CONTROL AND MONITOR OF AUTOMATED MATERIAL HANDLING TROLLEY

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ABSTRACT
Automated Material Handling Trolley is the system of transportation of material from one location to another in commercial as well as domestic places. For more flexibility and ease it is connected to internet with help of IOT technology. We first embed the path network of workplace in it. With the help of suitable algorithm like shortest path, strategy of path is decided. Simultaneously we upload the information on internet for controlling it and simulation purpose for future modification in it. This paper is mainly based on material handling with the feature of IOT to perform complex task in less time and efforts to give user-friendly environment.

KEYWORDS: Encoders, Wi-Fi module, Ultrasonic sensor, IOT, Material handling.

INTRODUCTION

Material handling is one of the important factors in today's industry .With the advancement in technology, different methods for increasing production are used. It has become the necessity of every manufacturing industry to launch its product in the optimum time. Increase in speed and yielding best quality products are the main objectives of every industry. Being one step ahead, the manual labor is getting converted into Industrial Automation. This project brings automation in the goods handling systems. It replaces human labor with reliable and consistent automated device which transports material.
The device gives its position updates and is connected to the internet. The user can even access the device from his mobile phone or tablet. The trolley can also detect obstacles coming in its way. The battery of the device is monitored and notified to the user. It finds the estimate time for which the device can be used further.
We are embedding a map into that trolley by giving a source and destination to perform its task of carrying material indoor. We are also introducing Internet of Things (IoT) in our project to keep the device connected to its user from any place. This device considers all the industrial parameters and also improves the efficiency in production. Time lag and human mistakes can be avoided, once this system is implemented.

LITERATURE REVIEW:

A. MATERIAL HANDLING TROLLEY:

1. CONVEYORS: Conveyors are used when material is to be moved frequently between specific points over a fixed path for merging, identifying and separating products to be conveyed to specific destinations.

2. INDUSTRIAL TRUCKS: Industrial trucks are used to move materials over variable paths. They provide more flexibility in movement than conveyors and cranes because there are no restrictions on the area covered, and they provide vertical movement if the truck has lifting capabilities.

3. ELECTRIC TRACK VEHICLE SYSTEM: An Electric Track Vehicle System (ETV) is a conveyor system for light goods transport. ETV system travels on a monorail track network. Initially, these systems were designed for documents transport and mail distribution in office buildings and headquarters. Later, further applications were designed for hospitals, libraries, retail stores and material handling in manufacturing plants.

4. AUTOMATED GUIDED VEHICLE (AGV): It is a mobile robot that follows markers or wires on the floor, or uses vision, magnets, or lasers for navigation. They are most often used in industrial applications to move materials around a manufacturing facility or warehouse.

B. PLATFORMS FOR IOT:

1. THINGWORX PLATFORM: This is a well-known IoT platform for integrating various nodes. It easily connects devices and sensors and enables connections to related information systems. ThingWorx automates complex processes to extract more value by learning from data and applying new insights. By using its resources and utilities one can analyse any IoT project.

2. PARTICLE CLOUD: Particle devices use microcontrollers to create sensor nodes and by mode of communication it transfers the fetched data on its cloud. This cloud was specially designed for microprocessors like Raspberry Pi. It provides additional features such as robust security and reliable infrastructures.

3. IBM BLUEMIX: A "thing" is any object with embedded electronics that can transfer data over a network without any human interaction. Bluemix platform provides the tools and services which are needed to connect, manage, analyse and secure IoT devices. Node-Red application is specially designed for Raspberry Pi. It connects sensor data to the Watson cloud.

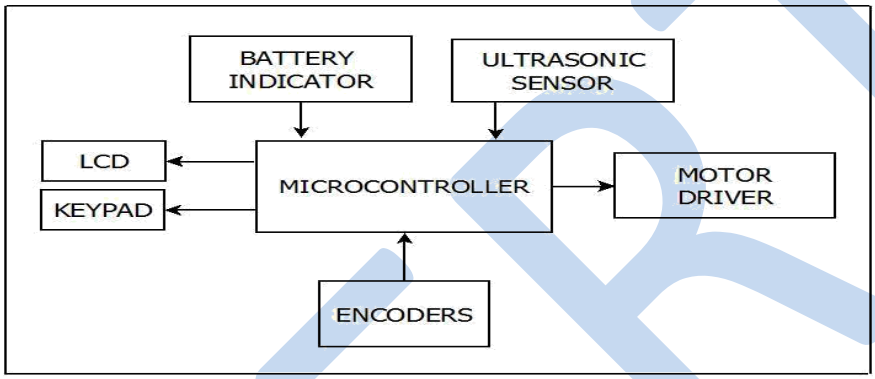
4. THINGER.IO PLATFORM: This platform allows installing the server in our own cloud and using the Open Source libraries for connecting our devices. It provides easy coding for turning on a light from the Internet or reading a sensor value on the MCU. Interfacing Arduino/Raspberry Pi with its cloud platform is well documented.

METHODOLOGY

Our system is comprised of two main components:

A. Material handling system
B. IoT Implementation

A. MATERIAL HANDLING SYSTEM:



1. STRATEGY OF PATH AND ALGORITHMS: In this section we plan the path network using various algorithms and decide the optimized path to be travelled.

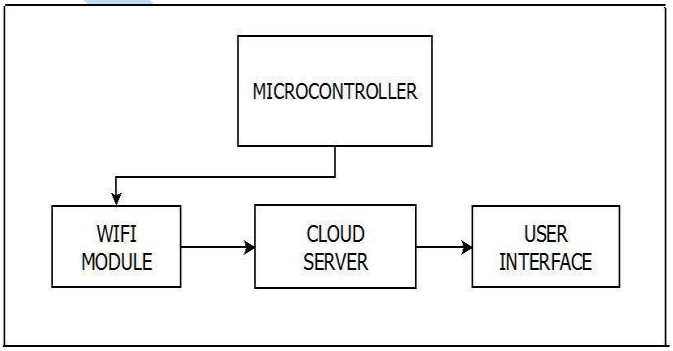
2. PATH FOLLOWING AND VELOCITY CONTROL BY USING ENCODERS: Encoders form the feedback unit and continuously give information about rotation of wheels. This information is used to determine distance travelled. Inertia control of material to avoid toppling of material can also be implemented.

3. OBSTACLE AVOIDANCE WITH ULTRASONIC SENSOR: Ultrasonic sensors are used to avoid obstacles encountered on the embedded path.

4. BATTERY MONITORING: Battery monitoring unit continuously monitors the voltage level of battery. If the voltage is lower than desired battery voltage a buzzer will give an alarm.

B. INTERFACING WITH IOT:

The platform Thinger.io is used for cloud interfacing with Arduino Mega 2560. Wi-Fi Module ESP8266 is used for providing wireless connectivity to the microcontroller. It is itself a microcontroller module which can transmit and receive data using UART protocol. This module is used for performing following tasks:



1. MONITORING OF TROLLEY: The encoder data which provides the distance travelled by the device is displayed on the cloud or mobile application by using Thinger.io platform. User can monitor the path travelled by the trolley from his mobile.

2. OBSTACLE DETECTION: If the trolley stops due to any obstacle, the user knows the status as it gets displayed on the website/mobile application.

3. BATTERY MONITORING: The power consumed by the device is measured by the controller and transmitted to the cloud. This feature estimates the time for which the device can be used with load.

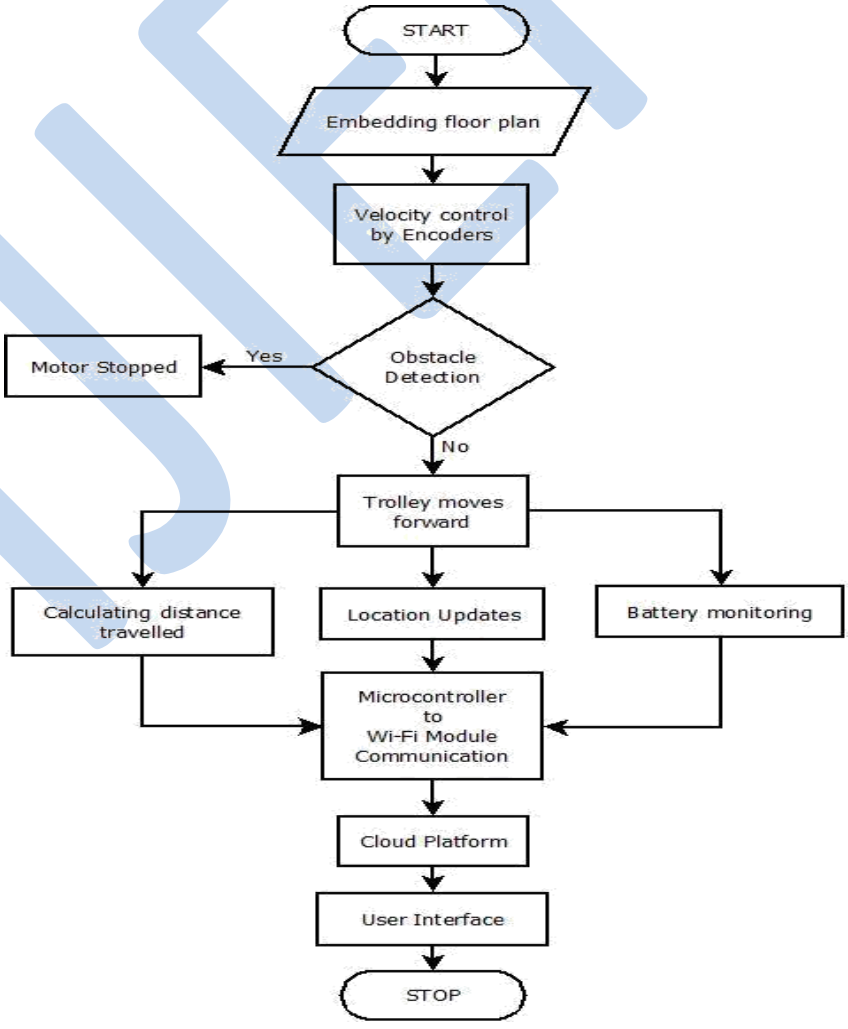
CALCULATIONS

Motor selection calculations: There are basically four kind of forces act on a moving body. They are frictional force due to rolling resistance, inertia force, gradient force and air drag force.
Hence,
i) $F_{T} = F_r + F_a + F_g + F_d$
ii)Neglecting air drag and gradient force and assuming coefficient of rolling as 0.04, frictional force, inertia force, gradient force, etc. are computed.

RESULTS

F_r = 39.24 N F_a = 55.40 N Total force = 94.64 N
Thus, to move in the forward direction a total of 94.64 N has to be overcome.
iii) Torque required to overcome this force is computed. Results:-
T = 47.32 kg-cm
iv) Rpm of motor at a velocity of 2.77 m/s is computed. Results:- 530 rpm
v) Using the above results, power required for driving motors is computed. Results:-
P = 263 W
As the device requires two driving motors,
Power requirement of each motor = 131.5 W Accordingly, Cytron 30A Single channel motor driver is used.

FLOWCHART OF OPERATION SEQUENCE



CONCLUSION

This project explains the concept of automating a material handling trolley and also introduces IoT. This device can be controlled and monitored by its user from anywhere using internet. Obstacle avoidance and battery monitoring are few additional features. Such trolleys are primarily used for indoor applications such as offices, malls, hospitals, industrial material handling etc. This project increases the efficiency and reliability of any manufacturing plant.

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INTERNET LINKS

1) https://console.thinger.io/#/console/statistics
2) https://www.ibm.com/cloud-computing/bluemix/
3) https://www.particle.io/
4) https://www.thingworx.com/platforms/