Crowd Estimation Using Embedded Technology

Ujjwal Singh

Abstract: In this article we propose an Arduino based population density monitoring system designed to efficiently monitor the population density in a particular area. The proposed system uses Arduino microcontroller to estimate the population density. This system uses pressure sensitive objects to efficiently predict the density, the prototype also uses display LEDs to indicate the density and help to evenly distribute the population.

Index Terms: embedded system, population density, public trains, LED display, Arduino, IOT, real time analysis, velostat

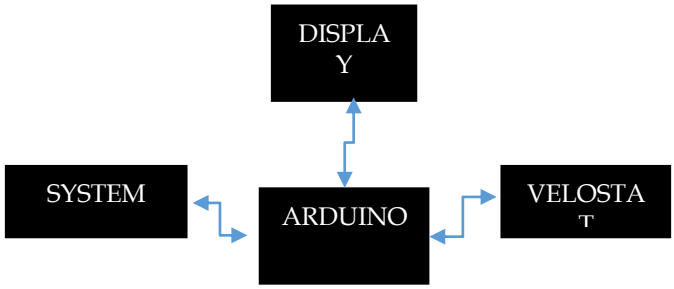
1 Introduction

Smart systems are the need of the hour, in a fast paced life we need systems to cope with our needs, these systems need to understand and analyse the drawbacks in the present establishments and provide a efficient solution to the issue. This calls for a smarter world. Consequently, the smart vision of the world involves much of computer science, computer engineering, and electrical engineering. Greater interactions among these com- munities will speed progress. Applications of IOT and embedded systems may be general or personalized. For the masses we need a solution that can be implemented on a large scale. The question is how to improve on what is already present? How to make the system self reliant and robust? In the field of crowd analysis, some researchers work on tracking of individuals in the crowd and masses of methods have been proposed, but the limitation is that there shouldn't have much overlap among the crowd. Because it's quite difficult to track targets in crowded scene. Here is when IOT comes into play, we just take a very common already present system and propose improvements according to our needs to give a system that is beneficial for the crowd. Although there is not yet a formal and widely accepted definition of "Smart City," the final aim is to make a better use of the public resources, increasing the quality of the services offered to the citizens, while reducing the operational costs of the public administrations. This objective can be pursued by the deployment of an urban IoT, i.e., a communication infrastructure that provides unified, simple, and economical access to a plethora of public services, thus unleashing potential synergies and increasing transparency to the citizens. Here we face an issue of cost cutting and how to reduce the cost of what we are trying to achieve. Every system needs new equipments for the system to improve, the bigger challenge is to find a way as efficient and as economical as possible. The paper suggests a crowd estimation system that is efficient and the equipment required to implement the system has a low cost. The proposed method not only estimates the crowd density but also helps disperse the crowd and distribute it evenly. Many a times we see that the crowd is scattered unevenly and this creates chaos, eg talking about a metro train we see the coaches whose doors open near the elevators or the lifts are more crowded as compared to the rest of the coaches or talking about an office complex where a gathering is being addressed people tend to form groups and cluster in various spots this leads to congestion in some areas while the other areas have a lot of free space. This problem has been addressed and an efficient system has been proposed to tackle the issue.

2 Proposed method

In this paper the proposed crowd estimation system is specifically designed for public transports or sophisticated peripheral complexes. The paper proposes the use of a velostat sheet which is a pressure sensitive conducting sheet whose resistance changes on application of pressure. The proposed idea is to equip the public transports and places where we observe static crowds with velostat sheets, by equipping we mean spreading the steet on the floor of the fecility. As long as we have the ground covered we can easily estimate the crowd in the periphery. The sheet needs to be connected to an ohm meter (micro or meg), as people will enter the facility they are bound to step on the sheet and this will apply pressure on the sheet thus reducing it's resistance and the sheet will conduct more easily. This reading when analysed can easily tell us how the count of the people standing or exerting force in the area Ohm meter: an ohm meter is a device use to check the resistance of a material. There are 2 types of ohm meter available micro-ohm meters and meg ohm meters. The former measures small resistance while the latter measures large resistance. Velostat : Velostat is a packaging material made of a polymeric foil (polyolefins)impregnated with carbon black to make it electrically conductive. It is used for the protection of items or devices that are susceptible to damage from electric discharge. Velostat is pressure sensitive and its resistance depends on the pressure applied to it, on increasing the pressure on it it's resistance is reduced and as the pressure is decreased it's resistance increases. Static crowd: this is a crowd which is stationary and it's focal point is fixed to a certain range. We see such types of crowds in public transports, seminar halls, stadiums etc. the existing methods that use image processing have limitation that if the entry is limited then those methods are very efficient but in case of public transport the capacity is not limited to a certain extent and many a times we see the place to be over crowded, in such cases the proposed method is highly efficient.

3 Implementation



BLOCK DIAGRAM FOR THE PROPOSED METHOD

1) The objective of this paper was to determine the value of the changing resistance, according to the number of people in the area.

2) For this we consider the velostat as a resistor whose resistance is unknown, and we design an ohm meter to determine the resistance.
3) The ohm meter is designed with the help of an Arduino which gives us real time values of the changing resistance (every 1 second), these values can be grouped and generalized for a certain group of people standing on the the velostat. The generalized values are used to display the population density in an area. The display is through LEDs. For over crowded periphery the red LED turns on, for less crowded periphery a Green LED turns on and for a moderately crowded periphery a yellow LED turns on.
4) The experiment was carried out with the help of metal weights (100 gm each), these weights were placed in different permutations and the value of the changing resistance is noted.

4 Observation Table

WEIGHT	POSITION	READING
500 gm	center	55777
300 gm	center	62874
300 gm, 200 gm	Center, opposite corners	67133
100 gm, 200 gm	Center, all corners	71999
200 gm, 100 gm	Center, 3 edges	77614

(assuming 1 person weights 100 gm)

5 Conclusion

This method accurately helps us estimate the crowd density and produce accurate results, this method is very economical and the setup cost is also minimal as compared to the present methods. By using the proposed method the public places can easily be made less chaotic and this method is also very helpful in managing large static crowds.

References

[1] W. Yue, S. Changhong, Z. Xianghong, and Y. Wei, "Design of new intelligent street light control system," in Proc. IEEE International Conference on Control Automation, 2010, pp. 1423–1427.

[2] C. Ozcelebi, and J. Lukkien, "Exploring user-centered intelligent road lighting design: a road map and future research directions," IEEE Trans. Consum. Electron, vol. 57, pp. 788-793, May 2011.

[3] C. Chun, C. Hung, L. Kun, C. Kuan, and Y. Chun, "A digitally wireless dimmable lighting system for two-area fluorescent lamps," in Proc. IEEE Region 10 Conference, 2010, pp. 2173-2178.

[4] L. Chushan, W. Jiande, and H. Xiangning, "Realization of a general LED lighting system based on a novel Power Line Communication technology," in Proc. IEEE Applied Power Electronics Conference and Exposition, 2010, pp. 2300-2304.

[5] P. Elejoste et al., "An Easy to Deploy Street Light Control System Based on Wireless Communication and LED Technology," Sensors (Basel), vol. 13, no. 5, pp. 6492–6523, May 2013.

[6] L. Atzori, A. Iera, and G. Morabito, “The internet of things: A survey,” Comput. Netw., vol. 54, no. 15, pp. 2787–2805, 2010.

[7] P. Bellavista, G. Cardone, A. Corradi, and L. Foschini, “Convergence of MANET and WSN in IoT urban scenarios,” IEEE Sens. J., vol. 13, no. 10, pp. 3558–3567, Oct. 2013.

[8] A. Laya, V. I. Bratu, and J. Markendahl, “Who is investing in machine-to- machine communications?” in Proc. 24th Eur. Reg. ITS Conf., Florence, Italy, Oct. 2013, pp. 20–23.

[9] H. Schaffers, N. Komninos, M. Pallot, B. Trousse, M. Nilsson, and A. Oliveira, “Smart cities and the future internet: Towards cooperation frameworks for open innovation,” The Future Internet, Lect. Notes Comput. Sci., vol. 6656, pp. 431–446, 2011.

[10] V. Bradshaw, The Building Environment: Active and Passive Control Systems. River Street, NJ, USA: Wiley, 2006.

[11] B. Brumitt, B. Meyers, J. Krumm, A. Kern, and S. A. Shafer, “Easyliving: Technologies for intelligent environments,” in Proc. 5th Int. Symp. Hand- held Ubiquitous Comput. (HUC), 2000, pp. 12–29.