ROBOTIC ARM BASED INTELLIGENT SYSTEM WITH AUTOMATIC PETROL BUNK AND AMOUNT COLLECTION

K roobini¹, P senthilkumar², P kathiresan³, GO girupaakaran⁴ and M saravanan⁵

¹ Assistant Professor, Bannari Amman Institute of Technology, Department of Mechatronics Engineering, Erode, Tamilnadu, India.
² PG Scholar, Bannari Amman Institute of Technology, Department of Mechatronics Engineering, Erode, Tamilnadu, India.
³, ⁴, ⁵ UG Scholar, Bannari Amman Institute of Technology, Department of Mechatronics Engineering, Erode, Tamilnadu, India.

roobini.ia19@bitsathy.ac.in, SENTHILKUMARP@bitsathy.ac.in, kathiresan.mc19@bitsathy.ac.in, girupaakaran.mc19@bitsathy.ac.in, Saravanan.me18@bitsathy.ac.in,

Abstract. The world is heading towards automation nowadays, but India is still at the beginning of the automation era. A rise in the number of vehicles in India has led to pollution and traffic in almost all of India’s cities in recent years. The supply of fuel to this large number of vehicles at fuel stations has created many problems in India. In our everyday lives, liquid dispensing systems in various places such as offices, bus stands, train stations, gas pumps are very commonly found. Currently, fuel stations are manually operated. Such fuel pumps take time and require more manpower. All these problems are sorted out by the use of unmanned petrol pumps to position fuel stations in distant locations, which take less time to run and are reliable and can be placed wherever the customer goes to make use of the electronic clearing system’s services. All these problems are sorted out by the use of unmanned petrol pumps. So, one of the best automation processes in our country is this proposed method. The automation of the gas station is a mandatory activity to be carried out due to the dramatic rise in the number of vehicles. To provide quick access and save time at the gas station, an autonomous petrol station using ATMEGA2560 is recommended. Our task reduces the use of human power often eliminates the possibility of all forms of cheating. For the convenience of the customer, automated billing facilitates swiping of credit / debit cards as well as cash depositor in the fuel counter itself.

Keywords: Image processing, Robotic arm, Automation, ATMEGA2560.

1. Introduction
Approximately all petrol pumps today need a microcontroller to regulate the electrical pumps for automation, driving the electrical pump to turn off accordingly. But it also needs manpower to run and raise revenue. The automation of the gas station is a mandatory activity to be carried out due to the dramatic rise in the number of vehicles. To provide quick access and save time at the petrol station, an automated petrol station using ATMEGA2560 is suggested. Our task reduces time and the use of human strength often decreases the risk of all forms of corruption. For the convenience of the customer, automated billing allows swiping of credit / debit cards as well as cash depositor in the fuel counter itself. This provides real-time details about the density of the fuel. Interfaces such as IR sensors, fire sensor, and camera/pumping unit, robotic arm, keypad and LCD display are regulated by the ATMEGA2560. To detect the vehicle type (4 wheeler), an IR sensor is used to transmit the signal to the Microcontroller. The cash / card unit allows the user to use cash / card (credit / debit card) to fill the required amount of petrol with a voice command given by the microcontroller to connect with the user to
enter the amount of petrol in the keypad. After swiping the card, the keypad is used to enter the fuel prices. The microcontroller triggers the relay driver for that specific time period when the desired number is entered on the keypad.

The relay output is related directly to the petrol pump. Then the fuel is pumped to sub tank from the main tank with the help of flow sensor the sub tank is consists of measuring scale so, the customer can able to view the proper quantity of the fuel it help to eliminates the possibility of all forms of cheating. At the same time the camera analysis the sticker which has pasted at the surface of fuel tank in the vehicle and send the signal to the microcontroller. After receiving the signal to robotic arm from the microcontroller. The robotic arm connects the filling hose to the vehicle's fuel tank triggered by the microcontroller. To activate the pumping motor for the specific time to perform our proposed work, a relay driver circuit is used. The quantity of fuel from the tank will be dispatched at the same time to the petrol tank of the vehicle and the corresponding cost will be shown on the LCD panel. The fire sensor detects and sends a control signal to the microcontroller in the event of a fire emergency occurring at the fuel station. The microcontroller shuts down the entire process and activates the relay to which the fire sprinklers are linked. In order to prevent fire at the station, the fire sprinklers spray water on the specific device. In order to save time and manpower, this project can also be easily implemented as an automated gas station.

2. Literature Survey

Automobile Fuel Pump Control System Using Embedded System [2]:
This paper is intended for the design of the Atmega-2560 microcontroller for Anti-Theft Control System for Automobiles, the Arduino mega-2560 Development Board and the relay switching circuit for the electronic fuel pump controller for pumping fuel to the vehicle engine. The main purpose of this project is to prevent a vehicle from being stolen. We are introducing a novel automotive anti-theft monitoring device that seeks to prevent a vehicle from being stolen. This device uses an embedded chip with an optical slot sensor or, during insertion that senses the key. This is accompanied by the device present in the vehicle asking the user via the Fingerprint Scanner to enter a unique password. A fingerprint consists of the password. If the user fails to enter the correct password and the location is monitored using a GPS module, a text message is sent to the owner. A warning about unauthorised use is also sent to the owner. In addition, the vehicle's fuel injector is deactivated so that the driver can not start the vehicle by any means. This method helps to take quick steps in an effort to rob. The design is powerful and simple.

SMART AUTOMATIC PETROL PUMP SYSTEM [3]:
The main objective of the project is to build a device capable of automatically deducting the quantity of petrol dispensed from the RFID technology based user card. In our everyday lives, liquid dispensing systems in various places such as offices, bus stands, train stations, gas pumps are very commonly found. Here we are going to present the latest fuel dispensing device of the era that is meant to be run using RFID technology with a prepaid card. The project primarily aims to build a prepaid card using RFID technology for the fuel bunk system and also the fuel dispensing system. At present, the petrol stations are manually run. Such petrol pumps need more human resources and are time-consuming. It is very expensive to put gas stations in distant areas to provide customers with excellent facilities. The use of an unmanned power pump, which takes less time to operate and is reliable and can be mounted anywhere, solves all these issues. The customer has to pay through the electronic clearing system to make use of the service.

3. SYSTEM OVERVIEW

The automation of the gas station is a mandatory activity to be carried out due to the dramatic rise in the number of vehicles. To provide quick access and save time consumption in the petrol station, an automated petrol station using ATMega2560 is proposed. Our work reduces the time as well as the use of manpower, therefore removing the likelihood of all kinds of cheating. For the convenience of the customer, automated billing allows swiping of credit / debit cards as well as cash depositor in the fuel counter itself. This provides real-time details about the density of the fuel.
3.1 Arduino Microcontroller
Arduino software is an open-source, Arduino is used for rapid prototyping, it has inbuilt library for many application. Easy-to-use both hardware and software. In this project, the Arduino board helps to Control all the peripherals which are interfaced. It controls all the parts through coding.

3.2 ATMEGA 2560
ATMega2560 is an arduino family based microcontroller board. Compared to all other arduino board ATMega2560 has most number of I/O port in it.

3.3 IR Sensor
Infrared technology is a broad range of wireless technology. Sensing is the main field of this sensor and is used remotely for TV. The infrared is categorized into three regions within the electromagnetic spectrum, which are the near infrared region, the mid infrared region and the far infrared region.
Near infrared region 700 nm to 1400 nm used for fibre optic communication
Mid infrared region 1400 nm to 3000 nm used for Heat sensing element
Far infrared region 3000 nm to 1 mm used for Thermal image processing

3.4 Display
One of the liquid crystal displays (LCD-16 * 2) is used in this prototype. You can monitor the LCD display with the liquid crystal library. It is quite because it has inbuilt library feature in it to use arduino interfacing of LCD.
To wire your LCD screen to your board, connect the following pins:
- LCD RS pin connected to digital pin 12
- LCD Enable pin connected to digital pin 11
- LCD D4 pin connected to digital pin 5
- LCD D5 pin connected to digital pin 4
- LCD D6 pin connected to digital pin 3
- LCD D7 pin connected to digital pin 2

3.5 Servo Motor
Servo motors are a single type of motor that can be operated by the control signal from the controller, motor angle or motor shaft, often control the direction of the servo motor. In many automation applications, this type of servo motor is used and even in the robotic arm, etc. Based on the function, various servo motors can be categorised according to size or torque. With Arduino’s support, the standard size of the servo motors can be driven directly without the need for an external power supply or driver IC. Usually, servo motors come with arms that are attached to the object required for movement, such as metals or plastic.

3.6 Keypad
In this proposed method, the keypad is used to enter the cost for petrol after swiping the card and also used in case amount.

3.7 DC Motor
A motor is an electric machine that transforms mechanical energy into electrical energy. The dc motor is used in this proposal to pump the fuel from the main tank to the sub tank and fill the vehicle tank too though.

3.8 Relay
One type of mechanical switch is a relay. The electric current flows through the relay coil and the coil is converted into an electromagnet, so that the circuit can be automatically closed. In order to be used in high-end industrial application products, relays have relays for their efficient operation. With proper coding, the microcontroller relay can be controlled automatically.

3.9 Camera
To image the location of the fuel tank in the car, the camera is mounted near the robotic arm. On the surface of the fuel tank the colour labels are pasted.
3.10 Flow sensor

The flow sensor is used to calculate the amount of fuel from the fuel reserve that is being filled into the fuel tank. Between the pump and the nozzle, the flow sensor is fixed. For continuous readings, one of its wires is linked to the controller.

4. METHODOLOGY OF INTELLIGENCE SYSTEM

When entering the parking lot, the car is parked and per the marker signals. The fuel is transferred by the customer from the main tank to the sub tank according to volume specifications. By capturing the sticker that has been pasted on the fuel box surface, the fuel loading side of the vehicle is filmed by the camera. The photos for more procession will go to the controller (Parikh et al. 2013). In the meantime, the image sent by camera will be processed to obtain the fuel cap centre stage. The fuel tank tracking is based using a signal mark. The marks are seen on the fuel tank in such a way that their coincidence becomes the subject of the fuel tank (Sheth et al. 2010). The centre will still remain the same, as seen from an angle, and even rural can be used. The controller quickly collects the four points and uses algorithms to locate the middle (Chauhan et al. 2011). This will assign the X, Y and Z coordinates of the fuel cap that is fed to the controller. According to this, the mechanism's drives would align the robotic arm to the fuel cap core. The arm travels in the Z direction now so that the fuel cap is pierced. If the arm is penetrated, the pump will be triggered to supply the gasoline. The pump stops when the reading of the flow sensor matches the controller's measured value. The retraction of the z axis is then carried out and the robot returns to its home location.

Fig 1: methodology of intelligence system in petrol station
5. BLOCK DIAGRAM

![Block Diagram of Microcontroller Based Automated Petrol Station](image)

**Fig 2**: Block diagram of microcontroller based automated petrol station

5.1 Detection and User Interface Module

In Detection and User Interface Module we had illustrated about the detection of the vehicle, identification of the card (debit/credit), cash detection and the user interface of $4 \times 4$ matrix keyboard. Vehicle is detected by using a IR sensor module, when a vehicle entered into the bay in the petrol station the IR senses the vehicle and send the control signal to the microcontroller, as soon as the signal received by the microcontroller responds to the user to enter the desired amount in the keypad.

When the desired mount is entered in to the keypad for example say Rs.50, then the user is asked for the next step of payment. The payment process is carried out by providing an cash /card unit. As per the preference of the user can choose either cash or card. Then the final step of the user is carried out by using a enter button finally the user enters all the necessary data required for filling the petrol.

![Detection and User Interface Module](image)

**Fig 3**: Detection and User Interface Module
5.2 Fuel Dispensing Module
The fuel dispensing module consists of a main tank as well as sub tank (measurement tank). The main tank is used for deposition of fuel in the underground, when the fuel is less in the sub tank it pumps the petrol from the ground to the measurement tank this is carried out by using a submersible motor. The sub tank (measurement tank) is responsible for measurement of fuel .the sub tank consists of measurement scale which is placed at the edge of the tank for accuracy and for avoiding cheating in the petrol station. When the desired amount is entered in the keyboard a solenoid valve activates and the sub tank dispenses fuel to the fuel tank of the vehicle when the desired amount of fuel is filled then the pump stops the desired amount of fuel can be verified by viewing the measurement tank.

![Diagram 4: Fuel Dispensing Module](image)

5.3 Robotic arm
Robotic arm is used to minimize the work of men. The automatic controlled “Robotic Arm” will fix the filling hose to the fuel tank of the vehicle which is triggered by the microcontroller. This will give the fuel cap, which is fed to the controller, the X, Y and Z coordinates. According to this, the mechanism’s drives would align the robotic arm to the fuel cap core. The arm travels in the Z direction now so that the fuel cap is pierced. If the arm is penetrated, the pump will be triggered to supply the gasoline. The pump stops when the reading of the flow sensor matches the controller’s measured value. The retraction of the z axis is then carried out and the robot returns to its home location.

![Diagram 5: Fuel Pump module](image)
6. Results and Discussion

**Fig 6**: Prototype Model of Microcontroller Based Automated Petrol Station
The Fig 6 shows the proposed working model of the microcontroller based automated petrol station. The model consists of 3 modules which are interfaced with arduino board along with displaying unit.

**Fig 7**: Ideal State of Automatic Petrol Station
Describes in Detection and User Interface Module we had illustrated about the detection of the vehicle, identification of the card (debit/credit), cash detection and the user interfacing of $4 \times 4$ matrix keyboard.

**Fig 8**: Entry of the Vehicle
Vehicle is detected by using a IR sensor module, when a vehicle entered in to the bay in the petrol station the IR senses the vehicle and sensed the control signal to the microcontroller, as soon as the signal received by the microcontroller responses to the user to enter the desired amount in the keypad.

**Fig 9**: Entering of Desire Amount
Fig 9, 10, 11 Describes working of the proposed model, the desired amount is entered in to the keypad for example say Rs.50, and then the user is asked for the next step of payment. The payment process is carried out by providing an cash/card unit. As per the preference of the user can choose either cash or card. then final step of the user is carried out by using a enter button finally the user enters all the necessary data required for filling the petrol.

Fig 12: Dispensing of Desire Amount of Fuel

The main tank is used for deposition of fuel in the underground, when the fuel quantity is enter by the customer in the sub tank it pumps the petrol from the ground to the measurement tank this is carried out by using submersible motor. The sub-tank (measurement tank) is responsible for measurement of fuel. The sub tank consists of measurement scale which is placed at the edge of the tank for accuracy and for avoiding cheating in the petrol station. When the desired amount is entered in the keyboard a solenoid valve activates and the sub tank dispenses fuel to the fuel tank of the vehicle when the desired amount of fuel is filled then the pump stops the desired amount of fuel can be verified by viewing the measurement tank.

Fig 13: Sticker pasted on the Fuel tank
7. Conclusion

Our project is a novel idea which can be a remedy for conversion of today’s manual system into automated system for fuel distribution. Microcontroller based automatic petrol station can be cost effectively utilized by increasing the robotic arm outlet. The microcontroller based automated petrol station utilizes cash/card swipe for fuel consumption which is user-friendly to customer. This project can be widely applied replacing existing system with minimum cost of replacement.

References

[1] Pradeep Raj, “Increasing accidents in the unmanned level crossing of the railways”, 2012.
[2] Automobile Fuel Pump Control System Based on Embedded System Security International Journal of Computer Technology and Electronics Engineering (IJCTEE) Volume 3, Issue 2, April 2013 By Eng.Homam Al-Bakri
[3] Aishwarya Jadhav, Lajari Patil, Leena Patil, A. D. Sonawane smart automatic petrol pump system International Journal of Science Technology and Management (IJSTM) Vol.No.6, Issue No.04, April 2017
[4] Sheth, S., Kher, R., Shah, R., Dudhat, P., & Jani, P. (2010). Automatic sorting system using machine vision. Multi-Disciplinary International Symposium on Control, Automation & Robotics., doi:10.13140/2.1.1432.1448.
[5] Chauhan, V., Sheth, S., Hindocha, B. R., Shah, R., Dudhat, P., & Jani, P. (2011). Design and development of a machine vision system for part color detection and sorting. In Proceedings of the International Conference on Signals, Systems & Automation (ICSSA) pp. 90–93. doi:10.13140/2.1.1628.7526.
[6] Xishi Wang, Ning Bin, and Cheng Yinhang, “A new microprocessor based approach to an automatic control system”, International Symposium on Industrial Electronics, pp. 842-843, 1992.
[7] Jeong Y., Choon-Sung Nam, Hee-Jin Jeong, and Dong Shin, “Train Auto Control System based on OSGi”, International Conference on Advanced Communication Technology, pp.276-279, 2008.
[8] Atul Kumar Dewangan, Meenu Gupta, and Pratibha Patel, “Automation of Railway Gate Control Using Micro-controller, International Journal of Engineering Research & Technology, pp.1-8, 2012.
[9] Parikh, P. A., Joshi, K. D., & Sheth, S. (2013). Color guided vehicle—an intelligent material handling mechatronic system. In Proceedings of the 1st International and 16th National Conference on Machines and Mechanisms (iNaCoMM2013), IIT Roorkee, India, pp. 628–635.
[10] Gunyoung Kim, Kyungwoo Kang, “Railway Gate Con- trol System at Railroad-Highway Grade Crossing in Korea”.
[11] J. Banuchandar, V. Kaliraj.P, Balasubramanian, S. Deepa, N.Thamilarasi “automated unmanned railway level crossing system” International Journal of Modern Engineering Research (IJMER) Vol.2, Issue.1, Jan-Feb 2012 pp-458-463 ISSN: 2249-6645.
[12] R.AnujTyagi,Er. GoutamArora “synopsis on automatic railway crossing system” S.D. Institute of Technology & Management Israna-(Panipat). Evaluation of Structural and Biological systems V, SPIE (2006).
[13] GuoXie, XinHongHei, Hiroshi Mochizuki, Sei Takahashi and Hideo Nakamura.“Formal Analysis of Automatic Train Protection and Block System for Regional Line Using VDM++” IJR International Journal of Railway Vol. 5, No. 2 / June 2012, pp. 65-70.
[14] QiaoJian-hua; Li Lin-sheng; Zhang Jing-gang; “Design of Rai Surface Crack-detecting System Based on Linear CCD Sensor” IEEE Int. con on Networking, Sensing and Control, 2008.
[15] K.Vijayakumar, S.R. Wylie, J. D. Cullen, C.C. Wright, A.I.AlShamm’a’a,“Non invasive rail track detection system using Microwave sensor”, Journal of App. Phy., 2009.
[16] Bowler, J. R., “Eddy contemporary interactidn with an ultimate crack: I. The bold problem,” J. Appl. Phys., Vol. 75, 8128–8137, 1994.
[17] Tagaki, T., M. Hashimoto, H. Fukutomi, M. Kurokawa, K. Miya, and H. Tsuboi, “Benchmark models of vortex tide taxing for steam generator tube: research and geometric analysis,” Int. J. Appl. Electrom. Vol. 4, 149–162, 1994.

[18] Tagaki, T., H. Huang, H. Fukutomi, and J. Tani, “Numerical evaluation of correlation between crack amount and current contemporary taxing signals by a identical abstain simulator,” IEEE Trans. Magn. Vol. 34, 2582–2584, 1998

[19] Specogna, S. and F. Trevisan, “Voltage obsessed coils contained by a discrete numerical come near to 3d eddy-currents,” Proceedings of the 11th intercontinental IGTE meeting on geometric Fields Calculation, 81–84, 2004.

[20] Tonti, E., “Algebraic topology and computational electromagnetism,” Proceedings of the 4th Int. Workshop on stimulating and captivating Fields , 284–294, 1998.

[21] Dodd, C. V. and W. E. Deeds, “Analytical solutions to eddy-current probe-coil problems,” J. Appl. Phys, Vol. 39, 2829–2838, 1968.

[22] Lewis, A. M., “A academic fashion of the comeback of an eddy-current prod to a surface-contravention metal low energy crack in a unexciting assess piece,” J. Phys. D.: Appl. Phys, Vol. 25, 319–326, 1992.

[23] Ferraris, G., “Rotazioni elettrodinamiche prodotte for each mezzo di correnti alternate,” Atti dell’Accademia delle Scienze di Torino, Vol. 23, 360, 1888 (in Italian Language).

[24] Rodger, D., P. J. Leonard, and H. C. Lai, “Interfacing the all-purpose 3D A-ψ sense with a gauzy expanse conductor model,” IEEE Trans. Magn, Vol. 28, No. 2, 1115–1117, 1992.

[25] Tsuboi, H. and T. Misaki, “Three dimensional laboratory analysis of whirlpool present giving out by the boundary bit reasoning by vector variables,” IEEE Trans. Magn, Vol. 23, 3044–3046, 1987.

[26] Weissenburger, W. D. and U. R. Christensen, “A set of contacts network manner to evaluate whirlpool currents on conducting surfaces,” IEEE Trans. Magn, Vol. 18, No. 2, 422–425, 1982.

[27] Weisteinn, W., “Euler angles,” MathWorld, a wolfram web resource, available online:http://mathworld.wolfram.com/EulerAngles.html.