A SURVEY PAPER ON DRIVERLESS METRO TRAIN

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ABSTRACT

As automation increases in train services, the main reason is to see how security can be increase. By using sensors, todays technologies and reconstruct the stations with walls on the platforms, the safety can increase for the effective. This project design a railway system consisting of a train, boom barriers and a station. The mechanical parts are made from scratch to get the system to work beneficially. The use of ARM as a micro controller where electrical components could be programmed, became the control of all subsystems. Ultrasonic- and IR sensors are used to detect if obstructions where located on the rails and to detect the oncoming train at the railway crossing. To increase safety, a wall was built on the platform with doors to prevent people from tracing the tracks. The platform door open and close simultaneously with the door on the train. As a result, all subsystems worked well separately. When connecting them with each other, some problems occur. For example, door operations has not match up to 100 percent, which still considered approved. The major problem is that the train became too heavy for the motor to drive it properly. As there is no time to implement a larger motor, the solution to increase the voltage with two 9V batteries connected in series.

Keyword: - *ARM, LPC2148, IR sensor, LCD, DC motor, Ultrasonic Sensor.*

1. INTRODUCTION

The advancement in the field of rail transportation lot of advancement is made till the date. The rail transport system has undergone a high transformation, starting from the early steam operated engines to the most recent bullet train. In metro systems, automation refers to the process in which responsibility for operation of the trains is transferred from the driver to the train control system. Then the numbers of rail lines are automated to reduce the operation cost and improving the security and safety of services. In this project is the Metro train equipped with the CPU, which is used to control the operation to and from the movement of the train which is written according to the written programmed path. The microcontroller from ARM7 is been used as CPU. When the train arrives at the station the sensor is according to the programming done onto the microcontroller. Then the door of the train is automatically opened so that the passengers can enter into the train and the door closes after the prescribed time set in the controller. Automations serves as important roles and functions on our communities. In particular, the automated train services that it costs a lot to buy in and replace systems. A main benefit of an automated system is more safety. By having sensors and other automated technologies utilized by the system. Thus allowing for information of collected data to be transmitted between different areas of the system; the train, the track and the control center. And moreover, automated doors on platforms working in unison with the train will further increase safety by preventing any obstructions to interfere with the tracks.

1.1 Objective and Aim of Work

The primary Goal of this project is to create a system when the train approaches to the station IR sensor detect the train and it stop on platform. And the IN and EXIT doors by using servo motor opens from IN door the passengers are counted by using IR sensor. Say if 10 passengers enter in the train the door automatically close or if no passenger enter or less than 10 enter then 10 min the doors are closed and the train moves ahead.

2. LITERATURE SURVEY

The main aim of this paper is to demonstrate the technology used in driverless metro trains which are functioning in many developed countries. A driverless prototype train is designed using ARM7 microcontroller that enables the automatic operation of the train from one stop to another. The proposed system aims in reducing the human intervention is metro trains to as minimum as possible which in turn reduces the possibility of human error. In this project LPC2148 microcontroller has been used as CPU. The automatic stopping of the train is carried out by RFID reader, which enables the train to stop when the RFID reader senses the RFID tags placed in the stations. The door of the trains is also enabled to operate automatically and IR sensors are placed near the doors to count the number of passengers leaving and entering the train. The train is also equipped with an obstacle detecting unit which stops the train when it senses an obstacle and the necessary information are displayed on an LCD. There has been much advancement in the urban railway transit, starting from the engine to the metro trains and to recent automatic metro trains. Driverless metro train is an intelligent and innovative mass transit solution. Driverless technology meets a certain number of objectives involved, including high capacity, speed and regularity, reduced operational cost, adaptability, and flexibility in terms of human resources; it fulfils the idea of new approach to mobility.

- The first implementation was in London underground Victoria line.
- Fully driverless system was only implemented in 2003 in Singapore.75 KM Dubai lines is longest metro line in world.
- Over a length of 21.45 km and the work on this project was sanctioned on April.1955
- The construction work started in 1956-62.
- After crossing so many hurdles Driverless Metro started its journey on August, 1967.

The primary motivations for automated metro systems are faster services, economy, safety, and energy efficiency. Compared with the traditional metro, the driverless train operating system can shrink the headway to a mere 60 s. Therefore, additional trains can be put into the system during the peak hours to transport passengers. Driverless train operating system can respond immediately to congestion, running more trains without the need for extra staff. Moreover, the frequency of the trains can also be enhanced in the low-traffic hours, as more and shorter trains can be inserted in traffic without the need for operational staff. On one side, driverless trains are being championed as a way of avoiding human error and reaching new levels of efficiency at a time when many metro systems are operating at the very limits of their capacity. On the other, critics are concerned about entrusting public safety to a driverless system, as well as the job losses.

This study gives a general overview for driverless train operating systems. The development history and future trends for driverless train operating systems the opportunities provided by driverless train operating systems, such as lower operation costs, increased capacity, and reliability**.**

3. INCREASED CAPACITY AND RELIABILITY

Reliable and robust operation is significant for metro systems. As pointed in, driverless train operating systems require trains to stop at any point if necessary, such as the evacuation of people in emergency circumstances and train malfunctions. It is showed that the long-term unreliability can reduce the passenger demand and metro effectiveness. The increase in the level of automation enhances the reliability and robustness of urban rail transit systems. In, it is reported that 33% of 5-min delay incidents could be reduced by switching from manual to automatic operation, There are several reasons that driverless train operating systems could improve the reliability The adjustments of running times and dwell times can be more precise and comprehensive, removal of drivers reduces the opportunities for incidents caused by human error and driverless train operating system manages the operations in terms of seconds, and it can recognize a system disruption more promptly.

The Dubai Metro reported that the service availability of their driverless train operating systems is 99.97%. In addition, the driverless train operating system operator Keolis stated that the availability of driverless train operating systems is between 99 and 99.99%. The reliability of the driverless train operating systems is much higher than that of the traditional metro systems, the availability of which is between 96 and 98%. However,

Cohen et al. claimed that the comparison between those sources may not be valid since a consistent measurement definition is needed and it should be validated over several years of data collection.

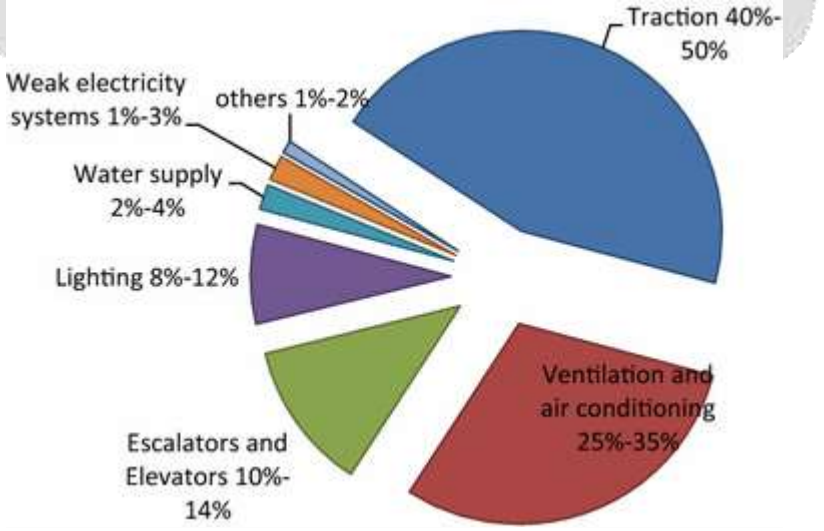
4 INCREASED FLEXIBILITY.

Flexibility is identified as the key operational advantage of driverless train operating systems by all automated metros. Driverless train operating system breaks the connection between train availability and staff availability, which means that trains can be more easily included in or removed from circulation based on the passenger demand. This real-time adaption of capacity to passenger demand can provide the passengers with better service and keep the operation costs as lower as possible. For sporting or other special events, in an automated line as many trains as needed can be injected into the required part of the line with short headways in response to the peaks in demand. Moreover, only a short notice, e.g., like 1 h before the special events, is needed rather than 3 months to schedule trains for automated metros as stated in. The flexibility of driverless train operating systems to increase capacity for passenger demand was demonstrated by the Vancouver Sky-Train during the Expo' 86 world's fair in its first year operation and during the Winter Olympics in February 2010.

The flexibility of driverless train operating systems makes variable train services possible during off-peak hours and at night to lower operational costs. Driverless train operating systems also make the 24/7 operations less constrained because the operation of trains is less dependent on staff availability. Now, the Copenhagen metro has enabled the 24/7 operation.

5. ENERGY EFFICIENCY

Energy efficiency is a major goal for any railways administration both economically and environmentally. As pointed out in, the energy cost is an important component for the total operation cost of railway companies. So it is important to introduce the energy-efficient strategies to reduce energy consumption of trains. Energy consumption in urban rail systems is affected by many factors (such as rolling stock, lighting systems, and air-conditioning systems) and the distribution of the energy consumption for these factors. 40–50% of the energy of urban rail transit systems is consumed by the traction of trains. The air-conditioning systems contribute to 25–35% of the total energy consumption. In addition, the energy consumption of the escalator and lift systems is about 10–14% of the total energy consumption. Moreover, the lighting systems consume about 8–12% of the total energy consumption.



Automatically controlled trains indeed consume less energy due to the optimized acceleration, traction, and braking processes, and it is reported that the energy consumption can be cut by as much as 30% depending on the degree of automation

In the operation experience of the Vancouver Sky-Train system, the energy consumption per passenger-kilometer is just less than half the average of the other systems since the braking process of train could be coordinated with other accelerating trains to enhance the usage of regenerative energy in driverless train operating systems. Since the usage of the regenerative energy is strongly affected by the power supply system and the traffic density, the Singapore MRT operator introduced inverters at substations to recover the regenerative energy for station auxiliary loads. These inverters can recover up to 5% of the total energy used by the urban rail transit systems.

In, an energy-efficient optimization approach is presented based on genetic algorithms, which reduces the energy consumption to 32.89% with a small increase (around 0.51%) in the travel time. Air-conditioning system is important for the passenger satisfaction. Various methods can be introduced to reduce the energy consumption, such as using equipment with better energy efficiency performance, installing carbon dioxide sensors to automatically adjust fresh air supply rates, and installing temperature sensors to make the system run when necessary. It is stated in that 86% of the world's driverless train operating metro lines install the PSDs. The installation of platform screen doors (PSDs), especially the full height PSDs, can reduce the energy consumption of the air-conditioning system by 50% when compared to those without PSDs, because PSDs act as barriers to isolate the stations from the tunnels or outside area. In addition, LED lighting can reduce the energy consumption of the lighting system by 30% and the LED lighting now is a common standard for automatic trains. Furthermore, driverless train operating systems could provide a flexible way to coordinate trains, and this flexibility can improve the system performances in many respects, such as the efficient usage of rolling stocks and regenerative energy.

6. HIGH LEVELS OF SAFETY AND SECURITY

Driverless train operating systems can improve the safety and security level of urban rail transit systems. In traditional urban rail transit lines, 50–60% of the incidents are caused by human error. Wang and Fang proposed a structured procedure to analyze the error behaviors of traffic dispatchers in emergency circumstances based on the human information processing theory and the modified task analysis framework. Driverless train operating systems remove the human driver from the system, and this could reduce or even eradicate the risk of human error. In addition, the safety can be increased further by automation since computerized systems control train movements more precisely than humans. New safety technologies are introduced to satisfy the safety requirement of driverless train operating systems, such as sensors, intrusion prevention and detection system, onboard CCTV, platform supervision, and onboard emergency calls. The intrusion prevention and detection system are activated when a person or a large object is in the track area, and the immediate emergency braking could be initiated depending on how far away the approaching train is. As mentioned by Nelson, the intrusion prevention and detection systems can virtually eliminate suicides and trespasser fatalities. In addition, surveillance systems and emergency calls would deter criminal activity. Furthermore, the PSDs do not allow passengers direct access the tracks, which reduces the system failures by approximated one-third. Dubai's Road and Transport Authority reported that the Dubai Metro network has a train fault rate of one fault per four million kilometers travelled, and the network is constantly monitored by two operation control centers to ensure the safety of passengers.

7. CONCLUSION

There are practical and safety benefits with an automated train system. Although our model cannot be made to materialize into reality as it required a control center and more sensitive sensors. The safety of our future trains can be increased with the use todays advanced technologies. Passengers can be protected by automated doors at train platforms. The trains can be programmed to operate in conjunctions with boom barriers and most importantly with human operators. By using this auto metro train the timings of the train will be exact and it avoids a lot of inconvenience to the passengers. The passenger counting technology provides more service, to track changes in passenger demand, and to track on time performance issues. This project will greatly reduce the human intervention

in the control of trains and hence saves a lot of time and money. Closer, more accurate relation of passenger boarding's and alighting's with respective locations Trains must operate without any staff onboard. Lower staffing costs.

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