Smart Overtaking System

T. Ranjithkumar
Assistant Professor, Department of Electronics and Communication Engineering, Sri Shanmugha College of Engineering and Technology, Sankari, Salem,Tamilnadu, India.

A. Anbarasu
UG Scholar, Department of Electronics and Communication Engineering, Sri Shanmugha College of Engineering and Technology, Sankari, Salem, Tamilnadu, India.

S. Kathirvel
UG Scholar, Department of Electronics and Communication Engineering, Sri Shanmugha College of Engineering and Technology, Sankari, Salem, Tamilnadu, India.

K. Hariharan
UG Scholar, Department of Electronics and Communication Engineering, Sri Shanmugha College of Engineering and Technology, Sankari, Salem, Tamilnadu, India.

D. Jotheesvaruban
UG Scholar, Department of Electronics and Communication Engineering, Sri Shanmugha College of Engineering and Technology, Sankari, Salem, Tamilnadu, India.

Abstract:- This paper evaluates a conceptualization of Vehicle Blind Spot Monitoring System (VBMS), which performs a more effective approach in barring eyeless spots of the motorist. The recently developed smart eyeless spot monitoring system simply fastening on an advancement of the antedating work, along with compromising stoner comity and cost- effectiveness. Compact design, dependable and low- cost that contributes to a largely affordable safety point are the flagship of this new system. Factors selection is the main part in constructing an affordable eyeless spot discovery system in the present work. Therefore, Arduino UNO R3 model and HC-SR04 ultrasonic detectors were employed for the VBMS system due to reasonable request price. Plus, the ultrasonic detector has demonstrated a remarkable performance in the once eyeless spot discovery system operation. Concerning easy installation as well as conservation on any vehicle, the VBMS is designed as a compact device which assembles the main control unit and sensitive parts in a single body to be located at the bottom of the side glass. Meanwhile, the hazard-warning signal is independently located at the passenger cube for fluently visible by the motorist. The angle and seeing range of detectors are both malleable but vital as their protrusions define the eyeless spot limit directly by characterizing low to a high implicit hazard. At the end of this work, a complete VBMS functional prototype has been established which is effective for real business on- road trials, with colorful conditions specified (static, colorful speed, and overhauled). From the data collected, all targets of the present work have been attained regarding the monitoring miracle shown by the new- erected system. Both pros and cons of VBMS are bandied about for further enhancement ideas on product development.

***Keywords: Arduino, blind spot, monitoring sensor*.**

I. INTRODUCTION

Throughout the driving course, the vital thing is for the motorist to gain information about the changing position of other vehicles on the road to insure a safe condition from road accidents and business logjams. Nevertheless, with the help of side glasses either doesn't cover the entire area around the vehicle to be seen straight by the motorist, as the hind quarter area on both sides of the vehicle are outside the side glass's reflection view. This is pertained to as eyeless spot of the vehicle (1). The eyeless spot is pivotal at a certain condition whereby a motorist fails to describe the presence of hazard as another vehicle enters the eyeless spot area, due to the structural rudiments of the vehicles that limits a full assessment of the road situation (2). This is the primary cause of vehicle crashes that substantially happens towards motorcyclists, which also has been proven by simulation analysis that eyeless spots happen to be a contributing factor towards the rider visibility problem, other than view inhibition and high speed (3). Besides that, the eyeless spot miracle may vary in effect from several factors like the motorist's height and vehicle's size. Plus, large vehicles come up with wider eyeless spots around the vehicle due to the height difference with standard-sized vehicles. Respecting these issues, special ways which were effectively tested in India were expressed in terms of aiding motorists as a decision-maker, by considering the parameter of hinder view glass and implicit impact to dwindle the eyeless spot area of heavy vehicles (4).Currently, considering the safety factor, multitudinous auto manufacturers in the worldwide have made a advance by equipping this technology on their buses with colorful ways initiated by Blind Spot Information System (BLIS) for Volvo, Audi Side Assist (ASA) for Audi and Blind Spot Monitoring (BSM) used by Mitsubishi, Toyota and Mazda as well. In an advanced automotive operation, VehicleAnti-Lock Braking System (ABS) is conceivably taken in control consequently by the objectification of an ultrasonic detector and Control Area Network (CAN) Bus protocol to help collision (5). Unfortunately, it's estimated that until 2016, only 3 of vehicle deals in Malaysia are manufactured with this technology point, which is technically little to none (6). While back in two times agone, the first test for eyeless spot technology has been commenced by the New Car Assessment Programme for South East Asian Countries (ASEAN NCAP), conducted on ten ASEAN popular auto models but none among them are of Malaysia's product (7). This shows that the demand for Malaysian vehicle manufacturers to include this safety outfit on our original products is at a pivotal state. In addition, arithmetic blocks also utilized [28-30].

Numerous approaches have been tried to attack the eyeless spot miracle similar to a camera- grounded system that used several stages for image processing but encounters a big issue regarding inadequate images for birth, that contributes to false and missing findings issue (8). The panoramic view that provides redundant safety information also may be useful if the deformation issue and slower performance regarding this work can be answered (9). Therefore, a simple processing approach via optic inflow has been demonstrated in compromising a real- time safety alarm, without database operation (10, 11, 12), indeed a different fashion through discovery of murk in day and headlamps in night- time had been tried for faster discovery but requires two different algorithms (13). Another design proposed a mongrel algorithm discovery system, designed to bring both effectiveness and delicacy, which consumes a fish- eye camera for a wide- angle view and software combination to define the incoming hazard, but not experimentally proved (14). A different complex deep literacy approach needs to be employed in achieving a vision discovery that's important towards environmental light intensity and shadow factor, which demonstrated up to97.56 system's delicacy (15).In short, the most favorable challenges that keep playing around in a vision- depending eyeless spot system are image deformation that performs in false alarm and complex system configuration. This induced the use of electromagnetic or ultrasonic radar sensors, whereby the operation doesn't circumscribe in the day or night time. Hence, this work aims to develop a functional prototype of a smart eyeless spot monitoring system for all types of vehicles. The Vehicle Blind Spot Monitoring System (VBMS) targeted to give a simple configuration but with zero warning failure since this safety point may be attributed to lives and severe damage matters. The prototype was tested in real road business with engagement of the Perodua Axia1.0 model as a testing vehicle.

II. RELATED WORKS

2.1 Ultrasonic sensor applications

The ultrasonic detector had been used for wide operations due to easy perpetration, eventually reducing the cost matter at the same time offering fast operation. The ultrasound surge used is distributed as a frequency surge beyond 20 kHz up to Gigahertz, which is too high to be audible by the human's observance (16). A work regarding ultrasonic detector operation on ever controlled robots had observed excellent distance measuring delicacy for avoiding single solid and invariant-structured obstacles (17), plus the capability to control the movement of independent robots effectively (18). Likewise, this detector in combination with a potentiometer may help in searching for available parking places in shopping promenades for case, via an online garçon system (19). A great design regarding automatically operated sewerage operation had demonstrated effective swash blockage junking by determining the height of accumulated waste using detectors inside a designed platform (20). These studies show that short distance dimensions can be performed well by the ultrasonic detector in colorful ways from the small to bigger operations.

2.2Arduino-based sensor for blind spot detection

A Vehicle Eyeless Spot System (VBSS) prototype device proposed by (21) is an illustration of which eyeless spot discovery that employs the Arduino control unit and the ultrasonic detectors which are eventually cheaper than the electromagnetic radar. The system has been effectively tested on the real road condition and successfully detected vehicles entering the eyeless spot zone. Nonetheless, as analogous to presently used BSM radar technology in the automotive assiduity, the VBSS distributed factors installation around the auto body still upholds a complexity issue. Wiring, corridor assembly and warning geste need to be critically compromised for a fresh outfit that's stoner-friendly. Hence, the benefits of this work will be attributed to a compact- designed system for easy installation as well as conservation purpose, low cost and high effectiveness not only for hazard discovery but to cover the threat situations as a motorist's co-pilot.

III. METHODOLOGY

3.1 Establishment of Design Concept

The new product design conception for the overall system's structure acquires compactness and flexibility as the main criteria. The compact or simpler design associated with optimum use of element device and body assembly, make it easier to be installed or' add-ons' to the current vehicle as well as conservation purposes. Meanwhile, the inflexibility concept drives a largely compatible eyeless spot content so that any mid-sized vehicle type may be equipped with this technology. The system's internal measure is a crucial part in the performance of these parcels. Figure 1 presents an overview of VBMS's inflow process.

Figure 1: VBMS workflow

The system begins with object discovery in the eyeless spot limit which depends on distance of detector propagation, in this case, the ultrasonic detectors. At this moment, the data signal is transferred to the control unit to be reused. The Arduino regulator takes over the process of relating the hazard and makes a decision.However, a warning signal will be blinked to warn the motorist about the incoming object, If the hazard is verified. During the final stage, the redundant information is handed to the motorist regarding the hazard threat position via object monitoring grounded on the distance measured by a detector within the eyeless spot zone, until it disappears. This monitoring fashion used is analogous to multitudinous Arduino-ultrasonic systems as the distance dimension determines different affair geste, including seeing operation for liquid leveling (22, 23).

3.2 Characterization of Internal Measures

3.2.1 Sensing range set up and program sketching

Beginning the setting up process, eyeless spot zone limit of the testing vehicle was specified first as the main part in developing the warning system which involves variables like viewing angles and vehicle model sizes (24), which is why the real- condition dimension of the vehicle is important as demonstrated in Figure 2 (a) expresses the right side of the vehicle with specific seeing range values, which are pre-determined in the rendering program. These values may vary in agreement with vehicle size

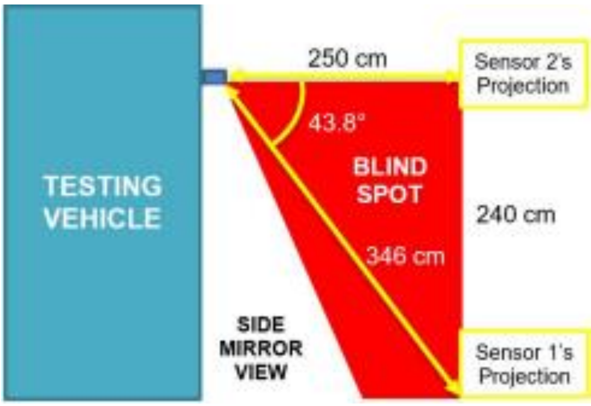

Figure 2: (a) VBMS sensing range on Perodua Axia model.

At first,2.5 m seeing range for Sensor 2 was set according to the minimal range of standard roads. By carrying the Sensor 2 seeing distance and the measured value from side glass to the aft end of the auto, Sensor 1 seeing range and propagation angle can be calculated consequently, which acts precisely within the set-up parameter.
An Arduino Integrated Development Environment (IDE) that compatible with Arduino Uno R3 was used for the construction of programming law, enabling the periodical input from detectors and LEDs to be transferred to the Arduino board incontinently via Universal Periodical Machine (USB) string. C language was used for programming law, where it measures the parameters and functions to be controlled while covering hazard, including the seeing range that determines the VBMS warning geste's. The rendering sketch uses' step ()'and' circle ()'as the medication and prosecution orders, independently. The circle function that makes the following canons continuously repeated after every one completes prosecution (25), which is important to give real- time monitoring. This part is responsible for the data processing stage and to spark the alarm geste, grounded on the seeing range.

3.2.2 Design modeling and simulation for system functional validation

Figure 3 describing a complete wiring illustration of the new VBMS on TinkerCad, the online-free Arduino simulator, allows the simulation to be run on the completed circuitry for functional- checked purposes. The written program law from the IDE software is used in the simulation test to see whether all the factors involved could work with the rendering program in order to pass the test before uploaded to the Arduino regulator set. This theoretical test is taken as a base standard for the overall connection and rendering synchronization, and detects indeed a single misconnection and locates the source of error specifically. It's simple to use and veritably practical for system

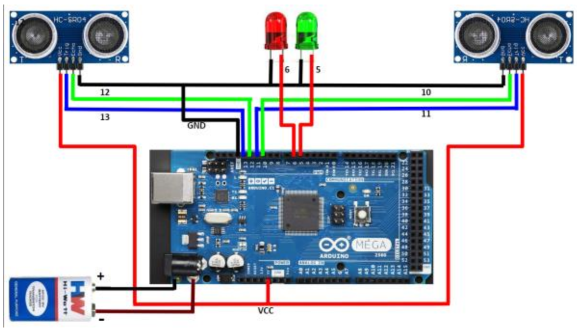

Figure 3:Schematic circuit of VBMS simulation

Then, once the system connects with power force, both ultrasonic detectors emit the ultrasound surge within a specific range and sense for the distance of the presence handicap to be transferred to the processing unit. In the meantime, the LEDs blink with different geste when the handicap moves within the seeing range, as controlled by the processor grounded on distance value calculated. These processes are repeated continuously until the system is powered off. Four legs are equipped on HC-SR04 detector, videlicet Voltage at the Common Collector (VCC)'for power force,'Trig For impulse detector,'Echo For impulse receiver, and'Ground (GND)'for ground connector. The leg connection for program law to the control unit system is epitomized in Table 1. All detectors and LEDs periodical input and affair which are the positive outstations are connected to the Arduino digital legs according to their associated Leg, while the negative terminal pertains to as the ground connection. As one misleading is enough to beget total casualty, these connections are arranged in a sequence of the number of legs for easy reference therefore precluding system malfunction in the VBMS performance test.

Table 1: Pin connection to Arduino board

Pin/Terminal	Sensor 1	Sensor 2	LED 1	LED 2

VCC	5V	5V	-	-
TRIG	13	11	-	-
ECHO	12	10	-	-
GND	GND	GND	-	-
POSITIVE	-	-	6	5
NEGATIVE	-	-	GND	

3.3 Development of Device Prototype

3.3.1 Sensing unit operation, compatibility, and limitations

Originally, the sensitive part of the system was chosen, which is an ultrasonic detector HCSR-04 module as shown in Figure 4, to be identified with the Arduino set. Exercising 5V Direct Current (DC) to emit a 40 kHz sonar surge, this detector performs anon-contact, high delicacy range of distance discovery between 2 cm to 500 cm range (26). To operate, it emits an ultrasound that pertains to a detector surge which bounces back upon hitting an handicap, called an echo surge. Due to Doppler effect, the reflected echo may be distorted from 40 kHz depending on the movement of the reflecting object but as long as the vibration doesn't be lower than echo frequency, the effect is negligible (27). In the new VBMS system, the coupling ultrasonic detectors work together in characterizing the incoming obstacles. These detectors play different places grounded on direction of protuberance for each to exclude the eyeless spot but assembled in a single body.

Figure 4: HC-SR04 Ultrasonic Sensor

Upon one complete cycle of surge trip, the time taken gained is a twofold of the distance between detector and handicap performing from started sound surge that travel forward and bounce backward to the receiver.where, is speed of sound (m/s) is temperature of air (ºC), distance from sensor to obstacle (m), while is sound wave time travel (s). Considering 20°C as the normal ambient temperature ( ), the calculated value of is equivalent to 340 m/s. where is the actual sensor-to-obstacle distance (m). Through the division of the distance calculated by 2, the correct distance value between sensor and detected object is finally obtained. In general, the temperature of air within detected range affects the accuracy of measurement, since the sound speed is strongly dependable on both temperature and humidity conditions [28]. The VBMS system has been programmed for a sustained normal terrain. Note that the speed of sound is directly commensurable to the temperature as much as0.6 m/ s per 1 °C (29). Accordingly, the detected reality will be measured nearer in elevated temperature and vice versa. Plus, the RH changes also may vary the dimension by0.036 for every 10 RH change although it isn't veritably significant under normal rainfall conditions. To ensure a largely reliable dimension, both detector body and ambient temperatures should be original. Hence, the installing position of this new device was set under the vehicle side glasses, to cover the detectors from sunray since it's an outside installation, therefore precluding the body from heat exposure. The warning signal was independently placed in the passenger cube, at which fluently visible by the motorist during hazard monitoring.

3.3.2 Correlation of main processing unit with alarm signal

Of the colorful electronics regulator unit from the request check, Arduino MEGA model R3 shown in Figure 5 is named due to further 54 digital I/ O legs, 16 analog inputs and a larger space for your sketch is the recommended board for 3D printers and robotics systems for the VBMS system. In terms of functionality, this device has been effectively employed in measuring, controlling, and displaying data using applicable factors and systems for particular purposes (30). Arduino is an open- source computer device equipped with an ATmega328 microcontroller with 20 MHz generating speed and 16- bit recitation specification (31), as a distance measuring cadence for VBMS. This easy-to- use platform also provides the utmost introductory functional digital device development for commerce with the terrain by detectors and selectors (32).

Figure 5: Arduino MEGA 2560

IV. CONCLUSION

The smart Vehicle Eyeless Spot Monitoring System (VBMS) system has demonstrated the capability to exclude the eyeless spot miracle. This recently developed device has good eventuality as a vehicle safety point in order to ameliorate the mindfulness among motorists regarding the presence of hazards around their vehicle. VBMS had been made in simple element system configuration, conforming a single control unit that combines two other element functions uniting with each other. The procedure of device development was done precisely according to sequence for software to tackle factors. Hence, no excrescence or skipped step happened until the final stage of product. The software system performed real- time processing without lagging due to smaller factors involved, plus the seeing distance adaptation was veritably practical via IDE software to be equipped on different vehicle sizes.

The stylish suitable detector chosen had handed true information for the motorist in colorful speed and vehicle conditions tested during the day and night time. The complete VBMS prototype has been considered achieving great cost- effectiveness in terms of factors, installation, and the functionality offered towards a vehicle road-driving safety. Looking towards the future, the new designed VBMS system could be extemporized in terms of detector quality, as the ultrasonic detector can not measure through walls, vacuum, high pressure or temperature, a high repetition rate, and unfit to measure directly in vapor terrain. Applying an advanced quality detector to this system will give the reliability in colorful conditions including off- road as well as four rainfall seasons overseas.

REFERENCES

[1] B. Maitra, M. F. Cheranchery, and P. Prasad, Rules for safe driving, in Training Manual for Drivers, 2017, ch. 4, pp. 69–109.

[2] P. O. Bresnev, A. V. Tumasov, D. V. Zeziulin, D. M. Porubov, and L. N. Orlov, Development of a detection road users system in vehicle A- pillar blind spots, in Proc. IOP Conf. Ser.: Mater. Sci. Eng., 2018, pp. 1–8.

[3] D. Farooq and J. Juhasz, Simulation analysis of contributing factors to rider visibility issues for car-motorcycle accidents, Period. Polytech. Transp. Eng., pp. 1–7, April 2019.

[4] P. Pitchipoo, D. S. Vincent, N. Rajini, and N. S. Rajakarunakaran, COPRAS decision model to optimize blind spot in heavy vehicles : A comparative perspective, Procedia Eng., vol. 97, pp. 1049–1059, Dec. 2014.

[5] N. K. A and K. Venkatasubramanian, Intelligent collision avoidance system at blind spots or sharp turns, School of Electronics Engineering, VIT University, Chennai, India, 2015.

[6] M. H. M. Isa, Blind spot technology must be seen, The Sun, pp. 1–2, April 2016.

[7] J. Lee, ASEAN NCAP organizes first blind spot monitor test, Paul Tan, 2018. [Online]. Available: https://paultan.org/2018/03/07/asean-ncap-organises -first-blind-spot-monitor-test/.

[8] D. Kwon, R. Malaiya, G. Yoon, J. Ryu, and S. Pi, A study on development of the camera-based blind spot detection system using the deep learning methodology, Appl. Sci., vol. 9, pp. 1–20, July 2019.

[9] M. W. Park, K. H. Jang, and S. K. Jung, Panoramic vision system to eliminate driver's blind spots using a laser sensor and cameras, Int. J. Intelligent Transp. Syst. Res., vol. 6, pp. 1–14, March 2012.

[10] J. Saboune, M. Arezoomand, L. Martel, and R. Laganiere, A visual blindspot monitoring system for safe lane changes a visual blindspot monitoring system for safe lane changes," in Proc. International Conference on Image Analysis and Processing (ICIAP), 2014, pp. 1–10.

[11] C. Fernandez, D. F. Llorca, M. A. Sotelo, I. G. Daza, A. M. Hellin, and S. Alvarez, Real-time vision-based blind spot warning system : experiments with motorcycles in daytime/nighttime conditions, Int. J. Automot. Technol., vol. 14, no. 1, pp. 113–122, Feb. 2013.

[12] C. Tsuchiya, S. Tanaka, and H. Furusho, Real-time vehicle detection using a single rear camera for a blind spot warning system, SAE Int. J. Passeng. Cars - Electrons. Electr. Syst., vol. 5, no. 1, pp. 146–153, May 2012.

[13] B. Wu, C. Kao, Y. Li, and M. Tsai, A real-time embedded blind spot safety assistance system, Int. J. Veh. Technol., pp. 1–15, April 2012.

[14] L. G. C. Iii and A. A. Hernandez, Hybrid detection for vehicle blind spot using fisheye camera : A Framework, in Proc. 4th International Conference on Computing and Applied Informatics (ICCAI), 2019, pp. 250–253.

[15] A. S. Alon, J. L. Dioses Jr., A machine vision Journal of Emerging Trends in Engineering Research (IJETER), Vol. 8, No. 4, pp. 1056-1061, April 2020.

[16] N. Seckel and A. Singh, Physics of 3D ultrasonic sensors, Toposens GmbH, pp. 1-11, July 2019.

[17] J. Azeta, C. Bolu, D. Hinvi, and A. A. Abioye, Obstacle detection using ultrasonic sensors for a mobile robot, in Prof. IOP Conf. Series: Materials Science and Engineering, 2019, pp. 1–5.

[18] S. Lee, J. Lim, G. Tewolde, and J. Kwon, Autonomous tour guide robot by using ultrasonic range sensors and QR code recognition in indoor environment, in Proc. IEEE International Conference on Electro/Information Technology, 2014, pp. 410–415.

[19] D. N. Bagenda and C. Parulian, Online information of parking area using ultrasonic sensors through wifi data acquisition, in Proc. IOP Conference Series: Earth and Environmental Science, 2018, pp. 1–7.

[20] S. Talukder, M. I. I. Sakib, Z. R. Talukder, U. Das, A. Saha, and N. S. N. Bayev, USenSewer : ultrasonic sensor and GSM-Arduino based automated sewerage management, in Proc. CTCEEC Conference Proceedings, 2017, pp. 1–6.

[21] M. Z. Hassan and H. I. Zainal Ariffin, Development of vehicle blind spot system for passenger cars, Appl. Mech. Mater., vol. 393, pp. 350–353, Sep. 2013.

[22] V. Raikar, A. Ranjan, P. Poddar, and K. J. Chaitanya, Arduino based smart water level monitoring and controlling for domestic application, Int. J. Res. Eng. Sci. Manag., vol. 2, no. 2, pp. 138–141, Feb. 2019.

[23] M. Husni, D. O. Siahaan, H. T. Ciptaningtyas, H. Studiawan, and Y. P. Aliarham, Liquid volume monitoring based on ultrasonic sensor and Arduino microcontroller, in Proc. IOP Conf. Series: Materials Science and Engineering, 2016, vol. 128, pp. 1–10.

[24] M. S. M. Hashim, A. H. Ismail, S. Abu Bakar, M. S. Muhamad Azmi, Z. Mohamad Razlan, A. Harun, N. S. Kamarrudin, I. Ibrahim, M. K. Faizi, M. A. M. Saad, M. F. H. Rani, A. R. Mahayadin, M. A. Rojan, M. S. Azizizol and M. H. Md Isa, Identifying blind spot zones for passenger cars using grid-based technique, J. Soc. Automot. Eng. Malaysia, vol. 2, no. 3, pp. 245–251, Sep. 2018.

[25] E. Z. Orji, C. V. Oleka, and U. I. Nduanya, Arduino based door automation system using ultrasonic sensor and servo motor, J. Sci. Eng. Res., vol. 5, no. 4, pp. 341–349, April 2018.

[26] H. R. Hatem, A. I. Abdalla, and Z. N. A. Al-rawi, Design and implementation of ultrasonic radar system for distance measurements using Arduino, Int. J. Eng. Technol., vol. 7, no. 4, pp. 3115–3118,Jan. 2018.

[27] A. Buachoom, A. Thedsakhulwong, and S. Wuttiprom, An Arduino board with ultrasonic sensor investigation of simple harmonic motion, in Proc. Siam Physics Congress (SPC2019): Physics beyond disruption society, 2019, pp. 1–4.

[28] P. Anguraj and T. Krishnan, "Design and implementation of modified BCD digit multiplier for digit-by-digit decimal multiplier," Analog Integr. Circuits Signal Process., pp. 1–12, 2021.

[29] T. Krishnan, S. Saravanan, A. S. Pillai, and P. Anguraj, "Design of high-speed RCA based 2-D bypassing multiplier for fir filter," Mater. Today Proc., Jul. 2020, doi: 10.1016/j.matpr.2020.05.803.

[30] T. Krishnan, S. Saravanan, P. Anguraj, and A. S. Pillai, "Design and implementation of area efficient EAIC modulo adder," Mater. Today Proc., vol. 33, pp. 3751–3756, 2020.