# BI-DIRECTIONAL VISITOR COUNTER BASED IOT AND RASPBERRY PI WITH VOICE ANNOUNCEMENT

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**Abstract -** Bi-Directional Visitor counter is a reliable circuit that takes over the task of counting number of person's visitors in the room. When somebody enters into the room then the counter is incremented by one. The total number of persons inside the room is displayed on the LCD, announced through speaker and updates website through wifi. The Raspberry pi 2 microcontroller does the above job, it receives the signals from the sensors, and this signals operated under the control of software which is stored in memory. It can be used to count the number of persons entering and leaving the room. As the persons enter, the count is incremented and vice versa. This circuit divided in three parts: sensor, controller and output. In this circuit, two IR-UWB sensor modules are used. Whenever an interruption is observed by both the sensors in forward direction, it increments the counter value. Similarly, an interruption is observed by both the sensors in backward direction, the count is decremented. The count value is calculated depending upon the sensors input and is displayed on LCD. The complete kit is controlled by Raspberry Pi 2 module. The raspberry pi 2 device looks like a motherboard, with the mounted chips and ports exposed, but it has all the components you need to connect input, output, and storage devices and start computing.

## I. INTRODUCTION

The "Internet of things" (IoT) [1] [2] is becoming an increasingly growing topic of conversation both in the workplace and outside of it. It's a concept that not only has the potential to impact how we live but also how we work.

This is the concept of basically connecting any device with an on and off switch to the Internet (and/or to each other). This includes everything from cellphones, coffee makers, washing machines, headphones, lamps, wearable devices etc. Nowadays IoT is being used with the combination of many sensors. Impulse radio ultra-wideband (IRUWB) radar sensor is also one of the things in this trend. The Ultra Sonic sensor is attracting attention as an intelligent sensor that can be easily used as an embedded type sensor with a simple hardware configuration [2] and can be used in various applications.

## II. LITERATUR SURVEY

A People Counting Technology People counting is a widely studied and commercially exploited subject. This section briefly reviews the typical technologies used for people counting.

### 1. Infrared Sensor

IR arrays combine a matrix of IR sensors to form array detectors. As the name suggests the sensor signals are provided as a matrix, where each element of the matrix corresponds to one IR sensor. Pattern recognition algorithms are able to detect people moving across the sensor's view at a claimed accuracy of 95%. This holds true even if two pedestrian's paths cross, or people walk in parallel. IR arrays provide a cost-effective solution and also operate without any ambient light source. IR arrays are widely used in commercial systems.

### 2. Infrared Motion Sensors

In people counting system based on PIR motion detectors, for each passage monitored, three PIR sensors are installed at a distance of 0.8m. The sensors are connected to a coordinator by a wireless RF link. Sensors detect motion events and send these data to the coordinator. The coordinator infers a people count from correlating the number, phase and time difference of peaks found in the signal. Extracting the size and moving patterns of individuals passing. By means of motion histograms based on frame-differenced images, the histograms classify detected movements. Probabilistic correlation is applied to determine a people count. The results of multiple cameras are joined in order to form a movement vector for each individual recognized. In contrast, proposes a solution based on a single ceiling-mounted camera, which identifies people by background extraction of the camera image.

**3. Video Cameras**

In the authors describe an approach to people counting (and localization) using multiple video cameras. The focus lies on

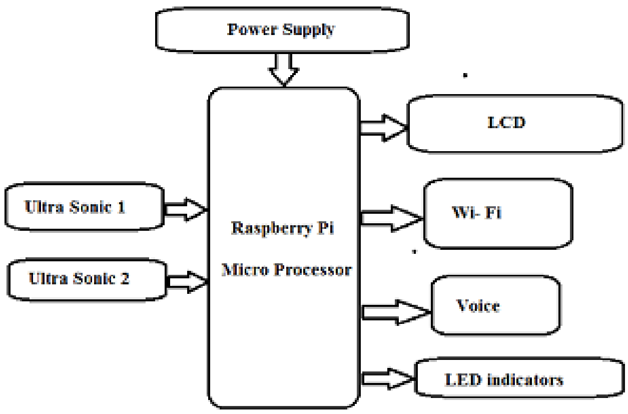
Although these type methods need some elaborate work, including feature selection and off-line training stage, they are more robust and efficient than that of detection based for a high-density crowd scene. Therefore, they gain extensive popularity in crowd counting problem.

**4. Ultra Sonic Sensors**

The authors of introduce a system employing ultrasonic sensors. Per each observed area a three-node sensor cluster is established, whereby each sensor node mounts an ultrasonic sensor. Multiple clusters are joined to cover a wider area. Nodes in each cluster communicate sensor readings by an RF link to the cluster's coordinator node. The latter contributes its own sensor measurements. By means of a distributed algorithm, nodes decide on whether to count a detected person. The sensor nodes require clock synchronization at the millisecond level in order to correlate the data exchanged. Despite the availability of clock synchronization protocols this imposes a disadvantage to this approach. The system achieves an overall counting accuracy of 90% using a probabilistic estimate of the total count, despite individual clusters achieving only around 80-90% accuracy.

## III. SYSTEM CONFIGURATION

We use two Ultra Sonic sensors equipped to count the number of passing people. The propagation direction of the radar is perpendicular to the moving direction of the human, which forms a kind of invisible two thin electronic layers to simultaneously count a number of passersby.




The reason for using two radar sensors is to recognize the direction from left to right, or from right to left, of the moving human. That is, through two thin electronic layers, a human passing by radars is detected, and counting is performed in both directions. For this purpose, the two radar sensors are designed to be spaced by a certain distance d.

If the distance d is wider, the difference time between the timing when the human passes through each radar sensor becomes larger, thereby making the recognition of the passing direction easier. However, if d large, before a human passes completely through the beam width of the radar, the human behind the followed human can come into the radar beam width, making ambiguity in radar signal. The ambiguity causes performance degradation. Conversely, if d is made too narrow, the time difference for the human to pass the two radars is reduced, and the accuracy of the direction recognition is decreased.

Fig.1 Block Diagram of Bi-Directional visitor counter based IoT and Raspberry Pi with voice announcement.

The radar signal processing described in this section was originally designed for signals provided by the pseudo-noise Ultra Sonic system using the maximum length-binary-sequence (M-sequence) as the stimulus signal [13]. As the signals acquired by the M-sequence Ultra Sonic have a form of the impulse responses of the environment through which the stimulus signals are propagating, the same processing procedures can also be directly applied for signals obtained by means of some other kinds of UWB radars, e.g. impulse UWB radars

## IV. SYSTEM HARDWARE MODULES

### 1. Raspberry Pi Board

The Raspberry Pi Camera Board is a custom designed add-on module for Raspberry Pi hardware. It attaches to Raspberry Pi hardware through a custom CSI interface. The sensor has 5 megapixel native resolutions in still capture mode. In video mode it supports capture resolutions up to 1080p at 30 frames per second. The camera module is light weight and small making it an ideal choice for mobile projects.

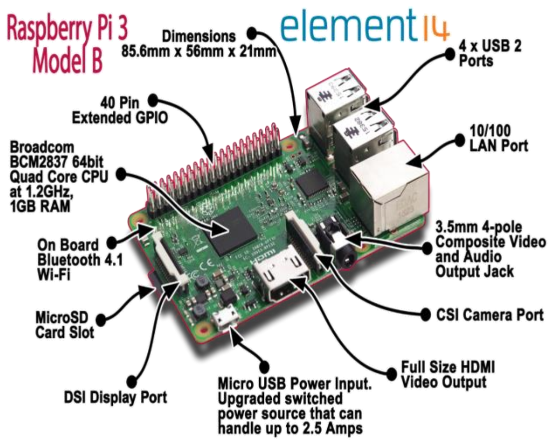



Fig.2 Raspberry Pi

In this example you will learn how to create a camera board object to connect to the Raspberry Pi Camera Board, capture images from the camera and process them in Python programming. Raspberry Pi Model B has 512Mb RAM, 2 USB ports and an Ethernet port. It has a Broadcom BCM2835 system on a chip which includes an ARM1176JZF-S 700 MHz processor, Video Core IV GPU, and an SD card. It has a fast 3D core accessed using the supplied OpenGL ES2.0 and Open libraries. The chip specifically provides HDMI and there is no VGA support. The foundation provides Debian and Arch Linux ARM distributions and also Python as the main programming language, with the support for BBC BASIC, C and Perl. This board is the central module of the whole embedded image capturing and processing system as given in figure 2. Its main parts include: main processing chip, memory, power supply HDMI Out, Ethernet port, USB ports and abundant global interfaces.

## 2. Ultra Sonic sensor:

We require four obstacle detection sensors. There are various sensors are available that are IR sensor, ultrasonic sensor, Temperature sensor etc. we have chosen ultrasonic HC-SR04 sensor, due to cost and operating range. This sensor has following features.


Fig 3: Ultrasonic sensor (HC-SR04

## 3. LCD 16 × 2 display:

The proposed liquid crystal LCD display is considered the spotlight of this work that regularly demonstrates several data synchronously over 16 columns and 2 rows. The main function of the proposed LCD display is to show the information reported by the employed

sensors as several attributes in order to clarify the situation of the system periodically. The connection scheme is proposed to be interfacing with Raspberry Pi board according to the diagram shown inFig.4, which is prepared by Frizzing program.

Fig 4: 16*2 LCD Display.

## 4. ESP8266 WiFi:

ESP8266 is Wi-Fi enabled system on chip (SoC) module developed by Expressive system. It is mostly used for development of IoT (Internet of Things) embedded applications.

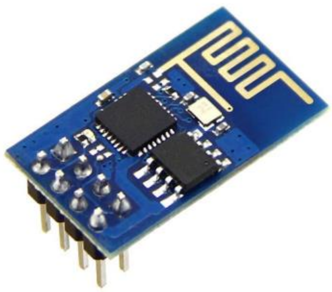


Fig 5 ESP8266-01 WiFi Module

ESP8266 comes with capabilities of

- 2.4 GHz Wi-Fi (802.11 b/g/n, supporting WPA/WPA2),
- general-purpose input/output (16 GPIO),
- Inter-Integrated Circuit (I²C) serial communication protocol,
- analog-to-digital conversion (10-bit ADC)
- Serial Peripheral Interface (SPI) serial communication protocol,
- I²S (Inter-IC Sound) interfaces with DMA(Direct Memory Access) (sharing pins with GPIO),
- UART (on dedicated pins, plus a transmit-only UART can be enabled on GPIO2), and
- Pulse-width modulation (PWM).

It employs a 32-bit RISC CPU based on the Tensilica Xtensa L106 running at 80 MHz (or over clocked to 160 MHz). It has a 64 KB boot ROM, 64 KB instruction RAM and 96 KB data RAM. External flash memory can be accessed through SPI.

ESP8266 module is low cost standalone wireless transceiver that can be used for end-point IoT developments.

To communicate with the ESP8266 module, microcontroller needs to use set of AT commands. Microcontroller communicates with ESP8266-01 module using UART having specified Baud rate.

## V. PEOPLE COUNTING ALGORITHM

- One of the goals is to estimate the number of persons passing through a door or entering into a room and leaving the room.
- Here, two Ultra Sonic sensors equipped with antennas which have narrow beam width to count the number of passing people.
- These two radar sensors are used to recognize the direction from left to right, or from right to left, of the moving human.
- That is, through two thin electronic layers, a human passing by radars is detected, and counting is performed in both directions.
- When the transmitted pulse hits the human target, part of it is reflected

due to the high reflectivity of the body.

- Here the mutual information between two sensors and the information of the individual is taken into consideration for detection.

## VI. EMBEDDED IMPLEMENTATION

We designed module for implementing the proposed people counting system. The hardware used in the module includes two radar sets for transmitting and receiving impulse signals, one Raspberry Pi 2 module for signal processing of two radar signals, and Wi-Fi module for transmission and LCD to for display. In each radar, the first processed signal is sent to the Raspberry Pi 2 module for secondary signal processing, resulting in the final counting

Result. The final counting result from the Raspberry Pi 2 is sent to the Wi-Fi module for transmission of the counting result.

## VII. EXPERIMENTAL RESULTS

A sequence of Ultra Sonic scans were measured using a time domain of 10 minutes at different scenarios. Here distance, time, speed of the person, direction of the person is taken into consideration in testing the project. Counting a Passing a person having normal speed of 5km/hr and at a distance of 30cm from the sensors. System detected a person passing through the IN gate with a speed of 5km/hr. Counting a passing person at high speed. System detected a person passing through the IN gate with a speed of 15km/hr. Counting a passing person at normal speed and at a distance of 60cms.

System did not detect a person passing through the IN gate with a speed of 5km/hr. Counting a passing person at normal speed and at a normal distance from both the ends. Here system had detected persons from different directions but the outcome of the test was always not correct.

Below are the images that were displayed on LCD.

Fig [3] shows the website output

## VIII. CONCLUSION

The UWB radar-based human detector has better than 80% detection probability with 1.58% false alarm rate in a realistic outdoor environment. While we only tested the detector in conditions containing fixed objects, it is likely that the maximum magnitude, range spread, and velocity features may be useful for discriminating humans from common clutter, such as small animals and baggage's, which might arise in a surveillance application. To improve detection performance, better segmentation techniques or feature aided tracking can be employed.

## IX. ACKNOWLEDGMENTS

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