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An Automated Human Queue Management Using Conveyor Belt, Sensors and Controller at Public Places, Holy Places or Shrines

Master Ajinkya Kale[1], Miss. Shivani Naidu[2], Miss. Bhagyashree Patel[3], Miss. Poonam Khobre[4], Prof. Sunil Rathod[5]
[1,2,3,4,5] *Computer Engineering Dept. , Dr. D Y Patil School of Engineering, Lohegaon, Pune, Savitribai Phule Pune University,Maharashtra,India*

Abstract*: *As technology is evolving rapidly with changing time, automation has become a crucial aspect of human's life to reduce the human effort. This has also played an important role in providing comfort and security to people which is also needed to overcome immense crowd at public places. Moreover, at the same time it is mandatory to manage people standing in the queue. Presently, human intervention is required to carry out security and management at all places. Many a times only a security guard or two will try to control the queue but when there is absence of security or management personnel in that case these tasks are left to an individual who stands in queue. The main aim of this invention is to provide systems and methods for an Automated Human Queue Management at Public places, Holy places or Shrines in the world. The proposed system incorporates two important belts for queue, one at service/site window and the other one at the entry point of the service/site location. According to the requirement many possible combinations of belts, boom bars as separators and sensors are feasible and can be fixed at diverse trace points on the belts. The complete belt movement, the boom bar movements for security and the sensors operations are done automatically using hardware controller controlled by a server computer or an embedded device. The complete operational flow of the intended system is described in further section and the drawing of the invention.
Keywords*: *Sensor, Controller, Automatic queue management, Conveyor belt, boom bar

I. INTRODUCTION

With increasing population management of crowd at various places, like Darshan site, Bank sector, Railway Reservation etc. is mandatory. This cannot be achieved manually as it becomes a very tedious job. Moreover, difficultly arises in controlling huge crowd and human safety is also at risk. To overcome these problems, the effective and automated solution is suggested in this paper. The principle purpose of this paper is to provide an Automated Human Queue Management which saves time and resources along with safety by providing an automatically moving belt on which people can stand in queue.

A. Some basic definitions to be known are

1) Queue: Queue represents a certain number of customers waiting for service. The capacity of a queue is either limited or unlimited. Bank is an example of unlimited queue length [3]
2) *Queuing:* Queuing is the process of moving customers in a specific sequence to a specific service according to the customer need. [3]
3) *Automated human queue management system:* electromechanical systems controlled by software systems for organizing the banks and holy places queues automatically using boom bars and sensors.

Our System comprises of a belt at service/site window and one or more belts at the entry point of the service/site location on which people can stand. To distant two people from one another, Boom bars or separators are required. Sensor mechanism is used to detect people and control movement of boom bars by pulling/putting it accordingly. Stepper motor is required for moving the belt automatically based on time interval. Controller is one of the major components of our system as it plays a vital role in controlling and synchronizing all the operations of above mentioned hardware. All the operations are monitored using server computer or an embedded device .interfacing controller with the server computer, MobaXterm software is used. MobaXterm provides all the important remote network tools (SSH, FTP, TELNET...) to windows desktop in single portable exe file which works out of the box. The preferred programming language used is Python. It's a high-level, dynamic programming language that focuses on code readability. Its syntax is easy to learn and coding can be done in fewer steps. It is used to program all the modules so that they can perform as per user's requirement.

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The rest of this paper is organized as follows. Section 2 consists of Literature Survey. Then our proposed queuing system model is shown in section 3. Advantages, Objectives and Disadvantages of proposed system are shown in section 4, followed by brief conclusions and suggestions for future work are shown in section 5. Then the references are shown in section 6.

II. LITERATURE SURVEY

We could not find much of the literature directly related to our proposed system. Few of the literatures are cited below.

A. Design and Optimization of Roller Conveyor System

D.K. Nannaware, R.R. Kharde. (2014)

This paper focuses on existing conveyor system and reducing overall weight of the material and saves cost. A conveyor system is a common piece of mechanical handling equipment that moves materials from one location to another [1]. It focuses on analysis and simulation, route optimization, energy efficiency.

B. Automated Queue Management System

Md. Nasir Uddin, Mm Rashid, Mg Mostafa, Belayet H, Sm Salam, Na Nithe & SZ Ahmed (2016)

This paper focuses only on management of banking queue system using different queuing algorithms. Its main goal is to provide an automated queuing system by deciding which customer to serve first depending upon the status of the queue and to save customer precious time. The system has the capability switching between different scheduling algorithms according to the testing results and average waiting time. This system does logical queue management. There's no automated movement of human. In this paper two different queue control systems are compared for switching between two different scheduling algorithms according to the testing result. The microcontroller used is software-compatible with the Arduino software development environment.

C. Automatic Queuing Model for Banking Applications

Dr. Ahmed S. A. AL-Jumaily, Dr. Huda K. T. AL-Jobori (2011)

This paper focuses only on management of banking queue system using different queuing algorithms. Its main goal is to provide an automated queuing system by deciding which customer to serve first depending upon the status of the queue and to save customer precious time. The system has the capability switching between different scheduling algorithms according to the testing results and average waiting time. This system does logical queue management. There's no automated movement of human. The paper concerns the modelling of the average waiting time that is taken into processing, in addition with the process of switching to the scheduling algorithm that gives the best average waiting time [3].

D. Human Tracking using Ceiling Pyro-electric Infrared Sensors

Xiaomu Luo, Baihua Shen, Xuemei Guo, Guocai Luo, Guoli Wang(2009)

This paper focuses on visibility modulation, localization and tracking algorithms. An infrared sensor is an electronic instrument which is used to sense certain characteristics of its surroundings by either emitting and/or detecting infrared radiation [5]. It can also detect object by measuring the heat emitted by the object. As compared to other schemes, higher tracking accuracy is obtained by proposed approach.

III. PROPOSED SYSTEM

A. Conceptual Design

Nowadays, there are huge queues at various religious and similar places wherein people wait in long queue and move one after another for either a glace of a site or pay their obligation to Almighty called Darshan in Hindus. The queue management is done physically by deploying the some fixed or limited number of man power. The people called security guards or managers are responsible of managing the queue at such places. Thus, an active research should focus on analysing the queues to optimize their operations, so that people's waiting time can be reduce.

In this research paper, an automated queue control system has been develop for organizing queue at holy places Shrines which saves time and resources for efficient way. The system provides an automatically moving belt on which people can stand in queue, sensor mechanism to control the movement of the belt and also to detect the human presence on the belt.

As well as this system has an embedded device with program as an alternative to Graphical User Interface Program on computer, to control operations of the belt with the sensors and controllers.

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B. System Design Overview

The scenario of the proposed system can be described as an automatically moving belt is provided on which people can stand in queue. The moving belts are provided at the entry queue and at the site/service window so that people can go comfortably till the exit point without any chaos. The sensors provided at entry queue give feedback to the control mechanism about the presence of human on the belt so that the belts are kept in moving condition and if no human is present the belts are kept in halt condition.

At the entry of the waiting queue belt where a person when enters in queue, is detected by sensor at entry point. The software program running in controller associated with the waiting queue belt works as object detection or human presence detection module. The signal is ON if the object is detected otherwise it is OFF. This signal is sent to the separator (Boom bar) and the control mechanism at separator has small motor connected to it that will put the separator in front of the person standing in queue.

The process runs two separate but parallel tasks; one for putting separator before human, one for pulling the separator with stopping the movement of the belt. These tasks are synchronized using appropriate hardware and software interfaces.

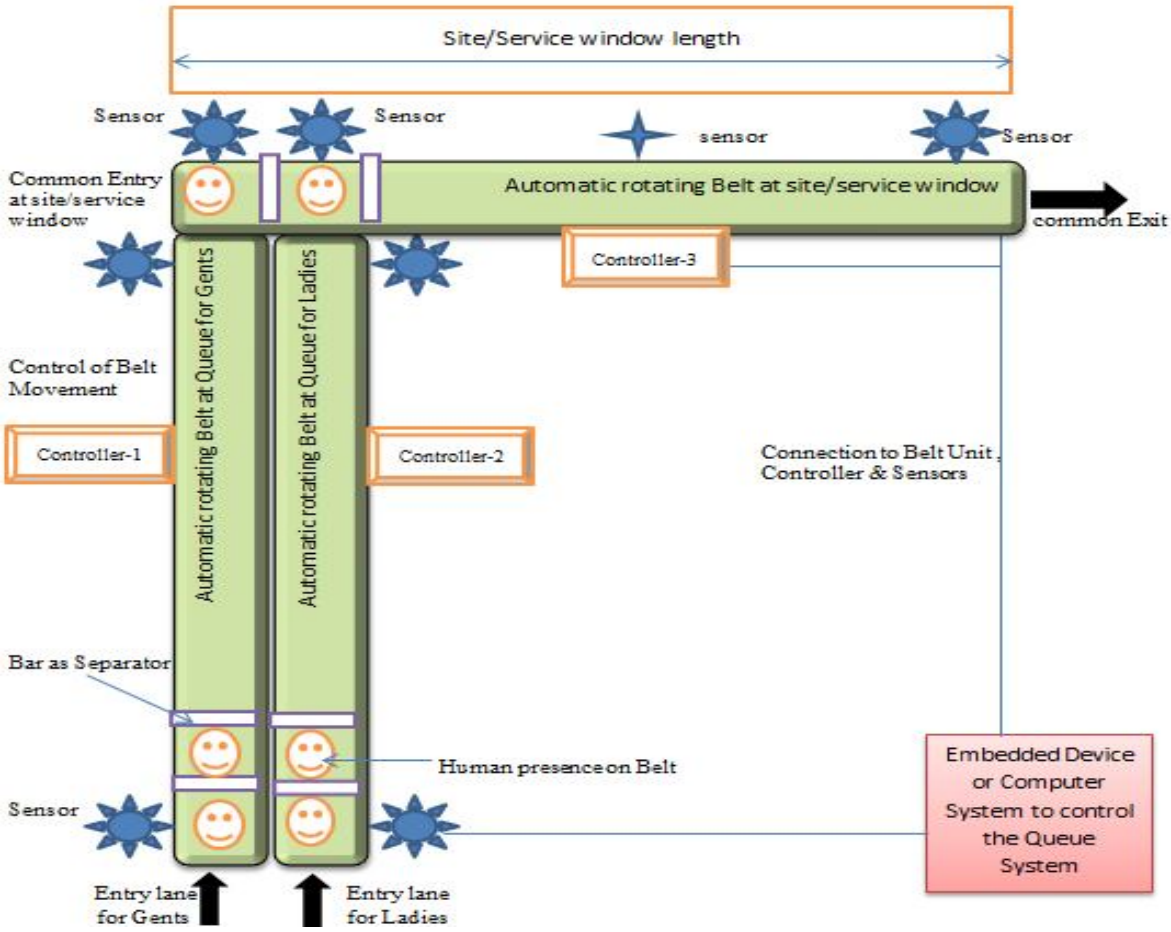

Fig. 1 System Architecture

The system architecture contains decentralized mechanism as an alternative to central mechanism, to control belt motion, put and remove boom bars for the separation of people on belt and manage various delay value of start/stop of belt.

C. Component Selection

1) Plastic roller Conveyor belt: A conveyor belt is the carrying medium of a belt conveyor system .A conveyor system is a common piece of mechanical handling equipment that moves materials from one location to another [1]. Conveyors are especially required in applications involving the transportation of heavy or bulky materials. It allows quick and efficient movement for a wide variety of materials, which make them very popular in the material handling and packaging industries. Here we have used plastic belt Conveyor to move people from one place to another in queue automatically. [1]

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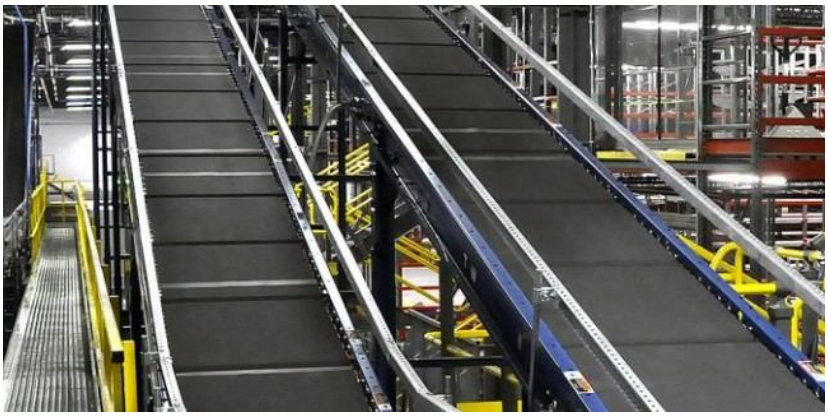

Fig. 2 Sample of Conveyor belt

2) Push- Pull automatic separators: Boom bar or separators are bars pivoted to allow the boom to block manual access through a controlled point. In this system we are using this bar for automatic human separation in queue and it will be managed by controller on the basis of sensor's responses .This bars can be made up of plastic or metal.

3) Controller (Raspberry pi): Controller is used to regulate, synchronize and manage all the operations of the hardware used in the system. These operations include all the process of system like start stop and delay operation of conveyor belt, manage operations of boom bars (Separators).

The controller used in our system is Raspberry Pi which is a series of small single-board computers. The Raspberry Pi foundation recommends the use of Raspbian, a Debian-based Linux operating system. So we have used the same in our system. But it is not mandatory to use Raspbian as many other operating systems can also run on the Raspberry Pi.

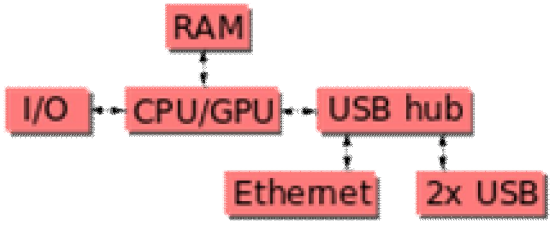

Fig. 3 General block diagram of Raspberry Pi Controller

4) Objects sensors: A sensor is a sophisticated device that measures a physical quantity like speed or pressure and converts it into a signal that can be measured electrically. Sensors are based on several working principals and types of measurements. In our case we are using object sensors that emit signals and measure the reflection to make indications. The object sensors plays an important role in our system as they detects the presence of object and immediately gives signal to controller which in turn controls the operations of boom bars or conveyor belt.

5) Stepper motor: Stepper motors are DC electric motors that divides a full rotation into a number of equal steps i.e. it move in discrete steps. The main advantage of stepper motor over normal motor is when electricity is provided stepper motor is rotated after equal interval of time, whereas in normal motors this time lapse (delay) can be provided manually i.e. normal motor will be rotating continuously. This continuous movement of belt is not required in our system. Therefore, we have used stepper motor instead of normal motor. Apart from these advantages there are many other significant advantages like it is inexpensive, stable, efficient, accurate (good stepper motor have an accuracy of 3-5% of a step and this error is non-cumulative from one step to the next), reliable since there are no contact brushes in the motor and life of motor is simply dependent of life of bearing, safe, easy to set-up and use etc. Thus in our system, stepper motor helps to move conveyor belt automatically.

6) Computer system: Computer system acts as a server and monitors all the operations carried out in the whole system. The processor used in this system is Intel core i5 processor. It has 1 GB RAM memory and 250 GB of hard disk and windows 10 operating system .The programming language is Python which is simple and high-level and is required to program all the hardware as per our requirements. In addition to this, MobaXterm software is used for graphical user interfacing.

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IV. CONCLUSIONS

This paper proposes a new system to control and manage queue automatically and efficiently. The major components and its parameters in the system are finalised. The proposed system helps to manage the queue automatically by using mechanism of automatic conveyor belt, sensors, microcontroller etc. which in turn helps in the movement of people and manages crowd in holy places efficiently.

Several articles and papers were reviewed to look into current approaches of queue management system. Although current approaches provide ease yet there can be certain improvement made to make queue system function more efficiently and moreover they are theoretical based.

A. Limitation

There can be infinite number of customers or infinite queue capacity, but in reality this is not feasible. Moreover 24x7 electricity is required so that the belt moves continuously whenever it detects any person.

B. Recommendation

There are some improvement can be made such as addition of sensors of cameras etc. This system can be made to become a product as earlier projects were only being made as for research and learning. Embedded device like mobiles can be used as servers. Multiple conveyor belts can be placed according to user's requirements. Logical queue management in banks can be mapped to physical model.

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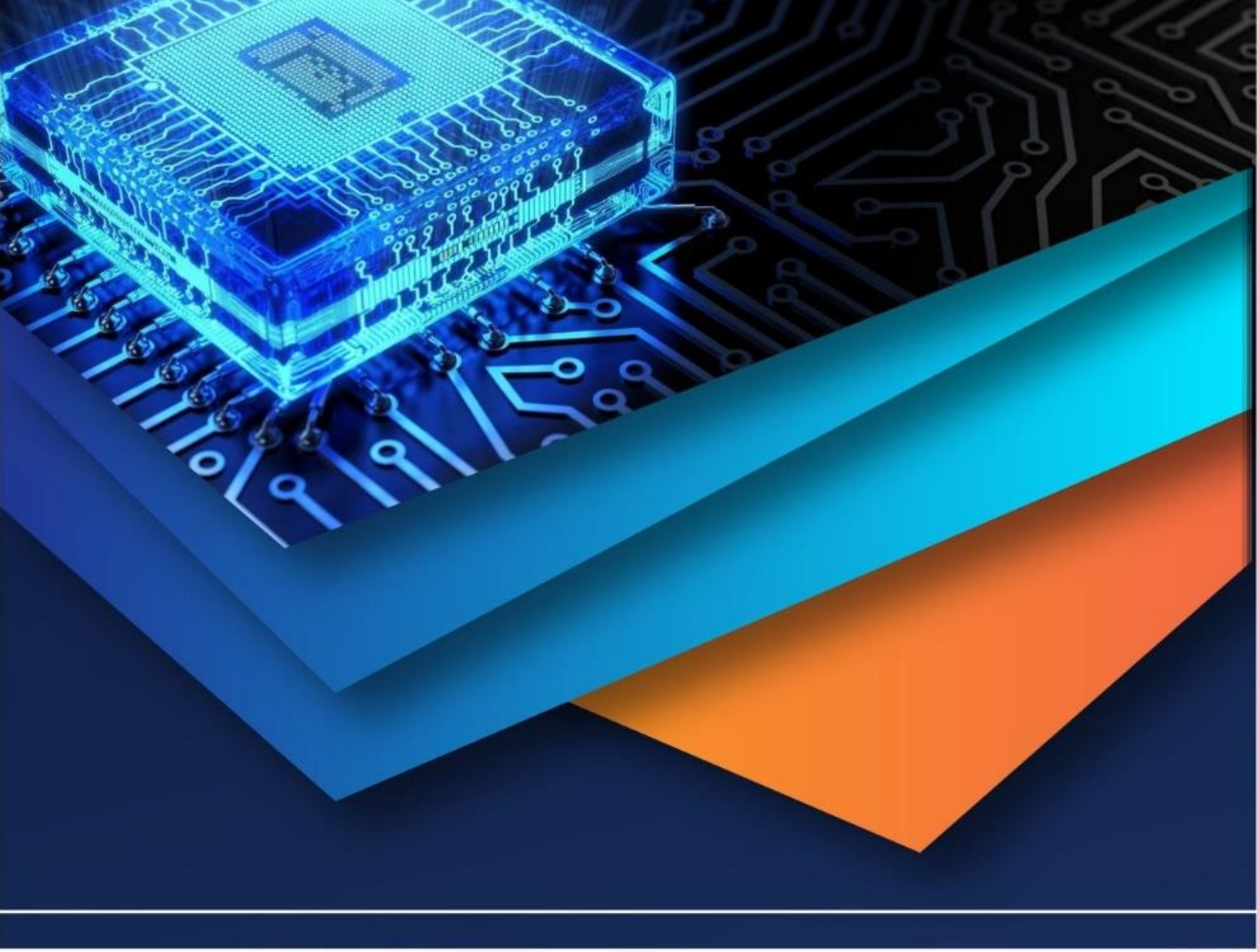

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