IoT based Smart Intelligent System for Automation of Waste Management

Dr. Nookala Venu

Assistant Professor, Internet of Things (IoT), Offered by Department of IT,
Madhav Institute of Technology & Science, Gwalior - 474 005, Madhya Pradesh, India,
(A Govt. Aided UGC Autonomous Institute).
venunookala@mitsgwalior.in

Article History: **Received:** 12.07.2023 **Revised:**28.07.2023 **Accepted:** 01.09.2023

Abstract

One of the main concerns with our environment has been solid waste management which in addition to disturbing the balance of the environment also has adverse effects on the health of the society. The detection, monitoring and management of waste are one of the primary problems of the present era. The process of making the things automatic is being exploited in almost all the major fields of life. Solid waste which is one of the sources and causes of environmental pollution has been defined under Resource Conservation and Recovery Act as any solid, semi-solid liquid or contained gaseous materials discarded from industrial, commercial, mining or agricultural operations and from community activities. We are going to implement a research project called IoT Based Smart Garbage and Waste Collection bins. These dustbins are interfaced with microcontroller-based system having ultrasonic sensor systems along with central system showing current status of garbage, on mobile web browser with HTML page by Wi-Fi. Hence the status will be updated on to the HTML page.

Keywords: *ESP32, Infrared Sensor, Ultrasonic Sensor*

DOI: 10.48047/ecb/2023.12.9.145

1. Introduction

The rising population of India poses serious threats with regard to the availability of living space, Utilization of natural resources and raw materials, education and employment. But another serious peril that follows is the escalating amount of waste generated each minute by an individual. Every city is grappling with the menace of ever increasing waste. An astounding 0.1 Million tons of waste is generated each day in our country. Sadly, only 5% of this colossal amount of waste is recycled. In India, the collection, transportation and disposal of MSW are unscientific and chaotic [1-2]. Uncontrolled dumping of waste on outskirts of towns and cities has created overflowing landfills which are not only impossible to reclaim because of the haphazard manner of dumping but also has serious environmental implications. When viewed

on a larger scale, the poor recovery rate has impeded the growth of the country as well as the economy of the nation. One possible solution for this problem could be segregating the waste at the disposal level itself [3-4]. We have thus come up with an Automatic waste segregator that categorizes the waste as wet, dry. This paper IOT Garbage Monitoring system is a very innovative system which will help to keep the cities clean [5-7]. This system monitors the garbage bins and informs about the level of garbage collected in the garbage bins via android app. Admin should monitor the dustbin. There should be send message to worker when garbage is reached to certain threshold [8-13]. In existing garbage monitoring system, local governments manage garbage by deploying garbage bins and employing multiple pickup businesses for garbage collection [14-17].

A large and cool container enables longer emptying intervals (no external odors). Financial and ecological savings are made in waste transportation costs. The UG LIFT system, intermediate waste storage can be realized in a modern and safe manner even in many demanding locations [18-23]. An underground intermediate storage solution is cool all the year round, and both the collection container & environment can be more hygienic and odor free. UG LIFT waste compactor system is suitable for any location where the cost-efficient and ecological waste management system is provided [24-31].

2. Objective

Smart waste management is idea where we can control lots of problems which disturbs the society in pollution and diseases [32-34]. The waste management has to be done instantly else it leads to irregular management which will have adverse effect on nature [35-36].

3. Literature Review

Waste Separator (IWS) that consists of a common trash can, with more containers inside it, using multimedia technology. People can throw their waste, no matter what kind, into the system [37-39]. The latter is able to decide what kind of waste it belongs to and to deposit it in the correct container. Garbage is a global problem that affects all living beings. A study from Grow NYC shows that 80% of the world's solid waste is produced in the United States of America. Also, 70% of its trash is used once and 45% is buried or burnt, such waste is paper, plastic [40-44]. UG (Under Ground) LIFT waste compactor is a space volume saving and modern system for all locations in which environment poses the challenges to the implementer. There is only a tiny or small bin in the ground. The assembly underground consists of two units' i.e. Container with a metal frame & compactor [45-48]. Installation of this system in a ready pit which takes only about three to four hours. The system is suited to all types of waste (Dry & Wet) and is an efficient solution for recycling. This system can be

dimensioned or graphed to match the location with standard compactor sizes are ($10m^3$, $16m^3$ and $20m^3$). In largest or limited size for UG LIFT underground compactor holds (>$100m^3$) of uncompact waste [49-54]. A large and cool container enables longer emptying intervals (no external odors). Financial and ecological savings are made in waste transportation costs. The UG LIFT system, intermediate waste storage can be realized in a modern and safe manner even in many demanding locations [55-58]. An underground intermediate storage solution is cool all the year round, and both the collection container & environment can be more hygienic and odor free. UG LIFT waste compactor system is suitable for any location where the cost-efficient and ecological waste management system is provided [59-62].

An automated vacuum waste collection system, also known as pneumatic refuse collection or automated vacuum collection (AVAC), transports waste at maximum speed through underground pneumatic tubes to the collection station where it is compacted and sealed in containers [63-67]. When the container is full, it is transported away and emptied (by using trucks). The system helps facilitate separation and recycling of waste. The process begins with the deposit of trash into intake hatches, called portholes, which may be specialized for waste, recycling. Portholes are located in areas (public) and on private property where the owner has opted in [68-74]. The waste is then pulled through an underground pipeline by an air pressure difference i.e., created by large industrial fans, in response to porthole sensors that indicate when the trash needs to be emptied and help ensure that only 1 kind of waste material is travelling through the pipe at a that time [75-79]. The pipelines converge on a central processing facility that uses automated software to direct the waste to the proper container, from there to be trucked into the trucks to its final location, such as a landfill or composting plant [80-82]. The Envac proprietary system, Envac Automated Waste Collection System, is used in more than 30 countries. Major cities in which the system is operating include Copenhagen, Barcelona, London, and Stockholm.

4. Description of the Proposed Methods

A.Proposed System

This is intended with IR sensors and Ultrasonic sensor which is controlled by ESP32. Ultrasonic sensors are used for measuring the waste present in the dustbins. The power supply is given to IR sensors and Ultrasonic sensors which are connected to esp32. Esp32 has an inbuilt wi-fi system. Esp32 will pass the information of the dustbin to the mobile device through Wi-Fi.

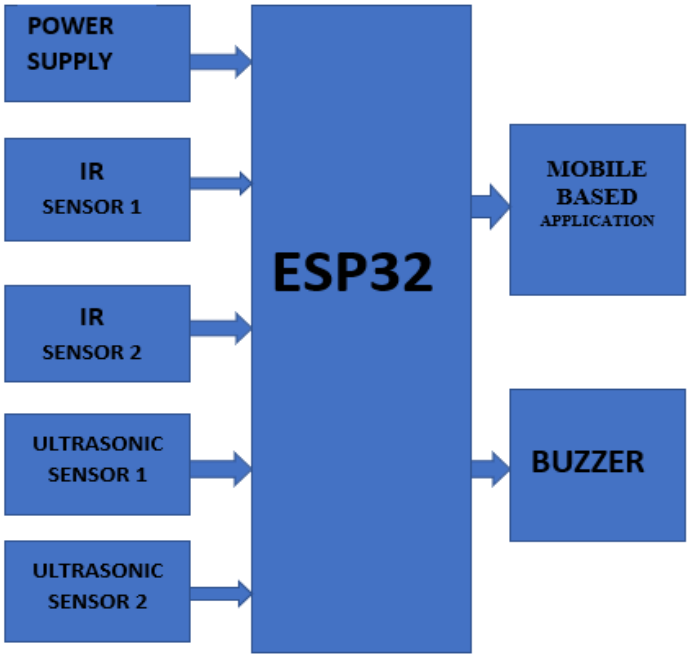

Fig.1: System Architecture

B. Hardware Requirements

ESP32: ESP32 is a series of low-cost, low-power system on a chip microcontroller with integrated Wi-Fi and dual-mode Bluetooth. The ESP32 series employs either a Tensilica Xtensa LX6 microprocessor in both dual-core and single-core variations, Xtensa LX7 dual-core microprocessor or a single-core RISC-V microprocessor and includes built-in antenna switches, RF balun, power amplifier, low-noise receive amplifier, filters, and power-management modules.

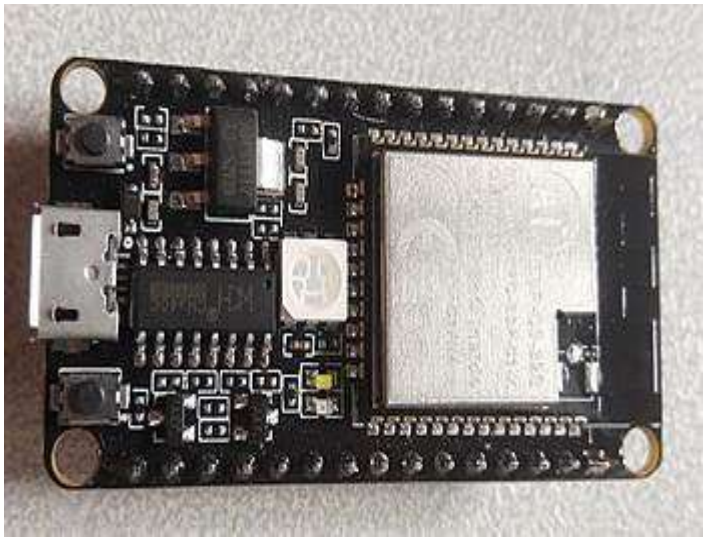

Fig.2:ESP32

Infrared Sensors: An infrared sensor is an electronic device that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion as well as the presence of an object due to intervention or interruption. These type of sensors measure only infrared radiation, rather than emitting it that is called as a passive IR sensor, an IR sensor is simply a device which detects IR radiation falling on it.

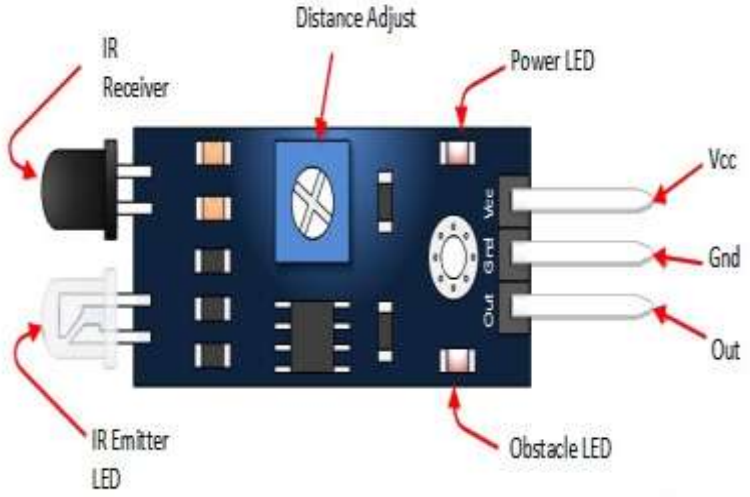

Fig.3: IR Sensor

Ultrasonic Sensor: Ultrasonic Sensors also known as transceivers when they both send and receive work on a principle similar to radar or sonar which evaluate attributes of a target by interpreting the echoes from radio or sound waves respectively. Ultrasonic sensors generate high frequency sound waves and evaluate the echo which is received back by the sensor. Sensors calculate the time interval between sending the signal and receiving the echo to determine the distance to an object. This technology can be used for measuring: wind speed and direction (anemometer), fullness of a tank and speed through air or water. For measuring speed or direction a device uses multiple detectors and calculates the speed from the relative distances to particulates in the air or water. To measure the amount of liquid in a tank, the sensor measures the distance to the surface of the fluid. Further applications include: humidifiers, sonar, medical ultrasonography, burglar alarms and non-destructive testing. Systems typically use a transducer which generates sound waves in the ultrasonic range, above 18,000 hertz, by turning electrical energy into sound, then upon receiving the echo turn the sound waves into electrical energy which can be measured and displayed. The technology is limited by the shapes of surfaces and the density or consistency of the material. For example foam on the surface of a fluid in a tank could distort a reading.

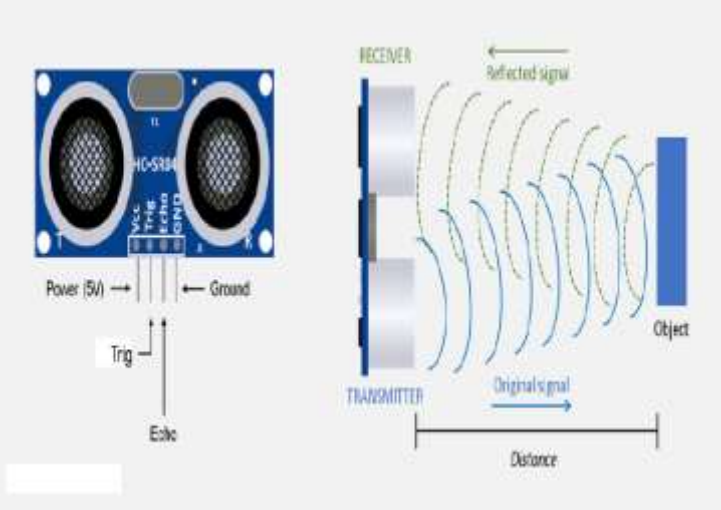

Fig.4: Ultrasonic Sensor

C. Software Recquirements

- Downloading Arduino IDE software and then power up Arduino Board.
- Launching Arduino IDE.
- The Arduino integrated development environment is a cross platform Application, that is written in Java programming language and C/C++.

D.Implementation of Project

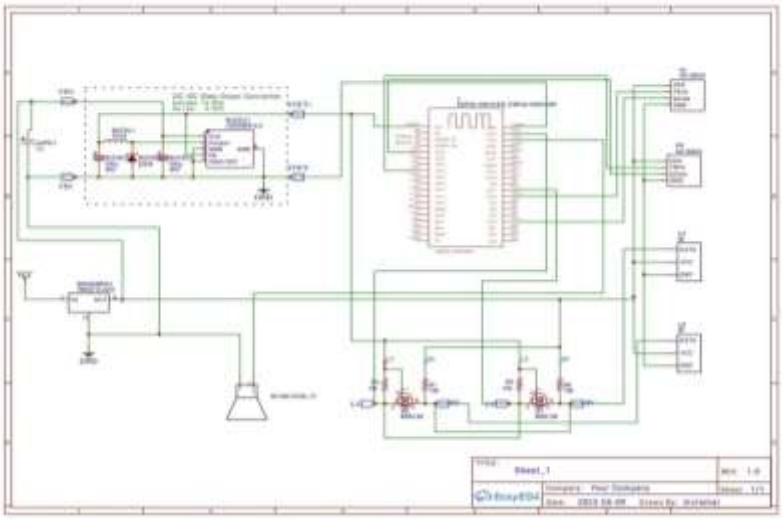

Fig.5: Schematic Diagram

Block diagram consist of components are Arduino Uno, Moisture sensor fC-28, Ultrasonic sensor HC- SR04, DC motor, relay and ESP8266 Wi-Fi module etc. Moisture sensor is used to detect garbage is either dry or wet. Two DC motors are used; one is for moving conveyor belt and second is for rotating dustbin position to collect garbage in separate dustbin. Relays are used for driving DC motors. Ultrasonic sensors are used to detect garbage level in dustbins, to

determine the dustbin is full or empty. One is used to detect garbage level of dry dustbin and second is to detect garbage level of wet dustbin. First power supply to Arduino is given through USB from laptop & external 12V power supply is given to both DC motors. In our project first garbage is placed on conveyor belt, then conveyor belt will move through DC motor then moisture sensor will detect garbage is dry or wet, if garbage is dry then it is collected in dry side of dustbin and if garbage is wet then dustbin will move 180 degree & collect garbage in wet side of dustbin. After this ultrasonic sensor will detect level of garbage in dustbins and send information to Arduino, then Arduino send this information to Wi-fi module & Wi-fi module update this information on mobile app. In the circuit diagram A0 pin of moisture sensor is connected to port C A0 pin of the Arduino. VCC & GND pins of moisture sensor are connected to 5v & GND of the Arduino. Trigger & echo pins of ultrasonic sensor 1 are connected to port D pin 4 & pin 5 of the Arduino respectively. Similarly trigger & echo pins of Ultrasonic sensor 2 are connected to port D pin 6& pin 7 of the Arduino respectively. Then VCC & GND of both ultrasonic sensors are connected to 5v & GND of the Arduino. DC motor 1 & DC motor 2 are connected to port B pin 0 & port B pin 1of the Arduino through Relay. Then VCC & GND of both relays are connected to VCC & GND of the Arduino. One end of the voltage divider network is connected to 5v & other end connected to port B pin 4 of the Arduino. VCC pin of ESP Wi-Fi module is connected to voltage divider network & GND is connected to GND of the Arduino. Reset pin of Wi-Fi module connected to the reset pin of Arduino.

5. Results and Discussions

Here we are using a one variable voltage source & we set -250V as a threshold value. By varying voltage below threshold value we got output on virtual terminal that is dustbin is not full. In proteus we connect this variable voltage source to the analog pin of ultrasonic sensor, connect trigger & echo to Arduino and potentiometer is using as moisture sensor and connecting to A0 pin of Arduino. Now upload the Arduino hex file ,after uploading the hex file, hit RUN button then virtual terminal will display distance measurement i.e. dustbin is either full or empty. Following pictures show the mobile app status and real time dustbin for 50% full dry & 100% full wet dustbin as well as database also.

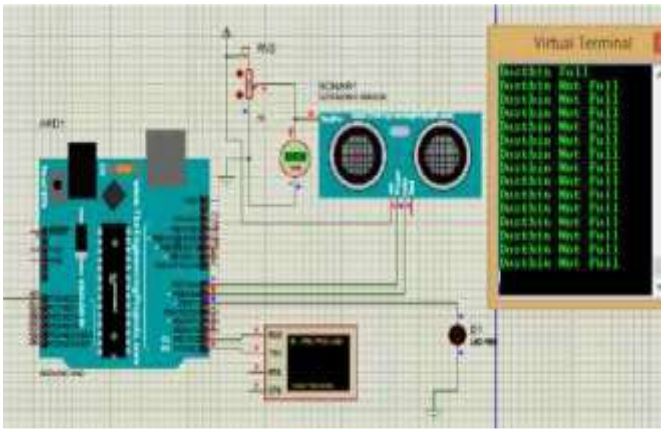

Fig.6: Simulation when dustbin is not full

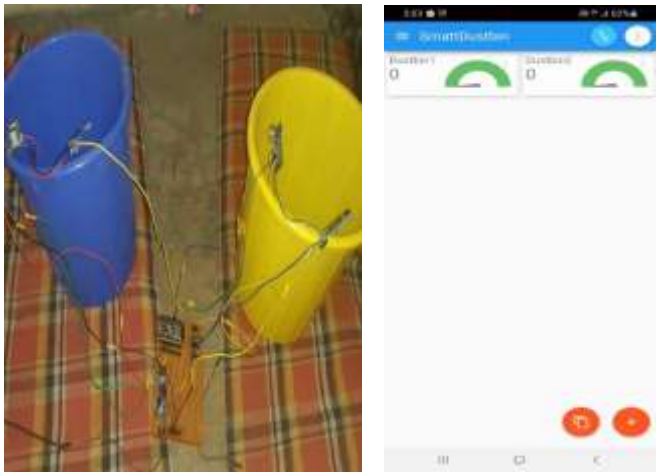

Fig.7: Status of the dustbin when it is empty

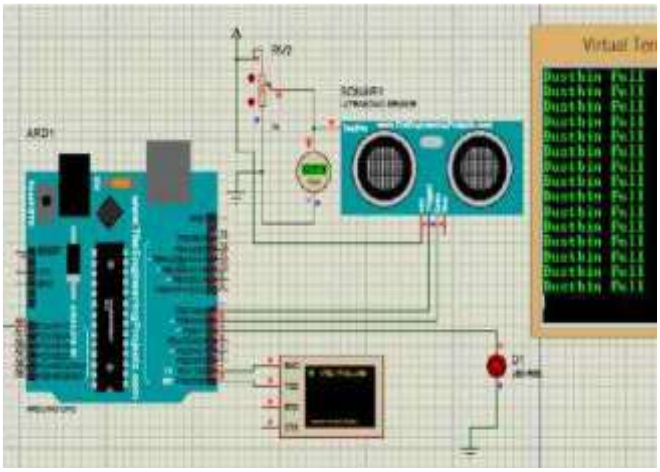

Fig.8: Simulation when dustbin is full

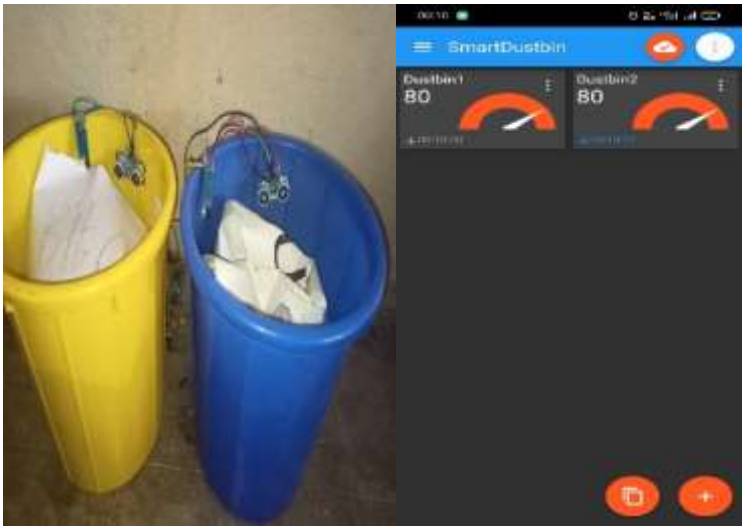

Fig.9: Status of the dustbin when it is full

6. Conclusion

The targeted waste collection saves times, money, and fuel and also reduce exhaust gas emission. Even garbage truck tours can be reduced by 30%. Hence by this project we can deal with RF technology, collection of garbage to make the premises clean.

References

[1] Vaigandla, K. K., & Venu, D. N. (2021). A survey on future generation wireless communications-5G: multiple access techniques, physical layer security, beamforming approach. Journal of Information and Computational Science, 11(9), 449-474.

[2] Venu, D., Arun Kumar, A., & Vaigandla, K. K. (2022). Review of Internet of Things (IoT) for Future Generation Wireless Communications. International Journal for Modern Trends in Science and Technology, 8(03), 01-08.

[3] Sujith, A. V. L. N., Swathi, R., Venkatasubramanian, R., Venu, N., Hemalatha, S., George, T., & Osman, S. M. (2022). Integrating nanomaterial and high-performance fuzzy-based machine learning approach for green energy conversion. Journal of Nanomaterials, 2022, 1-11.

[4] Venu, N., & Anuradha, B. (2013, December). Integration of hyperbolic tangent and Gaussian kernels for fuzzy C-means algorithm with spatial information for MRI segmentation. In 2013 Fifth International Conference on Advanced Computing (ICoAC) (pp. 280-285). IEEE.

[5] Vaigandla, K. K., & Venu, D. N. (2021). Ber, snr and papr analysis of ofdma and sc-fdma. GIS Science Journal, ISSN, (1869-9391), 970-977.

[6] Venu, N. (2014, April). Performance and evalution of Guassian kernals for FCM algorithm with mean filtering based denoising for MRI segmentation. In 2014 International Conference on Communication and Signal Processing (pp. 1680-1685). IEEE.

[7] Karthik Kumar Vaigandla, D. (2021, November). Survey on Massive MIMO: Technology, Challenges, Opportunities and Benefits. YMER , 271-282.

[8] Venu, N., & Anuradha, B. (2015). Multi-Kernels Integration for FCM algorithm for Medical Image Segmentation Using Histogram Analysis. Indian Journal of Science and Technology, 8(34), 1-8.

[9] Venu, N., Yuvaraj, D., Barnabas Paul Glady, J., Pattnaik, O., Singh, G., Singh, M., & Adigo, A. G. (2022). Execution of Multitarget Node Selection Scheme for Target Position Alteration Monitoring in MANET. Wireless Communications and Mobile Computing, 2022.

[10] Venu, N., Swathi, R., Sarangi, S. K., Subashini, V., Arulkumar, D., Ralhan, S., & Debtera, B. (2022). Optimization of Hello Message Broadcasting Prediction Model for Stability Analysis. Wireless Communications & Mobile Computing (Online), 2022.

[11] Venu, D. N. (2015). Analysis of Xtrinsic Sense MEMS Sensors. International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering , 4 (8), 7228-7234.

[12] Venu, N., & Anuradha, B. (2013). A novel multiple-kernel based fuzzy c-means algorithm with spatial information for medical image segmentation. International Journal of Image Processing (IJIP), 7(3), 286.

[13] Nookala Venu, A. (2018). Local mesh patterns for medical image segmentation. Asian Pacific Journal of Health Sciences, 5(1), 123-127.

[14] Venu, N., & Anuradha, B. (2013). PSNR Based Fuzzy Clustering Algorithms for MRI Medical Image Segmentation. International Journal of Image Processing and Visual Communication, 2(2), 01-07.

[15] Thouti, S., Venu, N., Rinku, D. R., Arora, A., & Rajeswaran, N. (2022). Investigation on identify the multiple issues in IoT devices using Convolutional Neural Network. Measurement: Sensors, 24, 100509.

[16] Venu, N., Revanesh, M., Supriya, M., Talawar, M. B., Asha, A., Isaac, L. D., & Ferede, A. W. (2022). Energy Auditing and Broken Path Identification for Routing in Large-Scale Mobile Networks Using Machine Learning. Wireless Communications and Mobile Computing, 2022.

[17] Kesavaiah, D. C., Goud, T. R., Rao, Y. S., & Venu, N. (2019). Radiation effect to MHD oscillatory flow in a channel filled through a porous medium with heat generation. Journal of Mathematical Control Science and Applications, 5(2), 71-80.

[18] Nookala Venu, B. A. (2015). Medical Image Segmentation Using Kernal Based Fuzzy C-Means Algorithm. International Journal of Engineering Innovation & Research , 4 (1), 207-212.

[19] Nookala Venu, D., Kumar, A., & Rao, M. A. S. (2022). BOTNET Attacks Detection in Internet of Things Using Machine Learning. NeuroQuantology, 20(4), 743-754.

[20] Venu, N., & Anuradha, B. (2014, February). Multi-Hyperbolic Tangent Fuzzy C-means Algorithm for MRI Segmentation. In Proceedings of International Conference on Advances in Communication, Network and Computing (CNC-2014), Elsevier (pp. 22-24).

[21] Nookala Venu, S. W. (2022). A Wearable Medicines Recognition System using Deep Learning for People with Visual Impairment. IJFANS, 12(1), 2340-2348.

[22] Nookala Venu, G. R. (2022). Smart Road Safety and Vehicle Accidents Prevention System for Mountain Road. International Journal for Innovative Engineering Management and Research , 11 (06), 209-214.

[23] Nookala Venu, D., Kumar, A., & Rao, M. A. S. (2022). Smart Agriculture with Internet of Things and Unmanned Aerial Vehicles. NeuroQuantology, 20(6), 9904-9914.

[24] Nookala Venu, D., Kumar, A., & Rao, M. A. S. (2022). Internet of Things Based Pulse Oximeter For Health Monitoring System. NeuroQuantology, 20(5), 5056-5066.

[25] Venu, D. N. DA (2021). Comparison of Traditional Method with watershed threshold segmentation Technique. The International journal of analytical and experimental modal analysis, 13, 181-187.

[26] Dr.Nookala Venu, D. K. (2022). Investigation on Internet of Things (IoT):Technologies, Challenges and Applications in Healthcare. International Journal of Research , XI (II), 208-218.

[27] Kesavaiah, D. C., Goud, T. R., Venu, N., & Rao, Y. S. (2021). MHD Effect on Convective Flow of Dusty Viscous Fluid with Fraction in a Porous Medium and Heat Generation. Journal of Mathematical Control Science and Applications, 7(2).

[28] Babu, K. R., Kesavaiah, D. C., Devika, B., & Venu, D. N. (2022). Radiation effect on MHD free convective heat absorbing Newtonian fluid with variable temperature. NeuroQuantology, 20(20), 1591-1599.

[29] Kesavaiah, D. C., Ahmed, M., Reddy, K. V., & Venu, D. N. (2022). Heat and mass transfer effects over isothermal infinite vertical plate of Newtonian fluid with chemical reaction. NeuroQuantology, 20(20), 957-967.

[30] Reddy, G. B., Kesavaiah, D. C., Reddy, G. B., & Venu, D. N. (2022). A note on heat transfer of MHD Jeffrey fluid over a stretching vertical surface through porous plate. NeuroQuantology, 20(15), 3472-3486.

[31] Chenna Kesavaiah, D., Govinda Chowdary, P., Rami Reddy, G., & Nookala, V. (2022). Radiation, radiation absorption, chemical reaction and hall effects on unsteady flow past an isothermal vertical plate in a rotating fluid with variable mass diffusion with heat source. NeuroQuantology, 20(11), 800-815.

[32] Kesavaiah, D. C., Prasad, M. K., Reddy, G. B., & Venu, N. (2022). Chemical Reaction, Heat and Mass Transfer Effects on MHD Peristaltic Transport in A Vertical Channel Through Space Porosity And Wall Properties. NeuroQuantology, 20(11), 781-794.

[33] Kesavaiah, D. C., Reddy, G. B., Kiran, A., & Venu, D. N. (2022). MHD effect on boundary layer flow of an unsteady incompressible micropolar fluid over a stretching surface. NeuroQuantology, 20(8), 9442-9452.

[34] Kesavaiah, D. C., Chowdary, P. G., Chitra, M., & Venu, D. N. (2022). Chemical reaction and MHD effects on free convection flow of a viscoelastic dusty gas through a semi infinite plate moving with radiative heat transfer. NeuroQuantology, 20(8), 9425-9434.

[35] Mr.RadhaKrishna Karne, M. M. (2022). Applications of IoT on Intrusion Detection System with Deep Learning Analysis. International Jourfor Innovative Engineering and Management Research , 11 (06), 227-232.

[36] Venu, N., & Anuradha, B. (2015). Two different multi-kernels for fuzzy C-means algorithm for medical image segmentation. Int. J. Eng. Trends Technol.(IJETT), 20, 77-82.

[37] Kesavaiah, D. C., Goud, T. R., Venu, N., & Rao, Y. S. (2017). Analytical Study on Induced Magnetic Field with Radiating Fluid over a Porous Vertical Plate with Heat Generation. Journal of Mathematical Control Science and Applications, 3(2).

[38] Dr. Nookala Venu, D. A. (2022, March). Routing and Self-Directed Vehicle Data Collection for Minimizing Data Loss in Underwater Network. IJFANS International Journal of Food and Nutritional Sciences , 170-183.

[39] Dr. Nookala Venu, D. A. (2022). Fuzzy Based Resource Management Approach for the Selection of Biomass Material. IJFANS International Journal of Food and Nutritional Sciences , 12 (2), 83-97.

[40] Ravindra Kumar Agarwal, D. S. (2022). A Novel Dates Palm Processing and Packaging Management System based on IoT and Deep Learning Approaches. IJFANS International Journal of Food and Nutritional Sciences , 11 (8), 1139-1151.

[41] Manthur Sreeramulu Manjunath, P. K. (2022). An Enhanced Machine Learning Approach For Identifying Paddy Crop Blast Disease Management Using Fuzzy Logic. IJFANS International Journal of Food and Nutritional Sciences , 11 (8), 1152-1163.

[42] K.P.Senthilkumar, K. C. (2022). Machine Learning Based Analysis and Classification of Rhizome Rot Disease in Turmeric Plants. IJFANS International Journal of Food and Nutritional Sciences , 11 (8), 1179-1190.

[43] Sowmya Jagadeesan, B. B. (2022). A Perishable Food Monitoring Model Based on IoT and Deep Learning to Improve Food Hygiene and Safety Management. IJFANS International Journal of Food and Nutritional Sciences , 11 (8), 1164-1178.

[44] Nookala Venu, S. K. (2022). Machine Learning Application for Medicine Distribution Management System. IJFANS International Journal of Food and Nutritional Sciences , 11 (1), 2323-2330.

[45] Reddy, A. V., Kumar, A. A., Venu, N., & Reddy, R. V. K. (2022). On optimization efficiency of scalability and availability of cloud-based software services using scale rate limiting algorithm. Measurement: Sensors, 24, 100468.

[46] D. Chenna Kesavaiah, T. Ramakrishna Goud, Y. V. Seshagiri Rao, Nookala Venu (2019): Radiation effect to MHD oscillatory flow in a channel filled through a porous medium with heat generation, Journal of Mathematical Control Science and Applications, Vol. 5 (2), pp. 71-80.

[47] Venu, D. N. (2022). Smart Agriculture Remote Monitoring System Using Low Power IOT Network. IJFANS International Journal of Food and Nutritional Sciences, 11 (6), 327-340.

[48] Venu, D. N. (2022). IOT Surveillance Robot Using ESP-32 Wi-Fi CAM & Arduino. IJFANS International Journal of Food and Nutritional Sciences , 11 (5), 198-205.

[49] Nookala Venu, N. S. (2022). Study and Experimental Analysis on FBMC and OFDM. International Journal for Innovative Engineering and Management Research,11 (6), 49-53.

[50] Sandhya rani B, S. K. (2022). Vehicle Fuel Level Monitor and Locate the Nearest Petrol Pumps using IoT. International Journal for Innovative Engineering and Management Research , 11 (06), 233-240.

[51] Nookala Venu, K. A. (2022). Face Mask Detection System Using Python Open CV, International Journal for Innovative Engineering and Management Research, 11 (6), 28-32.

[52] Nookala Venu, V. M. (2022). Alcohol Detection and Engine Locking System. International Journal for Innovative Engineering and Management Research , 11 (06), 157-160.

[53] Nookala Venu, C. B. (2022). Wireless Night Vision Camera on War Spying Robot. International Journal for Innovative Engineering and Management Research , 11 (06), 123-128.

[54] Venu, D. N. (2022). IOT Based Enabled Parking System in Public Areas. IJFANS International Journal of Food and Nutritional Sciences, 11 (4), 162-174.

[55] Venu, D. N. (2022). IOT Based Speech Recognition System to Improve the Performance of Emotion Detection. IJFANS International Journal of Food and Nutritional Sciences, 11 (3), 92-102.

[56] Dr.Nookala Venu, M. S. (2018). Local Maximum Edge Binary Patterns for Medical Image Segmentation. International Journal of Engineering and Techniques, 4 (1), 504-509.

[57] Venu, N., & Anuradha, B. (2016). Multi-hyperbolic tangent fuzzy c-means algorithm with spatial information for MRI segmentation. International Journal of Signal and Imaging Systems Engineering, 9(3), 135-145.

[58] Venu, N., & Anuradha, B. (2015). Hyperbolic Tangent Fuzzy C-Means Algorithm with Spatial Information for MRI Segmentation. International Journal of Applied Engineering Research, 10(7), 18241-18257.

[59] Venu, N., & Anuradha, B. (2015, April). Two different multi-kernels integration with spatial information in fuzzy C-means algorithm for medical image segmentation. In 2015 International Conference on Communications and Signal Processing (ICCSP) (pp. 0020-0025). IEEE.

[60] Nookala Venu, B. (2015). MRI Image Segmentation Using Gaussian Kernel Based Fuzzy C-Means Algorithm. International Journal of Electronics Communication and Computer Engineering , 6 (1), 140-145.

[61] Venu, N., & Anuradha, B. (2015). Evaluation of Integrated Hyperbolic Tangent and Gaussian Kernels Functions for Medical Image Segmentation. International Journal of Applied Engineering Research, 10(18), 38684-38689.

[62] Anita Tuljappa, V. N. (2022). Dufour and Chemical Reaction Effects on Two Dimensional incompressible flow of a Viscous fluid over Moving vertical surface. NeuroQuantology , 63-74.

[63] Ch. Achi Reddy, V. N. (2022). Magnetic Field And Chemical Reaction Effects on Unsteady Flow Past A Stimulate Isothermal Infinite Vertical Plate. NeuroQuantology, 20 (16), 5360-5373.

[64] Sowmya Jagadeesan, M. K. (2022). Implementation of an Internet of Things and Machine learning Based Smart Medicine Assistive System for Patients with Memory Impairment. IJFANS International Journal of Food and Nutritional Sciences , 1191-1202.

[65] Venu, D. N. (2023). Design Analysis and Classification of Digital Transmission Based Composite Relay and Artificial Neural Network Approach. IJFANS International Journal of Food and Nutritional Sciences , 12 (1), 680-63.

[66] Venu, D. N. (2023). Biomass Studies on Pyrolysis of Sugarcane Bagasse and Cashew Nut Shell for Liquid Fuels. IJFANS International Journal of Food and Nutritional Sciences , 11 (1), 695-706.

[67] Venu, D. N. (2023). Synthesis and Study on Feasibility of Ethanol Production from Leachate of Pretreatment of Sugarcane Bagasse. IJFANS International Journal of Food and Nutritional Sciences , 12 (1), 707-715.

[68] Venu, D. N. (2022). Design and Performance Analysis of Super Critical Fluid Extraction for SC-CO2. IJFANS International Journal of Food and Nutritional Sciences , 11 (12), 3854-3865.

[69] Venu, D. N. (2022). Supercritical Fluid Evaluation and Extraction of Phenol from Sugarcane Bagasse Pyrolysis Oil. IJFANS International Journal of Food and Nutritional Sciences , 11 (12), 3866-3876.

[70] Sandhya rani, D. V. (2022). IOT Based Smart Irrigation System Using Node MCU. International Journal For Innovative Engineering and Management Research , 11 (6), 100-106.

[71] Dr.Nookala Venu, A. E. (2022). Low Power Area Efficient ALU with Low Power Full Adder. International Journal For Innovative Engineering and Management Research , 11 (06), 167-170.

[72] Nookala Venu, B.Anuradha"Brain MRI Medical Image Segmentation Using Fuzzy Based Clustering Algorithms", International Journal of Engineering Trends and Technology (IJETT), V22 (2), 83-88 April 2015. ISSN: 2231-5381. www.ijettjournal.org. published by seventh sense research group.

[73] Dr. Nookala Venu, D. K. (2023). Implementation of Hello Time Gaps Tracking Scheme for Network Stability Analysis in MANET. European Chemical Bulletin , 12 (8), 5011-5026.

[74] Ch.Shashi Kumar, K. R. (2023). Chemical Reaction and Hall Effects on Unsteady Flow Past an Isothermal Vertical Plate in a Rotating Fluid with Variable Mass Diffusion. European Chemical Bulletin, 12 (8), 4991-5010.

[75] Venu, D. N. (2022). Classification Analysis for Local Mesh Patterns Using Medical Image Segmentation. IJFANS International Journal of Food and Nutritional Sciences,11 (12), 5232-5241.

[76] Venu, D. N. (2022). PSNR Based Levels Evaluation of FCM Algorithm with Peak and Valley Filtering Based Brain Images. IJFANS International Journal of Food and Nutritional Sciences, 11 (12), 5242-5253.

[77] Venu, D. N. (2023). Segmentation Analysis for Local Maximum Edge Binary Patterns using Medical Images. IJFANS International Journal of Food and Nutritional Sciences, 12 (1), 917-927.

[78] Venu, D. N. (2023). PSNR Based Evalution of Spatial Guassian Kernals For FCM Algorithm with Mean and Median Filtering Based Denoising for MRI Segmentation. IJFANS International Journal of Food and Nutritional Sciences, 12 (1), 928-939.

[79] Venu, D. N. (2022). Multi Guassian Kernals for FCM Algorithm with Mean and Peak-Valley-Kernal Filtering Based Denoising for MRI Segmentation Using PSNR Analysis. IJFANS International Journal of Food and Nutritional Sciences, 11 (11), 1965-1976.

[80] Dr.A.Arun Kumar, D. N. (2023). Enhanced Security Packet Acceptance for Target Position Alteration using Multi Accepter Scheme Assigning Algorithm in MANET. European Chemical Bulletin , 12 (8), 7003-7018.

[81] Dr.A.Arun Kumar, D. N. (2023). Analysis and Enhancement of Energy Auditing Routing for Identification of Broken Paths in Mobile Adhoc Networks. European Chemical Bulletin , 12 (8), 7019-7034.

[82] Dr. Sowgani Ramakrishna, D. A. (2023). Computational Mathematical Modelling of Radiative Chemical Reaction and Hall Effects on unsteady flow past an Isothermal Vertical Plate with radiation and Heat Absorption. European Chemical Bulletin , 12 (8), 8436-8452.