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A Study of IOT-Based Waste Management and Segregation Systems

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ABSTRACT: Garbage disposal has become a major global concern in recent years. Huge quantities of waste are generated so throwing it away has a negative impact on the ecosystem. The most popular way to get rid of waste is to just dump it in landfills, freely without any planning. The health of people as well as plants and animals is harmed by this practice. This may produce liquid leachate, which contaminates ground and surface waterways and distributes dangerous pathogens. It is necessary to create an effective smart garbage collection system in order to navigate over these problems. As the Internet of Things expands daily, it is becoming easier to find efficient solutions.A number of ideas with benefits and drawbacks have been put forth.

KEYWORDS: Smart waste monitoring and control, Internet of Things (IoT), Smart Cities, Smart Bins

I. INTRODUCTION

The management of solid waste has been a major environmental concern since it affects our society's environment and health. One of the biggest issues facing society today is the detection, monitoring, and management of trash. Maintaining a check on the trash in waste bins manually is an exhausting job involving more human labor, and financial resources than is possible with today's technologies. This is our strategy for an automated garbage disposal system. This is our IoT Garbage Monitoring framework, an innovative strategy that can contribute to the hygiene and health of the cities. This study is a survey based on an Internet of Things-based smart waste collection system.

II. LITERATURE SURVEY

Cities needs to come up with garbage disposal methods which are equally effective and efficient. A lot of recommendations have been offered and some of them are currently being implemented in reality. But it can't be considered to be productive. Therefore, a survey was carried out among multiple ideas, and this study outcome includes a survey among different ideas for an Internet of Things- based waste collection system.
A clever design for managing waste is the foundation of the waste collection system which is proposed in the study [1]. The proposed work is an Internet of Things (IoT)-based Smart waste separation and management device that uses sensors to detect waste products in dustbins. After it is wastes are detected, they can be separated using sensors, and information is immediately transmitted via IoT to a cloud database. The sensors and the Internet of Things module are connected via a microcontroller. An ultrasonic sensor is used to figure out the proximity.

The proposed work [2] describes the design and implementation of an Arduino microcontroller based on the internet of things (IoT) that uses ultrasonic sensors to detect the level of waste in garbage bins placed in designated waste locations. server The Arduino microcontroller also sends content level information to a central web-system that displays the garbage bin levels graphically, and it continuously displays the status information as "filled," "half- filled," or "empty" on an LCD screen at regular intervals. Ultrasonic sensors, a Wi-Fi module, and a microprocessor are used to do this. Using the Arduino IDE and the embedded C programming language, the Arduino Uno microcontroller was programmed. PHP scripting language was used to communicate with the web server through the hypertext preprocessor.

The proposed work in the paper [3] is to categorize rubbish into three primary types: metallic, wet, and dry. The dry waste is going to be further split into paper and plastic. The waste management system is made more convincing by this work's tiny size and straightforward design, which also happens to be cost-effective. The Arduino UNO board we'll be employing in this paper makes the system function easily and conveniently, which simplifies the design. All of these trash are recognized by their associated sensors, after their contents are disposed of in the allocated bins, where they

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can be recycled or used again promptly.

The proposed work in the paper [4] describes the design and implementation of an Arduino microcontroller based on the internet of things (IoT) that uses ultrasonic sensors to detect the level of waste in garbage bins placed in designated waste locations. server To get over the drawbacks of conventional trash management systems, this work suggests an Internet of Things-enabled solid waste management system for smart cities. The PBLMU (Public Bin Level Monitoring Unit) and HBLMU (Home Bin Level Monitoring Unit) end sensor nodes, which are utilized to track bins in public and household locations, respectively, make up the suggested architecture. The trash bin's unfilled level and location are measured by the PBLMUs and HBLMUs, which then process and send the information to a central monitoring station for analysis and storage. Each garbage can's unfilled status may be viewed and assessed by the waste collection authority thanks to an intuitive Graphical User Interface (GUI). The important experiments listed below were carried out in order to validate the suggested system architecture.(A) Eight garbage cans with PBLMUs were linked to a LoRaWAN network, and eight more trash cans with HBLMUs were linked to a Wi-Fi network. The garbage cans were stocked to varying degrees, and each trash can's matching empty level was tracked via an intelligent graphical user interface. (b) To determine a PBLMU's average current consumption, an experimental setup was built up to evaluate the sleep current and active current contributions. (c) In hypothetical circumstances, a PBLMU's life expectancy was calculated to be about 70 day.

The article [5] is to provide appropriate guidance about the type of garbage. We can obtain crucial data through IoT devices and sensors, such as the image of the garbage and its moisture content. Using image recognition and the amount of moisture, we can figure out if the target is dry waste or wet waste. As a result, incorrect waste disposal practices are less common and effective segregation is aided.

The proposed work [6] describes the design and implementation of an Arduino microcontroller based on the internet of things (IoT) that uses ultrasonic sensors to detect the level of waste in garbage bins placed in designated waste locations. server This study suggests a smart bin-based, Internet of Things- based effective waste collection system. It keeps an eye on the trash cans in real time and chooses which ones need to be emptied at each waste collection cycle. Additionally, the system has an improved navigation system that indicates the optimal path for gathering waste from the designated containers. In Mount Pleasant, Michigan, four trash cans are thought to be situated at random. In the situation under consideration, the average trip distance is reduced by 30.76% by the suggested solution in comparison to the conventional waste collecting system. As a result, it lowers the cost of fuel and manpower, allowing for real-time monitoring and improved navigation, which optimizes and streamlines the system.

The proposed work in the paper [7] describes the design and implementation of an Arduino microcontroller based on the internet of things (IoT) that uses ultrasonic sensors to detect the level of waste in garbage bins placed in designated waste locations. server A quick overview of an effective image processing technique to solve these issues is provided in this work. The garbage bin image's features were extracted using Gabor wavelet (GW), and the bin area was detected and cropped using Dynamic Time Warping (DTW). The classifier was trained using characteristics from the images. The garbage bin level was classified and the amount of waste inside the bin was estimated using a Multi- Layer Perceptron (MLP) classifier.

The proposed work in the paper [8] describes the design and implementation of an Arduino microcontroller based on the internet of things (IoT) that uses ultrasonic sensors to detect the level of waste in garbage bins placed in designated waste locations. server A quick overview of an effective image processing technique to solve these issues is provided in this work. The garbage bin image's features were extracted using Gabor wavelet (GW), and the bin area was detected and cropped using Dynamic Time Warping (DTW). The classifier was trained using characteristics from the images. The garbage bin level was classified and the amount of waste inside the bin was estimated using a Multi- Layer Perceptron (MLP) classifier. The statistical assessment of classifier perfd on image processing. In this study, an Internet of Things) based strategy for MQ4 and ultrasonic sensor-based rubbish disposal and monitoring. An ultrasonic sensor verifies the amount of trash that has been placed in the "smart bins," which are biodegradable and non biodegradable. The biodegradable trash can's degree of odor is monitored by MQ4 sensors. Through the use of an application, information about the non- biodegradable smart bin's threshold level is provided to the municipal corporation for garbage disposal. The biodegradable bin's lid slides and the waste is deposited in the chamber below if the threshold level is exceeded. This approach is a step toward a "smart city" and is more practical than the manual one.

The proposed work in [9] primary is to create a deep learning model-based smart waste management system which

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improves trash segregation and permits bin status monitoring in an Internet of things setting. Waste classification and categorization is accomplished by using the SSD MobileNetV2 Quantized, which is trained on a dataset comprising paper, cardboard, glass, metal, and plastic. The servo motor, attached to a plastic board, classifies the garbage into the appropriate waste compartment after the camera module, using the trained model on Tensor Flow Lite and Raspberry Pi 4, detects the waste. Real-time latitude and longitude are obtained using a GPS module, while the garbage fill % is tracked by an ultrasonic sensor.By using 915 MHz, the LoRa receiver receives the status of the smart bin from the LoRa module on the bin itself. The smart bin's electronic components are secured using an RFID-based locker that can only be unlocked for maintenance or upgrades with a registered RFID badge.

The purpose of the article[10] is to create a deep learning model based on Tensor Flow and the LoRa communication protocol to create an intelligent waste management system. Tensor flow handles real-time object detection and classification after receiving sensor data via LoRa. The servo motors in the bin regulate the many compartments that are designed to separate waste, such as the general waste compartment, the paper, plastic, and metal sections. Using a pre-trained object detection model, the Tensor Flow framework performs object recognition and waste classification. A camera attached to the Raspberry Pi 3 Model B+, which serves as the main processing unit, is utilized to detect objects. The object detection model is trained using waste picture data to create a frozen inference graph.Each trash container has an ultrasonic sensor installed to track the garbage's fill level. A GPS module is fitted to track the bin's location in real time. Data about the bin's location, fill level, and real-time status are transmitted using the LoRa communication protocol. An RFID module is integrated to facilitate identification of waste disposal staff.

The proposed work in the paper [11] , a Smart Recycling Bin that classifies waste using modern approaches. The system design leverages cutting edge technologies like neural networks and the LoRaWAN protocol, enabling for the low-cost manufacturing of the final product. A Smart Bin prototype that we developed was affordable and had a 92.1% accuracy rate in classifying various trash categories. The system can also improve the efficacy of the relevant authorities in waste management by remotely communicating important data to them.
The main aim of the proposed work in the paper[12] is to develop an Arduino Mega system that can automatically separate waste at the source and perform cleaning tasks. The bin's state and distance are estimated by the IR sensor, which sends the information via IFTTT (If this, then that) to send SMS messages. Places like offices, apartments, malls, etc. can use this bin. With the help of this system, waste management in smart cities will be automated and require no human involvement.

Some of the hardwares are used in the above reviews are mentioned below.

A . Ultrasonic sensor

An ultrasonic sensor measures distance or identifies objects by using sound waves that are higher beyond the range of human hearing, usually above 20,000 Hz. It is made up of a receiver and a transmitter. Ultrasonic waves are released from the transmitter and move through the atmosphere until they come into contact with an object. The waves are reflected back to the sensor's receiver when they come into contact with an item. The sensor calculates the distance to the item by measuring the time it takes for the waves to return. Because of their accuracy, non-contact nature, and versatility, ultrasonic sensors are frequently used in a variety of applications, including automotive systems, robotics, and industrial automation. They are especially helpful in situations when other sensors—like infrared sensors—might not work.

B. Color Sensor

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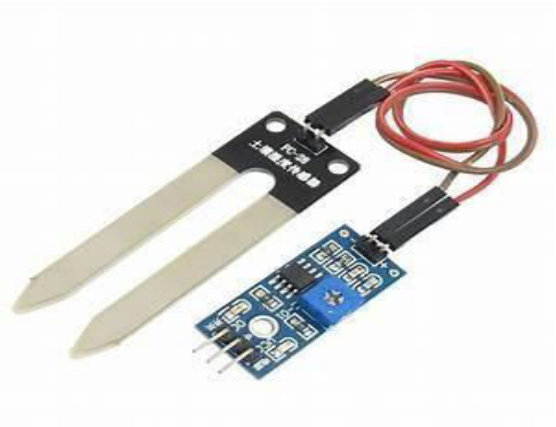
In order to improve the efficacy and precision of trash sorting and disposal procedures, color sensors must be integrated into an Internet of Things-based waste management system. Color sensors enable more accurate separation of recyclable, non- recyclable, and hazardous items by identifying and classifying trash based on its color. Color sensors can be installed in trash cans or other containers as part of a smart waste management system to composition in particular containers. The waste collection routes and recycling efforts can be optimized by the system enable instantaneous recognition of the various waste types' corresponding color codes. The central IoT platform receives this data and uses it to provide real-time information on the waste through the use of color sensors to automate the sorting process.

C .Moisture Sensor

The optimization of waste disposal operations can be greatly enhanced by the integration of moisture sensors into an Internet of Things-based waste management system. Moisture sensors provide important information about how wet or moist waste products are within bins or other containers. This knowledge is especially important for managing organic waste, since high moisture content can hasten decomposition, produce unwanted aromas, and result in the creation of potentially hazardous by products. Moisture sensor data can be sent in real- time to a central platform in an Internet of Things- enabled waste management system, enabling prompt action and proper waste processing. For example, if the system detects high moisture levels in organic waste, it can send out alarms for prompt collection or recommend changing the waste composition by increasing aeration.



D . IR Sensor

To maximize the efficiency of garbage collection and disposal procedures, Infrared (IR) sensor integration is crucial in Internet of Things-based waste management systems. By monitoring the infrared radiation that the things release, infrared sensors (IR sensors) are able to identify the presence and amount of waste within bins or containers. For the purpose of keeping an eye on fill levels and planning prompt garbage collection operations, this information is quite helpful. The real-time transmission of infrared sensor data to a central platform facilitates the optimization of waste collection trucks' routes in an IoT-enabled system. The system can minimize fuel usage and reduce wasteful trips by prioritizing collections based on actual need, as determined by accurately recognizing each container's fill condition. This improves trash management's environmental sustainability and operational efficiency while also saving money. By monitoring the infrared radiation that the things release, infrared sensors (IR sensors) are able to identify the presence and amount of waste within bins or containers. For the purpose of keeping an eye on fill levels and planning prompt garbage collection operations, this information is quite helpful. The real-time transmission of infrared sensor data to a central platform facilitates the optimization of waste collection trucks' routes in an IoT-enabled system. The system can minimize fuel usage and reduce wasteful trips by prioritizing collections based on actual need, as determined by accurately recognizing each container's fill condition. This leads to financial savings and a more environmentally sustainable approach to trash management in addition to improving operational efficiency.

E . Metal Sensor

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For garbage sorting and recycling operations to be as efficient as possible, the incorporation of metal sensors into an Internet of Things-based waste management system is critical. Metal sensors are essential for locating metallic objects in trash streams so that recyclables like steel and aluminum may be separated. Metal sensor data is sent in real- time to a central platform in a smart waste management system, enabling precise and automatic sorting processes. By ensuring that goods containing

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metal are kept separate from other debris, this helps to enhance recycling rates and lessen the impact on the environment. Metal sensors additionally aid in the detection of sharp or dangerous objects, improving safety precautions throughout the collection and processing of garbage. These sensors give real-time data on the amount of metal present in waste streams.

F. Servo Motor

The optimization of trash bin and container functionality is facilitated by the integration of servo motors in Internet of Things-based waste management systems. Servo motors can be used to automate lid-opening systems, making it easier to dispose of garbage hygienically and without using your hands. The servo motors in this system react to changes in trash levels within the containers by opening or closing the lids in real-time thanks to the Internet of Things. This facilitates effective waste collection procedures in addition to improving customer convenience. Furthermore, the use of variable lid-opening mechanisms according to the kind of trash being disposed of is made possible by servo motors, which makes it easier to separate recyclables from non-recyclables. The development of intelligent trash cans that can adjust to shifting waste disposal needs is made possible by the precise control provided by servo motors.

F. Node MCU ESP 8266

The Node MCU ESP8266 is a crucial component in an Internet of Things-based waste management system since it connects and synchronizes the system's many parts. The central IoT platform and the waste bins with sensors can communicate seamlessly thanks to this small and adaptable Wi-Fi- enabled microcontroller. Real-time data transfer from the Node MCU ESP8266 makes it possible to continuously monitor sensor readings, fill levels, and other important data. It is the best option for building a scalable and economical Internet of Things infrastructure because of its low cost, low power consumption, and compatibility with a wide range of sensors. With the help of the Node MCU ESP8266, the waste management system can now send data over the internet, enabling data-driven decision- making, effective route planning, and remote monitoring.

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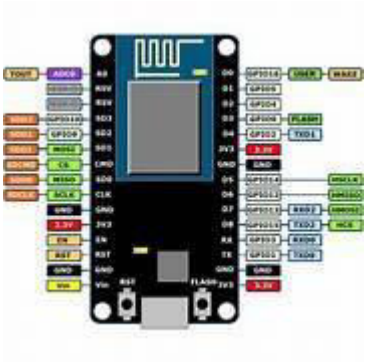

- **Internet Of Things (IoT)**

The term "Internet of Things" (IoT) describes the network of physical objects, appliances, cars, and other things that are connected and have sensors, software, and other embedded characteristics that allow them to trade and gather data. An intelligent and seamless system is created by this network of linked devices, allowing information to be shared and used toincrease productivity and decision- making. Applications for IoT are found in many different fields, such as smart homes, transportation, healthcare, and agriculture. Devices can connect with one another by utilizing the Internet of Things (IoT), which can provide real-time insights, automate procedures, and increase overall productivity. But as IoT grows, so do worries about security, privacy, and the moral use of data. As a result, these issues must be carefully considered as the technology develops.

- **Artificial Intelligence (AI)**

AI is the term used to describe the creation of computer systems that are capable of tasks that normally require human intelligence. This includes a broad range of skills, such as perception, learning, problem-solving, interpreting natural language, and decision-making. Systems can gradually increase their performance with machine learning, a kind of artificial intelligence, by using data and experience. Applications of artificial intelligence (AI) are numerous and include predictive analytics, driverless vehicles, picture and speech recognition, and virtual assistants. Neural network-based machine learning, or "deep learning," has made a substantial contribution to the most recent advances in artificial intelligence. In addition to its enormous potential to transform businesses and increase productivity, artificial intelligence (AI) raises ethical questions about biased algorithms, job displacement, and the responsible application of AI in crucial decision- making processes.

The Internet of Things (IoT) and Artificial Intelligence (AI) combined provide a transformative combination that increases the capabilities of linked devices. AI infuses the vast volumes of data produced by Internet of Things devices with intelligence and learning capabilities. Artificial Intelligence (AI) uses complex algorithms to evaluate real-time data, generating valuable insights and facilitating predictive analytics. This combination makes it easier to make proactive decisions, including anticipating industrial equipment problems or optimizing energy use in smart buildings. AI also enables automation in Internet of Things systems, enabling responsive answers in reaction to user actions or shifting circumstances. Furthermore, by detecting abnormalities and possible threats in IoT networks, AI-driven security solutions can improve the overall resilience of the system.

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Comparative analysis of related work are given below.

Ref	Year	H/w	S/W & Technology	No: sensors	Accuracy
1	2019	Ultra Sonic Sensor, Metal sensor, Moisture sensor, Arduino mega, buzzer, LCD display, servo motor	ML SURF KNN	3	99%
2	2020	Ultrasonic sensor, LED, LCD, Aurdino board	Embed ed c, Aurdin o IDE	3	NA
3	2018	Moisture sensor, laser LED, Proximity server,, DC motor	Aurdin o IDE	1	NA
4	2021	Ultra Sonic Sensor GPS	IOT LORA WAN	1	NA
5	2017	Capacitive inductance, Moisture, IR Proximity Sensor, Moisture Sensor, Inductive Sensor, Capacitive Sensor, Bacteria Sensor	IOT	6	NA

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6	2020	ESP 2866 Moisture Sensor, Ultra Sonic Sensor IR Sensor Gas Sensor	IOT	3	NA
7	2014	NA	GTW BW MLP	NO	99.50%
8	2018	Ultrasonic Sensor (2)	IOT Things of Speak Server (IOT)	3	NA
9	2021	AURDINO UNO Micro Sonic Sensor, Moisture Sensor	ML, IOT, Image Processing	2	NA
10	2021	Raspery Pi4, Ultra Sonic Sensor, Servo Driver Hat Servo Motor Li-PO-battery	CNN SSD Mobile Net V2	1	NA
11	2017	Raspberry Pi3 ARM Cortex-A53	CNN LoRa	No	92 1%
12	2021	IR Sensor (6) PIR Sensor (1) ARDUINO MEGA Board Proximity Sensor	Arduino IDE Thing speak IF TTT	9	NA

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III. CONCLUSION

Proper waste management helps prevent pollution of air, water, and soil. It reduces the release of harmful substances into the environment, minimizing negative impacts on ecosystems, wildlife, and human health. Many waste management practices, such as recycling and waste-to-energy technologies, generate renewable energy or recover energy from waste. This reduces the reliance on fossil fuels and helps combat climate change. In this paper, I have studied various ideas proposed for proper waste segregation. Since a stabilized system is needed for preventing harm caused to the environment due to improper disposal. . According to the obtained results, the proposed IoT-enabled solid waste implementing IoT based system is high. We can use AI (Artificial Intelligence) in future for making it more effective and efficient.

REFERENCES

[1]. ”Smart Garbage Segregation & Management System Using Internet of Things(IoT) & Machine Learning(ML)”. Shamin N;P Mohammed Fathimal ; Raghavendran R; KamaleshPrakash.(2019).
[2]. “IoT-Based Framework for Smart Waste Monitoring and Control System:” Sani Abba * and ChinakaIhechukwu, Published: 14 November 2020.
[3].”Automated Waste Segregator” A. Sharanya, U.Harika, N.Sriya, SreejaKochuvila.(2018).
[4] .”IoT-Enabled Solid Waste Management in Smart Cities”. Vishnu S; Ramson S.R.J; Senith S; Anagnostopoulos T; Abu-Mahfouz A.M; Fan Z; Srinivasan S; Kirubaraj A. (2021).
[5].”Eco-friendly IOT based waste segregation and management.B.R (Santhosh Kumar, N.Varalekshmi, SoundaryaS.Lokeshwari) (2017)
[6]. “An IoT Based Efficient Waste Collection System with Smart Bins” “KhandakerFoysalHaque ,RifatZabin† , Kumar Yelamarthi , PrasanthYanambaka , Ahmed Abdelgawad (2020).
[7].”Solid waste bin detection and classification using Dynamic Time Warping and MLP classifier”.Md. Shafiqul Islam, M.A. Hannan, Hassan Basri ,AiniHussain .
[8].”GARBAGE MONITORING AND DISPOSAL SYSTEM FOR SMART CITY USING IOT Dr.PrasunChowdhury ,RittikaSen , Dhruba Ray , Purushottam Roy and SouradeepSarkar.
[9].”Machine Learning and IoT Base Waste Management Module”(Rijwan khan, Santhosh Kumar)(2021)
[10].”A CNN Based Smart Wate Management System using Tensor flow Lite and LorRa –GPS shield in IOT Environment”.(Nicholas, Mohammed Tariqual Islam, MuhammedShahidul Islam)(2021).
management system is well suited for monitoring real-time trash bin information in smart cities. The study shows that mainly IoT based techniques are mostly used for waste segregation but the cost of JV1u1].on”Sleegug2rmeg0aet1ion78o,f wNastoe .usi5ng,IoMt”
[11].”Seggregation using IoT” .Harshithajoshi.(2017).
[12].”SMART GARBAGE SEGREGATOR USING IOT” (2021).SidhanthPandey,SairamMakkena, [JS1hu1ip].pnVueSaoc2hldu0evm1a. 7e 8, No. 5, May-
[13]. “T. J. Sheng, M. S. Islam, N. Misran, M. H. Baharuddin, H. Arshad, M. R. Islam, et al., "An Internet of Things based smart waste management system using LoRa and tensorflow deep learning model", IEEE Access, vol. 8, pp. 148793-148811, (2020)
[14].., “Smart waste collection system with low consumption LoRaWAN nodes and route optimization”. S Alvaro, L., Caridad, J., De Paz, J., Gonz ´ alez, G.V.(2018)
[15]. “Capacitated vehicle-routing problem model for scheduled solid waste collection and route optimization using PSO algorithm”. Hannan, M., Akhtar, M., Begum, R.A., Basri, H., Hussain, A., Scavino, E., (2018)
[16] “A noble proposal for Internet of garbage bins (IoGB)”. Jim, A.A.J., Kadir, R., Mamun, M.A.A., Nahid, A.-A., Ali, (2019)
[17] “Smart city platform development for an automated waste collection system”. Popa, C., Carutasu, G., Cotet, C., Carutasu, N., Dobrescu, (2017)
[18]., “Smart waste collection system with low consumption LoRaWAN nodes and route optimization”. Alvaro, L., Caridad, J., De Paz, J., Gonz ´ alez, G.V., Bajo.J(2018)

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