P-ISSN: 2528-5688
E-ISSN: 2528-5696

VOLT

Jurnal Ilmiah Pendidikan Teknik Elektro

Journal homepage: jurnal.untirta.ac.id/index.php/VOLT

Vol. 8, No. 1, April 2023, 1-10

Design a wristband based on Internet of Things for blind people

Atika Juliadrianni[1]*, Ibnu Ziad[1], S. Suroso[1]

[1]Department of Electrical Engineering, Politeknik Negeri Sriwijaya, Palembang 30137, Indonesia
*Corresponding author: atikajuliadrianni13@gmail.com

Received: 1 March 2023. Revised: 8 April 2023. Accepted: 18 April 2023. Available online: 30 April 2023
https://doi.org/10.30870/volt.v8i1.21392

Abstract

The objective of this research is to develop a tool that assists blind individuals and enhances their supervision. Specifically, the research focuses on designing blind wristbands that utilize the Internet of Things (IoT) technology. This study use quantitative approach and utilizes pre-experimental design to conduct experiments. This gadget facilitates the dissemination of information to the wearer of the wristband in order to prevent barriers. The tool is constructed utilizing the HC-SRF05 ultrasonic sensor, which will be utilized as an input and processed by the NodeMCU microcontroller ESP8266. The output will be produced by the buzzer. This tool utilizes advanced object detection capabilities to identify and locate items within a range of around 100 cm in front of it. The purpose of this feature is to furnish users with valuable information that can aid in avoiding potential impediments. This equipment is fitted with GPS to surveil and monitor the location of wristband users.

Keywords: blind people wristband; HC-SRF05 Ultrasonic Sensor; NodeMCU; microcontroller; ESP8266; buzzer; GPS

INTRODUCTION

Individuals with vision impairments frequently encounter challenges when performing everyday tasks. Blind individuals encounter several challenges in their daily activities, including restricted mobility due to walking limits and impaired spatial awareness caused by low vision. Consequently, navigating unfamiliar environments can prove to be arduous and hazardous for them (Pravitasari et al., 2014) (Lee et al., 2011) (Gelmuda & Kos, 2013) (Febriandi et al., 2020). Many visually impaired individuals often collide with walls or things directly in front of them. The objective of this project is to develop a tool called the Internet of Things (IoT)-Based Blind wristband Design, which aims to assist blind people and enhance their supervisory capabilities.

The utilization of technology has significantly enhanced living by streamlining regular tasks. An instance of technology utilization is remote monitoring. Thus, this study employs technology to assist visually impaired individuals in navigating and tracking their location by utilizing wristband for enhanced portability.

(Utomo, 2019) (Gubbi et al., 2013) (Zanella et al., 2014) provides a definition of the Internet of Things (IoT) as a technological system that allows for the management, communication, and collaboration with various objects and data through the internet network. The Internet of Things (IoT) establishes connectivity amongst inanimate items (Xu et al., 2014) (Adani & Salsabil, 2019). IoT is an innovative concept that seeks to extend the advantages of uninterrupted internet connectivity (Efendi, 2018) (Al-Fuqaha et al., 2015). According to (Utomo, 2019) the Internet of Things (IoT) is a technology that enhances the functionality of the internet and has the potential to revolutionize people's lives. An effective approach to comprehend the concept of the Internet of Things (IoT) is to endeavor to establish internet connectivity for all gadgets (Harsanto, 2020) (Swamy & Kota, 2020).

The wristband, based on the Internet of Things (IoT), operates by utilizing a scanning technique to detect objects. Currently, individuals with vision impairments typically utilize canes for walking. Nevertheless, the stick is limited in its ability to promptly detect and alert the presence of impediments in its path. Prior study has yielded findings regarding the development of blind gloves utilizing ultrasonic sensors and Arduino nano. The research serves the purpose of identifying things located up to 100 cm in front of the user (Ramadhana, 2020). An innovative aspect of this study is the incorporation of GPS technology, which enables the tracking of the whereabouts of blind individuals wearing the bracelet.

The findings of this research can serve as a foundation for aiding visually impaired individuals in doing their daily tasks through the utilization of blind bracelets. These bracelets can offer users valuable information to navigate around obstacles. Prior investigations have employed sticks or belts as receptacles for blind aids, but this study utilized wristbands as receptacles for blind aids, aiming to enhance accessibility for those with visual impairments. This tool is additionally coupled with GPS technology that leverages the application as an Internet of Things (IoT) platform, facilitating the monitoring and locating of blind bracelet users. This tool utilizes the HC-SRF05 ultrasonic sensor as an input, which is then processed by a microcontroller, and produces an output through a buzzer. This instrument has the capability to detect items within a radius of approximately 100 cm in front of it.

METHOD

This study employs quantitative methodologies utilizing an experimental research design. Figure 1 illustrates the research phase, which encompasses several steps including literature study, problem identification, hardware design, software design, hardware and software integration, tool system testing, and result analysis.

During the hardware design stage, the relevant components are prepared and installed into the hardware. Next, develop software in the format of Arduino IDE programming programs. The subsequent phase involves the incorporation of both Hardware and Software through installation. Ultimately, the testing tools and methods are utilized to assess the functionality and performance of the system for subsequent evaluation.

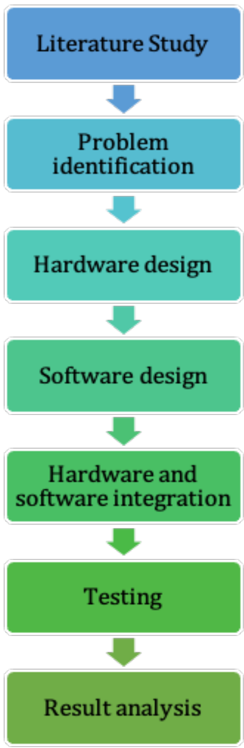

Figure 1. Research phase

Hardware design

The NodeMCU ESP8266 microcontroller is utilized as the primary controller of the device (Sindhu, R. D., Sari, I., & Lestari, D. P., 2021). This component will have primary control over the processing of incoming data and outgoing commands, making it the most crucial component. Furthermore, the HY-SR05 is employed as a proximity sensor that utilizes wave transmission to measure the distance by detecting the waves that rebound from the object and are then captured by the component (Frima Yudha, P. S., & Sani, R. A., 2019).

The GPS GY-NEO6M module functions as a sensor that detects and retrieves coordinate points by comparing the latitude and longitude positions of the device, resulting in the acquisition of coordinate values (Firdaus, F., & Ismail, I., 2020). Additionally, the buzzer serves as an automatic alert that produces sound as an output function. At last, an operational Android phone is running an Internet of Things (IoT) application that is capable of showing notifications and the user's location. Figure 2 displays a block diagram of the designed system circuit.

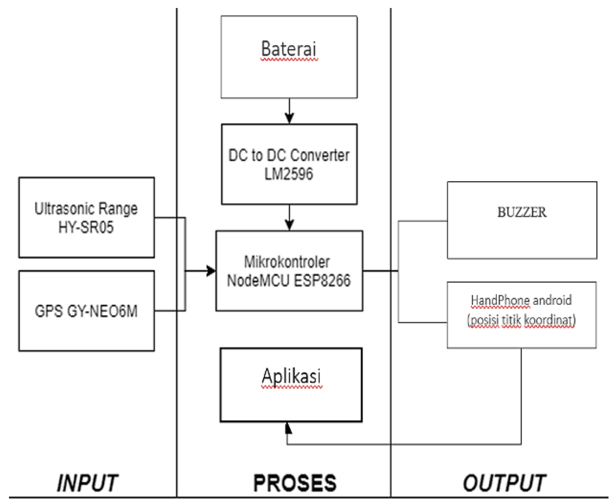

Figure 2. The block diagram of the designed system circuit.

The circuit diagram of the system can be observed in Figure 3. A GPS device is utilized to transmit application notifications when the wearer of the wristband exceeds a distance of 1 kilometer from a designated location. The point refers to the specific coordinate location of the application that is linked to the GPS point on the blind bracelet gadget. The process is referred to as the differential method.

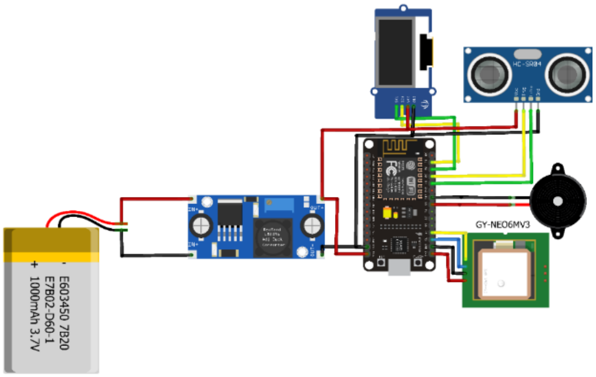

Figure 3. System circuit scheme

Software design

An application was developed to monitor the activities of blind individuals wearing wristbands. This application encompasses all the infrastructure and equipment employed in the sector, utilizing a monitoring mechanism based on the Internet of Things (IoT). The first step in designing this software involves creating a prototype, which is an early iteration of the software system. This prototype serves the purpose of illustrating concepts, conducting design tests, and identifying more issues and potential solutions (Renaningtias & Apriliani, 2021).

Arduino IDE software is used for system coding. This software is beneficial for programming on the NodeMCU ESP8266 microcontroller. Figure 4 illustrates the steps of the tool's operational system, while Figure 5 demonstrates the processing of these stages through the Arduino IDE.

The device is linked to a 5-volt battery and will activate upon pressing the on button. Subsequently, the tool is linked to a wifi network, enabling the system to retrieve data from the ultrasonic proximity sensor and GPS sensor. An alarm will ring from the buzzer if the proximity sensor detects an object or obstruction in front of it. The GPS application displays the location of the visually impaired user wearing the wristband on the map. Nevertheless, in the event that the wristband user who is visually impaired is beyond the designated range or a considerable distance away from the user, the GPS system will transmit an alert in the form of a notice to the corresponding application. This study established a definitive safe distance of 1 kilometer for those with visual impairments.

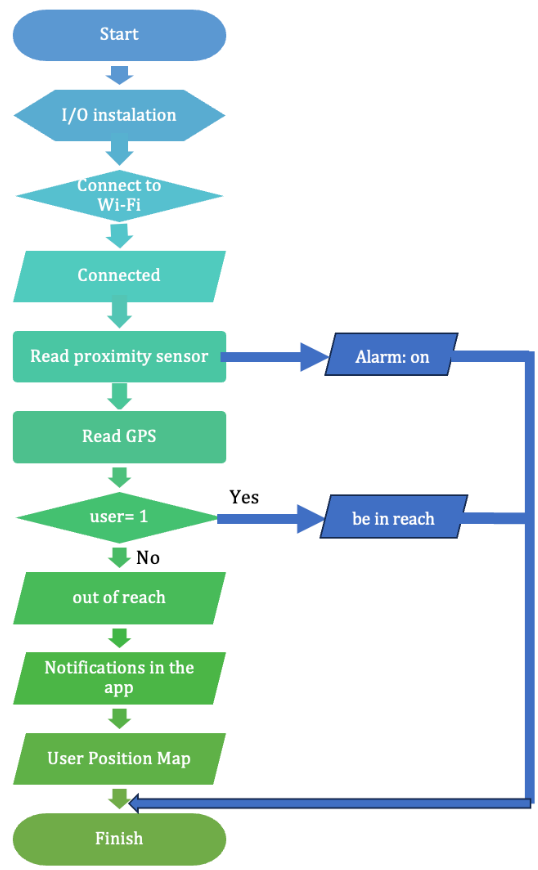

Figure 4. Software design

Integration of hardware and software

This integration is achieved by the amalgamation of hardware and software to ensure optimal performance and functionality. The integration of hardware with this application is accomplished through the utilization of Arduino IDE programming, as depicted in Figure 5.

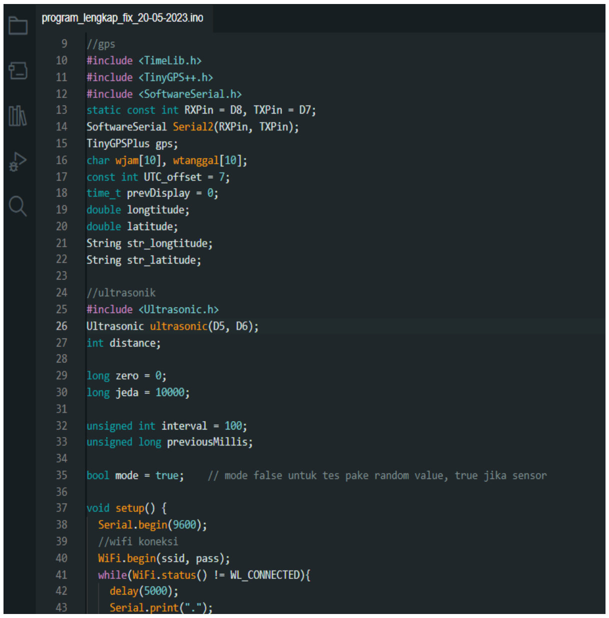

Figure 5. Programming in the Arduino IDE

System testing

The experiment was conducted by selecting a specific group of individuals, specifically visually impaired individuals who had been equipped with wristbands. Then, conducting experiments by intentionally altering the circumstances and observing blind individuals as they navigate planned obstacles, such as trees, walls, and other individuals. Furthermore, the experiment was conducted by affixing wristbands that obstruct vision to the participants. Next, maintain a distance of 1 kilometer from the application user to verify the proper functioning of the program and determine the location of the user wearing the blind bracelet based on the Internet of Things. The experiment undertaken is represented by Figure 6.

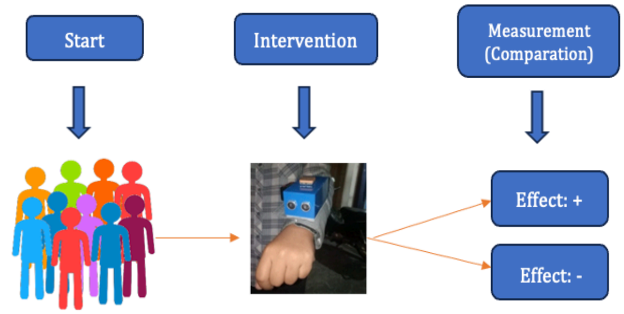

Figure 6. Experiment design

RESULT AND DISCUSSION

The research findings were obtained through system testing, which showcased the impeccable performance of the wristband. The results of wristband testing with obstructive objects such as doors, individuals in motion or at rest, sofas, cupboards, garbage bins, glass, and other objects are displayed in Table 1.

Table 1. HY-SR05 sensor testing

Test	Radius (cm)	Buzzer
1(people on the move)	50	on
2 (wall)	30	on
3 (door)	70	on
4 (glass)	400	off
5 (people do not move)	20	on
6 (sofa)	100	on
7 (cupboard)	90	on
8 (bed)	80	on
9 (bottle)	110	off
10 (trees)	65	on
11 (motorcycle)	100	on
12 (chair)	200	off
13 (chair)	40	on
14 (trees)	105	off
15 (glass)	95	on

According to Table 1, the sensor can identify items that are less than 100 cm in distance. However, if the object is more than 100 cm away, the sensor will not activate the buzzer to transmit a warning.

GPS Application

The functionality of the Ublox NEO 6M application and GPS has been tested to verify that the circuit operates as intended by a specifically built program. This program enables the system to send alarm notifications when the blind wristband user exceeds safe boundaries and allows for tracking of the user's position. Testing of this gadget is conducted both outdoors and indoors. Table 2 displays the test results.

Table 2. GPS application testing

Active	delivery	duration (minutes)	Coordinate of location
08:11	08:16	5	-2.9815815, 104.732967833
08:15	08:25	10	-2.9815, 104.7329
10:25	10:32	7	-2.98151, 104732547333
12:23	12:27	4	-2.9893715, 104.738040667
13:20	14:21	61	-2.989407167, 104.738023333
16:47	16:48	1	-2.98159, 104.73299
16:50	16:55	5	-3.2486107473 104.6773315607
17:10	17:25	15	-3.20413546203 104.6534857257
18:05	18:25	20	-2.975950859404 104.741771798137
18:27	18:30	3	-2.952495653245 104.71213641682739
18:40	19:30	50	-2.959875746704 104.73629072772417
19:35	19:53	18	-2.987078968417 104.74762734755242
21:11	21:12	1	-2.987745667, 104.73295
21:17	21:27	10	-2.98143, 104.73

How to use the differential approach to find your GPS position (Muyassaroh, S., 2014). Differential functions by calculating a point's or wristband user's position in relation to other points whose coordinates are known. Testing GPS applications—they function fine outside. However, GPS can still function properly but deliver data more slowly in a room where there is still an incoming signal. As shown in table 2, there are instances in which GPS is unable to receive signals when inside a closed space. Due to signal interference, GPS finds locations more difficult indoors. However, when tested outdoors, GPS finds coordinates quickly thanks to unimpeded signals.

Evaluating the prototype in its entirety

Parameter keberhasilan alat digunakan untuk mengetahui tingkat keberhasilan alat yang dikembangkan sesuai dengan karakteristiknya. Parameter keberhasilan alat dapat dilihat pada Tabel 3, sedangkan keterangan data alat survey dan data hasil pengujian tersaji dalam Tabel 4 dan 5.

Product success parameters are utilized to assess the efficacy of the generated tool based on its specific attributes. The success metrics of the products are displayed in Table 3, while the details of the instrument's survey data and test result data may be seen in Tables 4 and 5, respectively.

Table 3. Product success parameters

Element	Parameters
Ultrasonic Sensor and Buzzer	Effective of detecting distances below 100 cm using sound as a warning.
GPS and GPS Apps	This application gets the user's location and deliver notifications when it exceeds a predetermined distance.

Table 4. Survey Tool Data Description

Keywords	Descriptions
1	Tool working
0	Tool not working
HD	Front Obstacle
HK	Small Obstacle
OP	Plastic Object
OB	Moving Objects
GPS	Transmit coordinates

Tabel 5. Testing result

Name	HD	HK	OP	OB	GPS	%
NT	1	1	1	1	1	100%
JN	1	1	1	1	1	100%
AT	1	0	1	1	1	80%
BJ	1	1	1	1	1	100%
DK	1	1	1	0	1	80%
SS	1	1	1	0	1	80%
FD	1	1	1	1	1	100%
KS	1	1	1	1	1	100%
HS	1	0	1	1	1	80%
DL	1	0	0	1	1	60%
DA	1	1	1	0	1	80%
AJ	1	1	1	1	1	100%
AL	1	0	1	1	1	80%
AD	1	1	1	1	1	100%

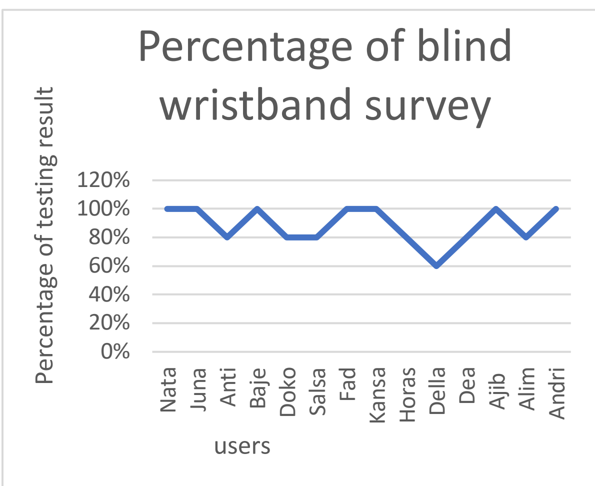

Figure 6. Blind wristband survey percentage

The accuracy value can be calculated using the formula:

$$\% = \frac{Total\ success}{Total\ subject} = \frac{1240}{14} = 88{,}5\%$$

Table 5 demonstrates that the Internet of Things (IoT) based blind wristband technology achieved a success rate of 88.5% when tested on 14 individuals with visual impairments. Figure 7 illustrates the tool's ability to identify the presence of the observed object.

Figure 7. User position map

Through conducted testing on the prototype, it has been determined that this tool had the capability to detect impediments in its path. Additionally, the sensor is capable of detecting both small things and objects in motion.

CONCLUSION

This wristband utilizes ultrasonic sensors, buzzers, and GPS technology, with the NodeMCU ESP8266 serving as the microprocessor. This product possesses an ability to identify items situated in its path and ascertain the location of visually impaired individuals or individuals wearing a wristband, thereby facilitating their mobility.

The ultrasonic sensor has a maximum range of 100 cm and the buzzer will emit sound if it senses an obstruction in its path. The GPS NEO 6M module demonstrates optimal performance in outside environments, while its functionality indoors is contingent upon the presence of a signal. When the GPS is located outdoors or in an unobstructed space, this application effortlessly displays the location of the visually impaired individual wearing the wristband. However, the software encounters challenges in displaying the position when the GPS is used indoors, as it is unable to accurately determine the location within an enclosed space. The signal also influences the rate at which GPS searches for coordinate points.

REFERENCES

Adani, F., & Salsabil, S. (2019). Internet of Things: sejarah teknologi dan penerapannya. *Jurnal Online Sekolah Tinggi Teknologi Mandala*, *14*(2), 92–99. http://ejournal.sttmandalabdg.ac.id/index.php/JIT/article/view/162

Al-Fuqaha, A., Guizani, M., Mohammadi, M., Aledhari, M., & Ayyash, M. (2015). Internet of Things: A Survey on Enabling Technologies, Protocols, and Applications. *IEEE Communications Surveys and Tutorials*, *17*(4), 2347–2376. https://doi.org/10.1109/COMST.2015.2444095

Efendi, Y. (2018). Internet Of Things (Iot) Sistem Pengendalian Lampu Menggunakan Raspberry Pi Berbasis Mobile. *Jurnal Ilmiah Ilmu Komputer Fakultas Ilmu Komputer Universitas Al Asyariah Mandar*, *4*(1), 19–26. https://doi.org/10.35329/JIIK.V4I1.48

Febriandi, D. R., Widiyani, A. Y., Abdullah, S., Warnars, H. L. H. S., & Utomo, W. H. (2020). Mobile smart application b-help for blind people community. *ICIC Express Letters, Part B: Applications*, *11*(1), 1–7. https://doi.org/10.24507/icicelb.11.01.1

Firdaus, F., & Ismail, I. (2020). Komparasi Akurasi Global Posistion System (GPS) Receiver U-blox Neo-6M dan U-blox Neo-M8N pada Navigasi Quadcopter. Elektron : Jurnal Ilmiah, 12(1), 12–15. https://doi.org/10.30630/eji.12.1.137

Frima Yudha, P. S., & Sani, R. A. (2019). Implementasi Sensor Ultrasonik Hc-Sr04 Sebagai Sensor Parkir Mobil Berbasis Arduino. EINSTEIN E-JOURNAL, 5(3). https://doi.org/10.24114/einstein.v5i3.12002

Gelmuda, W., & Kos, A. (2013). Multichannel ultrasonic range finder for blind people navigation. *Bulletin of the Polish Academy of Sciences: Technical Sciences*, *61*(3), 633–637. https://doi.org/10.2478/BPASTS-2013-0067

Gubbi, J., Buyya, R., Marusic, S., & Palaniswami, M. (2013). Internet of Things (IoT): A vision, architectural elements, and future directions. *Future Generation Computer Systems*, *29*(7), 1645–1660. https://doi.org/10.1016/J.FUTURE.2013.01.010

Harsanto, B. (2020). Inovasi internet of things pada sektor pertanian: pendekatan analisis scientometrics. *Informatika Pertanian*, *29*(2), 111. https://doi.org/10.21082/IP.V29N2.2020.P111-122

Lee, H. P., Chen, C. H., & Sheu, T. F. (2011). An accessible web-based information broadcasting system for blind people. *WEBIST 2011 - Proceedings of the 7th International Conference on Web Information Systems and Technologies*, 404–407. https://doi.org/10.5220/0003335904040407

Muyassaroh, S. (2014). Penyelesaian Persamaan Diferensial Parsial Fokker-Planck Dengan Metode Garis. CAUCHY: Jurnal Matematika Murni Dan Aplikasi, 3(3), 169–173. https://doi.org/10.18860/ca.v3i3.2943

Pravitasari, S. E., Soeaidy, M. S., & Hadi, M. (2014). Pemberdayaan Bagi Penyandang Tunanetra Guna Meningkatkan Kualitas Sumber Daya Manusia (Studi Pada UPT Rehabilitasi Sosial Cacat Netra Malang). *Jurnal Administrasi Publik*, *2*(1), 53–59. http://administrasipublik.studentjournal.ub.ac.id/index.php/jap/article/view/336

Ramadhana, R. (2020). Rancang bangun sarung tangan sebagai alat bantu tuna netra berbasis sensor ultrasonic dan arduino nano. *Jurnal Elektro Dan Telekomunikasi Terapan (e-Journal)*, *7*(2), 877–884. https://doi.org/10.25124/JETT.V7I2.3422

Renaningtias, N., & Apriliani, D. (2021). Penerapan metode prototype pada pengembangan sistem informasi tugas akhir mahasiswa. Rekursif: Jurnal Informatika, 9(1), doi: 10.33369/rekursif.v9i1.15772

Sindhu, R. D., Sari, I., & Lestari, D. P. (2021). Pembuatan Prototype Smart Home Menggunakan Nodemcu Esp8266 V3 Dan Chat Bot Pada Smartphone Android. Jurnal Ilmiah Informatika Komputer, 26(2), 123–135. https://doi.org/10.35760/ik.2021.v26i2.4157

Swamy, S. N., & Kota, S. R. (2020). An empirical study on system level aspects of Internet of Things (IoT). *IEEE Access*, *8*, 188082–188134. https://doi.org/10.1109/ACCESS.2020.3029847

Utomo, T. P. (2019). Potensi implementasi internet of things (iot) untuk perpustakaan. *Buletin Perpustakaan*, *2*(1), 1–18. https://journal.uii.ac.id/Buletin-Perpustakaan/article/view/15173

Xu, L. Da, He, W., & Li, S. (2014). Internet of things in industries: A survey. *IEEE Transactions on Industrial Informatics*, *10*(4), 2233–2243. https://doi.org/10.1109/TII.2014.2300753

Zanella, A., Bui, N., Castellani, A., Vangelista, L., & Zorzi, M. (2014). Internet of things for smart cities. *IEEE Internet of Things Journal*, *1*(1), 22–32. https://doi.org/10.1109/JIOT.2014.2306328