Autonomous Vehicle Transportation Using Wireless Technology

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***Abstract*- This paper illustrates the use of a vehicle in several industries and is capable of reducing extra strenuous and/or time consuming activities of humans. The main concentration of this work was on vehicle navigation, tracking, obstacle detection, weight overload, battery power measuring and also be able to locate the respective service station goods. Vehicle navigation employs RFID technology. The RFID reader is installed in the vehicle and reads the tags which are placed along its route. Whenever a vehicle reaches a service station it sends a message to the workers. Upon receiving a message, the workers can collect the respective service station goods using RFID. If the wrong goods are taken out of the vehicle, the buzzer gets activated. The obstacle detection can be done by ultrasonic sensors. If any obstacle in the route is detected, the message is sent to the control station of the industry using the GSM module. The load cell is used to indicate the weight overload to the workers. Two batteries have been together utilized to measure the required power by this developed vehicle. As soon as Battery1 becomes dry, the battery2 is made the main source of power and a message is sent to the control station through GSM. The control station having a GSM module receives the message and the result will be displayed in hyper terminal window on the PC (personal computer). The vehicle transportation uses PIC microcontroller, sensors and wireless technology.**

***Key word*: - PIC16F877A, RFID reader and tag, Ultrasonic sensor, Load cell, GSM module**

I. INTRODUCTION

Several industries have difficulties in transporting goods or raw materials from source to destination. To arrive at the destinations an RFID based way can be undertaken. By using RFID tag, commands to control vehicle movement such as turn right, turn left, move forward and move backward etc. can be given. Commands would be written into the RFID tags and placed on the vehicle's track[1]. The autonomous vehicle transportation can read the control commands from the tags and carry out its appropriate actions[2][3]. Vehicle's navigation can also be controlled by the operator from a remote location or control station and when a vehicle crosses a tag, it sends a message to the base station. The RFID has been deployed in different applications and functionalities[4][5]. For example if five service stations are available, when vehicle reaches second service station, the controller would send messages to the control station and also to its respective service station workers through GSM. So workers can collect the goods with the assistance of RFID reader. Authentication is mostly in a goods carriage because there is a chance of misplacement of goods. The RFID tag contains an epic number, which will be embedded in the controller. If in case a worker takes wrong materials out from the vehicle, the following events are carried out. The controller activates the buzzer and a message is displayed on the LCD. When all the goods have been delivered to its respective service stations, it will automatically send a message to the control station intimating them about the delivery of goods. Obstacle detection can be done by ultrasonic sensors and if an obstacle is detected in its path the vehicle would send a message to the base station and also to the nearest service station workers[6][7]. Appropriate steps can then be taken to remove the obstacle. Battery supply is connected to the microcontroller with an analog pin through voltage divider, So that the voltage level of the battery is continuously monitored. When battery level reaches a dry condition, the controller takes an action. Automatically the source of power shifts over to battery 2 and also a message is sent to worker with the use of wireless way. The worker can replace the dry battery and fix a rechargeable battery in the vehicle. The vehicle transportation uses PIC microcontroller, sensors, and wireless technology. The controller is cost effective and easy to work. A sensor absorbs the physical quantity value from the environment. Wireless technology is transmitting data from one place to another place. In that we are using GSM for communication between the control station and vehicle with use of AT commands.

II. OVERALL SYSTEM VIEW

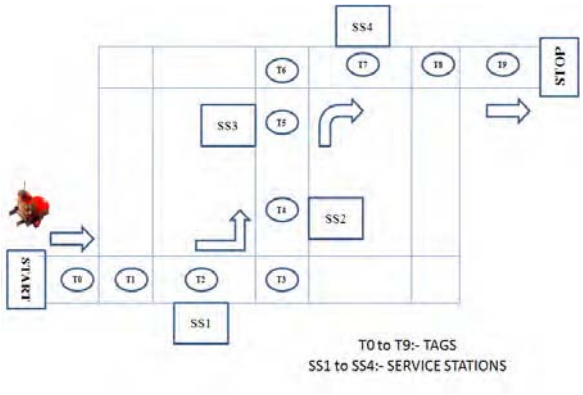

Figure1: RFID Navigation

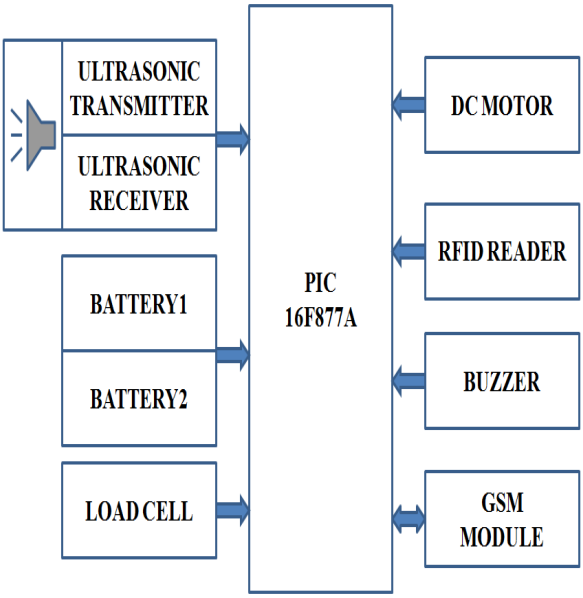

Figure2: Design of Vehicle

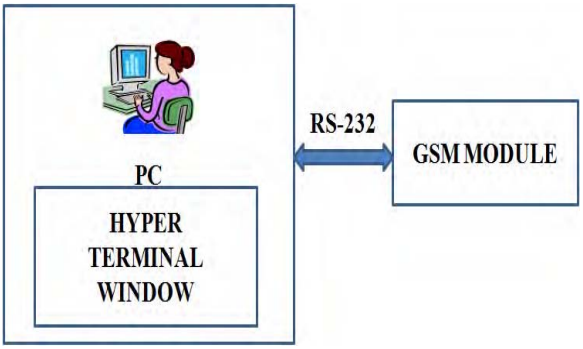

Figure 3: Design of Base Station

A. NAVIGATION THROUGH RFID TECHNOLOGY

RFID stands for radio frequency identification. It is an AIDC technology (automatic identification and data capture). This technology is used in several applications such as in medical laboratories, libraries, access control, animal identification, fast payment and vehicle navigation. It consists of two main components: an interrogator and a transponder. Reader is referred to as the interrogator which sends and receives the RF signal. Tag refers to the transponder which is attached to the object and identifys the objects. This combination has been proven to be quite fast and reliable. Microchip and antenna are an integral components of the tag. There are two types of tags. One is passive and the other, active tag and also wireless communication between reader and tag. There is no line of sight required between the devices. Passive tag is less expensive than the active tag.

Passive tag do not required power from the battery, it takes power from the reader. RFID operates in four frequencies. In our application we are using low frequency, it operates on 125 to 134 KHz band. Tag having 8 digit numbers, that number is predefined in the controller with the help of the reader to read the number[8][9].

B. PIC CONTROLLER BASED EMBEDDED SYSTEM

PIC stands for "peripheral interface controller". It is of RISC (Reduced Instruction Set Computer) design. PIC is Harvard architecture. Its design is simple and is faster than other architectures. It has a separate program and data bus. PIC16F877A is 16-bit device is available in 40-pin and 44-pin. It has 10 bit 8 channel, 3timer, and EPROM. They operate in 20MHZ. For the serial communication purpose we are using USART. The controller operates in 5V DC supply. This controller is multifunctional operation. All the modules are connected to the controller and each module connect to different pins. Embedded c programs are dumped to the controller, according to control the modules[10][11].

C. OBSTACLE DETECTION USING ULTRASONIC SENSOR

The purpose of the system is to detect an obstacle in the pathway of the vehicle using an ultrasonic detector and to avoid the collision of the obstacles. An ultrasonic sensor from micro sense technologies is used for distance measurement. This sensor has a transmitter and a receiver. They both operate synchronously in the same module. The sensor operates in 12V direct current supply. When comparing this with an IR sensor, it overcomes the problem of distance measuring of the obstacle and higher range. The ultrasonic pulse sends out and subsequently waits for the response. According to the device leaves the pulse in space. If the pulse collides with an object and it reflect the echo. This echo is sensed by the ultrasonic sensor and the controller takes the proper action. The send pulse in wherever from 40-200 KHz, but is normally in the 40-50 KHz range and the range of the sensor is 4.5 feet.

D. MESSAGE OVER GSM TECHNOLOGY

GSM (Global System for Mobile Communications) is a mobile phone network. It transmits voice and data service in digital cellular technology. This network operates in 900MHz and 1.8 GHz bands. It can transfer the data up to 9.6 kbps, the transmission data service is SMS. AT commands are used to control MODEMs. AT is the abbreviation for "ATTENTION", when connecting to the computer using the serial port and issue AT commands via hyper terminal window[12][13].

E. LOAD CELL

Load cell measures the weight overload in many applications, Such as electronic scale, price computing scale and digital scale. This is an analog device and consumes 5v power supply. It is transducer technique that converts mechanical force into an electrical signal. In this paper, 500 gram capacity type of load cell is used to measure the weight capacity of the vehicle and load cell is connected to a microcontroller analog pin.

III. DESIGN OF SYSTEM

Autonomous vehicle has been some prospective. Weight overload is measured by a load cell. This is analog device it gives the analog value to the controller. If the weight is above the certain level of vehicle, it can alert indication to the worker to use of buzzer sound and display in LCD. PIC consists of 40 pin IC. Two analog pins namely RA0&RA1, in that RA0 are connected to load cell, it measures the overload. The RFID reader is used to read the value according to the tag. Tag consists of EPIC number. There are two types of tag, active tag and passive tag. Active tag having internal battery and do not power from the reader. Passive tag does not contain the internal battery and thus operates an RFID reader for power, it have low range compare with active tag. The tag EPIC number defined in the controller with the help of vehicle can move in industries. In that RD4 to RD7 pins are used for DC motors. Relay used to control the DC motors for direction control [i.e.] move forward, move backward, move left, move right. There are four pins are controlled the DC motor RD4, RD5, RD6, RD7. The RD4 connected to motor1 and RD6 connected to motor2 is used to control forward direction, RD5 connected to motor1 and RD7 connected to motor2 is used to control reverse direction. The RD4 pin enables motor 1 to get forward direction and all other pins are disabled, it takes turn right. The same way RD6 pin enable motor 2 to get forward direction and all other pins are disabled, it takes turn left. If obstacle found in the way, the message will be sent to the worker as well as control station. After obstacle is cleared, cleared message send to control station with the help of a worker. Interface the ultrasonic sensor to the controller of RC1 pin. Vehicle reach the service stations sends the message to worker by the use of GSM. Each goods having tag number, worker collects the station goods using RFID reader. We move on to a power supply concept battery 1 is connected to RC4 and battery 2 is connected to RC5. First battery gets dry condition, it change the second battery with use of RA1 pin and send the message (battery changed) to central station. The RS-232 is used to serially transmit the data. In that system GSM, RFID is interconnected serial communication cable to the controller. GSM is only transmitting the data, for that serial communication TX pin and GND pin are connected. RFID is receiving the data from RS-232, for that RX pin and GND pin connected to the controller.

IV. FLOWCHART

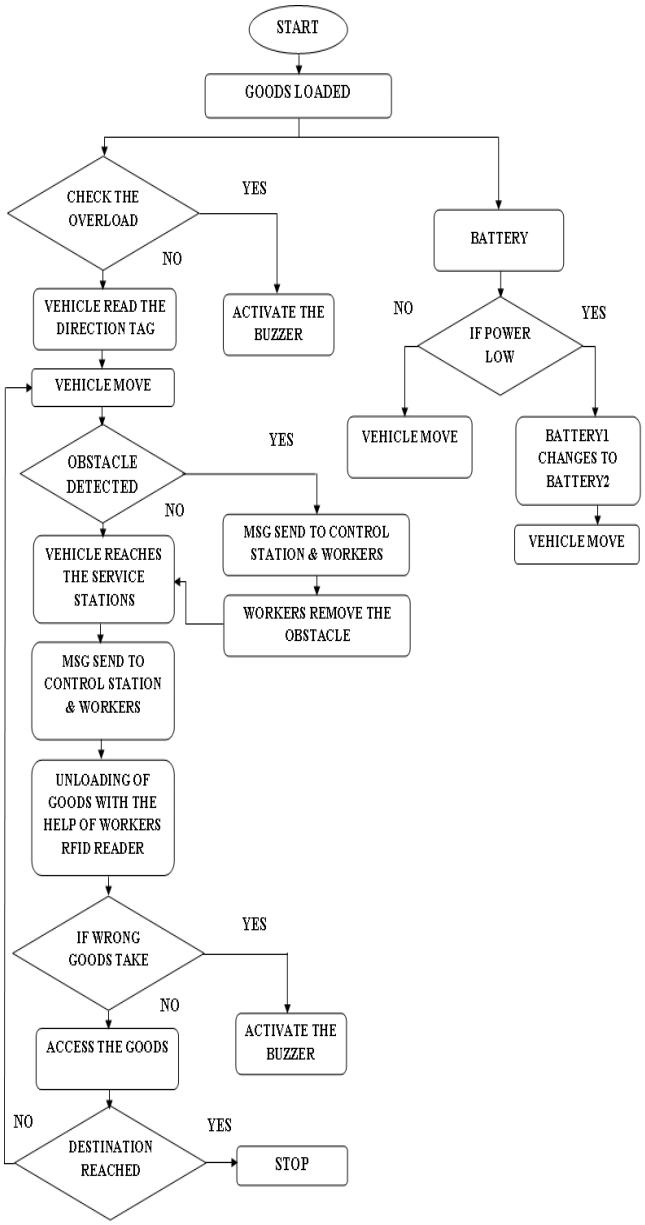

Figure 4: System Flow Diagram

V. EXPERIMENTAL RESULTS

Fig.5 shows the Overall structure of the autonomous vehicle transportation system. It takes the goods from one service station to another service station without the help of humans. Fig.6 shows the overload condition of the vehicle and an overload indication to the worker. Fig.7 shows autonomous vehicle navigation with the use of an RFID reader and tag, the each tag consists of EPIC number, according to vehicle move forward, backward, right, left and stops. Figures 8 & 9 show the battery conditions of the vehicle. As previously mentioned, two batteries have been installed in the vehicle and a check is performed every time on the battery condition with the use of voltage divider circuit. If a battery gets dry automatically the power source is changed to battery 2 as well as a changed message is sent to the worker. Fig. 10&11 obstacle detection in front of the vehicle using ultrasonic sensor and the obstacle detected message send to the respective worker to help of GSM module in the vehicle. Fig. 12&13 shows a vehicle reaches the service stations and the message send to the worker to help of GSM. Fig. 14&15 shows the respective service station workers collect the goods, if a correct good and wrong good taken out from the vehicle it shows to the worker by using the LCD display. Fig. 16&17 at the end of the industries with RFID tags to give the stop condition, the vehicle reached the destination and it will send the destination reached message to control station[14][15].

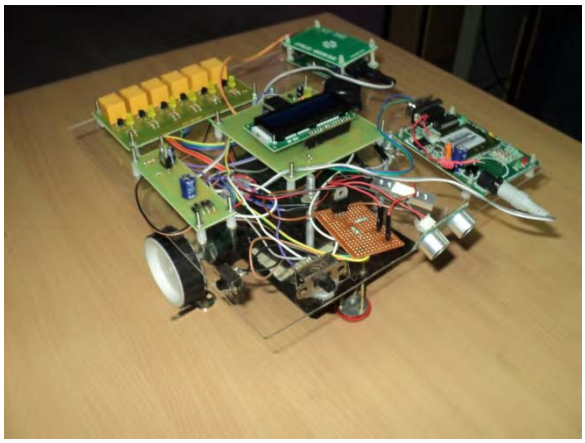

Fig. 5: Snapshot of overall vehicle

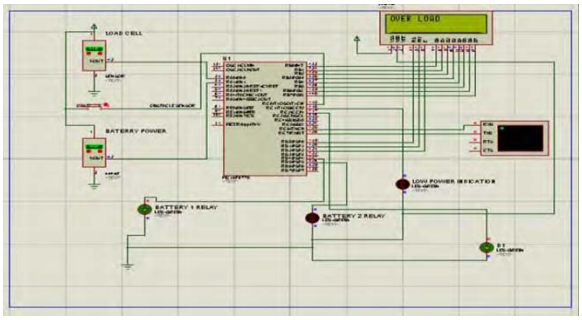

Fig.6:Snapshot of overload measuring

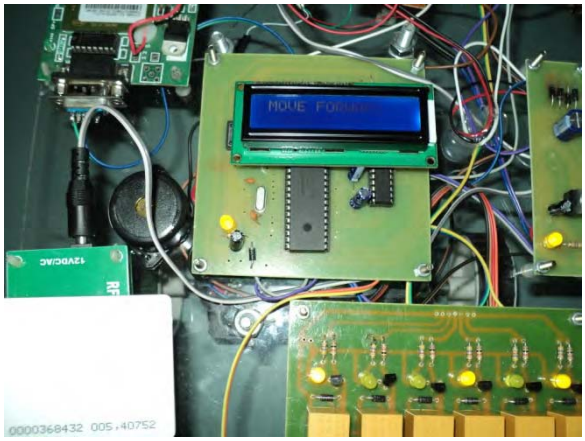

Fig. 7: Vehicle moves forward with help of RFID tag

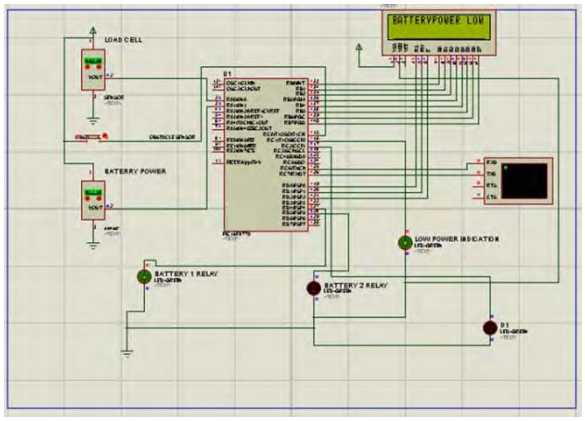

Fig. 8: Snapshot of battery power measuring

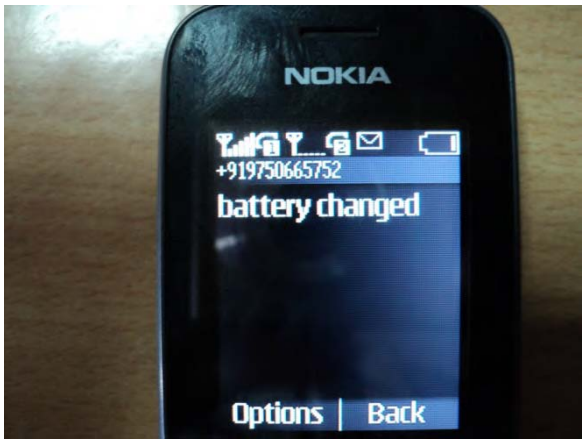

Fig. 9: Message sends to the worker

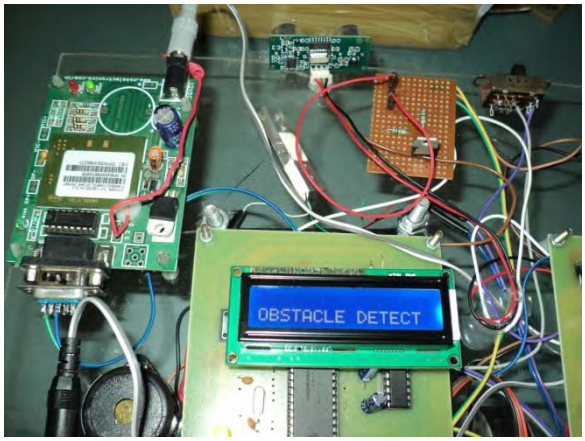

Fig. 10: Snapshot of obstacle detected

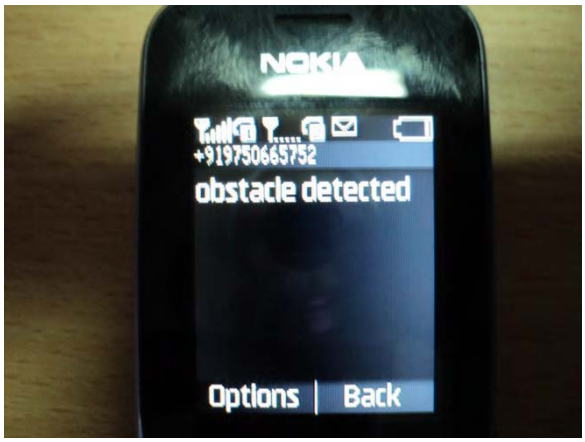

Fig. 11: Detected message sends to the worker

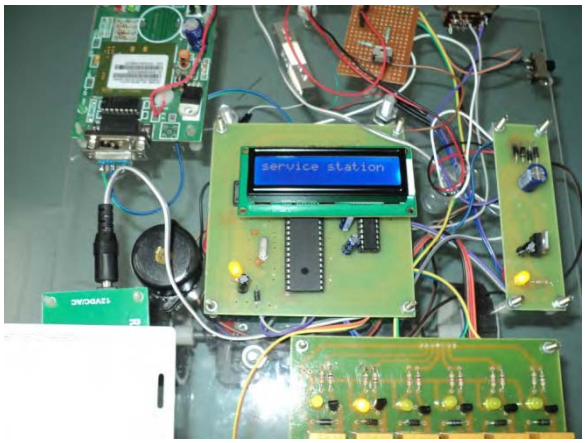

Fig. 12: Vehicle reaches the service station

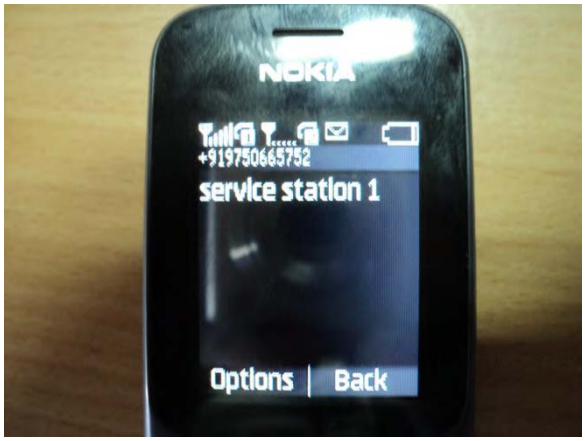

Fig. 13: Message to worker

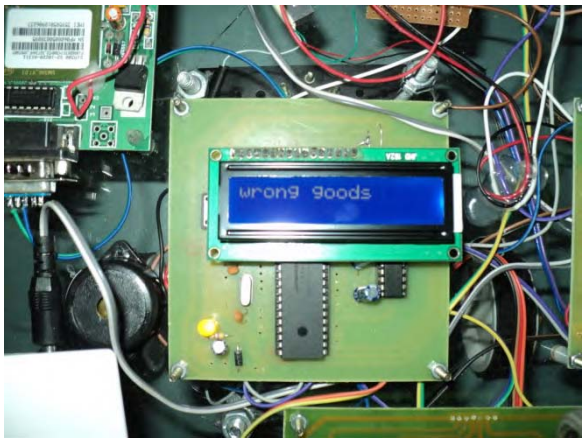

Fig. 14: Wrong good indication to worker

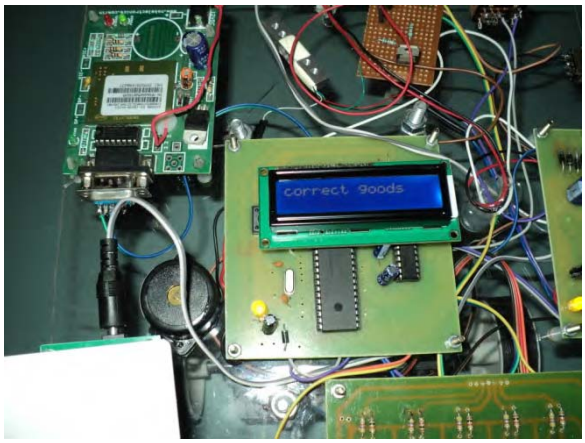

Fig. 15: Correct good indication to worker

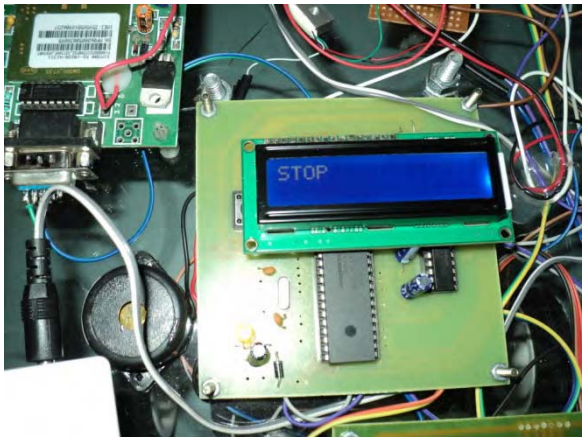

Fig. 16: Vehicle stops to help of the tag

Fig. 17: Destination reached message to control station

VI. CONCLUSION & FUTURE SCOPE

Autonomous vehicle transportation and delivery of goods in industries are effectively performed with RFID technology. The vehicle can do the accurate identification of obstacle in a path with the help of the ultrasonic sensor. It easily measures the load in the vehicle with the use of weight sensor. The battery condition is successfully measured by a voltage divider. Finally vehicle transportation systems are linked to a control station through messages by using a GSM modem. This unmanned vehicle system is capable of real time operaion and take goods from one service station to another service station. The results were experimentally verified. A future enhancement of the work involves the usage of cameras to identify the obstacle and take appropriate measures to tackle it.

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