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IoT Based Passenger Comfort and Services in Railways

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Abstract— Railways is one of the most extensively used modes of transportation in the world. The global passenger traffic is more likely to grow steadily in the upcoming years. The comfort and service provided to the passengers, on-board a railway train must be increased due to the growth in railway traffic. The proposed idea is a system for providing services to the passenger on requests in railway trains using Internet of Things (IoT). The requests from the passengers are allocated to the crew members based on priority scheduling. The database is used to keep track of every worker and maintains the record of workload details of the crew members in the profile of each crew member, which thus ensures better service to every passenger. Thus the proposed system using centralized method will have better performance over the conventional approach.

Keywords: IoT, multi-objective, passenger comfort and services, management, railways..

I. INTRODUCTION

In the recent years, transportation has grown multifold paving way for different modes of transportation. Railways has become the most important mode of transportation and with emerging technologies, railways has experienced tremendous transformation in its functional and servicing architecture. One of the growing needs is to automate the servicing architecture. Highly populated trains face severe issues which may have trouble in satisfying the passengers. The passenger discomfort can affect the productivity of railways in general. The cause for passenger discomfort is due to inattentive response of the railway officials, lack of available crew members. This happens mainly due to the mismanagement, and a lack of reliable communication system.

The Internet of things is relatively the latest technology which serves to be everyone's object of interest. This paradigm allows objects to be networked tothe internet. The devices that are connected to the network are controlled and remotely accessed to the existing network infrastructure. These devices collect useful data with the help of existing technologies and will transfer them to other devices that are connected in the network. Each device in the network would have a unique identifier through which they can be addressed. This facilitates the objects to communicate. The concept of IoT drives towards a fully connected world wherein users can control anything from anywhere. Applying the concept of IoT in railways can make it more coherent and organized, which can help further in better management.

In this paper we propose a System for passenger services and comfort which is based on IoT to cater the services that the on-board passenger requests for. The system operates based on the data collected from various objects that are connected in the network. Passenger requests from each compartment are collected continuously and then allocated to the crew members considering their workload factor and the availability of the crew member.

II. BASIC IDEA

Generally, in Indian railways the service to the passenger is rendered by using human resources i.e., the crew members who are in constant motion inside the train. The passengers who are in need of any service can make a call to the helpline numbers provided by the railways department. And the railway officials, who take the calls, allot the crew members to provide the service accordingly. This traditional process of assigning the crew members manually may take more time and the services rendered may be poor. Thus we could employ the following method of allotting the crew members automatically for completing the service using IoT.

The system consists of a Raspberry Pi microcontroller connected to the centralized server. All the compartments

in the train contain a 4x4 keypad matrix connected to a Raspberry Pi microcontroller kit. Each kit consists of a zigbee transceiver through which the message can be communicated. After the scheduling of requests by the server based on their priorities, the requests are allocated to the crew members by intimating them through SMS, containing the passenger and request details. If the requests are satisfied by the crew, then the passenger should specify the same through the mobile application installed in either the passenger's or the crew member's mobile phone by logging in using his ticket number. This can make clear that the crew member who was on a work is now allowed to take requests and also for every work done by each crew member, he is added with a constant work load factor so that on further allocation of requests can be a balanced one based on his
work done.

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III. MOBILE RESOURCE ALLOCATION

In the traditional resource allocation problems, the services are requested through dedicated helpline numbers. The resources are mostly allocated by the chief administrator and the administration rarely maintains the track record of the crew members. The railway personnel, who provide services such as ticket-checking, janitoring, catering, medical aid, etc., are the mobile resources that need to be allocated based on the in-coming passenger requests. Considering the factor that the involved resources are human being, who is prone to overload and fatigue, it is very difficult to balance the human factors without any tracking method in place. The challenging part is satisfying the passenger requests as well as balancing these human factors.

The above cited problem can be solved using Multi-Objective Optimization (MOO), wherein more than one real time objectives are considered to take a decision. The considered resources are the set of crew members within the train who need to be allocated to the incoming passenger requests. The problem is formally defined below.

1) *Request:* A request is a service that is being requested by the passenger on-board railway train. The desired service is requested by the passenger by giving the input via the 16x2 keypad matrix.

2) *Crew*: A crew is a set of members on-board the railway train.

3) *Request arrival*: The time at which the request has arrived is called as the request arrival time.

4) *Workload Factor:* In order to mark the work as accomplished and to balance the workload of the all the crew members a constant workload factor has been introduced. Every time a request has been completed, a constant value is added to the crew member's profile.

5) *Alert Time*: Alert time is the constant time after which an alert message is sent to the administrator, if the crew member fails to satisfy the request within the programmed time.

6) *Status*: A non-negative value is constantly updated automatically to distinguish the list of engaged crew member form the crew member who are idle.

Servicing a request is assignment of a crew member. The allocation first considers the crew members who are not assigned with any service at the time of allocation and compares the workload factor of the crew members. The service is assigned to the crew member with less workload factor. Hence, two factors, availability of the crew member and the constantly added workload factor is considered to assign a service.

IV. THE PROPOSED SYSTEM

With the dawn of new technologies, there is immense transformation in the servicing architecture of railways. Due to tremendous increase of passenger traffic in railways, the inconvenience of passengers occurs. One of major reason of passengers' discontentment is due to the unconcerned behavior of rail crew towards passengers during rail journeys. This happens because of the improper management and lack of reliable communication.

The Internet of Things (IoT) is a new technology that explore deeper in the field of ubiquitous computing. This technology involves a network of things where each device has its own unique address through which they can be recognized. The communication for exchange of information among different things can be facilitated by using this technology. This is a concept of fully connected network, where the users virtually control anything from anywhere. Hence IoT concepts can be used to implement a more systematic and manageable system.

In this paper, we propose our idea to solve the difficulties in servicing the requests from passenger in a railway transport. Also, balance the workload of the crew members. Services such as catering, medical aid etc. are provided by railway personnel. These requests need to be allocated based on importance or priority of the requests. Balancing the workload factors of the crew members and also satisfying the passenger requests makes the problem challenging.

The system focuses on providing services to the passenger. Balancing the workload factor of the crew is discussed later. The request when raised by the passenger, attended by the crew member within the train .In order to provide security to the system and counter hacking, some kind of authentication is required to ensure only the authorized people can raise requests. For this purpose, the system requires the passenger information such as passenger registered phone number or the ticket number.

V. SYSTEM ARCHITECTURE

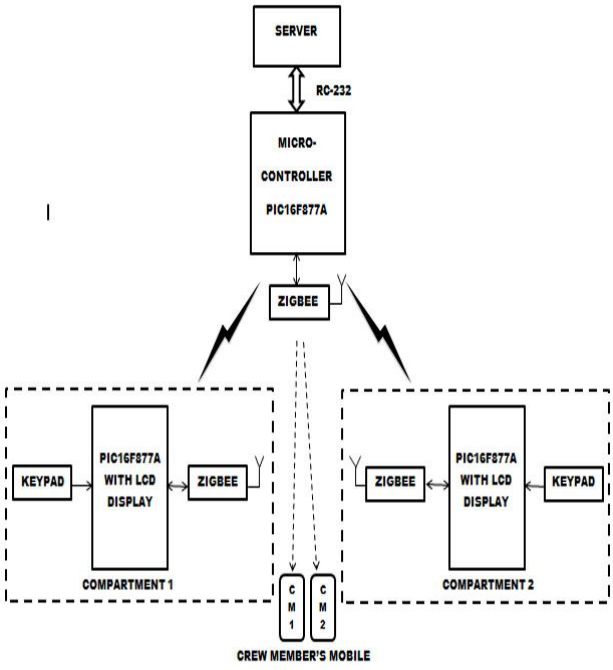

Fig. 1: System architecture of the proposed system

1.Microcontroller (PIC16f877A)

PIC16f877A is an 8-bit self-programming microcontroller that consists of 40 pins with 5 ports. It contains 256 bytes of EEPROM data memory, an ICD, 2 Comparators,8 channels of 10-bit Analog-to-Digital (A/D) converter, 2 capture/compare/PWM functions , a synchronous serial port and a Universal Asynchronous Receiver Transmitter (USART).

2.A 16X2 LCD DISPLAY

A 16x2 LCD display is very basic 7 segment display module that is commonly used in various devices and circuits. A 16x2 LCD means that it contains 2 lines which 16 characters per line, in which each character is displayed in a 5x7 pixel matrix. It has 2 registers called Command and Data.

3.Zigbee

Zigbee is a wireless standard that uses high-level communication protocol for creating small and low power digital radio personal area networks. It has low power consumption and transmits over a distance of 10-100 meters. But they can also pass the messages through a mesh network of intermediate devices to transmit over further longer distances.

4.RC-232

RC-232 is a standard used for serial communication transmission of data. It formally defines the signals connecting between a DTE (data terminal equipment) such as a computer terminal, and a DCE (data circuit-terminating equipment or data communication equipment), such as a modem. The transmission speed is much lower, with large voltage swing and large standard connectors with limited multi-drop capability.

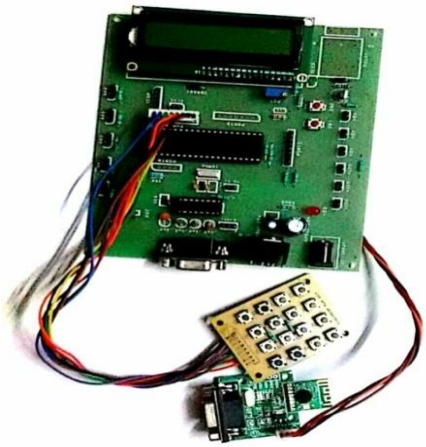

Fig. 2: A Pi-node interfaced with keypad and ZigBee

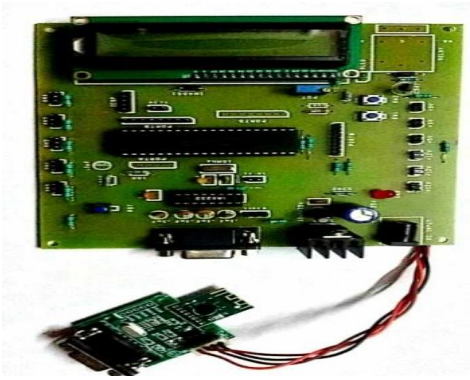

Fig. 3: Server Pi-node interfaced with ZigBee

V. WORKING & RESULTS

The system requires one-time infrastructure setup, where Raspberry Pi nodes are to be installed in each compartment of the train. These nodes demand a communication with the server, to send the requests raised by the passenger to the server. For this reason, each Pi node is interfaced to the ZigBee module for communication among the nodes.

Also, each Pi nodes are also interfaced to the keyboard to provide their input to the system. One such Pi nodes act as server. The server receives the requests from the other nodes and schedule them based on the priority of the requests. These scheduled requests are assigned to the crew member to be satisfied. The details of the passenger, who had sent the service request are sent to the mobile phone of the crew member via SMS.

The workload factor is a constant value that gets added to the profile of the crew at the end of each request completion. This parameter helps to evaluate the crew performance. Based on this parameter the new requests are assigned, where the crew with lowest workload value is selected.

The database contains the list of passengers, ticket number, registered phone number, seat number etc. It also maintains the crew details such as the crew name, no. of requests satisfied, workload factor, and current status of the crew. When new request is raised the request details such as the name of passenger initiated the request, priority of the request, time of request raised, time at which request is satisfied and the crew who satisfied the request. The coach numbers are mapped with the respective IP address of the nodes installed in that coach. This helps to easily identify the coach number where the request is raised.

Priority	Type of Request
1	Fire//Security or other emergency issues
2	Medical Services
3	Blanket Services
4	Catering Services

When the passenger initiates a request, he must provide the ticket number. This step authenticates him to be a valid user. Next, specify the type of request required. This request is sent to the server through the Pi network via ZigBee. It is added to message queue based on the priority. The request if has higher priority than the request already in the queue, the server re-schedules the requests. Otherwise, the request enters the queue in the same order as raised. The details containing the request information is updated with the new request information.

In order to balance the workload of the crew, the crew member with lowest workload factor is chosen to assign the new request. Initially, the current status of the crew will be “0“. Once the crew is assigned, the current status of the crew changes to ”1”.When the request is satisfied the current status changes back to “0”.This status helps to identify the crew who is free and which crew is busy with the allocated request. To specify that the request has been satisfied by the allotted crew member, an android application has been installed in the passengers’ or crew members’ mobile phone. The passenger who requested for the service can log in into the same by using his ticket number and mention if the request has been

satisfied. If so, the workload factor of that crew member will be increased by a constant number and his status will be changed from engaged to free.

The time of request is used to set specific time within which the crew has to attend the request. If this time limit is exceeded, the details are sent to the higher official as a notification. The request allocated to the crew via ZigBee, is received by the crew. The service when completed, a confirmation is received from the passenger through the application in mobile phone of the crew. This confirmation is sent to the server and the crew status is updated.

Fig. 4: Enter IP address of the server to connect

Fig. 5: Enter PNR Number to confirm request completion

VI. CONCLUSION

The paper proposed contains a system that collects request from the passenger in railways through input terminal and send the requests to the central server that schedules them based on priority of multi-objective optimization and allocates the requests to the crew members based on their work done. All this process is performed by the server automatically instead of a traditional manual process which may take comparatively more time and is also a tedious one. Thus, this process has a better performance than the former one and has an improved functionality.

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