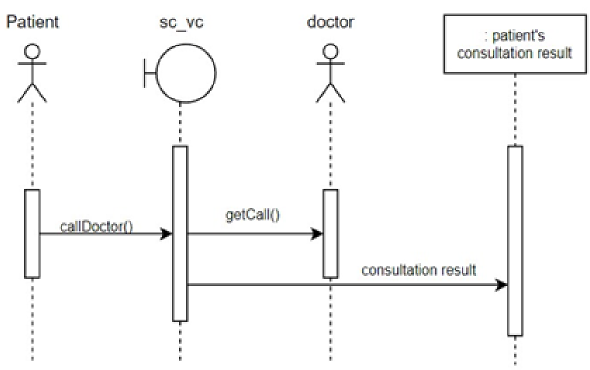
(a) (b)





(c) (d)





(e) (f)

Figure 3. Sequence diagram (a) login, (b) check height and weight, (c) check temperature, (d) oxygen saturation and heart rate, (e) check blood pressure, (f) online consultation

2.4 Class Diagram

Class diagram is a static structure diagram in UML that describes the structure of a system by showing system classes, their attributes, methods, and relationships between objects (Sulaiman, Ahmad, and Ahmad 2019)(Al-Fedaghi 2017). Figure 4 is a class diagram of the APKM system. In the class diagram there are 9 classes that will be used in system implementation. These classes include Patient, Doctor, Medical Staff, Load Cell Sensor, Oximeter, Thermal Camera, RFID, LIDAR, sphygmomanometer and Result. Each class has its own attributes and methods.

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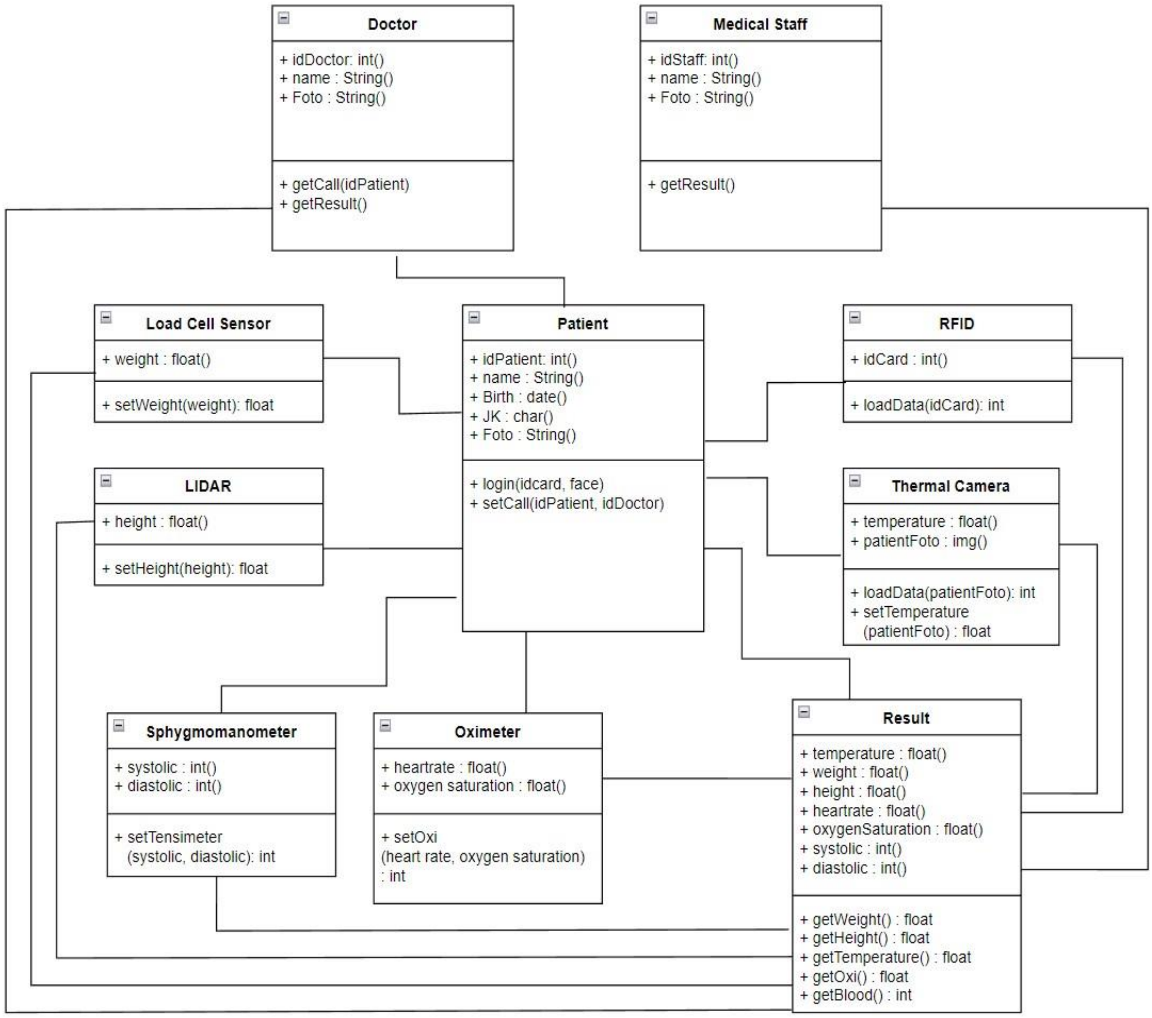
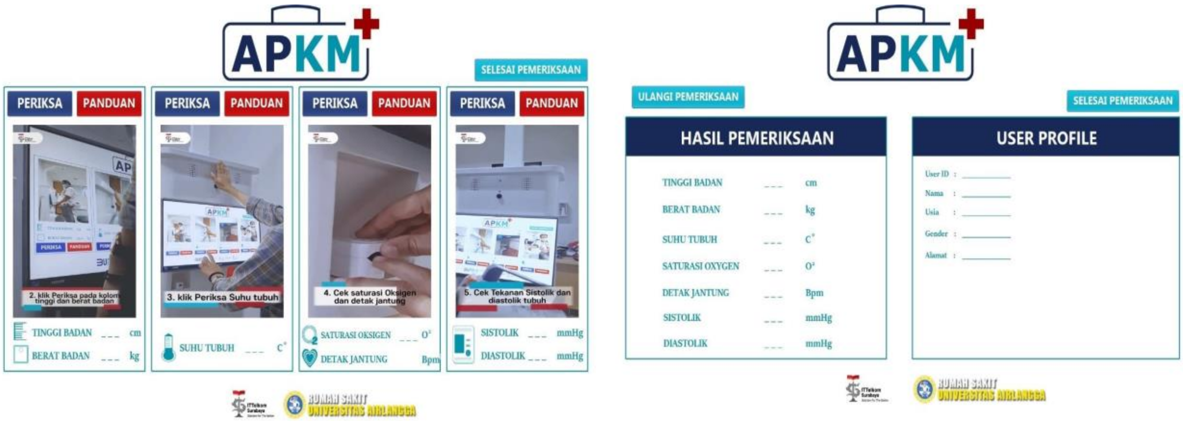


Figure 4. Class diagram

3. Results and Discussions

(a) (b)



(c) (d)

Figure 5. User Interface Design of Self-Health Examination Pavilion for Health Consultation (a) The form of APKM, (b) Login, (c) Examination page, (d) Result page

Based on the design stages that have been carried out, implementation is carried out using the Java language. The first implementation stage is to install each sensor and inspection tool in the APKM box. Figure 5(a) is the form of APKM. The APKM provides a monitor screen that can be operated by touch, so that hospital patients can easily use it. Each stage of using APKM is provided with voice guidance. Figure 5(b) is the user interface for the login page on APKM, where patients are instructed to place their ID cards. Furthermore, the camera will automatically detect the patient's face and synchronize it with the data on the ID card. If a match is detected between the id card and the patient's face, the page will move to the examination page, as shown in figure 5(c). Furthermore, the patient will carry out each stage of the examination, starting from checking height and weight, checking body temperature, checking heart rate and oxygen saturation, then checking blood pressure. The final stage is an online consultation with the doctor on duty. Every patient examination result data can be accessed by doctors and medical staff. Figure 5(d) is the user interface of the inspection results. The user interface displays all the results of the medical examinations that have been carried out by the patient. Figure 6 is the user interface when the patient has an online consultation with a doctor.

Figure 6. User interface: Online consultation

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4. Conclusion

The independent health examination platform (APKM) is designed to facilitate patient services in consulting with doctors. APKM aims to accelerate the queuing process in hospitals and reduce direct contact between patients and medical staff or doctors. By using APKM, patients can perform various health checks independently, such as measuring height and weight, checking body temperature, measuring oxygen saturation and heart rate, and checking blood pressure. After completing these examinations independently, patients have the option to proceed with a teleconference or online consultation with the doctor on duty, enabling medical consultations without the need for direct meetings.

The next research will focus on evaluating the effectiveness of APKM in improving healthcare service efficiency in hospitals and its impact on patient satisfaction. This study will involve analyzing APKM usage data, conducting interviews with patients and medical staff, and measuring various performance indicators such as patient wait times, the frequency of teleconference feature usage, and patient health outcomes. Thus, a deeper understanding of the benefits and challenges of implementing APKM in the healthcare system is expected to be obtained.

References

Al-Fedaghi, Sabah. 2017. 'Diagramming the Class Diagram: Toward a Unified Modeling Methodology'. 15(9). http://arxiv.org/abs/1710.00202.

Arora, Pardeep Kumar, and Rajesh Bhatia. 2018. 'Agent-Based Regression Test Case Generation Using Class Diagram, Use Cases and Activity Diagram'. *Procedia Computer Science* 125: 747–53.

Corpuz, Jeff Clyde G. 2021. 'Correspondence: Adapting to the Culture of "New Normal": An Emerging Response to COVID-19'. *Journal of Public Health (United Kingdom)* 43(2): E344–45.

Drury, John, Holly Carter, Evangelos Ntontis, and Selin Tekin Guven. 2021. 'Public Behaviour in Response to the COVID-19 Pandemic: Understanding the Role of Group Processes'. *BJPsych Open* 7(1): 1–6.

Liu, Y. et al. 2020. 'Aerodynamic Characteristics and RNA Concentration of SARS-CoV-2 Aerosol in Wuhan Hospitals during COVID-19 Outbreak'. *bioRxiv* 86(21).

Lupton, Deborah. 2017. 'Digital Health Now and in the Future: Findings from a Participatory Design Stakeholder Workshop'. *Digital Health* 3: 205520761774001.

Morikawa, Yousuke, Takayuki Omori, and Atsushi Ohnishi. 2018. 'Transformation Method from Scenario to Sequence Diagram'. *IC3K 2018 - Proceedings of the 10th International Joint Conference on Knowledge Discovery, Knowledge Engineering and Knowledge Management* 3(Ic3k): 136–43.

Ong, Sean Wei Xiang et al. 2020. 'Air, Surface Environmental, and Personal Protective Equipment Contamination by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) from a Symptomatic Patient'. *JAMA - Journal of the American Medical Association* 323(16): 1610–12.

Queen Elizabeth Enahoro et al. 2023. 'The Impact of Electronic Health Records on Healthcare Delivery and Patient Outcomes: A Review'. *World Journal of Advanced Research and Reviews* 21(2): 451–60.

Rusdianawati, Islami, Syarif Usman, Giza Great Biidznillah, and Taufik Rohman. 2021. 'Evaluasi Kepatuhan Asesmen Awal Medis Dan Keperawatan'. *Journal of Hospital Accreditation* 03(1): 27–33.

Sajeev, A. S.M., and Bugi Wibowo. 2003. 'UML Modeling for Regression Testing of Component Based Systems'. *Electronic Notes in Theoretical Computer Science* 82(6): 190–98. http://dx.doi.org/10.1016/S1571-0661(04)81037-5.

Sills, Matthew, Priyanka Ranade, and Sudip Mittal. 2020. 'Cybersecurity Threat Intelligence Augmentation and Embedding Improvement - A Healthcare Usecase'. *Proceedings - 2020 IEEE International Conference on Intelligence and Security Informatics, ISI 2020*.

Skyttberg, Niclas, Rong Chen, and Sabine Koch. 2018. 'Man vs Machine in Emergency Medicine - A Study on the Effects of Manual and Automatic Vital Sign Documentation on Data Quality and Perceived Workload, Using Observational Paired Sample Data and Questionnaires'. *BMC*

Emergency Medicine 18(1): 1–9.

Sulaiman, Noraini, Sharifah Sakinah Syed Ahmad, and Sabrina Ahmad. 2019. 'Logical Approach: Consistency Rules between Activity Diagram and Class Diagram'. *International Journal on Advanced Science, Engineering and Information Technology* 9(2): 552–59.

Tukur, Muhammad, Sani Umar, and Jameleddine Hassine. 2021. 'Requirement Engineering Challenges: A Systematic Mapping Study on the Academic and the Industrial Perspective'. *Arabian Journal for Science and Engineering* 46(4): 3723–48. https://doi.org/10.1007/s13369-020-05159-1.