iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 6 **Issue:** IV **Month of publication:** April 2018

DOI: http://doi.org/10.22214/ijraset.2018.4789

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue IV, April 2018- Available at www.ijraset.com

Smart Bus Management System using IOT

Mr. Jayakumar. S (AP/[SI.G])[1], Raviteja.S[2], Yadhu Krishna.P.B[3], Sushovan Bhattacharya[4], Adipta Biswas[5]
CSE Department, SRM Institute of Science and Technology, Ramapuram, Chennai-600089, India.

Abstract: The project has its use in smart bus management system. Users can scan QR reader instead of paper tickets. After profile registration, the user has to attach the bank details for amount transactions. Whenever a person decides to go on a bus, they have to select from and to location. By doing so, it will generate amount details for per head. After that, the users have to enter the number of tickets needed. Then in order to generate the actual ticket, the users have to scan the QR code. The money will be transferred from the bank and will be stored in the wallet. The user can also get SMS alert for ticket payment as a proof. Then from the admin side, they can easily calculate the amount details, the number of passengers entering into and departing from the bus using the web application and also by the sensors placed on the footboard of the bus. Then they can calculate per day amount for bus ticket information and also can generate per day 3 hours report for checking the crowd condition.

I. INTRODUCTION

BUSES are the most widely used public transportation in many cities today. Passengers face a major problem due to the lack of proper bus management by the authorities. They still depend on the method of manual ticket generation and management. Due to rising population in our country, the manual method of ticket generation has become a complicated process as they lack the awareness in solutions available with the latest technology. Passengers as well as conductor faces a tough time during the peak hours where ticket acquisition becomes the major issue. In order to overcome these difficulties faced by the commuters a new bus management system using IoT has been developed that allow efficient traveling during peak and normal hours. This management system includes technology such as IR sensors for passenger count, QR code for generating ticket using an application and database management that controls and stores the overall data that is being generated.

II. EXISTING SYSTEM

In the usual process, every bus is controlled by a conductor. The conductor collects money from each passenger in order to issue ticket accordingly. Initially, printed papers or tokens are used as tickets. Nowadays, handheld machines are used to print tickets. This system has many disadvantages. The passenger needs to keep his ticket along with him till the end of travel, the conductor should ensure that everyone has got the ticket, the time taken for ticketing is comparatively more and more amount of paper is needed to print the Ticket. Nowadays conductors are trained to operate the handheld ticketing machine. For example, if a passenger wishes to travel in the bus, they have to carry money with them. Then conductor will collect the money and will generate the ticket. This has to repeat for all passengers. This will take more time and waste of human resource as well as energy. Even handheld ticketing machine is comparatively slow and needs to be trained personnel to operate it. In the existing system, the passengers used to have an RFID tag and the conductor used to have an RFID Reader, read the RFID tag. But the destination should be entered manually, so that amount will be debited automatically from the tag. The major drawback of this existing system is that such arrangement consumes more time in case of accessing of a tag by every individual and also the hardware debugging will be a major problem. So to overcome that, implementation of ticketing system without RFID usage is developed in this proposal with an addition of a database that stores data of every journey made by passengers.

III. LITERATURE SURVEY

A. *Z. Wei, Y. Song, H. Liu, Y. Sheng, X. Wang, "The research and implementation of GPS intelligent transmission strategy based on on-board Android smartphones", Computer Science and Network Technology (ICCSNT) 2013 3rd International Conference on, pp. 1230-1233, 2013.*

Smartphones have been widely integrated with GPS receiver, which may provide accurate location information of vehicles without cost increase. Traditionally, LBS applications obtain vehicle locations then using the Hypertext Transfer Protocol (HTTP) protocol uploaded to central servers with a fixed frequency. In this paper, we exploit an intelligent strategy of GPS sensing and transmitting. Explicitly, we implemented a platform to collect real-time GPS data from vehicles. A common Android Smartphone serves as a GPS sensor in a vehicle. Client Application software is designed to generate GPS location updates with adaptive timestamps once it

executed. In the final comparison, MQTT push technology is introduced into GPS transmission in order to effectively reduce mobile traffic.

B. Y. Chen, T. Kunz, "Performance evaluation of IoT protocols under a constrained wireless access network", 2016 International Conference on Selected Topics in Mobile & Wireless Networking (MoWNeT), pp. 1-7, 2016.

One of the challenges faced by today's Internet of Things (IoT) is to efficiently support machine-to-machine communication, given that the remote sensors and the gateway devices are connected through low bandwidth, unreliable, or intermittent wireless communication links. In this paper, we quantitatively compare the performance of IoT protocols, namely MQTT (Message Queuing Telemetry Transport), CoAP (Constrained Application Protocol), DDS (Data Distribution Service) and a custom UDP-based protocol in a medical setting. The performance of the protocols was evaluated using a network emulator, allowing us to emulate a low bandwidth, high system latency, and high packet loss wireless access network. This paper reports the observed performance of the protocols and arrives at the conclusion that although DDS results in higher bandwidth usage than MQTT, its superior performance with regard to data latency and reliability makes it an attractive choice for medical IoT applications and beyond.

C. K. Tanaka, K. Naito, "Demo: Implementation of unconscious bus location sensing system with smartphone devices and beacon devices", 2016 13th IEEE Annual Consumer Communications & Networking Conference (CCNC), pp. 280-281, 2016.

This paper demonstrates a new unconscious sensing system for bus location. Our system is a new type of application based on participatory sensing systems. However, it can perform sensing operation without users' operation. Therefore, we can employ the mechanism to realize practical application such as bus location systems. Our sensing system consists of a beacon device, a smartphone application, and a cloud service. The beacon device is installed on a bus to activate the smartphone application. The smartphone application can upload a bus location to the cloud service when the smartphone application detects the beacon device. The cloud service manages the bus location and distributes them for smartphone applications. The demonstration shows a prototype system for a bus location system based on the new participatory sensing mechanism.

D. J. Gong, M. Liu, S. Zhang, "Hybrid dynamic prediction model of bus arrival time based on weighted of historical and real-time GPS data", 2013 25th Chinese Control and Decision Conference (CCDC), pp. 972-976, 2013.

Advanced traveler information systems (ATIS) are one component of intelligent transportation systems (ITS), and a major component of ATIS is travel time information. Global positioning system-based automatic vehicle location (AVL) systems have been adopted by many transit agencies for tracking their vehicles and predicting travel time in real time. It is a very important subject to improve the precision and reliability of the prediction model which can attract additional ridership, reduce passengers' anxieties and waiting times at bus stop, and increase their satisfaction. Furthermore, it can promote the development of city public transportation. This paper presents an improved approach to predict the public bus arrival time based on historical and real-time GPS data. After analyzing the components of bus arrival time systematically, the bus arrival time and dwell time at previous stops are chosen as the main input variables of the prediction model. At first, the algorithm of data interpolation and processing is designed to get the real-time GPS data as the input variables of the prediction models. Secondly, the statistical model is obtained based on the historical data of average running time of each link and dwelling time of each stop at given time-of-day and day-of-week, respectively. Thirdly, a hybrid dynamic prediction model is proposed to predict the bus arrival time. Finally, Actual GPS data from bus route 244 located in Shenyang, CHINA are used as a test bed. The index of Mean Absolute Percentage Error (MAPE) is used to evaluate the three models. The results show that the improved model outperforms the historical data based model in terms of prediction accuracy.

E. L. Singla, P. Bhatia, "GPS based bus tracking system", Computer Communication and Control (IC4) 2015 International Conference on, pp. 1-6, 2015.

In this fast life, everyone is in hurry to reach their destinations. In this case, waiting for the buses is not reliable. People who rely on the public transport their major concern is to know the real-time location of the bus for which they are waiting for and the time it will take to reach their bus stop. This information helps people in making better traveling decisions. This paper gives the major challenges in the public transport system and discusses various approaches to intelligently manage it. A current position of the bus is acquired by integrating GPS device on the bus and coordinates of the bus are sent by either GPRS service provided by GSM networks or SMS or RFID. GPS device is enabled on the tracking device and this information is sent to a centralized control unit or directly at the bus stops using RF receivers. This system is further integrated with the historical average speeds of each segment.

This is done to improve the accuracy by including the factors like a volume of traffic, crossings in each segment, day and time of day. People can track information using LEDs at bus stops, SMS, web application or Android application. GPS coordinates of the bus when sent to the centralized server where various arrival time estimation algorithms are applied using historical speed patterns.

F. *Foisal Mahedi Hasan et al., "RFID-based Ticketing for Public Transport System: Perspective Megacity Dhaka", 3rd IEEE International Conference on Computer Science and Information Technology (ICCSIT), vol. 6, pp. 459-462, 2010.*

The paper-based public transport ticketing system, prevailing in the mega city Dhaka (Bangladesh), introduces severe malfunction in the system, a malicious argument among public, corruption and most of all traffic jam. This paper actually suggests a much more public friendly, automated system of ticketing as well as the credit transaction with the use of RFID based tickets. The total system mainly acts to bring out the consistency among various bus agencies that will conclude in uniform access of passengers in daily rides through an automated server being updated every single time the passengers travel by carrying the RFID based tickets.

G. *R. Hamon, P. Borgnat, P. Flandrin, C. Robardet, "Networks as signals with an application to bike sharing system" in Global SIP 2013, Austin, Texas, USA:, Dec. 2013.*

Dynamic graphs are commonly used for describing networks with a time evolution. A method has been proposed to transform these graphs into a collection of signals indexed by vertices. This approach is here further explored in a number of different directions. First, the importance of a good indexing of a graph is stressed, and a solution is proposed using a node labeling algorithm which follows the structure of the graph. Second, a spectral analysis of identified signals is performed to compute features linked to graph properties such as regularity or structure in communities. Finally, these features can be tracked over time to evidence the structure evolution of the graph. As a case study, the approach is applied to a dynamic graph based on a dataset of trips made using the bike sharing system Vlov in use in Lyon, France. This is shown to offer specific insights on behaviors of bike users over time in two districts of the city.

H. *B. Danila, Y. Yu, J. K. Marsh, K. Bassler, "Optimal transport on complex nets", Phys. Rev. E, vol. 74, pp. 046106–6, October 2006.*

We present a heuristic algorithm for the optimization of transport on complex networks. Previously proposed network transport optimization algorithms aim at avoiding or reducing link overload. Our algorithm balances traffic on a network by minimizing the maximum node betweenness with as little path lengthening as possible, thus being useful in cases when networks are jamming due to node congestion. By using the resulting routing, a network can sustain significantly higher traffic without jamming than in the case of shortest path routing.

I. *R. Hua-Ling, "Origin-Destination Demands Estimation in Congested Dynamic Transit Networks", International Conference on Management Science & Engineering (14th), 2007.*

This paper investigates the problem of estimation of time-dependent passenger origin-destination (OD) matrices in congested transit networks where real-time updated passenger counts and prior OD matrices are available. A bilevel programming model is proposed for the dynamic estimation of passenger OD matrix. The upper level minimizes the sum of error measurements in dynamic passenger counts and time-dependent OD matrices, and the lower level is a new schedule-based dynamic transit assignment model that can determine simultaneously the dynamic average travel costs and route choices of passengers in congested transit networks. The lower-level problem can be formulated as a variational inequality problem. A heuristic solution algorithm is adapted for solving the proposed bilevel programming model. Finally, a numerical example is used to illustrate the applications of the proposed model and solution algorithm.

J. *P. Verma, J.S.Bhatia, "Design and Development of GPS-GSM based Tracking System with Google Map based Monitoring", International Journal of Computer Science, Engineering and Applications (IJCSEA), vol. 3, no. 3, pp. 33-40, 2013.*

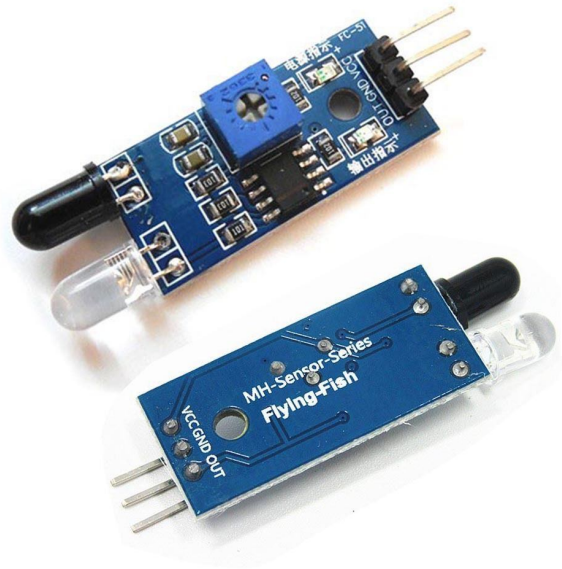
GPS is one of the technologies that are used in a huge number of applications today. One of the applications is tracking your vehicle and keeps regular monitoring on them. This tracking system can inform you the location and route traveled by a vehicle, and that information can be observed from any other remote location. It also includes the web application that provides you the exact location of a target. This system enables us to track the target in any weather conditions. This system uses GPS and GSM technologies. The paper includes the hardware part which comprises of GPS, GSM, Atmega microcontroller MAX 232, 16x2 LCD

and software part is used for interfacing all the required modules and a web application are also developed at the client side. The main objective is to design a system that can be easily installed and to provide the platform for further enhancement.

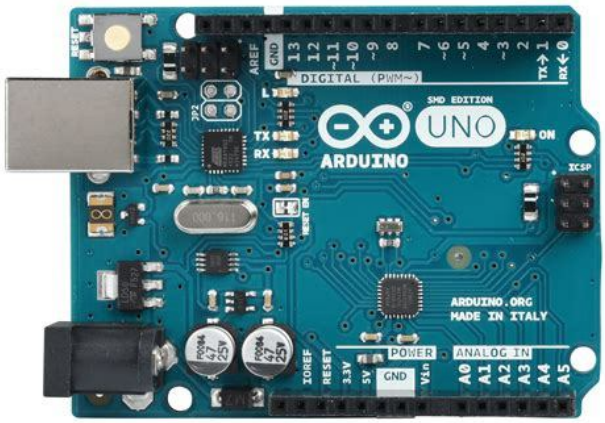
IV. PROPOSED SYSTEM

Buses are widely used public transportation in many cities today. With the "Smart Bus Management System Using IOT", users can scan the QR code instead of the paper tickets. The passengers are provided with an android app where they register their details by providing their mobile number, email id, user-name, and password. After registration, the users can log in with the id and password provided while registration. The next step will be adding the money to the wallet and it can be done by usual bank transaction by entering bank details manually. In the next process, the user has to enter the from and to address. By doing this the app will automatically generate the number of buses running on that particular route along with the amount details per head. Then comes the number of passengers to be traveled during that particular journey, enter the details and select next. Now it will generate the total amount that will be deducted from our wallet but before the amount will be deducted the passengers will have to scan the QR code that will be inside the bus with the conductor doing so the passengers will be notified with the ticket through the SMS to the number that we have provided during the registration. From the admin side, they will be notified of the number of passengers entering and deterring the bus with the help of sensors that will be placed at the footboard of the bus. IR sensors are connected to an arduino board that makes the passenger count updated in database.This updation of passenger count implies the rush in that area that helps the authorities to add or cut down the services in that particular area. By implementing this system the usage of liquid cash can be reduced and efficient ticketing can be implemented.

1) *About Android Application used:* In order to travel in smart bus passengers must have android application named "Smart Bus" that is available at free of cost without ads.It is completely developed in java with size less than 1 megabyte. Eclipse is the software that supports and runs the java codes and saves the code in .apk format.
2) *About The Hardware:* IR sensors and arduino board are the hardwares used here. The IR sensor is being placed on the footboard of the bus and it will be connected with the arduino board that transmits the data to the database.
3) *IR sensor:* IR Sensors works with the help of a specific light sensor to detect a select light wavelength in the Infra Red (IR) spectrum. LED which produces light at the same wavelength as what the sensor is looking for, it can look at the intensity of the received light. When an object is close to the sensor, the light from the LED bounces off the object and into the light sensor. This results in a large jump in the intensity, which are already known can be detected using a threshold.

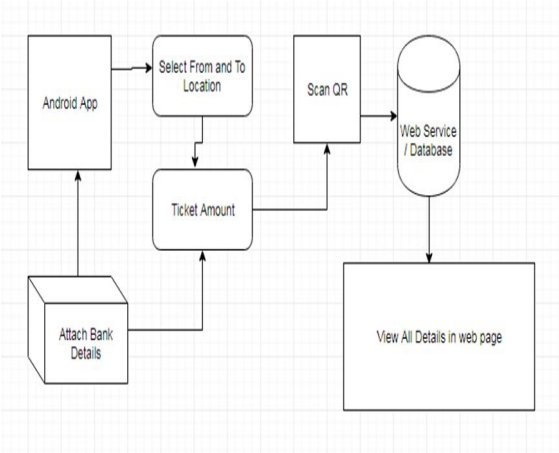


4) *About Arduino:* Arduino is an open source platform that is used for building electronics projects. Arduino consists of a physical programmable circuit board and a piece of software or IDE that runs on computer, used to generate and upload computer code to the physical board.



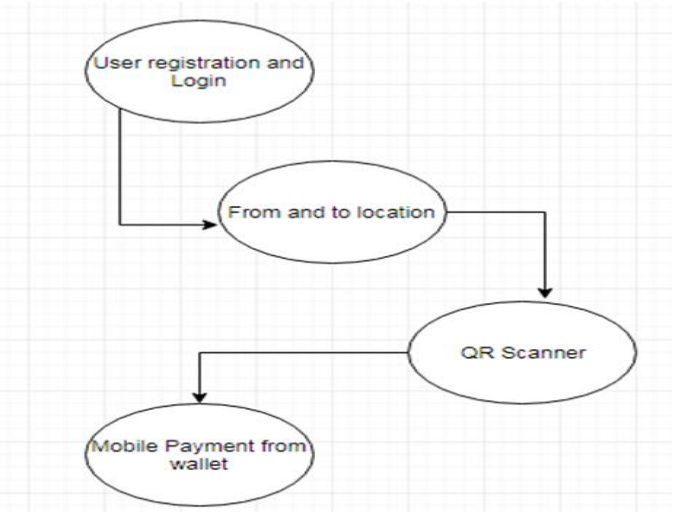
5) *About Database:* As many people use bus as their common transportation, huge data is generated that is stored in database. This can be viewed and analysed by authorities for making the transportation more efficient. Only authenticated persons have access to this database.

A. System Architecture

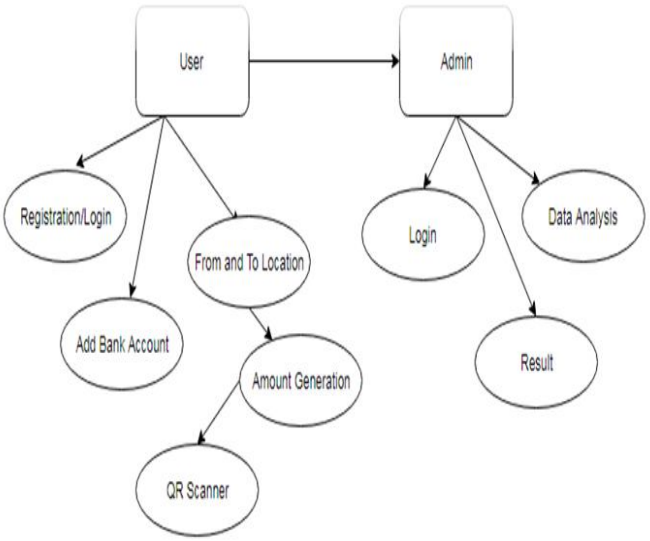


B. Data Flow

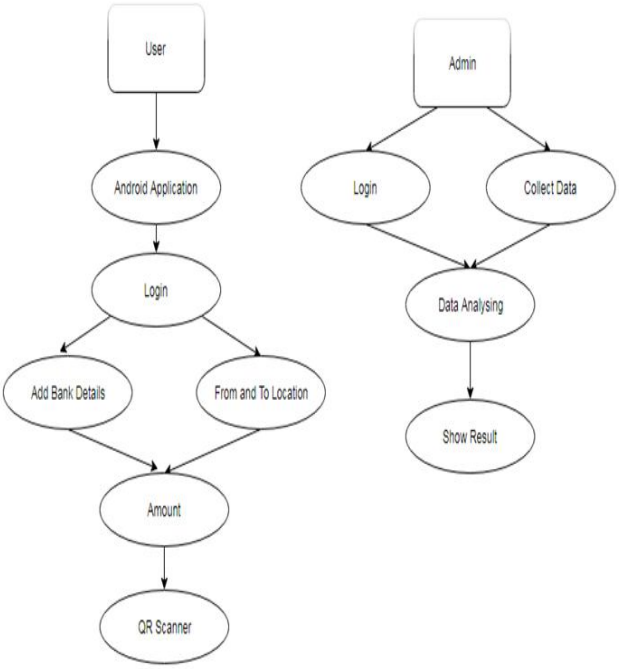
1) Level 0



2) Level 1



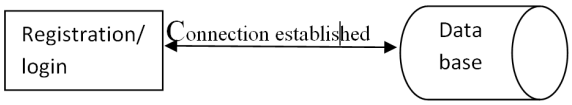
3) Level 2



V. MODULES

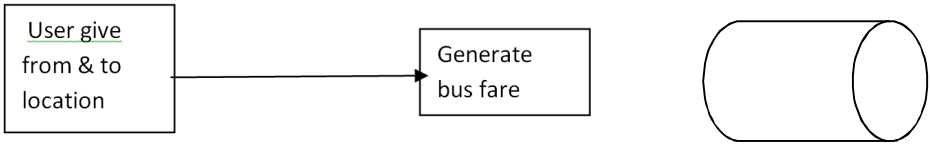
A. User registration

The users will be provided with an android application, where they have to register themselves by using their mail id and mobile number. A connection will be established as soon as the users register with the administration. Then they have to log in to their account in order to book the tickets.



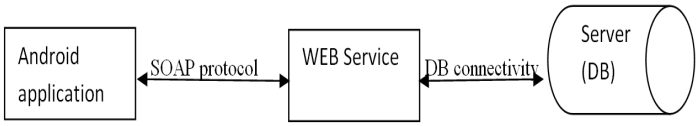
B. Location Selection

A user has to select the from and to location manually, by doing so it will generate fare details based on that location. After that, the passenger count has to be mentioned in the column provided in order to get total amount. In order to generate the ticket, the user has to use QR code that will be provided inside the bus.



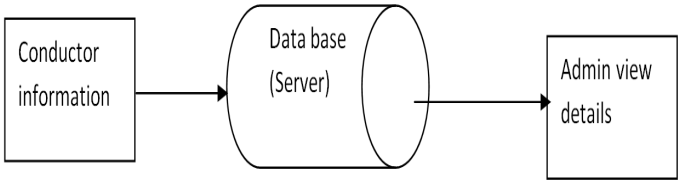
C. Web Service

Using SVM algorithm, a 3 hours report for checking the crowd condition is being introduced here that makes the public transportation even more efficiency. Then by analyzing the data, the management will easily be able to determine whether an additional bus has to be made to run on the particular route for a particular time or to cut the additional service of the bus.



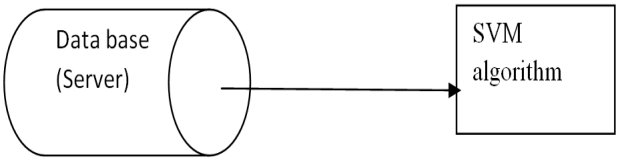
D. Database

The admin gets all the necessary details such as the username, the number of passengers entering into and departing from the bus, the total amount fare collected from a particular bus for the particular route. All these data will be stored automatically in the database as soon as the ticket is being generated to the passengers.



E. Classification

Using SVM algorithm, a 3 hours report for checking the crowd condition is being introduced here that makes the public transportation even more efficiency. Then by analyzing the data, the management will easily be able to determine whether an additional bus has to be made to run on the particular route for a particular time or to cut the additional service of the bus.



VI. WORKING

A. *Hardware*

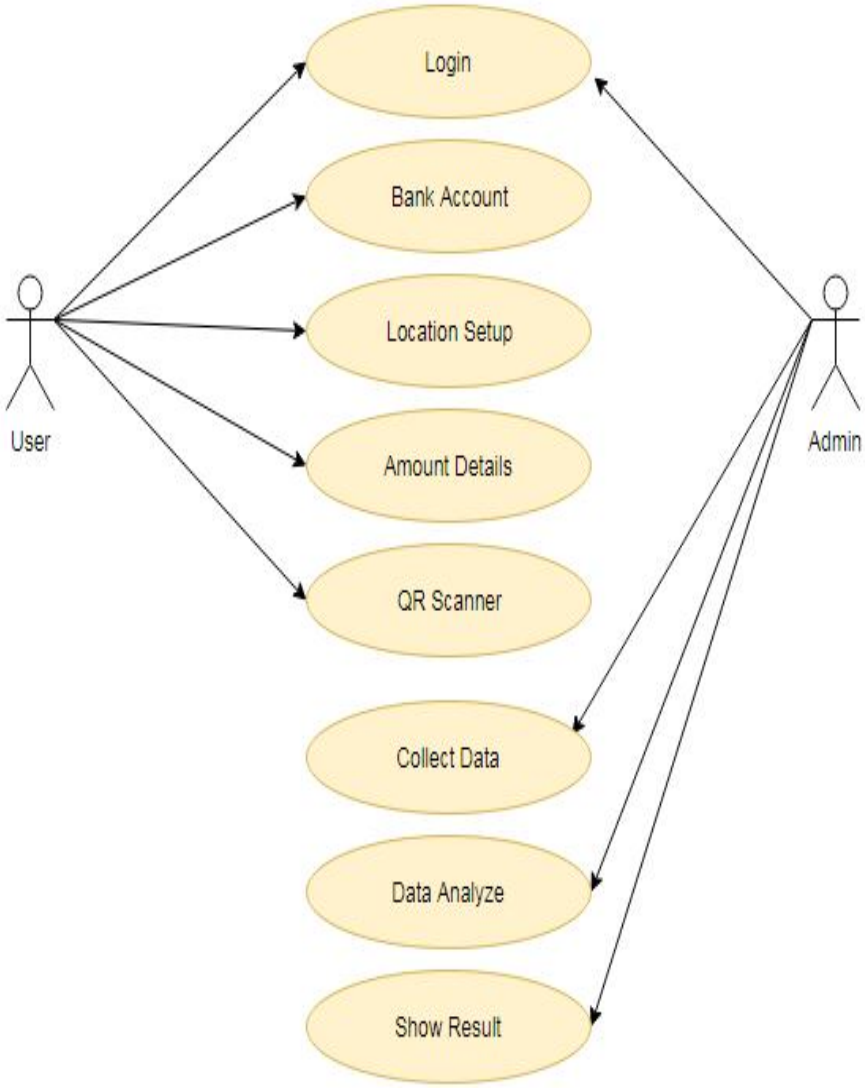
RAM – Min 4GB
Android Mobile
Arduino/NodeMCU
IR Sensor – 4
Wi-Fi Module

B. *Software*

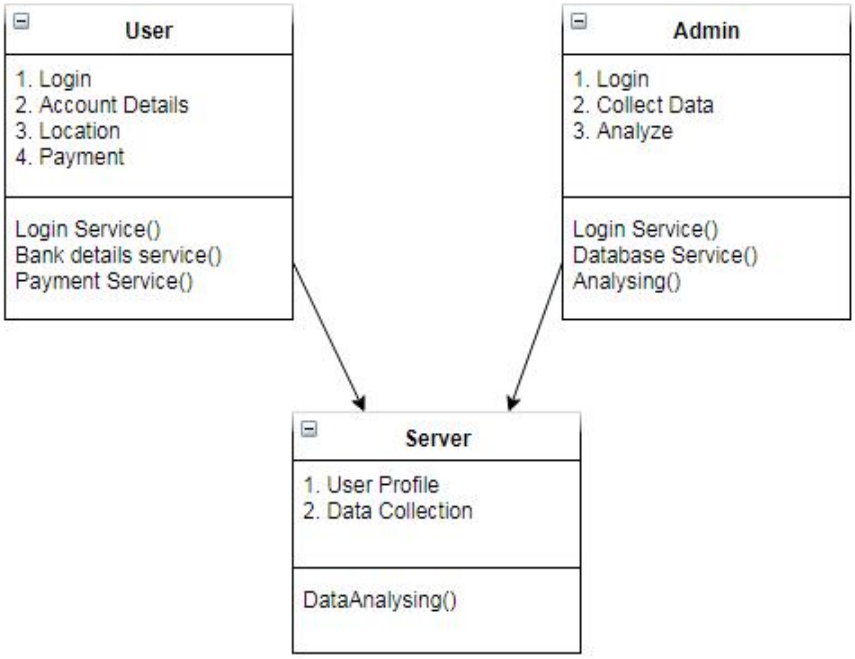
JDK
Android Eclipse (ADT-Bundle)
Netbeans IDE
Mysql and SQLyog

VII. UML DIAGRAM

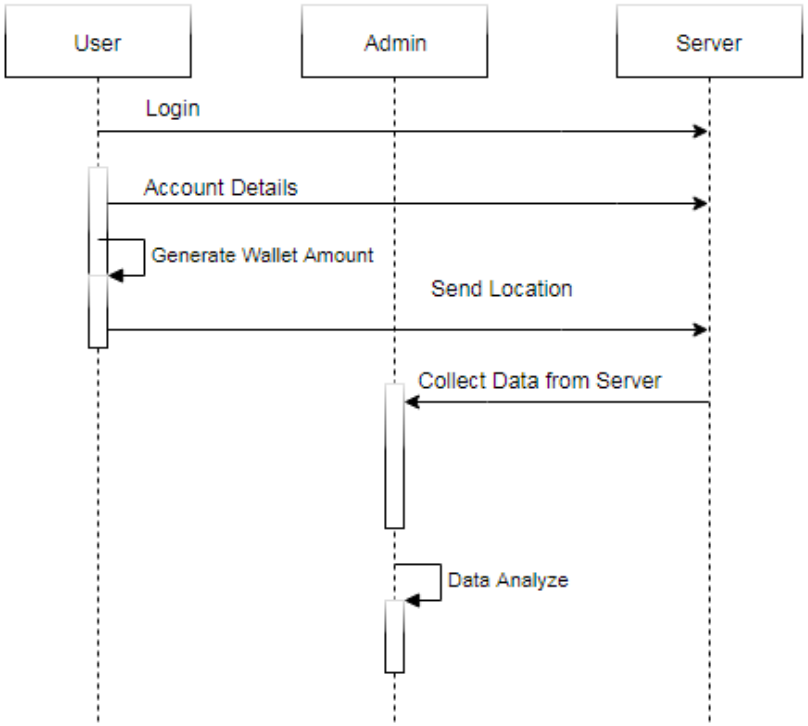
A. *Use Case Diagram*



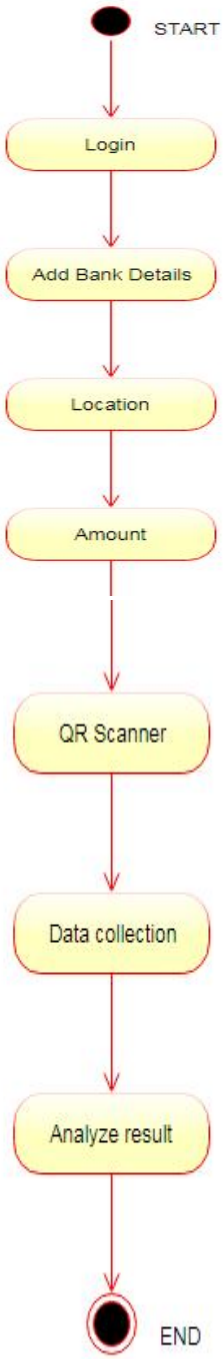
B. Class Diagram



C. Sequence Diagram



D. Activity Diagram



VIII. CONCLUSION

Thus by implementing this project, a greater complexity of the problems faced by common people can be reduced. As it uses no usage of paper, even the deforestation can be prevented and thus be saving our mother nature.

IX. ACKNOWLEDGMENT

The authors would like to thank the anonymous reviewers for their valuable comments.

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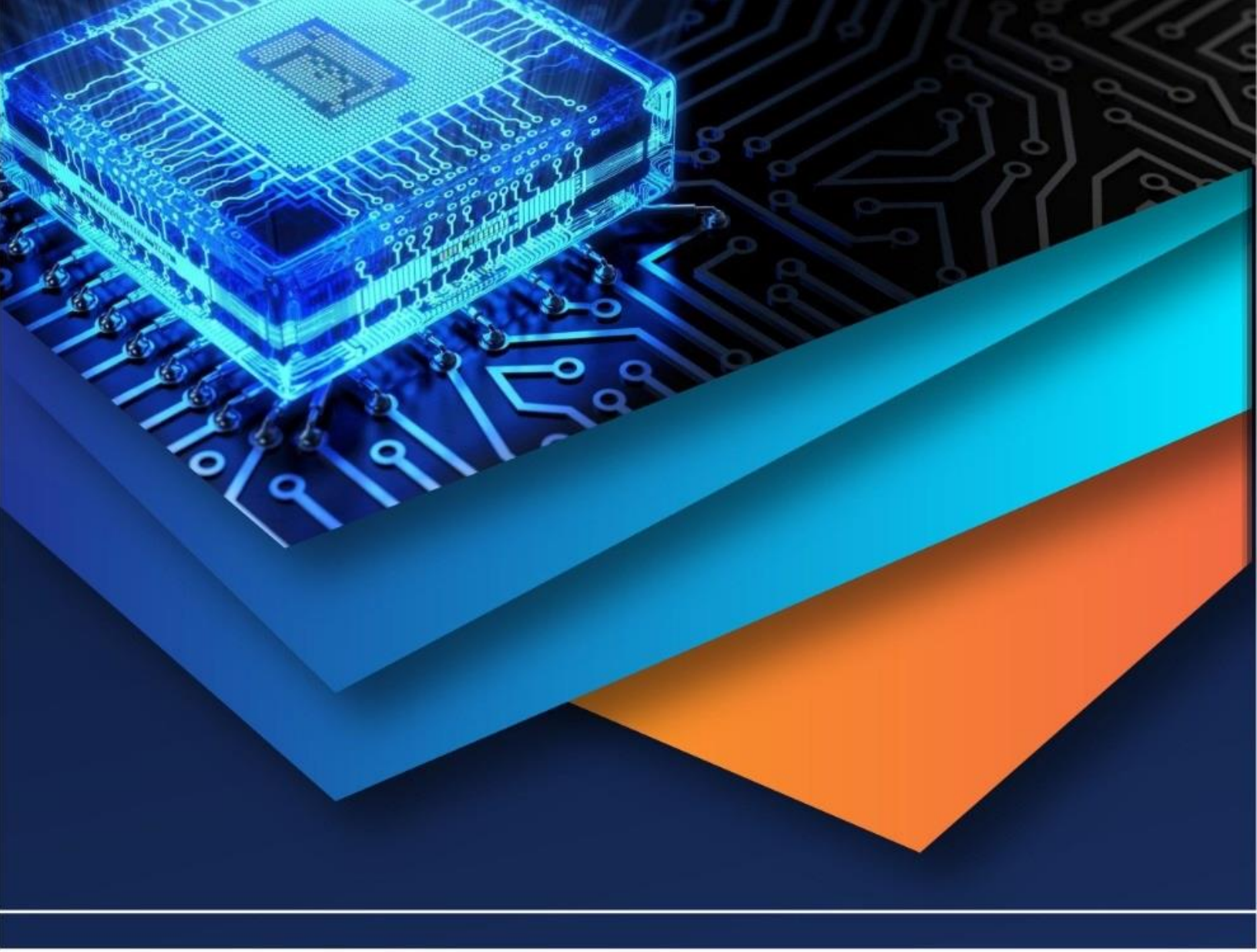

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