Automation of Solid Waste Bin State Management using ZIGBEE

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***Abstract*— In this project proposes automatic and dynamic solid waste bin status information using integrated sensing system. It presents the implementation mainly for difficulties such as manual monitoring of solid wastages in commercial areas like shopping malls, hospitals, commercial complexes and some crowd related entertaining places. Proposed system develops sensor based automatic monitoring and detection of bin disposing the solid wastages in the regular time interval as per the dynamic information given to the management. Here using different types of sensors to analyzing the bin status in three behaviors to sends the in sequence to microcontroller from end to end ADC to relay driver and bin control using zigbee transmitter.**

Keywords—Zigbee;SWM system.

I. INTRODUCTION

An intelligen solid waste bin operates to ensure the efficient measurement of its status while consuming minimum energy. At present, main cities around the world necessitate challenging solutions for solid waste administration (SWM), as a result of increase in suburban areas and the economy. SWM is a costly urban service that consumes around 20% - 50% of municipallity's annual budget in developing countries. Furthermore, 85% of solid waste management funds are spent on waste collection and transportation. It becomes an excessive wastage of resources when bins are collected that are filled up partially.

In dissipate collection and heartrending behavior, the operational cost can be reduced by optimizing the quantity and consumption of group bins and their collection rate. Estimating the status with waste level and weight of waste inside bins help to optimize compilation routes and improve compilation competence. A SWM system having static development and routing to collect waste strain more in service costs, longer transportation distances and increased labor hours compare to a system with active development and direction-finding attitude. And the designed potential cost savings of 10-20% and transport mileage savings of 26% when vibrant scheduling and routing were used.

For a truly active and automatic system, it is important to know the current and actual fill level of a bin slightly than a prediction relays on historical fill level data, which arises questions as 'at what instance will the bin be at an sufficient fill level to stick up for collection?'. So, to realize a SWM system with dynamic homework and direction-finding for waste collection, it is very useful and important to get real time data about the bin status. more than a few researches have been done over the last few decades concerning solid waste monitoring and administration. But a few of them deal with genuine time bin position data with a motive to apply dynamic scheduling and routing approach for an habitual solid waste administration system.

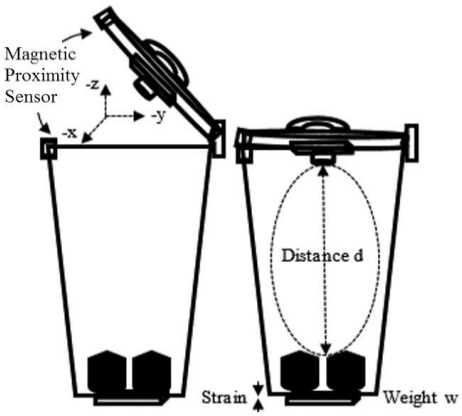

Fig.1 (a) Lid status sensing.

(b) Waste filling level and weight sensing.

II. DESIGN

As give details in the prospect chapter, the considerate of complete possible of the display board and the wireless intermediate in information transfer is the main issue that the following thesis of the following plan deals with.

we see in the more than outline, there are at least three interfacing circuit, MAX-232 with Microcontroller, LCD display with microcontroller, and MAX-232 with ZIGBEE[9] unit. Dedicating a general purpose computer at each and every site of the exhibit boards, although makes the task a lot easier but is too expensive to be a possibility.

Hence we employ PIC 16F877A microcontroller [2][4][6]. The complexity of coding substantially increases, but once programmed the module works at its robust best since it is a enthusiastic set in system and not a general purpose computer. The design procedure involves identifying and assemble all the necessary hardware and ensuring fail safe interfacing between all the components.

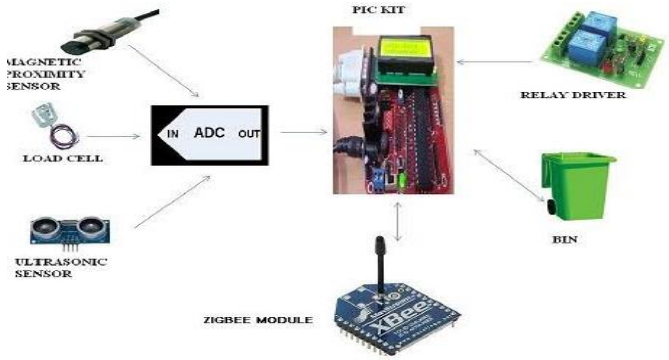

Fig 2. Architecture diagram

Therefore we utilize PIC 16F877A microcontroller. The complexity of coding substantially increases, but once programmed the module moving parts at its robust best since it is a dedicated embedded system and not a general purpose computer. The design process involves identifying and assemble all the required hardware and ensuring fail safe interfacing between all the components.

Then we have the coding procedure which has to take care of the delays between two successive transmission and most outstandingly the justification of the sender's number. The number of valid users can be more than one[7][8][9]. The limiting limitation is the RAM of the microcontroller to a certain extent than the coding complexity.

Initializations

The baud rate of the modem was set to be 4800 bps. The ECHO from the modem was turned off using the command ATE/ATE0 at the overexcited workstation[11]. For sequential broadcast and response to be possible both the DTE and DCE should have same operational baud rates. therefore to set the microcontroller on a baud rate of 4800bps, we set fatal count of regulator 1 at 0FFh (clock frequency = 1.8432). The TCON and SCON register were set consequently.

Serial transfer using TI and RI flags

After setting the baud rates of the two devices together the devices are now ready to transmit and collect data in form of characters. broadcast is done when TI standard is set and similarly data is recognized to be received when the Rx flag is set. The microcontroller then send an AT authority to the modem in form of string of font serially just when the TI standard is set. After reception of a character in the SBUF register of the microcontroller (reaction of MODEM with the understand message in its default format or ERROR communication or OK message), the RI standard is set and the received character is stimulated into the physical memory of the microcontroller.

Validity Check

After in sequence getting the characters the code then checks for start of the sender's number and then compare the number nature by character with the valid numeral pre-stored in the memory. Since we are employ just one suitable number, we are able to do the validation procedure vigorously i.e. without store the new communication in another position in the memory[10][18]. For more than one suitable information we would need more memory location to first store the total (valid/invalid) message in the memory and then do the association process.

Display

After authority check the control flow goes into the LCD plan unit to exhibit the valid communication stored in the memory. In case of multiple suitable numbers all invalid stored messages are deleted by proper branch in the code to the "apparent display" module.

Fig 3. LCD display

Fig.4 MPLAB software

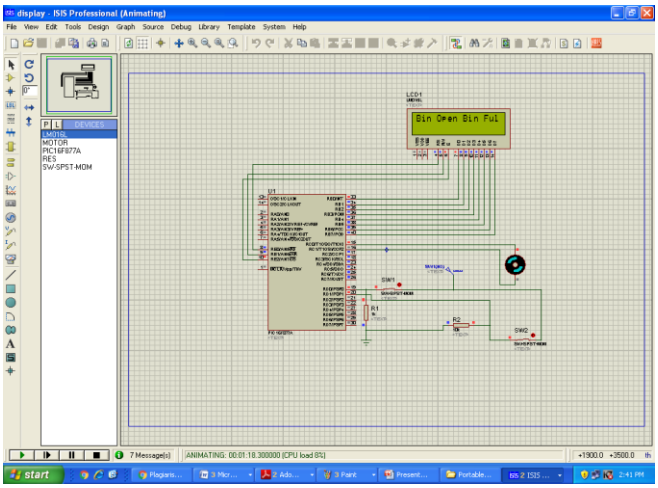

Fig 5. Software Result of the bin management system

Sensed sensor output standards are given to the ADC that converts the analog signals into digital, that digital value is given as a input of Microcontroller 16f877a. **PIC** is a

family of modified Harvard architecture microcontrollers completed by Microchip Technology, resulting from the PIC initially urban by General Instrument's Microelectronics Division. The name PIC originally referred to Peripheral Interface Controller. The primary parts of the family were available in 1976; by 2013 the corporation had ship more than twelve billion entity parts, used in a broad diversity of embedded systems.

Features of Microcontroller

Timer0: 8-bit timer/counter with 8-bit prescaler Timer1: 16-bit timer/counter with prescaler, can be incremented during Sleep via external crystal/clock Timer2: 8-bit timer/counter with 8-bit period register, prescaler and postscaler Two Capture, Compare, PWM modules Capture is 16-bit, max. resolution is 12.5 ns Compare is 16-bit, max. resolution is 200 ns PWM max. resolution is 10-bit Synchronous Serial Port (SSP) with SPI™ (Master mode) and I2C™ (Master/Slave) Universal Synchronous Asynchronous Receiver Transmitter (USART/SCI) with 9-bit address detection Parallel Slave Port (PSP) – 8 bits wide with external RD, WR and CS controls (40/44-pin only) Brown-out detection circuitry for Brown-out Reset (BOR)

III. SERIAL DATA COMMUNICATION

Computers must be able to communicate with other computers in modern multi-processor distributed systems. One cost-effective way to communicate is to send and receive data bytes serially. The P16F77 micro controller has serial data communication circuits that transmits and receive the data. By configuring the SPEN in RCSTA we can enable the serial communication in P16F877. Similarly by configuring the TXSTA (Transmit Status and Control Register) and RCSTA (Receive Status and Control Register) we can transmit and receive the data serially. The any date in TXREG (Transmit Register) transmit the data and the data which is in RCREG (Receive Register) is the receive data. The following figure shows the TXSTA and RCSTA.

IV. STANDARDS BASED

The foundation of every ZigBee standard and specification is the powerful IEEE 802.15.4 physical radio standard operating in unlicensed bands worldwide at 2.4GHz (global), 915Mhz (Americas) and 868Mhz (Europe). It delivers raw data throughput rates of 250Kbs at 2.4GHz (16 channels), 40Kbs at 915Mhz (10 channels) and 20Kbs at 868Mhz (1 channel). Transmission distances are remarkable for a low-power solution, ranging from 10 to 1,600 meters, depending on power output and environmental conditions, such as other buildings, interior wall types and geographic topology.

V. INTERFACING

A. *V.Interfacing*

DTE and DCE The terms DTE and DCE are very common in the data communications market. DTE is short for Data Terminal Equipment and DCE stands for Data Communications Equipment. But what do they really mean? As the full DTE name indicates this is a piece of device that ends a communication line, whereas the DCE provides a path for communication

VI. PIC MICROCONTROLLER

The term PIC, or Peripheral Interface Controller, is the name given by Microchip Technologies to its single – chip microcontrollers. These devices have been phenomenally successful in the market for many reasons, the most significant ones are mentioned below. PIC micros have grown in steadily in popularity over the last decade, ever since their inception into the market in the early 1990s. PIC micros have grown to become the most widely used microcontrollers in the 8- bit microcontroller segment. The PIC16F877 is 40 pin IC. There are six ports in this microcontroller. Namely PORT A, PORT B, PORT C, PORT D and PORT E. Among these ports PORT B, PORT C and PORT D contains 8-pins, where PORTA contains 6-pins and PORT E contains 3-pins.

VI. SOFTWARE TOOLS

ProteusISIS7 is used to run the MPLAB coding. Result of the bin management system is shown in fig. above. Figure shows the output as a form of LCD Display[6][7]. There are 3 sensors are used that is Weight sensor, Magnetic proximity sensor, Ultrasonic sensor. Weight sensor is used to sense the fill level of dusts and Magnetic proximity sensor is used to sense the lid position whether it is open or close and Ultrasonic sensor is used to sense the distances. An ultrasonic sensor transmit ultrasonic influence from its sensor skull and once more receives the ultrasonic waves reflect from an item.

VII. CONCLUSION

This is a exclusive effort which integrate accelerometer, magnetic proximity, ultrasonic and mass sensing methodologies respectively. The integrated sensing system is calculated by rule-based conclusion procedure to offer a proficient and repeated bin status monitor system. The vital end is the algorithm which synthesize bin operative situation, its lid category, time threshold and weighted down status sensitivity. The operation of the system is assess by a number of check run. The algorithm with the intellect scheme has lead to an clear bin which is very well-organized for solid waste organization automation.

REFERENCES

[1] P. H. Brunner and J. Fellner, “Setting priorities for waste management strategies in developing countries,” *Waste Manage. Res.*, vol. 25, no. 3, pp. 234–240, Jun. 2007.
[2] T. Kulcar, “Optimizing solid waste collection in Brussels,” *Eur. J. Oper. Res.*, vol. 90, no. 1, pp. 71–77, 1996.

[3] M. Faccio, A. Persona, and G. Zanin, "Waste collection multi objective model with real time traceability data," *Waste Manage.*, vol. 31, no. 12, pp. 2391–2405, 2011.
[4] L. A. Guerrero, G. Maas, and W. Hogland, "Solid waste management challenges for cities in developing countries," *Waste Manage.*, vol. 33, no. 1, pp. 220–232, 2013.
[5] H. Krikke, I. L. Blanc, M. van Krieken, and H. Fleuren, "Low-frequency collection of materials disassembled from end-of-life vehicles: On the
value of on-line monitoring in optimizing route planning," *Int. J. Prod. Econ.*, vol. 111, no. 2, pp. 209–228, 2008.
[6] O. M. Johansson, "The effect of dynamic scheduling and routing in a solid waste management system," *Waste Manage.*, vol. 26, no. 8, pp. 875–885, 2006.
[7] F. McLeod *et al.*, "Dynamic collection scheduling using remote asset monitoring: Case study in the UK charity sector," *Transp. Res. Rec., J. Transp. Res. Board*, vol. 2378, no. 1, pp. 65–72, 2013, doi: 10.3141/2378-07. AL MAMUN *et al.*: INTEGRATED SENSING SYSTEMS AND ALGORITHMS 567.
[8] M. Hannan, M. Arebey, R. A. Begum, and H. Basri, "Radio frequency identification (RFID) and communication technologies for solid waste bin and truck monitoring system," *Waste Manage.*, vol. 31, no. 12,pp. 2406–2413, 2011.
[9] M. Arebey, M. A. Hannan, H. Basri, and H. bdullah, "Solid waste monitoring and management using RFID, GIS and GSM," in *Proc. IEEE*
Student Conf. Res. Develop. (SCOReD), Nov. 2009, pp. 37–40.
[10] A. Rovetta, F. Xiumin, F. Vicentini, Z. Minghua, A. Giusti, and H. Qichang, "Early detection and evaluation of waste through sensorized containers for a collection monitoring application," *Waste Manage.*,vol. 29,no.12,pp.2939–2949,2009.
[11] M. Faccio, A. Persona, and G. Zanin, "Waste collection multi objective model with real time traceability data," *Waste Manage.*, vol. 31, no. 12, pp. 2391–2405, 2011.
[12] S. Longhi *et al.*, "Solid waste management architecture using wireless sensor network technology," in *Proc. 5th IEEE Int. Conf. New Technol.,Mobility Secur. (NTMS)*, May 2012, pp. 1–5.
[13] M.-H. Tsai, Y.-C. Liu, and W. Fang, "A three-axis CMOS-MEMS accelerometer structure with vertically integrated fully differential sensing electrodes," *J. Microelectromech. Syst.*, vol. 21, no. 6, pp. 1329–1337, 2012.
[14] M. J. Caruso, T. Bratland, C. H. Smith, and R. Schneider, "A new perspective on magnetic field sensing," *Sensors-Peterborough*, vol. 15, pp. 34–47, Dec. 1998. [15] A. Carullo and M. Parvis, "An ultrasonic sensor for distance measurement in automotive applications," *IEEE Sensors J.*, vol. 1, no. 2,pp. 1–143, Aug. 2001.
[15] C. Huddleston, "Sensor application-pressure and load sensors," in *Intelligent Sensor Design Using the Microchip DsPIC*. Amsterdam, The Netherlands: Elsevier, 2006, pp. 209–227.
[16] (Mar. 24, 2014). *Waspmote*. [Online]. Available: http://www.libelium.com/products/waspmote/
[17] (Mar. 24, 2014). LIS331DLH, MEMS Digital Output Motion Sensor Ultra Low Power High Performance 3-Axes 'Nano' Accelerometer.
[18] [Online]. Available: http://www.st.com/web/en/resource/technical/document/datasheet/CD00213470.pdf
[19] (Mar. 24, 2014). *PLA41201, Magnetic Proximity Sensor*. [Online].Available: http://www.wce-electronics.com/
[20]] (Mar. 24, 2014). *XL-MaxSonar- WR/WRC Series, High Resolution,IP67 Weather Resistant, Ultra Sonic Range Finder*. [Online].Available: http://www.maxbotix.com/documents/XL-MaxSonar-WR _Datasheet.pdf
[21] (Mar. 24, 2014). *AMS Load Sensor*. [Online]. Available: http:// china-hanyu.en.alibaba.com/product/201058465-00005013/AMS_ load _sensor.html.