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AUTOMATION OF PARCEL DELIVERY COLLECTION USING IOT – SMART FREIGHT BOX

Nivedhitha.G, T. Sujithra
Vel Tech Dr.RR and Dr.SR University, Tamilnadu, India

Aksheya Suresh, Bhavadharani
Rajalakshmi Engineering College, Chennai, Tamilnadu, India

ABSTRACT

The Internet of Things (IoT) is a scenario in which objects, animals or people are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. IoT has evolved from the convergence of wireless technologies, micro-electromechanical systems (MEMS) and the Internet. With IoT, devices typically gather data and stream it over the Internet to a central source, where it is analyzed and processed. As the capabilities of things connected to the Internet continue to advance, they will become more intelligent by combining data into more useful information. In our modern busy lifestyles we are often not having enough time to respond to our routine activities like – answering a person at the door or for collecting a door delivery. To handle such situations we propose a solution by automating the parcel collection unit. This paper discusses about the part of IoT in home sophistication, the proposed approach for automating the parcel delivery collection, the working and design of the SFB.

Key words: Internet of Things, Smart Freight Box, e-retailers, barcode.

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1. INTRODUCTION

1.1. Internet of Things

The Internet of Things (IoT) is the network of physical objects or "things" embedded with electronics, software, sensors and connectivity to enable it to achieve greater value and service by exchanging information with the manufacturer, operator and/or other related devices. Each matter is uniquely identifiable through its embedded computing system but is able to interpret within the existing Internet infrastructure [3]. The IoT has its technological roots in the decades-long effort to monitor and control the physical environment in which people work and play. Its most basic components are embedded devices that have existed for

years: thermostats that sense ambient temperature and control heating and cooling systems, sensors that manage braking systems in automobiles, pacemakers that regulate the heart, airplane black boxes that track flight paths and location devices that monitor the whereabouts of industrial equipment. Through IoT connectivity, the supplier can monitor and assess the state of the equipment and plan interventions rather than just react.

Typically, it is required to offer advanced connectivity of devices, systems, and services that goes beyond machine-to-machine communications (M2M) and handles a variety of protocols, knowledge bases, and applications. The interconnection of these embedded devices (including smart objects), is expected to usher in automation in virtually all countries, while also enabling advanced applications like a Smart Grid. Affairs, in the IoT, can refer to a broad assortment of devices such as heart monitoring implants, biochip transponders on farm animals, electric clams in coastal waters, automobiles with built-in sensors, or field operation devices that help firefighters in search and delivery. These devices collect useful data with the aid of several existing technologies and then autonomously flow the data between other devices.

Current market examples include smart thermostat systems and washer/dryers that use Wi-Fi for remote monitoring. As well the plethora of new application areas for Internet connected automation, to expand into, it is also expected to generate big quantities of information from diverse locations that is aggregated at a very high speed, thereby increasing the need to better index, computer memory and process such information. The figure 1 depicts the IoT scenario where hardware devices (sensors) and mobile applications are connected to cloud.

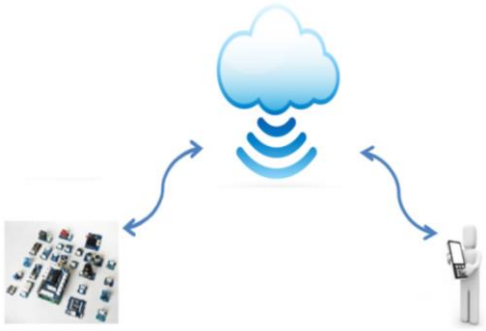

Figure 1 Internet of Things

1.2. IoT in Home Sophistication

In our houses, cars, and factories, we are surrounded by tiny, intelligent devices that capture data about how we live and what we do. Now they are beginning to talk to one another. Soon we'll be able to choreograph them to respond to our needs, solve our problems[5].The combination of the Internet and emerging technologies such as near field communications, real-time localization, and embedded sensors lets us transform everyday objects into smart objects that can understand and react to their environment. Such objects are building blocks for the Internet of Things and enable novel computing applications.

A wide-ranging Internet of Things (IOT) ecosystem is emerging to support the process of connecting real-world objects like buildings, roads, household appliances, and human bodies to the Internet via sensors and microprocessor chips that record and transmit data such as sound waves, temperature, movement, and other variables. The IoT shall be able to incorporate transparently and seamlessly a large number of different and heterogeneous end systems, while providing open access to selected subsets of data for the development of a

plethora of digital services[6]. From enhancing playtime to improving security, networked devices are making our homes safer, smarter, and more connected [1].

Building a general architecture for the IoT is hence a very complex task, mainly because of the extremely large variety of devices, link layer technologies, and services that may be involved in such a system.

1.3. Motivation

In our daily life, ordering things online has greatly reduced the time and effort rather purchasing it personally. But in such cases, the availability of the customer at the time of product delivery is always essential. The requirement of this constraint minimises the easiness of ordering the product online. Hence automation of parcel/product receiving will certainly lead to an easy and safe fulfilment for an online ordering. This is the motive behind the proposal of an approach for automation of parcel receiving.

2. PROPOSED SYSTEM

The Internet of Things concept is much broader in the sense that everyday objects that did not previously seem electronic are connected to the internet via sensors. The proposed approach uses the integration of IoT, cloud and mobile application for the automation process.

The idea is to introduce a Smart Freight Box (SFB) which will be able to verify and accept the ordered parcel as well as acknowledging the customer and the e-retailers.

2.1. Smart Freight Box

The SFB is a courier/parcel collecting box which is to be installed in our home like A/C in a place where the outsiders and insiders can be able to access it for placing and collecting the parcel respectively. It consists of barcode sensor, weight sensor loading cell and doors on both sides of the box for placing and collecting the parcel as when the customer is available. It will also contain a shifting belt where the parcel will be placed initially. After verification of the parcel it will be shifted inner ward so that the parcel will reside in a place safely until the customer is able to collect it.

3. WORKING

The working of the SFB is discussed as three phases as follows

- Pre-delivery Phase
- Delivery Phase
- Post-delivery Phase

3.1. Pre-delivery Phase

The customer places an order in any e-retailer website. If the order is confirmed the e-retailer will send the parcel information which includes the barcode and approximate weight of the parcel to the customer. The customer in turn can feed these details in cloud. Once it is fed in the cloud, the customer will be able to safely receive his/her parcel even if he is anywhere in the world.

3.2. Delivery Phase

The package delivery worker walks in with the parcel for delivery. The worker has to place the parcel in SFB for delivering it. He opens the front door of SFB and places the parcel on

the shifting belt. The SFB verifies the parcel with two parameters- barcode and weight. This verification process is done by two components.

Weight Sensor Loading cell- The shifting belt shifts the parcel to weight sensor where the weight of the parcel is checked with the approximate weight which has been fed in the cloud by the customer in pre-delivery phase. The figure 2 shows the weight sensor that can hold up to 1kg of weight.

Figure 2 Weight Sensor

Barcode Sensor-The barcode sensor or barcode reader is placed on top of the weight sensor so that it can read the barcode of the ordered item and verify. This information is also taken from the information which has been fed in the cloud by the customer in pre-delivery phase. The figure 3 shows the barcode reader.

Figure 3 Barcode Reader

After the parcel is verified by SFB, it sends an acknowledgement message to the customer that the two parameters matches with the information fed in the cloud. The front door closes automatically and shifting belt shifts the parcel inner ward so that no outsiders can have access to the parcel unless the SFB is opened from the backdoor which will be inside the home.

3.3. Post-delivery Phase

In the post-delivery phase, the package delivery worker is required to send an acknowledgement to the e-retailer that the parcel has been delivered to the customer. The customer receives a delivery link from the e-retailer where he/she has to confirm whether the parcel is received and it is the same ordered parcel. With this last step of verification the e-retailer can finally conclude that the parcel has been delivered to the customer.

4. SYSTEM DESIGN

The SFB box consists of two components for verification and a shifting belt. The figure 4 shows the cardboard model of Smart Freight Box.

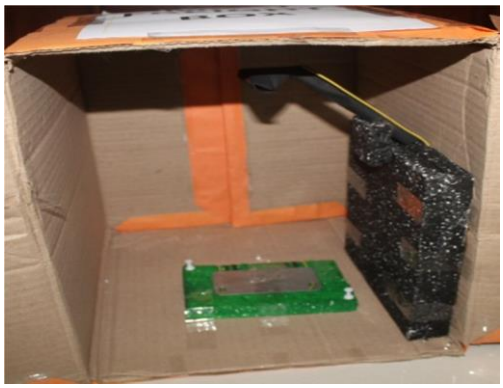

Figure 4 Model of Smart Freight Box

In the above figure the component attached to the side wall of the SFB is the barcode sensor and the component attached to the base of SFB is the weight sensor. The figure 5 shows the SFB being fitted in the wall of the customer's home.

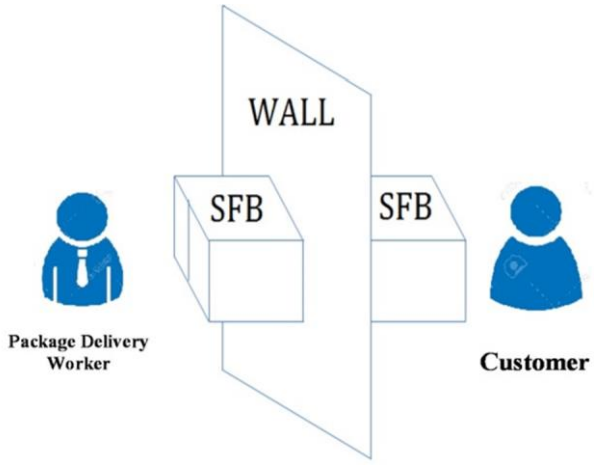

Figure 5 SFB Fitted in the Wall of House

The front door of the SFB can be accessed by the package delivery worker and the customer can receive their package through the back door.

4.1. Cross-sectional View

Fig 6 shows the cross-sectional view of SFB when it is fit to the wall of house. It is fitted such that it projects partially outside the wall on both sides for the ease of access.

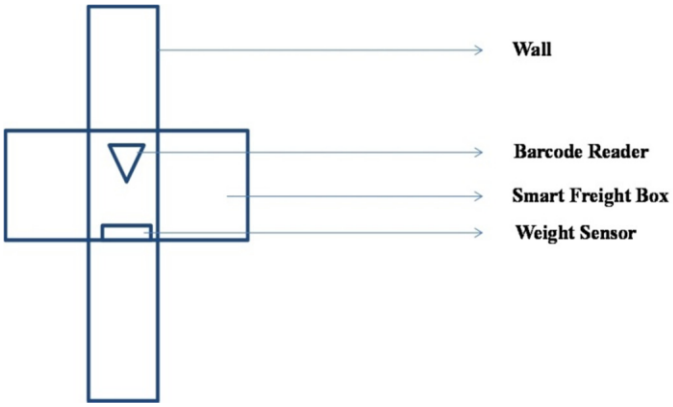

Figure 6 Cross-Sectional View of SFB

5. OVERALL PROCESS

Fig 7 depicts the overall process of the automation of parcel delivery collection. The sequence of steps in the automation of parcel delivery collection is listed as follows.

- Places the Order.
- Sends Order id, Barcode and weight information.
- Feeds Data(Order id, Barcode , weight) into the cloud.
- Passes the data to Smart Freight Box.
- Places the parcel inside Smart Freight Box.
- Verifies Barcode and Weight with the data retrieved from Cloud.
- Sends a “Parcel Received” Message – via cloud.

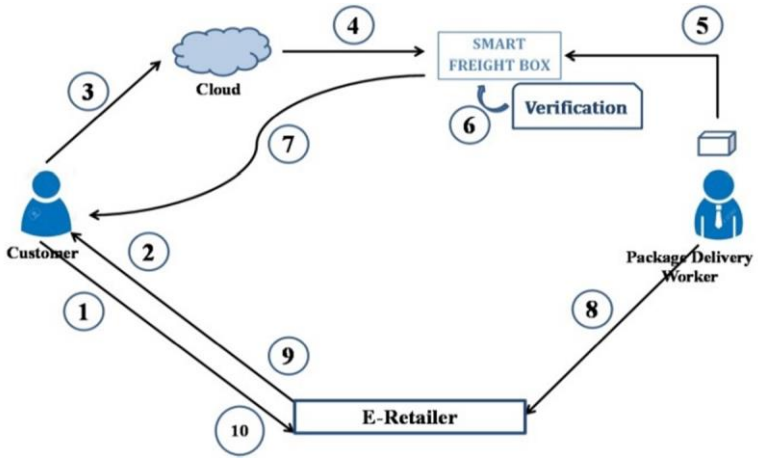

Figure 7 Overall Process of IoT and SFB

- Sends a “Delivered Message”.
- Sends a “Confirmation Message”.
- Sends an “Acknowledgement Message”.

6. HARDWARE REQUIREMENTS

The hardware components required for the automation of the parcel delivery collection are as follows.

6.1. Barcode Reader

Minimum Depth of Field	2.5 mm
Light Source	650 nm
Maximum Depth Of Field	600 mm
Shock Resistance	1.5 m

6.2. Weight Sensor

The weight sensor with Digital Electronic Scale 1Kg Weight Weighing Sensor Load Cell 3-12V DC S2 is required.

6.3. Arduino

Arduino is a tool for making computers that can sense and control more of the physical world than your desktop computer. It's an open-source physical computing platform based on a simple microcontroller board, and a development environment for writing software for the board.

Robodo Uno R3 Development Board Atmega328p Atmega16u2 with USB cable for Arduino is required.

7. CONCLUSION AND FUTURE WORK

In this paper, a new idea for automating parcel delivery collection has been proposed. This makes delivery of the parcel easier and safe even in the absence of the customer.

Future work can be focussed on customizing the Smart Freight Box which improves Security and Scalability.

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