Smart security system for Indian rail wagons using IOT

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Smart security system for Indian rail wagons using IOT

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Abstract. The objective of this project is to create a Security System for the goods that are carried in open top freight trains. The most efficient way to secure anything from thieves is to have a continuous observation. So for continuous observation of the open top freight train, Camera module2 has been used. Passive Infrared Sensor (PIR) 1 has been used to detect the motion or to sense movement of people, animals, or any object. So whenever a motion is detected by the PIR sensor, the Camera takes a picture of that particular instance. That picture will be send to the Raspberry PI which does Skin Detection Algorithm and specifies whether that motion was created by a human or not. If a human makes it, then that picture will send to the drop box. Any Official can have a look at the same. The existing system has a CCTV installed at various critical locations like bridges, railway stations etc. but they does not provide a continuous observation. This paper describes about the Security System that provides continuous observation for open top freight trains so that goods can be carried safely to its destination.

1. Introduction

There are many cases reported for coal mines thief near the rural areas when the train halts for some time. This has affected a lot in the Indian railways economy. So this paper devices a new technique for Indian railways to remotely monitor the system. The proposed model has a motion detection sensor which detects the motion of the object which performs skin detection and then sends the image to the railway server using IoT. So that immediately an action can be taken to avoid coal thief. The conceptual diagram is given in the Figure 1.

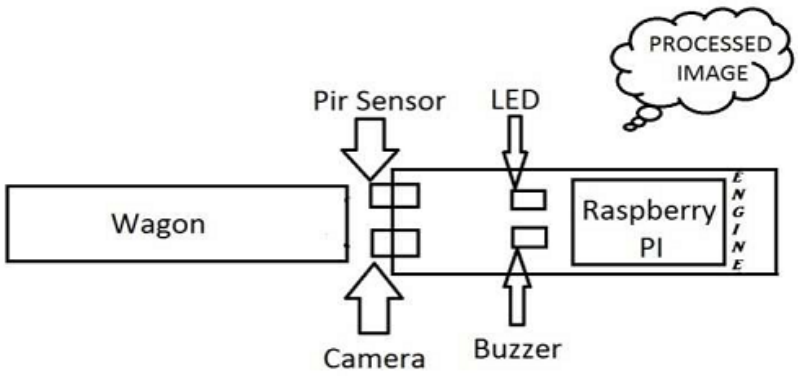

Figure 1. Conceptual diagram

2. Related works

Design and development of an integrated and heterogeneous network was proposed by Sandro Chiocchio et al [1] and which concentrates on board communication through an 868 MHz Wireless Sensor Network component, data communications across a mobile network through M2M (Machine-to-Machine) communication, data collection on the Cloud for processing and detection of anomalies.

To reduce the energy consumption to values sustainable by energy harvesters without penalizing the quality of service, a bi-periodic communication scheme for the local wireless transmission was proposed by Alessandro et al [2] with a dynamic management and consumption model of receiver and GPRS transceiver, which optimize the sleep modes. The proposed solutions are compared and the theoretical predictions are validated by measurements using different operating conditions.

Several key aspects when applying sensor networks such as radio wave propagation, energy scavenging and performance of the WSN aboard the wagon were investigated by Mathias et al [3]. The aboard network communicates at 2.45 GHz, and the external communication is an 868 MHz radio frequency radio link. Though WSN node energy is limited, appropriate energy scavenging schemes are proposed and evaluated using prototypes. Effort has been proposed to improve the identified gaps. The work suggests that piezoelectric harvesting technique is adoptable in which experiments scavenged 2.32 mW.

Bidhan et al [4] proposed train over speed protection system. Application of RFID was studied in detail over complex railway system automation. Application of RFID technology can improve the operating efficiency, safety of men and machines, and improve economy.

A feasibility study was presented by Eugen et al [5] and considered a real-world deployment on one of Europe's busiest railroad sections. Raw data obtained was from there which was annotated with the help of video footage and contains vibration patterns of 186 trains of six various types with accuracy of 97%. Length of the train wagons was measured using mean-squared error method. Visual inspection of the data shows further opportunities to improve the measurement of speed and detection of worn-out wheels.

Traffic monitoring is the search for moving trains in SAR images where trains are located, their velocity is determined, and type & number of wagons are identified. Commuter trains in the area of Munich, Germany are considered for their case study by Gottfried et al [6] and they concentrated on feature extraction of TerraSAR-X images.

In the proposed work, Camera captures snapshots of the intruder only when motion is detected. This will not lead to unnecessary wastage of storage of space. Also, the system has capability of detecting animal, leaves etc. against human intervention. The image of the intruder will be sent to the driver node.

3. Hardware and software

3.1 *Hardware*

The Components used are microcontroller Raspberry pi 3b, PIR sensor, Camera module2, led, buzzer and power supply for Raspberry pi.

3.1.1 *Raspberry pi 3b*

It is a device where all the processing of information takes place. It is used to process the PIR sensor data, perform the skin detection algorithm and is a communication device that sends images to the railway server in anomalies. The microcontroller Raspberry pi used in the project is shown in Figure 2 with the specification as follows:

Figure 2. Raspberry pi 3b

SoC: Broadcom BCM2837
CPU: 4× ARM Cortex-A53, 1.2GHz
GPU: Broadcom Video Core IV
RAM: 1GB LPDDR2 (900 MHz)
Networking: 10/100 Ethernet, 2.4GHz 802.11n wireless
Bluetooth: Bluetooth 4.1 Classic, Bluetooth Low Energy
Storage: micro SD
GPIO: 40-pin header, populated

3.1.2 *PIR Sensor (SB0061)*
It is a module used to detect the motion of the object. The Sensor specifications is given below

Compact size: 28 x 38 mm
Supply current: DC 5v-20v
Current drain: <50uA
Voltage Output: High/Low signal: 3.3V

3.1.3 *Pi Camera module*
This module is used to captures the live video with a resolution of 5MP as shown in Figure 3.

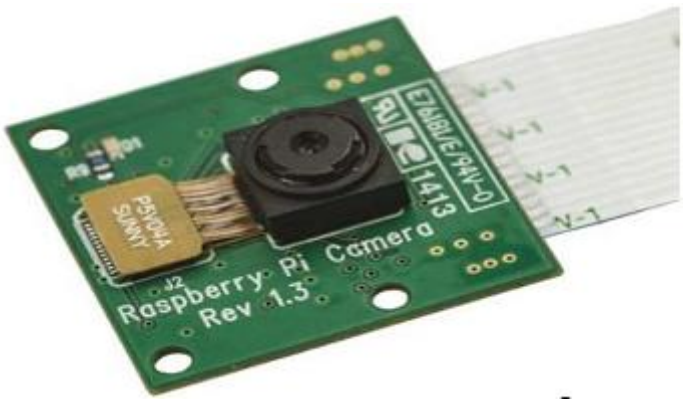

Figure 3. Pi Camera module

3.2 *Software*

The PIR sensor and skin detection algorithm is performed in python idle 2.7.Node red graphical tool of IBM blue mix is used for sending the images to the railway node and images are also uploaded to drop box.

Algorithm

Step 1: The PIR sensor is mounted on the railway wagon along with the pi camera.
Step 2: The PIR sensor detects the motion of the object. It can be anything like leaves, trees, animals etc.
Step 3: As the motion is detected by the PIR camera starts the live streaming.
Step 4: After this the camera's live video is given as input to the skin detection algorithm.
The human skin is detected.
Step 5: Then the image of the thief is sent to the railway node using IOT (Node Red) and images are also uploaded in drop box.

4. System integration

After testing the modules mentioned above individually, they have been integrated together with the Raspberry PI. Now, as soon as the motion is detected by the PIR Raspberry PI invokes the camera to take an image of that instance. Once the image is taken the Rasp Image Processing i.e. Skin Detection Algorithm to make out whether the image captured is a human. If it was a human then that picture will be uploaded to the drop box and also images are sent to railway node using IOT. Any official can have a look at that picture provided if he has internet connection. So using this system it will become easy for the officials to carry out further investigation. The system integration is shown in Figure 4.

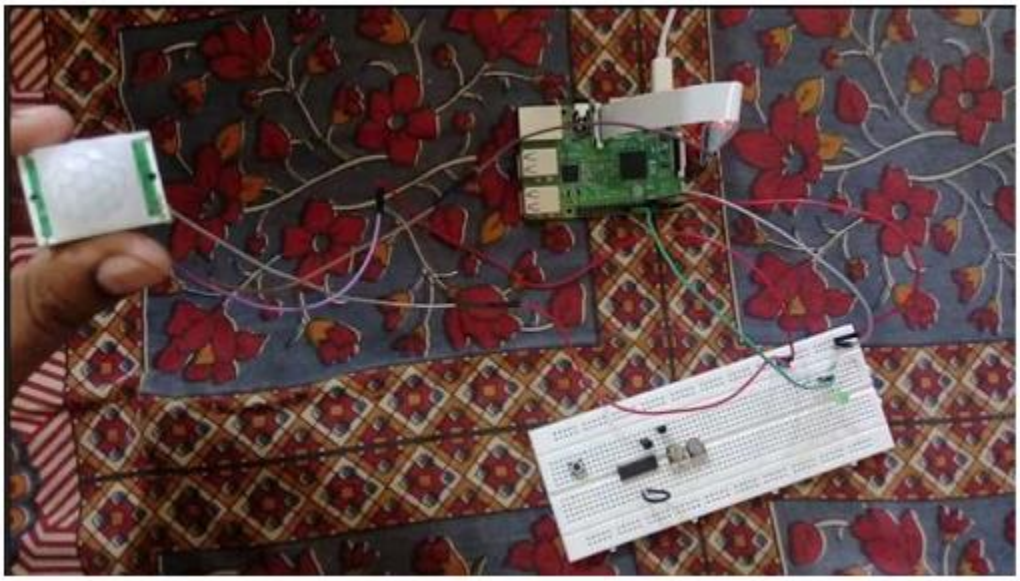

Figure 4. System Integration

5. Implementation and results

Drop box software is used to store files in cloud storage. It offers cloud storage, file synchronization and client software.

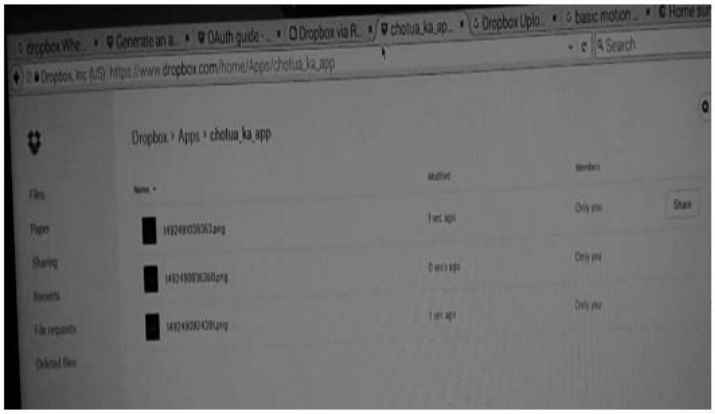

Figure 5. Detected images auto uploaded to the Drop box

For auto uploading the pictures, we have installed Drop box up loader onto the Raspberry PI. And then we have created an account in the Drop box Developers. After logging in to Drop box account we have created an app to store the pictures in the cloud storage. Whenever the motion is detected, the picture of that instance is taken by the camera will get uploaded to the Drop box. Figure 5 shows the detected images that were auto uploaded to the Drop box app. Images are auto uploaded to the Drop box App provided the Skin Detection Algorithm. The Algorithm confirms that the skin has been detected and it is human as shown in Figure 6. This project helps Railway officials to carry further investigation. It also prevents theft of goods from the open top freight trains. Any Railway Officials can access that images that would be uploaded to the app provided if he has an internet connection. Memory is sufficiently available as cloud storage platform has been used videos can also get auto uploaded to the Drop box App.

Figure 6. Skin detection output

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