

MANAGING IMMACULATE INDIA DRECK MANAGEMENT SYSTEM USING SENSOR WITH IOT

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Abstract:

An embedded system is a computer system with a dedicated function within a larger mechanical or electrical system, often with real-time computing constraints. It is embedded as part of a complete device often including hardware and mechanical parts. By contrast, a general-purpose computer, such as a personal computer (PC), is designed to be flexible and to meet a wide range of end-user needs. Embedded systems control many devices in common use today. Modern embedded systems are often based on microcontrollers (i.e. CPUs with integrated memory and/or peripheral interfaces) but ordinary microprocessors (using external chips for memory and peripheral interface circuits) are also still common, especially in more complex systems. In either case, the processor(s) used may be types ranging from rather general purpose to very specialized in certain class of computations, or even custom designed for the application at hand. A common standard class of dedicated processors is the digital signal processor (DSP). We introduce the Smart receptacle framework that recognizes totality of wastage canister. The framework is intended to gather information and to convey the information through remote work arrange. The framework additionally utilizes obligation cycle method to decrease control utilization and to boost operational time. The rain sensor module is a simple device for rain recognition. It can be utilized as a switch when raindrop falls through the sprinkling board and furthermore to measure precipitation power. We present the new idea for shutting the receptacle naturally when the rain sensor sense rain identification. The Smart receptacle framework was tried in an open air condition. Through the proving ground, we gathered information and connected sense-production techniques to acquire litter container use and litter canister day by day regularity data. With such data, wastage canister suppliers and cleaning contractual workers can settle on better choice to build efficiency.

Keywords — Buzzer, arduino board, sensor, SPI protocols.

Introduction

Swachh Bharat Abhiyan (English: Clean India Mission and curtailed as SBA or SBM for "Swatch Bharat Mission") is a national battle by the Government of India, covering 4,041 statutory urban communities and towns, to clean the avenues, streets and framework of the nation. In our framework, the Smart dustbins are associated with the web to get the ongoing data of the brilliant dustbins. In the current years, there was a fast development in populace which prompts more waste transfer. So a legitimate waste administration framework is important to abstain from spreading some fatal infections. Dealing with the brilliant containers by observing its status and appropriately taking the choice. There are number of dustbins are situated all through the city or the Campus (Educational Institutions, Companies, Hospitals and so on.). The point of the mission is to cover all the rustic and urban zones of the nation to display this nation as a perfect nation before the world. With the multiplication of Mobile system gadgets, for example, PDAs,

sensors, cameras. It is conceivable to gather enormous measure of rubbish. In the metropolitan urban communities it isn't conceivable to check every last place where the refuse dump yard is full or not. So we have presented another idea utilizing ultrasonic sensor. This is a sensor which hint about the heap put on it. So the rubbish can likewise be checked thusly. Ordinarily, in our city we see that the waste receptacles or dustbins put at open spots are over-burden. It makes unhygienic conditions for individuals and in addition offensiveness to that place leaving awful stench. To maintain a strategic distance from every such circumstance we will actualize an undertaking called IoT Based Smart Garbage and Waste Collection receptacles.

This framework additionally screens the phony reports and consequently can lessen the debasement in the general administration framework. In the event that the dustbin isn't cleaned in particular time, at that point the record is sent to the higher expert who can make proper move against the concerned

temporary worker. This decreases the aggregate number of outings of waste accumulation vehicle and consequently lessens the general consumption related with the trash gathering. It extreme keeps cleanness in the general public. Accordingly, the brilliant junk administration framework makes the rubbish gathering more proficient the utilization of sun powered boards in such frameworks may lessen the vitality utilization. These clean canister model can be connected to any of the keen urban communities around the globe. A waste gathering and checking group which is conveyed for accumulation of rubbish from the city can be guided in a well way for gathering.

RELATED WORKS

1. Theodoros Anagnostopoulos, Arkady Zaslavsky, Alexey Medvedev in the year 2015 presented a dynamic directing calculation which is demonstrated hearty if there should be an occurrence of truck breakdowns, for instance when a truck is over-burden or harmed and require substitution. Moreover we join a heterogeneous armada of trucks which is demonstrated cost productive in this manner decreasing waste accumulation operational costs when squander transported from stops, brief waste stockpiling zones, to dumps. Virtual worlds of Things (part) empower imaginative administrations abusing sensor information from sensors installed in the city. Squander accumulation is dealt with as a potential IoT benefit which misuses vigor and cost effectiveness of a heterogeneous armada. By fusing HCTs we accomplish lessening of the waste accumulation operational expenses since course treks to the dumps are decreased because of high waste stockpiling limit of these trucks. At long last, the proposed models are assessed on engineered and genuine information from the city region of St. Petersburg, Russia. The models show consistency and accuracy. Squander accumulation in past years was dealt with in a fairly static manner. The expansion of sensors and actuators empower dynamic models as well. Dynamic booking and steering model in applies limit sensors and remote correspondence foundation along these lines to know about the canisters state. It consolidates systematic displaying and discrete-occasion recreation keeping in mind the end goal to accomplish continuous dynamic directing and planning.

2. Hanan Idoudi, Oumaima Ben Abderrahim, Khalil Mabrouk in the year 2014 presented about characterize basic measurements to quantify and demonstrate joins soundness at that point, we infer diverse measurements to show steadiness of ways. Second, we utilized our measurements to examine, by recreations, the impact of portability and introductory topology on ways security. Our recreations demonstrated that proactive steering dependably registers low soundness ways. We think about the strength of connections and ways in MANETs. At that end, we characterize a nonexclusive and basic model for connections and ways strength in MANETs, at that point, we research, utilizing the new characterized measurements, the impact of versatility under different situations. Our investigation demonstrated that our

model is splendidly equipped for foreseeing the conduct of connections and ways and that proactive steering dependably develops low security ways even under moderate moving hubs. Proactive directing depends on the development of briefest ways and their support amid a steering period. In the event that the directing time frame is high and joined to the versatility impact, likelihood of utilizing a broken way right now of steering gets high on the grounds that directing data isn't a la mode. We characterized initial a basic model for security calculation of the two connections and ways. At that point we utilized our new characterized measurements to ponder by recreation the effect of topology and hubs portability on connections and ways solidness.

3. Muthukumaran P, Swagata B Sarkar in the year 2013 presented about happenings in light of the fact that starting at now there is no framework set up that can screen the trash receptacles and show the same to the organization. Notwithstanding this Water is a standout amongst the most vital common assets. Consequently it can likewise go about as a programmed twofold beware of the piece of the administration experts too. Here every junk canister is fitted with the Adhoc handset for correspondence, a sensor for checking the level of trash in the receptacle. Water is dispersed to various territories at various circumstances by opening and shutting the individual solenoid valves. The entire procedure should be possible naturally with the assistance of the microcontroller and with no human mediation which brings about quicker and precise process because of the nearness of in assembled ADC. Along these lines the water circulation should be possible naturally. Water dissemination frameworks today are not computerized and it needs people to work the valves physically. The refuse may flood whenever which can't be observed naturally in the current framework. The requirement for overseeing civil strong waste in an effective way has turned out to be intense. Mindfulness with respect to the danger of strong waste contaminating every key component of living is developing universally and broadly.

4. T. Gomes, N. Brito, J. Mendes, J. Cabral and A. Tavares in the year 2012 presented about the installed stage for observing the filling level of reusing containers, with ease execution, remote correspondences and low power engineering that can be utilized as a part of any sort of existing reusing canister. WECO, a remote inserted answer for checking the level of the containers situated in reusing spots. The proposed framework consequently cautions a remote focal station when a canister achieves a programmable filling level, therefore staying away from the need to spot check if the receptacle is full and guaranteeing that the reusing spot is kept clean. The filling level readings of each canister in a reusing spot are made utilizing a ultrasonic sensor. The information gathered by the observing stage is then sent to the remote focal station that procedures it with a specific end goal to advance courses and build up a planned accumulation of the reusing spots. The got comes about, has carried on not surprisingly, being a decent answer for a minimal effort, low power and remote checking framework. It can be utilized as a part of all the current

reusing containers in the market and it can be incorporated with the current observing stage. We guarantee a productive information gathering from the filling level of the reusing receptacles. This checking stage is additionally autonomous from the application utilized; which implies that it can be utilized as a part of other a few applications that require a modern observing framework.

5. Hu Lingling, Li Haifeng, Xu Xu, Li Jian in the year 2011 presented about the Internet of Things has turned out to be well known through the Auto-ID Centre. Radio-recurrence recognizable proof (RFID) is frequently observed as an essential for the Internet of Things. In the event that all objects of day by day life were furnished with radio labels, they could be recognized and stocked by PCs. The control of the vehicle in the virtual data space, it accomplishes exact and keen vehicle administration. 5 layers structure of the framework and its working principals are depicted. It has been working in Nanjing city for the comfort of logical administration of vehicles. We presented a clever vehicle observing framework in view of the Internet of Things, which secures vehicle data and the status of street arrange continuously. The vehicle and the driver's personality data are built into electronic qualifications in the institutionalized shape. Depictions are prepared through the "tag acknowledgment" module, and are changed to the vehicle number plate, and after that are checked with the DCARD.

6. Pablo Puñal Pereira, Jens Eliasson, Rumen Kyusakov in the year 2013 presented today's WSNs normally use dedicated gateways to bridge sensors and IP networks. The installation and maintenance of such a WSN infrastructure are expensive and non-scalable. As the number of smart phone users grows exponentially every year, a powerful mobile computing platform could be used as an alternative WSN infrastructure, which is ubiquitous and scalable. This paper studies the major challenges of using mobile phones as spontaneous gateways of WSNs in IoT systems. The challenges include matching the throughput of mobile phone gateways and sensor data rate at hotspot locations, securing sensor data access and providing accounting records of gateway the service offered by mobile phones. The difference between IoT and M2M is that IoT aims an open access platform independent of applications while M2M offers a closed system designed for vertical market applications. The goal of IoT is to offer ubiquitous accesses of the status of Things, represented by sensor data, for Internet applications. WSN architectures has a high entry barrier. Until they are widely adopted in a large scale, the service cost per sensor could be very less cellular network dedicated for M2M. Gateway between sensors and cellular network, they claim low cost cellular deployment because the cell size can be very large. The WSN gateway can bridge the low power PHY/Link layers designed for sensors and Wi-Fi or Ethernet connected to Internet backhaul. The third type of WSN architecture uses mobile terminals as the gateways for WSNs. Mobile gateways increases not only the infrastructure cost but also sensor cost due to the lower average energy used on sensors

7. Jun Li, Yanyong Zhang, Yih-Farn Chen, Kiran Nagaraja, Sugang Li and Dipankar Raychaudhuri in the year 2003 an all-encompassing system engineering comprising of heterogeneous gadgets is introduced. The design is made out of Embedded Internet Systems (EIS) and utilizations standard correspondence conventions. One vital element is the utilization of the Service-arranged engineering (SOA) worldview. The utilization of SOA, by use of the COAP convention and standard administrations, empowers the proposed design to trade sensor and actuator information with an Internet-based cloud and additionally a client's neighbourhood cloud comprising of sensor IoT gadgets, advanced mobile phones and portable PCs. Another segment of the design is an electronic human-machine interface for arrangement, checking and representation of sensor and actuator information utilizing developing web innovations for organized information handling. This demonstrates the utilization of SOA, and RESTful web benefits specifically, is practical on asset compelled stages while supporting genuine versatility. The wearable sensors are a vital instrument to get information shape the human body with minimal level of interruption. For instance, it is conceivable to take estimations of the level of oxygen in the blood, electrocardiograms, breath rate, temperature, circulatory strain, skin mugginess, level of stress. Bluetooth-prepared organized sensor hubs can accomplish great interoperability with purchaser gadgets, have bring down power utilization than Wi-Fi, Transmission is a decent component that counteracts bundle misfortune amid the correspondence between two indistinguishable frameworks. Cell phone to make the Bluetooth PAN which was associated with the Internet by a remote LAN. It is imperative to take note of that in this procedure we didn't utilize any extra programming on the telephone. Parcel misfortune amid the correspondence between two indistinguishable frameworks would affirms that the correspondence ought to be steady however make blockages.

8. Ou Zhou and Xie Xiaopeng in the year 2012 presented the information pool in vehicle and the stage of the vehicular impromptu systems were organized. Component of transmitting information between information poor in vehicle and vehicular specially appointed systems should have been talked about. The steering system, stack extent, and MAC convention should have been progressed. In the meantime more auto sensors, chip, car transport controller, remote specialized gadgets, GPS and GIS frameworks, and in vehicle stimulation and varying media hardware were introduced, so auto dynamic security execution was enhanced and improved. In this paper, through research of the in vehicle transport organize innovation in view of Internet of Things, data was traded between the v2v and base station control focus. Along these lines vehicle driving status checking data, vehicle area data, street movement data were circulated processed, spared and alluded, and driving would turn out to be more secure. The vehicle inner transport organize, outer remote correspondence arrange and the Internet were bound together as a substantial framework, and online continuous checking of

Vehicular status, ongoing observing of in-vehicle products, vehicular specially appointed systems The 6th framework module was base station server and control focus server of Internet module. Utilizing distributed computing stage, undertakings were incorporated overseen and planned by control focus server. GPRS and 3G innovation for vehicle organizing frameworks conveyed amongst vehicles and versatile base stations by just point to point, the data traded amongst vehicle and vehicle couldn't be performed. The data traded amongst vehicle and vehicle couldn't be performed, and data of vehicle impact, vehicle disappointment, couldn't be constant, quick, and productively imparted amongst vehicle and vehicle.

9. Ferran Reverter Manel Gasulla Ramon Pallas Areny in the year 2013 presented about inexactly set paper fills the container however does not weight much. Capacitive sensors have high-impedance, which suggests low power utilization an alluring trademark in sensor systems. Nonetheless, financially accessible capacitive level sensors are expected for the procedure business, which make them excessively cumbersome and costly for the planned application. A hypothetical model subjectively portrays the impacts of the nearness of adjacent conductive protests either grounded or ungrounded. Last point of this work is to plan a sensor system to enhance strong waste accumulation in structures. That system ought to stay away from superfluous outings of individuals accountable for discharging the cases that gather paper to be reused. The electronic interface regularly be detached so as to keep away from any confinements requesting wastebasket position close (and stopped) to an electrical plug. Two cathode setups have been tried up close and personal and coplanar terminals. Trial comes about show great concurrence with the hypothetical expectations .If the meddling article is ceaselessly present, the sensor can be aligned set up and a proper capacitance edge set. In the event that a half-full' wastebasket is incidentally conveyed near a metallic protest, an excess combine of terminals near the crate base would identify an expansion in capacitance contributed by that question however not by additionally paper dumped into the wicker container. Weight sensors mounted at the base of the container are not reasonable either, in light of the fact that the heaviness of the dumped paper

10. Chen Kim Heng, Quoc Chinh Nguyen, Siwei Jiang, Puay Siew Tan Abhishek Gupta, Bingshui Da, and Yew Soon Ong in the year 2013 presented inexactly set paper fills the container however does not weight much. Capacitive sensors have high-impedance, which suggests low power utilization an alluring trademark in sensor systems. Nonetheless, financially accessible capacitive level sensors are expected for the procedure business, which make them excessively cumbersome and costly for the planned application. A hypothetical model subjectively portrays the impacts of the nearness of adjacent conductive protests either grounded or ungrounded. Last point of this work is to plan a sensor system to enhance strong waste accumulation in structures. That system ought to stay away from superfluous outings of individuals accountable for discharging the cases that

gather paper to be reused. The electronic interface regularly be detached so as to keep away from any confinements requesting wastebasket position close (and stopped) to an electrical plug. Two cathode setups have been tried up close and personal and coplanar terminals. Trial comes about show great concurrence with the hypothetical expectations .If the meddling article is ceaselessly present, the sensor can be aligned set up and a proper capacitance edge set. In the event that a half-full' wastebasket is incidentally conveyed near a metallic protest, an excess combine of terminals near the crate base would identify an expansion in capacitance contributed by that question however not by additionally paper dumped into the wicker container. Weight sensors mounted at the base of the container are not reasonable either, in light of the fact that the heaviness of the dumped paper

PROPOSED WORK

A sensor node is installed in every Smart bin. It senses bin fullness and report readings and sensor statuses by using GSM modem. The ultrasonic sensor used fullness of the smart bin. Whenever rain falls occurs the smart bin will detected with the help rain fall sensor to avoid unwanted loading bin. The UART will be used to update the status of the bin whether is full or not through internet. The buzzer which gives alert when abnormal activity from the smart bin.

The bin is full means red led will glow and green led will glow when bin is not full. The SMS will be sent. Smart bin providers are able to identify and decide whether a particular area needs extra litter bins to be placed nearby or removal and relocate existing litter bins to other places where they are needed. From the Smart bin daily seasonality information, cleaning operators are able to better plan when they should send their cleaners to empty the bins, and they are also able to plan which routes their cleaners need to take. It will increase the efficiency of fuel consumption It will reduce the fuel consumption

SYSTEM DESIGN

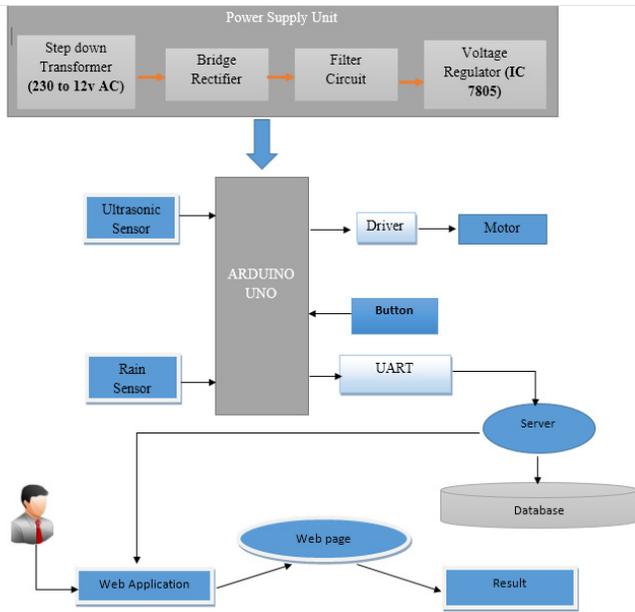


Figure 1 Architecture design

ULTRA SONIC SENSOR

Ultrasonic sensors take a shot at a standard like sonar which assesses separation of an objective by deciphering the echoes from ultrasonic sound waves. This ultrasonic module measures the separation precisely which gives 0cm - 400cm with a gross blunder of 3cm. Its reduced size, higher range and simple ease of use make it a helpful sensor for remove estimation and mapping.

The module can without much of a stretch be interfaced to small scale controllers where the activating and estimation should be possible utilizing two stick. The sensor transmits an ultrasonic wave and delivers a yield beat that compares to the time required for the burst resound to come back to the sensor. By estimating the resound beat width, the separation to target can without much of a stretch be figured.

RAINFALL SENSOR

The Raindrop Detection Sensor module is a simple to-utilize and ease drop acknowledgment sensor. The sensor works through a progression of uncovered parallel follows on board which produces electrical varieties when drops or water volume changes.

DATABASE: MYSQL

MySQL is a database management system (DBMS). A database is a structured collection of data. To access, manipulate, and process data stored in a database, you need a DBMS. Because

computers are very effective at handling large amounts of data, database management plays a central role in computing. But more than being a DBMS, MySQL is a relational database management system (RDBMS). A relational database stores data in separate tables rather than putting all the data into one large repository. Doing so adds tremendous speed and flexibility. Amazon.com and eBay.com are examples of complex e-commerce solutions that depend on database applications to transact business with their customers and partners. MySQL is easy to use, yet extremely powerful, secure, and scalable.

Table: alert

Column Information

Calculate Optimal Datatypes

Find the optimal datatypes for this table by reading existing data. [Read more](#)

Field	Type	Comment
date	varchar(15) NULL	
time	varchar(15) NULL	
Rainfall	varchar(15) NULL	
Garpage	varchar(15) NULL	
buzzer	varchar(5) NULL	

Figure 2 Alert table

Table: userdetails

Column Information

Calculate Optimal Datatypes

Find the optimal datatypes for this table by reading existing data. [Read more](#)

Field	Type	Comment
name	varchar(30) NULL	
password	varchar(30) NULL	
cpasword	varchar(30) NULL	
mailid	varchar(30) NULL	
phoneno	varchar(30) NULL	
Address	varchar(30) NULL	

Figure 3 User details table

WEB APPLICATION

The web application is designed to monitor the fullness of bin from anywhere using internet connection. The web application is designed using HTML and JSP. JSP is server side scripting language for the web development. JSP can be used with HTML code and with various web engine frameworks. The webpage can be easily queried and information can be retrieved in an efficient manner using web application.

CONCLUSION

In the metropolitan urban communities it isn't conceivable to check every last place where the refuse dump yard is full or not. So we have presented another idea utilizing ultrasonic sensor. This is a sensor which hint about the heap put on it. So the rubbish can likewise be checked thusly. We gathered information and connected sense-production techniques to acquire litter container use and litter canister day by day

regularity data. With such data, wastage canister suppliers and cleaning contractual workers can settle on better choice to build efficiency.

REFERENCES

- 1) T. Anagnostopoulos, A. Zaslavsky, “Robust Waste Collection exploiting Cost Efficiency of IoT potentiality in Smart Cities”, IEEE 1st International Conference on Recent Advances in Internet of Things (RIoT), 2015, pp. 1-6.
- 2) T. Anagnostopoulos, A. Zaslavsky, “Effective Waste Collection with Shortest Path Semi-Static and Dynamic Routing”, IEEE 14th International Conference on Next Generation Wired/Wireless Advanced Networks and Systems (NEW2AN) and 7th Conference on ruSMART, 2014, pp. 95-105.
- 3) P. Muthukumaran, and S. B. Sarkar, “Solid waste disposal and water distribution system using the mobile adhoc network”, IEEE International Conference on Emerging Trends in Communication, Control, Signal Processing & Computing Applications (C2SPCA), 2013, pp. 1-4.
- 4) T. Gomes, N. Brito, J. Mendes, J. Cabral, and A. Tavares, “WECO: A wireless platform for monitoring recycling point spots”, IEEE 16th Mediterranean Electro technical Conference (MELECON), 2012, pp. 468-472.
- 5) H. Lingling, L. Haifeng, X. Xu, and L. Jian, “An Intelligent Vehicle Monitoring System Based on Internet of Things”, IEEE 7th International Conference on Computational Intelligence and Security (CIS), 2011, pp. 231-233.
- 6) P. P. Pereira, J. Eliasson, R. Kyusakov, J. Delsing, A. Raayatinezhad, and M. Johansson, “Enabling Cloud Connectivity for Mobile Internet of Things Applications”, In the Proceedings of the IEEE 7th International Symposium on Service-Oriented System Engineering (SOSE), 2013, pp. 515-526.
- 7) J. Li, Y. Zhang, Y. F. Chen, K. Nagaraja, S. Li, and D. Raychaudhuri, “A Mobile Phone Based WSN Infrastructure for IoT over Future Internet Architecture”, IEEE International Conference on Internet of Things and Cyber, Physical and Social Computing (iThings/CPSCoM), 2013, pp. 426-433.
- 8) O. Zhou, and X. Xiaopeng, “Research on In-vehicle Bus Network Based on Internet of Things”, IEEE 4th International Conference on Computational and Information Sciences (ICCIS), 2012, pp. 981-984.
- 9) F. Reverter, M. Gasulla, and R. Pallas-Areny, “Capacitive level sensing for solid-waste collection”, In the Proceedings of IEEE Conference on Sensors, vol. 1, 2003, pp. 7-11.
- 10) A. Runka, B. Ombuki-Berman, and M. Ventresca, “A search space analysis for the waste collection vehicle routing problem with time windows”, In the Proceedings of the 11th Annual ACM Conference on Genetic and Evolutionary Computation,

[11] J. Jin, J. Gubbi, S. Marusic, and M. Palaniswami, “An Information Framework for Creating a Smart City Through Internet of Things”, Internet of Things Journal, vol. 1 (2), 2014, pp. 112-121.

[12] J. Ma, “Internet-of-Things: Technology evolution and challenges”, IEEE MTT-S International Microwave Symposium (IMS), 2014,

[13] A. Vakali, L. Anthopoulos, and S. Krco, “Smart Cities Data Streams Integration: experimenting with Internet of Things and social data flows”, In the Proceedings of the 4th ACM International Conference on Web Intelligence, Mining and Semantics (WIMS’14), 2014, pp. 1-5.

[14] A. J. Jara, P. Lopez, D. Fernandez, J. F. Castillo, M. A. Zamora, and A. F. Skarmeta, “Mobile digcovery: discovering and interacting with the world through the Internet of Things”, Personal and Ubiquitous Computing, vol. 18 (2), 2014, pp. 323-338.

[15] E. Theodoridis, G. Mylonas, and I. Chatzigiannakis, “Developing an IoT Smart City Framework”, Urban Computing & Modern Cities Workshop, IEEE 4th International Conference on Information, Intelligence, Systems and Applications (IISA), 2013, pp. 1-6.

[16] G. Suci, A. Vulpe, S. Halunga, O. Fratu, G. Todoran, and V. Suci, “Smart Cities Built on Resilient Cloud Computing and Secure Internet of Things”, IEEE 19th International Conference on Control Systems and Computer Science (CSCS), 2013, pp. 513-518.

[17] G. Fortino, A. Guerrieri, W. Russo, and C. Savaglio, “Integration of agent-based and Cloud Computing for the smart objects-oriented IoT”, In the Proceedings of the IEEE 18th International Conference on Computer Supported Cooperative Work in Design (CSCWD), 2014, pp. 493-498.

[18] P. P. Pereira, J. Eliasson, R. Kyusakov, J. Delsing, A. Raayatinezhad, and M. Johansson, “Enabling Cloud Connectivity for Mobile Internet of Things Applications”, In the Proceedings of the IEEE 7th International Symposium on Service-Oriented System Engineering (SOSE), 2013, pp. 515-526.

[19] J. Li, Y. Zhang, Y. F. Chen, K. Nagaraja, S. Li, and D. Raychaudhuri, “A Mobile Phone Based WSN Infrastructure for IoT over Future Internet Architecture”, IEEE International Conference on Internet of Things and Cyber, Physical and Social Computing (iThings/CPSCoM), 2013, pp. 426-433.

[20] O. Zhou, and X. Xiaopeng, “Research on In-vehicle Bus Network Based on Internet of Things”, IEEE 4th International

Conference on Computational and Information Sciences (ICCIS), 2012, pp. 981-984.

[21] F. Reverter, M. Gasulla, and R. Pallas-Areny, “Capacitive level sensing for solid-waste collection”, In the Proceedings of IEEE Conference on Sensors, vol. 1, 2003, pp. 7-11.

[22] A. Runka, B. Ombuki-Berman, and M. Ventresca, “A search space analysis for the waste collection vehicle routing problem with time windows”, In the Proceedings of the 11th Annual ACM Conference on Genetic and Evolutionary Computation,