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Implementation of Logistic Management System Using IOT and Open Source Hardware

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Abstract:

Managing of Logistics is a significant aspect in Real time applications. Some of the aspects like delay in delivery of goods, real time identification of cargo vehicle, overload of goods in vehicle, misplacement of goods are some of the issues that are facing by the logistics management. The Global positioning system is used to track the location of the cargo based on its latitude and longitude positions. The GSM/GPRS module facilitates the location to the administrator. The RFID system facilitates the tracking and correct placement of goods in the cargo. The Open source hardware facilitates the processing and orderly management of goods details in the webserver. If more goods are placed in the cargo, then the cargo may not move or reach at expected time due to overload of the goods in the cargo. So by the employment of weight sensor the overload of goods in the cargo is eliminated. This system also serves the security purpose as periodically updating of location on the web server the real time data of cargo are updated with the aid of Open source hardware. Integration of IoT, RFID, GPS, GSM/GPRS and open source hardware yields in good results and can perform its activities in real time. This system yields in dynamic updating of data from the cargo and delays in the delivery of goods are also eliminated, positioning of cargo vehicle is provided, overload of goods is also eliminated.

Keywords — **Logistics, GSM, GPS, Radio Frequency identification, Open source hardware, IoT..**

I. INTRODUCTION

The logistics are playing a significant aspect in present scenarios. A logistic system performs the operation of goods flow. As the oil price are hiking day by day, there must be an approach to maintain effective transportation which reduces the unnecessary usage of oil. The Vehicle tracking system is primarily implemented on ships, but due to changes in the technology pace, there have been several applications in the tracking scheme. The vehicle tracking system helps to track the vehicle and update the information in real time. The cargo tracking mechanism is one of the approaches to track the vehicle's position. The cargo tracking scheme is employed by the GPS system so as to position the vehicle. The GPS and RFID technology, both seem to be the best approach and promising in Real time localization systems [1]. The intelligent transportation system is integrated with the tracking system.

The Global positioning system comprises of a network of satellites. The Global positioning system primary application is in military. The Global Positioning system works on the basis of satellite signals. The communication between the satellites and the GPS system is mainly based on the radio waves. The Global Positioning system is basically comprised of three segments. The satellite constellation, ground networks, the user system is the three segments used in the GPS. The satellite constellation subsists a set of satellite functions on providing data signals to the user equipment. The ground network maintains the space segment. The user system acquires the signals from the space segment and upon further computation the navigation is provided. The radio waves are emitted by the satellite system and are received by the GSP system. The triangulation scheme is employed to calculate the latitude and longitude position in a 2-D approach. Based on the latitude and longitude position the location of the system is computed. The

direction of travelling and average speed is calculated based on the location of the system. Therefore Global positioning system enables any device to determine its position. So the Global Positioning System can be efficiently integrated with the cargo vehicle system.

The Radio frequency identification basically works on the emission of electromagnetic waves. The RFID system comprises of RFID tag, RFID reader and Application hardware. The tags are classified based on the range of coverage, size, cost. The tags are Active, Passive and semi-passive Tags. Among the above mentioned tags the RFID passive tag suits to be more economical and can be easily adhered without much installation effort [2]. The RFID readers are classified into two types they are the active reader and passive reader. The Active RFID reader emits a electromagnetic wave the tags which are in the proximity of the reader will get activated by these waves and the information from the tags is gathered the reader. The RFID system works on low range, High range, Ultra High range, but depending upon the need of the application the appropriate RFID system must be chosen. In this 21st century, RFID assures to be the most promising technology in the field of logistics. In the logistics application the RFID technology replaces the Barcode technology. As the Barcode technology is not secure, the label can be easily damaged, the optical reader used to read the barcodes are not economical.

The Internet of Things triggers the communication between sensors, various modules, people, internet protocols in an efficient manner. The prime goal of IoT is to connect the physical world with the people and facilitates users with more functions that were not possible in the traditional approaches [3]. The IoT facilitates the physical objects with the feature of decision making. The physical objects are getting connected to the internet in a rapid increasing way with the facility of the internet. IoT is playing a remarkable role in all the domains and thus ensuring a quality life. The applications where human decision making is difficult can be altered by the employment of IoT in the domains like transportation, Automation, health care, Supply chain management [4]. The underlying technologies in the IoT make the transformation from the traditional way to smart way. In Industries the IoT is playing a significant aspect. IoT bridges the gap practical aspects and research.

II. RELATED WORK

The traditional vehicle tracking system is a stand alone system which is primarily applied to the Bus tracking system [5]. This system comprises of a microprocessor, power source, RF transceivers. The RF transceivers are installed on every moving vehicle based on the coordinates determined by the GPS the microprocessor will process the information. The RF transceivers are stationed at every bus stop. The RF transceivers stationed at the bus stop are passive components which will be activated when the vehicle with RF transceivers will be in the range of communication. The GSM module is capable of sending the SMS to the central server about the bus location. So that the users can track the buses based on their routes where the data is residing in the database.

The web based vehicle tracking system has a tracking device mounted on the vehicle, a central server for gathering all the information. The web based application facilitates the users with a graphical interface so that they can visualize the path [6]. The vehicle tracking system is also implemented with the aid of Android application in the smart phone. Every vehicle will be integrated with a smart phone and acquires their GPS coordinates. The acquired coordinates of the vehicle will be transferred to the central server. The users can visualize the updated data from the vehicle through the Android application on their smart phones. For better visualization the real time data of the vehicle can be visualized on the google maps.

Based on the prediction models the vehicle location can be predicted based on the vehicle previous travelling time. This system can be used where traffic conditions and maintained to be constant [7]. These predictive models work on the average travel time and average travel speed. The average travel time uses the previous data of the time intervals as the inputs. The average speed of

vehicles uses the previous data of speed of vehicles over different segments [8]. The distance of each segment can be estimated based on the GPS information. The time series model is established based on the factors that will be affected by the varying of time [9]. In this model the system assumes that traffic will remain to be constant in the future.

The regression model works under unstable traffic conditions. This model works on the basis of a set of independent variables and then finds a dependent variable based on the mathematical function. The Kalman filtering model has the ability in managing traffic with time dependent factors. The Artificial Neural network has the ability to determine the relationship between arrival time and the independent variables. The Artificial Neural network system is useful to function on complex mathematical equations, but it is a slow process. The Support vector machines and support vector regressions are used for the prediction of arrival time based on the neural network algorithm. Support vector machines with the help of linear optimization eliminates the over-fitting problem.

III. TECHNOLOGIES IN THE ERA OF LOGISTICS AND SUPPLY CHAIN

A. RFID Applications in different stages of supply chain:

The supply chain ranges from supply, purchase, production, transportation, storage, sale to consumption all together integrated in the logistics system. In logistics system the information and accuracy are the key role in supply chain. The system will result in low accuracy if the supply chain information is not shared. Logistics integrated with RFID will result in real time information processing and can apply to all the aspects of materials ranging from raw materials to furnished goods. RFID in the production and manufacturing stage can result in tracking of raw materials, Goods in the production area, which results in reduction of error rate and labor cost. RFID in the storage stage facilitates automatic processing of information and deals with in flow, out flow, arranging of materials in the site area. RFID in the distribution stage leads to efficient monitoring of goods so as to improve the accuracy, packing of goods in a distributed network. RFID in the transportation stage facilitates identification, positioning and tracking of cargo vehicles accurately. By the employment of RFID and GPS system together will result in real time positioning of cargo vehicles. RFID in the retailing stage will track sales of goods and facilitates decision making in case of any real time support. By implementing the anti-theft function the theft of goods can be eliminated.

B. Global Positioning System and General packet radio service in Logistics management:

In all the major countries the GPS traffic management has been given more significance due to effective transportation. The GPS system is now extends to all the applications because of its efficiency. Among various applications of Global Positioning System the vehicle monitoring system is one of the emerging applications. In the early days of the GPS technology due to wireless communication technology issues the GPS has been influenced by some disadvantages. The current existing GPS technology is enhanced and has been working efficiently and providing dynamic positioning of the vehicle. As the system has the precision and accuracy issues related to wireless data transmission, so real time data transmission is not possible. The employment of GSM may not give satisfactory results. So by the employment of GPRS technology the above wireless data transmission issues will be eliminated and effective communication is possible. GPRS is a packet data transmission system based on the GSM. The GPRS is more beneficiary due to high speed data transmission, it is an online system, low cost, strong data processing capability. Due to the above advantages the GPRS is used to facilitate efficient data transmission. The GPS and GPRS both integrated together will result efficient positioning and monitoring. The earlier GSM and GPRS systems are used in taxis and ambulances. The GPS and GPRS system improves safe driving, goods tracking, monitoring management. The GPS and GPRS systems, both are having tremendous advantages in the application of logistics

management. The RFID, GSM, GPRS integrated system is reliable, real time data transmission, safety, high speed. In this integrated system the cargo vehicle can be tracked and positioned and will create a new approach in the transportation system.

C. RFID, GPS, GPRS in Logistics management:

The combination of RFID, GPS, GPRS results in a multi purpose technological system. Generally, the cargo vehicle monitoring system is divided into two modules. Among the two modules, one module is placed in the cargo and another module is placed at the monitoring system. The RFID, GPS, GPRS are three different areas, but combining all the three technologies together will result in vehicle orientation and monitoring of applications. The RFID tags has a unique identification number which makes them appropriate for uniquely identifying and tracking goods. The RFID reader has the capability to read the RFID tags which are in its range. The communication between the RFID reader and tags are based on the electromagnetic waves. The RFID can track and identify moving objects in a short span of time. The GPS can position any object based on its latitude and longitude position with the help of satellite signals. The GPRS has the facility to get connected to the internet can uniquely transfer the data from the cargo system to the main server. The GPRS system has the functionality to complete the connection between the systems and is able to send the data that is gathered from the RFID, GPS with the help of a processing element.

IV. SYSTEM IMPLEMENTATION

In this cargo logistics management system the system comprises of a transmitter and receiver section. The transmitter arrangement is done at the Cargo vehicle. The receiver arrangement is done at the Warehouse central section. The transmitter section depicted in the figure 1 comprises of a GPS, GPRS, Weight sensor, Arduino UNO, RFID system. The receiver section depicted in the figure 2 comprises of a central server Raspberry Pi 3.

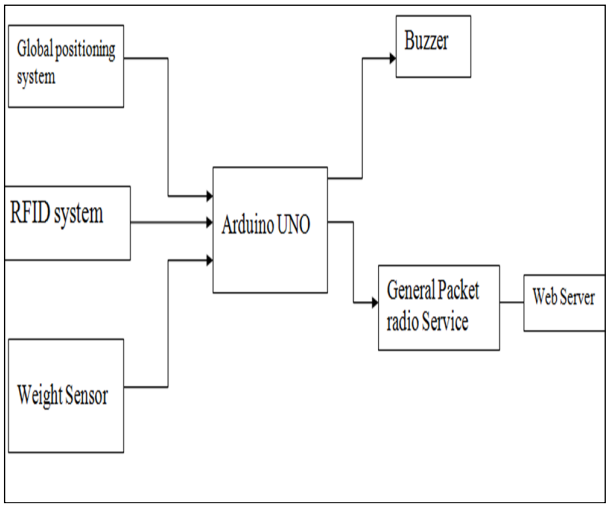


Fig.1 Functional Block diagram of transmitter section.

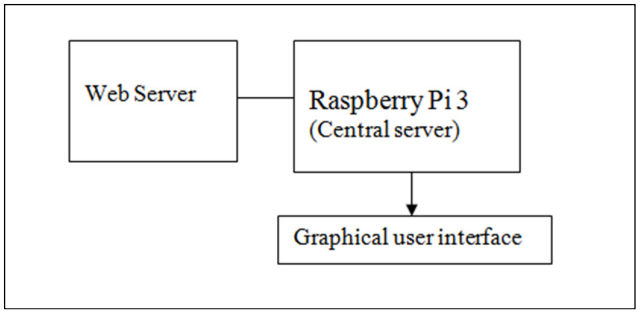


Fig.2 Functional Block diagram of Receiver section.

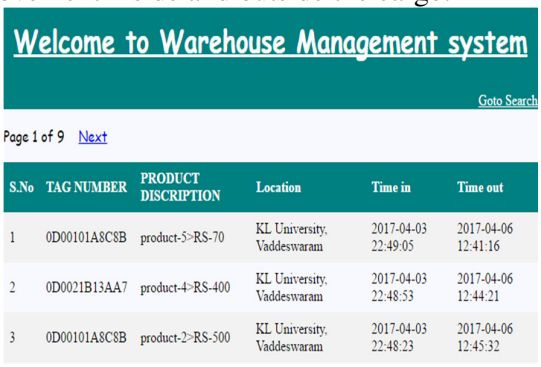
In the transmitter section, the GPS module is arranged in the cargo vehicle for providing the latitude and longitude position and time details of the cargo vehicle. The GPS system functions on the basis of satellite communication, So that's why it is best chosen for outdoor positioning. The GPS is interfaced to the Arduino UNO for processing of raw data. In the RFID system, the passive tags are attached to the goods that are eligible for entry into the cargo. Every tag has a unique identification number which makes them possible for identification. The RFID reader is arranged at the cargo entry so as to keep track of the products. The RFID system is also interfaced with the Arduino UNO and it is programmed with the Arduino IDE. The Arduino UNO and the RFID system are responsible for calculating the Time in and Time out of the goods into the cargo vehicle. The GPRS

system is built on the architecture of GSM is responsible for transmitting the cargo vehicle location, details about the goods in the cargo their timely information to the central server via the data packets. The weight sensor HX711 is interfaced to Arduino UNO to detect the load that the cargo vehicle is maintained. If the cargo vehicle is overloaded with goods above the threshold value, then an alarm will be given. So that cargo vehicle cannot be overloaded.

In the receiver section, the Raspberry Pi 3 acts as a central server gathering all the information from the cargo vehicle and dynamic data Updating is possible. The collected data are arranged in the form of rows and columns in the database on the web server. The Administrator has the facility to track the vehicle position, timestamps of loading and unloading of goods in the cargo vehicle with the help of a web server.

V. RESULTS AND DISCUSSION

The figure 3 which is depicted below represents the information in the form of a webpage of the products in the cargo. Here Tag number depicts a specified tag number, product description illustrates the brief description of the products, location field depicts the information regarding the cargo vehicle's position. It ensures the administrator the movement of the vehicle. The time in and time out are the respective time stamps so as to maintain a detailed transaction regarding the product movement inside and outside the cargo.


Welcome to Warehouse Management system

Goto Search

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S.No	TAG NUMBER	PRODUCT DISCRIPTION	Location	Time in	Time out
1	0D00101A8C8B	product-5>RS-70	KL University, Vaddeswaram	2017-04-03 22:49:05	2017-04-06 12:41:16
2	0D0021B13AA7	product-4>RS-400	KL University, Vaddeswaram	2017-04-03 22:48:53	2017-04-06 12:44:21
3	0D00101A8C8B	product-2>RS-500	KL University, Vaddeswaram	2017-04-03 22:48:23	2017-04-06 12:45:32

Fig.3 Web page results in the central server.

The weight sensor activities are controlled by the open source hardware Arduino Uno. The weight sensor senses the weight of the product of the cargo, if the cargo is overloaded then a message will be sent to the administrator and the cargo driver notifying the stage of overloading.

VI. CONCLUSION

This work focuses on real tracking of goods, cargo vehicles by using IoT and open source hardware. By this system the cargo vehicle can be tracked from anywhere and can eliminate the delay delivery and theft of vehicles. Hence this GPS and RFID integrated system suits best for real time localization. In this logistics management system the technology used were efficient and resulted in real time. By small alternation this system can be further enhanced and can extend its services to other applications.

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