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WAREHOUSE AUTOMATION

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ABSTRACT

Warehouse Management System helps in the inventory management and in proper storage and uses high storage racks and fixed bins to store the products. Material cab adjusted at the storage bin level and this bin is further monitored by the system and can easily access the products in the specified bin. WMS keeps recording the stock level difference in the storage bins and racks and gives the information about the balance stock. WMS is used to track those products which are stored in the storage bins to assure the receiving of the goods which can be put aside any time and can be further used. Storage location had a problem with manual system and no proper location was allocated to the products but by the management of warehouse system a proper location is allocated to the goods and this space location selection has made the best use of the available space in the warehouse. In a large warehouse, storing and retrieving of materials or goods is difficult to operate by manpower alone. There are a lot of large and tall storage racks in a warehouse to store these copious materials. This will cause danger to workers such as slipping, falling from high places, getting hit by falling objects as well as accidents that involve a fork lift truck. Furthermore, human error such as the material is kept in a wrong place or rack, will give difficulty for the company to trace back the material. This project presents an automated warehouse system which provides more efficiency, more accuracy and reduces human effort.

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I. INTRODUCTION

The word 'Automation' is derived from ancient Greek words of Auto (means self) Matos (means moving). Thus, a mechanism move by itself or self dictated is called automation. As compared with manual systems, automation systems provides superior performance in terms of precision, power and speed of operation.

Automation increases the production rate by producing greater output for a given labour input. It is not possible for human workers to work for long hours without losing accuracy. In other hand, without compromising on accuracy, automated control systems able to work for long hours. Hence increased productivity and efficiency per hour of labour input.

In a large warehouse, storing and retrieving of materials or goods is difficult to operate by manpower alone. That is why an automated storage and receiving system (ASRS) is utilized to reduce the overall problems occurred in the warehouse. ASRS system is designed for automated storage and retrieval of parts and items in manufacturing, distribution, retail, wholesale and institutions.

II. METHODOLOGY

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This project has two sections-one is control panel section and other is robotic section. Control panel is controlled by PIC microcontroller and all robotic functions are controlled by arduino. Storage and retrieval of goods/products is done by robot. This reduces human efforts and gives more accuracy.

III.PROPOSED SYSTEM

This project has two sections-one is control panel section and other is robotic section. Control panel is controlled by PIC microcontroller and all robotic functions are controlled by arduino. Storage and retrieval of goods/products is done by robot. This reduces human efforts and gives more accuracy.

In robotic section, ultrasonic sensors are used for object sensing and IR sensor array is used for line following. Servo motors are used for movement of robotic arm and PMDC motors are used for movement of base chassis. The transmitter module takes serial input and transmits these signals through RF. The transmitted signals are received by the receiver module placed away from the source of transmission.

In control panel section, keypad is used for giving inputs and LCD is used for display purpose. The transmitter module takes serial input and transmits these signals through RF. The transmitted signals are received by the receiver module placed away from the source of transmission.

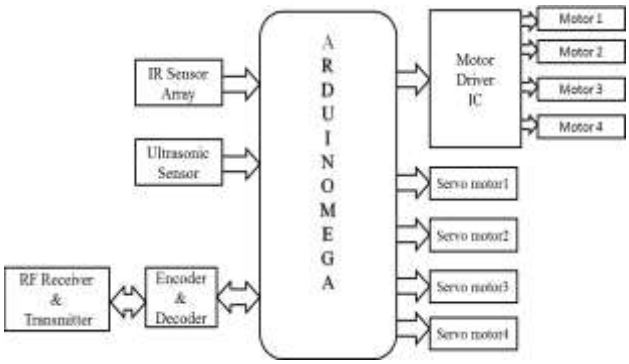

Fig 1.Robotic Section Block Diagram

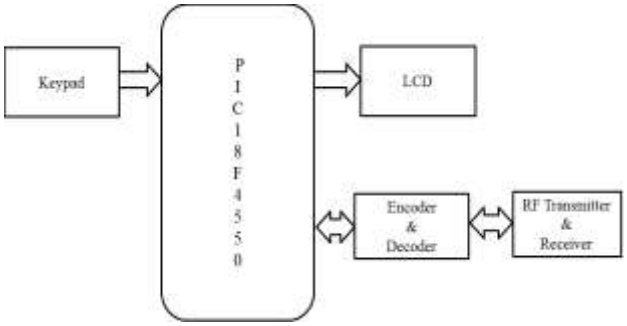

Fig 2.Control Panel Section Block Diagram

3.1. Arduino Mega

The Arduino Mega 2560[6] is a microcontroller board based on the ATmega2560 (datasheet). It has 54 digital input/output pins (of which 14 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC to-DC adapter or battery to get started. The Mega is compatible with most shields designed for the Arduino Duemilanove or Diecimila.

3.2. PIC18F4550

PIC18F4550 is a programmed IC which controls the operations of the whole control panel section. It has on board USB transceiver with on-chip voltage regulator,5 crystal modes including high-precision PLL for USB, extended watchdog timer, master synchronous serial port module, 10 bit analog to digital converter. It is self programmable under software control.

3.3. Infrared Sensor (IR)

An infrared sensor is an electronic device, that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion .These types of sensors measures only infrared radiation, rather than emitting it that is called as a passive IR sensor. Usually in the infrared spectrum, all the objects radiate some form of thermal radiations. These types of radiations are invisible to our eyes, that can be detected by an infrared sensor. The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode which is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light falls on the photodiode, the resistances and these output voltages, change in proportion to the magnitude of the IR light received.

3.4. Lithium Polymer (LiPo) Battery

A LiPo batteries consists of multiple cells. These cells deliver across 3.7 Volts. A 3S LiPo would therefore supply about 11.1 Volts. S stands for number of cells connected in series.Apart from the cells discharge rate is defined by the letter ‘C’. Most batteries cases say something like 25C to 40C discharge rate. This sees that 25C is nominal discharge rate and 40C is maximum burst discharge rate. Its advisable to stay on or below nominal discharge rate to preserve battery future life. Not all brands say something about the peak discharge rate on the battery itself. The battery capacity is defined in mAh. mAh means Mille-Ampere per hour. A battery with a 1000mAh capacity can deliver 1 Ampere for 1 hr. Or 1mA for 1000 hours. The battery capacity, together with the LiPo battery’s discharge rate will define its maximum current output.

Example calculation of discharge rate:
A 3S 1300 mAh 25C LiPo pack will give:
1300mAh x 25C =32.5 mAh discharge rate.
32.5 mAh / 1000= 32.5 Ampere constant discharge rate.
So, a 1300 mAh and 25C LiPo can handle an Ampere draw of 32.5A at max.
Example calculation of max. Working time:
A maximum constant current draw is 11 Amperes.

So,
Working time = (1300mAh/1000) / 11 = 1.18 x 60 = 7.09 minutes working time

3.5. Liquid Crystal Display (LCD 16x2)

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 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 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 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.
Features of LCD:

- 5 x 8 dots with cursor.
- Built-in controller (KS 0066 or Equivalent).
- + 5V power supply (Also available for + 3V).
- 1/16 duty cycle.
- B/L to be driven by pin 1, pin 2 or pin 15, pin 16 or A.K (LED).
- N.V. optional for + 3V power supply.

3.6.Keypad (4x4)

A 4x4 matrix keypad requires eight Input/Output ports for interfacing is used as an example. Rows are connected to Peripheral Input/Output (PIO) pins configured as output. Columns are connected to PIO pins configured as input with interrupts. In this configuration, four pull-up resistors must be added in order to apply a high level on the corresponding input pins.
Keypad Working

This Application Note describes programming techniques implemented on the AT91 ARM-based microcontroller for scanning a 4x4 Keyboard matrix usually found in both consumer and industrial applications for numeric data entry.,AT91 Keyboard interface In this application, a 4x4 matrix keypad requires eight Input/Output ports for interfacing is used as an example. Rows are connected to Peripheral Input/Output (PIO) pins configured as output. Columns are connected to PIO pins configured as input with interrupts. In this configuration, four pull-up resistors must be added in order to apply a high level on the corresponding input pins as shown in Figure 1. The corresponding hexadecimal value of the pressed key is sent on four LEDs.
Features of Keypad:

- Contact debouncing.
- Easy to interface.
- Interfaces to any microcontroller or microprocessor.
- Data valid output signal for interrupt activation

3.7. RF Module

This radio frequency (RF) transmission system employs Amplitude Shift Keying (ASK) with transmitter/receiver (Tx/Rx) pair operating at 434 MHz. The transmitter module takes serial input and transmits these signals through RF. The transmitted signals are received by the receiver module placed away from the source of transmission.

The system allows one way communication between two nodes, namely, transmission and reception. The RF module has been used in conjunction with a set of four channel encoder/decoder ICs. Here HT12E & HT12D have been used as encoder and decoder respectively. The encoder converts the parallel inputs (from the remote switches) into serial set of signals. These signals are serially transferred through RF to the reception point. The decoder is used after the RF receiver to decode the serial format and retrieve the original signals as outputs. These outputs can be observed on corresponding LEDs.

Encoder IC (HT12E) receives parallel data in the form of address bits and control bits. The control signals from remote switches along with 8 address bits constitute a set of 12 parallel signals. The encoder HT12E encodes these parallel signals into serial bits. Transmission is enabled by providing ground to pin14 which is active low. The control signals are given at pins 10-13 of HT12E. The serial data is fed to the RF transmitter through pin17 of HT12E.

Transmitter, upon receiving serial data from encoder IC (HT12E), transmits it wirelessly to the RF receiver. The receiver, upon receiving these signals, sends them to the decoder IC (HT12D) through pin2. The serial data is received at the data pin (DIN, pin14) of HT12D. The decoder then retrieves the original parallel format from the received serial data.

When no signal is received at data pin of HT12D, it remains in standby mode and consumes very less current (less than 1μA) for a voltage of 5V. When signal is received by receiver, it is given to DIN pin (pin14) of HT12D. On reception of signal, oscillator of HT12D gets activated. IC HT12D then decodes the serial data and checks the address bits three times. If these bits match with the local address pins (pins 1-8) of HT12D, then it puts the data bits on its data pins (pins 10-13) and makes the VT pin high. An LED is connected to VT pin (pin17) of the decoder. This LED works as an indicator to indicate a valid transmission. The corresponding output is thus generated at the data pins of decoder IC. A signal is sent by lowering any or all the pins 10-13 of HT12E and corresponding signal is received at receiver's end (at HT12D). Address bits are configured by using the by using the first 8 pins of both encoder and decoder ICs. To send a particular signal, address bits must be same at encoder and decoder ICs. By configuring the address bits

properly, a single RF transmitter can also be used to control different RF receivers of same frequency. To summarize, on each transmission, 12 bits of data is transmitted consisting of 8 address bits and 4 data bits. The signal is received at receiver's end which is then fed into decoder IC. If address bits get matched, decoder converts it into parallel data and the corresponding data bits get lowered which could be then used to drive the LEDs.

Features of RF Module:

- Easy for operation.
- Low power consumption.
- Serial interface(RS232).
- Provide link layer packet control.
- Operating frequency:916.50MHz.
- Maximum data rate:22.5kbps.

IV.RESULTS

Stage 1: Robotic Arm Assembly

Fig 3. Robotic Arm Assembly

Above picture shows the assembled structure of robotic arm which consist of mechanical brackets, Servo motors (NRS-995, NRS-585) and gripper. 4 Axis Robotic Arm is designed for small mobile robots for object manipulation. It can grip objects up to 60mm wide with the griping force of 250gms. Arm has reach of 29cm. It can lift the payload up to 155gms.

Stage 2: Mechanical Structure of Robot

Fig 4. Mechanical Structure Of Robot

Above picture shows the Mechanical structure of Robot which consists of Robotic arm,PMDC motor,Wheels.

Stage 3: Control Panel Section

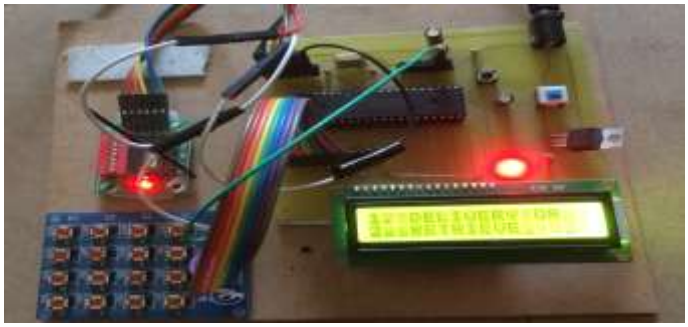

Fig 5. Control Panel Section

Above picture shows the complete design of Control Panel with PIC18f4550 & other components.

Stage 4:Final Robotic Section And Control Panel Section.

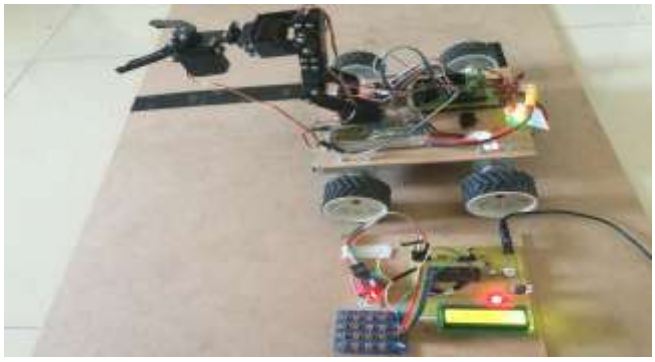

Fig 6. Final Robotic Section And Control Panel Section

This is the final stage, in which complete structure of Robot and Control Panel is designed. It has all Hardware components assembled on it.

V. CONCLUSION

A warehouse automation project can be a home run that drives a company towards increased profitability. On the other hand, poorly thought-out automation projects have driven companies out of business. Determining the right technology and processes to automate is vital to remaining competitive. Practicing the right methodology for system design, integration, and procurement will ensure that the project will be completed on time, on budget, and will meet expectations.

Despite the strong correlation to improved performance, overall adoption rates for warehouse automation remain fairly low. Some technologies still suffer from outdated misconceptions about up-front cost or lack of flexibility. Piece pick operations are a key sector with tremendous untapped potential to improve their bottom line through utilizing warehouse automation to a greater extent.

As businesses grow their warehouses and inventory expands but often the systems in place do not keep up. Inefficiencies from these antiquated systems often go undetected and therefore contain several hidden

costs. Warehouse operations need to keep pace with systems and technology that can reduce waste and maximize efficiency. A Warehouse Management System (WMS) and handheld computers with wireless communications are the tools of a modern warehouse. These devices and the use of bar codes greatly improve the efficiency of a warehouse and eliminate waste.

System where goods are placed into and removed from store by remote control with assistance of electronic data processing equipments. It removes the difficulty of warehouse system. From warehouse automation we manage the database of the product.

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