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UNAUTHORIZED VEHICLE LOCATION IN RESTRICTED AREAS

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***Abstract*— When a logistic Vehicle (truck/trailer) comes to a company to pick up/drop some items it has been noticed that they often meander in to unauthorized areas and spend additional amount of time in the premises. This problem has proliferated to a great extent in recent times and resulting in major losses for the company. The issue can be overcome by implementing a solution using IOT. When these vehicles enter the company premises, they should be given a RFID tag and BLE beacon. The tag must be installed at the bottom of the vehicle and the beacon must be in the vehicle at all times. The time of arrival and the work must be entered in the system and the system calculates the estimated amount of time for the delivery or pick up. If the vehicle does not return to the gate in that time then the BLE beacons gets activated to search for the live location of the vehicle. The system also allots a unique parking slot for each vehicle. In the parking area, IR sensors and cameras are used to detect the vehicle in the respective slots. Even after executing all this, if the vehicle enters into the restricted regions then the RFID reader on speed bumper detects the vehicle and informs the security. The whole system follows MQTT protocol for communication. In this way, confidential information of the company is safe and retained.**

***Index Terms*— Unauthorized, restricted, vehicle, logistic, delivery, security, breach, parking, RFID, BLE, beacons, IoT, number plate, unidentified, premises, IR, MQTT , RTC, speed breaker.**

I. INTRODUCTION

Security has become a major concern over the world, be it physical or virtual. Many factories and companies are facing serious issues of truck drivers or outsiders traipsing around in the campus in places where confidential work may be going on. These individuals are spending an excess amount of time on the company grounds than necessary bringing into doubt their intentions. Such breaches are increasing day by day and threatening the companies or factories.

If these unfortunate activities continue, the company's confidential data and ideas will become compromised. It may lead to downfall of the company, if this situation is not handled at the right time. Hence the need for a system to keep check on such unauthorized access arises. The unidentified outsiders must be tracked and located if they enter any unauthorized premises and roam around for a long time.

II. LITERATURE SURVEY

[1] Describes the importance of MQTT in IoT, the architecture of MQTT, various domains where MQTT is used, different brokers of MQTT, current issues in MQTT and future trends.

[2] Consolidates the information on the state-of-the-art BLE beacon, from its application and deployment cases, hardware requirements, and casing design to its software and protocol design, and it delivers a timely review of the related research challenges.

[3] Suggests an automated way of parking toll collection based on the number plates of the vehicle and the time for which the vehicle is parked in the parking lot. This work deals with the problem from field of artificial intelligence, computer vision (image processing) and neural networks in the construction of an Automatic Number Plate Recognition System (ANPR).

[4] Presents traffic and vehicle monitoring system based on IoT. The proposed system is built using ATMEGA 2560 micro-controller board, and AMICA NodeMCU IoT board, and UBLOX NEO 6N GPS module. The compact design makes the system more reliable and accurate.

[5] Introduces a Smart Parking System (SPS) which enables the user to find a nearest parking area and gives availability of parking slots in that respective parking area. It mainly focuses on reducing the time in finding the parking lots and also it avoids the unnecessary travelling through filled parking lots in a parking area.

III. NEED

To enhance security many solutions have been proposed including increased manpower or IoT based system which makes use of GPS tracking. But these solutions are not economical. In addition, the proposed solution should be fast and must cover the entire region of the said factory or company. Few have expatiated any research or solution on vehicle monitoring inside the premises. Most of the time this issue is overlooked but it has become a major concern in recent times.

IV. CHALLENGES

There are various things which need to be taken care of to design this system. Firstly, a fixed time slot must be assigned to the vehicle based on the number of items to be picked or dropped. If the time exceeds the allotted time then the security guards must be alerted. Secondly, at the time of entry an individual parking slot must be assigned to each vehicle so that there is no confusion among the drivers and unintentional wandering in restricted places is avoided. Thirdly, the location should be tracked for the entire visit and when it enters an unauthorized place the system must detect the breach and alert the security guards and the concerned authorities

V. SOLUTION

Many methods can be used to tackle this problem. Our proposed solution is as follows. When a vehicle enters the premise, a timer gets initialized. A tag is given to the driver to track the location of the vehicle during the entire time of their visit. A fixed parking slot is then assigned in the authorized region for them with the camera surveillance in the parking area. In unauthorized areas, the speed bumpers should have an identifier which would alert the guards if the delivery/pickup vehicle tries to enter. Employees inform the guards once the work is completed.

VI. SYSTEM DESIGN

A. RFID tags for identification

When the vehicle enters the gate of the company, it is stopped by the security guards. At the same time, the guards should give them an RFID tag which should be attached at the bottom of the vehicle and beacons for tracking. RFID tag when comes in contact with RFID reader, it gets identified.

1) What is RFID?

RFID is an acronym for "radio-frequency identification" and refers to a technology whereby digital data encoded in RFID tags or smart labels (defined below) are captured by a reader via radio waves. It is the wireless non-contact use of radio frequency waves to transfer data. Tagging items with RFID tags allows users to automatically and uniquely identify and track inventory and assets. RFID takes auto-ID technology to the next level by allowing tags to be read without line of sight and, depending on the type of RFID, having a read range between a few centimeters to over 20+ meters.

2) How does RFID work?

RFID belongs to a group of technologies referred to as Automatic Identification and Data Capture (AIDC). AIDC methods automatically identify objects, collect data about them, and enter those data directly into computer systems with little or no human intervention. RFID methods utilize radio waves to accomplish this. At a simple level, RFID systems consist of three components: an RFID tag or smart label, an RFID reader, and an antenna. RFID tags contain an integrated circuit and an antenna, which are used to transmit data to the RFID reader (also called an interrogator). The reader then converts the radio waves to a more usable form of data. Information collected from the tags is then transferred through a communications interface to a host computer system, where the data can be stored in a database and analyzed at a later time.

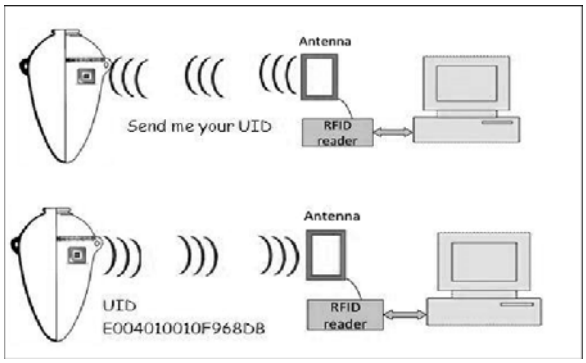

Fig. 1. RTC DS 1307

3) Components of RFID system

a) A RFID tag: It consists of a silicon microchip attached to a small antenna and mounted on a substrate and encapsulated in different materials like plastic or glass veil and with an adhesive on the back side to be attached to objects.

b) A reader: It consists of a scanner with antennas to transmit and receive signals and is responsible for communication with the tag and receives the information from the tag. Here, the RFID reader used is RC522. It functions at 13.56 MHz.

c) A Processor or a Controller: It can be a host computer with a Microprocessor or a micro-controller which receives the reader input and processes the data. Here, the processor used for implementation of the system is Raspberry PI 3B+.

4) How a vehicle is detected in unauthorized areas using RFID?

The speed bumpers in restricted areas are installed with RFID reader. When a visitor vehicle passes over the bumper, the reader identifies the vehicle as each vehicle is installed with a RFID tag at the bottom portion. The reader is connected to the processor. After identifying the individual vehicle through UID (Unique Identification) number of the particular tag, the information is then conveyed to the front gate or security guards about an unauthorized visit in restricted area.

B. Time stamp

Entry should be made in the computer systems by the guards that a vehicle has entered the premises, noting down its number plate number, time of entry and the work for which it is entering the factory grounds.

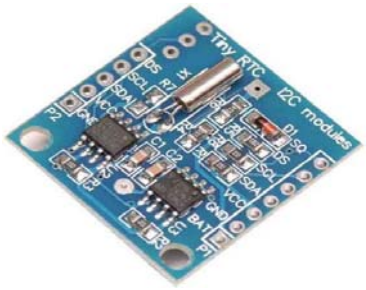

Fig. 2. RTC DS 1307

The work must be segregated into various groups and assigned an estimated time limit. If the time spent by the pick-up/delivery trucks is more than the expected time, then the system must alert the guards through MQTT (Message Queuing Telemetry Transport).

The time can be calculated by using RTC (Real Time Clock) as Raspberry Pi does not have an inbuilt clock. The RTC gives the exact date and time. When the time crosses the estimated duration then through coding, the security and required authorities are alerted through MQTT protocol.

C. Fixed Parking Slot

The system generates an individual parking slot for each vehicle after checking the status (availability or unavailability) of each parking slot. The slot should be informed to the drivers at the gate during entry.

1) Check availability of parking slot

The system checks if a particular slot is free with the help of IR (infrared) sensors. In the parking, IR sensors are installed on the ground in the middle of the parking slot. If the vehicle is not present, the receiver of the IR sensor will not receive any signal. If the vehicle is present in the parking then the receiver of the IR sensor will receive a signal. In this way it can be identified if the vehicle is parked or not.

The time required approximately for the truck to reach the parking slot is calculated. If the vehicle is not parked within the calculated time then, the guards will be alerted.

2) Working of IR

An infrared sensor emits and/or detects infrared radiation to sense its surroundings. The working of any Infrared sensor is governed by three laws: Planck's Radiation law, Stephen – Boltzmann law and Wien's Displacement law.

Planck's law states that "every object emits radiation at a temperature not equal to 00K". Stephen – Boltzmann law states that "at all wavelengths, the total energy emitted by a black body is proportional to the fourth power of the absolute temperature". According to Wien's Displacement law, "the radiation curve of a black body for different temperatures will reach its peak at a wavelength inversely proportional to the temperature".

The basic concept of an Infrared Sensor which is used as Obstacle detector is to transmit an infrared signal, this infrared signal bounces from the surface of an object and the signal is received at the infrared receiver.

There are five basic elements used in a typical infrared detection system: an infrared source, a transmission medium, optical component, infrared detectors or receivers and signal processing. Infrared lasers and Infrared LED's of specific wavelength can be used as infrared sources. The three main types of media used for infrared transmission are vacuum, atmosphere and optical fibers. Optical components are used to focus the infrared radiation or to limit the spectral response.

Optical lenses made of Quartz, Germanium and Silicon are used to focus the infrared radiation. Infrared receivers can be photo-diodes, photo-transistors etc. Some important specifications of infrared receivers are photo-sensitivity, detectivity and noise equivalent power. Signal processing is done by amplifiers as the output of infrared detectors is very small.

D. Bluetooth Low Energy(BLE)

To detect the vehicles in the restricted zones, Bluetooth low energy (BLE) beacons can be used as proximity detectors installed in the unauthorized areas.

BLE is a form of wireless communication designed especially for short-range communication. BLE is very similar to Wi-Fi in the sense that it allows devices to communicate with each other. However, BLE is meant for situations where battery life is preferred over high data transfer speeds. For example, say you want to broadcast marketing campaigns in the close proximity of a newly launched headphone. The amount of data you need to transfer to a visitor's smartphone is extremely small, hence BLE compatible beacons do the job quickly without draining the battery.

Most smart phones and tablets today are BLE compatible, which means they can seamlessly communicate with Bluetooth enabled wireless headphones, digital signage, car stereos, fitness trackers, smart watches and hardware devices like beacons.

So BLE beacons are kept in the restricted regions. During the time of entry the mobile of the drivers and the delivery boys are connected to the system Bluetooth so that the beacons in the restricted regions can detect if the security is breached.

1) Working of BLE

BLE (shown in Fig. 3) data transfer is essentially a one-way communication. Let's take an example of BLE beacons trying to communicate with a smart-phone in close proximity – a Bluetooth Low Energy beacon broadcasts packets of data at regular intervals of time. These data packets are detected by app/pre-installed services on smart-phones nearby. This BLE communication triggers actions such as, pushing a message or promoting an app.

To save energy and provide higher data transfer speed, the entire BLE communication framework consists of 40 frequency channels, separated by 2MHz. 3 of these channels are the primary advertisement channels while the remaining 37 channels are secondary channels, also known as data channels. The Bluetooth communication starts with the 3 primary advertisement channels and then offloads to the secondary channels.

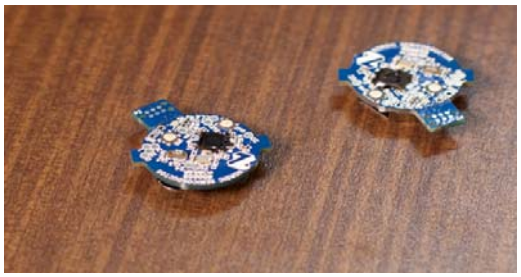

Fig. 3. BLE Beacon

Channels are secondary channels, also known as data channels. The Bluetooth communication starts with the 3 primary advertisement channels and then offloads to the secondary channels.

E. License Plate Recognition

Sometimes it may happen that the truck may somehow miss the speed bumper, for such cases if the parking slot is empty then the cameras installed in the restricted areas will spot vehicles through pictures.

By pattern recognition and image processing, the number plate number will be identified. This method is called License Plate Recognition or LPR for short. The steps are as follows:

1) License Plate Detection

The first step is to detect the License plate from the car. We will use the contour option in OpenCV to detect rectangular objects to find the number plate. The accuracy can be improved if we know the exact size, color and approximate location of the number plate. Normally the detection algorithm is trained based on the position of camera and type of number plate used in that particular country. This gets trickier if the image does not even have a car, in this case we will take an additional step to detect the car and then the license plate.

2) Character Segmentation

Once we have detected the License Plate we have to crop it out and save it as a new image. Again this can be done easily using OpenCV.

3) Character Recognition

Now, the new image that we obtained in the previous step is sure to have some characters (Numbers/Alphabets) written on it. So, we can perform OCR (Optical Character Recognition) on it to detect the number.

F. Message Queuing Telemetry Transport(MQTT)

Once the work (delivery/pickup) is completed by the restricted members, the employees of the factory will inform the security guards. This communication will take place with the help of MQTT (Message Queuing Telemetry Transport). The employees will publish the data in channels, mosquito acts as broker; it will give the data to the subscribers (security guards). At the exit time, the time spent in the premises will be calculated by using RTC (Real time Clock); the RFID and beacon tags will be returned to the security guards so that they can be reused. The whole system can be implemented on any development boards.

MQTT is one of the most commonly used protocols in IoT projects. It stands for Message Queuing Telemetry Transport. In addition, it is designed as a lightweight messaging protocol that uses publish/subscribe operations to exchange data between clients and the server. Furthermore, its small size, low power usage, minimized data packets and ease of implementation make the protocol ideal for the "machine-to-machine" or "Internet of Things" world.

1) Why MQTT?

MQTT has unique features you can hardly find in other protocols, like:

- It's a lightweight protocol. So, it's easy to implement in software and fast in data transmission.
- It's based on a messaging technique. The MQTT protocol is as fast as WhatsApp message/messenger.
- Minimized data packets. Hence, low network usage.
- Low power usage. As a result, it saves the connected device's battery.
- It is real time. That's specifically what makes it perfect for IoT application.

2) How MQTT works?

Working of MQTT is shown in Fig. 4.Like any other internet protocol, MQTT is based on clients and a server. The server is the guy who is responsible for handling the client's requests of receiving or sending data between each other. MQTT server is called a broker and the clients are simply the connected devices.

- When a device (a client) wants to send data to the broker, the operation is called "publish".
- When a device (a client) wants to receive data from the broker, the operation is called "subscribe".

In addition, these clients are publishing and subscribing to topics. So, the broker here is the one that handles the publishing/subscribing actions to the target topics.

3) MQTT Components

- Broker, which is the server that handles the data transmission between the clients.
- A topic, which is the place a device wants to put or retrieve a message to/from.
- The message, which is the data that a device receives "when subscribing" from a topic or sends "when publishing" to a topic.
- Publish, is the process a device does to send its message to the broker.
- Subscribe, where a device does to retrieve a message from the broker.

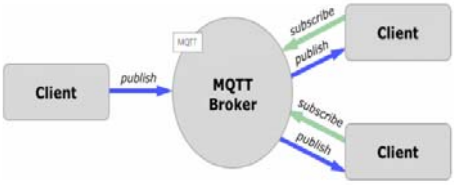

Fig. 4. MQTT working

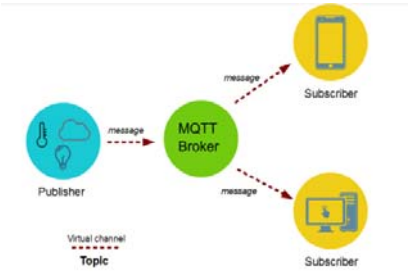

Fig. 5. MQTT components

VII. CONCLUSION

An efficient system to curb the problem of unauthorized vehicle access is successfully implemented. The system will help the company or factory to identify any security violations. The time spent inside the campus is calculated by RTC and if it goes past the allotted or estimated time, the guards will contact the employee or region of company where the delivery is taking place, enquiring about the whereabouts of the delivery man. The system checks if the vehicle is parked in the correct parking slot. If it enters into unauthorized zones, then the system identifies it and informs the concerned authorities. In this way an impartial security is maintained in the company premises and it remains risk free.

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