

## Research Article

# Smart Class System Prototyping through Sustainable Infrastructure Based on Mobile Application SPACE (Smart Program - Class Architecture) Integrated Smart Building Management System

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**Abstract.**

Optimizing innovation in the use of health technology in infrastructure will directly impact the conditions of social interaction in the community, including within the scope of the school area. The Smart Class concept collaborates with learning carried out in a hybrid way. However, it is not yet fully optimized by digitizing the existing infrastructure with the concept of managing school facilities and infrastructure. The implementation of the Smart Class uses the intelligent building management system (IBMS), where this system integrates all parts of the building with the Internet of Things (IoT), facilities, and infrastructure and can minimize pandemic transmission in the academic sphere by accessing via mobile app. This research aims to analyze the design of the smart program class architecture integrated monitoring system to implement IoT-integrated health protocols, especially in the middle school scope. This research uses qualitative and quantitative methods with descriptive analysis through the development of user research at the system design stage. The output of this innovation is how schools implement digital technology comprehensively, starting from the application of IoT, sensors, and databases in a real-time mobile app environment. There are three main things: the data input, data processing, and output value. The intervention of school needs can be expanded with the integration of the learning management system in the form of integrated learning management the learning process, which is in line with monitoring the use of infrastructure in schools. Through this Smart Class concept, schools can still operate optimally without any applicable health policies and can provide excellent academic services.

**Keywords:** smart class system prototyping, sustainable infrastructure mobile application, SPACE smart building management system

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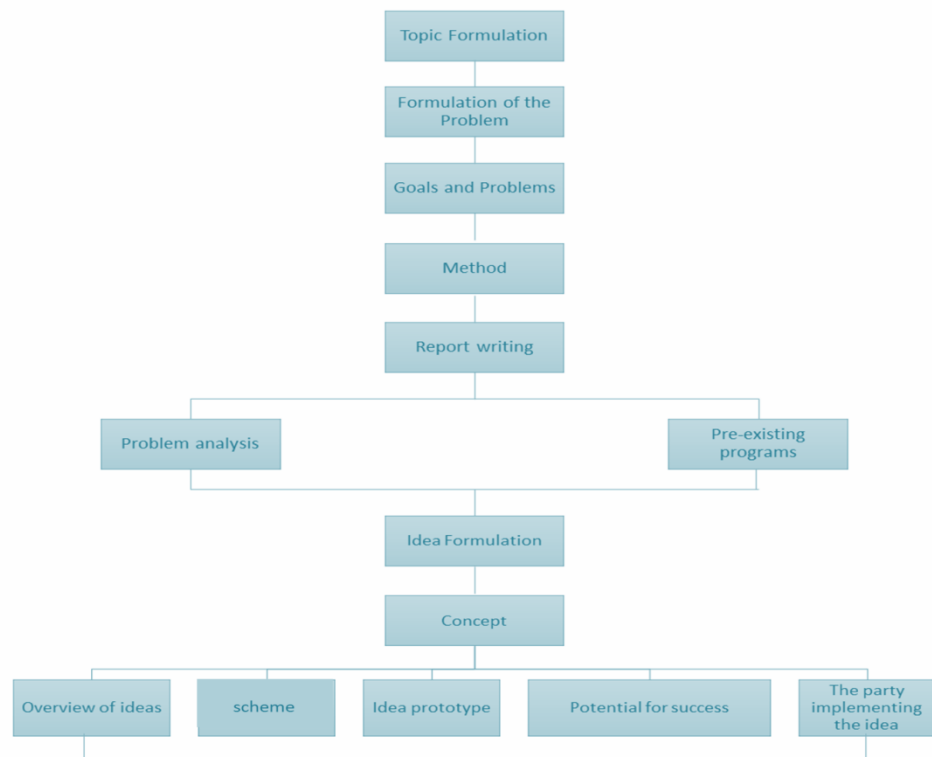
## 1. INTRODUCTION

The spread of COVID-19 is growing rapidly worldwide, including in Indonesia. The period of the COVID-19 pandemic in Indonesia until the beginning of 2022 has experienced fluctuations. However, now it is heading for a new normal era, along with the loosening of rules related to Health protocols [1]. Implementing certain statuses to declare the COVID-19 emergency level and become a source of decision making regarding PPKM activities. However, people's routines have returned to normal while still observing health protocols and promoting the vaccination program. Facing the COVID-19 pandemic requires maximum efforts to break the existing chain of transmission by protecting residents' activities from risks that may occur due to exposure to the virus after the COVID-19 pandemic. Breaking the chain of the COVID-19 pandemic can be done individually by using masks and washing hands and in groups by keeping a distance (social distancing). Social Distancing is an effort to stop the spread of the virus by keeping a distance to avoid physical contact [2].

Unforeseen circumstances in the face of COVID-19 have brought major changes to various sectors, including the education sector. The relaxation of the recommendation to wear masks in public places should not be used as a habit of neglect in the Health protocol. It can minimize the spread of other disease viruses that cannot be diagnosed medically. Indonesia has implemented new normal policies in various sectors, including education. The government chose to implement new policies normally in education to increase productivity and accommodate the learning needs of students in schools. The new normal policy is intended to open schools by implementing strict health protocols through Face-to-face Learning (PTM) so that several Health protocol rules must be observed, especially in providing facilities that support the discipline of Health protocols [3]. The condition of the COVID-19 pandemic in Indonesia has changed the learning process in all schools in Indonesia to Distance Education (PJJ) or learning from home to reduce cases of being infected with COVID-19, starting from the elementary school level to the university level. The purpose of this study is to find out the right technological innovations to support in the field of education for students, especially school infrastructure students during post-COVID-19, to know the work scheme of the Smart Program system - Class Architecture Integrated Mobile Apps and Intelligent Building Management System and to know the potential implementation of the Smart Program - Class Architecture Integrated Mobile Apps and Intelligent Building Management System. System Smart Program - Class Architecture.

## 2. METHOD

The data used in this study are qualitative and quantitative data from various relevant literature and several existing sources and references. According to the Big Indonesian Dictionary, qualitative data is not in the form of numbers obtained from recordings, observations, interviews, or written materials. At the same time, quantitative data can be measured or calculated directly as a variable number or number. The sources included data from journals and books on the issues raised. The research method used is descriptive analysis. The descriptive analysis examines the status of a group of people, an object, a set of conditions, a system of thought or a class of events in the present [4]. The data to be analyzed is data sourced from literature studies. A literature study is a series of activities related to collecting library data, reading and taking notes and managing research materials. The framework of Research The following is a framework for writing the idea of a SPACE.



**Figure 1:** Framework of research.

The flow of writing in SPACE (Smart Program - Class Architecture) begins with the formulation of topics related to how the physical distancing monitoring system in the school area is to realize Smart School during the COVID-19 pandemic. Then it is formulated in the form of a problem where SPACE (Smart Program - Class Architecture) provides the best solution for monitoring the implementation of physical distancing in

school areas that apply health protocols, especially with various applications of IoT technology, sensors, and databases. Then the objectives and problems raised in the research are determined. The research method used is descriptive analysis through literature studies that have been obtained and in the form of futuristic idea analysis to explain how this system will work ideally.

### 3. RESULTS AND DISCUSSION

#### 3.1. Post-Pandemic COVID-19 Conditions in the Education Sector

The current COVID-19 pandemic entered Indonesia in 2020. All fields, including education, have felt the impact. Learning that was initially carried out face-to-face had to switch to distance learning. This is based on the Minister of Education and Culture policy in Circular Letter Number 15 of 2020 concerning Guidelines for Organizing Learning from Home in an Emergency Period for the Spread of COVID-19. Distance learning is an institution-based formal education where learning groups are separated, and a communication system is used in interaction [5]. Distance learning aims to reduce the spread of the COVID-19 virus. There are several positive impacts if student study at home, such as strengthening family relationships, students can learn directly from parents, and so on. However, studying at home also has negative impacts, such as students becoming lazy to study, becoming addicted to playing, finding it difficult to find interactive learning media, etc [6].

This solution is intended to overcome the problems currently being faced by implementing strategies to prevent virus transmission. The use of technology is designed in the form of applications that have been integrated with the IoT system, where the input obtained from the sensors used and the output will be in the form of data results that will come out on the operator's computer and application. The development of facilities and infrastructure is carried out by planning with an optimization that supports both classroom learning and those that require learning experiences, such as being supported by virtual laboratory components and offline with a hybrid strategy.

#### 3.2. Approach to the Procurement of Sustainable School Facilities and Infrastructure

Approach to the procurement of sustainable school facilities and infrastructure to overcome problems in education in the post-pandemic era for this limited face-to-face

learning system, monitoring tools such as thermal detectors, the application of social distancing, and other 5M health protocols are needed [7]. SPACE system (Smart Program - Class Architecture) is to sterilize school areas using UV light, provide virtual spaces based on VR (Virtual Reality) and AR (Augmented Reality) technology, as well as education through content related to COVID-19. These tools can assist various parties in minimizing the unintended impact of implementing a limited PTM policy. The benefits of the research areas a form of the author's contribution to the development of appropriate technology-based innovations in the fields of health and education, providing information about forms of innovation in technology that are integrated with the progress of the times and means to develop technology-based innovations, health and education to deal with the COVID-19 also provides an overview and schematic of the proposed ideas to make them easier to implement. Factors that influence the success of educational programs are the availability of adequate educational infrastructure and optimal management. All facilities and infrastructure must be managed properly to support the learning process and are used as needed so that learning can run according to educational goals. In the learning process, facilities and infrastructure are needed to support the running of the activation process [8]. Therefore, the management of facilities and infrastructure is needed by every institution.

Following the Government Regulation of the Republic of Indonesia Article 1 Number 19 of 2005 concerning Standard of Infrastructure, it is stated that: Standard of Infrastructure is a national standard of education relating to minimum criteria concerning study rooms, places of exercise, places of worship, libraries, laboratories, workshops, playgrounds [9]. Creative places and other educational resources are needed to support the learning process, including information and communication technology. With the existence of adequate facilities and infrastructure, it is expected to achieve the initial goals of the institution itself. However, so that the educational facilities and infrastructure follow the needs, there is a need for further studies on the management of facilities and infrastructure so that the vision and mission of the institution will be achieved according to the initial plan. If these needs are met, the continuity of learning is certainly more effective and efficient.

### **3.3. Management of Facilities and Infrastructure in the Program**

Management of facilities and infrastructure is the activity of regulating and managing educational facilities and infrastructure effectively and efficiently to achieve the goals that have been set. Management of facilities and infrastructure is a collaborative process

that enables the institution's effective and efficient use of educational facilities and infrastructure [10]. Management of educational facilities and infrastructure is the entire process of obtaining, using and monitoring the facilities and equipment used to support the provision of education. In general, the purpose of the management of educational facilities and infrastructure is to provide professional services in educational facilities and infrastructure to organize an effective and efficient educational process.

The principles in the management of educational facilities and infrastructure include the principle of achieving goals, the principle of efficiency, the administrative principle, the principle of clarity of responsibility, and the principle of cohesion [11]. In the implementation of the SPACE program related to functional managerial facilities, namely as follows:

1. Needs planning
2. The process of procurement of educational facilities and infrastructure
3. Use of educational facilities and infrastructure
4. Recording/management of educational facilities and infrastructure
5. Elimination of facilities and infrastructure and infrastructure in the program

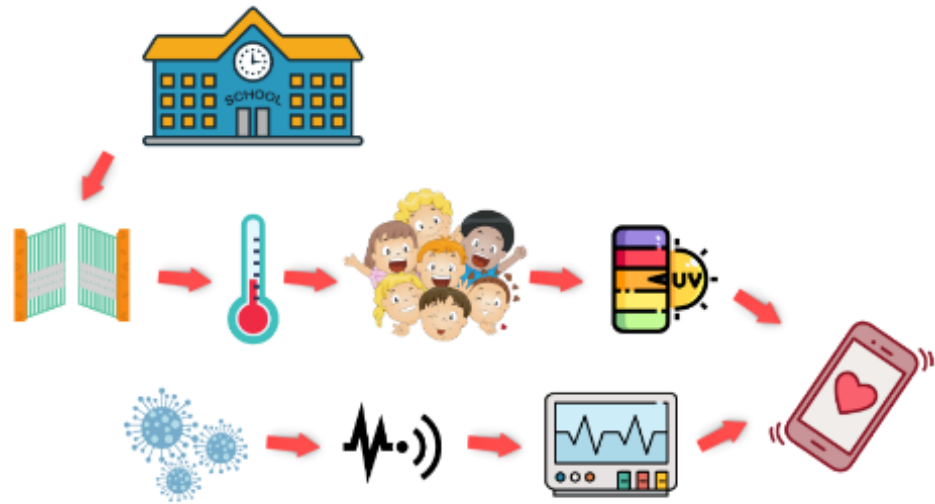
### 3.4. Concept of the SPACE Program Program

In dealing with the adaptation of new habits, this rule was made to minimize the risk of virus transmission. It contains the application of health protocols to carry out physical distancing, use masks, carry hand sanitiser, avoid crowds, not interact with sick people, etc. This policy has positive and negative impacts on human life. The positive impact of this policy is to reduce the spread of the COVID-19 virus; the negative impact is to weaken economic activities and massively disrupt public health and social interaction. Based on letter Number 3 of 2020 issued by the Ministry of Education and Culture regarding the prevention of COVID-19 in academic units, point five states that ensure education units carry out regular cleaning of the room and environment of the education unit, especially door handles, light switches, computers, keyboards (keyboard) and other facilities that are often held by hands [11]. Many teachers face the obstacle today by implementing the COVID-19 prevention strategy that has not been optimal. In addition, there are still many students who are not aware of following the health protocol.

### 3.5. The Use of Application

Internet of Things is a technology that supports connectivity between computers, smart-phones, and home devices with sensors, actuators, and software. The exchange of data and information through infrastructure and internet networks allows human work to be easier and carry out effective communication. Various health parameters can be read with various sensors. IoT with the application of technology consisting of data acquisition in any environment in sensors, communication technology (sensor networks, device-to-device communication, machine-to-machine communication, fog computing, and cloud computing [12]. The provision of IoT-based health services will provide complete access that affects the increase and reduces the cost of health services. Artificial intelligence or artificial intelligence is knowledge in computer science known as AI. To simplify and speed up human work, AI is the science of building a computer system that can demonstrate intelligence in various ways, even things that humans cannot do. AI or Artificial Intelligence is commonly used in medical applications to help find solutions to medical problems [13]. The emergence of artificial intelligence in the health sector has spurred the development of applications such as, for example, in the disease diagnosis process.

An expert system is a computer program designed to reason like an expert about a particular area of expertise. Two main parts comprise an expert system: the development environment and the consulting environment used by non-expert users to obtain expert knowledge. UV light or ultraviolet light is a ray with destructive properties for organisms with the power of radiation emitted. The use of UV is used in aseptic conditions. The wavelength of UV light is in the wavelength range of 4nm to 400nm, and the efficiency of UV light in controlling the activity of microorganisms is in the wavelength range of 365nm [14]. Several steps must be followed in designing a system using an expert system: Pick up the map advice from the experts, Representation of knowledge to a computer, Knowledge inference, and Knowledge transfer to users. Although there are rules that apply, the indirect application is not optimal, especially in the scope of the school. The school area is in the city centre or the centre of the crowd and students from various scattered areas. Overall system analysis involves system variations through an automated approach to the interaction of artificial systems and computer control that adjusts several hardware and software components. The operating system works by providing input or data input to obtain output in the form of activities that automatically run according to the instructions in the system operation.



**Figure 2:** Framework of the SPACE.

### 3.6. The IBMS (Intelligent Building Management System)

In the IBMS (Intelligent Building Management System) framework, a few centres will be depicted to help strengthen the shrewd grounds. The first is about energy strengthening, and the second is innovation strengthening. The first is about energy strengthening. The clever structure framework utilizes a few foreordained strategies to enable energy.

The strategy depends on an overall idea, custom-fitted to the particular requirements of each building, and there are Indoor Sensors, Outdoor Sensors: sensors that focus more on external conditions regarding temperature, humidity, and efficiency for operation. Controller, Decision unit, and Database. By implementing the IBMS (intelligent building management system) in a SPACE, solving the problems that exist in smart school becomes easier because every system already has a class respectively for control management. Implementing an integrated program requires collaboration with various parties, such as The management of public facilities, Local Education offices, the Nearest Regional Health Office, companies/Industry, Private Institutions and other stakeholders. To implement the program, maximum financial assistance is needed by involving private institutions or companies and other stakeholders who will help accelerate access to smart primary schools to carry out comfortable learning for students immediately.



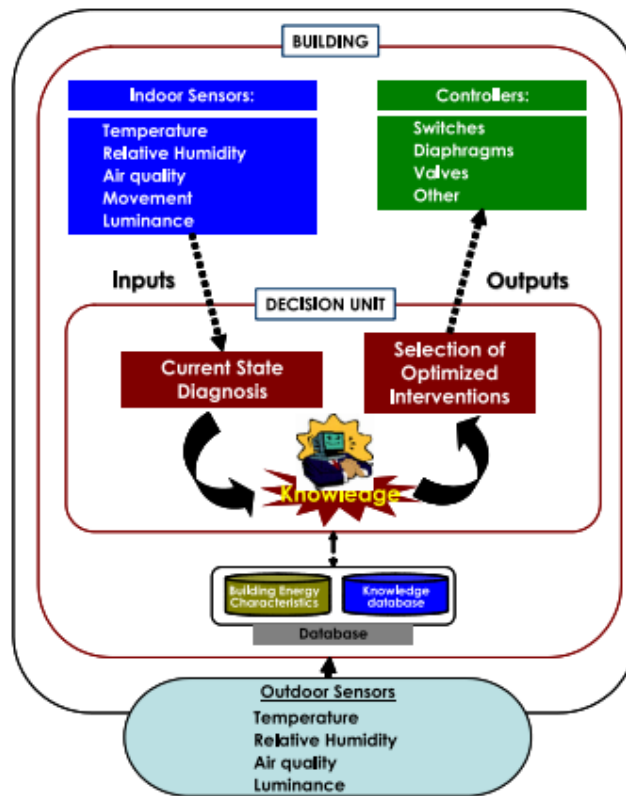


Figure 3: Intelligent building management system for SPACE.

### 3.7. Mobile Integrated System on Application

Mobile integrated system on the system that is integrated with this application is in the form of user device systems ranging from Android, iOS to Windows, and performs various functions from the use of features such as LMS, Virtual laboratory, Quiz Features, Interactive chat, and other smart class features that support the monitoring and controlling process continuously. Real-time. Besides that, there is a virtual reality system in the form of Augmented Reality and Virtual Reality sections and a graphic manager in the form of an Avatar graphical representation computing system, especially during online meetings for hybrid learning. The system on the user's device has a role in adjusting the needs of each device used. Furthermore, the virtual reality system is useful in transforming the appearance of virtual meetings from the form of video conferences into the form of 3-dimensional virtual reality. The virtual reality system is integrated by involving additional technology in VR glasses connected to the user's device. In addition to the learning process that functions as a Learning management system, with some optimization of the use of API, it is possible to carry out the process of controlling and monitoring, including in laboratory managerial activities for schools. The following is the user interface of the SPACE application.

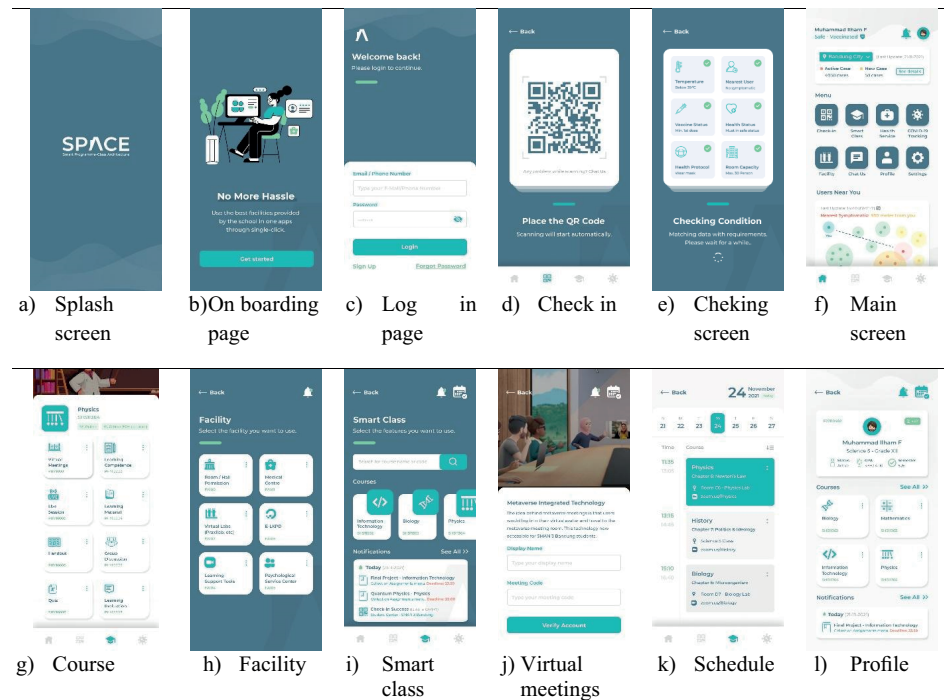


Figure 4: User interface of SPACE application.

## 4. CONCLUSION

The implementation of (Smart Program - Class Architecture) Smart Class Development Through Sustainable Infrastructure Integrated Mobile Apps and Intelligent Building Management System has been well integrated. It can be applied as a digital innovation to support learning facilities in the digital era toward society 5.0. Conceptually, the general description of SPACE consists of data input, data processing and control output values through a mobile application. The existence of SPACE can accelerate the implementation of health protocols in the academic sphere. IoT-based technology with digitization can be a parameter of adaptive ability in dealing with limited situations in accessing quality education services for students.

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