

DESIGN OF IOT ENABLED BUS MONITORING SYSTEM USING MOBILE APPLICATION

Bharti Singh Thakur*¹, Sunil Saha*²

*¹M. Tech. Scholar, Department Of Electronics And Communication, GGITS, Jabalpur, India.

*²Assistant Professor, Department Of Electronics And Communication, GGITS, Jabalpur, India.

ABSTRACT

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 RFID 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.

I. INTRODUCTION

Public Transportation is the significant methods for Bus among individuals. A new study by the National Sample Survey Organization says that regarding 62-66% of individuals utilize the transport as their method of transport. Individuals, over the long haul, hang tight for the transports at the bus station, since they didn't have a thought regarding transport running status, since they can't get the area of the transport, they will take some different methods of Bus to arrive at their objective. This work plans a public Bus global positioning framework for brilliant urban areas transportation and expects to give the moment status of the transport to the clients through a computerized framework. This paper manages NodeMCU which fills in as the focal regulator going about as the cerebrum of the framework. To obliterate the manual log section and to mechanize the interaction this paper assumes a crucial part. Android cell phone application is picked as the medium to speak with the travelers that give simple access. In this work following the transports, on the Blynk-IoT utilization of utilizing a cell phone, refreshing the travelers through constant warnings and improving the availability to the framework. RFID based Security work for school transports is describe in [4], Their work design is parceled into two subsystems: one of which uses RFID advancement to distinguish the Buses improvement and perform disturbing responses at whatever point required. An IoT based Bus worldwide situating work to show the force zone of the Bus and seat availability in the showing up transports in [3], it used RFID advancement for following the Bus and Thingspeak web specialist for showing the territory of the Bus and seat openness 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.

II. 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.

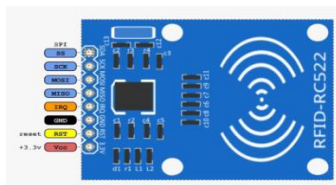


Fig 1: An passive UHF-RFID tag receiver [5]

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 a ultra high frequency RFID receivers which has 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. RISC microcontroller-based NodeMCU is an open-source firmware produced for Wi-Fi chip ESP8266. 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.

III. 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 than Thingspeak 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 framework is appeared in figure 2 comprises of two modules. The principal module is the detecting module and the second is the IoT application. The detecting module involves UHF-RFID unit which is utilized for detecting the transport when it arrives at the bus station. The module is an IoT application that gives a UI and gives area updates to the traveler. The square chart for the proposed framework is appeared in Fig 2 The modules are additionally partitioned into three areas in particular,

- Bus unit
- Central preparing unit
- IoT application

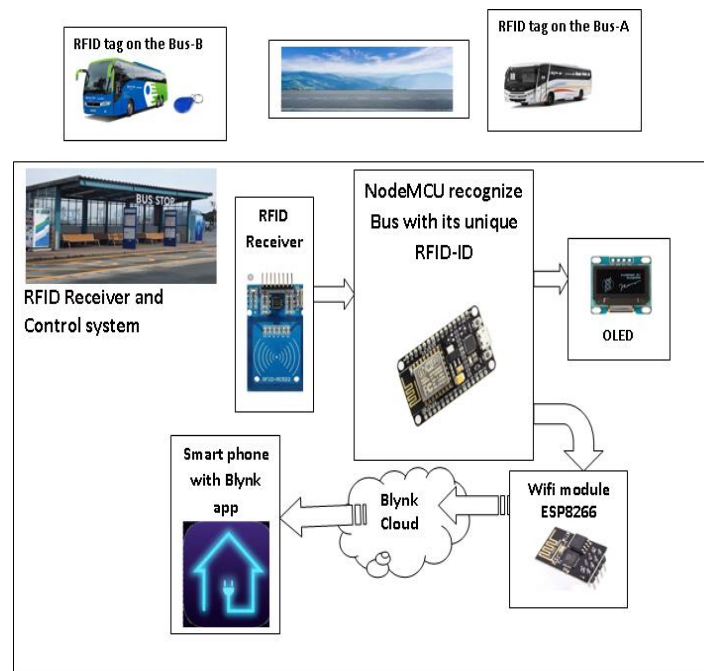


Fig 2: Schematic diagram of the proposed system

The Bus unit contains, RFID labels inside the Bus and a RFID transmitter are put outside the Bus unit. RFID labels are of front and back labels which are put on the different circumstance inside the vehicle. RFID transmitter is used to perceive the appearance and trip of Bus at Bus stops. The central getting ready unit includes NodeMCU that cycle the data got from various modules of the work. IoT application is created using the Blynk stage which gives better UI and urges basic section to the work.

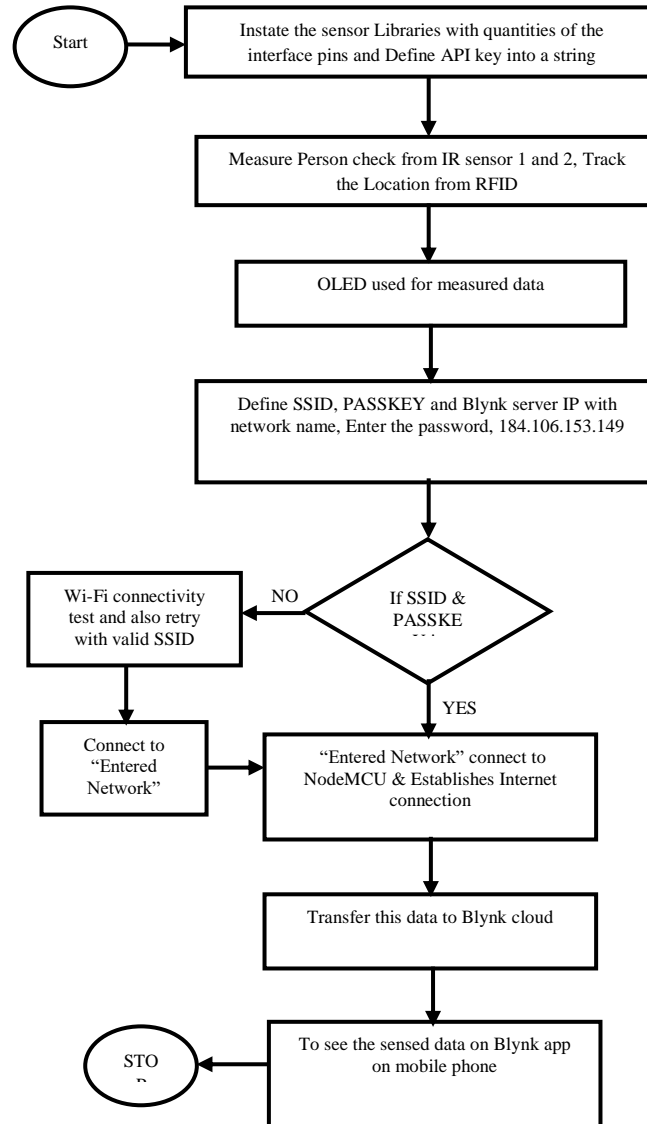


Fig 3: Flow chart of proposed work

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]:

$$Dis = Ri * si$$

Ri is sweep of the road (6371 km)

$$si = 2 * kp \tan^{-1}(\sqrt{kp}, \sqrt{1-kp})$$

$$kp = \sin^2(Li/2) + \cos(Li1) * \cos(Li2) * \sin^2(li/2)$$

Li = contrast in scope = Li2-Li1

li = contrast in longitude = li2-li1

Figure 3 shows the working progression of proposed work. The activities of the work are planned to perform normally with no human assistance and are botch slanted. The significant working squares are Bus module, planning unit and end UI. UI is wanted to use IoT application with Blynk stage. From the outset, the work stays idle until the objective is recognized. At the point when the goal is recognized a clue is delivered off the planning unit including yield from RFID unit containing stand-out RFID labels that are placed in front and back

circumstance of the vehicles and responses from RFID transmitter. Each Bus has its remarkable ID containing 12 pieces. Likewise, the region of the Bus is trailed by Blynk and offers it to the dealing with unit. Also, there will moreover be a timestamp which passes on the appearance and transport running period of the Bus at the bus stop. It will in like manner give the accompanying region of the Bus that will be reached. This component can give the transport an away from about the accompanying zone of the Bus and offers versatility to pick elective vehicles for helpful access. To avoid botches and to support the ideal appearance of the vehicles, the zone of the Bus close by its ID or course number is endlessly revived to the affirmed individuals or locales through alerts organizations sent by IoT cloud [13]. Application interface will be the most fitting response to serve all age social occasions of transport with the best insight.

IV. RESULT

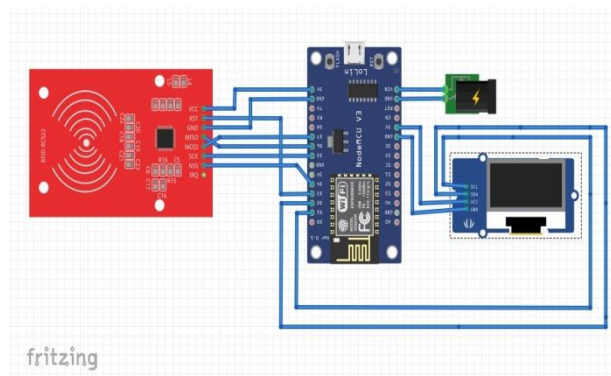


Fig 4: Schematic design

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. Also, False Rejection Rate (FRR) can be used to monitor the probability of correct detection it is the percentage of identification instances in which the correct instance is incorrectly rejected.

$$FAR = \frac{\text{Number of false acceptance}}{\text{s out of total identification attempts}}$$

$$FRR = \frac{\text{Number of false rejection}}{\text{out of total identification attempts}}$$

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 scenario 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

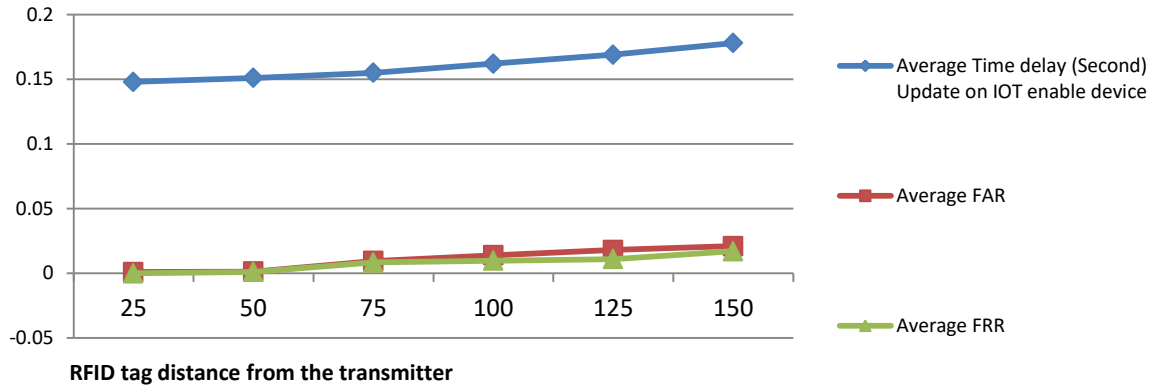


Fig 5: FAR, FRR and Time delay observed on the variable distance of tag from the transmitter

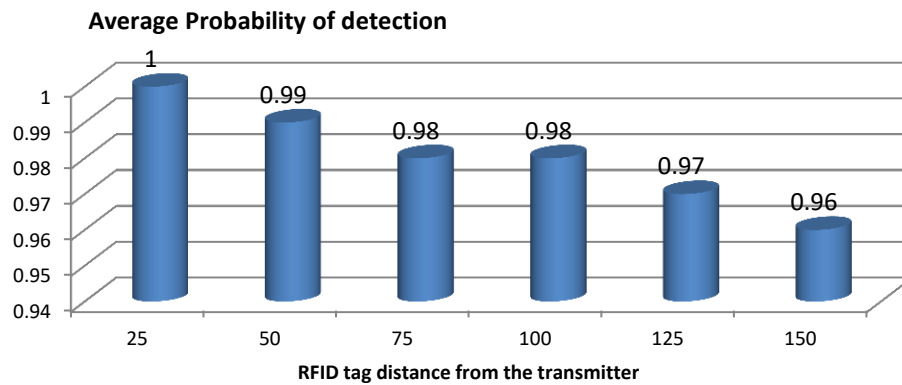


Fig 6: Probability of detection observed on the variable distance of tag from the transmitter

Figure 5 and figure 6 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	FAR	FRR	PoD
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
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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 Thingspeak 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 8 shows 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.

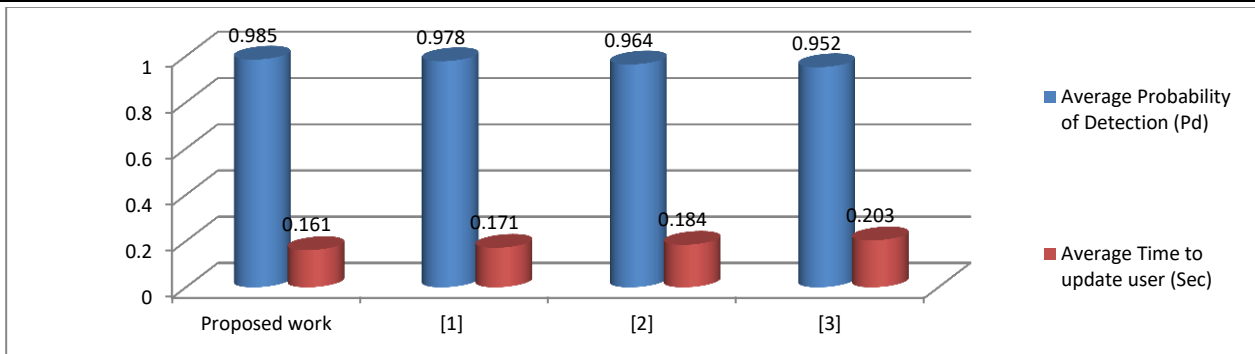


Fig 8: Comparative results analysis

V. CONCLUSION

IoT based Public Bus worldwide situating work is a genuine procedure that can discover and follow the vehicles. The achievement of the worldwide situating work lies in giving a straightforward interface utilizing an Android application to the customer. This work fills in as a model that can imagine the situation with Public vehicle ships distantly. The arranged work can be passed on in every natural and metropolitan domains which gives a straightforward environment to the transport. This work can be loosened up in evaluating the deduced appearance period of the Bus with a recognized deferment. Security for this work can be established by setting up a video surveillance environment. Besides, sensors can be sent in the transmitter's territory to screen the traffic conditions in the different Bus courses.

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