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RFID BASED IOT ENABLED REAL-TIME BUS TRACKING SYSTEM USING MQTT CLOUD AND NODEMCU

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A B S T R A C T

Public Transportation is the major means of Bus among people. A recent survey by the National Sample Survey Organization says that about 62-66% of people use the bus as their mode of transport. Public Bus tracking system aims at providing the instant status of the bus to the users via an automated system. This paper describes a design of IoT enabled real time bus tracking system. In this work a bus tracking mobile phone app is developed, using that people can exactly locate the bus status and time to bus arrival at bus-stop. This work uses high frequency RFID tags at buses and RFID receivers at bus-stops and with NodeMCU real time RIFD tagging (bus running) information is collected and uploaded on cloud. Users can access the bus running and status from cloud on mobile app in real time.

Keywords: *Internet on Things, UHF-RFID, Bus-monitoring, NodeMCU, Blynk cloud, FAR, FRR.*

1. INTRODUCTION

Public Transportation is the major means of Bus among people. A recent survey by the National Sample Survey Organization says that about 62-66% of people use the bus as their mode of transport. People, in the long run, wait for the buses at the bus stop, since they did not have idea about bus running status, since they are unable to get the location of the bus they get to take some other modes of Bus to reach their destination. This work designs a public Bus tracking system for smart cities transportation and aims to providing the instant status of the bus to the users via an automated system. This paper deals with NodeMCU which serves as the central controller acting as the brain of the system. To destroy the manual log entry and to automate the process this paper plays a vital role. Android mobile phone app is chosen as the medium to communicate with the passengers that provide easy access. In this work tracking the buses, on Blynk-IoT application of using a mobile phone, updating the passengers through real time notifications and improving the accessibility to the system.

RFID based Security work for school transports is describe in [4], Their work configuration is partitioned into two subsystems: one of which utilizes RFID innovation to detect the Buses development and perform alarming reactions whenever required. An IoT based Bus global positioning work to show the momentum area of the Bus and seat accessibility in the showing up transports in [3], it utilized RFID innovation for following the Bus and Thingspeak web worker for showing the area of the Bus and seat accessibility in the android application in a PDA. [2] developed a setup with the buses having RFID tags inside an RFID transmitter on each Bus stops, they used Arduino for tracing and GSM module for acknowledgement via sending the following messages to the approved people. GPS is utilized for getting the area of the transports in [1], they use UHF-RFID in programmed vehicles distinguishing proof is concentrated by the methods for another reproduction structure.

This work is advancement of previous work discussed above, this work is replacing GPS based real time bus tracking [1] with UHF-RFID and NodeMCU based real time sensing based tacking, this work is also replacing GSM messaging-based notification [2] with Blynk cloud based mobile app real time data update.

RFID BASED TRACKING

Radio Frequency Identification (RFID)[1,2] shown in figure-1 is the remote non-contact utilization of radio recurrence waves to move information.

Fig. 1 An passive UHF-RFID tag receiver [5]

Tagging things with RFID tags permits clients to naturally and particularly distinguish and track things. In this work unique bus code RFID tags are fixed at every bus and every Bus-stop contains aultra-high frequency RFID receivers which have range up-to 25 meters. Whenever the bus crosses the bus-stops receivers detect the RFID unique code and NodeMCU [13] at bus-stop puts that bus code information along with the bus-stop id and time on Blynk cloud. NodeMCU is an open-source RISC microcontroller-based firmware produced for ESP8266 Wi-Fi chip. Blynk cloud [10] is intended for the Internet of Things. It can control equipment distantly, it can show sensor information, it can store information, visualize it and do numerous other cool things. Blynk Server is answerable for all the correspondences between the cell phone and equipment.

2. METHODOLOGY

Presented work is using Ultra High-Frequency RFID receiver, however previous works [1], [2] and [3] uses high High-Frequency RFID. Presented work is using NodeMCU instead of Arduino used in [2], Node-MCU contains an integrated Wi-Fi module which makes the fast communication then Arduino. Presented work is using Blynk cloud service [10] for IoT connectivity for advance real-time updating of the bus tracking. Blynk is more advance and faster thanThing-speak web server used by [3]. The three modifications made in compare with available work for real-time monitoring and improving the probability of detection in the IoT environment.

A. IMPLEMENTATION:

The proposed system shown in figure 2 consists of two modules. The first module is the sensing module and the second is the IoT application. Sensing module comprises of UHF-RFID unit which is used for sensing the bus when it reaches the bus stop. The module is an IoT application which provides a user interface and gives location updates to the passenger. The block diagram for the proposed system is shown in Fig 2 The modules are further divided into three sections namely,

- Bus unit
- Central processing unit
- IoT application

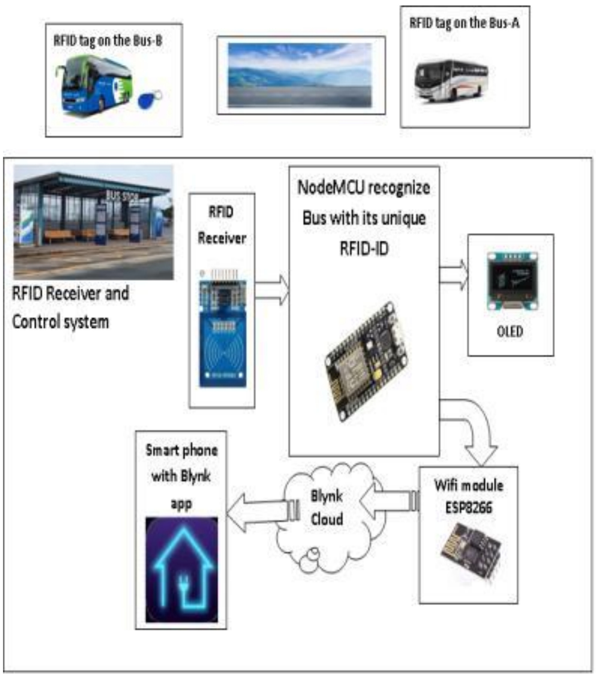

Fig. 2 Schematic diagram of the proposed system

The Bus unit contains, RFID tags inside the Bus and RFID transmitter are put outside the Bus unit. RFID tags are of front and back tags which are put on the separate situation inside the transport. RFID transmitter is utilized to recognize the appearance and flight of Bus at Bus stops. Focal preparing unit involves NodeMCU that cycle the information got from different modules of the work. IoT application is fabricated utilizing Blynk stage which gives better UI and encourages simple entry to the work.

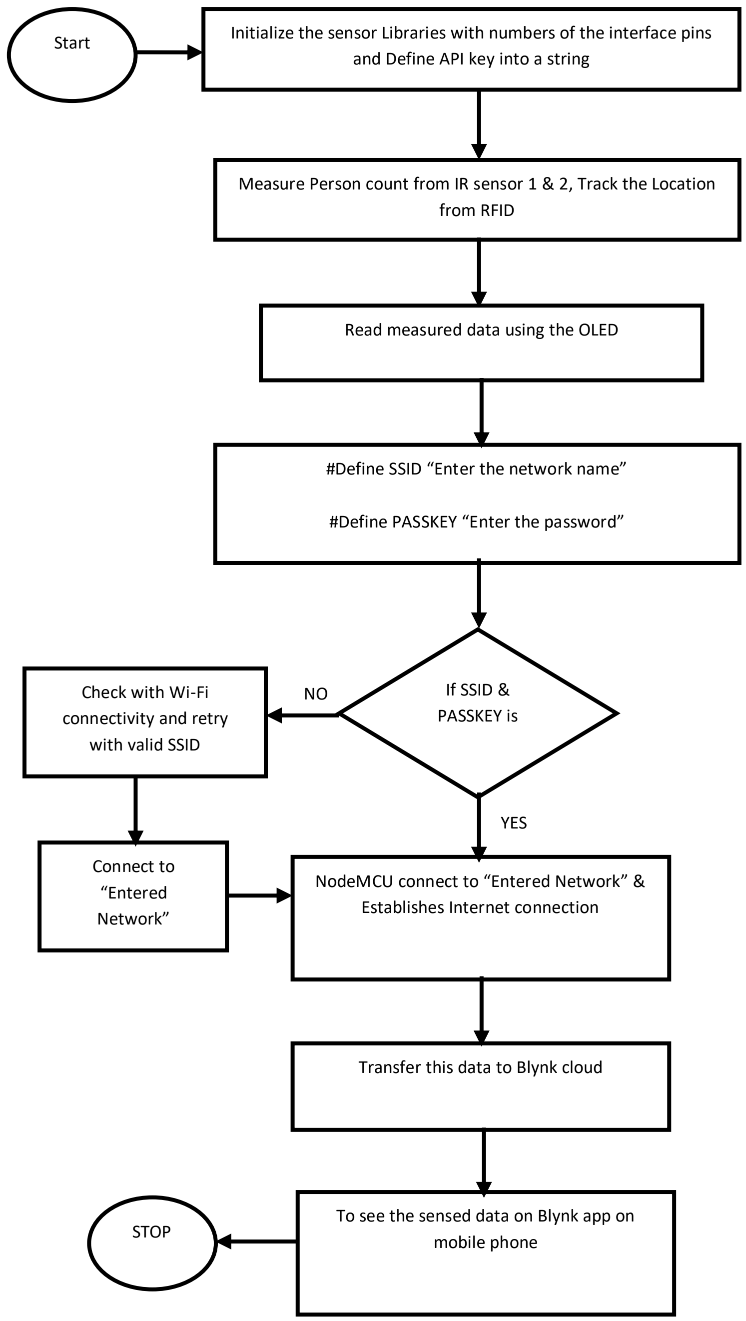

Fig. 3 Flow chart of proposed work

The application in android phone will contain the current bus stop, and next bus stop information of specific bus that will be reached. Application administration can likewise be stretched out by planning an information base which contains the information, guaranteeing the ideal appearance of the buses. The proposed work gives adaptability to the client and it is versatile supporting different client availability. Availability to the web builds the exactness of the proposed work. The separation between two Buses on the road is determined utilizing the Haversine equation [2]. It utilizes two sets of scope and longitude areas. Utilizing the Haversine Formula [2]:

D = R*s
R is sweep of the road (6371 km)
s = 2*k tan-1(√k,√(1-k))
k = sin2(L/2)+cos(L1)*cos(L2)*sin2(l/2)
L = contrast in scope = L2-L1
l = contrast in longitude = l2-l1

Figure 3 shows the working flow of proposed work. The exercises of the work are intended to perform naturally with no human help and are mistake inclined. The major working squares are Bus module, preparing unit and end UI. UI is planned to utilize IoT application with Blynk stage. At first, the work stays inert until the target is distinguished. When the objective is distinguished a hint is shipped off the preparing unit including yield from RFID unit containing one of a kind RFID tags that are put in front and back situation of the transports and reactions from RFID transmitter. Each Bus has its exceptional ID containing 12 pieces. Also, the area of the Bus is followed by Blynk and offers it to the handling unit. Moreover, there will likewise be a timestamp which passes on the appearance and bus running season of the Bus at the bus station. It will likewise give the following area of the Bus that will be reached. This element can give the bus an away from about the following area of the Bus and gives adaptability to pick elective transports for convenient access. To stay away from mistakes and to encourage the ideal appearance of the transports, the area of the Bus alongside its ID or course number is ceaselessly refreshed to the approved people or sites through warnings administrations sent by IoT cloud [13]. Application interface will be the best answer to serve all age gatherings of bus with the best experience.

3. RESULT

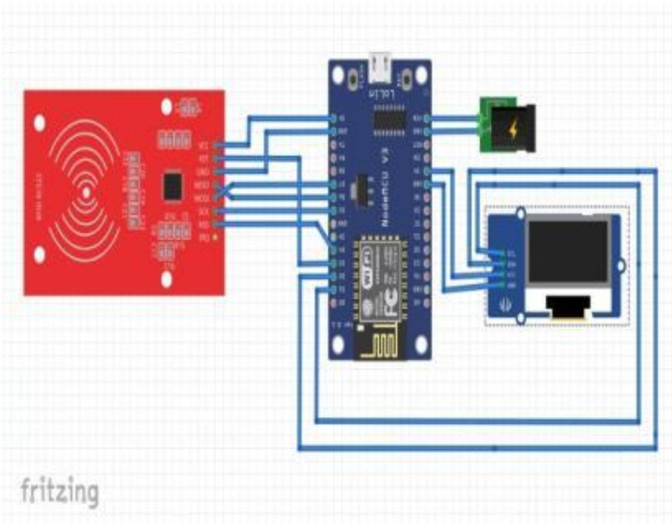

Fig. 4 Schematic design

Figure 4 above is the schematic design which shows the interconnections. The first analytical parameter for the proposed work is a time delay. The time delay signifies that whether the system is updating real-time bus monitoring information or not. The controller at the bus stop must upload the bus status on the cloud in real-time so the user can get the real-time information. Second analytical parameter for the proposed work is the probability of correct detection of the correct bus with correct route information. the probability can also be measure with False Acceptance Rate (FAR) is the percentage of identification instances in which is wrong are incorrectly accepted as correct. The third parameter for the analysis is the distance of the RFID tag from the transmitter. The table-1 below shows the results obtained for the implemented work for eight different test case scenarios when RFID tag is located at different distances from receiver in test prototype design.

TABLE 1: ANALYTICAL PARAMETERS OBSERVE AT DIFFERENT TAG DISTANCE

RFID tag distance from the transmitter	Average Time delay (Mille sec) Update on IOT enable device	Average FAR	Average FRR	Average Probability of detection
25 cm	148	0.0010	0	1
50 cm	151	0.0014	0.0011	0.99
75 cm	155	0.0095	0.0084	0.98
100 cm	162	0.014	0.0097	0.98
125 cm	169	0.018	0.011	0.97
150 cm	178	0.021	0.017	0.96

Table1 shows the analysis of observe test results with six different cases which are different distance between RFID transmitter and receiver. Table 2 below shows the results parameters observe with eight different cases of different numbers of buses and different numbers of bus-stops. it shows the impact on FAR, FRR, Probability of detection and app update time with more or less buses and more or less bus stops.

TABLE 2: TEST RESULTS OBSERVED FOR DIFFERENT COUNT OF BUS AND BUS-STOPS

Test case	Time delay (Mille sec) Update on IOT enable device	FAR	FRR	Probability of detection
One Bus A and 4 Bus stop (S1, S2, S3 & S4)	152	0	0	1
Two Bus (A&B) and 4 Bus stop (S1, S2, S3 & S4)	157	0.01	0	0.99
Three Bus (A,B& C) and 4 Bus stop (S1,S2,S3 & S4)	160	0.012	0.008	0.988
four Bus (A,B,C&D) and 4 Bus stop (S1,S2,S3 & S4)	161	0.018	0.011	0.982
One Bus A and 2 Bus stop (S1&S2)	138	0	0	1
Two Bus (A&B)and 2 Bus stop (S1&S2)	140	0	0	1
Three Bus (A, B & C) and 2 Bus stop (S1&S2)	141	0	0.002	1
four Bus (A, B, C&D) and 2 Bus stop (S1& S2)	142	0.01	0.009	0.99

Fig. 7 Bus monitoring on the Blynk app

From table 2 above and it may be observed that when the numbers of either buses or bus stop increases that the FAR and FRR rate also gets incremented and the probability of detection decreases however for maximum FAR 0.018 and FRR 0.011 are considerably less (in compare with availed work [1], [2] & [3]). The response time is also very good transmitting device to cloud to receiving device in just 161 milliseconds make the proposed work a real-time monitoring system. Figure 7 shows blynk app interface which is updating the bus at the bus-stop. user can any time open the app and get the information of bus on the app.

TABLE 3. COMPARATIVE ANALYSIS

Work	Proposed work	[1]	[2]	[3]
Method	HF-RFID for bus tracking, NodeMCU for control and Blynk cloud to update user	UHF-RFID for bus tracking, Arduino for control and Things peak cloud to update user	UHF-RFID for bus tracking, AVR for control and GSM for update user	GPS for bus tracking Arduino for control and GSM for update user
Average Probability of Detection (Pd)	0.985	0.978	0.964	0.952
Average FAR	0.011			
Average FRR	0.009			
Average Time to update user	161 ms	171 ms	184 ms	203 ms

Table 3 and figure 6 show the comparative results. It may be observe that this work is having probability of detection of 0.985 which is high then [1], [2] and [3] also it may be observe that the bus status gets updated on the app in 161 ms which is less then available work [1], [2] and [3] hence the proposed work can be consider more real time then previous works.

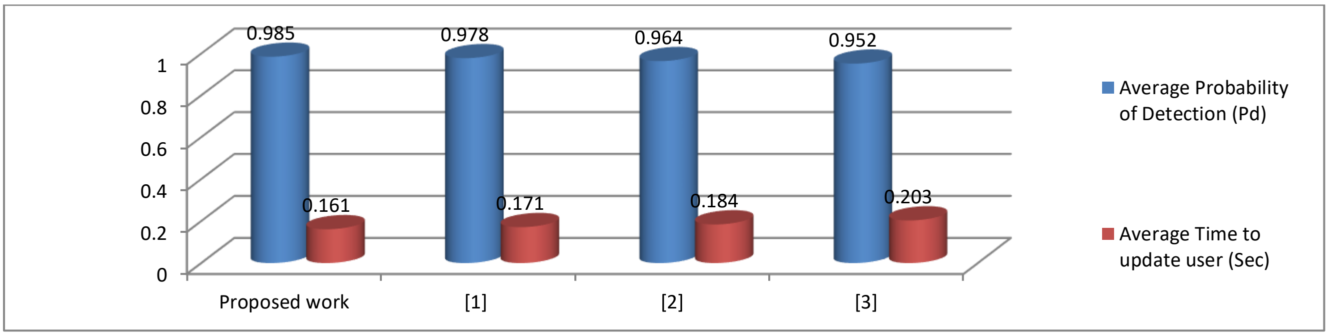

Fig.6 Comparative results analysis

4. CONCLUSION

IoT based Public Bus global positioning work is a serious strategy that can find and track the transports. The accomplishment of the global positioning work lies in giving a simple interface using an Android application to the client. This work fills in as a model that can envision the status of public vehicle transports remotely. The planned work can be conveyed in each rustic and metropolitan territories which gives an easy-to-understand climate to the bus. This work can be stretched out in assessing the surmised appearance season of the Bus with an acknowledged postponement. Security for this work can be created by establishing a video reconnaissance climate. Moreover, sensors can be sent in the transmitter's area to screen the traffic conditions in the separate Bus courses.

REFERENCES

[1] A. Larionov, R. E. Ivanov and V. M. Vishnevsky, "UHF RFID in Automatic Vehicle Identification: Analysis and Simulation," in IEEE Journal of Radio Frequency Identification, vol. 1, no. 1, pp. 3-12, March 2017.

[2] Deebika Shree, J. Anusuya and S. Malathy, "Continuous Bus Tracking and Location Updation System," 2019 fifth International Conference on Advanced Computing and Communication Systems (ICACCS), Coimbatore, India, 2019, pp. 242-245.

[3] P. A. Kamble and R. A. Vatti, "Bus following and checking to utilize RFID," 2017 Fourth International Conference on Image Information Processing (ICIIP), Shimla, 2017, pp. 1-6.

[4] T. Lindgren, B. Kvarnström and J. Ekman, "Monte Carlo reenactment of a radio recurrence recognizable proof framework with moving transponders utilizing the fractional component equal circuit technique," in IET Microwaves, Antennas and Propagation, vol. 4, no. 12, pp. 2069-2076, December 2010.

[5] Habadi and Y. S. Abu Abdullah, "Keen Safety School Buses System Using RFID and Carbon Dioxide Detection," 2018 first International Conference on Computer Applications and Information Security (ICCAIS), Riyadh, 2018, pp. 1-7.

[6] Sarah Aimi Saad, Amirah 'Aisha Badrul Hisham, Mohamad HafisIzran Ishak, MohdHusainiMohdFauzi, Muhammad AriffBaharudin, Nurul Hawaii Idris "Continuous on-Campus Public Transportation Monitoring System " IEEE fourteenth International Colloquium on Signal Processing and its Applications (CSPA 2018), 9 - 10 March 2018.

[7] Darshan Ingle, Dr A. B. Bagwan " Real-Time Analysis and Simulation of Efficient Bus Monitoring System" second International meeting on Electronics, Communication and Aerospace Technology (ICEC 2018)

[8] Manini Kumbhar, Meghana Surface, Pratibha Mastud, AvdhutSalunke " Real-Time Web-Based Bus Tracking System" IRJET-International Research Journal of Engineering and Technology, Volume: 03| Issue: 02 | Feb-2016

[9] Nusrath Jahan, Kamal Hossein and Muhammad Kamrul, Hossain Patwary "Execution of a Vehicle Tracking System utilizing Smartphone and SMS administration" 2017 fourth International Conference on Advances in Electrical Engineering (ICAEE) 28-30 September.