

Target Object Recognition and Path Following Trolley Robot Using LIDAR

Submitted in partial fulfilment of the requirements for the award of
Bachelor of Engineering degree in
Electronics and Instrumentation Engineering
by

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SCHOOL OF ELECTRICAL AND ELECTRONICS

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**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **M.HEMALATHA** (Reg.No: 37180009) and **S.SRI SHAILU** (Reg.No: 37180017) who carried out the project entitled Target Object Recognition and Path Following Robot using LIDAR under my supervision from January 2021 to March 2021

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We, **M.HEMALATHA** (Register No: 37180009) and **S.SRI SHAILU** (Register No:37180017) hereby declare that the Project Report entitled **Target Object Recognition and Path Following Trolley Robot using Lidar** done by us under the guidance of Mr. N.R.KRISHNAMOORTHY, ME., Ph.D is submitted in partial fulfilment of the requirements for the award of Bachelor of Engineering degree in ELECTRONICS AND INSTRUMENTATION ENGINEERING.

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ABSTRACT

Colour tracking is one of the most important topics in the field of computer Vision. Detection and tracking of moving objects within the video scenes is that the first relevant step within the information extraction in many computer vision applications. This idea can be used for the customers arriving at place. The robot is meant to trace objects by spinning left and right and driving forward and backward to maintain a constant distance between the robot and the object. Images are captured by the camera of an ARM11 Raspberry Pi device which is attached to the robot. Customer can also search for location of a product by entering the name of the product. This system also implemented with automatic billing using RFID reader and tag. This colour tracking feature is embedded with contouring technique. The contouring technique deals with the isolation of the target object and removes the other details from the frame. It blurs the portion of the frame where the target object is not subjected.

This colour tracking technology is embedded with motor for the movement of the robot with the help of raspberry pi. The billing system is efficiently done with the help of RFID which read by RF reader. At the end of the billing, the invoice, the amount reduced and the balance amount is displayed in the LCD display. Not only in the LCD display, it is also notified in our mobile in the form of a message. The turning of robot depends on the movement the target object in the frame. When the target object moves right, the robot turns right and when the target object moves left, the robot turns left. This system is implemented with automatically to identify moves to the line path. TF mini Lidar is used to detect the obstacles detection. If any obstacles are detected the trolley will stop automatically. The trolley robot with all such features is new to the world of technology and will enhance the experience of shopping.

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LIST OF ABBREVIATIONS

RFID	-	Radio Frequency Identification
LCD	-	Liquid Crystal Display
CV	-	Computer Vision
GPIO	-	General Purpose Input Output
UART	-	Universal Asynchronous Receiver/Transmitter
EEPROM	-	Electrically Erasable Read Only Memory
LIDAR	-	Light Detection And Ranging
LED	-	Light Emitting Diode
SD	-	Secure Digital
DC	-	Direct Current
IC	-	Integrated Circuit
OS	-	Operating System
HDMI	-	High Definition Media Interface
USB	-	Universal Serial Bus
SOC	-	System On Chip
ISA	-	Instruction Set Architecture
SPI	-	Serial Peripheral Interface
MISO	-	Master Input Slave Output
MOSI	-	Master Output Slave Input
SLCK	-	Serial Clock
ISP	-	In-System Programming
IRC	-	Internet Relay Chat
PC	-	Personal Computer
ID	-	Identity Document
VCC	-	Voltage Common Collector
GND	-	Ground
CRT	-	Cathode Ray Tube
CPU	-	Central Processing Unit
GT	-	Ground Truth
TP	-	True Positive
FP	-	False Positive

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CHAPTER 1

INTRODUCTION

The advent of wireless technology in conjunction with the other communication techniques helps in making ecommerce very fashionable. Modern futuristic product is that the one that aids the comfort, convenience and efficiency in lifestyle. The main goal of this project is to provide a low cost, easily scalable, and rugged system for aiding shopping face to face. This will find yourself to be very beneficial for the retail stores as more people will enjoy the shopping experience and are available more often to buy. An object tracking device aims to return up with flight of object over time by locating its position in each frames of video. Generally, object following has two main tasks. One is to urge the thing and another one is to work out the correspondence between the articles in each frames of video. These tasks could also be performed either individually or together. In primary case, the article in region has been detected by detector mechanism and later affiliation between objects in sequence of frame has been done by hunter. In later case, the article region and correspondence are together calculable. It's getting to be done by iteratively change object location and region info obtained from previous frames. Shopping is one among the interesting things and basic need for each human. At the present no such embedded system is used in shopping. But this easy task can't be easily performed because customer possesses to await billing procedure for while. The aim of this project is to utilize newly updated technologies and to overcome the difficulties while shopping in retail shop. Thus, we are proposing the smart trolley system by using microcontroller with LIDAR as a newly updated technology.

The System consists of TF mini LIDAR for obstacle avoidance. Each trolley will consist of a unique trolley address. The customers can scan the items by their own and the LCD screen on the shopping cart will keep updating the total. The billing counter can at any point of your time inquire about the present items present within the trolley. This will end up to be very beneficial for the retail stores as more people will enjoy the shopping experience and are available more often to buy. The Smart Shopping trolley has the potential to make the shopping experience comfortable, pleasurable and efficient for the customer.

CHAPTER 2

LITERATURE SURVEY

A.S. Silva et al. in 2016 discussed a novel approach for an object recognition and tracking system, here known as SRCCA by using color recognition within the HSV color space and active contour models (ACM) with the techniques employed for object tracking and detection, also because the elaboration of an open source software through the use of C++ programming language and Open CV functions. To develop the tracking efficiency for targets in motion, the video capturing device was controlled by two servomotors, enabling the target to be followed, just in case it moves in the x or y-axis.

Baoying Chen et al. in 2017 discussed the instability of traditional color feature tracking algorithm in some complex scenes, an object tracking algorithm with integrating color and contour features is proposed. The algorithm still uses the normal particle filter to predict the target, but in iteration whenever, when searching the simplest position of the target, the colour and contour information of the target can be adaptively combined. Experiments show that it shows good effectiveness and robustness compared with the normal algorithms when the target is interfered between similar colors or the target is partially obscured.

Jancy Jabbar et al. in 2017 have developed automatic monitoring of the region using single stationary camera had become a vital part of the surveillance. The tracking of moving objects can undergo limitations such as illumination variation, camera noise, and occlusion. Many methods exist to overcome this limitation. In the multiple moving object system detection is completed by using Mixture of Gaussian supported background subtraction to urge foreground mask. In tracking, it is handled by merge and split technique, feature correspondence is completed using Delta E based colour feature of the multiple moving objects. Delta E gives single value for the colour difference between the objects.

Yi Zheng et al. in 2016 discussed about the human computer interaction, hand tracking is of great importance. A practical and effective hand tracking method by integrating color and shape cues supported particle filters is proposed. Firstly, an elliptical tracking window containing the hand is set manually within the initial frame. Then the likelihood functions of two tracking cues are often obtained. A first order system equation is employed because the motion model.

In the tracking process, the weights of every cue are calculated frame by frame. Experimental results demonstrate the proposed method that can track the moving hand accurately

Sheng fang Lu et al. in 2018 discussed Automatic fault inspection, aiming at either one target or an object of a foothold predictive within the image, could also be a standard paradigm in railway maintenance. However, the fault detection of multiple targets with unknown initial locations is never conducted. In this paper, an automatic fault detection system for multiple targets supported time-scale normalization is proposed with the high-quality linear camera. For location of the multiple targets within the image sequences, it's important to form sure that the target and standard images are exactly aligned. To affect this problem, the image distortion, caused by the speed fluctuation of the moving train or the discordant movement between the linear scan camera and therefore the train, must be corrected consistent with the dimensions of the quality image. The scale in variant feature transformation points based on Sobel gradient is first extracted and matched accurately with the geometric constraint.

Galande Jayshree et al. in 2018 discussed concept of RFID tags and RFID reader to scan the products and get the bill of total number of item purchased. But the RFID systems are costlier than barcode system and it are often less reliable. To overcome this drawback we've used the concept of automated shopping trolley using raspberry pi and barcode scanner with LCD display, it consist barcode rather than RFID tags. The customer will scan the barcode instead of RFID tags. Also with the utilization of barcode we don't have to attach separate tags to the products, barcode is printed on the merchandise itself.

Leena Thomas et al. in 2017 discussed an innovative concept of RFID Based Smart Shopping and Billing. The key idea here is to assist a person in everyday shopping in terms of reduced time spent while purchasing a product. The main goal is to provide a technology oriented, low-cost, easily scalable, and rugged system for aiding shopping in person. The developed system comprises of a Server unit (SU), a User Interface unit (UIU), an in-built Billing Unit (BU) and Central unit (CU).SU will help in establishing and maintaining the connection of the shopping cart with the main server. UIU will provide the customer with user interface and the billing unit enables the user to pay the amount and leave the place without waiting at the counter in large queues.

These units are integrated into a smart enclosed system and are tested to satisfy the functionality. The smart shopping cart will help shorten the checkout lines thereby helping the customers at retail stores. The customers will be able to scan the items themselves and the LCD screen on the shopping cart will keep updating the total. This will turn out to be very beneficial for the retail stores as more people will enjoy the shopping experience and come more often to shop.

Sarala T et al. in 2018 discussed main purpose is to assist a person in Shopping to reduce time while purchasing products. Electronic trolley is fitted out with Barcode reader that scans the identification of outcome and internet connection with shop's server. It is also consists of LCD exhibits that notify the number of items and total amount to customers and Barcode scanner identifies the outcome and updates the bill. Swiping machine will be provided to recompense the bill through credit/debit cards. In this paper, we report the performance or administration of reliable and more efficiency smart trolley shopping using WSN such a trolley is acceptable for supermarkets, it can helps in reducing manpower and creating better shopping occurrence for customers. All the items or products will be provision with barcode. Barcode reader will be positioned in all the trolleys to identify the product and refurbish the bill. It is consumer oriented system which makes today's shopping easier, faster and enjoyable. The organisation is composed of BARCODE based trolleys which liaise with the act or instance of preparing invoice wirelessly using a Barcode reader. The customer will be able to scan the products themselves and LCD exhibits on the trolley will updating the number items and total bill. This is huge profitable for retail stores as more customers will enjoy the shopping. The main goal of smart electronic shopping market trolley is to reduce the time taken in billing section in shopping malls and grocery stores by designing a smart electronic trolley which uses barcode reader to allow users to self-checkout and increase the productivity time and reduce the paper usage while billing and reduce the man power in the billing section.

R.N. Jogekar et al. in 2018 discussed our views on an automated shopping trolley using raspberry pi device combined with bar code scanner and LCD display. As we know that during sales and holidays we observe rush at supermarkets and due to this billing process becomes more time consuming and customer cannot stand for too long in a queue for billing purpose so, here we can make use of the automated shopping trolley which has barcode scanner,

raspberry pi and LCD display. Using this trolley the customer will self-scan the product by himself and prepare the bill. Hence, there will be no long queue in the supermarket at billing counter for billing purpose. In this paper they have proposed a system in which RFID tags are attached with products and that tags are read by the RFID reader. But in this system it may happen that more than one RFID tag can respond at the same time. Also, RFID tags are usually larger than barcode. To overcome this drawback we use barcode and barcode scanner which is more efficient.

Vaishali Rane et al. in 2019 discussed to minimize the Queue at a billing counter in a shopping complex. Smart Trolley does the same by displaying the total price of the product kept inside the cart. In this way the customer can directly pay the amount at the billing counter and leave with the commodities he/she has bought. The hardware is based on Arduino Uno, RFID Reader Module, RFID Card and Buzzer. It eliminates the traditional scanning of products at the counter and in turn speeds up the entire process of shopping, also with this system the customer shall know the total amount to be paid and hence can accordingly plan his shopping only buying the essential commodities resulting in enhanced savings. Since the entire process of billing is automated it reduces the possibility of human error substantially. Also the system has a feature to delete the scanned products by customer to further optimize the shopping experience.

Viswanadha V et al. in 2018 discussed each and every product has barcode tag on it. Barcode scanner reads the product information before put into the trolley. The customers have to drop every product in the trolley after scanning the products. Whenever the customers scan the products, the Raspberry Pi touch screen display displays the cost of the products, total number of items and total cost of the products. When the customer wants to remove the product from the cart, a push button is placed in the cart. Then customer presses the button and scans the product then automatically reduces the cost of the product in the total amount and as well as it removes from cart. So that the customer must know total amount of products before they go to the billing section and thus it improves the speed of the purchasing. A QR code is attached to the trolley. The customer scans the QR code then an E-bill is generated into the customer mobile and the customer can pay through online or offline.

Raghav Chadha et al. in 2019 discussed the framework planned comprises of smart labels (Passive RFID Tags), appended to physical objects. They radiate radio waves which are encountered by the RFID Reader in trolley system; the coiled antenna inside the smart labels start to emit a magnetic field around it. The smart label withdraws power from it, energizing the circuits in the tag. The label at that point sends the data that is present in the smart label by converting the radio waves to a more usable form of data. Products added into the trolley are scanned using RFID and matched with the Database and hence product name is shown on the LCD screen. When the customer has completed the shopping the application will be redirected to the payments page, where the payment can be made by cash or card. After making the payment the customer can logout.

Mr.P.Chandrasekar et al. in 2014 discussed each cart is attached with product identification device (PID), through ZigBee communication PID sends its information to central automated billing system, there it calculates net price for the purchased products. Customer can get their billing information at the packing section according to their Cart Identification Number.

Ashutosh Walimbe et al. in 2020 discussed autonomous shopping carts which move to the section as customer click on a map on either the cart screen or on a mobile application. Also, the stock of all products could be updated in real-time, so that customers get to know which products are not available at the moment, saving their time.

Mayur Sanap et al. in 2020 discussed a system that can detect products without scanning the line of sight using RFID technology, as well as this system, provides visually help to the customer for a recording of total bill amount and product details. The System is designed such that all purchase product information and total bill amount is wirelessly transferred to the billing counter which helps to reduce the time of shopping.

CHAPTER 3

AIM & SCOPE

Aim of the current work is to develop a robot for the activity of the trolley. Installing programmed trolley value ID and billing card utilizing RFID tag. As a general arrangement this robot will move along the shopping person particularly for old people groups and when the trolley is full, it will naturally moves to the counter.

3.1 BLOCK DIAGRAM

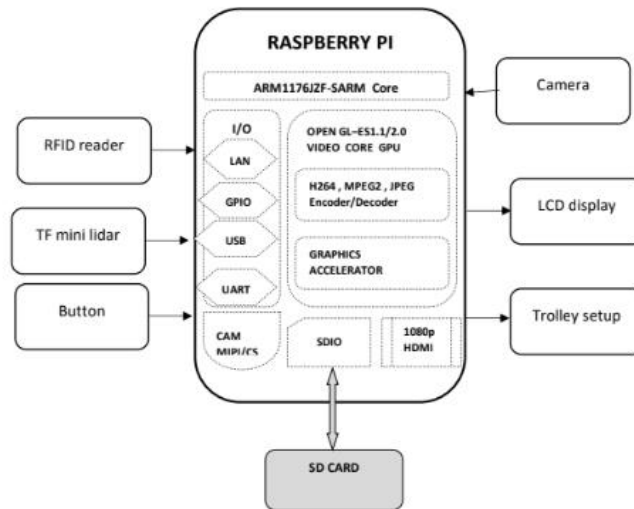


Fig: 3.1: Block diagram

Raspberry pi has been taken as the core of the article following trolley which is associated with an info gadgets camera, TF mini lidar, button and RFID reader with labels, each depicting various items which is shown in the Fig: 3.1. A robot is made and remaining parts are fixed. An engine arrangement makes the development of the robot. Bill is sent to the customer's mobile as SMS.

3.2 EXISTING SYSTEM

Study on IoT applications may be a popular topic in recent years, but smart shopping systems have not been well investigated. In recent years, some research works being published regarding improving customers' shopping experience. We proposed the idea of tracking a customer within the store and discovering customers' interests so as to supply personalized coupons. the thought of smart shelves and smart cart were also discussed in their work.

Smart cart can be tracked using RFID technology and smart shelves can monitor the situation and statuses of the items. Smart cart and that they are one among the primary examples to deal with the antitheft issue. Their design was almost like a mail receptacle: a chute, where items are inserted and scanned, then dropped into a closed chamber. The chamber had a door on the highest which could only be opened if the user had purchased the things.

3.2.1 DISADVANTAGES

- The trolley ought to be moved by client.
- They should remain in long line for billing.
- Lot of time is squandered for billing reason.
- Energy gets squandered on moving trolley from one spot.

3.3 PROPOSED SYSTEM

This aims to assist create intelligent autonomous behaviour and movement control which makes it vital for the appliance of object trolley follower. The camera is one type of hardware which will be used as a sensor to assist identifies the encompassing environment and may be connected with python. python programming language functions as digital image processing and produces an output which will be used as an impact regard to follow a target supported color on human follower trolley robot .Python is meant for developers and researchers within the field of computer vision and artificial artificial nerves, genetic algorithms, symbolic logic and robotics. This research discusses the planning and builds new innovations from the target trolley robots. The researcher will implement for goods trolley. The benefit of robot that can facilitate transfer of goods from one place to another. The traditional and conservative manual trolley is not effective in terms of your time and energy cause by the trolley system is using the hand or manual trolley when moving items. This conveys the importance of automatic trolleys makes it easier for trolley supermarket's users. This tool will then follow the target employing a camera sensor by detecting the colours R, G and B from the target color using python which uses open CV as an open source library to simplify the image processing of trolley robot. So that this trolley can help humans move things and make a way of comfort and efficiency while doing these activities.

TF mini lidar is used to find the distance and obstacles. Once to press the button trolley automatically goes to the billing location

3.3.1 ADVANTAGES

- The proposed framework contains changed client following progression.
- Automatic billing system is implemented.
- Time of the client is saved.
- The details of product and billing are displayed.

CHAPTER 4

METHODS, ALGORITHMS AND MATERIALS

4.1 CIRCUIT DIAGRAM

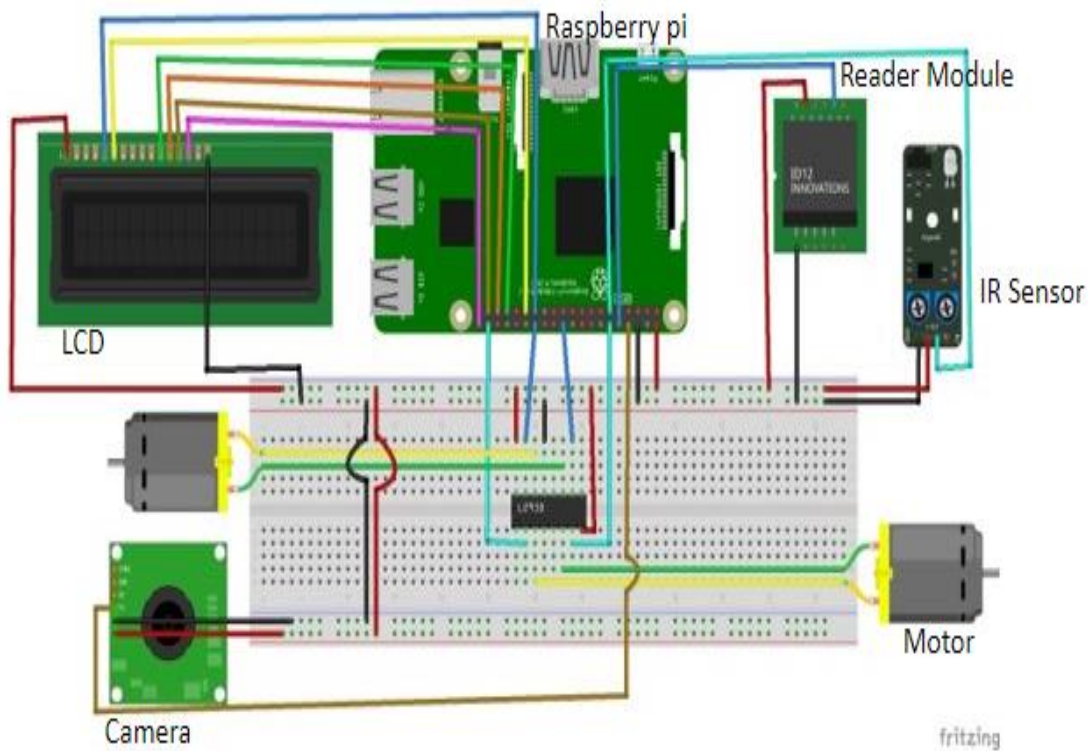


Fig: 4.1: Circuit diagram

The force supply (VSS/V) pins of all pieces are connected with the capacity source and furthermore the ground pins of the similar are connected with the ground pin of the capacity source is shown in Fig: 4.1. The adjusted GPIO ID number is clarified with the yield pins of the enormous number of bits. The LCD pins are connected with the distinctive GPIO pins. The RFID reader's TX pin is clarified with the TX GPIO pin accessible in the raspberry pi board, likewise to the RX pin. In this way, the pins are connected for the development of the segment. Flow chart is shown in Fig: 4.2.

4.2 FLOW CHART

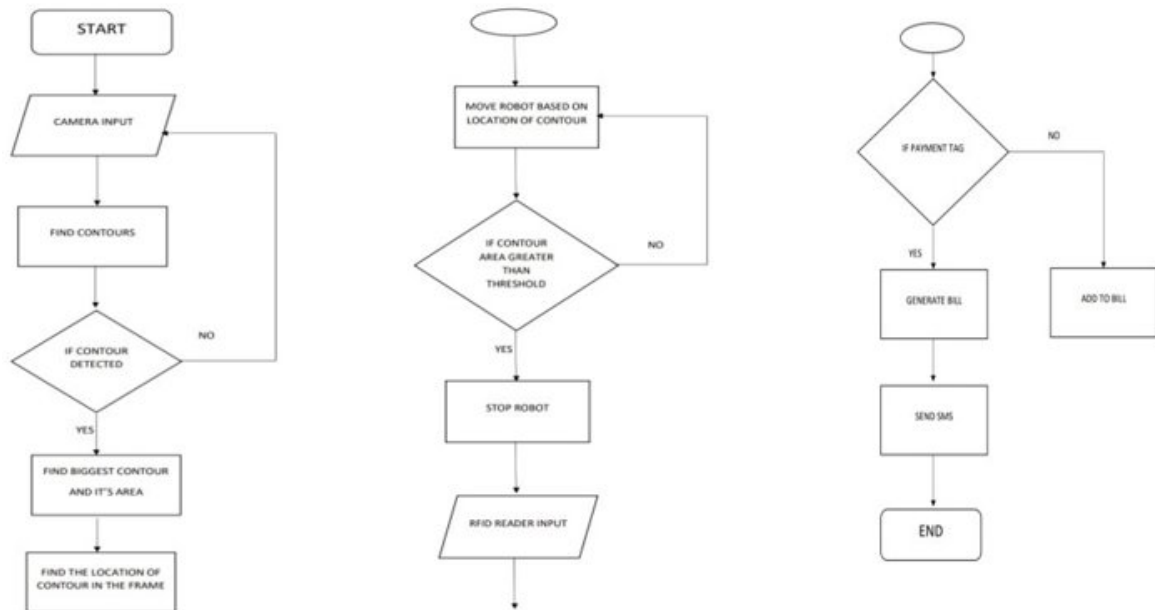


Fig: 4.2: Flow chart

4.3 HARDWARE REQUIREMENTS

- ❖ Raspberry Pi board.
- ❖ Camera.
- ❖ Robot trolley
- ❖ LCD
- ❖ RFID
- ❖ RFID READER and RAG
- ❖ TF mini lidar
- ❖ Button

4.3.1 RASPBERRY PI BOARD

Raspberry Pi could be a little single-board Computer made in UK by Raspberry Pi establishment to impel the preparation of programming in schools and in non-present day nations. Novel model become clearly more norm than expected fixing outside of its objective market, for uses like robots. The focal point of the Raspberry Pi could be a Broadcom System on Chip (SoC) which combines

ARM sensible CPU and on-chip reasonable preparing unit and Videocore IV. the key section from First an ideal opportunity to the Third time joins:

CPU speed goes from 700 MHz to 1.2 GHz, On make full Memory (RAM) goes from 256 MB to 1 GB, USB opening changes from 1 space to USB openings, HDMI composite video yield and 3.5mm jack, Low level yield is given by GPIO pins which support standard shows like I2C (between encouraged circuit), Ethernet 8 Position 8 Contact (8P8C) shown in Fig: 4.3.

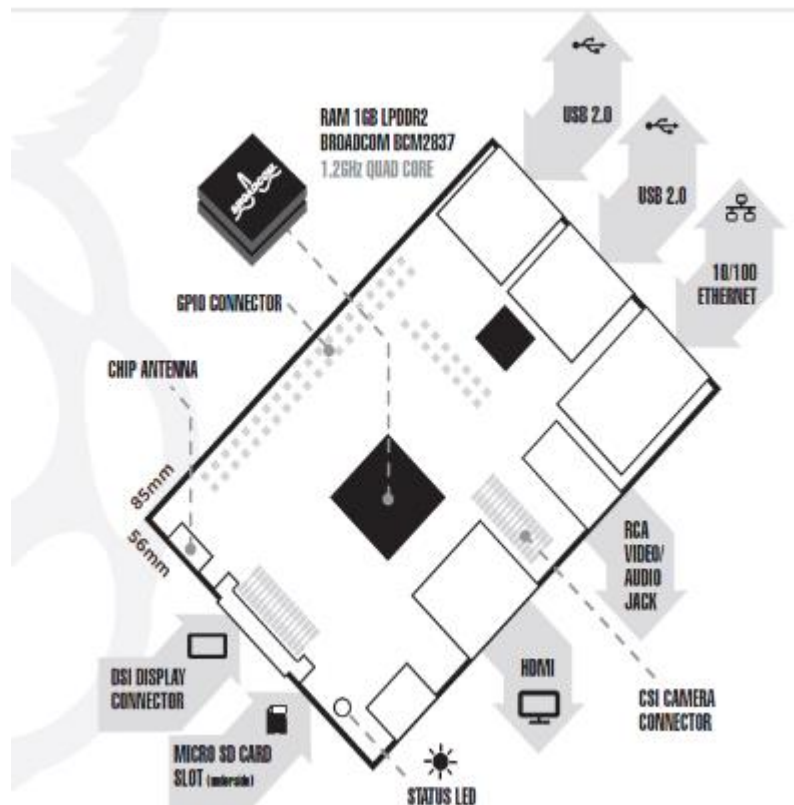


Fig: 4.3: Raspberry pi outline

The ARM-based BCM2837 is the mystery of how the Raspberry Pi can deal with the 5V 1A force supply given by the on board little USB port. It's also the motivation driving why you will not discover any sparkle sinks on the gadget: the chip's low force draw unmistakably changes over into on the mark of no waste warmth, in any case, during bewildered dealing with attempts. It does, in any case, derive that the Raspberry Pi isn't practical with standard PC programming. Most of programming for work domains and workstations is worked considering the x86 heading set arrangement, as found in processors from any likeness to AMD, Intel and VIA. Consequently, it will not sudden spike well known for the ARM-based Raspberry Pi. The BCM2837 utilizes an age of ARM's processor arrangement

called ARM11, which as such is organized around an understanding of the heading set planning called ARMv6.

This legitimizes reviewing: ARMv6 could be a lightweight and shocking arrangement, yet has a foe in the further made ARMv7 planning used by the ARM Cortex get together of processors. Programming made for ARMv7, such as programming made for x86, is disastrously not reasonable with the Raspberry Pi's BCM2837— dismissing the way that designers can consistently change the thing over to make it appropriate. This isn't to recommend that you simply are restricted in your decisions. As you'll find later in the book, there's a lot of programming accessible for the ARMv6 heading set, and as the Raspberry Pi's ubiquity keeps making, that may just expansion. In this book, you'll moreover arranged out an approach to shape your own thing for the Pi whether you have no commitment in programming.

SPECIFICATIONS

Processor: Broadcom BCM2387 chipset, 1.2GHz Quad-Core ARM Cortex-A53, 802.11 b/g/n Wireless LAN and Bluetooth 4.1 (Bluetooth Classic and LE)

GPU: Dual Core VideoCore IV® Multimedia Co-Processor. Provides Open GL ES 2.0, hardware-accelerated OpenVG, and 1080p30 H.264 high-profile decode. Capable of 1Gpixel/s, 1.5Gtexel/s or 24GFLOPs with texture filtering and DMA infrastructure

Memory: 1GB LPDDR2

Operating System: Boots from Micro SD card, running a version of the Linux operating system or Windows 10 IoT

Dimensions: 85 x 56 x 17mm

Power Micro: USB socket 5V1, 2.5A

The Raspberry Pi's GPIO port and its pin definitions Pin numbers for the GPIO port are part into two lines, with the base line taking the odd numbers and the top line the even numbers. It's essential to remember this when working with the Pi's GPIO port: most different gadgets utilize an alternate framework for numbering pins, and on the grounds that there are no markings on the actual Pi, it's not difficult to get befuddled between the pins. Interface nothing to the pins checked Do Not Connect; these are held for interior elements of the Pi's BCM2837

framework on-chip (SoC) equipment. Interfacing anything to these will bring about harm to the Pi. Refer Table 4.1, 4.2, 4.3 & 4.4.

Table 4.1(a,b,c,d): GPIO Port

	Pull	ALT0	ALT1	ALT2	ALT3	ALT4	ALT5
GPIO0	High	SDA0	SA5	<reserved>			
GPIO1	High	SCL0	SA4	<reserved>			
GPIO2	High	SDA1	SA3	<reserved>			
GPIO3	High	SCL1	SA2	<reserved>			
GPIO4	High	GPCLK0	SA1	<reserved>			ARM_TDI
GPIO5	High	GPCLK1	SA0	<reserved>			ARM_TDO
GPIO6	High	GPCLK2	SOE_N / SE	<reserved>			ARM_RTCK
GPIO7	High	SPI0_CE1_N	SWE_N / SRW_N	<reserved>			
GPIO8	High	SPI0_CE0_N	SD0	<reserved>			
GPIO9	Low	SPI0_MISO	SD1	<reserved>			
GPIO10	Low	SPI0_MOSI	SD2	<reserved>			
GPIO11	Low	SPI0_SCLK	SD3	<reserved>			
GPIO12	Low	PWM0	SD4	<reserved>			ARM_TMS

(b)

GPIO25	Low	<reserved>	SD17	<reserved>	SD1_DAT1	ARM_TCK	
GPIO26	Low	<reserved>	<reserved>	<reserved>	SD1_DAT2	ARM_TDI	
GPIO27	Low	<reserved>	<reserved>	<reserved>	SD1_DAT3	ARM_TMS	
GPIO28	-	SDA0	SA5	PCM_CLK	<reserved>		
GPIO29	-	SCL0	SA4	PCM_FS	<reserved>		
GPIO30	Low	<reserved>	SA3	PCM_DIN	CTS0		CTS1
GPIO31	Low	<reserved>	SA2	PCM_DOUT	RTS0		RTS1
GPIO32	Low	GPCLK0	SA1	<reserved>	TXD0		TXD1
GPIO33	Low	<reserved>	SA0	<reserved>	RXD0		RXD1
GPIO34	High	GPCLK0	SOE_N / SE	<reserved>	<reserved>		

(c)

GPIO13	Low	PWM1	SD5	<reserved>			ARM_TCK
GPIO14	Low	TXD0	SD6	<reserved>			TXD1
GPIO15	Low	RXD0	SD7	<reserved>			RXD1
GPIO16	Low	<reserved>	SD8	<reserved>	CTS0	SPI1_CE2_N	CTS1
GPIO17	Low	<reserved>	SD9	<reserved>	RTS0	SPI1_CE1_N	RTS1
GPIO18	Low	PCM_CLK	SD10	<reserved>	BSCSL SDA / MSTR	SPI1_CE0_N	PWM0
GPIO19	Low	PCM_FS	SD11	<reserved>	BSCSL SCL / RCLK	SPI1_MISO	PWM1
GPIO20	Low	PCM_DIN	SD12	<reserved>	BSCSL / MISO	SPI1_MOSI	GPCLK0
GPIO21	Low	PCM_DOUT	SD13	<reserved>	BSCSL / CE_N	SPI1_SCLK	GPCLK1
GPIO22	Low	<reserved>	SD14	<reserved>	SD1_CLK	ARM_TRST	
GPIO23	Low	<reserved>	SD15	<reserved>	SD1_CMD	ARM_RTCK	
GPIO24	Low	<reserved>	SD16	<reserved>	SD1_DAT0	ARM_TDO	

(d)

GPIO41	Low	PWM1	SD5	<reserved>	<reserved>	SPI2_MOSI	RXD1
GPIO42	Low	GPCLK1	SD6	<reserved>	<reserved>	SPI2_SCLK	RTS1
GPIO43	Low	GPCLK2	SD7	<reserved>	<reserved>	SPI2_CE0_N	CTS1
GPIO44	-	GPCLK1	SDA0	SDA1	<reserved>	SPI2_CE1_N	
GPIO45	-	PWM1	SCL0	SCL1	<reserved>	SPI2_CE2_N	
GPIO46	High	<internal>					
GPIO47	High	<internal>					
GPIO48	High	<internal>					
GPIO49	High	<internal>					
GPIO50	High	<internal>					
GPIO51	High	<internal>					
GPIO52	High	<internal>					
GPIO53	High	<internal>					

Table 4.2: GPFSEL0

Bit(s)	Field Name	Description	Type	Reset
31-30	---	Reserved	R	0
29-27	FSEL9	<u>FSEL9 - Function Select 9</u> 000 = GPIO Pin 9 is an input 001 = GPIO Pin 9 is an output 100 = GPIO Pin 9 takes alternate function 0 101 = GPIO Pin 9 takes alternate function 1 110 = GPIO Pin 9 takes alternate function 2 111 = GPIO Pin 9 takes alternate function 3 011 = GPIO Pin 9 takes alternate function 4 010 = GPIO Pin 9 takes alternate function 5	R/W	0
26-24	FSEL8	FSEL8 - Function Select 8	R/W	0
23-21	FSEL7	FSEL7 - Function Select 7	R/W	0
20-18	FSEL6	FSEL6 - Function Select 6	R/W	0
17-15	FSEL5	FSEL5 - Function Select 5	R/W	0
14-12	FSEL4	FSEL4 - Function Select 4	R/W	0
11-9	FSEL3	FSEL3 - Function Select 3	R/W	0
8-6	FSEL2	FSEL2 - Function Select 2	R/W	0
5-3	FSEL1	FSEL1 - Function Select 1	R/W	0
2-0	FSEL0	FSEL0 - Function Select 0	R/W	0

Table 4.3: GPFSEL1

Bit(s)	Field Name	Description	Type	Reset
31-30	---	Reserved	R	0
29-27	FSEL19	<u>FSEL19 - Function Select 19</u> 000 = GPIO Pin 19 is an input 001 = GPIO Pin 19 is an output 100 = GPIO Pin 19 takes alternate function 0 101 = GPIO Pin 19 takes alternate function 1 110 = GPIO Pin 19 takes alternate function 2 111 = GPIO Pin 19 takes alternate function 3 011 = GPIO Pin 19 takes alternate function 4 010 = GPIO Pin 19 takes alternate function 5	R/W	0
26-24	FSEL18	FSEL18 - Function Select 18	R/W	0
23-21	FSEL17	FSEL17 - Function Select 17	R/W	0
20-18	FSEL16	FSEL16 - Function Select 16	R/W	0
17-15	FSEL15	FSEL15 - Function Select 15	R/W	0
14-12	FSEL14	FSEL14 - Function Select 14	R/W	0
11-9	FSEL13	FSEL13 - Function Select 13	R/W	0
8-6	FSEL12	FSEL12 - Function Select 12	R/W	0
5-3	FSEL11	FSEL11 - Function Select 11	R/W	0
2-0	FSEL10	FSEL10 - Function Select 10	R/W	0

Table 4.4(a,b,c,d): GPIO REGISTERS

(a)

Bit(s)	Field Name	Description	Type	Reset
31-30	---	Reserved	R	0
29-27	FSEL29	FSEL29 - Function Select 29 000 = GPIO Pin 29 is an input 001 = GPIO Pin 29 is an output 100 = GPIO Pin 29 takes alternate function 0 101 = GPIO Pin 29 takes alternate function 1 110 = GPIO Pin 29 takes alternate function 2 111 = GPIO Pin 29 takes alternate function 3 011 = GPIO Pin 29 takes alternate function 4 010 = GPIO Pin 29 takes alternate function 5	R/W	0
26-24	FSEL28	FSEL28 - Function Select 28	R/W	0
23-21	FSEL27	FSEL27 - Function Select 27	R/W	0
20-18	FSEL26	FSEL26 - Function Select 26	R/W	0
17-15	FSEL25	FSEL25 - Function Select 25	R/W	0
14-12	FSEL24	FSEL24 - Function Select 24	R/W	0
11-9	FSEL23	FSEL23 - Function Select 23	R/W	0
8-6	FSEL22	FSEL22 - Function Select 22	R/W	0
5-3	FSEL21	FSEL21 - Function Select 21	R/W	0
2-0	FSEL20	FSEL20 - Function Select 20	R/W	0

(b)

GPIO Alternate function select register 2

Bit(s)	Field Name	Description	Type	Reset
31-30	---	Reserved	R	0
29-27	FSEL39	FSEL39 - Function Select 39 000 = GPIO Pin 39 is an input 001 = GPIO Pin 39 is an output 100 = GPIO Pin 39 takes alternate function 0 101 = GPIO Pin 39 takes alternate function 1 110 = GPIO Pin 39 takes alternate function 2 111 = GPIO Pin 39 takes alternate function 3 011 = GPIO Pin 39 takes alternate function 4 010 = GPIO Pin 39 takes alternate function 5	R/W	0
26-24	FSEL38	FSEL38 - Function Select 38	R/W	0
23-21	FSEL37	FSEL37 - Function Select 37	R/W	0
20-18	FSEL36	FSEL36 - Function Select 36	R/W	0
17-15	FSEL35	FSEL35 - Function Select 35	R/W	0
14-12	FSEL34	FSEL34 - Function Select 34	R/W	0
11-9	FSEL33	FSEL33 - Function Select 33	R/W	0
8-6	FSEL32	FSEL32 - Function Select 32	R/W	0

(c)

Bit(s)	Field Name	Description	Type	Reset
31-30	--	Reserved	R	0
29-27	FSEL49	<u>FSEL49 - Function Select 49</u> 000 = GPIO Pin 49 is an input 001 = GPIO Pin 49 is an output 100 = GPIO Pin 49 takes alternate function 0 101 = GPIO Pin 49 takes alternate function 1 110 = GPIO Pin 49 takes alternate function 2 111 = GPIO Pin 49 takes alternate function 3 011 = GPIO Pin 49 takes alternate function 4 010 = GPIO Pin 49 takes alternate function 5	R/W	0
26-24	FSEL48	FSEL48 - Function Select 48	R/W	0
23-21	FSEL47	FSEL47 - Function Select 47	R/W	0
20-18	FSEL46	FSEL46 - Function Select 46	R/W	0
17-15	FSEL45	FSEL45 - Function Select 45	R/W	0
14-12	FSEL44	FSEL44 - Function Select 44	R/W	0
11-9	FSEL43	FSEL43 - Function Select 43	R/W	0
8-6	FSEL42	FSEL42 - Function Select 42	R/W	0
5-3	FSEL41	FSEL41 - Function Select 41	R/W	0
2-0	FSEL40	FSEL40 - Function Select 40	R/W	0

(d)

GPIO Alternate function select register 4

Bit(s)	Field Name	Description	Type	Reset
31-12	--	Reserved	R	0
11-9	FSEL53	<u>FSEL53 - Function Select 53</u> 000 = GPIO Pin 53 is an input 001 = GPIO Pin 53 is an output 100 = GPIO Pin 53 takes alternate function 0 101 = GPIO Pin 53 takes alternate function 1 110 = GPIO Pin 53 takes alternate function 2 111 = GPIO Pin 53 takes alternate function 3 011 = GPIO Pin 53 takes alternate function 4 010 = GPIO Pin 53 takes alternate function 5	R/W	0
8-6	FSEL52	FSEL52 - Function Select 52	R/W	0
5-3	FSEL51	FSEL51 - Function Select 51	R/W	0
2-0	FSEL50	FSEL50 - Function Select 50	R/W	0

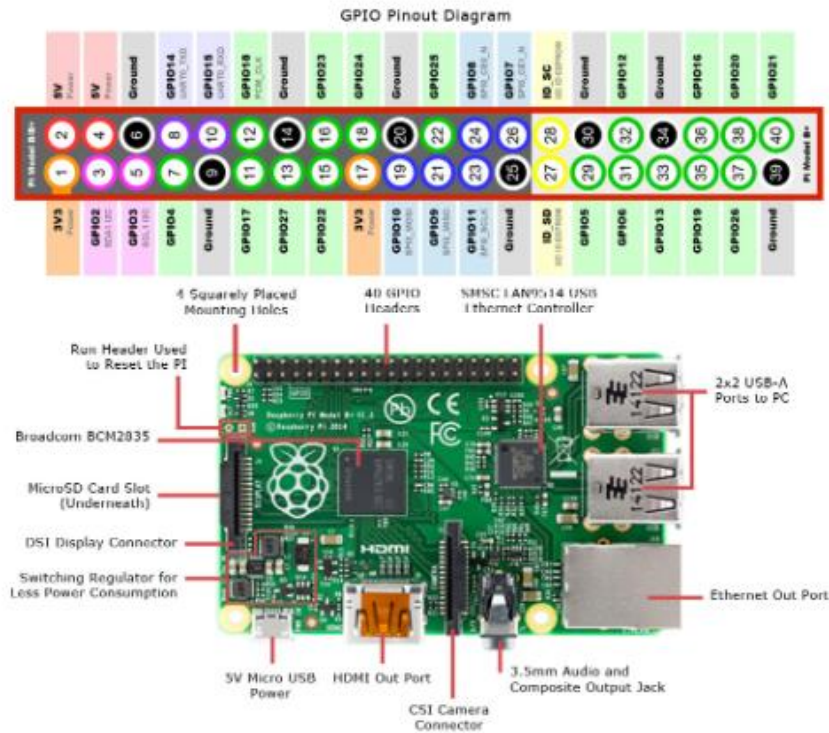


Fig: 4.4: Raspberry pi GPIO layout

Although the Pi's GPIO port provides a 5 V power supply, tapped from the incoming power on the micro-USB hub, on Pin 2, the Pi's internal workings are based on 3.3 V logic. This means that the components on the Pi work from a 3.3 V power supply. If you're planning on creating a circuit that will interface with the Pi through its GPIO port, make sure you are using components compatible with 3.3 V logic or are passing the circuit through a voltage regulator before it reaches the Pi. Connecting a 5 V supply to any pin on the Raspberry Pi's GPIO port, or directly shorting either of the power supply pins (Pin 1 and Pin 2) to any other pin will result in damage to the Pi. Because the port is wired directly to pins on the Broadcom BCM2837 SoC processor, you will not be able to repair any damage you do to it. Always be extra careful when working around the GPIO port.

The GPIO port provides seven pins for general-purpose use by default: Pin 11, Pin 12, Pin 13, Pin 15, Pin 16, Pin 18 and Pin 22 as shown in Fig: 4.4. Additionally, Pin 7 while defaulting to providing a clock signal for general purpose use can also be used as a general purpose pin, giving eight pins in total. These pins can be toggled between two states: high, where they are providing a positive voltage of 3.3 V; and low, where they are equal to ground or 0 V.

This equates to the 1 and 0 of binary logic, and can be used to turn other components on or off. You'll learn more about this later in the chapter. The Pi's internal logic operates at 3.3 V. This is in contrast to many common microcontroller devices, such as the popular Arduino and its variants, which typically operate at 5 V. Devices designed for the Arduino may not work with the Pi unless a level translator or optical isolator is used between the two. Likewise, connecting pins on a 5 V microcontroller directly to the Raspberry Pi's GPIO port will not work and may permanently damage the Pi.

In addition to these general-purpose pins, the GPIO port has pins dedicated to particular buses. These buses are described in the following subsections.

Installing the GPIO Python Library

Since the launch of the Pi, numerous developers have created software modules known as libraries for making full use of its various functions. In particular, programmers have addressed the Pi users' need to access the GPIO port without having to know low-level programming.

These libraries are designed to extend the functionality of the base Python language, much like the pygame software described, "Python Basics". Installing one of these libraries gives Python the ability to easily address the Pi's GPIO port, although it means that anyone planning to use the software you create will also have to download and install the library before it will work. There are several GPIO Python libraries available, but for the purpose of this section, we recommend that you use the raspberry-gpio-python library, which was at version 0.2.0 at the time of writing. Although it's possible to download the Python library through a web browser, it's significantly quicker to do so through the terminal as part of the installation process. Just follow these steps:

1. Open a terminal window on your Raspberry Pi from the Accessories menu, or use the console if you haven't loaded a desktop environment.

2. Type `wget`

<http://raspberrypi-gpio-python.googlecode.com/files/RPi.GPIO-0.2.0.tar.gz>

to download the library to your home directory. If a newer version has been released, replace the version number—0.2.0—with the current version.

3. Type `tar xvfz RPi.GPIO-0.2.0.tar.gz` to extract the contents of the file. This command is case-sensitive, so make sure to type the capital letters.
4. Type `cd RPi.GPIO-0.2.0` to change to the newly created directory. Again, if you downloaded a newer version of the library, replace the version number with that of the downloaded version.
5. Type `sudo python setup.py install` to install the library into Python. Although the GPIO library is now installed in Python, it won't be loaded by default. Like pygame, the library needs to be explicitly imported into your program `m`. To use the library, start your program with `import RPi.GPIO as GPIO` at the top. You'll learn more about this in the following examples.

The Raspberry Pi's GPIO port does not provide any protection against voltage spikes or electrical shorts. Always make sure you've checked that your circuit is sound before connecting it to the Pi. If possible, use an isolation board such as the Gertboard to provide protection.

Calculating Limiting Resistor Values an LED needs a current limiting resistor to protect it from burning out. Without a resistor, an LED will likely only work for a short time before failing and An LED needs a current limiting resistor to protect it from burning out. Without a resistor, an LED will likely only work for a short time before failing and needing to be replaced. Knowing a resistor is required is one thing, but it's also important to pick the right resistor for the job. Too high a value and the LED will be extremely dim or fail to light at all; too low a value and it will burn out. To calculate the resistor value required, you will need to know the forward current of your LED. This is the maximum current the LED can draw before being damaged, and is measured in milliamps (mA). You'll also need to know the forward voltage of the LED. This latter value, measured in volts, should be 3.3 V or lower—any higher, and the LED will require an external power supply and a switching device known as a transistor before it will work with the Pi.

The easiest way to work out how large a resistor is required is with the formula $R=(V-F)/I$, where R is resistance in ohms, V is the voltage applied to the LED, F is the forward voltage of the LED and I is the maximum forward current of the LED in amps (with a thousand mA to the amp). Taking a typical red LED with a forward current of 25 mA and a forward voltage of 1.7 V, and powering it using the 3.3 V supplied by the Pi's GPIO port, you can calculate the resistor needed as (3.3

– $1.7 / 0.025 = 64$. Thus, a resistor of $64\ \Omega$ or higher will protect the LED. These figures rarely come out to match the common resistor values as sold, so when you're choosing a resistor, always round up to ensure the LED is protected. The nearest commonly available value is $68\ \Omega$, which will adequately protect the LED. If you don't know the forward voltage and forward current of your LEDs (for example, if the LEDs did not come with documentation or were salvaged from scrap electronics), err on the side of caution and fit a reasonably large resistor. If the LED is too dim, you can revise downwards—but it's impossible to repair an LED that has been blown.

4.3.2 Camera



Fig: 4.5: Camera

A webcam(Fig: 4.5) is a video camera that feeds or streams an image or video in real time to or through a computer to a computer network, such as the Internet. Webcams are typically small cameras that sit on a desk, attach to a user's monitor, or are built into the hardware. Webcams can be used during a video chat session involving two or more people, with conversations that include live audio and video. For example, Apple's iSight camera, which is built into Apple laptops, iMacs and a number of iPhones can be used for video chat sessions, using the iChat instant messaging program (now called Messages). Webcam software enables users to record a video or stream the video on the Internet. As video streaming over the Internet requires a lot of bandwidth, such streams usually use compressed formats. The maximum resolution of a webcam is also lower than most hand held video cameras, as higher resolutions would be reduced during transmission. The lower resolution enables webcams to be relatively inexpensive compared to most video cameras, but the effect is adequate for video chat sessions.

SPECIFICATIONS

Interface	USB
Image sensor	CMOS
Lens	3P High quality lens
Video resolution	640*480(30 FPS)
Cable length	1.2 Meter
Product dimension	40.5*63.5*70.5 mm (W*D*H)
Package dimension	85*65*97 mm (W*D*H)
Net weight	70 g

Various lenses are available, the most common in consumer-grade webcams being a plastic lens that can be manually moved in and out to focus the camera. Fixed-focus lenses, which have no provision for adjustment, are also available. As a camera system's depth of field is greater for small image formats and is greater for lenses with a large f-number (small aperture), the systems used in webcams have a sufficiently large depth of field that the use of a fixed-focus lens does not impact image sharpness to a great extent.

Most models use simple, focal-free optics (fixed focus, factory-set for the usual distance from the monitor to which it is fastened to the user) or manual focus.

Compression

Digital video streams are represented by huge amounts of data, burdening its transmission (from the image sensor, where the data is continuously created) and storage alike. Most if not all cheap webcams come with built-in ASIC to do video compression in real-time.

Support electronics read the image from the sensor and transmit it to the host computer. The camera pictured to the right, for example, uses a Sonix SN9C101 to transmit its image over USB. Typically, each frame is transmitted uncompressed in RGB or YUV or compressed as JPEG. Some cameras, such as mobile-phone cameras, use a CMOS sensor with supporting electronics "on die", i.e. the sensor and the supporting electronics are built on a single silicon chip to save space and manufacturing costs. Most webcams feature built-in microphones to make video calling and videoconferencing more convenient.

Interface

Typical interfaces used by articles marketed as a “webcam” are USB, Ethernet and IEEE (denominated as IP camera). Further interfaces such as e.g. Composite video or S-Video are also available. The USB video device class (UVC) specification allows inter-connectivity of webcams to computers without the need for proprietary device drivers.

Software

Various proprietary as well as free and open-source software is available to handle the UVC stream. One could use Gvvcview or GStreamer and GStreamer-based software to handle the UVC stream.

Characteristics

Webcams are known for their low manufacturing cost and their high flexibility, making them the lowest-cost form of video telephony. As webcams evolved simultaneously with display technologies, USB interface speeds and broadband internet speeds, the resolution went up from gradually 320×240, to 640×480, and some even offering 1280×720 (aka 720p) or 1920×1080 (aka 1080p) resolution.

Despite the low cost, the resolution offered as of 2019 is impressive, with now the low-end webcams offering resolutions of 720p, mid-range webcams offering 1080p resolution, and high-end webcams offering 4K resolution at 60 fps.

Webcams have become a source of security and privacy issues, as some built-in webcams can be remotely activated by spyware. To address this concern, many webcams come with a physical lens cover.

Uses

The most popular use of webcams is the establishment of video links, permitting computers to act as videophones or videoconference stations. Other popular uses include security surveillance, computer vision, video broadcasting, and for recording social videos. The video streams provided by webcams can be used for a number of purposes.

4.3.3 ROBOT TROLLEY

This setup includes a base connected with motors for the operation of wheels for movement. In this setup all the hardware equipments are being embedded.

DC motor and l293d driver

A machine that converts DC electrical power into mechanical power is known as a Direct Current motor(Fig: 4.6). DC motor working is based on the principle that when a current carrying conductor is placed in a magnetic field, the conductor experiences a mechanical force.



Fig: 4.6: DC-Motor

An electric motor is an electrical machine which converts electrical energy into mechanical energy. The basic working principle of a DC motor is: "whenever a current carrying conductor is placed in a magnetic field, it experiences a mechanical force". The direction of this force is given by Fleming's left-hand rule and its magnitude is given by $F = BIL$. Where, B = magnetic flux density, I = current and L = length of the conductor within the magnetic field.

If we stretch the first finger, second finger and thumb of our left hand to be perpendicular to each other, and the direction of magnetic field is represented by the first finger, direction of the current is represented by the second finger, and then the thumb represents direction of the force experienced by the current carrying conductor.

When armature windings are connected to a DC supply, an electric current sets up in the winding. Magnetic field may be provided by field winding (electromagnetism) or by using permanent magnets. In this case, current carrying armature conductors experience a force due to the magnetic field, according to the principle stated above.

SPECIFICATIONS

- Standard 130 Type DC motor
- Operating Voltage: 4.5V to 9V
- Recommended/Rated Voltage: 6V
- Current at No load: 70mA (max)
- No-load Speed: 9000 rpm
- Loaded current: 250mA (approx.)
- Rated Load: 10g*cm
- Motor Size: 27.5mm x 20mm x 15mm
- Weight: 17 grams

Types of DC Motors

DC motors are usually classified on the basis of their excitation configuration, as follows

- Separately excited (field winding is fed by external source)
- Self-excited -
 - Series wound (field winding is connected in series with the armature)
 - Shunt wound (field winding is connected in parallel with the armature)
 - Compound wound -

Applications of a DC Motor

It depends on the type of DC motor, which applications are ideal. Generally speaking, the following applications are common:

- Cranes
- Conveyors
- Pumps
- Fans
- Machine tools
- Air compressors
- Toys
- Motor starters in cars

L293D

L293D is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction. L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It means that you can control two DC motor with a single L293D IC. Dual H-bridge Motor Driver integrated circuit (IC). The L293d can drive small and quiet big motors as well, check the Voltage Specification at the end.

It works on the concept of H-bridge. H-bridge is a circuit which allows the voltage to be flown in either direction. As you know voltage need to change its direction for being able to rotate the motor in clockwise or anticlockwise direction, Hence H-bridge IC is ideal for driving a DC motor. In a single L293D chip there are two h-Bridge circuit inside the IC which can rotate two dc motor independently. Due its size it is very much used in robotic application for controlling DC motors. Given below is the pin diagram of a L293D motor controller Fig: 4.7.

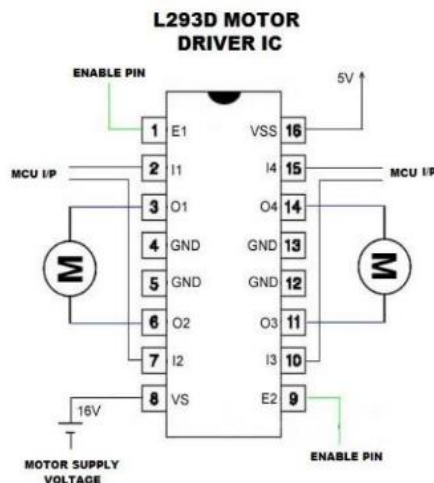


Fig: 4.7(a): Motor IC

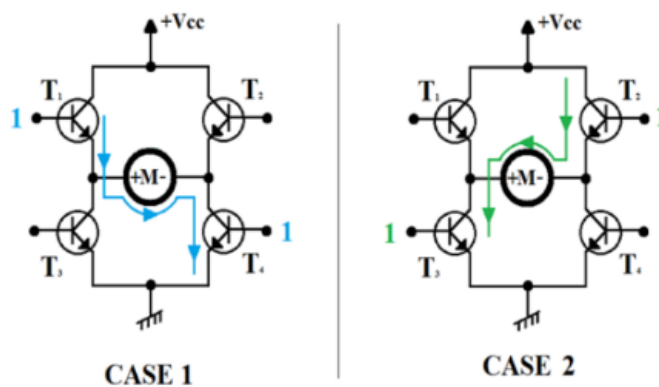


Fig: 4.7(b): Working of Motor IC

- L293D motor driver IC contains two H-bridge circuit inside it, which may also use darlington transistor some times for current amplification.
- Let we understand this H-bridge circuit(Fig: 4.8), in case 1, when logic '1' apply to transistor T1 and T4, motor starts rotating in clockwise direction due to circuit complete and current flows through it as shown by blue indication.
- In case 2, we apply logic '1' to transistor T2 and T3, so motor starts rotating in anti-clockwise direction due to circuit complete and direction of current flows through it is shown by green indication.
- As I mentioned that logic '1' apply to T1 & T4 or T2 & T3 is just for simplicity cause this transistor is hard wired inside IC so you just need to take care of pin-out and apply logic to IC's pin directly and carried out your work.

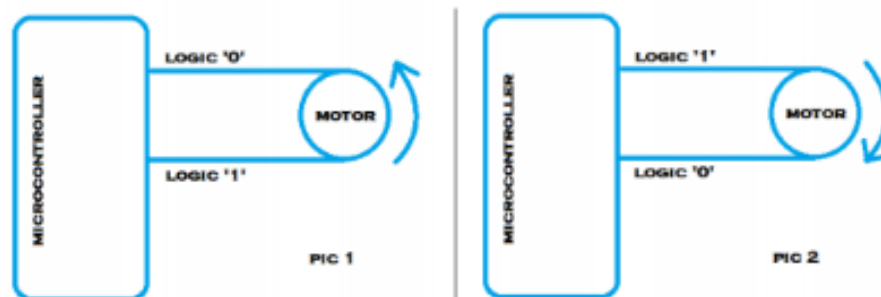


Fig: 4.8: Motor setup with microcontroller

- As you can see on above pic Fig: 4.8, understanding of motor is simple as seen.
- Motor rotates in the direction of higher potential to lower potential.
- Here we make this diagram as simple as we can, cause easy understanding (not use L293D IC).

The motor driver IC deals with heavy currents. Due to so much current flow the IC gets heated. So, we need a heat sink to reduce the heating. Therefore, there are 4 ground pins. When we solder the pins on PCB, we get a huge metallic area between the grounds where the heat can be released.

Voltage Specification

VCC is the voltage that it needs for its own internal operation 5v; L293D will not use this voltage for driving the motor. For driving the motors it has a separate provision to provide motor supply VSS (V supply). L293d will use this to drive the motor. It means if you want to operate a motor at 9V then you need to provide a

Supply of 9V across VSS Motor supply.

4.3.4 LCD (Liquid Crystal Display)

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications shown in Fig: 4.9. A 16×2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

A 16×2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5×7 pixel matrix. This LCD has two registers namely, Command and Data. The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD. Click to learn more about internal structure of a LCD.

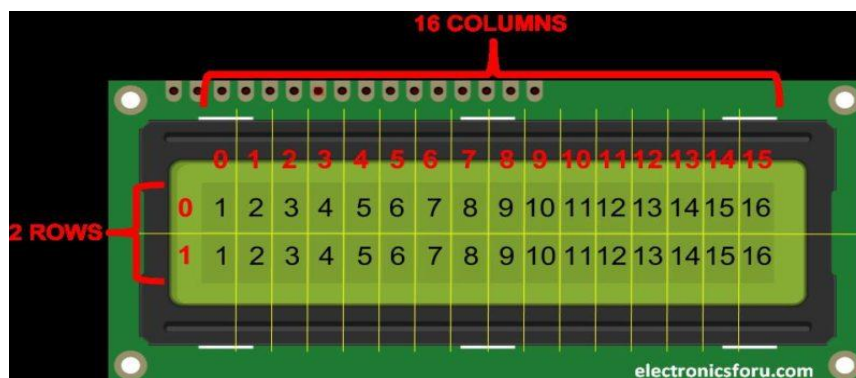


Fig: 4.9: LCD

- The basic structure of LCD should be controlled by changing the applied current.
- We must use a polarized light.
- Liquid crystal should be able to control both of the operation to transmit or can also be able to change the polarized light.

As mentioned above that we need to take two polarized glass pieces filter in the making of the liquid crystal. The glass which does not have a polarized film on the surface of it must be rubbed with a special polymer which will create microscopic grooves on the surface of the polarized glass filter. The grooves must be in the same direction of the polarized film. Now we have to add a coating of pneumatic liquid phase crystal on one of the polarized filter of the polarized glass.

The microscopic channel cause the first layer molecule to align with filter orientation. When the right angle appears at the first layer piece, we should add a second piece of glass with the polarized film. The first filter will be naturally polarized as the light strikes it at the starting stage. Thus the light travels through each layer and guided on the next with the help of molecule. The molecule tends to change its plane of vibration of the light in order to match their angle. When the light reaches to the far end of the liquid crystal substance, it vibrates at the same angle as that of the final layer of the molecule vibrates. The light is allowed to enter into the device only if the second layer of the polarized glass matches with the final layer of the molecule.

The principle behind the LCD's is that when an electrical current is applied to the liquid crystal molecule, the molecule tends to untwist. This causes the angle of light which is passing through the molecule of the polarized glass and also cause a change in the angle of the top polarizing filter. As a result a little light is allowed to pass the polarized glass through a particular area of the LCD. Thus that particular area will become dark compared to other. The LCD works on the principle of blocking light. While constructing the LCD's, a reflected mirror is arranged at the back. An electrode plane is made of indium-tin oxide which is kept on top and a polarized glass with a polarizing film is also added on the bottom of the device. The complete region of the LCD has to be enclosed by a common electrode and above it should be the liquid crystal matter. Fig: 4.10 & 4.11 shows the LCD connection and pinout diagram.

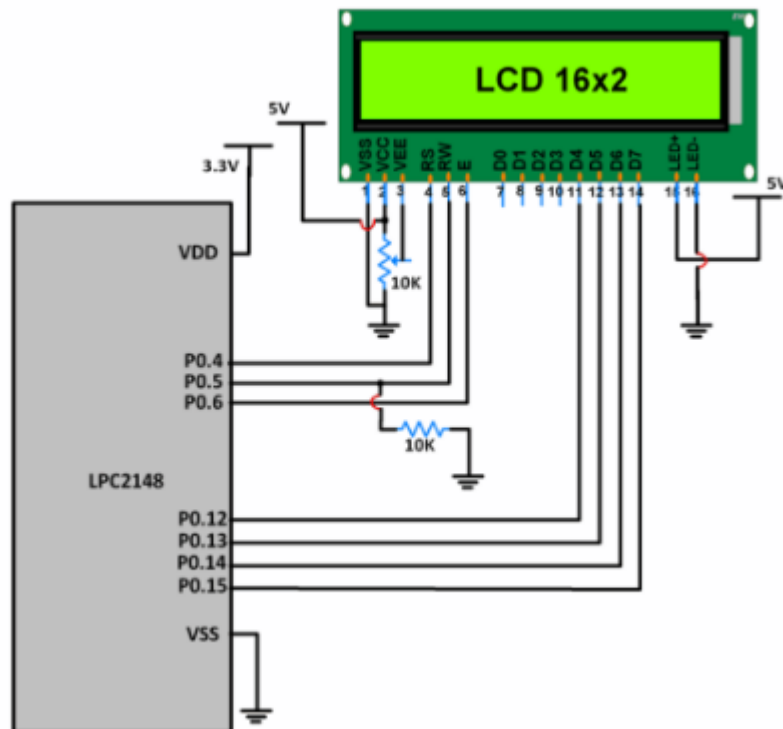


Fig: 4.10: LCD Connection

Next c to the second piece of glass with an electrode in the form of the rectangle on the bottom and, on top, another polarizing film. It must be considered that both the pieces are kept at right angles. When there is no current, the light passes through the front of the LCD it will be reflected by the mirror and bounced back. As the electrode is connected to a battery the current from it will cause the liquid crystals between the common-plane electrode and the electrode shaped like a rectangle to untwist. Thus the light is blocked from passing through that particular rectangular area appears blank. LCD Pin table is shown in 4.8.

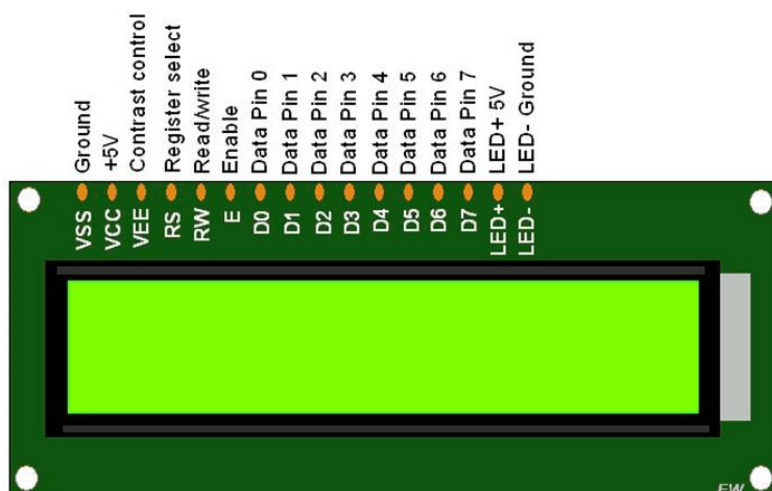


Fig: 4.11:16*2 LCD Pinout Diagram

Table 4.8: LCD Pin table

S.NO	PIN NO.	Pin Name	Pin Type	Pin Description	Pin Connection
1	Pin 1	Ground	Source Pin	This is a ground pin of LCD	Connected to the ground of the MCU/Power source
2	Pin 2	VCC	Source Pin	This is the supply voltage pin of LCD	Connected to the supply pin of Power source
3	Pin 3	V0/VEE	Control Pin	Adjusts the contrast of the LCD	Connected to a variable POT that can source 0-5V
4	Pin 4	Register Select	Control Pin	Toggles between Command/Data register	Connected to a MCU pin and gets either 0 or 1 0-Command Mode 1-Data Mode
5	Pin 5	Read/Write	Control Pin	Toggles the LCD between read/write operation	Connected to a MCU pin and gets either 0 or 1 0-Write Mode 1-Read Mode
6	Pin 6	Enable	Control Pin	Must be held high to perform Read/Write Operation	Connected to a MCU and always held high
7	Pin 7-14	Data Bits (0-7)	Data/Command Pin	Pins used to send command or data to the LCD	In 4-wire Mode Only 4 pins (0-3) is connected to MCU In 8-wire Mode All 8 pins(0-7) Are connected to MCU
8	Pin 15	LED Positive	LED Pin	Normal LED like operation to illuminate the LCD	Connected to +5V
9	Pin 16	LED Negative	LED Pin	Connected to a MCU pin and gets either 0 or 1 0-Command Mode 1-Data Mode	Connected to ground

4.3.5 Radio frequency Identification (RFID)

- Radio frequency Identification (RFID) is a wireless identification technology that uses radio waves to identify the presence of RFID tags shown in Fig: 4.12.
- Just like Bar code reader, RFID technology is used for identification of people, object etc. presence.
- In barcode technology, we need to optically scan the barcode by keeping it in front of reader, whereas in RFID technology we just need to bring RFID tags in range of readers. Also, barcodes can get damaged or unreadable, which is not in the case for most of the RFID.
- RFID is used in many applications like attendance system in which every person will have their separate RFID tag which will help identify person and their attendance. RFID is used in many companies to provide access to their authorized employees.
- It is also helpful to keep track of goods and in automated toll collection system on highway by embedding Tag (having unique ID) on them.

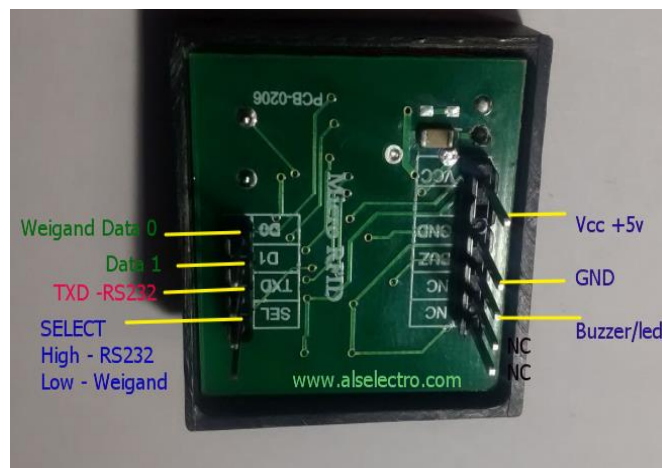


Fig: 4.12: RFID

RFID based system has two basic elements

RFID Tag

RFID tag includes microchip with radio antenna mounted on substrate which carries 12 Byte unique Identification number shown in Fig: 4.13.

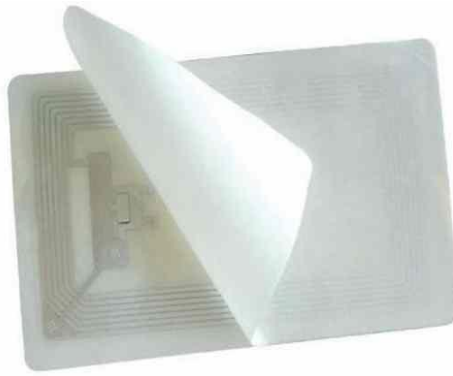


Fig: 4.13: RFID Tag

RFID Reader

It is used to read unique ID from RFID tags. Whenever RFID tags come in range, the RFID reader reads its unique ID and transmits it serially to the microcontroller or PC. The RFID reader has a transceiver and an antenna mounted on it. It is mostly fixed in a stationary position shown in Fig: 4.14.



Fig: 4.14: RFID Reader

Basically, RFID systems are categorised as active and passive based on how they are powered and their range.

1. Active RFID system

Active RFID tags have their own transmitter and power source (Mostly battery operated). They operate at 455 MHz, 2.45 GHz, or 5.8 GHz, and they typically have a read range of 60 feet to 300 feet (20 meters to 100 meters).

2. Passive RFID system

Passive RFID tags do not have a transmitter, they simply reflect energy (radio waves) back coming from the RFID reader antenna. They operate in Low frequency (~125 KHz) as well as High frequency (~13 MHz) band and have a limited read range of up to ~1m. There are two modes of coupling for communication used in RFID as,

1. Inductive coupling, in which RFID reader emits magnetic field and whenever RFID tags enters the magnetic field which creates energy response from RFID tags and is detected by RFID reader. As the magnetic field drops sharply with distance, it is used for short distance applications.
2. Capacitive coupling, where reader emits electromagnetic waves and whenever that waves encounters RFID tags, RFID tag reflects signal containing information of ID.

RFID Reader has transceiver which generates a radio signal and transmits it through antenna. This signal itself is in the form of energy which is used to activate and power the tag.

When RFID tag comes in range of signal transmitted by the reader, transponder in the tag is hit by this signal. A tag draws power from the electromagnetic field created by reader. Then, the transponder converts that radio signal into the usable power. After getting power, transponder sends all the information it has stored in it, such as unique ID to the RFID reader in the form of RF signal. Then, RFID reader puts this unique ID data in the form of byte on serial Tx (transmit) pin. This data can be used or accessed by PC or microcontroller serially using UART communication.

There are various RFID readers available according to their frequency are shown in Table 4.6.

Table 4.6: RFID Frequencies

FREQUENCY	RANGE	DIFFERENT MODULE	APPLICATIONS
120-150 kHz	5-20 cm	EM-18, ILA-12, etc.	Factory data collection, identifying animals etc.
13.56 MHz	10cm-1m	MFRC522, SM130	Smart cards

EM18 is a RFID reader which is used to read RFID tags of frequency 125 kHz. After reading tags, it transmits unique ID serially to the PC or microcontroller using UART communication or Wiegand format on respective pins. EM18 RFID reader reads the data from RFID tags which contains stored ID which is of 12 bytes. EM18 RFID reader doesn't require line-of-sight. Also, it has identification range which is short i.e. in few centimetres.

EM-18 Pin Configuration

EM-18 is a nine pin device. Among nine pins, 2 pins are not connected, so we basically have to consider seven terminals shown in Fig: 4.15 & Table 4.7.

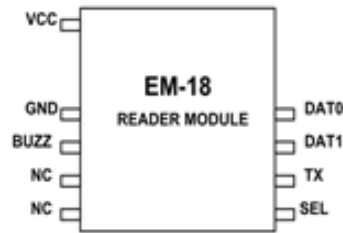


Fig: 4.15: Pin Configuration of Reader

Table 4.7: Pin Description

PIN NUMBER	DESCRIPTION
VCC	Should be connected to positive of power source.
GND	Should be connected to ground.
BUZZ	Should be connected to BUZZER
NC	No Connection
NC	No Connection
SEL	SEL=1 then o/p =RS232 SEL=0then o/p=WEIGAND
TX	DATA is given out through TX of RS232
DATA1	WEIGAND interface DATA HIGH pin
DATA0	WEIGAND interface DATA LOW pin

EM-18 is used like any other sensor module. First we choose the mode of communication between MODULE and CONTROLLER. Next we will program the controller to receive data from module to display. Next power the system. When a tag is brought near the MODULE it reads the ID and sends the information to controller. The controller receives the information and performs action programmed by us.

Step1: Establishing a mode of communication. EM-18 can provide output through two communication interface. One is RS232 and another is WEIGAND. The form of communication is selected by SEL pin. If SEL pin is selected HIGH then form of communication is RS232 and if SEL pin is pulled LOW then form of communication is WEIGAND. Usually the RS232 is selected because it's popular so SEL pin is pulled HIGH.

Step2: The output of MODULE bit rate is 9600bps (bit per second). The controller should be programmed to receive information from MODULE at this rate. If bit rate of controller mismatches then the system will not work correctly.

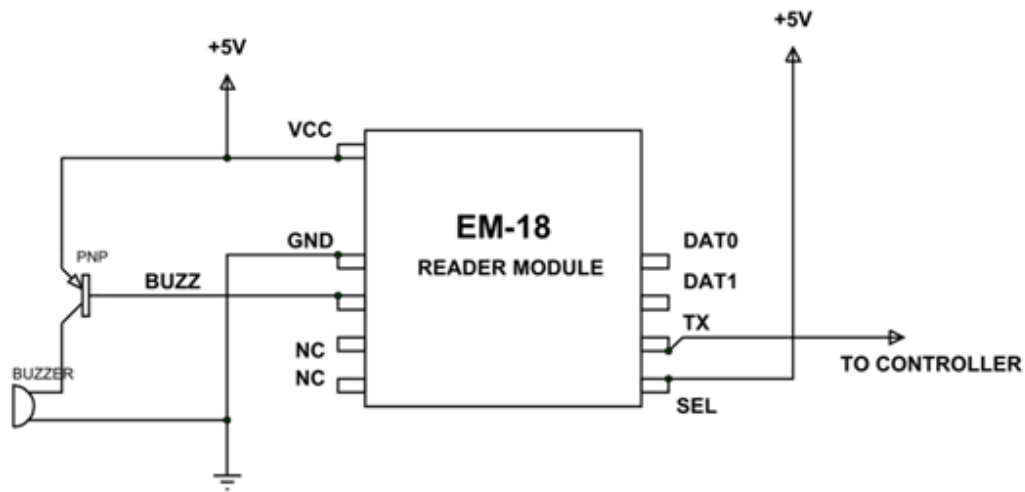


Fig: 4.16: Reader Connection

In the circuit (Fig: 4.16) BUZZER is not compulsory. When a TAG is read the BUZZER turns ON. As given in circuit, TX is given to CONTROLLER which is to receive DATA. Consider a TAG is brought near the MODULE. The MODULE reads the ID and sends the information to controller in 12 ASCII CHARACTERS. In them, 10CHARACTERS represent the TAG ID and 2 CHARACTERS are XOR of previous 10 CHARACTERS. So DATA sent = 10ASCII DATA (tag no.) + 2ASCII DATA (XOR result)

Once the Information is sent, the MODULES stop sending DATA. This serial DATA received by the controller though RX pin contains TAG information which is ready for processing. We can program the controller to save the DATA or process it to provide response immediately.

EM-18 Features and Specifications

- Operating voltage of EM-18: +4.5V to +5.5V
- Can operate on LOW power
- Operating temperature: 0oC to +80oC
- Operating frequency:125KHz
- Communication parameter:9600bps
- Reading distance: 10cm, depending on TAG
- Integrated Antenna

4.3.6 TF mini Lidar



Fig: 4.17: TF Mini Lidar

The TF Mini Lidar(Fig: 4.17)is a unidirectional laser range finder based on time-of-flight (Toff) technology. It consists of special optical and electronic devices, which integrates adaptive algorithm for indoor and outdoor application environment. It has tiny body and high performance in distance measurement. The laser sensor can be used as a distance-measuring tool to detect the distance from it to obstacles. It can also be used as an eye of a robot; it provides distance information for robotic safe avoidance and route selection. It supports for system automation in a variety of machine control scenarios. Because of its small size, light weight and low power consumption, it is also suitable for altitude holding and terrain following.

TF Mini's maximum detection distance is 12 meters. TF Mini also supports 100Hz sampling resolution, within 6 meters; its accuracy is within 4cm, 6~12 meters, and accuracy within 6 cm. FOV of 2.3 degree. Its anti-interference is strong, and can work in outdoor light; the overall weight is 4.7g.TF Mini LiDAR adopts UART (TTL) communication interface, can supplied by standard 5V, and its average power consumption is 0.6w.

Principle of Distance Measurement

TF mini is based on TOF, namely, Time of Flight principle. To be specific, the product transmits modulation wave of near infrared ray on a periodic basis, which wave will reflect after contacting object. The product obtains time of flight by measuring round-trip phase difference and then calculates relative range between

the product and the detection object, as shown in Figure 4.18 & 4.19. Lidar wiring connection is shown in fig: 4.20.

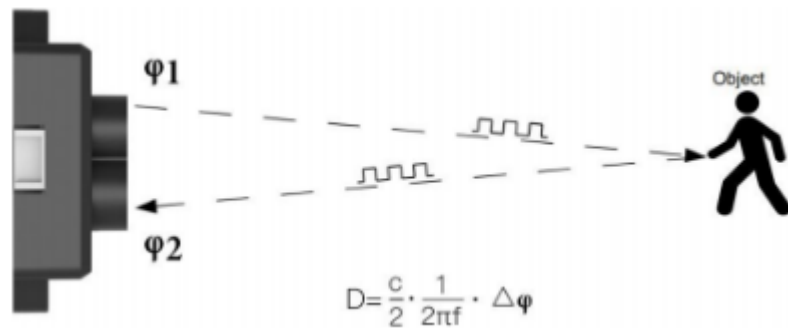


Fig: 4.18: TOF Principle

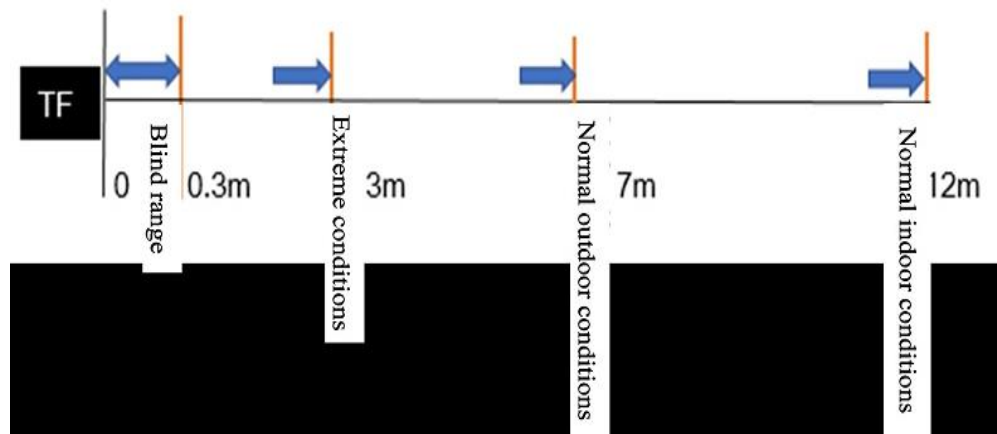


Fig: 4.19: Measurement range schematic diagram

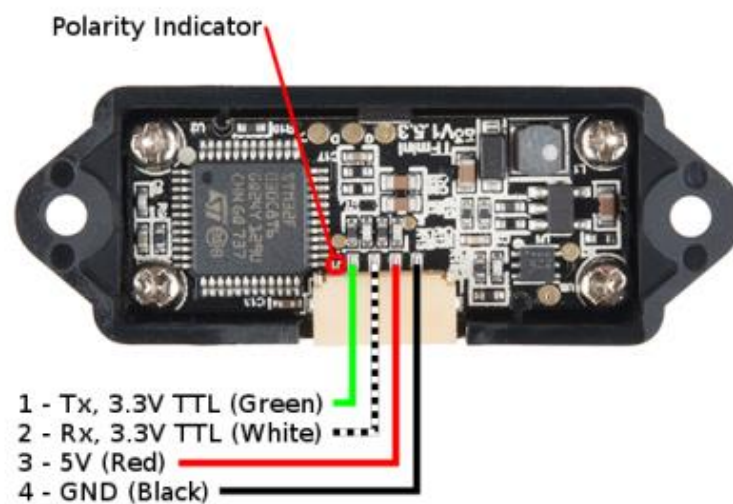


Fig: 4.20: Lidar Wiring Connection

4.3.7 PUSH BUTTON



Fig: 4.21: Push Button

Press Buttons are regularly open material switches (refer Fig: 4.21). Press gets grant us to power the circuit or make a particular affiliation exactly when we press the button. Just, it makes the circuit related when pressed and breaks when conveyed. A press button is moreover used for setting off of the SCR by entryway terminal. These are the most notable gets which we find in our consistently life electronic equipment's. A segment of the uses of the Push button are referred to at the end of the article.

4.4 SOFTWARE REQUIREMENTS

- Open CV
- Python
- Raspbian Stretch

4.4.1 OPEN CV

OpenCV was started at Intel in 1999 by Gary Bradsky and the first release came out in 2000. Vadim Pisarevsky joined Gary Bradsky to manage Intel's Russian software OpenCV team. In 2005, OpenCV was used on Stanley, the vehicle who won 2005 DARPA Grand Challenge. Later its active development continued under the support of Willow Garage, with Gary Bradsky and Vadim Pisarevsky leading the project. Right now, OpenCV supports a lot of algorithms related to Computer Vision and Machine Learning and it is expanding day-by-day.

Currently OpenCV supports a wide variety of programming languages like C++, Python, Java etc and is available on different platforms including Windows,

Linux, OS X, Android, iOS etc. Also, interfaces based on CUDA and OpenCL are also under active development for high-speed GPU operations.

OpenCV-Python is the Python API of OpenCV. It combines the best qualities of OpenCV C++ API and Python language. Python is a general purpose programming language started by Guido van Rossum, which became very popular in short time mainly because of its simplicity and code readability. It enables the programmer to express his ideas in fewer lines of code without reducing any readability.

Compared to other languages like C/C++, Python is slower. But another important feature of Python is that it can be easily extended with C/C++. This feature helps us to write computationally intensive codes in C/C++ and create a Python wrapper for it so that we can use these wrappers as Python modules. This gives us two advantages: first, our code is as fast as original C/C++ code (since it is the actual C++ code working in background) and second, it is very easy to code in Python. This is how OpenCV-Python works, it is a Python wrapper around original C++ implementation and the support of Numpy makes the task more easier. Numpy is a highly optimized library for numerical operations. It gives a MATLAB-style syntax. All the OpenCV array structures are converted to-and-from Numpy arrays. So whatever operations you can do in Numpy, you can combine it with OpenCV, which increases number of weapons in your arsenal. Besides that, several other libraries like SciPy, Matplotlib which supports Numpy can be used with this. So OpenCV-Python is an appropriate tool for fast prototyping of computer vision problems.

4.4.2 PYTHON

Python is an interpreted high-level programming language for programming. Python offers multiple options for developing GUI (Graphical User Interface). Out of all the GUI methods, tkinter is most commonly used method. It is a standard Python interface to the Tk GUI toolkit shipped with Python. Python with tkinter outputs the fastest and easiest way to create the GUI applications. Creating a GUI using tkinter is an easy task.

Python features a dynamic type system and automatic memory management. It supports multiple programming paradigms, including object-oriented, imperative, functional and procedural, and has a large and

comprehensive library. Python is a multi-paradigm programming language. Object-oriented programming and structured programming are fully supported, and many of its features support functional programming and aspect-oriented programming (including by meta programming and meta objects (magic methods)). Many other paradigms are supported via extensions, including design by contract and logic programming.

4.4.3 RASPIAN STRETCH

This chapter introduces the devices and software which are used in this bachelor's thesis. The chapter also contains short introduction to the Linux operating system which is used in this thesis. Raspbian is officially recommended for beginners and it includes the graphical desktop environment called LXDE. Raspbian Wheezy is one of the fastest ways to setup and get the RasPi running. (McManus, S. & Cook, M. 2013, 20.).

There are considerable numbers of programming languages which have been adapted for Raspberry Pi. Python programming language is recommended by The Raspberry Pi foundation especially for the beginners. Basically any programming language which can be compiled for ARMv6 can run on the Raspberry Pi. Therefore the users are not restricted to use only the Python. On the Raspberry Pi there are preinstalled several languages for example C, C++, Java, Scratch and Ruby. (Raspberry Pi Foundation [Ref. 5.2.2015].).

Raspberry Pi doesn't come with an operating system. This is not a weakness, however, rather a feature that means you can choose from a wide of OSs, each of which can be flashed to an SD card (or microSD card for the Raspberry Pi B+) in a few simple steps. Here's how to get a new OS installed and running on your Pi –and how to clone your perfect setup for quick disaster recovery.

Operating systems such as the recommended Raspbian, ArchLinux, Risc OS and even Android come ready to run on your Raspberry Pi. I'll show you the two main ways add an operating system – and once you've got your Pi setup how you want it, we'll look at how to clone the card so that it can be restored following errors (or for temporary reuse of your SD card).

The following tutorials assume that you have a basic Raspberry Pi package and Windows to manage your SD card writing and cloning. Flash an OS to SD and Boot Your Raspberry Pi

Whichever operating system you download for your Raspberry Pi, the process of writing it to an SD card is the same. However, there are some differences in SD card writing between desktop operating systems. You'll also need to ensure that your card is blank and formatted, and at least 2 GB.



Fig: 4.22: SD Formatter

For Windows users (and also those of you with Mac OS X) the tool of choice for writing a Raspberry Pi OS image to SD card is SD Formatter, from the SD Association. With the card inserted into your computer's card reader, and ensuring you have the correct Drive letter selected in the drop-down menu, open the Option menu and select Full (Erase) and On. This ensures that the full capacity of the storage card will be available.

Click OK, then Format to begin as shown in Fig: 4.22.

To write the disk image, use Win32DiskImager, available from Sourceforge. You may need to run with administrator privileges. Select the correct drive letter for your SD card, browse to the image file and click Write to commence the process. Win32DiskImager will inform you when the data has been written.

If writing the disk image seems too much hassle or is beyond your abilities, it is possible to purchase SD cards with Raspbian pre-installed. Booting Raspbian for the First Time

With Raspbian installed, you'll need to login with the following credentials:

Username: pi

Password: raspberry

For other operating systems, check the documentation to find the default login credentials. Remember that the password will not be displayed as you type it; there are no Windows-style * symbols representing the letters. Instead, it will appear that you haven't entered a password. This is a security feature in Linux to prevent people guessing the length of your passphrase. Just type the password regardless. In Raspbian, you can change your password by running and selecting the Change Password option.

Install Raspbian, XBMC, Risc OS, OpenElec & ArchLinux Easily With NOOBS. For a simpler, more streamlined install of the more popular Raspberry Pi distros such as Raspbian, ArchLinux, XBMC and OpenElec media centres, as well as Risc OS and Pidora – you can employ NOOBS, the New out Of Box Software installation system. Perfecting Your Raspberry Pi OS. Different Raspberry Pi projects require a varying amount of software; it really all depends on what you're planning to do. The SD card contains the Raspberry Pi's operating system (the OS is the software that makes it work, like Windows on a PC or OSX on a Mac). This is very different from most computers and it is what many people find the most daunting part of setting up their Raspberry Pi. It is actually very straightforward—just different!

CHAPTER 5

RESULT & DISCUSSION

For the performance analysis, the input colour is taken as “Yellow” in the program. When the camera identifies the objective it says in which bearing does the trolley arrangement should move. At the point when the objective is in focus, the trolley pushes ahead with some separation from the camera (Fig: 5.1). At the point when the objective is in left, the trolley moves left with some separation from the camera (Fig: 5.2). At the point when the objective is in right, the trolley moves directly with some separation from the camera (Fig: 5.3). The development stops when the item is near the camera (Fig: 5.4). Utilizing the RFID, the billing process is completed and this yield is appeared in the LCD show, the hang tight an ideal opportunity for the identification is appeared in Fig: 5.5 and once the RFID tag is kept on the reader, the additional item is appeared in Fig: 5.6. In the event that a similar tag is kept on the reader the item gets eliminated as demonstrated in

Fig: 5.7. Lastly the aggregate sum is being appeared and the tag (card) is kept on the reader for the instalment and the sum is decreased from the card is appeared in Fig: 5.8. On the off chance that the cash is deficient, it will show "In sufficient Fund" in the LCD display (Fig: 5.9) and consequently shows the equilibrium in the card too. The sms is shipped off the client's enlisted portable number (Fig: 5.12). We can look for the item by composing the item name, it will show the rack and line subtleties of the product (Fig: 5.10). On the off chance that we press the push button when the trolley is full, it will consequently goes to the counter by following the line path (Fig: 5.11).

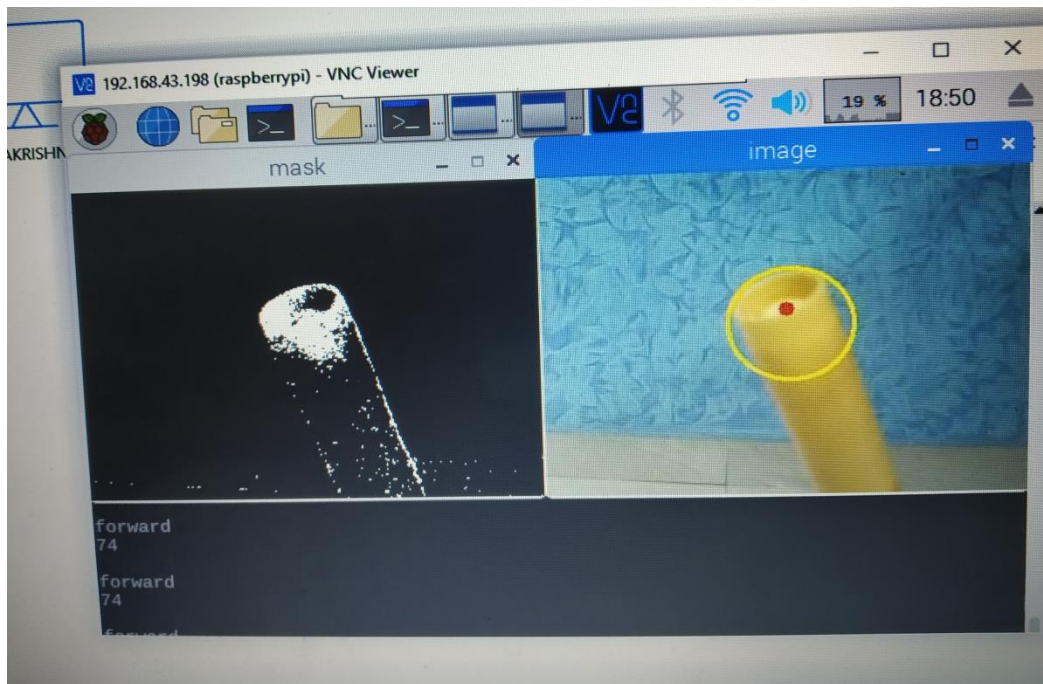


Fig: 5.1: Forward movement detection

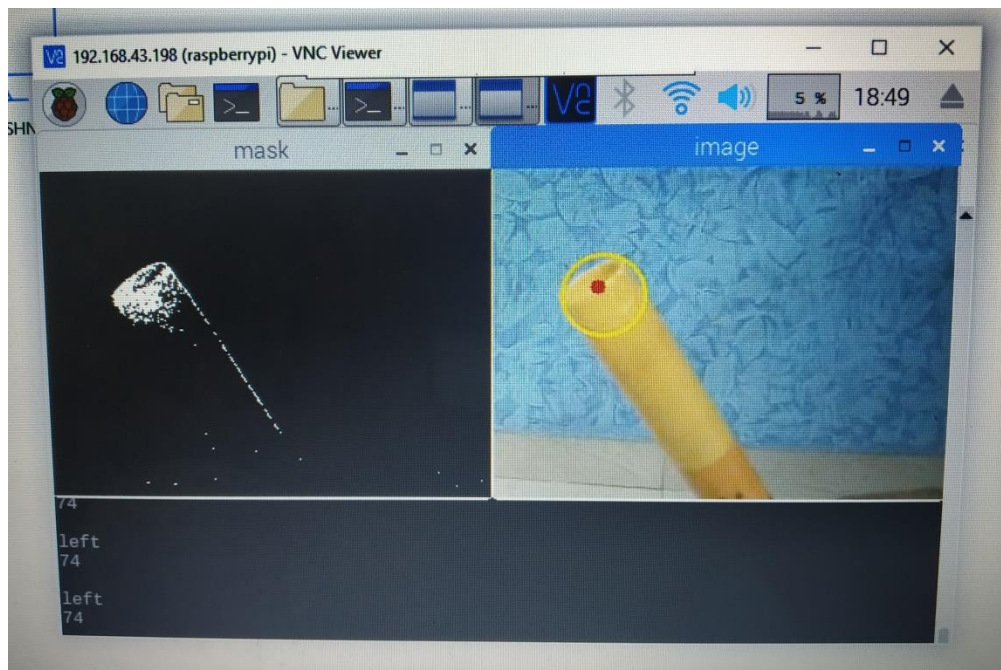


Fig: 5.2: Left movement detection

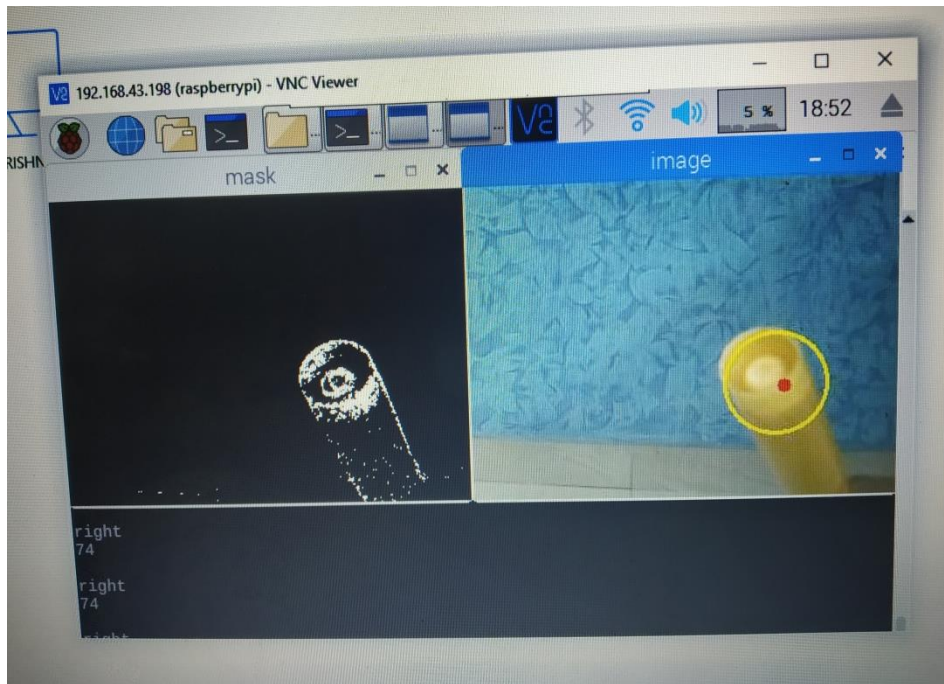


Fig: 5.3: Right movement detection

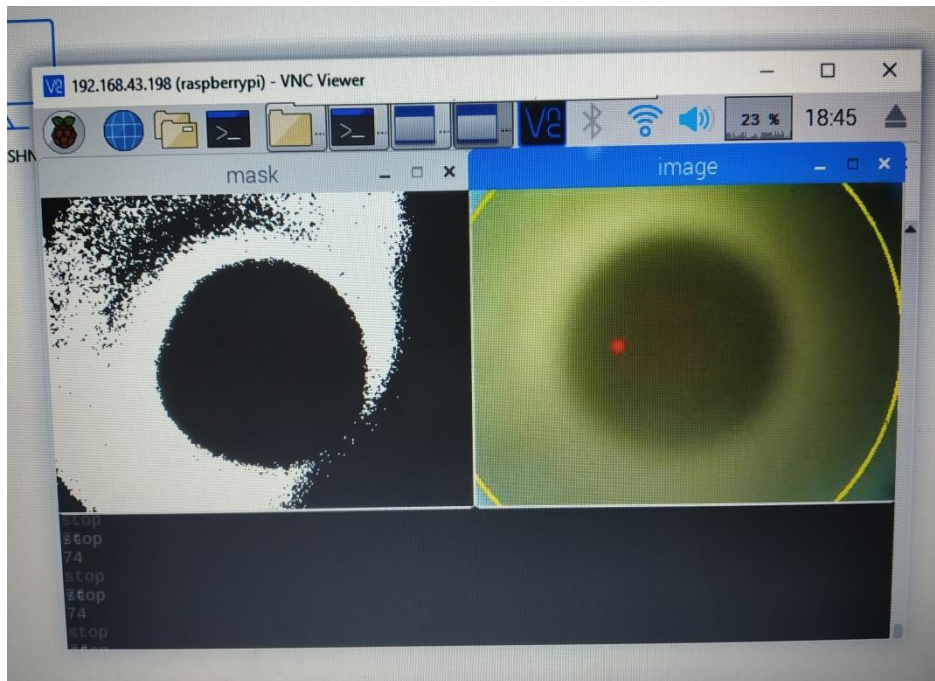


Fig: 5.4: stop detection



Fig: 5.5: Waiting for detection



Fig: 5.6: Rice Detected (added)



Fig: 5.7: Rice Detected (removed)



Fig: 5.8: Total amount

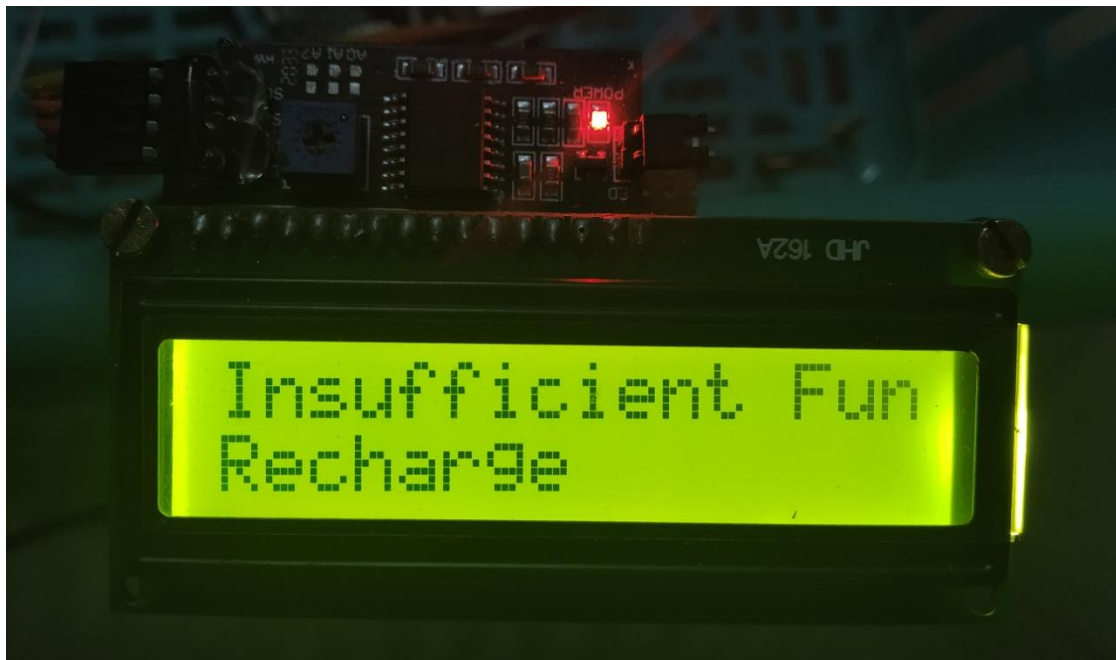


Fig: 5.9: Insufficient fund

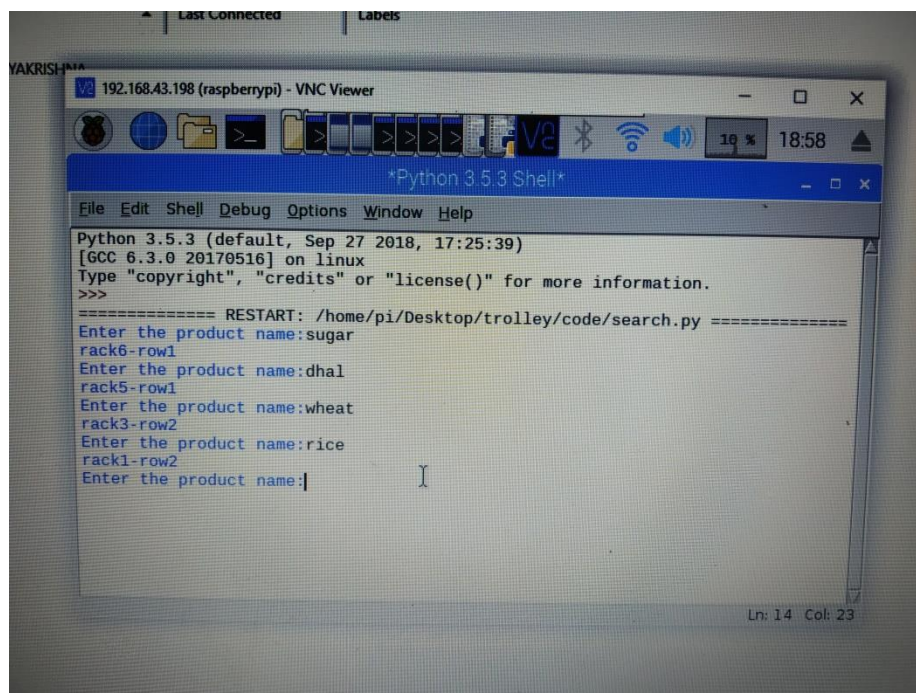


Fig: 5.10: Product search

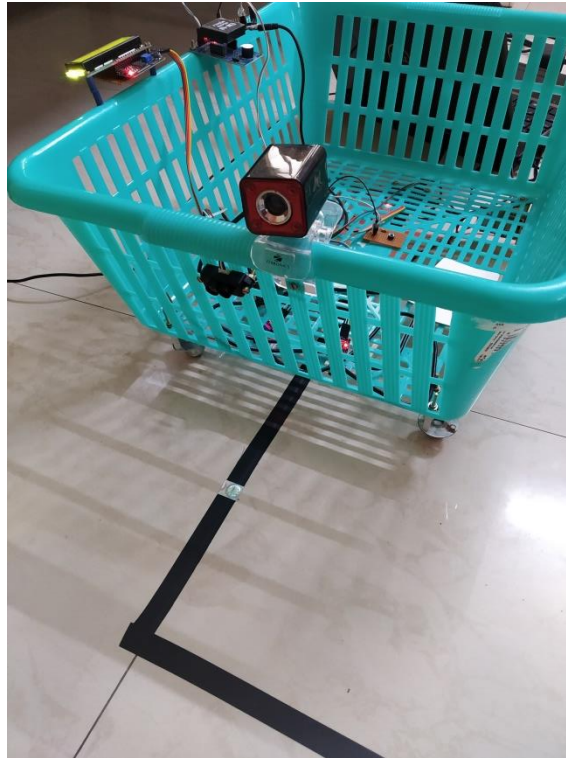


Fig: 5.11: Line path follower

2 18-3 11:54 PM

*Sent from your Twilio trial account -
0 reduced from your card
balance: 300*

*Sent from your Twilio trial account -
159 reduced from your card
balance: 141*

*Sent from your Twilio trial account -
Insufficient Funds*

This message is sent from an unknown number.

ID [Turn on Smart Messaging](#)

+

Text message

2

↑

Fig: 5.12: SMS

CHAPTER 6

CONCLUSION AND FUTURE SCOPE

FUTURE SCOPE

Contingent upon the RFID reader utilized, it could read around 7 labels during a second. what's more, in this manner the significant undertaking of keeping away from the reading of a comparable label on different occasions has likewise been refined by executing a tranquil label work. At long last, the charging is finished in almost one 10th of the time needed in charging framework counting the time needed in dispatching the things which incorporate eliminating of labels from the things. Further, in future we will expect to executing it in shopping centers utilizing a long reach RFID reader.

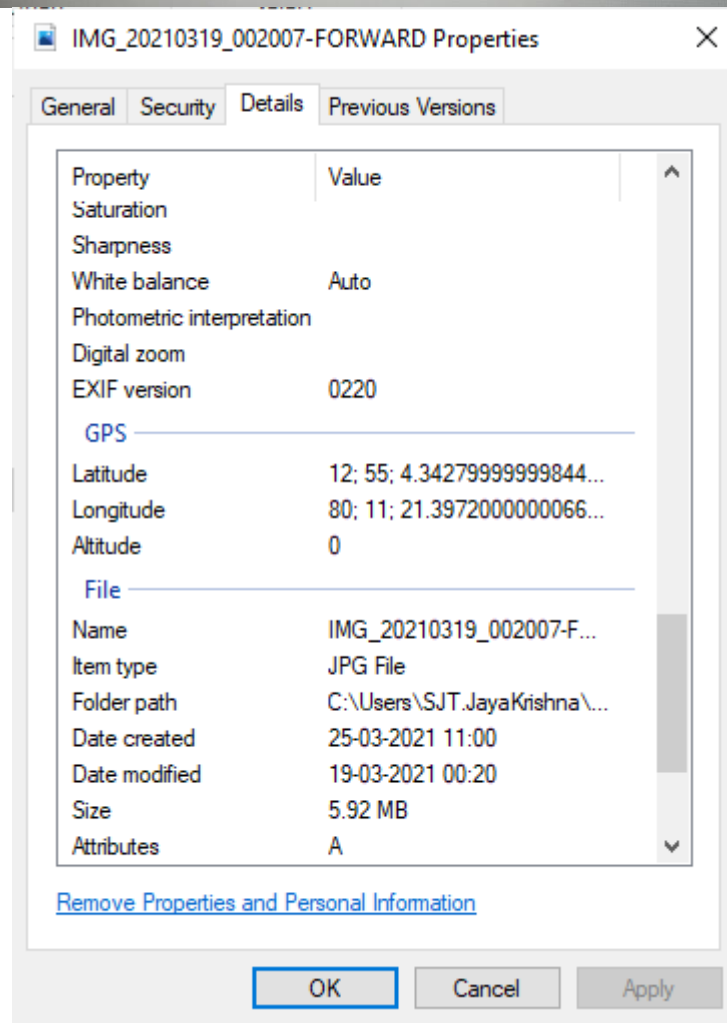
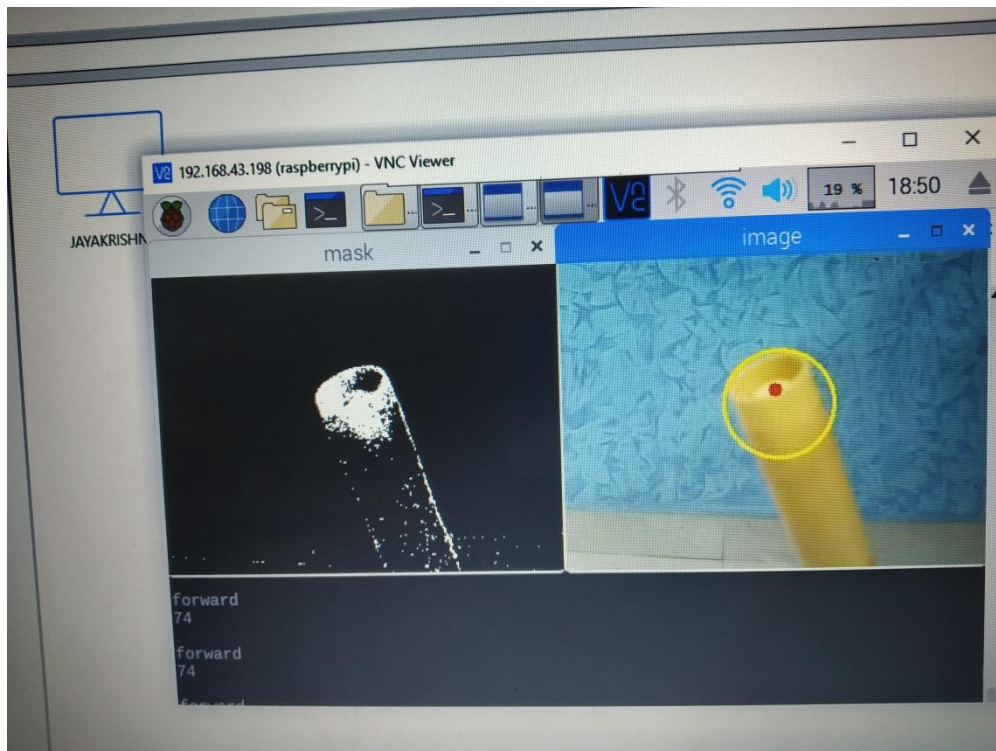
CONCLUSION

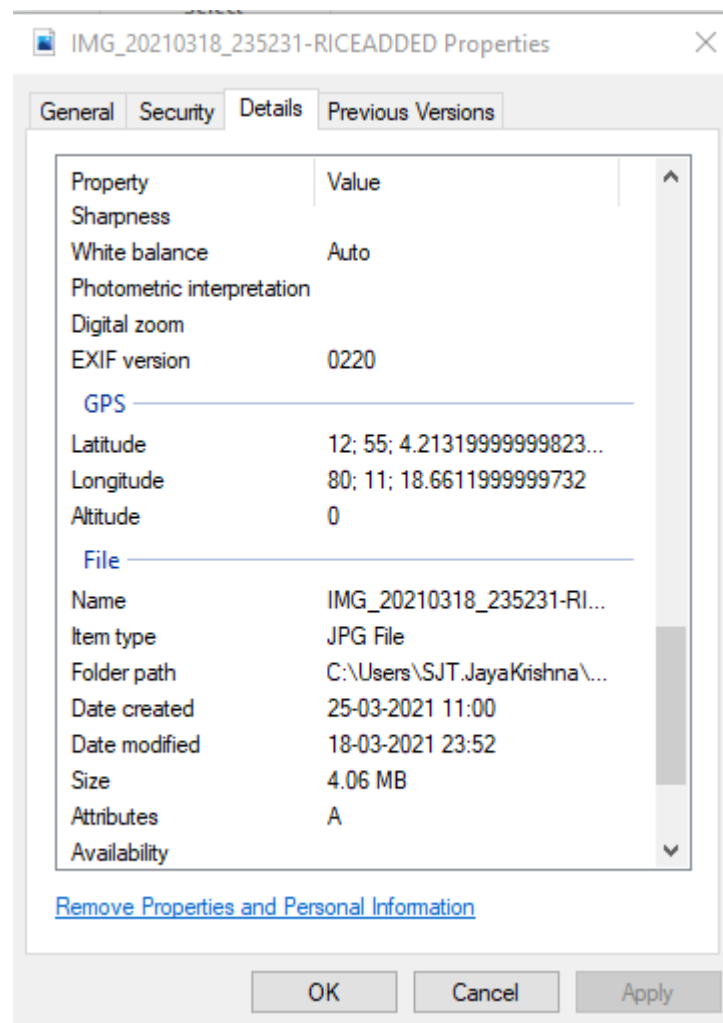
By methods for this paper we keep an eye on plan to change the charging interaction, fabricate it quick and increment the security utilizing RFID procedure. The trolley has the component figure precisely and show the whole expenses of the whole item inside it. This simplifies it for the customer to understand what sum the individual in question has to pay during shopping and not at the checkout. One can erase the item from the trolley simply by filtering it again on the off chance that the person doesn't need it. The framework proposed is profoundly reliable, bonafide, dependable and time-successful. There will be decrease in wage sum given to laborers, decrease in burglary. Likewise, the framework is very time-effective. This will take the looking mastery to an exceptional level. Extraordinary boundaries like the framework boundaries of smart trolley like items name what's more, items cost are consistently show..

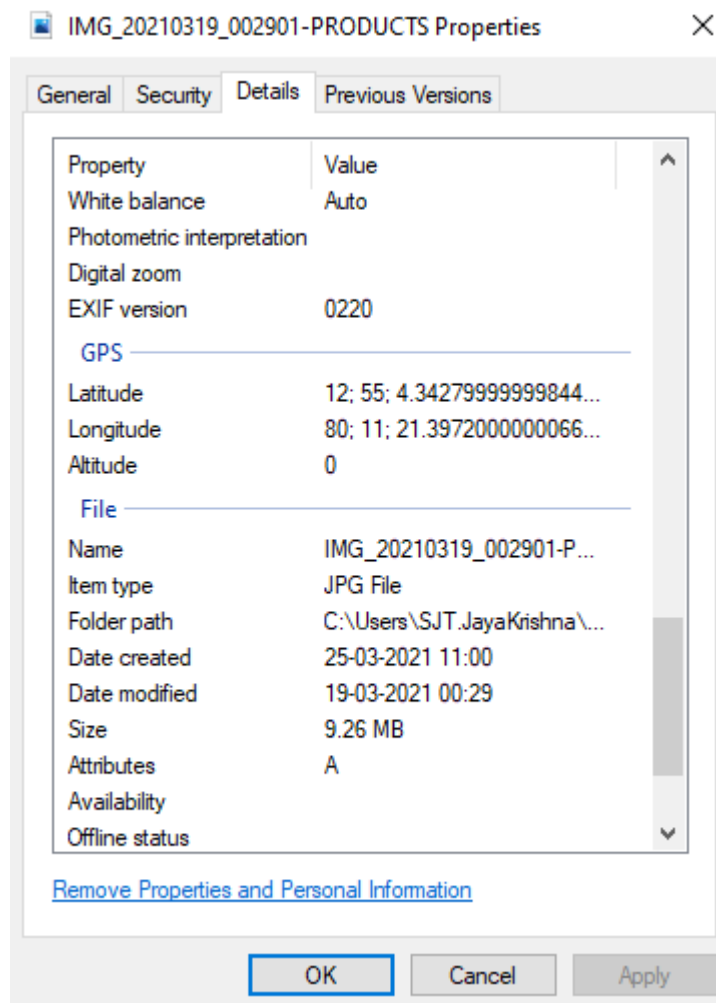
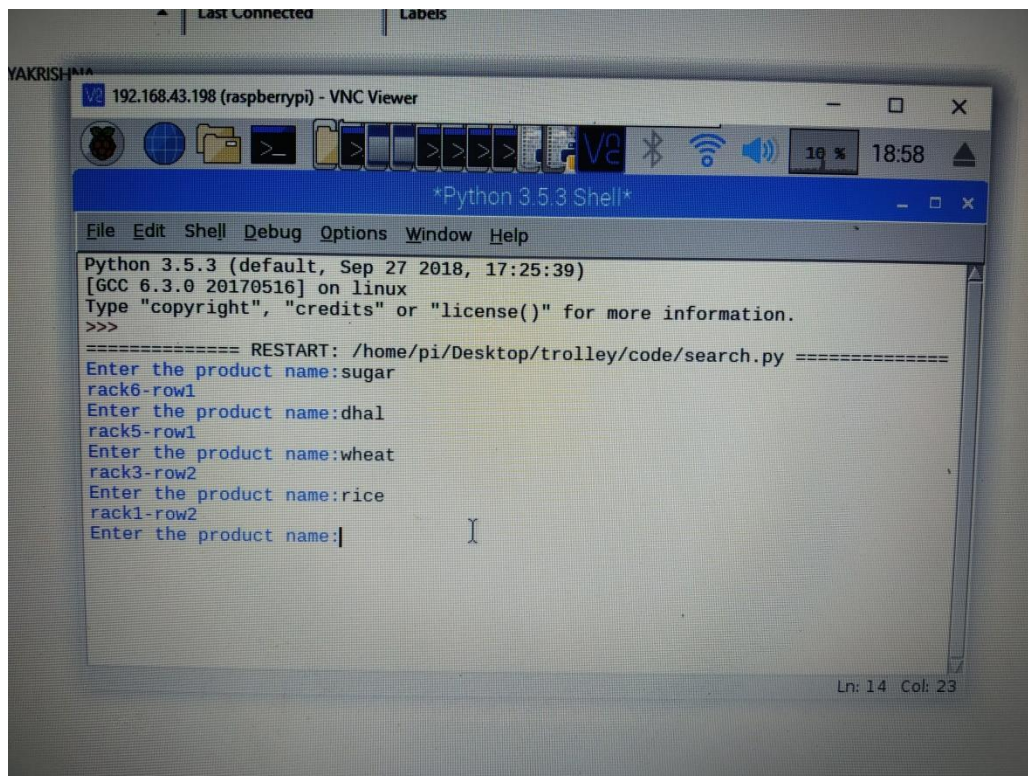
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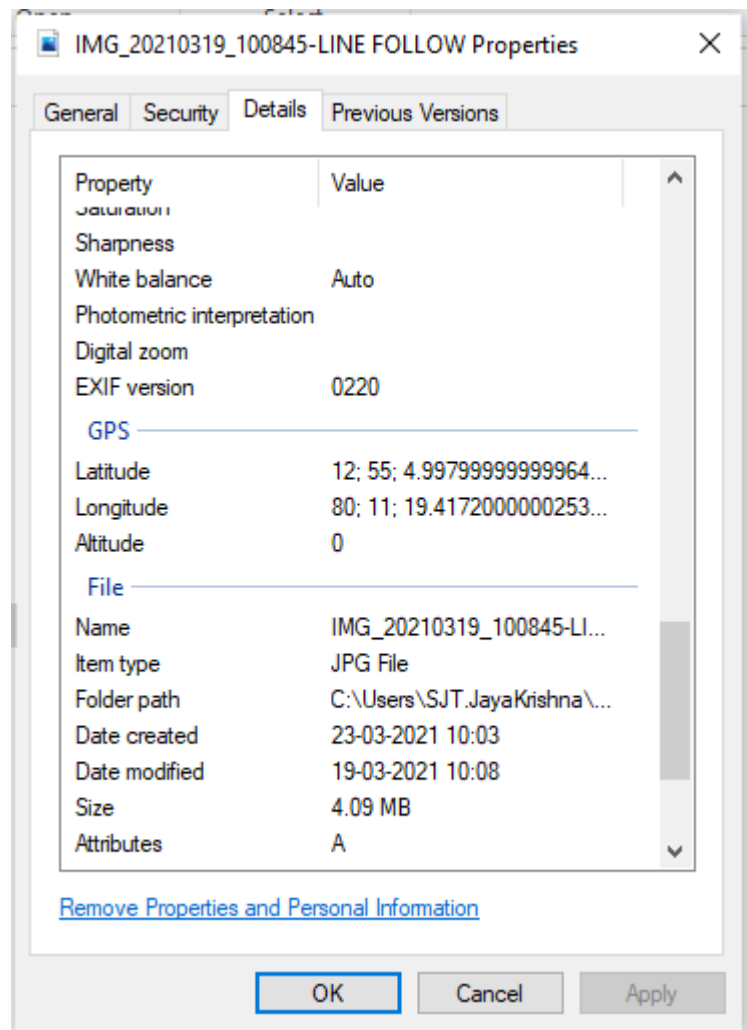
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APPENDIX A – GEO TAG PHOTOS









APPENDIX B : PLAGIARISM REPORT

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9/03/2021

BONAFIDE CERTIFICATE

This is to certify that the following students of **Sathyabama Institute of Science and Technology** has attended project classes on "**Target Object Recognition and Path follower trolley robot using LIDAR**" Guided by **Sathish.R** in our organization from the period of January 8th 2021 to March 5th 2021.

Schedule:

Weekdays: 12.00 p.m to 03.00 p.m

Weekend & Other Holidays: 12.00 a.m to 03.00 p.m

Student Information:

M. Hemalatha (37180009), Final Year-E&I

S. Srishailu (37180017), Final Year-E&I

For Pantech ProEd Pvt Ltd.,

Authorized Signatory.

Srinivasan.N
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