ABSTRACT
This project is about to build an autonomous robot which is a Pick and Place Robot using Line Tracking. This project contains three main parts which are electric circuit, mechanical design and programming. To build a good autonomous robot, the robot must be very easily and freely need to be controlled by the pilot to make sure it can perform well. Commonly, this robot is used to pick and place items, for some function like in factory, send the container from front of line to end of line or some other function that need to sent item from other place to one another place. Basically, this robot uses several sensors to guide the direction which has been lined with black tape and the robot is using several motors for the movements. This project focuses on the usage of PIC as a controller, motor as a mover and sensor as the line guider. This robot functions fully controlled by software which are programmable.

KEYWORDS PIC 16F877A, Radio-frequency identification (RFID), Pick and Place Robot.

I. INTRODUCTION
A robot can be defined as a programmable, self-controlled device consisting of electronic, electrical, or mechanical units. More generally, it is a machine that functions in place of a living agent. Robots are especially desirable for certain work functions because, unlike humans, they never get tired; they can work in physical conditions that are uncomfortable or even dangerous; they can operate in airless conditions; they do not get bored by repetition; and they cannot be distracted from the task at hand. This article is based on the research project which is an autonomous robot to be use in food industry. The robot is powerful, reliable and can be used in hot temperature area where a human after working for so long can become sick and exhausted. The most apparent reasons that are associated in installing of robotic systems in food industry are
- Saving of manpower
- Improved quality & efficiency.
- Ability to work in any hostile environment.
- Increased consistency & flexibility.
- Increased yields and reduced wastage.

In today’s fast paced world competition in industrial field is very fierce. Time is money than more than ever before. Efficiency and productivity are very important. In order to increase the efficiency and productivity, losing time in every process should be eliminated. Walking time for transferring an object is a loss of time. This loss in time can be reduced or eliminated by using mobile robots with arm that can carry a heavy load that may need many people to carry. In this way, the man power is reduced. Many factors are needed to be considered in man power. The main factor is the fatigue. Break time should be given to avoid over fatigue. Compared to human, robots can repeat the tasks continuously. In addition to fatigue, idleness and laziness of the operator are also factors that contribute to low efficiency. Therefore, nowadays automation is strongly recommended over man power. The main objective of this project is to develop an autonomous mobile robot for pick and place of raw materials in industries. The project being a mobile autonomous industrial robot, line follower technology is used for the mobility with control from a microcontroller. The mechanical design of the robot is the most complex or difficult part of this project compared to the electronic circuit design. Mechanical design involves the construction of a base with wheels for movement, a strong and fixed arm with joints to bend and an end effector at the end of the arm. The end effector is the part which holds an object. Carries it and then drops it at another place. These operations can be programmed in a microcontroller in the correct sequence. Only when the mechanical design is complete we can start with the electronic circuit design and interfacing them.

Requirements of a good robot design includes
1) The robot must be as light as possible.
2) The arm should be rigid enough to withstand forces generated due to
   - Its own body weight
   - Weight of the object to be lifted.
   - Inertia forces due to change in velocity
   - Centrifugal forces due to change in velocity
   - The cost should be minimized.

II. EXISTING SYSTEM
In the before technology they were many methods used to design and implement, and also different algorithms were used for navigating the mobile robot. Unlike bar codes, no clear line of sight is required to obtain an accurate read. As the bar codes were high of cost we are using the RFID Tags. The most common and popular navigation techniques suggested in the state of the art generally fall under one of the following categories: map-based technique, deadreckoning-based technique, landmark-based technique, vision-based technique, and behavior-based technique. Each navigation technique has its own advantages and disadvantages.

2.1 Dead reckoning
Dead reckoning navigation system provides position, heading, linear, and angular velocity of an autonomous mobile robot and it is widely used due to its simplicity and easy maintenance. The shortcomings of the dead-reckoning navigation system is that small precision errors and sensor drifts inevitably lead to increasing cumulative errors in the robot’s position and orientation, unless an independent reference is used periodically to correct the error. To overcome these shortcomings, researchers shifted their attention to landmark-based mobile robot navigation system.

2.2 Landmark based navigation
Landmark-based navigation strategies rely on the identification and subsequent recognition of distinct
features or objects in the environment that may be a priori known or extracted dynamically. However, due to the noise in sensors and possible change in the environment, the recognition process of features or objects might be difficult. To resolve these issues, some researchers investigated vision based navigation systems.

2.3 Vision based navigation
Where a mobile robot uses visual features to guide itself in the environment. Such techniques also revealed some disadvantages, which include the lack of information depth, complex image processing algorithms with high computational burden, and the dependence on the working environment.

2.4 Behaviour based navigation
Another research avenue was to opt for behavior-based navigation systems. This type of paradigms was credited to be suitable for unstructured environments as they can incorporate a large number of sensors. They can also be accompanied with tools of computation intelligence, such as fuzzy logic, neural networks, genetic algorithms, and several combinations of them. Nevertheless, behavior-based navigation techniques also require a high computational power and in some cases they lead to significant cumulative errors due to the inevitable noise associated to the sensor measurements.

To overcome some of the demerits of the aforementioned techniques, integrating RFID systems emerged lately as a promising alternative navigation method. In some studies, RFID tags are placed in predefined locations in the workspace and the robot is pre-equipped with an RFID reader to communicate with the tags during its navigation in the environment.

III. PROPOSED SYSTEM
To overcome the above problems we are using the different technique and microcontroller. The utilization of RFID technology is novel and might enhance the existed automation system. The PIC (16F877A) Microcontroller is used to control the proposed autonomous mobile robot and to communicate with RFID reader. Due to the uniqueness of RFID tag, the moving control commands such as turn right, turn left, speed up and speed down etc. The autonomous mobile robot can read the moving control commands from the tags and accomplish the proper actions. The novel localization system for a mobile robot is proposed to improve the efficiency of the system.

3.1 Electronic Design
The components that are needed for the electronic circuit design includes Light Emitting Diode-Phototransistor pairs, resistors, potentiometers, RFID Tag (transponder) and Reader, DC Geared motors, Motor Driver IC’s and microcontroller. The microcontroller used here is PIC 16F877A. Either L293D or ULN 2003 can be used as motor driver IC but if we use ULN 2003 IC, we need to connect relays to give supply to the motors.

3.2 Block Diagram
The overall operation or design of the robot can be classified into five blocks which are, Power Supply block, Line Follower block, Controller block, Motor Driver Circuit block and the Radio Frequency Power supply is needed for each and every component used in the project. The power source used is a 12V DC rechargeable battery. This 12V supply is directly given to the motors used but for the operation of the IC’s 5V supply is needed and thus we connect a regulator to the output of this 12V battery.

IV. LINE FOLLOWER
The line follower is a self operating robot that detects and follows a line that is drawn on the floor. The path consists of a black line on a white surface (or it may be reverse of that). The control system used must sense a line and maneuver the robot to stay on course, while constantly correcting the wrong moves using feedback mechanism, thus forming a simple yet effective closed loop System. The robot is designed to follow very tight curves. The path is a black line on a white background with width of 3 cm (except at bends where a little variation may be present). It may contain paths laterally displaced by an around 3 cm and also gap of at most 5 cm.

4.1 Basic design Requirements:
The robot is built with PIC 16F877A, L293D, IR sensors, LM324, platform consisting of a toy car chassis (or handmade Al sheet chassis). The robot is
designed using two motors controlling wheels. It has infrared sensors on the bottom for detect black tracking tape. It captures the line position with the help of these optical sensors called opto-couplers mounted at front end of the robot. (Each opto-coupler consists of an IR LED and an IR Sensor) when the sensors detect black surface, output of comparator, LM324 is low logic and for white surface the output is high. It reports to the microcontroller for accurate control and steering of motors. Microcontroller PIC 16f877A and motor driver IC’s L293D and ULN 2003 are used to drive the motors.

4.2 Basic operation
The basic operations of the line follower are as follows
- Capture line position with optical sensors mounted at front end of the robot. For this a combination of IR LED’s and Photo Transistor called an opto-coupler is used. The line sensing process requires high resolution and high robustness.
- Steer robot to track the line with any steering mechanism. To achieve this we use two motors governing wheels motion.

Fig 2: Line follower circuit with LCD

V. RADIO-FREQUENCY IDENTIFICATION (RFID)
Radio-frequency identification (RFID) is the wireless non-contact use of radio-frequency electromagnetic fields to transfer data, for the purposes of automatically identifying and tracking tags attached to objects. Some tags require no battery and are powered and read at short ranges via magnetic fields (electromagnetic induction). Others use a local power source and emit radio waves (electromagnetic radiation at radio frequencies). The tag contains electronically stored information which may be read from up to several meters away. Unlike a bar code, the tag does not need to be within line of sight of the reader and may be embedded in the tracked object. The output signal from the microcontroller is insufficient to drive the motor. Thus, a driver IC is needed between the microcontroller and the motor which amplifies the output signal from controller. The L293D is designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V.

5.1 Sensors
A Photodiode is a p-n junction or p-i-n structure. When an infrared photon of sufficient energy strikes the diode, it excites an electron thereby creating a mobile electron and a positively charged electron hole. If the absorption occurs in the junction's depletion region, or one diffusion length away from it, these carriers are swept from the junction by the built-in field of the depletion region, producing a photocurrent. Photodiodes can be used under either zero bias (photovoltaic mode) or reverse bias (photoconductive mode). Reverse bias induces only little current (known as saturation or back current) along its direction. But a more important effect of reverse bias is widening of the depletion layer (therefore expanding the reaction volume) and strengthening the photocurrent when infrared falls on it. There is a limit on the distance between IR LED and infrared sensor for the pair to operate in the desired manner. In our case distance is about 5mm.

IR reflective sensors have one emitter (IR LED) and one receiver (Photo-Transistor or photo diode) which constitute a pair. They are placed in such a way that the light emitted by the LED is collected by the Photo-transistor which brings about a change in
resistance. If we have white surface it reflects the light and it will sensed by the receiver, similarly if we have black surface it absorbs the light and receiver cannot sense light. Photo diode has property that if IR light fall on it its electrical resistance comes down (i.e. its comes down from 150kΩ to 10kΩ if no noise present). For sense the change in resistance we use voltage divider circuit.

Fig 3. Sensor concept

The output signal from the sensor is fed as an input to one of the inverting terminal of the comparator which compares this signal with the reference voltage set by using a potentiometer which is fed to the non-inverting terminal of the comparator IC. When the sensor or emitter pair is on a reflecting surface, the sensor is on i.e., in low impedance mode in which one can easily view as LED corresponding to that sensor doesn’t glow. The output of the OP-AMP is high signal and this high signal is given to the microcontroller. And when the sensor is on a non-reflecting surface, it is off i.e., High impedance mode in which one can easily view as LED corresponding to that sensor glows up and low signal is given to the microcontroller.

The resistance of the sensor decreases when IR (infrared) light falls on it. A good sensor will have near zero resistance in presence of light and a very large resistance in absence of light. Whether the sensors are Light Dependent Resistors (LDR), laser diode, Infrared Sensors, Ultrasonic Sensors or anything else, the outputs of the sensor modules are fed to the Non-inverting input of a comparator. The reference voltage of the comparator is fed to the inverting input of the comparator by a trim pot or a tuning device connected between the supply lines. LM324 is a comparator IC that digitizes the analog signal from the sensor array. Since the output of LM324 is TTL compatible it can be directly fed to the master microcontroller.

Fig 4. Sensor Interfacing with Microcontroller

The generalized connection diagram of Sensor Interfacing with microcontroller is shown below. The tuning potentiometer is used to set the reference voltage level of the comparator. In other words, it is used to adjust the sensitivity of the sensor.

5.2 Basic Operation

When the power supply is given, the robot moves over the black line by continuously sensing the black and white colours. When the RFID reader detects the RFID tag, the mobility of the robot is stopped and the operation of the arm to pick the object starts. Once the object is picked, again the robot moves over the black line and on sensing the other RFID tag, the robot stops and drops the object. This operation continues.

VI. CONCLUSION

An autonomous robots which can be controlled with wireless technology from the remote and this robot follows the line and move to the desired location and perform pick and place operation of item. These Robots can be deployed in vital locations and also used for military for rescue mission. These Autonomous unmanned robots can communicate with adhoc network and can perform better operation.

REFERENCES