

Public Bicycle Sharing System for Smart City Application

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Abstract — Transportation is a basic need of society. There were different media of transportation; the bicycle is the cheapest, pollution less, easily available and affordable source of transportation. In this system, people can borrow the bicycle from the nearer base station, take a ride and return to any stations in the city. This approach may be used as a short-distance trip supplement for private vehicles as well as regular public transportation. The aim of this proposed system is to provide efficient urban mobility and public transport. This system is developed for an area five km in diameter. This system includes registration of the user at base station through RFID card, the location of the cycle by GPS, emergency calling through GSM.

Keywords — Digital India, GPS, GSM, Public bicycle sharing system, RFID

I. INTRODUCTION

India has launched “Digital India” program. Under this different type of activities is conducted by the government of India. The Pune smart city is one of them. Transportation is important issues identified by Pune’s citizens. Because of Motorized traffic impact on human health and it lead to air pollution, accidents, congestion and more time wasted stuck in traffic. Widening roads flyovers are temporary solutions. Public Bicycle Sharing is a term for the use of the bicycle on a need basis for shorts trips without having to own one. Users can check out a cycle station at any time of the day, use it and return it to any cycle station located nearby their destination. Various stations will be placed near popular destinations bus stop, trains stations, market areas. and other than these areas where trip or journeys on cycle can be made easily. Depending on the city size, public bicycle sharing system may be several hundred to a few hundred bicycle stations across the city.

In Europe, Bicycle share system began in 1965. Now a day, more than 700 cities around the world have their bicycle sharing system program and more programs are starting every year. The largest systems are implemented in cities like Hangzhou and Shanghai of china having 90 thousand and 60 thousand bicycle respectively. Highly successful promotion bicycling as a feasible and valued transport option in The Velib, Washington D.C and. London.

The paper is organized as: Section II explains the detailed literature of existing bicycle sharing systems; section III explains the working of proposed system, Hardware and software implementation has been presented in section IV, results are explain in section V and finally the paper has been concluded in Section VI.

II. LITERATURE SURVEY

In last decade, different kind of system has been proposed by different countries. Some of the systems are reviewed below.

Yifan Zhao, Gang Pan, Chao Teng, Longbiao Chen, Shijian Li [1] proposed a system based on Smartphone based IoT that is Public Bicycle Sharing System plan (PBS) for Healthy Life and named it as "Green Bicycling". This system has aim of improvement in the cyclist experience and to encourage user to use the system for daily purpose. In this system, it allows the cyclist to get information about bicycle station spots along with the forecast state. To get this goal completed, it improved network prediction model of propagation is proposed. Along with these, in this system, there is provision for the system to measure how much calories burnt during the trip. The system application is developed in the Windows OS based Phone.

Moyin Li, Jiawei Zhang, Xiao Pan, Philip S. Yu University of Illinois of Chicago, IL, United State of America [2] proposed "Bicycle-Sharing System Analysis and Trip Prediction". In this system, people can get and give back bikes at any stations in the service region very easily. The main purpose of Bicycle sharing system module is green and low carbon efficient system development. Hierarchical prediction model in this system predict the number of bikes that will be rent from / returned in the future

Kai-Way Chun, Zih- Hong Chain, Chi-chia sun proposed an IOT Solution for public bicycle [3]. The aim of this system is effectively reduced bicycle theft rate trough localization method. The main proposed IOT introduce lithium battery charger to collect energy from the bicycle. It working is based on the remote operator to relocate spare's bike to reduce bicycle station congestion status. This is the Theft control mechanism. The advantage of this system is reduction in noise and air pollution.

Ying Zhangl, Zhengdong Huang is proposing the "Performance Evaluation of Bike Sharing System" [4]. IITC faculty, University of Twente, Enscheda, Netherlands, School of Urban Design, Wuhan University, Wuhan, China and give to name "Intelligent Transportation Systems." This sharing of bike system is a "manual and self-service" system. A "public bike card" is needed to rent and return bikes and this card can be got freely by using your ID card or other valid documents.

But Due to lack of accurate data on cost and benefit of this bike sharing system, the people could rent bikes free of cost by using a "Public card."

Frauke Behrendt, Chris Kieferis. proposing the "Smart e-bike monitoring system [5]. Department of Informatics, University of Sussex, Brighton BN1 9QJ, UK, School of Arts, Design and Media, University of Brighton, Brighton BN2 4GJ, UK. The SEMS is a stable platform for analyzing, collecting and sharing data about a fleet of e-bikes. The design with development and implementation of the system contribute to understanding e-bikes as a distinct mode of transport and to conceptualizing a fleet of e-bikes as a distributed network, or an IoT. and with large numbers of e-bikes in use simultaneously. The system works autonomously, resulting in high-quality and real-time data about each bike's location and the level of assistance chosen by trial participants. It is always on and requires no interference from researchers that might influence normal participant behavior.

Linlin, Li, Huiyuan Jiang is proposed "The Research of the Development Transportation Countermeasures on the Medium" [6]. This paper is a case of Yicheng in Hubei province. The quantitative calculation is based on the field research and Establish quantitative calculation with the MNL model. The features of the structure on the small and medium cities' transport capacity are the conclusion of the research.

We can also be proposed an appropriately advance city public transport system for the medium and small cities to alleviate the traffic problems. The paper aimed at providing new ideas of transport development for small and medium urban in China.

Cheng-Chung Li is proposed "An Improved Model for Efficiently Transport You Bike". The main contribution of this paper is to define the You Bike transport problem, which can precisely simulate the practical case and propose an algorithm to address this problem in a uniform space. Moreover, based on the discussions above, this new problem has strong connection to the k-server, k-taxi, and k-truck problem, which are classical problems in the field of the online algorithm. The corresponding results in this paper can

be viewed as a foundation for theoretical research and provide a theoretical model for researchers with no related backgrounds as reference. In conclusion, we can address the You Bike transport problem in a non-uniform space or refer the historical data to obtain a closer or better result. For other factors, they have significant obstacles to be overcome.

III. PROPOSED SYSTEM

The block diagram of proposed system is shown in fig. 1.

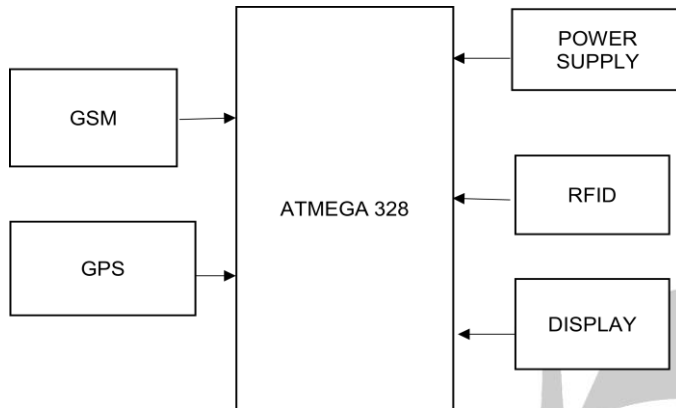


Fig.1. Block diagram of proposed bicycle sharing system

The block diagram contains is at mega 328 controllers, GPS GY-6M NEO UBLOXS, GSM SIM 800, RFID Reader module, power supply, Display (LCD).

This system is used only for authorized user. Therefore, the first step is database of particular user is saved to sever. It contains all the information of user like name, address and payment details, payment mode is based like as prepaid system. Register into the system and get RFID card as an identification card. RFID Reader module used as an authentication purpose Login into the system using RFID card User authentication and generation of timestamp on the server database. Allocate bicycle for particular user. GPRS service is used along with GSM. In case of emergency, there is GPS it locates the exact location of bicycle after reaching to the destination logout through system, Automatic billing from user's account. Theft Protection of bicycle is done through continues monitoring of GPS location of bicycle, this is the main advantages of bicycle sharing system In hardware part whenever user get login that time user get a random code for unlocking the bicycle from stand, after entering this code into module near bicycle, bicycle will unlock and user will

get access to it. At the time of returning the bicycle, the user has to just put bicycle in stand and bicycle will get lock and then user has to swipe his RFID tag again at base station where he wants to left bicycle to logout from system and billing process. The billing process is like as prepaid system. Firstly, User recharges his account and then proceeds to the login system and then borrow bicycle from any base station and leave it into another base whichever you want to leave it.

IV. IMPLEMENTATION

A. Hardware Implementation

A smart ID tag is linked to the Public Bicycle sharing system, for the PBS, a software and IoT based server system and application developed or mandatory form of identification is used for registering a user as an authorized person of the Public Bicycle sharing system; Cycle sharing provides an ideal transportation for short trips and a feeder to other public transport options in new developed cities and town. Bicycle sharing can help reduce pollution such as traffic congestion, noise and improve safety on the route. For users, it is a healthy mode of transport, often quicker than other modes for short distances, without the need to maintain the cycle or worrying about where to park. Along with an emergency switch will be provided to cycle in case of emergency such as cycle puncture or accident etc. This system is developed for five km diameter. This system includes registration of the user at base station through RFID card, location of the cycle by GPS, emergency calling through GSM.

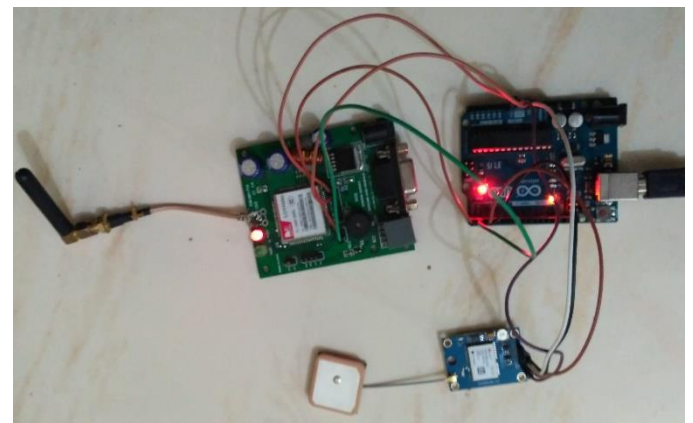


Fig.2. Hardware Design

1. Arduino

Arduino is an open-source platform for embedded and used

for building embedded electronic projects. Both the physical and programmable pin to burn the IC is present in Arduino and run the program using IDE (Integrated Development Environment) that runs on computer, used to write and upload computer code to the physical board.

As a platform Arduino becomes much popular with people just who are new to Embedded, and for good reason. The Arduino does not need separate part of hardware.

2. RFID

RFID Reader Module This is a low frequency (125 KHz) RFID reader which uses for read the tag of given card. It contains unique id which is displayed on display.

3. Global System for Mobile (GSM)

GSM is global system for mobile phone communication and used to provide various services such as SMS. GSMK is modulation technique. It is used in GSM. GSM module uses a protocol for setup and control is based on the AT-Command. AT commands of GSM are extension commands. An example of AT commands is here, +CMGS (Send SMS message), and +CMGR (Read SMS messages) are extended commands. The main objective of this application is whenever accident occurs it will send message of position of vehicle which is accessed using GPS to pre-programmed number.

4. GPS Global Positioning (GPS)

This is a System used in navigation and your position on globe can be located using it, with precision of usually within a few yards or meters. Using satellite GPS collect the coordination point to locate the object. It transmits data via high frequency radio waves back to Earth. GPS uses satellite for mensurate your position. The GPS unit used to calculate the travel time of the signals transmitted from the satellites, and by multiplying it with the speed of light to determine exactly how far the object is from every satellite its sampling.

$$\text{Distance} = \text{velocity (speed)} \times \text{time} \quad (1)$$

GPS used to calculate a latitude and longitude to track movement. [2] GPS receiver uses NMEA -0183 protocol as

defined by the National Marine Electronics Association (NMEA).It gives output in terms of latitude/longitude, north/south, time, date etc.

B. Software Implementation

As for as counsel, here software implementation is main part of this system. It contains web page, server, and database. All the information from the user login, billing process, using the GPS track the location and logout it all the process include on that section.



Fig.3. Web Page

In Software design part, we used Hosting. For hosting the website, pbs.16mb.com is used. All of the web pages are designed using the PHP and HTML. It contains User login details, particular user having own username and password using this login in to the system.

The initial login page is as shown in Fig. 3. It contains users email id and password. Initially, users have to register for services. After registration, user can login and use the service. The webpage after login is shown in Fig. 4.

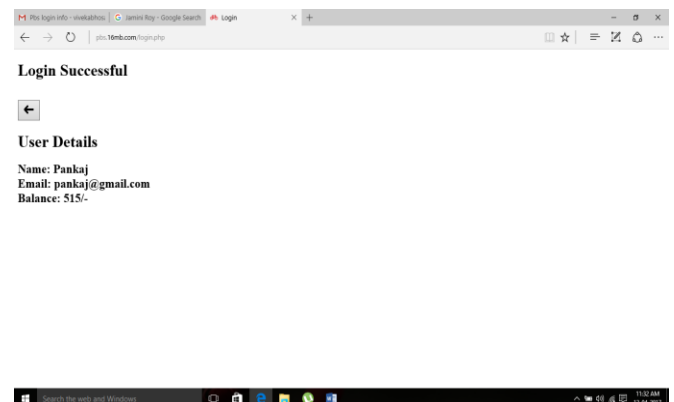


Fig. 4 Login Page

The information of users is as shown in Fig.5.

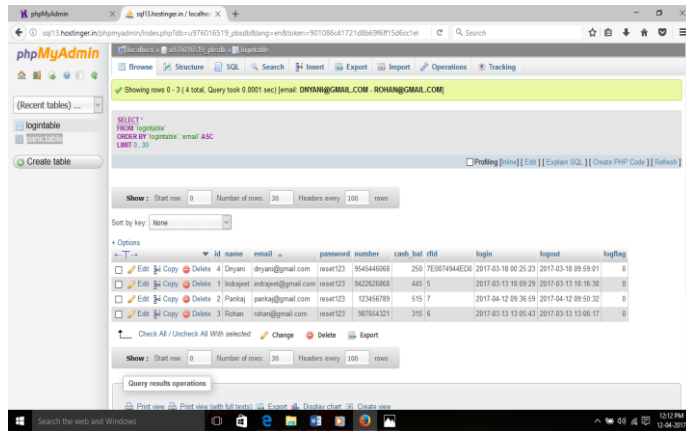


Fig.5 Login Details

For database management, we used the MySQL. For testing the website offline, we used AMMPS application in which PHP my admin panel is available. This also provides database management application offline. As shown in Fig.3 below, the login page for user using website pbs.16mb.com. Where, know about his account details and available balance in his account.

V. RESULTS AND DISCUSSION

In every loop, the core of bicycle-share remains elementary: user can get a bike from one place and give back it to another, making point-to-point, transportation by human powered is feasible. A Public bicycle-sharing system is a service where bicycles are made available for shared use to individual's user on a short term basis. The system allocates bicycle to the users securely through unique RFID thus provides an effective way and only authorized user can be successfully login in to system of bicycle sharing system module. GPS provides real-time location of the bicycle by using GSM through GPRS, and also which serves as theft protection and emergency situation handling.

VI. CONCLUSION

The proposed bicycle sharing system is implemented for small distance travel near about 5 KM where many time we use motorcycle, to avoid this cycle sharing system is designed where we can borrow cycle from any station and return to another one. The system has too many advantages like it will help to control the pollution, improves the health of the user,

improve traffic jam problem etc.

In future, the proposed system can be extended for large area with maximum facilities.

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