

AN IOT ENABLING SMART CITY SERVICES USING PIC 16F877A MICROCONTROLLER

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ABSTRACT

The Internet of Things (IOT) is constantly evolving and is giving unique solutions to everyday problem faced by man. "Smart City" is one such implementation aimed at improving the lifestyle of human beings. We deploy the concept of integrating different case situations in this paper. The review includes solid waste management, rain water harvesting, automated street light and solar energy management. These are selected to improve the quality of our lifestyle and to utilize the natural resources to the benefit of our livelihood.

Index Terms – Internet of Things, Rain water harvesting, Smart City, Solar energy management, Waste management.

I.INTRODUCTION

By 2050, the vast amount of earth population will move to urban areas thus forming vast cities. Such cities require a smart sustainable infrastructure to manage citizens' needs and offer fundamental and more advanced services. The adoption of future internet technologies enhanced by the use of internet protocol (IP) on numerous wireless sensors enables the internet of things paradigm. A SMART CITY is a city well performing in a forward looking way in the following fundamental components (i.e. smart economy, smart mobility, smart environment, smart people, smart living and smart governance) built on the 'smart' combination of endowments and activities of self decisive independent and aware citizens. [1]

Waste management from its inception to its disposal is one of the important challenges for the municipal corporations in all over the world. Dust bins placed across cities set at open places are flooding because of increment in the waste each day and making unhygienic condition for the citizens. We have proposed wireless solid waste management system for smart cities which allows municipal corporations to monitor status of dustbins remotely over web server and keep cities clean very efficiently by optimizing cost and time required for it [2]. Micro-electrical mechanical system is used to evolve sensors over the last past decades. The enormous numbers of sensors are redistributed for sensing as well as accumulating data from its neighborhood through IOT. Industrial township area yields smoke on account of burning of petrol, diesel, coal, fossil fuels, etc. The leading goal of this paper is to evaluate smoke released in the environment. [3] Flooding can cause many damage and victims. The raising of the water level can be predicted and a smart city

as disaster plans. Prevention measures as building dams deepen the river bed or creation of reservoir basins take a lot of effort and cost. Hence we are use IOT to monitor the Water level in the streets and take precaution actions to avoid flood [5]. In today's traffic, the disabled people find it difficult to cross the busy roads. Hence we enable them to cross the roads with ease through RF transmitter. The street lights are being used all day long. In order to conserve energy, the street lights are turned on only in the presence of humans.

II.LITERATURE SURVEY

2.1. IOT based solid waste management system for smart city

Things (inserted gadgets) that are associated with the Internet and occasionally these gadgets can be checked from the web are regularly called as IOT i.e. Internet of Things. In this framework dustbins are arranged at different locations. The Smart clean dustbins are related with the web to get the ongoing status. Two ultrasonic sensors are settled at the highest point of the dustbin to avoid inaccurate level

Measurement and is interfaced with PIC microcontroller. Weight sensor is placed at the base of the dustbin and is additionally interfaced with controller to recognize over weight of the junk filled in the dustbin. Both sensors send the signals to the controller. The RF-transmitter encode the information originating from PIC and send to arduino unit which acts as receiver, it sends the information to RF-collector which is associated with the arduino Ethernet shield. Arduino collects information received by the collector and transfer on website page through the Ethernet shield.

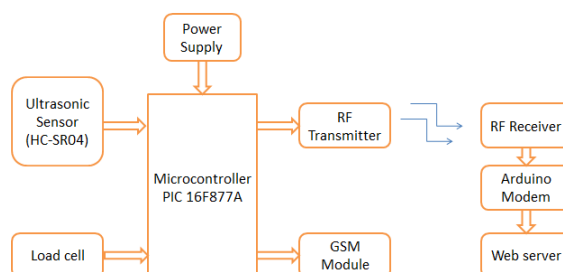


Fig.2.1 Block diagram of the system

Ultrasonic sensor is used to check the level status of dustbin so to determine if it is full or empty, while Load cell senses the weight of the garbage present in the dustbin and to determine if the threshold limit is reached or not. Algorithm has developed which checks filled level continuously and if dustbin is filled to its maximum limit

then there is indication on LCD display at the same time the encoded signal will be transferred by RF transmitter. RF receiver receives the data which is then transferred to the arduino modem connected with the Ethernet shield. Active status of dustbin is shown on web page using connections through Ethernet shield. Simplified flowchart of proposed system is shown in figure (2). Monitoring the webpage will help the garbage

collection department to track for the exact location and amount of the garbage. The garbage vehicles can then unload the garbage from a particular location. The function of GSM module is to send a message to the garbage collection department.

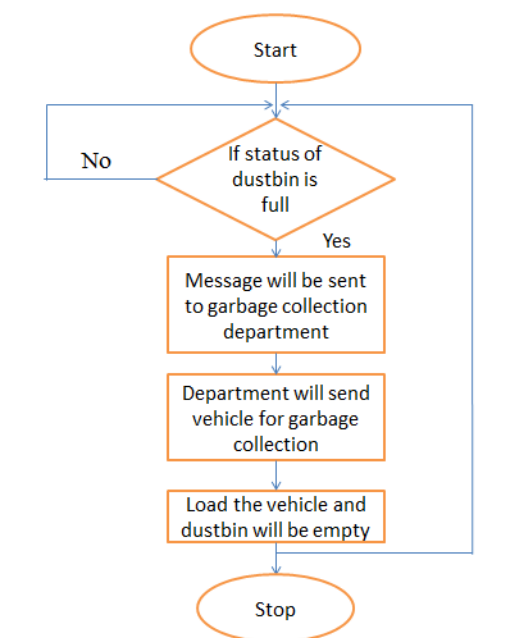


Fig.2.2 System flowchart

2.2. Challenges and opportunities of waste management in IOT enabled smart cities: A survey

In this paper, we focus on the efficient planning of waste collection activities. We also focus on dynamic models on contemporary waste collection with the proliferation of Radio Frequency Identification (RFID), sensors and actuators. We define the concept of waste management context that aims to setup the basis for classifying waste management models. The waste management context incorporates the hardware, tools, data and software that a waste management model adopts to become the basis for realizing a waste management solution. In general, the waste management context could be categorized in three main categories: (i) the physical infrastructure, (ii) the IOT Technology, and (iii) the software analytics. These categories are discrete which means that the relevant context of each model belongs only to one of the aforementioned categories. Our taxonomy is organized concretely (i.e., we pay attention not only to the infrastructure but also to the data and the required software) to cover a range of diverse components and features. Each contextual component and feature is assigned specific values denoting its rational existence in the proposed taxonomy.

2.3. Flood control of the smart city Prague

Flooding can cause a lot of damage and casualties. Prevention measures as building dams deepen the river bed or creation of reservoir basins take a lot of effort and cost. Just before the onset of flooding peoples/animals from affected areas can be evacuated and via removable dams part of the city can be protected. If the dams are

close to the border of the city it protects great parts but as a consequence it limits the riverbed and water flow. The building of dams and evacuation of people takes a lot of effort, cost and time. The question where to place the dams, when and where to evacuate people is the outcome of highly probabilistic calculation depending of the availability of material and transport, man and machines and of cause the time needed to build such dams. At regular times there are huge training sessions organized for rescue workers and other people involved in the execution of disaster plans. The organization of such training sessions is rather complex especially to design disasters as realistic as possible and to get involved people highly motivated.



Fig.2.3 Measurement of water level

2.4. Vehicle Traffic and Flood Monitoring with Reroute System Using Bayesian Networks Analysis

This paper makes the following contributions: (1) develop a sensor network that monitors flood level; (2) generate a predictive rerouting path using Bayesian Network based from real-time image processing and flood level data; and (3) develop a user mobile interface that served as the viewing access in monitoring vehicle traffic, flooded areas and possible reroutes.

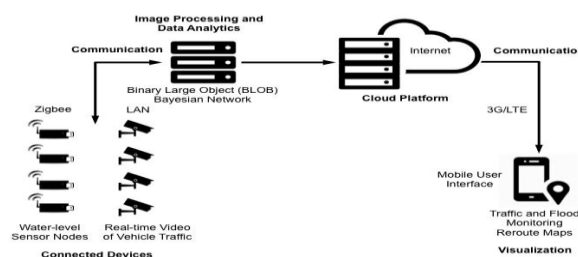


Fig.2.4 Monitoring through IoT

Various solutions in monitoring vehicle road traffic and flood level integrated with IOT to provide alternative paths for the drivers and public commuters. In [4], an Intelligent Transport System (ITS) is developed to serve as a solution to the waste of energy caused by traffic congestion and inefficient traffic. Two major concepts are needed to be considered to make the ITS possible; the availability of real-time accurate traffic flow data and the

interface of the traffic flow forecast model. To address the solution to the problem with the real-time collection of data, WSNs were applied. It would serve as self-organizing networks that have a large number of nodes integrating information collection, data processing, and wireless communication. Through WSNs, it was said that the system can collect information about the real-time behavior of traffic that could support the analyzation of the mathematical algorithm.

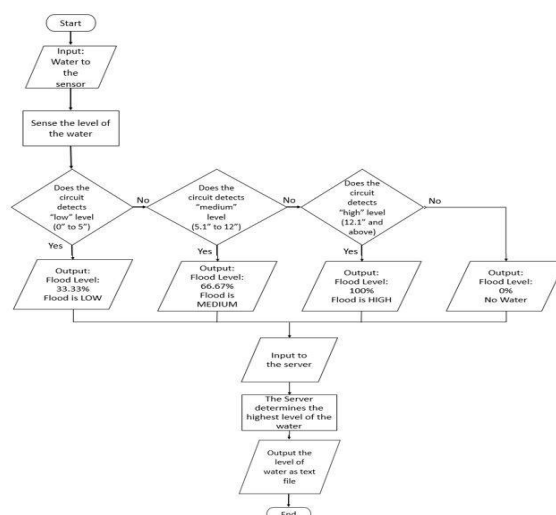


Fig.2.5 System flowchart description

2.5. IOT Based Street Lighting and Traffic Management System

In this modern era where energy is the major concern worldwide, it is our prior responsibility & liability to save energy effectively. With the development of technology, where automation system plays a vital role in daily life experience and also it is being preferred over the traditional manual system today. The main purpose of this project is to invent an intelligent system which can make decisions for luminous control (ON/OFF/DIM) considering the light intensity. Here the day and night mode can be identified by fixing a particular intensity value on LDR sensor and street light can be controlled by IR sensor. The interesting part of this paper is the installation of solar cell for the power supply but in course of circumstances, if the solar cell is unable to do so, a secondary backup DC current will maintain the situation immediately. Another remarkable part of this project is to maintain the traffic signal automatically without any help of traffic police and monitor the entire system through internet by installing surveillance camera. All the components of this project are very simple and cost effective but efficient to make a reliable intelligence system.

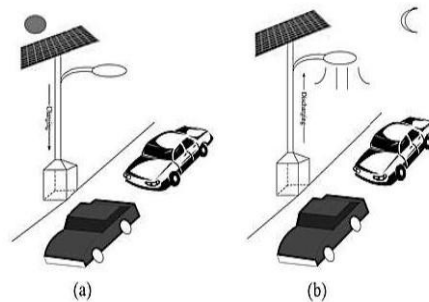


Fig.2.6 Scenarios of Solar lighting system operation



Fig.2.7 Traffic Barrier and Signal management

In day light, the street light remains off and in the night, it can automatically dimming the light for the parts of the streets having no vehicles and goes on the brighten state for these parts once there are some vehicles that are passing by the road. At the time of red signal a barrier will appear automatically which has been done by using servo motor and at the time of green signal, the barrier will disappear. Another signal is added here to avoid accident which is yellow signal. It means if any vehicle is on the barrier zone, it is time for them to stay away immediately and it gives warning to stop immediately those are behind the barrier zone.

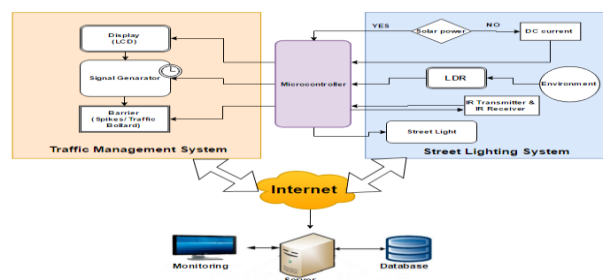


Fig.2.8. Internet of things Schematic showing of the system architecture

III. SYSTEM DESCRIPTION

In the proposed system we enable the tracking of full process involved in a solid waste management from the indication of waste to the disposal of wastes by the department. The ultrasonic sensor in the dustbin counts the number of wastes in the garbage. If the garbage reaches the threshold a message is sent to the garbage man through IOT. The monitoring of waste disposal is done with the help of using an RFID transmitter and reader fitted with the Dustbin and the garbage man indicating the clearance of garbage in a particular area. An RF transmitter is provided to the disabled people so that they can cross the roads by simply pressing a button causing the traffic to glow RED. A smoke sensor is also used to detect the vehicle which creates pollution to an extent and is alerted through IOT to the monitoring section. The vehicle number is detected using RFID attached to the vehicle. An LDR is used for indicating the need for lamp considering the intensity of light. An IR sensor is used to detect the presence of Humans. Based on the Output of IR the street light is turned ON or OFF. A water level sensor is used to detect the rain water level on the surface. If the water level is greater than the threshold the water is sucked with the help of Spray motor. The water thus is used for Rain water harvesting.

Fig.3.1. Block diagram of transmitter

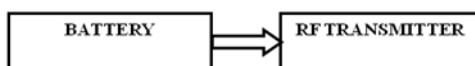


Fig.3.2. Handicap section

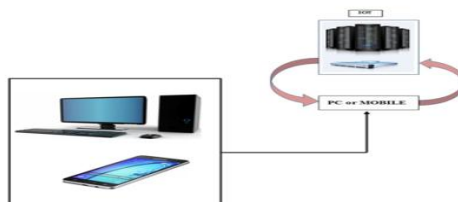


Fig.3.3. Monitoring section

IV.RESULT AND ANALYSIS

4.1. Case 1

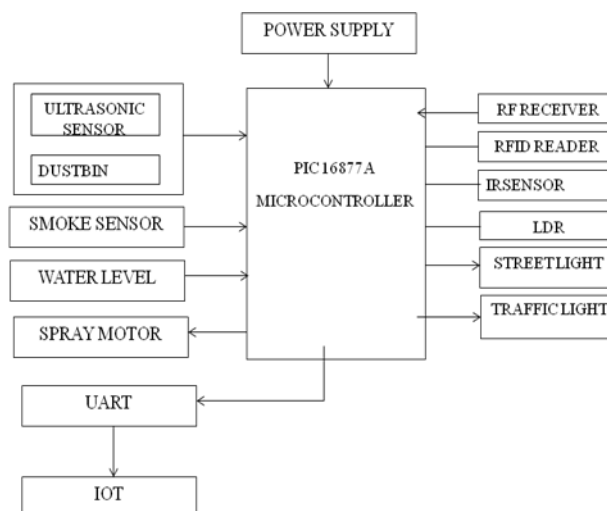
We have performed 10 test runs which completed 2 full cycles of loading and unloading of garbage. The empirical outcomes shown in figure (6) represent the bin filling level values for both ultrasonic sensors placed at top of the bin, weight of waste inside the bin and respective status. Various possible combinations have been tested to assess performance of proposed prototype under different conditions. If the bin is almost empty level shown by both ultrasonic sensors is less than 1 cm for filling level and 0 kg weight by load cell. Gradually, we loaded bin with garbage and recorded readings for the same. At certain point when bin was fully filled no values were displayed by both ultrasonic sensor and load cell this is nothing but overload condition. Again we unloaded the garbage from bin which has shown us large variation in values of level sensor A and B, because garbage was mainly unloaded from right side of bin.



Fig.4.1. Measured filling level readings by sensors

4.2. Case 2

In this paper we discussed a serious game on a flooding disaster in the city of Prague. Regularly the lower parts of the city are flooded. People and animals in dangerous areas have to be informed and in case have to be evacuated to higher parts of the city. Actions have to be taken such as placing removable dams, bags of sands, removing obstacles and in case creating areas to buffer water stream-upwards. To be prepared all these scenarios have to be trained. Creating scenarios in real life on a large scale is no options but serious gaming can provide an alternative solution.



4.3. Case 3

At first, we made a prototype to evaluate how we will arrange our entire system, what will we need to do further research and development as shown in Fig.4.

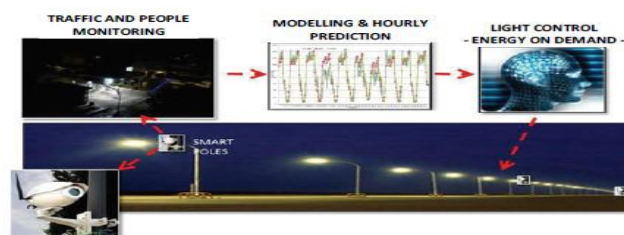


Fig.4.2. Model of our proposed system

This system has been developed and tested in the field for several months to verify the entire functionality under real life condition. By using our methodology, a huge amount of power near about 30-40% can be saved and the curse of traffic jam can be deprived because of obeying the traffic rules. And due to the monitoring system all unwanted situation can be captured and stored for further use.

V. CONCLUSION

From this survey, we conclude that:

5.1. Case 1:

This paper improves practicality of IOT based solid waste collection and management system for smart city. The Integrated sensing system is designed using ultrasonic sensor monitoring system. Still there is good scope for improvement in algorithm which synthesize bin operative situation, its status, time threshold and loaded status perception. Optimizing power required for the system would also be a challenge. Numbers of test runs were performed for assessment of proposed system.

5.2. Case 2

In order to provide safety road, water level during flood is detected at regular times. The alarm system is used to provide caution when the drains reach the threshold level. Hence the water is diverted and it is used for rain water harvesting.

5.3. Case 3

In order to conserve energy, automatic turning on and off mechanism of street light is used. To enrich our daily life with IOT, the use and necessity of technological system is very important to establish a smart city. Because we believe, the more research and development of IOT, the more development & establishment of smart city will be observed. So we realize, our proposed system can fulfill this particular demand. This project is easy, reliable, cost effective and significant in daily life. In our project, the traffic lighting system parts is perfect and can fulfill the demand of energy saving. In future, we wish to develop an android app to evaluate the traffic load monitoring/ evaluating. This app will be able to show us the traffic jam status of every single streets/ roads in a city. And by seeing this status we can easily change our route of journey toward the less jam streets. Here the development of monitoring part is pretty much basic & simple but able to fulfill the general demands. In near future we will establish an identification technology based on image processing like vehicle license plate identification. So we can say, the framework of creating a smart city, IOT plays a vital role and in near future, our research work will be a small contribution.

Thus on implementing such smart city applications, a high standard of living is assured to the citizens providing a secured life and making a wealthy nation.

REFERENCES

- [1] D. Estrin, "Participatory sensing: Applications and architecture [Internet Predictions]," IEEE Internet Comput, vol. 14, no. 1, pp. 12–42, 2010.
- [2] B. Guo et al., "Mobile crowd sensing and computing : The review of an emerging human-powered sensing paradigm," ACM Comput. Surv., vol. 48, no. 1, 2015.
- [3] R. Bhoraskar, N. Vankadhara, B. Raman, and P. Kulkarni, "Wolverine: Traffic and road condition estimation using smartphone sensors," in 4th International Conference on Communication Systems and Networks ,2012, pp. 1–6.
- [4] S. Hu, L. Su, H. Liu, H. Wang, and T. F. Abdelzaher, "SmartRoad," ACM Trans Sens. Networks, vol. 11, no. 4, pp. 1–27, 2015.
- [5] F. Wu and H. Lim, "UrbanMobilitySense: A user-centric participatory sensing system for transportation activity surveys," IEEE Sens. J., vol. 14, no. 12, pp. 4165–4174, 2014.
- [6] P. Zhou, Y. Zheng, and M. Li, "How long to wait? : Predicting bus arrival time with mobile phone based participatory sensing," IEEE Trans. Mob.Comput., vol. 13, no. 6, pp. 379–392, 2012.
- [7] E. D'Hondt, M. Stevens, and A. Jacobs, "Participatory noise mapping works! An evaluation of participatory sensing as an alternative to standard techniques for environmental monitoring," Pervasive Mob. Comput., vol. 9, no. 5, pp. 681–694, 2013.
- [8] E. Kanjo, "NoiseSPY: A real-time mobile phone platform for urban noise monitoring and mapping," Mob. Networks Appl., vol. 15, pp. 562–574, 2010.
- [9] R. Rana, C. T. Chou, N. Bulusu, S. Kanhere, and W. Hu, "Ear-Phone: A context-aware noise mapping using smart phones," Pervasive Mob. Comput., vol. 17, pp. 1–22, 2014.
- [10] E. Paulos, R. J. Honicky, and E. Goodman, "Sensing Atmosphere," in ACM Conf. on Embedded Networked Sensor Systems, 2007, pp. 9–11.