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Moving Grocery Store using A.I Powered Robots

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ABSTRACT

Robot made many impact on many different sectors. Nowadays Robots are powered with A.I and Machine Learning to make it more powerful and to meet specific requirement of customers. On January 2018 we started a research on robotics and a.i which can make a impact on E-commerce sector. Our objective behind this project is to replace human effort in transporting order placed by customer through e-commerce platform. And finally we made a breakthrough. on November 2018 we exhibited our project titled as Junky Box Robot : The Moving Grocery Store. Our robot is able to deliver orders placed by customer using the technologies like Computer Vison , Machine Learning , Artificial Intelligence, Deep learning, Sensor Fusion etc. We tested this robot in a selected locality and passed all obstruction and all security measures.

KEYWORDS: *iot, robotics, ai, ml, dl, sensor fusion, cv, arduino*

I. INTRODUCTION

This project has mainly 7 objectives or features that will be explained in details in the further. Feature of Robot are as follows On-time Delivery based on locality given, security and Authentication for detecting intruders, Autonomous Driverless technology for by-road transport, secured payment solar powered power backup system, Tamper/defective product sensing and reporting, active 24x7 hours .these 7 features are explained below in detail. Our research include training robot to deploy robot for a specific task.

II. Motivation of the project

If you are an online consumer of goods then you might have faced these following situations

1. Long Delivery time
2. tampered/defective product delivered
3. guarantee / warranty of product
4. Missing of product
5. Tracking issues

Technology has advanced. So why can't we make robots to resolve these problems. So we take a research and done a prototype and find that the above problem can be resolved by help of technologies like A.I, Machine Learning, Computer Vision, Deep Learning & Sensor Fusion.

III. Methodology

Methodology is based on the Working prototype of Junkybox robot: A.I powered Robot.

A. Existing Methodology

Existing method is somewhat similar to our proposed idea based on technology used. But cannot explained with one example since it's a combination of different existing technology. The best example is Amazon Go project introduced by AMAZON INC. in United States on 2017.

Amazon Go project is a convenience static stores in US, operated in four locations in Seattle, Washington, Chicago & Illinois.

B. Proposed System

The proposed system integrates all individual systems under one board. So that the cost of overall system will be reduced efficiently.

1. Dedicated App for Placing Order

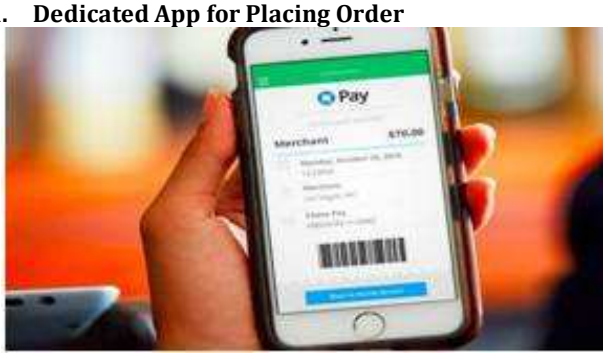

Fig.1. Egro-Store App, payment portal

We have a dedicated app in which the order can be added to cart. Payment can be done both prepaid and post-paid via any online wallet. Moreover app have many other features like showing the existing stoke of product and also finding an ideal Junky box robot nearby for fast delivery (like uber or Ola Taxi concept)

2. Autonomous Driverless Moving System

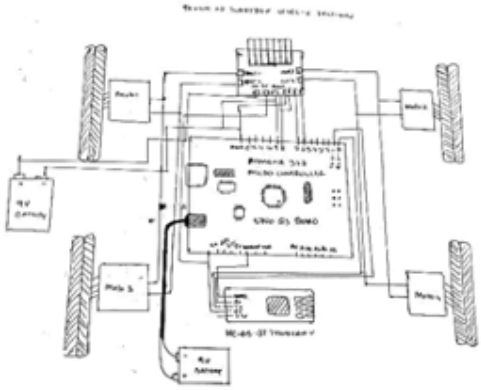

Fig.2. Architecture of Junky box Wheel control

We have a specially designed Moving part attached to the bottom part of our Robot which help it to move across all terrains.

Also included many safety features like ABS and Pedestrian & Signal Detection also have manual mode (When Autopilot Mode Off) using power of A.I and CV

3. User Authentication

Fig.3. QR code Authentication

Using Technologies like CV & Deep Learning the Robot is able to distinguish its user from other non-users. Also can be used at the time of emergency.

4. Solar Powered

Fig.4. Solar cell of Junky box

Powered with solar so that robot can work throughout day & night with battery backup technology during night period.

5. Virtual control

Fig.5. Virtual Monitor & Controller

In India Autonomous car is not feasible so that as an existing solution we found out to be is control virtually from base station to clients location safely. (Service available only in selected locations)

6. Inbuilt gas sensors & storing unit for food products

Fig.6. Fresh Food products

Using Technologies like Deep Learning, machine Learning & Sensor Fusion, Robot is able to distinguish between products. Basically food products need special care so the cabin is designed with sensors. So based on sensor value the robot is able to control cooling/ heating mechanism to keep the food fresh during journey. Or give an insight/alert for company when food is not able to deliver as fresh.

7. Secured Payment Gateway

Fig.7. Secured Payment Gateway

Payment Gateway is Encrypted and Secured from all kind of threat. Use concept of Bit-Coin/ Block chain technology.

C. Procedure Flow

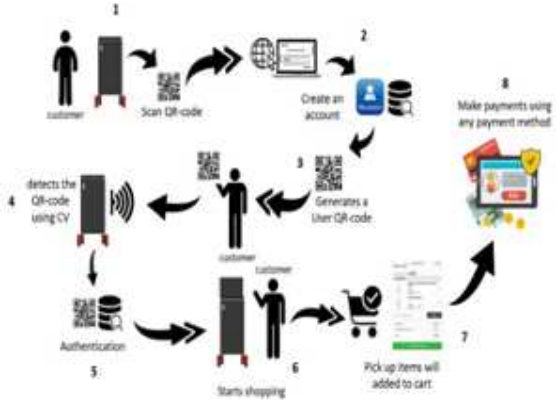

Fig.8. Working Principle of Junky box Robot

At first, the customer have to scan the QR-code which will redirect to create an account in the online shopping website page if he/she doesn't have an account (more efficient way) then, After creating an account, a user-authentication QR-code is Generated. The front-part of Junky box lies Camera sensor powered with computer vision technology and once the QR-code (Generated) is shown to the camera, the camera will immediately detects the QR-code and authenticate with its database corresponding to the account created. Once this step is completed the customer is able to shop within its limit. So what all things you taken or choose from the store will be automatically added to your Checkout cart in online website and payment can be made using your Card or any other online wallets you have.

1. Using Technologies like computer vision and deep learning enhance and improve the existing shopping experience.
2. Using Artificial Intelligence Robot will be able to sell like a shopkeeper trying to sell its product.
3. Work 24 x 7 efficiently without any delays or tired.
4. Also helpful in transporting goods to one store to another.
5. Using its Deep Learning algorithm understand the crowded area where selling items is legal and profitable.

IV. Components

Following are the components used for prototyping our project.

A. Arduino UNO Dev. Board

Fig.9 Arduino UNO Dev. Board (source: google.com)

As Arduino UNO is an open-source development board it also have an IDE, a community for the support. It also easy to design projects with it since it has at-mega.

B. SG-90 Servo Motors

Fig.10. SG-90 Servo Motors

Servo motors are handy when you need simple rotatory motions. SG-90 is very lightweight and compact servos which helps in movement of our prototype parts.

C. LED

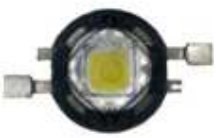

Fig.11. Light emitting Diode

LED's are very handy for all sorts of lighting. And its very power efficient and easy for circuitry works.

D. SR-04 Ultrasonic Sensors

Fig.12. SR-04 Ultrasonic Sensor

It's useful to detect the obstacles in front to avoid hitting. It also allows to analyse the distance between the obstacle and the body.

E. Stepper motor

Fig.13. Stepper Motor

For ready motion we need stepper motors for the job to be done.

F. Camera modules

Fig.14. Web Camera Module

If there's a need of security we rely on cameras, it analyses every sides and reports thefts to the company. Also helps in avoiding hitting to obstacles nearby. Image recognition helps in identifying people and other objects for easy reach to the customers.

G. Gas sensors

Fig.15. Gas sensor

We need gas sensors to detect harmful gases in the food products that helps in delivering fresh foods to the customers. Also to analyse decaying of food in near future.

H. ESP8266 NodeMCU 12e

Fig.16. esp8266 nodemcu 12e

Node MCU is the common name for this board helps in controlling

The product wireless, it's also a development board like Arduino UNO but its very lightweight and compact than Arduino.

I. L298N motor Shield

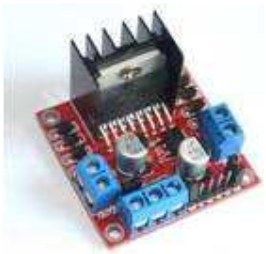

Fig.17. L298N Motor Shield

We need a driver for controlling the movement of wheels of the robotic car, then we found out the best driver for it.

V. Programming

A. Junkybox_box_code.ino

```
/* licenced by pineapplem3 Inc. This program is used for Junkybox any reproduction of this code is strictly prohibited. Compiled and developed by : Nirmal Ram

*/

#include <Servo.h>

Servo servo1; // any name can be choosen in case of " myservo" Servo servo2;

int internallimit = 12 , externallimit = 5; void setup() {

pinMode(12, OUTPUT);          // buzzer alert

pinMode(6, OUTPUT);          // Redlight

pinMode(7, OUTPUT);          //greenlight

pinMode(5, OUTPUT);          //bluelight

pinMode(3, OUTPUT);          // triggger is

output of external sensor

pinMode(4, INPUT);           // echo is input

of external sensor

pinMode(8, OUTPUT);          // triggger is

output of internal sensor

pinMode(9, INPUT);           // echo is input

of internal sensor

servo1.attach(10);

servo2.attach(2);

Serial.begin(9600);

}

void servoup()

{

servo1.write(45); // initial down stage servo2.write(65); //initial down stage Serial.println("\n\n Access Granted . Pickup your items from cart . Happy shopping !");

}

void servodown()

{

servo1.write(110); //fixed up stage servo2.write(0); //fixed up stage Serial.println("\n\n The Door is Locked . Scan QRcode to Proceed . ");

}

void internalsensor()

{

delay(1000);

digitalWrite(8, LOW);

delayMicroseconds(2);

digitalWrite(8, HIGH);

delayMicroseconds(5); // will send waves of 2 ms low wave & 5 ms high wave

long x1 = pulseIn(9, HIGH);

int internalsensor = x1 / (29 * 2); Serial.print(" \nInternal sensor detected

= ");

Serial.println(internalsensor);

}

void externalsensor()

{

//delay(1000);

digitalWrite(3, LOW);

delayMicroseconds(2);

digitalWrite(3, HIGH);

delayMicroseconds(5); // will send waves of 2 ms low wave & 5 ms high wave

long x2 = pulseIn(4, HIGH);
```

```
int externalsensor = x2 / (29 * 2);

//Serial.print(" \nExternal sensor

detected = ");

Serial.println(externalsensor);


}

void redlighton()

{

digitalWrite(6, HIGH); // turn on red Light Serial.print("
\n\n Red Light is activated");

}

void redlightoff()

{

digitalWrite(6, LOW); // turn off red light

Serial.print(" \n\n Red Light is

deactivated");

}

void bluelighton()

{

digitalWrite(5, HIGH); // turn on blue Light

Serial.print(" \n\n Blue Light is

activated");

}

void bluelightoff()

{

digitalWrite(5, LOW); // turn off blue light

Serial.print("\n\n Blue Light is

deactivated");

}

void greenlighton()

{

digitalWrite(7, HIGH); // turn on green Light

Serial.print("\n\n Green Light is

activated");

}

void greenlightoff()

{

digitalWrite(7, LOW); // turn off green light

Serial.print("\n\n Green Light is

deactivated");

}

void alert()       // Turn On Buzzer & LEDS

Blink Circuit

{

Serial.print("\n\n Warning...Something Wrong. Securing
Vault . Doors Locked"); digitalWrite(12, HIGH);
digitalWrite(7, HIGH); digitalWrite(6, HIGH); digitalWrite(5,
HIGH);

delay(50);

digitalWrite(12, LOW);

digitalWrite(7, LOW);

digitalWrite(6, LOW);

digitalWrite(5, LOW);

delay(50);

}

void buzzer()       // barcode reading sound

{

digitalWrite(12, HIGH);

delay(50);

digitalWrite(12, LOW);

delay(50);

Serial.print("\n\n BarCode Detected. Authentication Success.
Database Updated.....(100%)"); }


void loop() {

servodown();

externalsensor();

internalsensor();

delay(1000);
```

```
redlighton();
digitalWrite(3, LOW);
delayMicroseconds(2);
digitalWrite(3, HIGH);
delayMicroseconds(5); // will send waves of 2 ms low wave & 5 ms high wave
long x2 = pulseIn(4, HIGH);
int externalsensor = x2 / (29 * 2);
//Serial.print(" \nExternal sensor
detected = ");
Serial.println(externalsensor);

if (externalsensor <= externallimit)
{
redlightoff();
buzzer();
greenlighton();
servoup();
int count = 4;
int i=0;
while(i<=count)
{
internalsensor();
delay(1000);
digitalWrite(8, LOW);
delayMicroseconds(2);
digitalWrite(8, HIGH);
delayMicroseconds(5); // will send waves of 2 ms low wave & 5 ms high wave
long x1 = pulseIn(9, HIGH);
int internalsensor = x1 / (29 * 2); Serial.print(" \nInternal sensor
detected = ");
Serial.println(internalsensor);
bluelighton();
if (internalsensor <= internallimit)
{
count--;
buzzer();
}
}
bluelightoff();
delay(1500);
servodown();
greenlightoff();
delay(1000);
}
else {
digitalWrite(8, LOW);
delayMicroseconds(2);
digitalWrite(8, HIGH);
delayMicroseconds(5); // will send waves of 2 ms low wave & 5 ms high wave
long x1 = pulseIn(9, HIGH);
int internalsensor = x1 / (29 * 2); Serial.print(" \nInternal sensor detected
= ");
Serial.println(internalsensor);
if (internalsensor <= internallimit)
{
while(1){
alert();
}
}
}
}
```

B. Junkybox_wheel_code.ino

```
int trigger = 3;
```

```
int echo = 2;

int RMP = 10, RMN = 11, LMP = 7, LMN = 6;

void setup() {

pinMode(trigger, OUTPUT);              // triggger

is output

pinMode(echo, INPUT);                  // echo is

input

pinMode(RMP, OUTPUT);

pinMode(RMN, OUTPUT);

pinMode(LMN, OUTPUT);

pinMode(LMP, OUTPUT);

pinMode(5, OUTPUT);

pinMode(4, OUTPUT);

Serial.begin(9600);

}

void left() {

Serial.println("moving left for 5 second" );

Serial.println("bluetooth working"); digitalWrite(RMP,
HIGH); digitalWrite(RMN, LOW); digitalWrite(LMP, LOW);
digitalWrite(LMN, HIGH);

}

void right() {

Serial.println("moving Right for 5

second" );

Serial.println("bluetooth working");

digitalWrite(RMP, LOW);

digitalWrite(RMN, HIGH);

digitalWrite(LMP, HIGH);

digitalWrite(LMN, LOW);

}

void backward() {

Serial.println("moving Backwards for 5

second" );

//RIGHT MOTION

digitalWrite(RMP, LOW); digitalWrite(RMN, HIGH);
digitalWrite(LMP, LOW); digitalWrite(LMN, HIGH);

}

void forward()

{

Serial.println("moving forward for 5

second" );

Serial.println("bluetooth working");

//LEFT MOTION digitalWrite(RMP, HIGH);
digitalWrite(RMN, LOW); digitalWrite(LMP, HIGH);
digitalWrite(LMN, LOW);

}

void stopme()

{

Serial.println("stop command" ); digitalWrite(RMP, LOW);
digitalWrite(RMN, LOW); digitalWrite(LMP, LOW);
digitalWrite(LMN, LOW);

}

void loop()

{

digitalWrite(trigger, LOW); delayMicroseconds(2);
digitalWrite(trigger, HIGH);

delayMicroseconds(5); // will send waves of 2 ms low wave
& 5 ms high wave

long x = pulseIn(echo, HIGH);

int y = x / (29 * 2);

Serial.print(" cm ");

Serial.println(y);

delay(1000);

if (y < 60) {

digitalWrite(5, HIGH);

digitalWrite(4, HIGH);

stopme();

}

if (Serial.available())

{

char c = Serial.read();
```

```
if (c == 'l' || c == 'L')

{

digitalWrite(trigger, LOW); delayMicroseconds(2);
digitalWrite(trigger, HIGH);

delayMicroseconds(5); // will send waves of 2 ms low wave
& 5 ms high wave

long x = pulseIn(echo, HIGH);

int y = x / (29 * 2);

Serial.print(" cm ");

Serial.println(y);

delay(1000);

if (y < 60) {

digitalWrite(5, HIGH);

digitalWrite(4, HIGH);

stopme();

delay(500);

backward();

delay(2000);

}

else {

left();

digitalWrite(5, LOW);

digitalWrite(4, LOW);

}

}

else if (c == 'r' || c == 'R')

{

digitalWrite(trigger, LOW); delayMicroseconds(2);
digitalWrite(trigger, HIGH);


delayMicroseconds(5); // will send waves of 2 ms low wave
& 5 ms high wave

long x = pulseIn(echo, HIGH);

int y = x / (29 * 2);

Serial.print(" cm ");

Serial.println(y);

delay(1000);

if (y < 60) {

digitalWrite(5, HIGH);

digitalWrite(4, HIGH);

stopme();

delay(500);

backward();

delay(2000);

}

else {

right();

digitalWrite(5, LOW);

digitalWrite(4, LOW);

}

}

else if (c == 'F' || c == 'f')

{

digitalWrite(trigger, LOW); delayMicroseconds(2);
digitalWrite(trigger, HIGH);

delayMicroseconds(5); // will send waves of 2 ms low wave
& 5 ms high wave

long x = pulseIn(echo, HIGH);

int y = x / (29 * 2);

Serial.print(" cm ");

Serial.println(y);

delay(1000);

if (y < 60) {

digitalWrite(5, HIGH);

digitalWrite(4, HIGH);

stopme();

delay(500);

backward();

delay(2000);
```

```
}

else {

forward();

digitalWrite(5, LOW);

digitalWrite(4, LOW);

}

}

else if (c == 'b' || c == 'B')

{

digitalWrite(trigger, LOW); delayMicroseconds(2); digitalWrite(trigger, HIGH);

delayMicroseconds(5); // will send waves of 2 ms low wave & 5 ms high wave

long x = pulseIn(echo, HIGH);

int y = x / (29 * 2);

Serial.print(" cm ");

Serial.println(y);

delay(1000);

if (y < 60) {

digitalWrite(5, HIGH);

digitalWrite(4, HIGH);

stopme();

delay(500);

backward();

delay(2000);
}

else {

backward();

digitalWrite(5, LOW);

digitalWrite(4, LOW);
}
}

else if (c == 'S' || c == 's')
{
stopme();
}
}
}
```

VI. Outcome expected

1. Able to Deliver a Product based on the location of customer.
2. Security Measures
3. Autonomous driverless movement
4. Virtual Control & Insights
5. Authenticate user
6. Fraud detection
7. Able to keep Food Product Fresh
8. Power Backup

VII. Acknowledgment

This is an opportunity to express my sincere gratitude to all. At the very outset, we express our thanks to the almighty god for all the blessings endowed on us. The report is submitted in regard with the project done as a part of the fourth semester curriculum, we acknowledge our Sahrdaya College of engineering and technology for giving us the opportunity to do our project.

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