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Internet of Things Based on Smart Mirror to Improve Interactive Learning

Mochammad Haldi Widianto[1], Ranny[2], Nathasia Florentina Thejowahyono[3], Seto Benson Handoyo[4]
[1,2,3,4] Informatics Departement, School of Computer Science, Bina Nusantara University, Jakarta, Indonesia, 11480, [1]mochamad.widianto@binus.ac.id, [2]ranny@binus.ac.id, [3]florentinanatasya@gmail.com, [4]Setobenson7@gmail.com

ABSTRACT

Today, the technology of the Internet of Things (IoT) experiencing ongoing development can be said to be very rapid. Various office equipment and even city pages have been integrated with the internet. In addition to technological developments also occur in the mirror, smart mirror technology is one of the new things, especially in the field of learning, still in traditional technology where mirrors are only used for mirroring. The use of mirrors in education is not yet desirable, so there is a need for innovation in that field. Some studies have involved microcontrollers such as raspberry pi that have been applied to mirrors, where innovation through mirrors is becoming more and more. So that the innovations carried out on the Smart Mirror using mirrors of homes, offices and pages that have a scheduling automation system, turn on video, music, face recognition and control using Android. Students and lecturers need this technology to increase student involvement. The Smart Mirror in this study gave students and lecturers a variety of intelligent experiences. Students and Lecturers can innovate in teaching and learning activities by making changes to their control (Android). In this research has succeeded in creating a new smart mirror innovation with facial recognition needed for students and lecturers to be used for daily teaching and learning activities, especially in the university area in Bandung.

Key words : Smart Mirror, Learning, Internet of Things .

1. INTRODUCTION

Internet of Things (IoT) is a term used to inform "technology, systems and design concepts related to currents, voltages, and waves that arise from things that will always be connected to the internet based on the physical environment". This refers to networks on objects (objects) that can be uniquely informed, and they represent virtually in a function such as the Internet, which can download and inspire and then exchange data remotely so that it can be controlled across the entire network infrastructure—consists of key components, including sensing functions and applications services [1]–[3].

There has been a steady and significant growth in the use of data science in the form of smart devices in recent years. This proves as a result of the industry's rapid growth called the Internet of Things (IoT). Every day more and more of this industry in the field of smart devices, vehicles, buildings, and others. Where objects are composed of software and electronics are interconnected either by a particular network or to the Internet[4],[5],[6], [7].

Furthermore, technological developments have many impacts, various information such as news, etc., can be found the concept of Smart Mirror for Smart Home, Smart City very easily, Smar Environment has become increasingly widespread. The basic system of the Smart Mirror that follows the concept of the Internet of Things (IoT) was developed in general for broad purposes and specifically to enable users to manage and control lecturers and students during teaching and learning activities. In this case, the formation of student interaction has been identified as an essential problem that must be formed by most educational institutions. Too many things must be done at the same time and time. Lecturers also cannot be multitasking. For example, when to-do-list with a number of teaching and learning work. Another example is when a user is too busy managing other activities besides teaching and learning, so something else is needed to help[8]–[11].

According to one study before, technology is one of the universities in Indonesia. Always thought their lives would be facilitated by the presence of technologists [12]. This smart device has been used by almost all Indonesian citizens, helping some people solve everyday problems by providing efficient and effective solutions.

In the Previously research [13], the use of smart mirrors is placed on home appliances so that it helps people to do activities by utilizing mirrors, where settings such as the latest information, videos, and also high-speed internet access. Smart Mirror is a mirror that allows users to freely interact with the display of important information on the screen, while also providing text and messaging features.

This is supported by using innovative technology to achieve interactive and effective education. A screen that has reflective properties such as a mirror makes students and students more curious when the learning process occurs. Based on the development of a microcontroller, unidirectional mirror, frame, and other hardware devices, a smart mirror, as a mirror display screen, offers a safer, more convenient, faster, more precise, and smarter type, information-based to support quality education. So hopefully, this tool will help students be more creative, innovative, and more interested in all subjects [14]–[16].

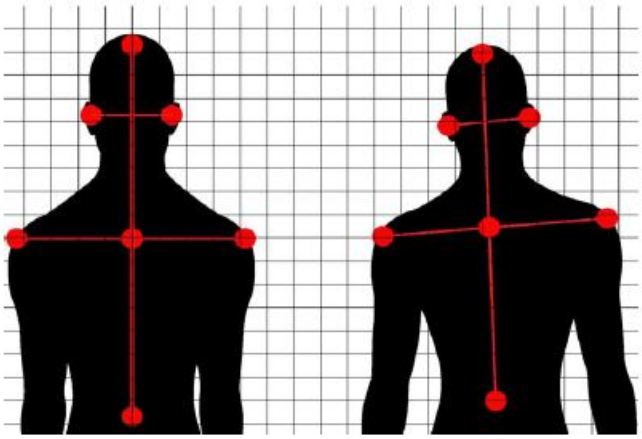

Figure 1: Example of correct posture according to the predefined criteria (left),
and example of incorrect posture (right) [4]

In the previous study, as in Figure 1, Shows researchers used the concept of face recognition above only used for different functions, namely in the teaching and learning process. Most of the research is also often used for office, industry, and other environmental activities. So the authors conducted several experiments regarding the use of intelligent mirrors in the teaching and learning process. For research in the teaching and learning process itself, only a few researchers who improvised did not use technology to increase student involvement and improve quality [17][18][19].

This research was made and will be applied at Bina Nusantara University in Bandung with flexible features so that some features can be used well and support innovation. This smart mirror can also be used as learning using markers. The very basic difference with traditional mirrors is; mirror on the mirror is easy to use as is the to-do-list to help with information and also recognizes faces to add other features such as videos to help with the task.

2. RELATED WORK

The following is a comparison table of several studies conducted in Table 1. to show some comparison to see the contribution of this research

Table 1: Previous research

NO	Author	Title	Result
1	[2]	*Smart Mirror for Home and Work Environment*	Use Smart Mirror in the Home and Work Office
2	[3]	*Smart Interactive Mirror Display*	Smart Mirror is used as an interactive Mirror
3	[4]	*Smart mirror E-health assistant - Posture analyze an algorithm*	Smart Mirror is to control the body with face recognition
4	[5]	*Voice Controlled Smart Mirror with Multifactor Authentication*	This research explain how simple microcontroller use for voice recognition
5	[6]	*Internet of Things Based Smart Mirrors: A Literature Review*	Smart Mirror Review in IEEE etc
6	[7]	*Smart Mirror for Smart Life Soft Computing and Data Mining Centre*	Smart Mirror for computing and Data Mining digital Science
7	[8]	*Design of Smart Mirror Based on Raspberry Pi*	The System for design simple, smart mirror

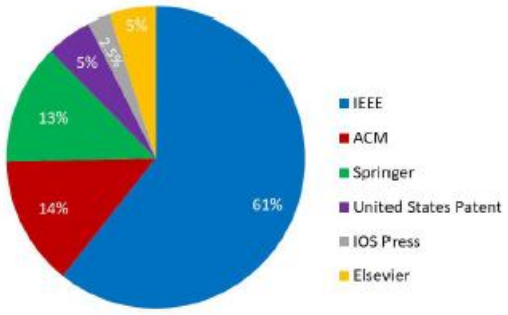

Figure 2: The number of studies that have been published in several well-known journals [9]

Figure 2 shows have a relation with this research because some research on IoT in general and in particular is always published in IEEE so that in this study,, almost all references use IEEE.

The approach in this study also uses the methodology used in this case called The Evolutionary Prototyping. The prototype model is a life-cycle model that allows applications to be developed in stages so that they can be modified easily according to user feedback. Evolutionary prototyping focuses on collecting the correct set and is consistent with several requirements. The process of building quality software in a sustainable way through clarification of existing requirements. Findings that did not previously exist or were unknown. Traditionally, repeated checks using system requirements have a panacea sought by practitioners. The user can give instructions to the system to see a list of available commands. Then, they can give commands via the voice instructions provided.

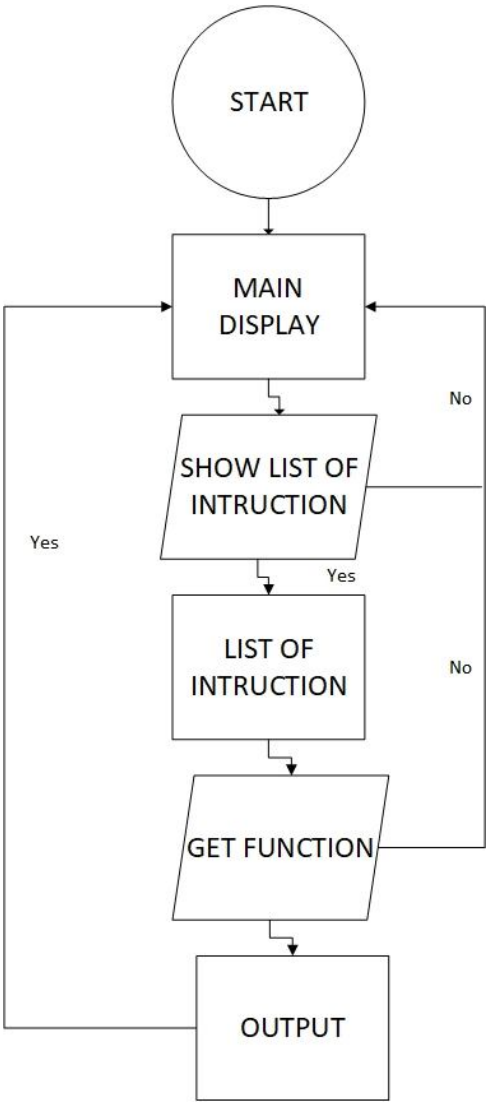

Figure 3: Smart Mirror Flow Chart

3. DESIGN HARDWARE AND SOFTWARE

The overall framework and working principles in this study are in accordance with the following picture:

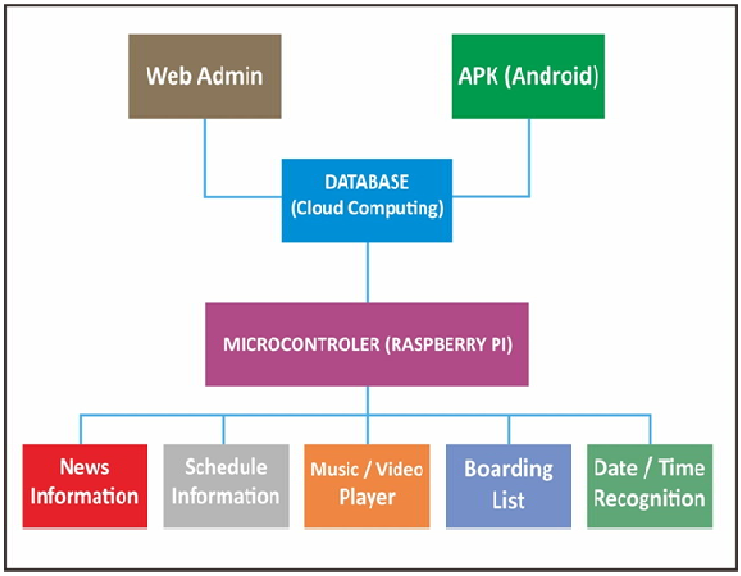

Figure 4: Smart Mirror Flow Diagram Function

In Figure 4 above shows the system structured to give users full access without any authentication requirements to all services and functions through a database server. Everything is done and controlled using WebAdmin from face recognition and lecturer-student interaction. Primary data is also integrated by the microcontroller, with tools such as; access to information, to-fo-lists, face recognition, and videos. It is expected that in the future, the smart mirror tools provided can be used as virtual reality and augmented reality interactions with software such as Unity Game Engine Development.

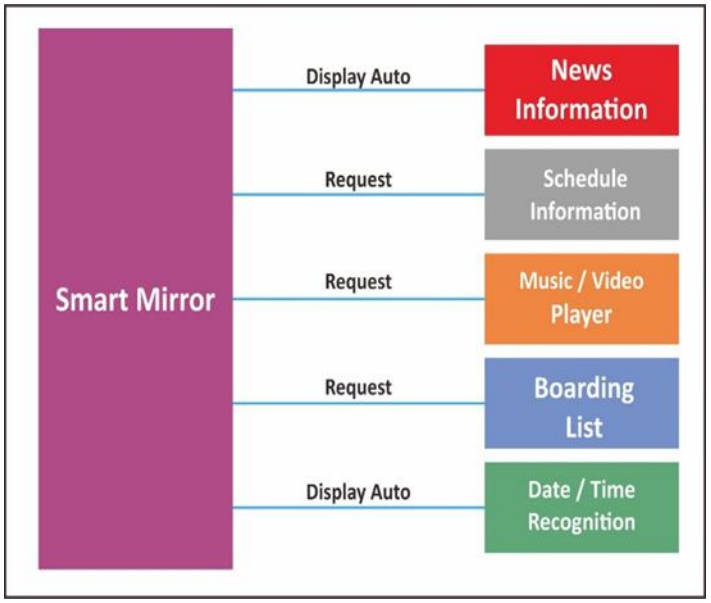

Figure 5: System Design

The system of Figure 5 above shows used and attached using several steps and principles which will be explained below

3.1 Raspberry Pi

Raspberry Pi is a microcomputer module that has an input digital output port like the microcontroller board. But when compared to the raspberry pi board and another microcontroller, raspberry pi has a port/connection for display in the form of TV or PC monitors and USB connections for keyboards and mice that are not owned by another type of microcontroller [11].

To use Raspberry pi, researchers need an operating system (example OS: Windows, Linux, Mac, Unix). Operating systems that are widely used include Linux Raspbian. Here uses Raspbian OS GNU / Linux 10 (buster), which is a version the latest from the Raspbian OS. Then, how to install raspbian OS on a raspberry pi that is owned. Here are some stages regarding the installation of raspbian OS [10].

3.2 Database System

The programming language in website development is to use PHP using the CI (Codeigniter) framework. The Codeigniter Framework has a Model-View-Controller (MVC) architecture [23].

1. Model
The model represents data used by applications, such as databases, RSS, or data obtained from API calls, and actions that involve the operation of Create, Read, Update, and Delete (CRUD) data.

2. View
The view is information that is displayed to the user through a browser, usually in the form of HTML files or PHP code that compiles a template for a website. In CodeIgniter, the view can be parts of a page, template, or other types of pages or templates [24].

3. Controller
The controller is a "business logic" that serves as a bridge between the model and view. The controller will respond to HTTP requests coming from the user (through a browser). From this request, the controller will determine what needs to be done.

This digital information board web creation system requires a MySQL database that is used to store all the required content. In this database, there are also several tables to facilitate data management. The following is a database design that has been made**.**

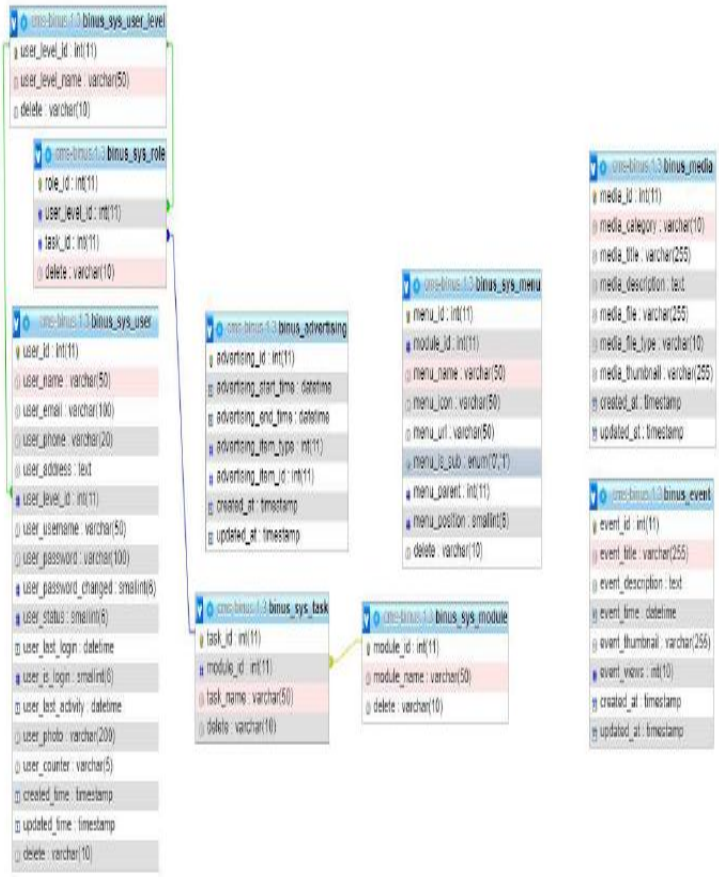

Figure 6: Database Overview

4. DESIGN IMPLEMENTATION

After setting up a number of tools and making this technology, researchers conducted several schemes to meet the objectives

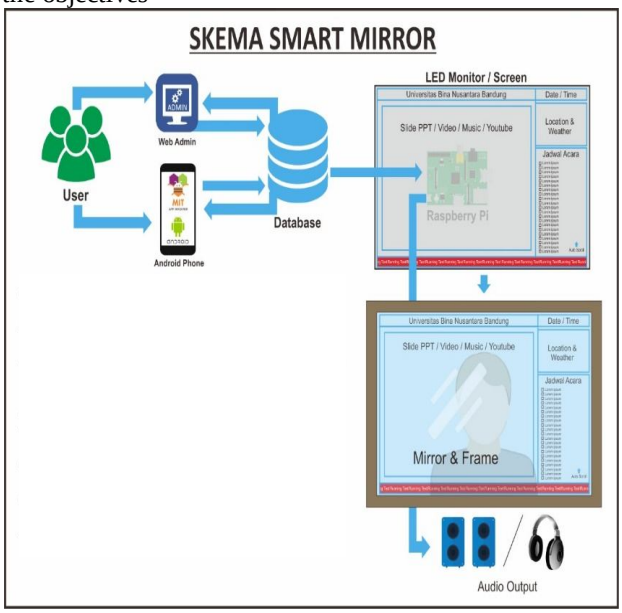

Figure 7: Smart Mirror Scheme

The system, especially the large mirror control system, consists of one-way mirrors, driver boards, screens, etc. The system has a basic system like a mirror screen and the interaction between the two names, humans and computers [25]. In accordance with the nature of the mirror, used by researchers so they can load information when teaching and learning activities in the database, such as the weather, news, time, facial recognition, etc. Smart Mirror can also use a user's mobile phone via a WLAN network and can be remotely using Web-Based or Android such as changing the contents of the word board, changing the mirror image, etc. Show in discuss it in Figure 7.

Figure 7 shows if the image uses a full view and functions to see the information that always supports and has software forms like videos, slides, ppt, and pdf. So lecturers and students need to optimize this. The best form is landscape because of the resolution scale. The picture below is the result of research forms

Figure 8: Display login page Web Admin/Android

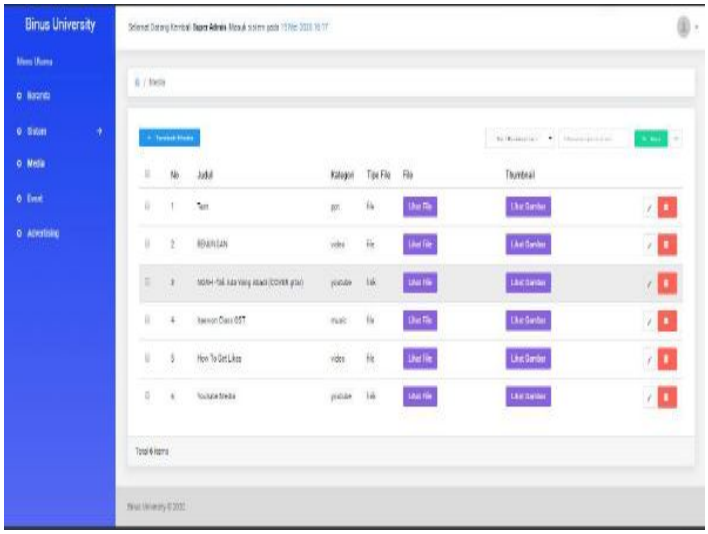

Figure 9: Display Menu Media WEB Admin

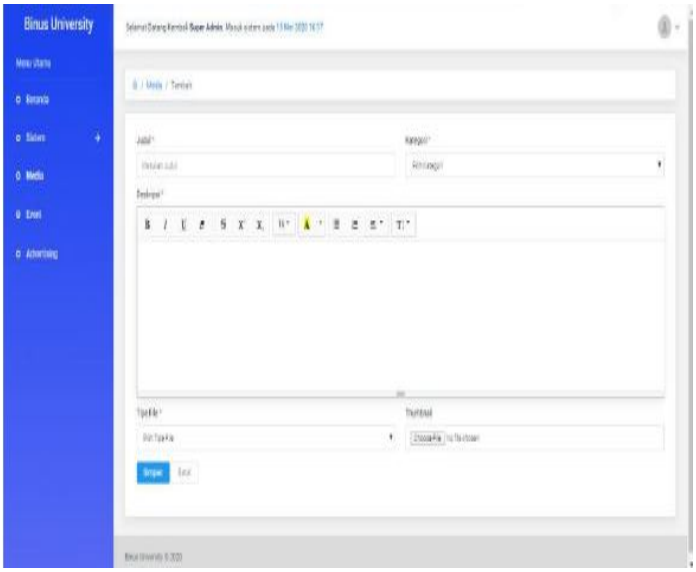

Figure 10: Display Sub Media Menu Web Admin

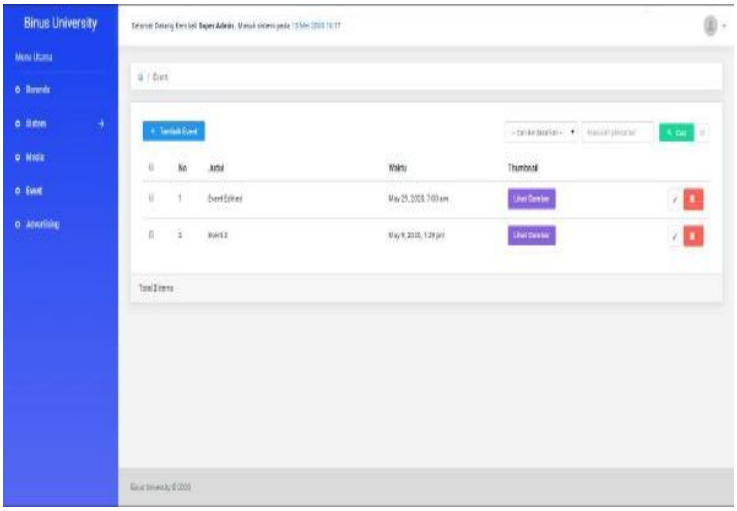

Figure 11: Event Menu Web Admin

Figure 12: Connect with Face Recognition

4.1 Effects on improving education

In accordance with Figure 12 shows this tool can be used for interactive classes because smart mirrors can also be drawn with unique glass markers. Basically, the class is interactive and has student-teacher involvement, carried out by increasing conscious interaction between the two. This can be granted with the use of this smart mirror.

With the provision of smart mirrors as a hardware framework, it can also increase creativity for both of them to continue to innovate on this tool

Figure 8-12 Above shows the result of the Smart Mirror that researchers made, from the initial display android and web admin to connect facial recognition. So that it is expected to be able to increase interaction between lecturers and students using this available tool

5. SYSTEM TESTING

The results of the research were successful in carrying out several tests using the BlackBox method on the software and hardware system of the smart mirror device. This method is carried out to ascertain whether the system in the study has met the requirements. The terms "Success" and "Fail" appear as a compilation of field trials conducted with good or bad results. To be applied and developed in the future system. Table 2 shows the results of the unit tests conducted by the researchers.

Table 2: System Testing Result

Test Case	Expected Result	Actual Result (1)	Actual Result (1)
Raspberry Pi Configuration	Can log in Raspberry Pi	Success	Success
Database Setup	Display Configuration Database	Success	Success
Connect Database to Raspi	Can Connect	Fail	Success
Login Menu	Can Display Login Menu	Success	Success
Dashboard Menu	Can Display Dashboard Menu	Success	Success
Media Menu	Can Display Media Menu	Success	Success
Event Menu	Can Display Event Menu	Success	Success
Frontend Display	Display Menu Frontend	Success	Success
Face Recognition	Display System	Fail	Fail
Influence on learning	Increase lecturer-student innovation	Success	Success

In addition to testing using the BlackBox method, the author also conducted a field test using 70 participants (lecturer and student) who were ready to assess the quality of this device. Finally, the results obtained in the form of charts like Figure 13 below:

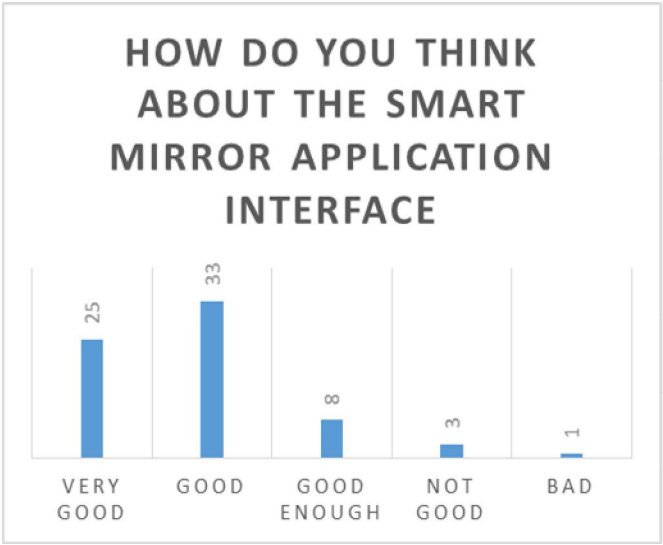

Figure 13: Questioner Result 1

In Figure 13. proven if stretched from very good - quite good, only about 4 or 5.71% of people do not like this application Smart Mirror. This is due to a face recognition system failure, even though the application is in accordance with the

standard. So that the essence is obtained if the Smart Mirror interface is feasible to use.

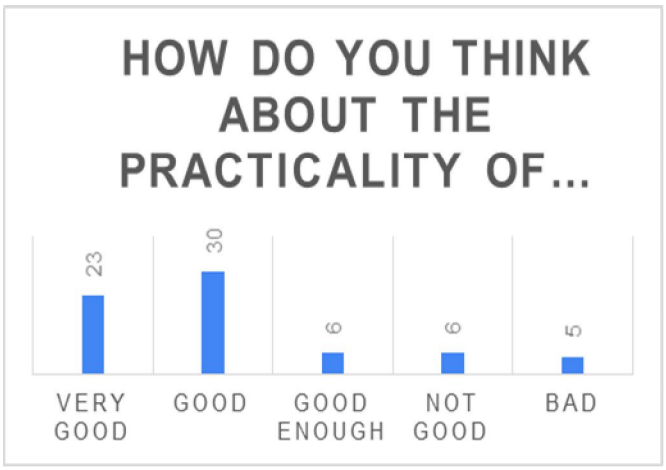

Figure 14: Questioner Result 2

In Figure 14. Shows about 11 people, or 15.1% of people, do not like the practicality of the Smart Mirror, the figure above is reasonable. This is because the application still uses web Admin and face recognition failure, because most lecturers, especially parents, are very difficult to use this. So that the requirements need to be improved

5. CONCLUSION

Based on the research results and the results of the implementation of the smart mirror at the University of BINUS Bandung has been able to have positive results. Some concept tools are based on informatics and several databases. The smart mirror test and its implementation have been successful and so can improve learning and successfully connected to the login menu, login event, marketing login, frontend, backend, etc. so that it can be accepted. The next smart mirror test has also been successfully accessed with a smart mirror device and can be used to improve learning. Finally, the smart mirror test failed to make face recognition so that in some questionnaires, it influenced the results.

ACKNOWLEDGEMENT

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REFERENCES

[1] S. Ziegler, S. Nikoletsea, S. Krco, J. Rolim, and J. Fernandes, "**Internet of Things and crowd sourcing - A paradigm change for the research on the Internet of Things**," *IEEE World Forum Internet Things, WF-IoT 2015 - Proc.*, pp. 395–399, 2015.

[2] M. Hamza, S. A. Lohar, S. Ghulamani, and A. Shah, "**Smart Mirror for Home and Work Environment**," pp. 1–4, 2020.

[3] V. Singh and D. Singh, "**Smart Interactive Mirror Display**," *Proc. Int. Conf. Mach. Learn. Big Data, Cloud Parallel Comput. Trends, Prespectives Prospect. Com. 2019*, pp. 140–145, 2019.

[4] B. Cvetkoska, N. Marina, D. C. Bogatinoska, and Z. Mitreski, "**Smart mirror E-health assistant - Posture analyze algorithm**," *17th IEEE Int. Conf. Smart Technol. EUROCON 2017 - Conf. Proc.*, no. July, pp. 507–512, 2017.

[5] M. H. Widianto, "**Analysis of application of online work exchange using technology acceptance model and innovation diffusion theory**," *J. Theor. Appl. Inf. Technol.*, vol. 98, no. 10, pp. 1697–1711, 2020.

[6] S. Ghanghas, S. Dahiya, M. K. Pandey, and S. Tripathi, "**Design and development of iot based intelligent home automation system**," *Int. J. Emerg. Trends Eng. Res.*, vol. 8, no. 7, pp. 3487–3494, 2020.

[7] Anchal and P. Mittal, "**Iot based intelligent modeling of smart home parking environment**," *Int. J. Emerg. Trends Eng. Res.*, vol. 8, no. 7, pp. 3442–3446, 2020.

[8] A. C. Njaka, N. Li, and L. Li, "**Voice Controlled Smart Mirror with Multifactor Authentication**," *2018 IEEE Int. Smart Cities Conf. ISC2 2018*, 2019.

[9] D. A. Alboaneen *et al.*, "**Internet of Things Based Smart Mirrors: A Literature Review**," *ICCAIS 2020 - 3rd Int. Conf. Comput. Appl. Inf. Secur.*, no. 1, 2020.

[10] M. Mu *et al.*, "**Smart Mirror for Smart Life Soft Computing and Data Mining Centre**," pp. 4–8, 2017.

[11] Y. Sun, L. Geng, and K. Dan, "**Design of Smart Mirror Based on Raspberry Pi**," *Proc. - 3rd Int. Conf. Intell. Transp. Big Data Smart City, ICITBS 2018*, vol. 2018-Janua, pp. 77–80, 2018.

[12] Y. D. Nurseha and L. N. Pradany, "**Survei Aplikasi E-learning untuk Mendukung Proses Belajar Mengajar pada Institusi Pendidikan Menggunakan Standar Kualitas ISO/IEC 9126**," *J. Ultim. InfoSys*, vol. 5, no. 2, pp. 106–111, 2014.

[13] L. Bruno, "済無No Title No Title," *J. Chem. Inf. Model.*, vol. 53, no. 9, pp. 1689–1699, 2019.

[14] Yusrizal, "**Survey of the Use of Information and Communicaton Technology in the Border Regio**," *J. Teknol. Inf. dan Komun. Inf. dan Komun.*, vol. 5, no. 1, pp. 13–28, 2016.

[15] D. Evans, "**IoT by Cisco 2011.pdf**," *Cisco Internet Bus. Solut. Gr.*, no. April, 2011.

[16] M. Murphy, "**Population definitions for comparative surveys in education**," *Aust. Counc. Educ. Res.*, no. January, p. 33, 2016.

[17] A. Nimota, J. Kadir, T. A. Adebayo, and S. Abayomi, "**Visionary Leadership and Staff Innovative Behaviour in Public Colleges of Education In Kwara State, Nigeria,**" *Int. J. Educ.*, vol. 12, no. 2, p. 72, 2020.

[18] A. Yenas, "**The importance of strengthening relationality: Experiences of women living with visible, physical disabilities in rural Papua New Guinea**," *Int. Educ. J.*, vol. 18, no. 2, pp. 95–109, 2019.

[19] D. Samsudin and T. I. Hardini, "**the Influence of Learning Styles and Metacognitive Skills on Students' Critical Thinking in the Context of Student Creativity Program**," *Int. J. Educ.*, vol. 11, no. 2, p. 117, 2019.

[20] A. Johri, S. Jafri, R. N. Wahi, and D. Pandey, "**Smart mirror: A time-saving and affordable assistant**," *2018 4th Int. Conf. Comput. Commun. Autom. ICCCA 2018*, pp. 1–4, 2018.

[21] R. Nadaf and V. Bonal, "**Smart Mirror using Raspberry Pi as a Security and Vigilance System**," *2019 3rd Int. Conf. Trends Electron. Informatics*, no. Icoei, pp. 360–365, 2019.

[22] M. Tani and N. Umezu, "**Development of A Smart Mirror with Life Log Functions and Its Evaluation**," *2018 IEEE 7th Glob. Conf. Consum. Electron. GCCE 2018*, no. Gcce, pp. 851–852, 2018.

[23] P. A. W. Putro and R. Rionaldy, "**Implementation of the Park Schema on User Authentication Services Using Password-Based Web Codeigniter Library to Overcome Man in the Middle Attack**," *Proc. 2019 4th Int. Conf. Informatics Comput. ICIC 2019*, 2019.

[24] R. Valarezo and T. Guarda, "**Comparativo de los Frameworks Laravel y Codeigniter Frameworks**," *2018 13th Iber. Conf. Inf. Syst. Technol.*, pp. 1–6, 2018.

[25] G. Moller and D. Strawn, "**Patent Application Publication (10) Pub . No .: US 2015 / 0144564 A1**," vol. 1, no. 19, 2015.