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A Review of Techniques used in Automatic Human Following Trolley

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Abstract - *Automatic human following trolley is a cart which follows the user by maintaining constant distance from user. This reduces the human effort of pulling or pushing the cart. Researchers have used different methodologies for fabricating such trolleys with multiple features and usages. Electronic sensors and Cameras equipped with Open CV are mostly used to tag and follow the user. Additional features include automatic billing system using RFID or QR, Displaying various information regarding product prices, total cart value or facility layout on cart etc. This review paper discusses and compared various methods used by different researchers and their utility. This study shall help other researchers and manufacturers of such trolleys by giving them comparative study.*

Key Words: Human following trolley, Raspberry Pi, Arduino, RFID, QR Reader.

1. INTRODUCTION

The trolley is important and inseparable part of our daily shopping experience in Mega Marts and other shop. There hasn't been much improvement in the design of these traditional trolleys in recent past. Sometimes it becomes inconvenient for elderly people and otherwise in rush-hours.

Now days image processing and sensor based intelligent solutions are being used for such trolleys to make such conventional trolleys smart. These trolleys can be made wheelchair based or based on sign language inputs to make is more user friendly for blind users. This review discusses various methods used and applications of automatic human following trolleys. This review under following areas – User Detection, Locomotion Data Inputs, Movement, Additional Features and Applications.

1.1 Scope of Discussion

This review considers following heads for discussion – User Detection, Locomotion Data Inputs, Microprocessor and Hardware, Additional Features and Applications.

2. USER DETECTION

User detection includes identifying correct user by the human following trolley and storing his/her data for future so that user can be followed.

Denny (Denny Irawan et al., March 2019) uses colour detection method to detect the user. A webcam is used to capture photographs of user's shirt and them same colour values are stored and followed by the trolley. Arduino Uno microcontroller and laptop with Open CV are used as microcontroller and for image processing respectively. This has a drawback when multiple users with same shirt colour stand in front of the trolley.

Divya (Divya T M et al., May 2019) has shown how RFID tag can be used for user detection. The user is given unique RFID tag which is read by RFID Reader and trolley follows that RFID tag.

Sayali (Sayali N Joshi et al., April 2019) has used a Pi camera and unique tag placed on user's back to follow the unique user of the trolley. Here also python based Open CV platform is used for image processing. Due to unique tag this method gives solution for drawbacks which are present in detecting unique user in previously discussed methods.

Dmitry (Dmitry Ryunmin et al., March 2019) has used acoustic and sign language inputs for trolley using Kinet 2.0 device.

Yen (Yen Leng Ng et al., February 2015) has used auto-calibrating line follower sensor LSS05 to follow the predefined lines in shopping aisles. It does not follow user but moves on predefined lines based on user inputs given using Bluetooth connected smartphone.

3. LOCOMOTION DATA INUTS

After detecting user, the next step is to follow the user. For that locomotion related inputs should be provided to the trolley. This helps in following the user and in avoiding collisions of trolley either with user or with other obstacles.

Denny (Denny Irawan et al., March 2019), Divya (Divya T M et al., May 2019) and Sayali (Sayali N Joshi et al., April 2019) use ultrasonic sensor to track and follow the user. The ultrasonic sensor maintains constant distance between user and trolley. It also helps in avoiding collision with other obstacles. If distance is more than predefined distance, then trolley moves forward and stops when that predefined distance is reached.

Dmitry (Dmitry Ryunmin et al., March 2019) has used Kinet 2.0 device and webcam to give audio and sign language inputs for trolley movement. There are used as inputs for trolley movement.

Yen (Yen Leng Ng et al., February 2015) has Bluetooth module HC-06 for wireless data transmission between

Arduino Mega 2560 and Android smartphones. User inputs are received using Android smartphone casing subsequent trolley movement.

4. MICROPROCESSOR AND HARDWARE

Research Paper	Microprocessor	Hardware
Denny Irawan et al., March 2019	Arduino	L298N Motor driver, 2 DC Motors
(Divya T M et al., May 2019	Raspberry Pi	Motor Drivers, DC Motors
Sayali N Joshi et al., April 2019	Raspberry Pi	L293D Motor Driver, 2 DC Motors
Dmitry Ryunmin et al., March 2019	Kinet 2.0 software hardware complex	Motor Driver, DC Motors
Yen Leng Ng et al., February 2015	Arduino Mega 2560	MD30C Motor Driver, Electric Motor with gear

5. ADDITIONAL FEATURES

Different features are added to automatic human following trolley to make it more convenient and user friendly. In this paper these features are compared.

Divya (Divya T M et al., May 2019) has used QR scanner for product identification in the shopping cart. The QR code on products is read by QR scanner and it shows price and other details of the product on a display attached to the trolley. It will also show total cart value to help user for his purchase according to his budget.

Dmitry (Dmitry Ryunmin et al., March 2019) has used acoustic and sign language inputs for trolley to make it user friendly for people who cannot speak. This trolley has intelligent system which stores data of different audio and visual inputs and their meanings. A normal person can directly give acoustic inputs to the trolley and trolley will follow those instructions. In a same a way for a person who cannot speak can give inputs in sign language and trolley will follow those instructions. Russian sign language is used in this research as a visual input.

Yen (Yen Leng Ng et al., February 2015) has discussed a trolley which can be used in big malls or warehoused which follows the predefined lines on aisles. The trolley is connected to android mobile phone using Bluetooth module. Here the user can give necessary inputs to the trolley using his smartphone. A special app can be tailormade for this purpose

6. APPLICATIONS

The automatic human following trolley finds its applications at multiple places. It is mainly used in big shopping malls where it will help in reducing human effort and making shopping hassle free by giving necessary information on screen attached to the trolley.

Line follower-based trolleys can be used in warehouses for movement of goods. Trolleys with acoustic and visual inputs enablement can be used at differently abled friendly places. Such trolleys will do great help for older and sick people. Researchers can take reference from this review for further improvement in designs of such trolleys for varied applications.

7. CONCLUSION

As discussed in the review different approached are being used to make human following trolley. Some of them have drawbacks of not identifying unique user when shirt colours of different users are same. Some of the researchers have shown how the method of using unique tags or RFIDs can be used to detect unique users. Dmitry (Dmitry Ryunmin et al., March 2019) has also made efforts in making trolleys more user friendly by giving option of acoustic inputs for trolley movement. The researchers can refer this review paper to obtain comparative study of methods and software/hardware used in making human following trolley.

8. FUTURE SCOPE

There is lot of scope in adding multiple features in current human following trolleys. Such shopping trolleys can be provided with the function of GPS scanner to locate them in huge shopping malls. The mobile based payment system can be integrated with this trolley to make payments just by scanning codes on these trolleys. RFID based payment system can also be used in a same way as it is used at toll gates. RFID stickers can be pasted to these trolleys for payment enablement. This will reduce long queues at payment desks of the shopping malls. Auto parking feature can be provided to these trolleys so that they can be parked automatically once their use is over. Trolleys can be enabled as an intelligent GPS device to help users to locate different sections of shopping mall. They can also be provided with weight measuring devices and auto-billing system bases on weights and products. This will allow in purchasing grains without any human intervention.

Wireless communication features can be added in this trolley to make it controllable from long distance. It can be used for military purposes by mounting video recording camera.

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