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Design of Food Supply Monitoring System with Emergency Alert Strategies

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ABSTRACT: Transportation and Distribution (T&D) of fresh food is a tremendous and developing venture because of expanding request and overall sourcing of fresh food. Lamentably, fresh food Transportation and Distribution experiences huge decay and waste as well as from dreary proficiency. Here, productivity is characterized as the part of Transportation and Distribution limit that is utilized. Current Transportation and Distribution effectiveness appraisals of trucks and trailers are in the 10-to-20 percent range and food deterioration and waste assessments are in the 12 percent range. Fresh food is effectively tainted and ruined or debased food is for the most part in charge of food borne sicknesses that influence 48 million individuals yearly in the only us. Inventory network coordination is changing a result of the present pattern of re-appropriating activities to a mutual outsider or outsider coordination. Shared coordination is additionally helped by a few Internet of Things (IoT) based arrangements, for example, GS1 standard–based RFID marking of offices, areas, items, bundles, and bearers. These arrangements alongside detecting and correspondences innovations empower savvy Transportation and Distribution. The Physical Internet: an open worldwide coordination framework established on physical, computerized and operational interconnectivity includes a large number of these thoughts and applies ideas from Internet Information Exchange to certifiable delivery forms. We have stretched out these ideas to crisp food coordination, exhibiting a few similitudes to computerized environments.

KEYWORDS: Fresh Food Supply Chain, Transportation and Distribution, T&D, IoT, Internet of Things, GS1 Standard, Logistics

I. INTRODUCTION

The modern society believes in recent technologies and mainly focused related to the devices, which can provide communication abilities to users. Internet of Things (IOT) is a refined form of network, which can interlink many physical devices, household items and many more electronic components. The complete version of Internet of Things (IOT) is associated with multiple integrations such as Software, Hardware and Web Services. The Internet of Things (IoT) environment is an emerging technology that is expected to connect billions of multiple objects through the Internet. The emerging IoT is going to impact the quality of human lives in many aspects which provide seamless integration of information and communication technologies shortly. The enabling technologies of IoT are WSN, RFID, and emerging communication and information technologies. Ubiquitous sensing has the ability to infer and measure the surroundings through the embedded devices in the environment.

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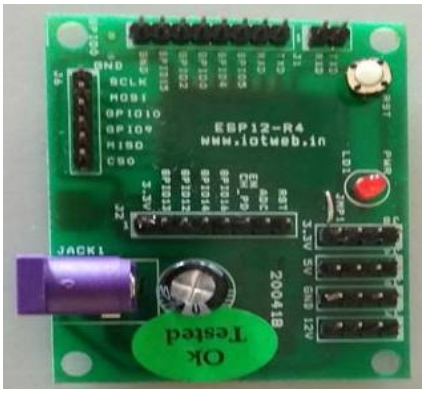

Fig. 1 IoT Module

This IoT module provides a huge support to simplify the process of fresh food supply chain process and help to attain more benefits over the environment. These solutions along with sensing and communications technologies enable intelligent T&D. The Physical Internet an open global logistics system founded on physical, digital, and operational interconnectivity encompasses many of these ideas and applies concepts from Internet data transfer to real world shipping processes. We have extended these concepts to fresh food logistics, demonstrating several similarities to computer networks. The critical problem with transporting fresh food is the deterioration in quality over time while it passes through the T&D pipeline and is subjected to different temperatures, humidity levels, vibrations, and so on. This exposure affects the product in multiple ways, including the attributes detected by the customers (color, texture, odor, firmness, and taste) and latent parameters such as vitamin and bacterial content or chemical changes. Although T&D pipelines already include some level of temperature and quality monitoring at intermediate points, in this article we discuss a fine grained, continuous monitoring of the products quality. Assisted by centralized data collection and analytic, our proposed mechanisms can substantially reduce food waste, improve T&D efficiency, and support quick removal of contaminated or spoiled food from the supply chain.

A. BENEFITS OF INTERNET OF THINGS (IOT)

The IOT module comes with lots of benefits; all of them are listed in details below:

(i) Simplicity: Users not required to use GSM/GPRS modules with SIM card to enable the internet facility to devices. Such devices are available in market also, but providing only low quality of connectivity support and mostly accept 2G level of speed to operate, so that the performance is highly affected. But the proposed Internet of Things (IoT) does not requires any SIM Card or other complex devices, it simply connects with our available WiFi and operates according to that.

(ii) Cost Benefits: The cost of the total module is so cheap compare to the present complex modules in market. The minimum price of available complex devices in market is not less than 2,500 INR. But our device is comparatively lesser cost than the device present into the market.

(iii) Sensor Updation: With the help of our Internet of Things (IoT), users can push 5 to 8 different Sensor values to server within a second of time interval, so it is accurate in speed. Once the sensor values are pushed into server, anyone can attain the view of data and come to know the present strategy of sensors in remote place. In this module, the dynamic sensor details modification facility is given to user itself, Users can define how many sensors are required and they can change the name of Sensors from respective website as well.

(iv) Triggering / Load Control: In the same manner of pushing the data into server, you can get the triggers from server to operate the device according to that. Here other options are also available such as, users are not expected to

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write the program to operate the devices based on given trigger and the device's digital pins will be getting High and Low based on the operation of website/app given to user. If any user/developer wants to operate the device via Microcontroller for specific reasons, then they can get the triggers and they can process by their own.

(v) Perspective: The Internet of Things (IoT) can Push and Control the device bi-directionally within a second of time as per quoted. For this we designed a view in both Android Application as well as Web Page, users can utilize this and control or view the device as per their wish.

(vi) GPS and GSM: In this Internet of Things (IoT) module, one benefit is added by means of enabling the Wireless GPS and GSM by means of developed Android Application. Once the user switches on the device, they need to open the given Android Application in mobile as well. Once it is done, the device can get the connected GPS readings such as Longitude, Latitude and Address from the mobile GPS and pushed it to our IOT device immediately without any delay, so that the developer/user can get the particular view as per their wish. And also the GPS summary is maintained into server with proper date and time. The GSM module is operated vice versa like when the sensor values are exceeded, the trigger will be captured by mobile application and immediately it passes the SMS to the respective mobile number. The mobile number can dynamically be updated from the user end through website or mobile application.

B. RFID READER - EM18

This module directly connects to any microcontroller UART or through a RS232 converter to PC. It gives UART/Wiegand26 output. This RFID Reader Module works with any 125 KHz RFID tags

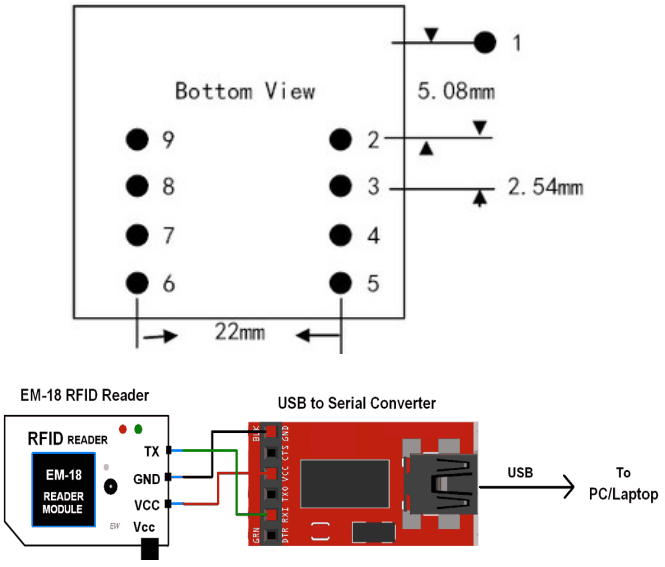

Fig. 2 EM18 RFID Reader Schematic View

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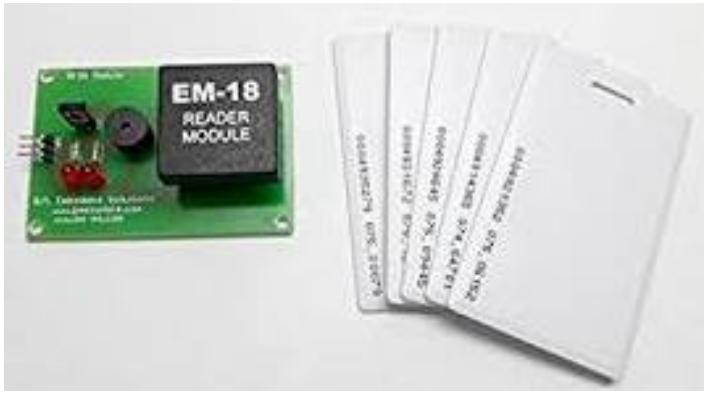

Fig. 3 EM18 RFID Reader with RFID Cards

Specifications

- 5VDC through USB (External 5V supply will boost range of the module)
- Current: <50mA
- Operating Frequency: 125Khz
- Read Distance: 10cm
- Size of RFID reader module: 32mm(length) * 32mm(width) * 8mm(height)

C. GAS SENSOR

A gas/fire sensor is a device that detects the presence of gases (or) fire in an area, often as part of a safety system. This type of equipment is used to detect a gas leak or other emissions and can interface with a control system so a process can be automatically shut down. A gas sensor can sound an alarm to operators in the area where the leak is occurring, giving them the opportunity to leave. This type of device is important because there are many gases that can be harmful to organic life, such as humans or animals.

Fig. 4 Gas Sensor

II. LITERATURE SURVEY

Third-Party Logistics: A Meta-Analytic Review and Investigation of its Impact on Performance - R. Leuschner et al. – 2014 [1]: Interest in third-party logistics has been steadily increasing over the last two decades. Recently, increased focus by researchers has produced a solid literature base of academic research. In this article, a meta-analytic approach is employed to provide a quantitative review of the empirical literature and examine relevant constructs.

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Fifty-four samples across 69 peer-reviewed journal articles, yielding a total of 9,386 observations, were obtained and analyzed. We used transaction cost economics and the resource-based view as lenses to hypothesize a structural model of the relationships between relational governance structure, logistics customer service, and firm performance. Additional relationships were also found and analyzed, helping to clarify the mixed existing findings in the literature. The study concludes by mapping out future directions for 3PL research, based on the study's findings.

Towards a Physical Internet: Meeting the Global Logistics Sustainability Grand Challenge - B. Montreuil – 2011 [2]: This system starts with the assertion that the way physical objects are currently transported, handled, stored, realized, supplied, and used throughout the world is unsustainable economically, environmentally, and socially. Evidence supporting this assertion is exposed through a set of key unsustainability symptoms. Then, the paper expresses the goal to revert this situation, thus meeting the global logistics sustainability grand challenge. It suggests exploiting the Digital Internet metaphor to develop a Physical Internet vision toward meeting this grand challenge. The paradigm breaking vision is introduced through a set of its key characteristics. The paper then proceeds with addressing the implications and requirements for implementing the Physical Internet vision as a means to meet the grand challenge. It concludes with a call for further research, innovation, and development to really shape and assess the vision and, much more important, to give it flesh through real initiatives and projects so as to really influence in a positive way the collective future. For this to happen, it emphasizes the requirement for multidisciplinary collaboration among and between academia, industry, and government across localities, countries, and continents.

A Food Transportation Framework for an Efficient and Worker-Friendly Fresh Food Physical Internet - A. Pal and K. Kant - 2017 [3]: In this system, we introduce a physical Internet architecture for fresh food distribution networks with the goal of meeting the key challenges of maximizing the freshness of the delivered product and minimizing waste. The physical Internet (PI) architecture is based on the fundamental assumptions of infrastructure sharing among various parties standardized addressing of all entities and modularized operations. In this paper, we enhance the PI architecture by including freshness metric and the space-efficient loading/unloading of heterogeneous perishable goods onto the trucks depending on their delivery requirements. We also discuss mechanisms for reducing empty miles of trucks and the carbon footprint of the logistics while reducing the driver's away-from-home time for long distance delivery. Via extensive simulations, the paper shows that the proposed architecture reduces the driver's away-from-home time by ~93%, whereas it improves the food delivery freshness by ~5%. We show that there is a clear tradeoff between the transportation efficiency of the trucks and the delivery freshness of the food packages.

Internet of Perishable Logistics - K. Kant and A. Pal - 2017 [4]: A novel networking model called the Internet of Perishable Logistics (IoPL) attempts to exploit the synergies between the cyber Internet carrying time-sensitive information packets and distribution logistics for perishable commodities such as fresh food. The article discusses the research challenges and opportunities brought about by the perishable commodity distribution logistics field and potential approaches that could enrich this domain as well as that of the cyber Internet.

New Packaging Technologies, Materials, and Formats for Fast-Moving Consumer Products - J.P. Kerry – 2013 [5]: Smart packaging technologies will play a significant role in the continued development of fast-moving consumer goods. Huge interest in product wastage is now becoming a "hot political button" due to issues pertaining to resource security and environmental concerns, especially with respect to food. Resources are becoming more scarce, making material wastage taboo. Cost has been the key barrier for smart packaging to date, but new technological approaches will help address this issue. As product prices increase, especially for food and beverages, investment will become increasingly worthwhile. Safer and higher quality goods will be demanded as the global economy shrinks and food and material prices increase. Consumers will still desire convenience, luxury, and, where necessary, pampering; therefore, the potential uses for smart packaging technologies within the high-value cosmetic and personal care area are numerous. The protection of product brands and the need for demonstrated product authenticity (based on product quality and safety attributes) needs to be addressed by smart packaging technologies, especially with respect to the sale and consumption of medicinal products.

Magnetic Induction Based Sensing and Localization for Fresh Food Logistics - A. Pal and K. Kant - 2017 [7]: Sensing of food spoilage and contamination is an active area of research, with many types of contact and noncontact

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sensors are being developed that can track fresh food quality throughout the distribution process. In this paper, we consider the communication of the sensed product quality along with the box position (in the stack of boxes in the truck or in a warehouse room) to the next level, in order to make the logistics more efficient and less wasteful. Given the water-rich, inhomogeneous biological media, RF or ultrasonic based communications are inappropriate in such environments, and we instead explore Magnetic Induction (MI) based communication framework in the HF band (3-30 MHz). We propose a novel magnetic induction based localization scheme to localize the boxes and study its accuracy via extensive simulations. We show that with a small number of anchor nodes, the localization can be done without any errors for boxes as small as 0.5 meter on the side, and with small errors even for boxes half as big. Our preliminary analysis suggests that such sensors can last for several years without any battery replacement.

III. SYSTEM ANALYSIS

A. Existing System

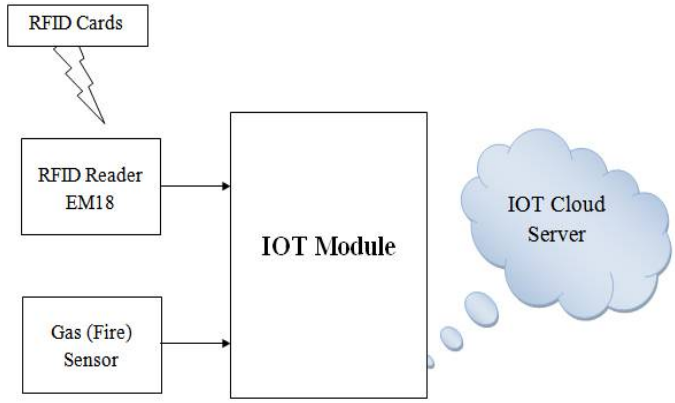
GSM based transportation identification systems are failed in the case of network connection and speed operations, because of 2G powered connectivity. No option is available to monitor the details of container or truck or products in remote manner. Users cannot control or get to know the location details of the respective container immediately, if they are in remote place. Obviously they don't have any option to get the alert details if any accidents such as chemical leakages, fire accidents and so on in remote place without IOT.

DISADVANTAGES OF EXISTING SYSTEM

- Poor in Performance.
- Cost wise Expensive.
- Slow in Operation.
- Cannot Operate Devices Remotely.

B. Proposed System

Well our proposed design is a model to convert the past negatives into positives. The system fully operated via power device called Internet of Things (IOT), so it doesn't requires any GSM module or other costly devices such as Raspberry PI and so on. We have replaced the existing slow operations with powerful IOT based operations, which establishes a connection between any phones and monitor the container details more efficiently. This enables user to get alert immediately if any accidents occurred and also the devices allows the user to monitor the container/truck/product at any time and any place through a web application as well as android application, as you are well aware that android is an open source. Alert is also raised immediately while in emergency cases such as fire accidents or chemical leakages. Requires very low power supply such as 12v DC only, so it is effective and powerful.



(a)

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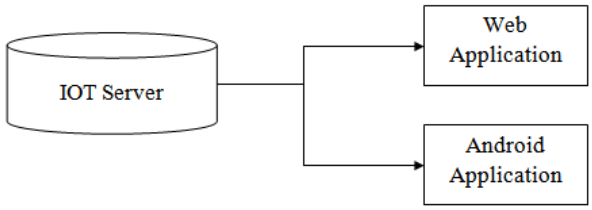

(b)

Fig.5 Proposed System Block Diagram (a) Master (b) Slave

ADVANTAGES OF PROPOSED SYSTEM

- Portable Device to perform more efficient Operations.
- Cost effective process.
- Intelligent, Compact and faster to operate because this device can support 3G as well as 4G network connectivity.

IV. RESULTS AND DISCUSSION

In this section, we provided the complete results of entire project with its practical proofs. The following figure shows the complete IoT based food supply monitoring system.EM18 reader module is used to read the information stored in RFID cards. IoT module is used to push the data from server to user and vice versa. IoT module contains NodeMCU. NodeMCU contain inbuilt wifi when compared to other microcontrollers.

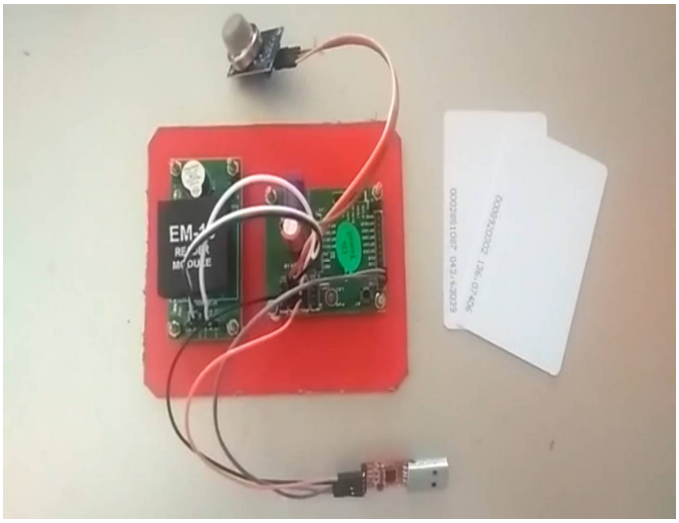

Fig.6 IoT based Food Supply Monitoring System

The following figure shows the container location along with latitude and longitude of the container. It also contains the current address of the container containing the commodities. We also have spot option. By clicking the spot option we can see the location of the container in the Google map. This will be shown in Fig 14.We can also view the details about the individual product in the container by clicking view product option. For that first we have to register that product in the module. After that scanning of the product has to be done. We can the details like product name, weight, latitude, longitude, address, contact number etc.,

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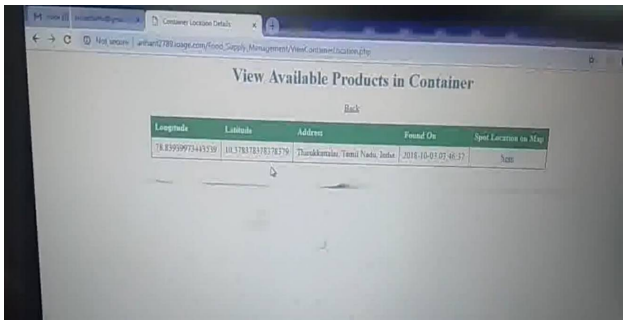


Fig.7 Container Location Summary

The following figure illustrates the container location along with Google Map summary which is spotted by using identified latitude and longitude of the container.

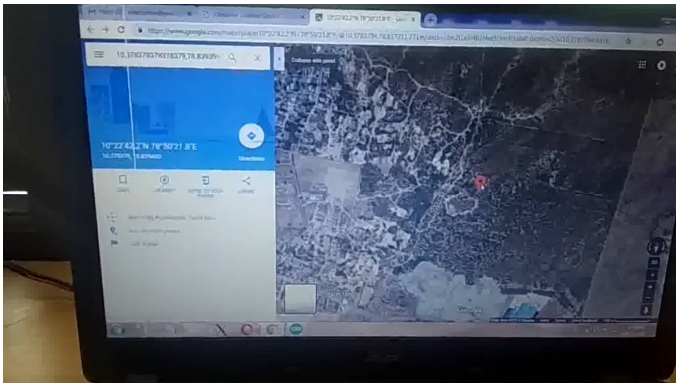
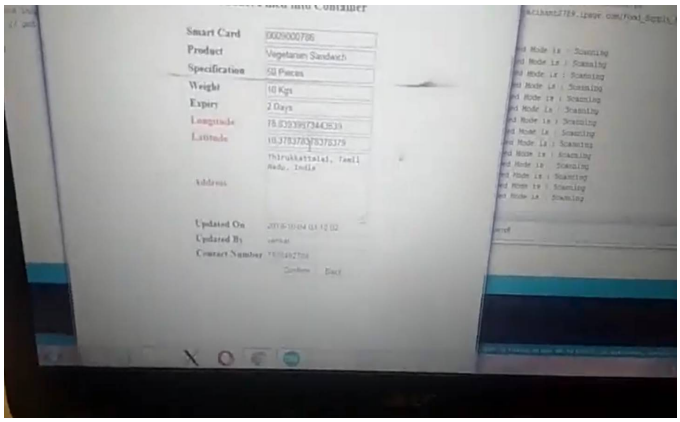


Fig. 8 Location of the Truck in Google Map

The following figure shows the page which allows the user to create a product details and it shows the respective details of the product.



The following figure shows the shows the alert message when gas leakage is found. Alert message contain the location of the truck .Link will given along with the alert message. By clicking the link we can track the latitude and

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longitude of the truck. The alert message will be send to more one or more than one user. After getting the alert message, the vendor will take the remedy actions to prevent the truck from an accident.

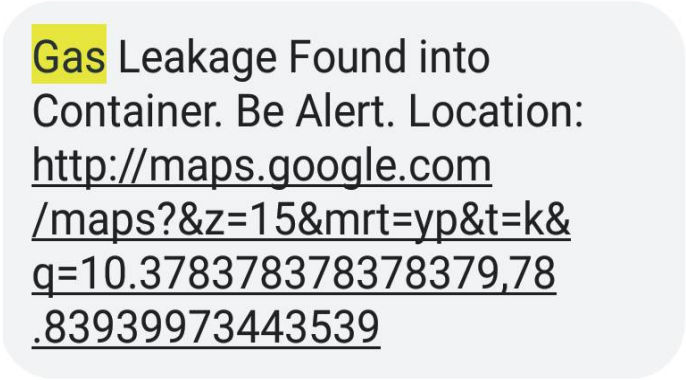

Fig. 9 Alert Message to Vendor

V. CONCLUSION AND FUTURE WORK

Our integrated IoT based online monitoring approach using smart logistics can address the critical needs of reducing food waste, increasing transportation efficiency, and tracking food contamination. The emerging MI-based communications technology appears well suited for local communications in this environment; however, there are several challenges to making the technology work reliably in the highly dense and dynamic environment of real-world logistics operations. Further advances are needed to derive actionable intelligence from the collected data in real-world conditions, such as the presence of faulty modules or patchy cellular communications. Real-world logistics operations also have other complexities that make flexible distribution challenging, such as delivery contracts, party-specific distribution policies, and specific data privacy needs.

Our coordinated IoT based web observing methodology utilizes keen coordination which can address the basic needs of lessening nourishment squander, expanding transportation effectiveness, and following sustenance sullying. The developing MI based correspondences innovation seems appropriate for neighborhood interchanges. In this condition, there are a few difficulties to making the innovation work dependably in the very thick and dynamic condition of certifiable co-ordination activities. Further advances are expected in future to get significant knowledge from the gathered information in genuine conditions. For example, the nearness of broken modules or inconsistent cell interchanges according to neighborhood conditions. Genuine coordination tasks have different complexities that make adaptable appropriation testing, such as conveyance contracts, party explicit dissemination strategies and explicit information protection needs. We trust this article will goad further research and provide solutions to current technical issues.

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