Acta Informatica Malaysia (AIM)

DOI: http://doi.org/10.26480/aim.02.2020.22.25

ZIBELINE INTERNATIONAL PUBLISHING

ISSN: 2521-0874 (Print)
ISSN: 2521-0505(Online)
CODEN: AIMCCO

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REVIEW ARTICLE

IOT BASED STATISTICAL APPROACH FOR HUMAN CROWD DENSITY ESTIMATION-DESIGN AND ANALYSIS

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ARTICLE DETAILS

Article History:

Received 13 April 2020
Accepted 18 May 2020
Available online 11 June 2020

ABSTRACT

In this paper we present an IoT based solution that can reduce the complexity of crowd estimation. About the human crowd estimation many technique are in existence but now a day's more work are going on in the field of IoT, because this is era of IoT and most of the every organization is shifted towards IoT based system. So we are also proposed this system in this field and we are using the Respberry Pi-3 which are having quad core processor that can very useful and gives better result and gives accurate number even in the humans are very close to each others. This IoT based model can easily implements in the crowded areas and monitor the same in this area. The camera module in this model also helps to differentiate between human and other bodies. As this is a mobile model it can easily fix on the walls of street light and in the time of dark or in night the camera capture clear image for process in the presence of street light. So that this model gives better result almost 70% better result in compare to exiting approaches.

KEYWORDS

VZigBee, Crowd Density, Respberry Pi-3, IoTBCET, RFID

1. INTRODUCTION

Our objective of this work is that where we reduce the complexity of crowd estimation by using IoT based system by using Raspberry Pi system that can easily count the humans. The IoT based localization is a process of counting the humans by their position and movement within a network by using mathematical techniques (Boukerche et al., 2007; Ni et al., 2003). The system is able to perform by location sensing by using RFID or target tracking and sometimes both (Dian and Ni, 2009; Arai et al., 2010).

Crowd counting and monitoring is very useful to avoid the accident. This device handling technique play a very important role for estimating crowd and gives a very good result in compare the exiting approaches.

In this approach every one having mobile devices and our system received signal between receiver and sender that are very useful data for our approach.

So that the objective of this paper is to be very clear that we develop a system and discuss the significant factors effecting the RFID identification.

Once the effectiveness of human crowd is understood then we easily get the information from all users.

The system can estimate in real-time and based on RFID (IoT Based) Previous proposed methods can't count number of people, and track the crowds in real-time. If the number of individuals increases, the system degrades drastically (Xu et al., 2013).

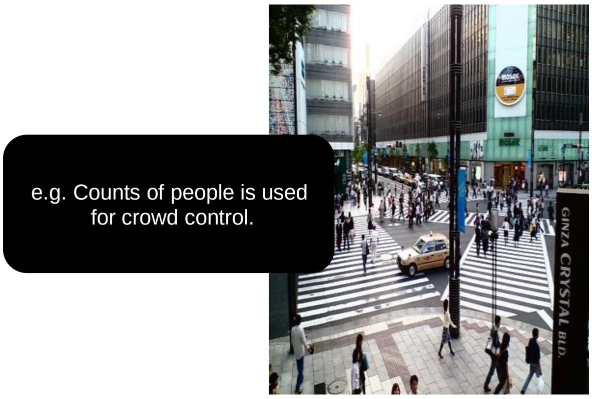

Figure 1: Shows the crowded area

A large group of peoples are called crowd who are available in a particular area. In general place like airport, daily market, bus stations, railway station like places is very necessary and difficult task to identify the unwanted person over thousands of peoples. It is very difficult for human to count the head and identified over thousands of gathering manually (Arai et al., 2010).

2. LITERATURE REVIEW

In smart system based counting, peoples are usually avoided in all aspect they are not agreed to share the personal location in the system so that is main challenge for head counting. Most of the system are used the data

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Cite the Article: Jugal Kishor Gupta, Sanjay Kumar Gupta (2020). Iot Based Statistical Approach For Human Crowd Density Estimation-Design And Analysis. *Acta Informatica Malaysia, 4(1): 22-25.*

which are given by peoples in crowd which are give not guarantee to share so that we gives the some inceptive or some offers to the crowd so that they can share the information which are very necessary to head counting (Huang and Chan, 2011; Bahl and Padmanabhan, 2000).

A Wi-Fi based where they allow crowd to play a geographical game and based on that they collect the information from the users. They allow only playing in Wi-Fi enabled area so that crowd may be bound and also it will be a challenge for that (Oka and Lampe, 2010).

Related works on the field RFID based system are discussed below in a table:

Table 1: Shows comparative study of different techniques

Sensing Facilities	Related Work/Platform	Main Features
Participatory	WISP-based [10]-RFID Hand phone crowd monitoring	Provides framework on crowd based system ,provide geographical data on mass event gathering Provide collaborative Wi-Fi and Bluetooth system
Non participatory	Electronic Frog Eye-Wi-Fi[8] Wi-Counter[11]-Wi-Fi	Utilizes channel based state information to estimate crowd density Provide three phase iterative

Crowd dynamics for analysis is also very complex topics now a day's (Liu et al., 2010). In this paper an effective techniques are used and gives better results over DOE.

In the DOE they used the crowd dynamic factors that can reduce the overall complexity. So this technique is useful in non dance areas.

The ZigBee chipset are used in the model are dramatically changes on the result as discussed and shown by others in their paper (Litvinski and Gherbi, 2013; Liu et al., 2010).

In the work of RF based H-CDE is shown in the table they said in their paper that RF tagged devices are used but the major challenge in this regard is to be difficulties of tagging the RF tag in the crowded areas (Fadhlullah and Ismail, 2015).

May be person is not interested to involve or participate in this model so it's necessary to ask the every one about the benefits of this model (Curtis et al., 2011).

The visual sensors that have been widely used are wireless sensor network, computer vision, smart camera, sensor fusion and few more; and the non-visual sensors are Call-Data-Records, Wi-Fi Signals Measurement, Smart Eva track, Social Network and Bluetooth etc. Automatic crowd understanding has a massive impact on several applications including surveillance and security, situation awareness, crowd management, public space design, intelligent and virtual environments (Karamouzas et al., 2014; CNN Network, 2015).

3. Design and Experimental Framework

Proposed system uses the Raspberry Pi-3 model B RASP-3 motherboard with the Wi-Fi facilities for faster the process. This motherboard having 4 USB ports one HDMI port it builds with the 64 bit processor. It's like a quad core CPU with micro SD slots. It takes less power for operation and easily buildup the process.

RFID tags are very useful and it can easily tag on the items. And now a day's every mobile system having the Wi-Fi that is useful for identification of movement of human in crowd.

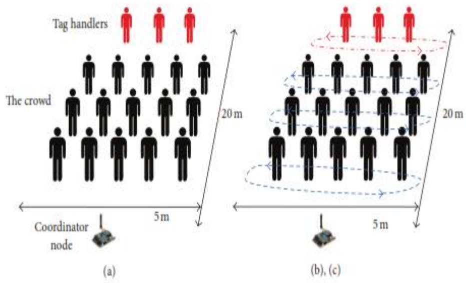

Figure 2: figure a. shows the experimental setup where all elements are static in nature and in figure b and c the crowd having movements within a given area.

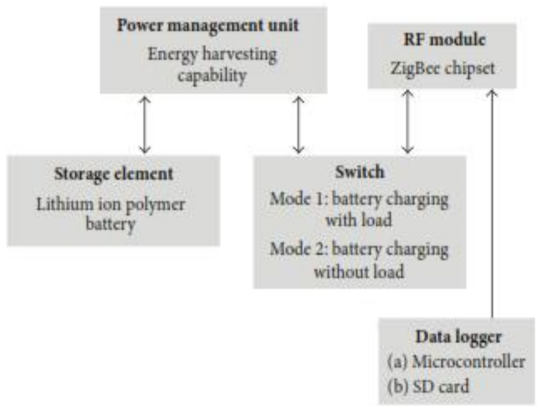

Figure 3: Block Diagram of the system

This is a block diagram of the system where we used batteries which are charge by harvesting.

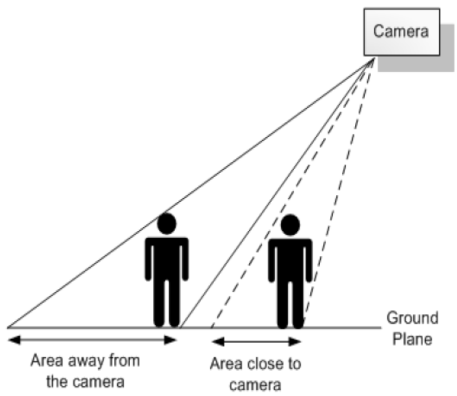

Figure 4: Shows camera module location

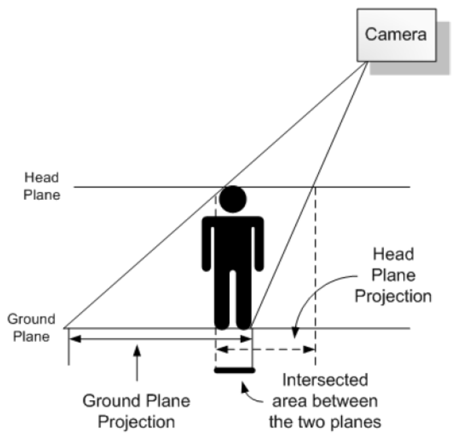

Figure 5: Shows camera module

In this system we also using the camara based image identifier so that we can easily differenciate between human and other body like robot etc.

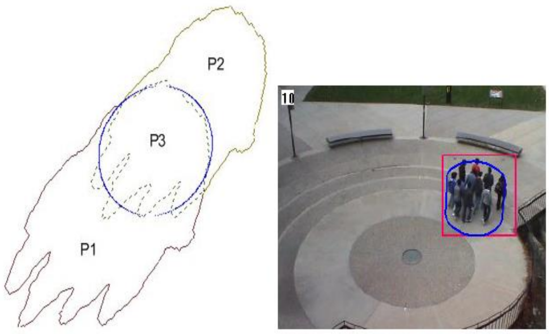

Figure 6: Shows Dance areas

That shows the dense population in a one place that create a problem on camera based system that cannot be measure the exact image so that we need IoT based system that are used the human system RFID tags.

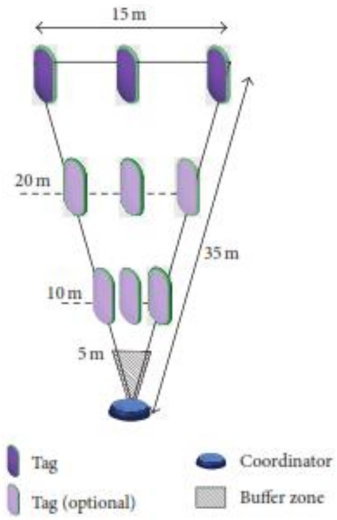

Figure 7: Shows identification of Humans

This shows the how we differentiate the human body and others items. That is very useful technique for identifying such type of process.

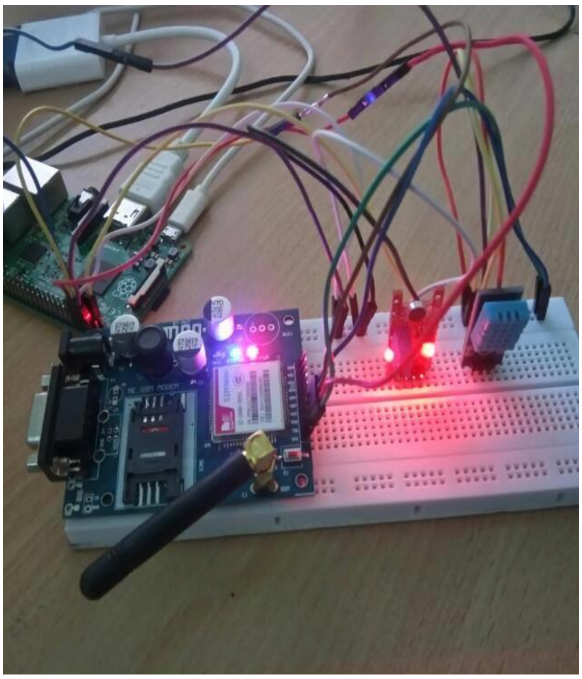

Figure 8: Shows Working Module

This model shows how our proposed system should work and easily it can be installed in any place.

Here we use raspberry pi that are having quad core processor and very helpful in this processing and gives accurate result for further process.

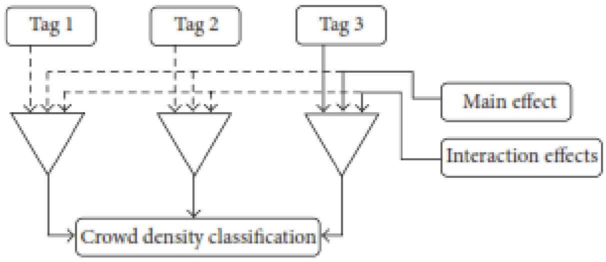

Figure 9: Shows item RFID Tag

4. Results & Discussion

For better understanding of this proposed model we need some Experimental setup.

Table 2: Shows level and factors with count level

Factors	Level 1	Level 2	Level 3
Crowd size (Human)	5	10	15
Crowd pattern	Scattered	Lumped	---
Location (m)	10	20	30
Number of tags	1	2	3

We observe three difference scenes of the crowd and seen 8 difference positions also we have camera height was varied from 29 feet to 80 feet and the tilt of camera was varied from 30 to 40 degrees and most crowded scene is up to 50 people.

Table 3: Shows number of frames with shape error per frame

Group Size (No. Of peoples)	No. of Frames	Heuristic Error per frame	Shape Error per frame
8	332	1.44	1.17
9	530	1.51	1.30
8	372	1.04	0.85
11	354	1.81	0.72
9	384	0.71	0.83
10	156	1.53	1.24
10	224	1.86	1.03

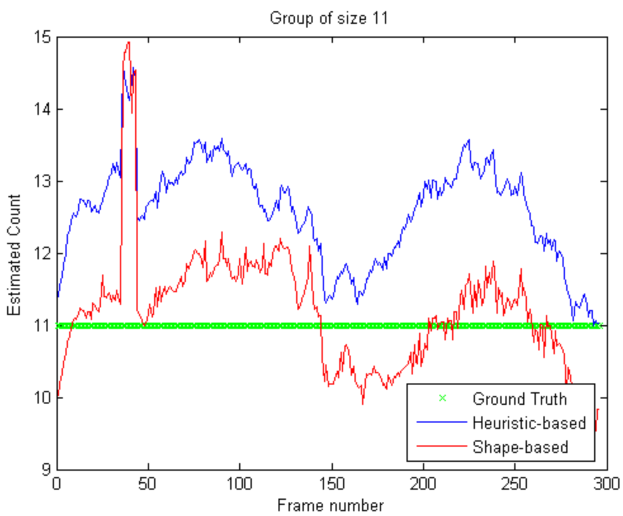

Figure 10: Plotting of exact counts over a group of 11 people

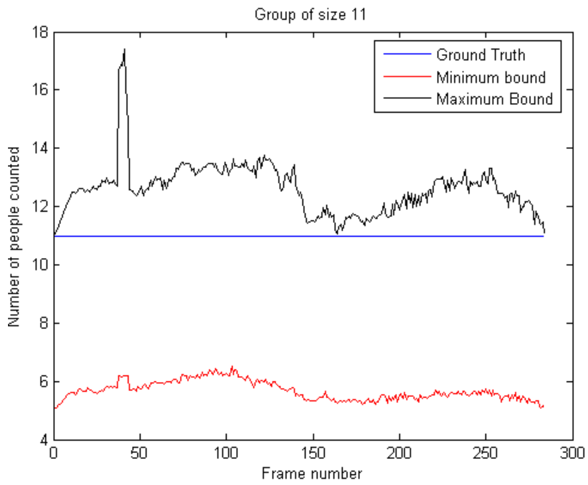

Figure 11: Plotting of exact counts over a group of 11 people in dance areas

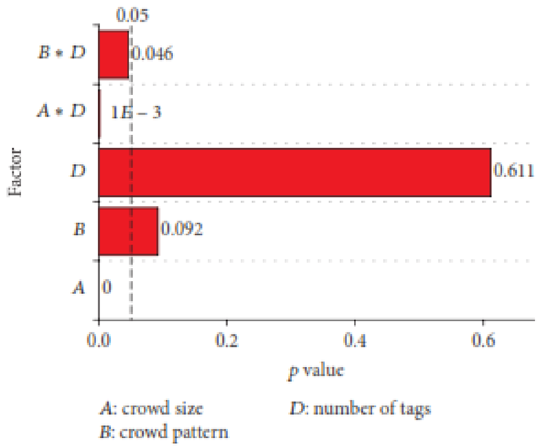

Figure 12: Plotting of factors and values

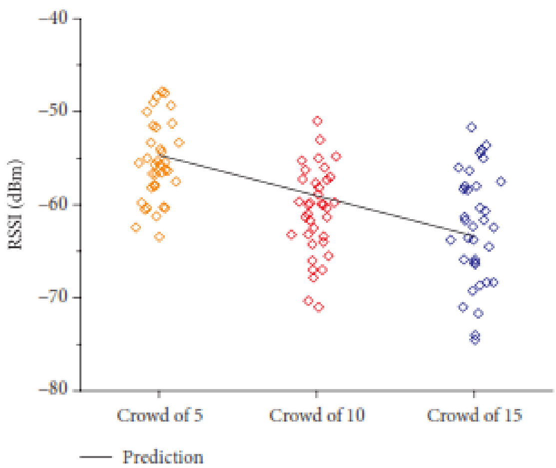

Figure 13: Plotting of exact counts over a group of 15 people

5. Conclusions

So in this proposed system that can count crowds of people accurately in real-time. In this proposed model we are easily count the humans in dance areas by using RFID tags and camera module easily identify the humans body. There are occasional problems with current method that can be resolved in this approach.

As future aspects we can work upon the data analytics concepts where we can test with more items images, and we also work upon the movable devices based on IoT that can move if system require.

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