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HYBRID RTLS IN HOSPITAL MANAGEMENT SYSTEM

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Abstract - *The real-time location systems (RTLS) take recently important part in many location-aware systems especially in indoor objects localization tasks and become popular in recent years and have been in use in many areas such as logistics, transportation and medicine. It has been used to extract the primary event logs which contain the data related to movements of patients, doctor, staff and equipment. Therefore, we propose a system which minimizes the location error with less processing time for an indoor moving patient. We developed the web application using the programming language like c#, Microsoft visual studio and we make use of Database to store the data. The application is used to entering the data of in and out record details like patient, doctor, staffs and all the surgery components in the hospital and it also helps for tracking and or to generate the report of each equipment in the hospital.*

***Key Words*: radio frequency identification (RFID), real time location system (RTLS), Beacons, RFID tag.**

1. INTRODUCTION

Recently, with growing markets and huge potential predicted, location tracking systems have become more important in hospitals to support the medical staff with tasks such as patient tracking and asset management. Companies have successfully deployed systems in many hospitals with a return on investment (ROI).The real-time locating system (RTLS) is a system that can be used to track the position of an object within a coverage area with the minimum time delay. The tracked object is usually equipped with some portable electronic device-tag that can communicate or, at least, receive a signal from device anchor with a known position. A RTLS typically consists of anchors, tags see, and a location engine.

In this work, we want to evaluate a proximity-based location tracking system for the use in the hospital. It was developed on a simple, low-cost basis with modern technology and with specific requirements in mind. The goal was to constantly track users (medical staff members and medical equipment) whenever they are in rooms with an active location tracking system installed.

2. OBJECTIVES OF THE PROJECT

They aimed at showing the feasibility and the advantages of using of RTLS to get a complete and correct log file enabling to use all the Process Mining benefits in order to make a diagnosis and propose improvements. Furthermore this method is even more adapted to healthcare. Further works would deal with also use RTLS tags to hospital staff (nurses, doctors…) in this approach Problems such as the inactivity of the tag and random changes into other nearby rooms because of multipath effects arise. So only this project will explains about the tracking of each equipment in the hospital section like staff, doctors, medical equipment and we keep the tracking of inn and out of each component from the room. Generation of reports for the tracking equipment's by using the web application which has been created and all the date is stored in the database.

3. AIM AND SCOPE

This contribution aims to provide detailed information concerning the implementation and testing of a basic RFID system for e-Health applications, in particular, for tracking and managing assets (medication and patients) in hospitals. While the architecture of the proposed system is quite similar to those already deployed in hospitals worldwide, the aim here is to provide additional details about implementation features that must be taken into account to ensure proper functionality: (i) choice of the antennas depending on the coverage area and cost; (ii) item traceability depending on the RFID tags' detectability; and (iii) simplicity and ease of use of the graphical user interface (GUI). Although the scope of the RFID system described in this contribution is restricted to a small area of the hospital, the architecture is fully scalable to cover the needs of the different medical services in a hospital.

4. DESIGN METHOLODY (PART 1)

The first phase of the project is to monitor the patient, nurse, doctors, medical equipment and automatic hand sanitizing (asset tracking). And track the each one and maintain the proper report which has been generated from the web application.

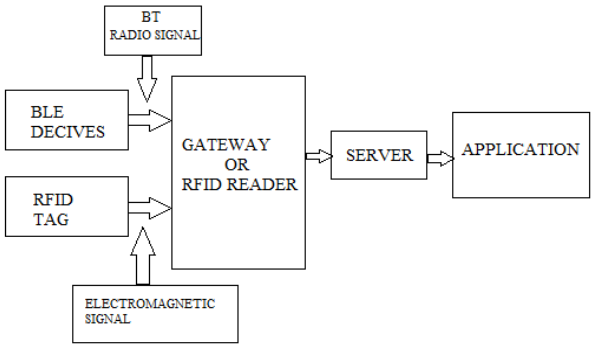


Fig 1: Block diagram of tracking of BLE devices.

4.1 The key requirements of Hardware and Software components in this technical project are:

HARDWARE USED:

- Minew Gateway
- Minew BLE devices
- Automatic Hand Sanitizer
- ESP32 WROOM 32

SOFTWARES USED:

- C#
- MQTT broker
- Microsoft Visual Studio

The different becon devices are:

WEARABLE BECON

CARD BEACON

ASSET BEACON

Fig 2: different becon devices

The above figures shows the different BLE devices which is used to track the moving object like the wearable beacon is used for the nurse, the card beacon is used for the doctors and the asset beacon is used the medical devices. Life of These devices are almost 2 to 3 years and the distance it can detect is up to 50 to 60 meter.

4.2 BLE & WiFi Gateway

G1 is a Bluetooth low energy (BLE) to Wi-Fi connectivity gateway without the uses of smartphones or apps. The G1 gateway collects the data from iBeacon, Eddy stone, BLE sensor and other BLE devices, and then sends to the local server or remote cloud server by HTTP / MQTT protocol over Wi-Fi / Ethernet. The subsequent version G1 Gateway will also implement the connection with BLE devices. This product is a science fiction with a color lamp ring on the top. It can be fixed by sticker or screw thread

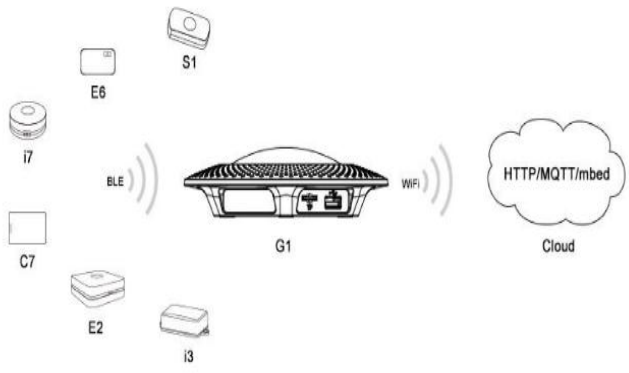


Fig 3: connection of different ble devices to gateway

S1: Bluetooth temperature & humidity sensor

E2: 300 to 500 meters Max Beacon

G1: Bluetooth & WiFi gateway

C7: Credit card beacon with RFID/NFC

4.3 MESSAGE QUERY TELEMETRY TRANSPORT (MQTT)

The protocol uses a publish/subscribe architecture in contrast to HTTP with its request/response paradigm. Publish/Subscribe is event-driven and enables messages to be pushed to clients. The central communication point is the MQTT broker, it is in charge of dispatching all messages between the senders and the rightful receivers. Each client that publishes a message to the broker, includes a topic into the message. The topic is the routing information for the broker. Each client that wants to receive messages subscribes to a certain topic and the broker delivers all messages with the matching topic to the client. Therefore the clients don't have to know each other, they only communicate over the topic. This architecture enables highly scalable solutions without dependencies between the data.

Fig 4: MQTT publishing and subscribe to different devices

The difference to HTTP is that a client doesn't have to pull the information it needs, but the broker pushes the information to the client, in the case there is something new. Therefore each MQTT client has a permanently open TCP connection to the broker. If this connection is interrupted by any circumstances, the MQTT broker can buffer all messages and send them to the client when it is back online. As mentioned before the central concept in MQTT to dispatch messages are topics.

4.4 AUTOMATIC HAND SANITIZER

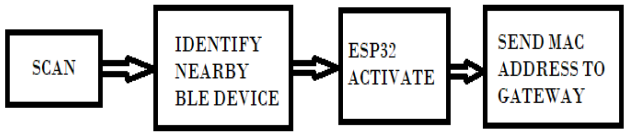


Fig 5: block diagram of interfacing with ESP32

- Interface of ESP32 WROOM 32.
- WIFI+BT+BLE MCU module.
- Operates in 3.3v.
- Collect the nearby BLE device.
- Conversion.
- Send MAC address to the gateway.

5.5 DESIGN METHOLODY (PART 2)

The second phase of the project is to monitor the surgical equipment and linen tracking by using the rfid tag and rfid reader.

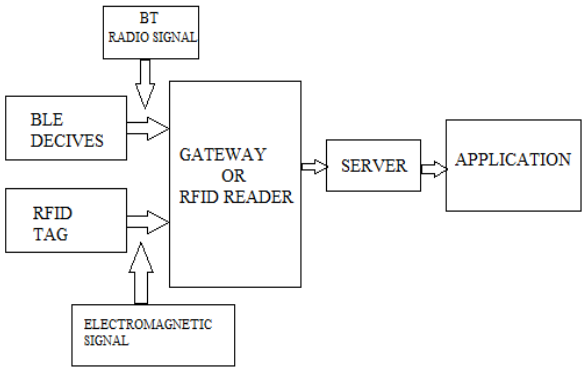
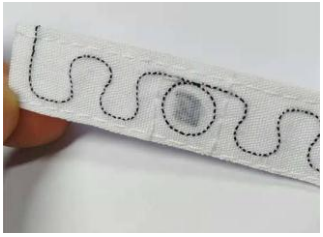


Fig 6: block diagram of surgical and linen tracking

Above block diagram shoes the detection of surgical equipment and the linen tracking by using the small rfid tag and the android mobile hand held reader. The rfid tag is placed in the different medical surgical equipment and the linen cloths in the hospital these tags are used to detect or identify by using the rfid handled reader which collect the data and store in the database.

4.6 HARDWARE COMPONENTS

SURGICAL RFID TAG



LINEN RFID TAG

Fig 7: rfid tag for surgical and linen tracking

- Placing an RFID tag is very important
- SIZE (6*2)mm
- FREQUENCY (865 – 928MHz) UHF
- DISTANCE (1.5 - 2)meter

4.7 MOBILE HANDHELD RFID READER

Fig 8: Mobile handheld rfid reader

- ❑ Operates in UHF (865 – 868)MHz
- ❑ R/W range 6-7 meter
- ❑ Build our own android application
- ❑ Easy to handle

5. RESULTS

Screenshot shows that the results of this project in which the report of the each equipment, nurse, doctors hand sanitizing, medical surgical equipment and linen has been successfully saved in the database of each single ble devices and the rfid tag has been saved and get printed for the further usage. The web page which has been developed to add the details of doctors, staff like name, address, mac id etc.. And it has the option to generate the report for data wise, room wise and the equipment wise we can generate the report for different types.

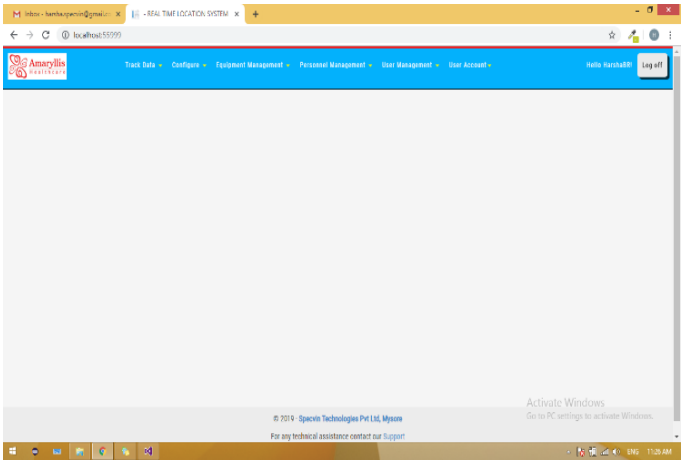


Fig 9: screenshot of web server page to add the details

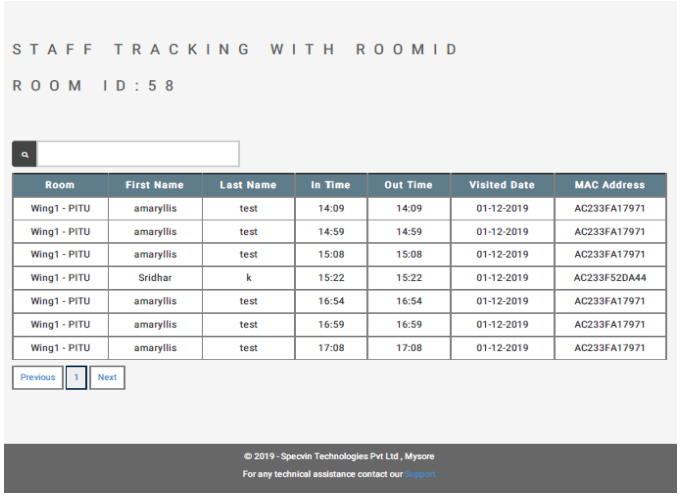


Fig 10: report generated for the staff tracking with room id

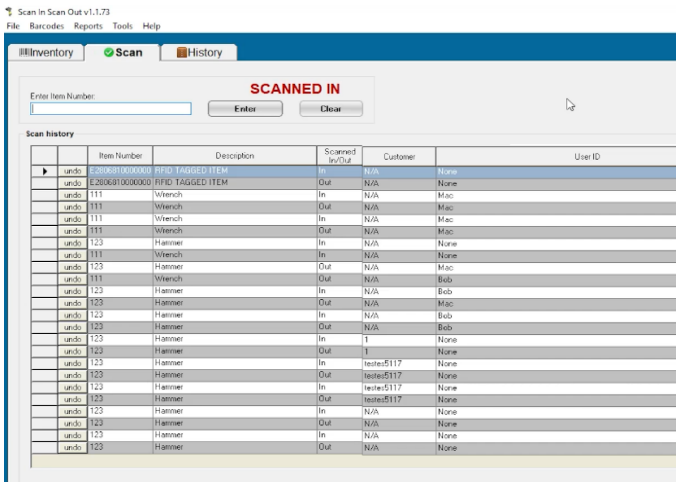


Fig 11: screenshot of surgical equipment which indicates the status of the tag which is used or not.

6. CONCLUSIONS

This contribution has revised the impact of RFID systems for reducing the risk of medical errors in hospitals and loosing lot of money, especially in the field of drug administration. The added value comes from the hardware point-of-view, discussing advantages and limitations of different kinds of RFID technology, and analyzing the coverage area and the effects of multipath in the case of UHF RFID systems and the different beacon. A proof-of-concept based on UHF RFID hardware is presented, proposing a basic architecture for tracking medical items and drugs, which can be easily integrated within medical information services and network infrastructure already deployed in the majority of hospitals. A mobile application has been implemented to show real-time information about the items tagged with RFID tags, aiming to make it as simple as possible so every potential user can understand how it works almost immediately.

Tests conducted in a hospital have shown that UHF RFID technology can be successfully used to detect passive RFID tags at distances up to 3–4 m even in NLOS conditions, requiring similar hardware needs as HF RFID or NFC-based management systems. Thanks to its longer reading distance, UHF RFID has less impact than other RFID technologies, not requiring the users of the system (doctors, patients, nurses) to approach the readers.

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