Smart Security Box For Intelligent Packaging System

Karthik A[1], Kiran B M [2], Manjunatha M [3], Manoj B R [4], Dr. Sharanabasappa [5]

[1,2,3,4]UG Student, Dept. of ECE, DBIT, Bengaluru, VTU, Belagavi, Karnataka India

[5]Assistant Professor, Dept. of ECE, DBIT, Bengaluru, VTU, Belagavi, Karnataka India

Abstract - The Intelligent Packaging System (IPS), which uses an electronic smart security box to track the issue of packages being opened during shipping, updates the location of the package as well as its temperature and position with respect to its x-y coordinates. This updates the information about the package to the user's mobile phone via the Telegram application. In order to determine whether a package has been unlawfully opened, IPS employs a large number of sensors that continuously measure the physical properties inside the package. They can take the required action after receiving this notice and notifying those who need to know. The customer uses an OTP that is obtained at the customer's mobile and enters it to unlock the box and reset the device if there is no alarm; otherwise, the normal delivery occurs. The proposed system ensures that the customer receives the genuine and secured products.

Keywords: Internet of Things(IOT), Security Box, NodeMCU, Intelligent Packing System(IPS), Sensors

I INTRODUCTION

Internet of Things is the concept of connecting any device to the Internet and to other connected devices. The IoT is a giant network of connected things and people – all of which collect and share data about the way they are used and about the environment around them. IoT has made it possible for the physical world to meet the digital world and cooperate with each other. It offers numerous benefits to organizations by enabling them to automate and simplify their daily tasks.

Human error can occasionally result in catastrophic situations that result in the loss of valuables in the modern world. The deliberate overloading of a vehicle with packages is one such scenario. Damage and improper treatment of the shipment result from it. The complexity of products and the rise in customer expectations and experience have rendered conventional packaging methods outmoded. Traditional packaging techniques also don't give the manufacturer and the client crucial information about the product during transportation. to create an intelligent packaging system that authenticates, secures, and tracks high-value shipments using the Internet of Things. The proposed system aims to create a kit that can identify any intrusion into its space, provide information about all the relevant environmental factors of the environment in which the product is stored inside the package, alert those in charge of the product's delivery cycle, and reset itself at the end of the cycle so it can be used again in the further deliveries. This project's main goal is to ensure the safety of the packages during transportation while also measuring the features of the goods and the atmosphere both inside and outside of the package. When a box is opened, the Intelligent Packaging System project's electronic packaging technologies are intended to efficiently send out an alert. By providing information about all relevant characteristics, the kit's goal is to identify any type of incursion into its region. The customer receives a notification when the values in these parameters cross a certain value. In the absence of an alert, a typical delivery occurs. The client then uses an generated OTP that is delivered to the customer's mobile device to unlock the box and recieve the package. The kit can then be reset and used again for further deliveries.

II RELATED WORK

Safial Islam Ayon, and Abu Saleh Bin Shahadat [1] proposed a one of the main concerns with home automation systems is security, which is necessary to ensure inhabitants' comfort and safety. The smart security box described in this article delivers messages to the authorized user whenever an unauthorized user tries to compromise the smart box's security. The Global System for Mobile (GSM) Communications module with Short Message Service and Arduino open-source electronics platform were principally used in the development of this smart security box. Based on actual data, it has been determined that this low-cost, low-power smart security box is reliable and accurate in terms of detecting and notifying security breaches to authorized users. This prospective smart security box may be used for both personal and professional purposes, and it has a good penetration rate into both the domestic and global markets for smart security technology.

Himalayee Saini1, Anita Sharma [2] developed a RFID and GSM based Intelligent Courier Mailbox System where this paper describes a device which is capable of identifying the arrival of the courier and forward the same to the receiver. On the receiver side there is a letterbox which has a RFID reader, GSM module and LCD screen. The courier person scans the RFID tag on the courier using the RFID Reader present at the letterbox. If the identity number matches with the identity number fed by the user, the RFID reader sends a command to the microcontroller to open the gate of the letterbox. The Microcontroller is programmed in such a manner that after the opening of the gate it automatically closes after 15 seconds. In the event of mismatch of identity number an error message is displayed on the LCD screen.

Thanat Nonthaputha , Montree Kumngern [3] prepared the final stage for the quickly expanding online purchasing is for deliverymen to give clients their packages. Too frequently, deliverymen must make a second delivery the following day if the consumers are not there. This paper introduces a smart box for receiving packages built on an Arduino platform

Nivedhitha.G, T. Sujithra [4] presented As internet-connected objects' capabilities develop, they will grow smarter by integrating data to produce more insightful insights. We frequently lack the time necessary for regular tasks like opening the door or picking up a delivery at the door because of our hectic modern lifestyles. We suggest automating the parcel collecting unit as a way to address such circumstances. The role of IoT in home sophistication, the suggested method for automating the parcel delivery pickup, and the operation and design of the SFB are all covered in this article.

Md R Haque, M Mohammad [5] developed a Product Home Delivery autonomous quadcopter where This article describes the quadcopter (QC), a low-cost, autonomous flight capable Unmanned Aerial Vehicle (UAV) that uses an android cellphone as its primary on-board computing unit to deliver packages that have been bought online. This QC can identify and reach its goal by using Google Maps. This essay exhibits QC's capacity to deliver an online-ordered package and then return to the beginning point. Future studies on the use of QC for parcel delivery are made possible by the method's encouraging results.

By Ge Wang [6] developed verifiable smart packaging with passive RFID. To do this, we create and put into use Echoscope, a non-destructive package testing and verification system employing commercial passive RFID systems.. Utilizing backscatter signals ensures that the RF sources are same and that the characteristics reflecting the internal state are unaffected. In comparison to other nondestructive testing techniques like X-ray and ultrasound, Echoscope is far less expensive and has a considerably wider application.

III PROPOSED METHODOLOGY

Figure 1 depicts the Intelligent Packaging Solution's proposed technique. The system uses an LCD display to show each operation, an LDR sensor to check whether the IPS is closed properly, and a MEMS sensor to check whether the IPS box has been handled improperly. To ascertain whether a package is included in the IPS kit, an IR sensor is used. A DHT sensor tracks the temperature and humidity inside the IPS, while GPS tracks the current location and GSM (Node MCU) notifies the user if the product is handled improperly.

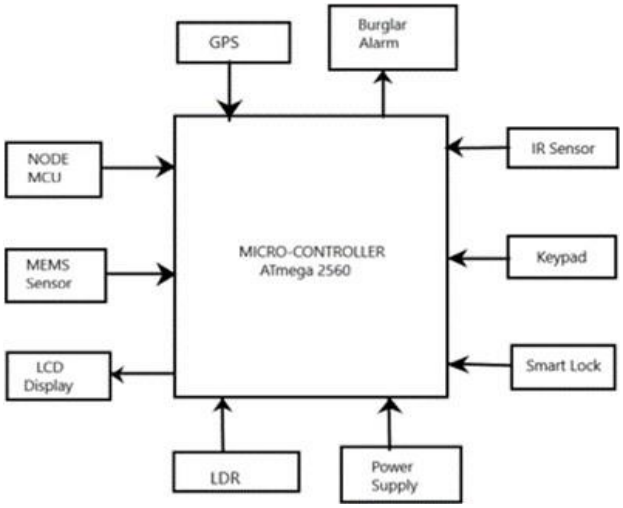

Fig 1: Block diagram of IPS

A small compartment will be created for the IPS development kit, which will then be inserted inside the box that has to be secured. The IPS development kit's sensors will be turned on and activated at this point. The kit will travel within the box until it reaches its destination and then be removed when the data has been verified. The first item in the bundle is the IPS development kit, which enables tracking. Along with the package's contents, this is inserted inside. The kit must be positioned as close to the contents of the box as feasible in order for it to function effectively and without any interruptions. The IPS development kit begins executing the programmed application, which causes it to begin sending data to the cloud. The web interface created especially for this function makes the data in the cloud visible. Both in the IPS development kit and on the cloud, the data is continuously monitored. The IPS development kit is reset upon receipt of the OTP and is then prepared for return shipment and installation on a subsequent package, continuing the cycle of the IPS development kit.

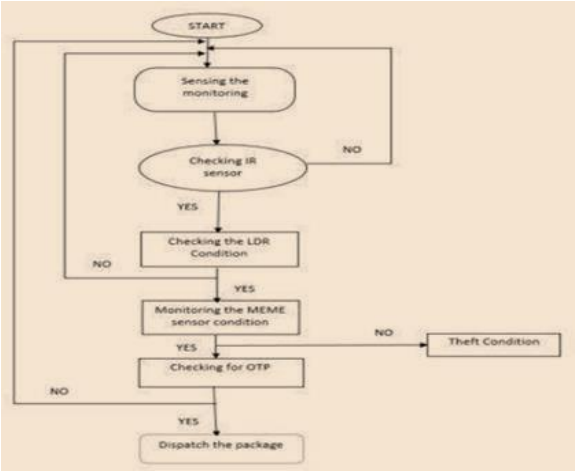

Fig 2: Flowchart of the working model

The flow regulation of an IPS is seen in fig.2 above. The sensors inside the kit will initially begin working and sense the environment, displaying the values in the LCD display and notifying the customer's phone of the same. The LDR condition will then check whether the box is closed or not. The IR sensor senses the object an placed in front of it and closes the box lid after verification and an auto-generated OTP will be sent to customer through internet . Once it reaches its destination, the client must enter the received OTP into the keypad and wait for it to match with the cloud then the box's lid may be opened; otherwise, a mismatch in the OTP will be shown on display and the user's mobile phone will be contacted.

IV HARDWARE AND SOFTWARE REQUIREMENTS

HARDWARE REQUIREMENTS

1) **Arduino**: The suggested system uses an Arduino Mega 2650 and an ATMega16, an 8-bit microcontroller. It guarantees excellent performance with little power consumption. It can carry out 131 instructions in a single machine cycle thanks to a progressive Reduced Instruction Set Computing (RISC) architecture.
2) **LCD Display**: LCD displays alphanumeric symbols by using its light monitoring capabilities. 16 columns and 2 lines make up the table. Up to 16 characters may be shown across two lines [19]. In this system, the alarm message and the remainder of the time are displayed.
3) **LDR Sensor**: The resistance of the LDR changes in response to the amount of light. In the suggested approach, if someone tries to open the box before the scheduled time, a light will drop in the LDR and the sensor will turn on. It then sends a signal to the Arduino microcontroller, which causes the microcontroller to do the necessary activities.
4) **IR Sensor**: IR sensors are now widely used in motion detectors, which are used in building services to switch on lamps or in alarm systems to detect unwelcome guests. In a defined angle range, the sensor elements detect the heat radiation (infrared radiation) that changes over time and space due to the movement of people.
5) **Keypad**: A keypad is a block or pad of buttons set with an arrangement of digits, symbols, or alphabetical letters. Pads mostly containing numbers and used with computers are numeric keypads.
6) **NodeMCU**: The NodeMCU is an open-source software and hardware development environment built around an inexpensive System-on-a-Chip (SoC) called the ESP8266. The ESP8266, designed and manufactured by Espressif Systems, contains the crucial elements of a computer: CPU, RAM, networking (WiFi), and even a modern operating system and SDK. That makes it an excellent choice for Internet of Things projects

SOFTWARE REQUIREMENTS

1) **Arduino IDE:** The Arduino is a single-board microcontroller solution for many DIY projects, we will look at the Integrated Development Environment, or IDE, that is used to program it. Once the installer has downloaded, go ahead and install the IDE. Arduino IDE is an open source software that is mainly used for writing and compiling the code into the Arduino Module. The Arduino IDE is incredibly minimalistic, yet it provides a near-complete environment for most Arduino-based projects. The middle section of the IDE is a simple text editor that where you can enter the program code. The bottom section of the IDE is dedicated to an output window that is used to see the status of the compilation, how much memory has been used

2) **Botfather:** Botfather is a universal automation framework developed by some European students. Botfather was initialy created to compete with other CS students in creating bots for casual games. Since then it has been extended to allow the automation of Android, Browser and Desktop apps.There are no limits what purpose Botfather could serve for you though. One could for example write automated tests for websites, apps and desktop applications using Botfather. Botfather can also be a great tool for students to learn coding and explore complex subjects such as machine learning.

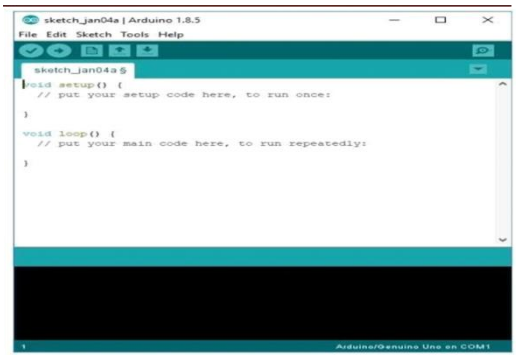

Fig 3: **Arduino IDE**

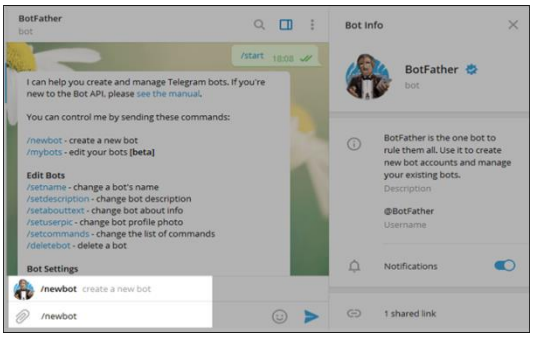

Fig 4: **Botfather**

V WORKING FLOW

1. At first object should be placed inside the smart security box, IR sensor will detect the object and "OBJECT PLACED" message will be displayed on LCD as in Fig.5(a) and Fig.5(b).

Fig.5 (a). Working Flow

Fig.5 (b) Working Flow

The message "REMOVE HANDS LID IS CLOSING" is displayed to inform that box is ready to be sealed then another immediate message is " SEALED BOX" is display to convey that box is sealed as in fig. 5(c) and fig.5(d)

Fig.5 (c). Working Flow

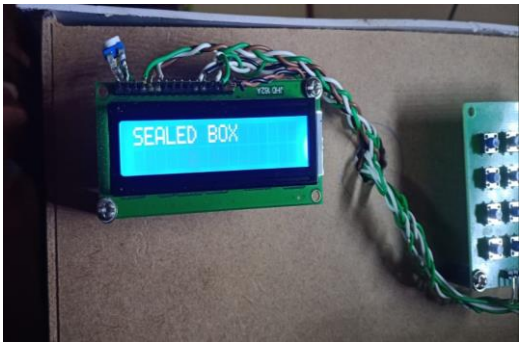

Fig.5 (d) Working Flow

2. LID will close automatically with the help of gear motor and "SEALED BOX" message will be displayed on LCD as in Fig.5(e)

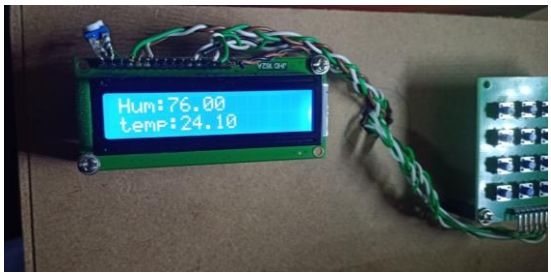

Fig.5 (e) Working Flow

3. Detection of humidity and temperature will be done with the help of DHT-11 sensor and the measured temperature and humidity value "Hum:76.00 temp:24.10" is displayed on LCD as shown in Fig.5(f).

Fig.5 (f). Working Flow

Fig.5 (g) Working Flow

4. "ENTER OTP" message will be displayed on the LCD. Here customer has already received a server generated OTP to his mobile, which he has to enter in the pins of 484 keypad provided outside the sealed box , if the customer enters the wrong OTP the "WRONG PASSWORD TRY AGAIN" message will be displayed as in Fig.5(g) and Fig.5(h).

Fig.5 (h). Working Flow

Fig.5 (i) Working Flow

5. When the customer enters the correct OTP then the smart security box will be unlocked and the "OTP MATCHED UNLOCKING PACKAGE" message will be displayed as in Fig.5(h) and Fig.5(i).

Fig.3.23(j) Working Flow

6. "PICK PACKAGE" message will be displayed on LED as in Fig.5(j).

APPLICATIONS

- Same application with modifications can be used in industries for valuable things and other belongings safety.
- Logistics companies.
- In hospitals for keeping belongings of doctors and patients safely.
- The valuable assets are shipped safe and secure.

VI EXPERIMENTAL RESULTS AND CONCLUSION

The IPS development kit is tucked within the packaging that has to be secured in a small area. The kit has enough room in the package for it to function correctly. The IPS development kit's sensors will be turned on and activated at this point. The kit will travel within the box until it reaches its destination, where it will be removed once the data has been verified. The IPS development kit begins executing the programmed application, which causes it to begin sending data to the internet. An alert is delivered to the client, the logistics partner, and the product maker if there is a problem with the package. This gives them the freedom to take whatever steps are required to either halt the shipment in route or to check its integrity. After receiving the OTP, the IPS development kit is reset and prepared to be returned by the shipping business and put on a new package, continuing its cycle.

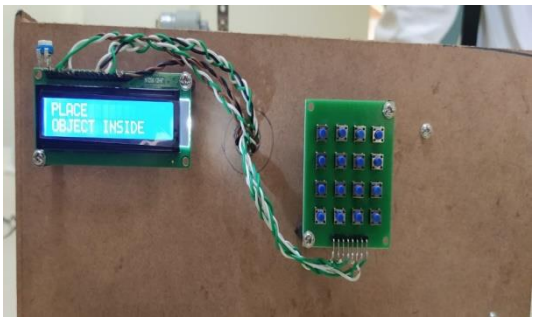

Fig.6 Front View

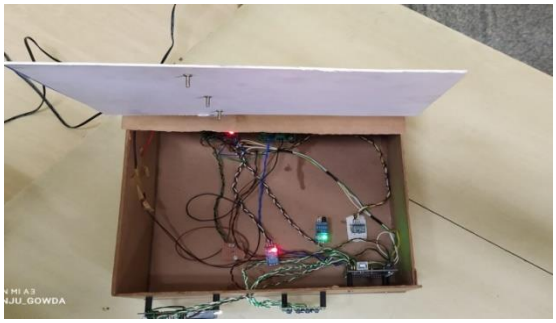

Fig.7 Internal View

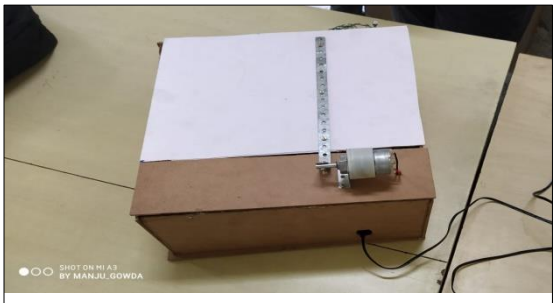

Fig.8 Top View

CONCLUSION

In our suggested approach, the courier delivery's lack of security may be rectified. When it comes to securing the items and ensuring their safe transportation to the appropriate businesses or clients, this implementation may show to be highly beneficial. The location of the parcel that has to be delivered from the source to the customer's destination may be tracked with the use of GPS. For tracking couriers within a car, a server and a smartphone are utilized. A vehicle's geographic coordinate and unique ID, which were retrieved from the black box, will be recorded and used to track the whereabouts of the car at any time and from any location. This approach improves the safety of the packages while bringing innovation to the current technology.

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