Islamic University of Technology

(An organization of Islamic Cooperation)

Project Tittle:

RFID Based Car Parking System in IUT

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Acknowledgement

At first we would like to thank The Almighty Allah without whose grace we could not have successfully completed our project! Next we would like to pay our heartfelt thanks to Dr. Md. Nurul Absar Chowdhury for his kind cooperation. We would also like to thank all the instructor & other staff of the machine & welding shops for their sincere & spontaneous assistance. In the end we would like to thank each other for our perseverance & group spirit which helped us make the project a success.

Declaration

This is to declare that the project titled "RFID Based Car Parking System in IUT" was designed & successfully implemented by us under the supervision of Dr. Md. Nurul Absar Chowdhury, Professor, MCE department, IUT. The following thesis has not been submitted elsewhere for the reward of any degree or diploma or for publication.

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Contents

Abstract

The goal of our project is to develop a RFID based car parking system in IUT. For achieving this goal we needed to design a electrical circuit integrating RFID reader & tag with a arduino board. At the end of the semester we have successfully completed the required electrical & electronic circuit for identification & control. Though we couldn’t establish the system in the parking area yet, but if it is established in future then, It will also provide the security besides automation of parking through RFID technology. There is no waiting time for manual processing of receipts. Nevertheless, there remains ample room for further development and analysis.

Chapter: 1

Introduction

Section: 1

Definition Of 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. The tags contain electronically stored information. Some tags are powered by and read at short ranges (a few meters) via magnetic fields (electromagnetic induction). Others use a local power source such as a battery, or else have no battery but collect energy from the interrogating EM field, and then act as a passive transponder to emit microwaves or UHF radio waves (i.e., electromagnetic radiation at high frequencies). Battery powered tags may operate at hundreds of meters. Unlike a bar code, the tag does not necessarily need to be within line of sight of the reader, and may be embedded in the tracked object.

The use of RFID technology is expanding rapidly in numerous applications such as logistics, supply chain management, transportation, healthcare and aviation. Due to the variety of the current applications, typical RFID systems use application specific hardware and proprietary protocols. The integration of business systems with factory floor automation is a challenge with many aspects to consider. However, one bright spot is clearly visible: RFID information technology, which helps bridge the gap. RFID is enabling companies to see further into the supply chain than ever before, providing more accurate real-time information and improvements in process efficiency.

History Of RFID:

In 1945 Léon Theremin invented an espionage tool for the Soviet Union which retransmitted incident radio waves with audio information. Sound waves vibrated a diaphragm which slightly altered the shape of the resonator, which modulated the reflected radio frequency. Even though this device was a covert listening device, not an identification tag, it is considered to be a predecessor of RFID technology, because it was likewise passive, being energized and activated by waves from an outside source.

Similar technology, such as the IFF transponder developed in the United Kingdom, was routinely used by the allies in World War II to identify aircraft as friend or foe. Transponders are still used by most powered aircraft to this day. Another early work exploring RFID is the landmark 1948 paper by Harry Stockman, titled "Communication by Means of Reflected Power" (Proceedings of the IRE, pp 1196–1204, October 1948). Stockman predicted that "... considerable research and development work has to be done before the remaining basic problems in reflected-power communication are solved, and before the field of useful applications is explored."

Mario Cardullo's device, patented on January 23, 1973, was the first true ancestor of modern RFID, as it was a passive radio transponder with memory. The initial device was passive, powered by the interrogating signal, and was demonstrated in 1971 to the New York Port Authority and other potential users and consisted of a transponder with 16 bit memory for use as a toll device. The basic Cardullo patent covers the use of RF, sound and light as transmission media. The original business plan presented to investors in 1969 showed uses in transportation (automotive vehicle identification, automatic toll system, electronic license plate, electronic manifest, vehicle routing, vehicle performance monitoring), banking (electronic check book, electronic credit card), security (personnel identification, automatic gates, surveillance) and medical (identification, patient history).

An early demonstration of reflected power (modulated backscatter) RFID tags, both passive and semi-passive, was performed by Steven Depp, Alfred Koelle, and Robert Freyman at the Los Alamos National Laboratory in 1973.[4] The portable system operated at 915 MHz and used 12-bit tags. This technique is used by the majority of today's UHFID and microwave RFID tags.

The first patent to be associated with the abbreviation RFID was granted to Charles Walton in 1983.

Benefits of using RFID

RFID allows the wireless storage and automatic retrieval of data. It provides a significant improvement over not only conventional identification, tracking, and stocking of objects, but over the barcode system as well. RFID is expected to help boost supply chain efficiency, improve security, cut down on theft and counterfeiting, increase asset visibility, enhance inventory control, automate stock replenishment, etc (Landt 2005). By the use of RFID technology, manually achieved workloads will be decreased considerably (Penttila et al. 2006). RFID technology is universal, useful and efficient (Zhang et al. 2005). RFID technology increases company efficiency and provides advantages on both company and client-wise (Higgins and Cairney 2006). RFID technology is much more secure (if cryptographic modules are involved) compared to other networks (Xiao et al. 2006). RFID labels play an important role as an inventory tracking technology (Goodrum et al. 2006). RFID is becoming an important identification technology in applications such as inventory management, security access, personnel identification, factory automation, automotive toll debiting, and vehicle identification to name just a few (Ostojic et al. 2007).

Section: 2

Components Of RFID

Tags

A radio-frequency identification system uses *tags*, or *labels* attached to the objects to be identified. Two-way radio transmitter-receivers called *interrogators* or *readers* send a signal to the tag and read its response.

Fig: RFID Tag

RFID tags can be either passive, active or battery-assisted passive. An active tag has an on-board battery and periodically transmits its ID signal. A battery-assisted passive (BAP) has a small battery on board and is activated when in the presence of a RFID reader. A passive tag is cheaper and smaller because it has no battery. However, to start operation of passive tags, they must be illuminated with a power level roughly three magnitudes stronger than for signal transmission. That makes a difference in interference and in exposure to radiation.

Tags may either be read-only, having a factory-assigned serial number that is used as a key into a database, or may be read/write, where object-specific data can be written into the tag by the system user. Field programmable tags may be write-once, read-multiple; "blank" tags may be written with an electronic product code by the user. A tag with no inherent identity is always threatened to get manipulated.

RFID tags contain at least two parts: an integrated circuit for storing and processing information, modulating and demodulating a radio-frequency (RF) signal, collecting DC power from the incident reader signal, and other specialized functions; and an antenna for receiving and transmitting the signal. The tag information is stored in a non-volatile memory. The RFID tag includes either a chip-wired logic or a programmed or programmable data processor for processing the transmission and sensor data, respectively.

An RFID reader transmits an encoded radio signal to interrogate the tag. The RFID tag receives the message and then responds with its identification and other information. This may be only a unique tag serial number, or may be product-related information such as a stock number, lot or batch number, production date, or other specific information.

Readers

RFID systems can be classified by the type of tag and reader. A **Passive Reader Active Tag** (**PRAT**) system has a passive reader which only receives radio signals from active tags (battery operated, transmit only). The reception range of a PRAT system reader can be adjusted from 1–2,000 feet (0.30–610 m), allowing flexibility in applications such as asset protection and supervision.

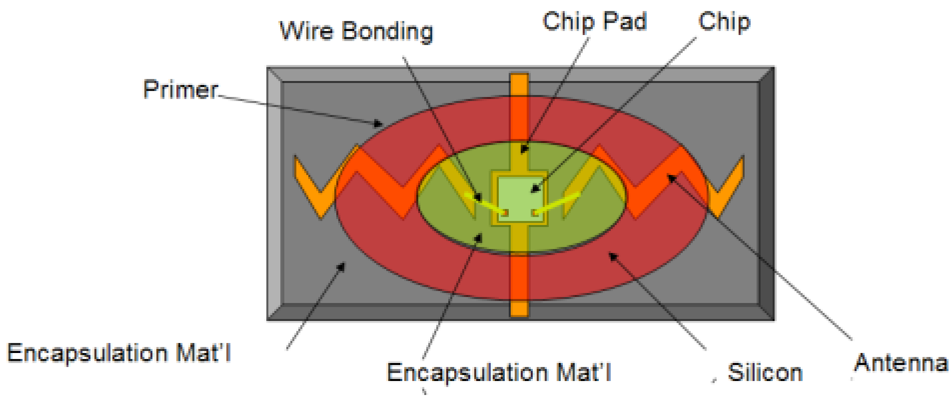


Fig: RFID Reader

An **Active Reader Passive Tag** (**ARPT**) system has an active reader, which transmits interrogator signals and also receives authentication replies from passive tags. An **Active Reader Active**

Tag (ARAT) system uses active tags awoken with an interrogator signal from the active reader. A variation of this system could also use a Battery-Assisted Passive (BAP) tag which acts like a passive tag but has a small battery to power the tag's return reporting signal.

Fixed readers are set up to create a specific interrogation zone which can be tightly controlled. This allows a highly defined reading area for when tags go in and out of the interrogation zone. Mobile readers may be hand-held or mounted on carts or vehicles.

Frequencies

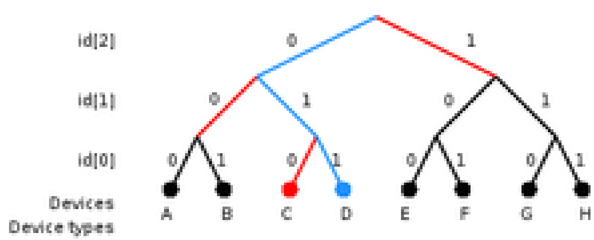
RFID frequency bands

Band	**Regulations**	**Range**	**Data speed**	**Remarks**	**Approximate tag cost in volume (2006) US $**
120–150 kHz (LF)	Unregulated	10 cm	Low	Animal identification, factory data collection	$1
13.56 MHz (HF)	ISM band worldwide	10 cm - 1 m	Low to moderate	Smart cards (MIFARE, ISO/IEC 14443)	$0.50
433 MHz (UHF)	Short Range Devices	1–100 m	Moderate	Defence applications, with active tags	$5
865-868 MHz (Europe) 902-928 MHz (North America) UHF	ISM band	1–12 m	Moderate to high	EAN, various standards	$0.15 (passive tags)
2450-5800 MHz (microwave)	ISM band	1–2 m	High	802.11 WLAN, Bluetooth standards	$25 (active tags)
3.1–10 GHz (microwave)	Ultra wide band	to 200 M	High	requires semi-active or active tags	$5 projected

Signaling

Signaling between the reader and the tag is done in several different incompatible ways, depending on the frequency band used by the tag. Tags operating on LF and HF bands are, in terms of radio wavelength, very close to the reader antenna because they are only a small percentage of a wavelength away. In this near field region, the tag is closely coupled electrically with the transmitter in the reader. The tag can modulate the field produced by the reader by changing the electrical loading the tag represents. By switching between lower and higher relative loads, the tag produces a change that the reader can detect. At UHF and higher frequencies, the tag is more than one radio wavelength away from the reader, requiring a different approach. The tag can backscatter a signal. Active tags may contain functionally separated transmitters and receivers, and the tag need not respond on a frequency related to the reader's interrogation signal.

An Electronic Product Code (EPC) is one common type of data stored in a tag. When written into the tag by an RFID printer, the tag contains a 96-bit string of data. The first eight bits are a header which identifies the version of the protocol. The next 28 bits identify the organization that manages the data for this tag; the organization number is assigned by the EPCGlobal consortium. The next 24 bits are an object class, identifying the kind of product; the last 36 bits are a unique serial number for a particular tag. These last two fields are set by the organization that issued the tag. Rather like a URL, the total electronic product code number can be used as a key into a global database to uniquely identify a particular product.



Often more than one tag will respond to a tag reader, for example, many individual products with tags may be shipped in a common box or on a common pallet. Collision detection is important to allow reading of data. Two different types of protocols are used to "singulate" a particular tag, allowing its data to be read in the midst of many similar tags. In aslotted Aloha system, the reader broadcasts an initialization command and a parameter that the tags individually use to pseudo-randomly delay their responses. When using an "adaptive binary tree" protocol, the reader sends an initialization symbol and then transmits one bit of ID data at a time; only tags with matching bits respond, and eventually only one tag matches the complete ID string.

Both methods have drawbacks when used with many tags or with multiple overlapping readers. Bulk reading is a strategy for interrogating multiple tags at the same time, but lacks sufficient precision for inventory control.

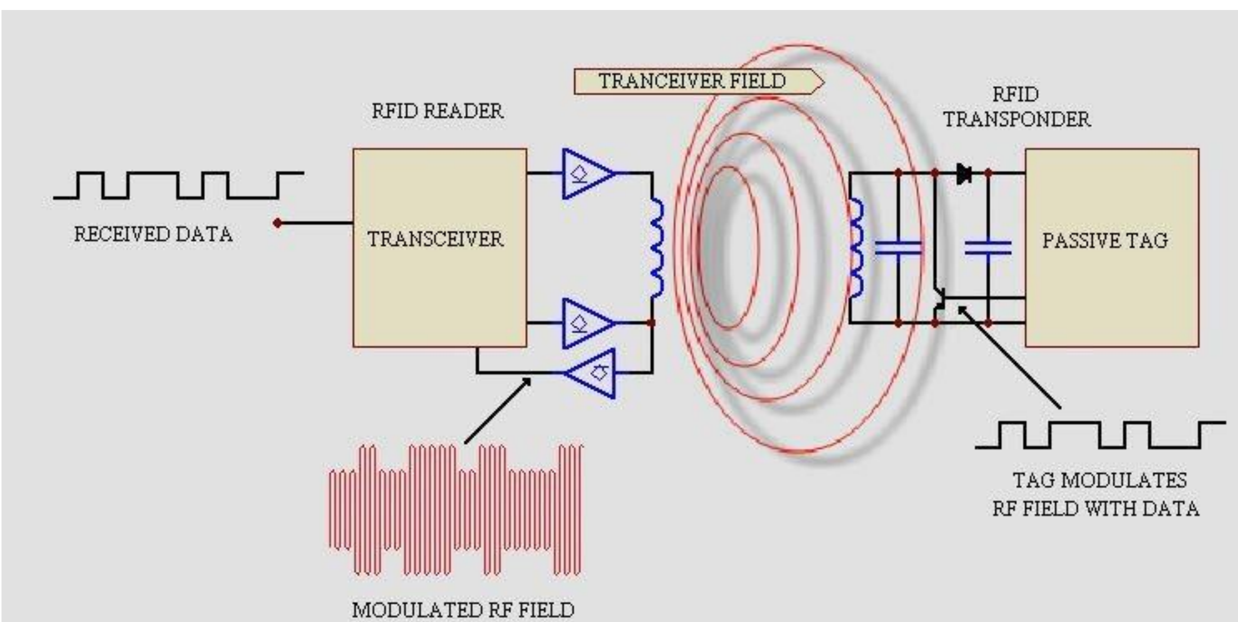
Miniaturization

RFIDs are easy to conceal or incorporate in other items. For example, in 2009 researchers at Bristol University successfully glued RFID micro-transponders to live ants in order to study their behaviorThis trend towards increasingly miniaturized RFIDs is likely to continue as technology advances.

Hitachi holds the record for the smallest RFID chip, at 0.05mm × 0.05mm. This is 1/64th the size of the previous record holder, the mu-chip.[13] Manufacture is enabled by using the silicon-on-insulator (SOI) process. These dust-sized chips can store 38-digit numbers using 128-bit Read Only Memory (ROM). A major challenge is the attachment of antennas, thus limiting read range to only millimeters.

Section: 3

How Does RFID Works



RFID reader, one of the core components of RFID technology, sends signal around. Active tag senda its own identification signal around, whereas passive tag, getting the signal, uses it as power source and modulates incoming signal, after which resends it back to reader. Reader, after getting the modulated signal, demodulates it and transfers the data it extracts to the application program. After this step, it is application program's responsibility to process tag data.

RFID applications in the market

The market for RFID technology is growing rapidly, with significant opportunities to add value (Miles 2008). There are many applications which depend on RFID technology in the market, especially in retail and health sector. One of these applications is developed in Taiwan to be used for patient registration and management in hospitals (Wang et all 2006). In this application, an RFID band, which is a bracelet like stripe, is given to the user to be used during the hospital processes. In this stripe, according to the application infrastructure, there exists only RFID unique identifier, or sometimes owner's personal information. Retail applications of RFID are mainly used in shopping center automation. Radio frequency is a technology that supermarkets are already using in a number of places throughout the store. There are supermarkets where consumers walk into a store, select products whose packages are embedded with small radio frequency UPC codes, and exit the store without ever going through a checkout line or signing on the dotted line. By using RFID tags instead of those paper based or barcode labels, not only user satisfaction in fast total price calculation of objects bought without having each piece in shop-car read by infrared sensor reader or barcode reader, also reconciliation and dayclosing operations become easier. Besides, this infrastructure is also used for user tendency in shopping and had an effect on decreasing the thieveness (Chandramouli et all 2005). RFID based document management systems are another aspect of applications that depend on this technology. In those applications, a tag is glued on a document after matching and keeping the record of what document has what tag in an electronic format. In another way, tag is glued on the document after each tag encoded with the related data on paper based document. Whenever necessary, either reading the unique identity, or directly reading the related data, searched document can be found easily. Nowadays, this technology is also being used for separation of original and non-original products in markets. Each product, after being produced or just before sent to the market, is attached an RFID tag (Weinstein 2005). By using information in this tag, product properties or originality can be searched quickly (Bal 2007). RFID has become very popular in many areas such as purchasing and distribution logistics, automation, manufacturing companies and even the wine industry where it is used as an anti-fraud system (Curty et all 2007).

RFID applications in the industry

RFID is used for hundreds, if not thousands, of applications such as preventing theft of automobiles and merchandise; collecting tolls without stopping; managing traffic; gaining entrance to buildings; automating parking; controlling access of vehicles to gated communities, corporate campuses and airports; dispensing goods; even providing ski lift access (Landt 2005). Different uses of the RFID technology were reported recent years in the manufacturing industry (Budak et all 2007). RFID technology can be applied in many different areas in the transportation domain– –for example, electronic toll collection, electronic vehicle registration, automatic vehicle identification, fleet management, traffic management, and vehicle positioning. The technology can also be used in car parking, access control, and electronic fare collection (Banks et all 2007). IBM has transformed chip production at it's Fishkill plant with semiconductor manufacturing system that leverages real-time information to automatically control the fabrication process, enabling employees to work more productively and be more responsive to customers' product status inquiries (IBM Fishkill semiconductor plant). IBM has accomplished this using IBM Siview standard, a manufacturing execution system that the company integrated with its own wireless e-business technology. Siview standard leverages information from IBM DB2 Universal Database to automatically control each step of the fabrication process that need to be applied to every wafer containing chips, and supports data analysis tools that provide production-related statistics. In the manual coding system, the identification sheets were manually updated at every stage in the production line. In the RFID-based system, however, updates are automatically written on the tag as the vehicle advances on the production line without the risk of operator error. The application of RFID technology for tool tracking on construction job sites was discussed in (Goodrum et al 2006, Stankovski et al 2006). The potential of RFID and mobile-computing technologies in improving the maintenance of facilities at Frankfurt Airport was presented in (Legner and Thiesse 2006). An interesting application of RFID technology in mines detection was reported in (Ruff and Hession-Kunz 2001).

RFID in the automotive industry

Electronic tracking and identification technology, which is the predecessor of RFID, has been in use in the automotive industry for around 20 years, but only to a limited extent. The major applications lie in vehicle identification and protection (Borysowich, 2004). One of the rapidly budding applications of the use of RFID technology in the automotive industry is in vehicle immobilizers. Over the past few years, immobilizers have become very common in new cars, and over 40 percent of the new cars manufactured in North America come equipped with RFID-enabled immobilizers (RFID Update, 2006). BMW and Vauxhall use RFID tags to enable accurate customization of customer orders (Brewer and Landers 1997). A read/write smart tag is programmed in the customer order. The tag is then attached to and travels with the car during production process. This tracking ensures that the car is manufactured with the correct color, model, interior, and any other option the customer specifies. Ford Motor Company has successfully implemented an RFID-based Just-In-Time manufacturing model at its facility in Cuautitlan, Mexico (Johnson 2002). The appeal of RFID technology in the automotive industry is the real time visibility and security protection that it offers the automobile itself, as well as the benefits in the assembly processes of automobiles. For example, General Motors, Volkswagen, and Johnson Controls are already employing RFID tags and readers in their assembly operations, whereas TNT Logistics had deployed RFID technology to optimize the process of just-in-time parts sequencing to its automobile-manufacturing customers. Because of these emerging benefits offered by RFID, it has almost revolutionized the industry (Banks et all 2007). TNT Logistics, the largest provider of third-party logistics services to the automotive industry, has launched an initiative to deploy RFID technology as part of its logistics solution offered to automotive manufacturers at the end of 2005 (Banks et all 2007). The initiative started at the Material Sequencing Center operated by TNT Logistics for Ford Motor Company to support their assembly plant in Dearborn, Michigan (Kiritsis, 2006). Manufacturers are ambitious to find ways to boost the process security and data quality of material flow systems, optimize material planning, reduce error rates, employ labor efficiently, and accelerate transport processes. Siemens RFID solutions play a crucial role in addressing and eliminating these issues in the automotive industry (www.siemens.com).

Implementation of RFID technology in control center of a parking lot

During the last four decades numerous parking search models have been developed (Ker and Foster 1991, Saltzman 1997, Shoup 1999, Thompson and Richardson 1998, Arnott and Rowse 1999, Waterson et all 2001). Since parking plays an important role in the traffic system one of the problem concerning this area is parking revenue. RFID technology is an automated vehicle identification system that is useful and requires no personnel. Vehicles are identified and parking-lot fees are collected automatically via this system (Pala and Inanc 2007). RFID system enables vehicles to check-in and check-out under fast, secure and convenient conditions. Most of the gate controlling systems includes barriers. The timing of the gates and additional sensors enables a one by one parking-lot circulation thus preventing multi check-ins or check-outs at a time (Glover and Bhatt 2006). RFID readers control check-in and check-out barriers. RFID is a technology that collects parking fees without having to stop vehicles (Anonymous 2005). Since RFID technology is contactless identification technology a suggestion was given to use this technology in parking systems. Advantages of RFID technology in comparison to other technologies are:

- No need for physical contact between data carrier and the communication device
- Tags can be used repeatedly.
- Robust tags can withstand extreme conditions and temperature.
- Low maintenance costs.
- Tags available in a range of types, sizes and materials.
- Non-line-of-sight communication makes it possible to read and write tags in dirty conditions.
- RFID tags may be read by the RFID system at one time.
- Extremely low error rate.

It is the sole purpose of this study to utilize such an important technology with an application. In this study, via RFID technology, some solutions are provided for the problems encountered in parking lot management systems to the present and some important results have been gathered. In this study, the main components of RFID technology which are RFID readers, RFID labels, a barrier to control the gate and software have been utilized. The software aimed to handle the management, controlling, transaction reporting and operation tasks for parking lots located on various parts of the city.

Chapter 2

System Design

Section:1

System Design

In order to enhance the utilization of the parking lot and in order to prevent the perking of unauthorized person, there is a need to build a digital parking lot management system for the faculties in IUT. With the rapid development of communication and computer technologies, it is possible to achieve this goal. In this project, the RFID technology has been used to maximize parking utilization & as well as authentication. The RFID kit includes RFID windshield tags and RFID readers. The RFID reader is connected to a microcontroller in the control box. As shown in Figure , where a car with enabled RFID windshield tag drives up to the gate, the RFID reader will automatically read the information from tag through the built in antenna. The received information will be delivered to the microcontroller where the information will be verified. If the received information matches the information in the database, the control box will send a command to open the barrier. The number of cars in the parking lot and the number of available spaces will be updated immediately. This parking lot management system enables user to operate an unattended parking barrier with controlled parking access privileges. The system is ideal for apartments and condos, gated communities, business parking lots and garages, university parking areas and recreation operations from hotel to RV camps.

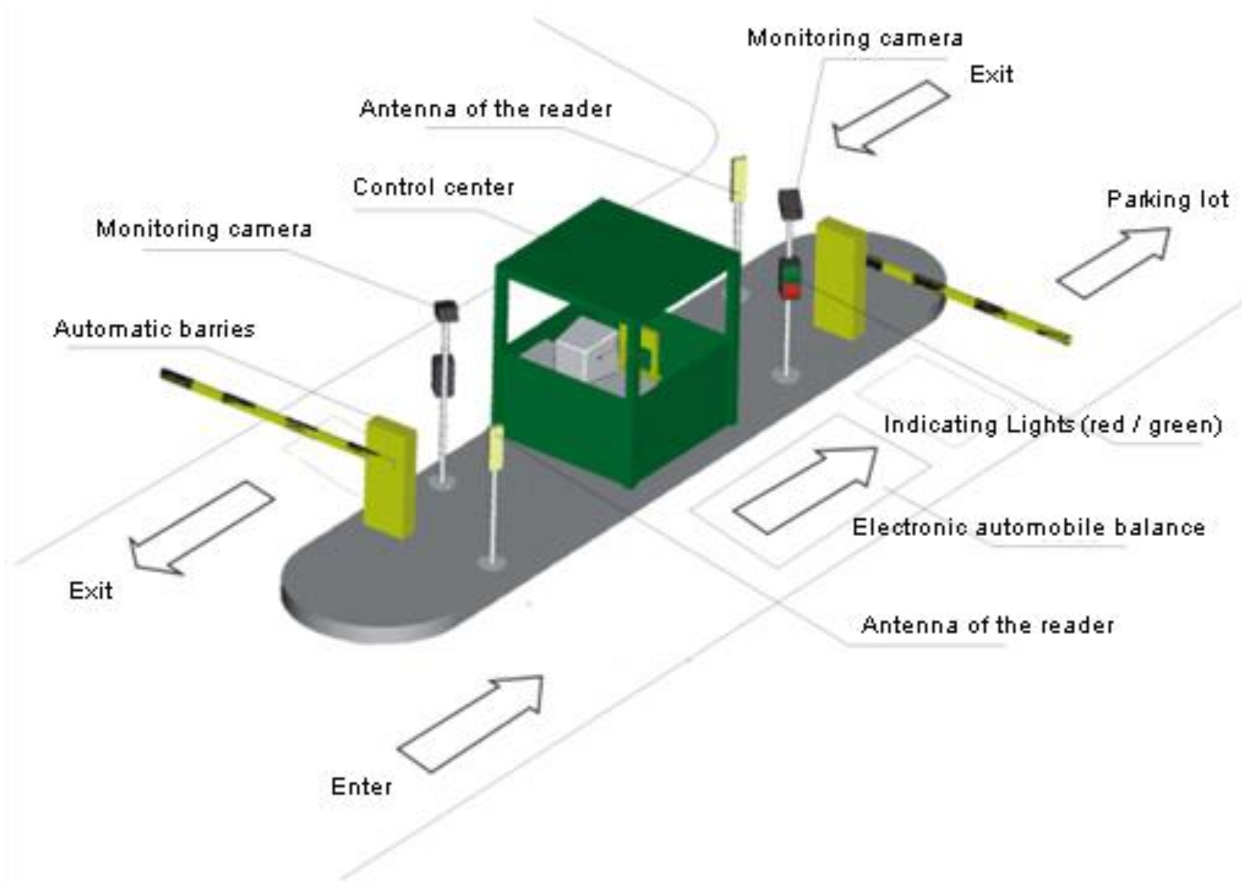


Fig: Proposed design of Digital car parking system in IUT

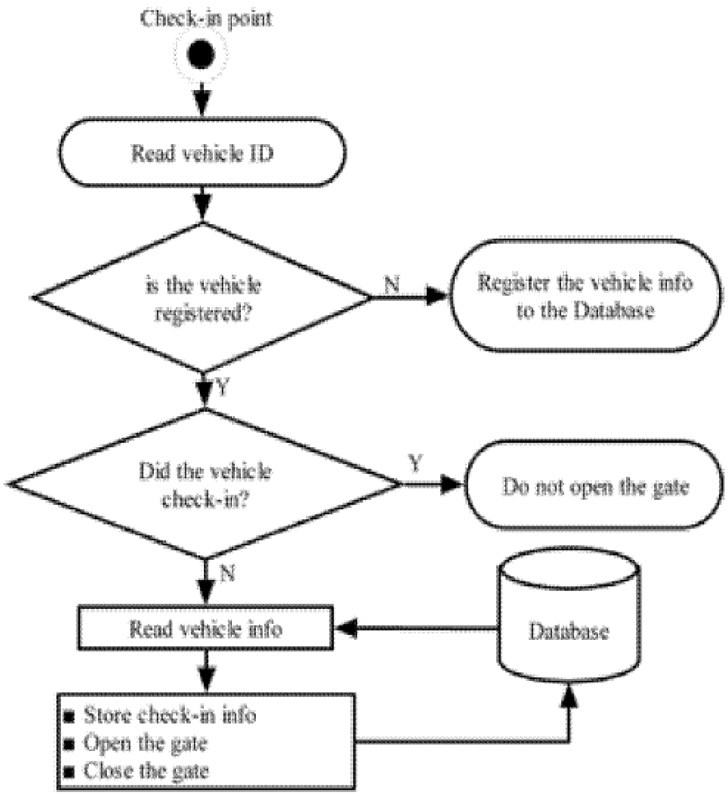


Fig: Parking lot check in process

Specifications of the major components we used in this project:

RFID Sheild:

In this shield we use the RFID Reader, ID-12, from sparkfun. This Reader has a built in antenna. Power the module, hold up a card, and get a serial string output containing the unique ID of the card.

The shield is connected with the Piduino. Data Pin 1 is connected with the Digital Pin 2 and Data Pin 0 is connected with Digital Pin 0. There is an onboard 5v regulator which takes power from VIN of Piduino. So an external power is required to operate this shield.

Layout:

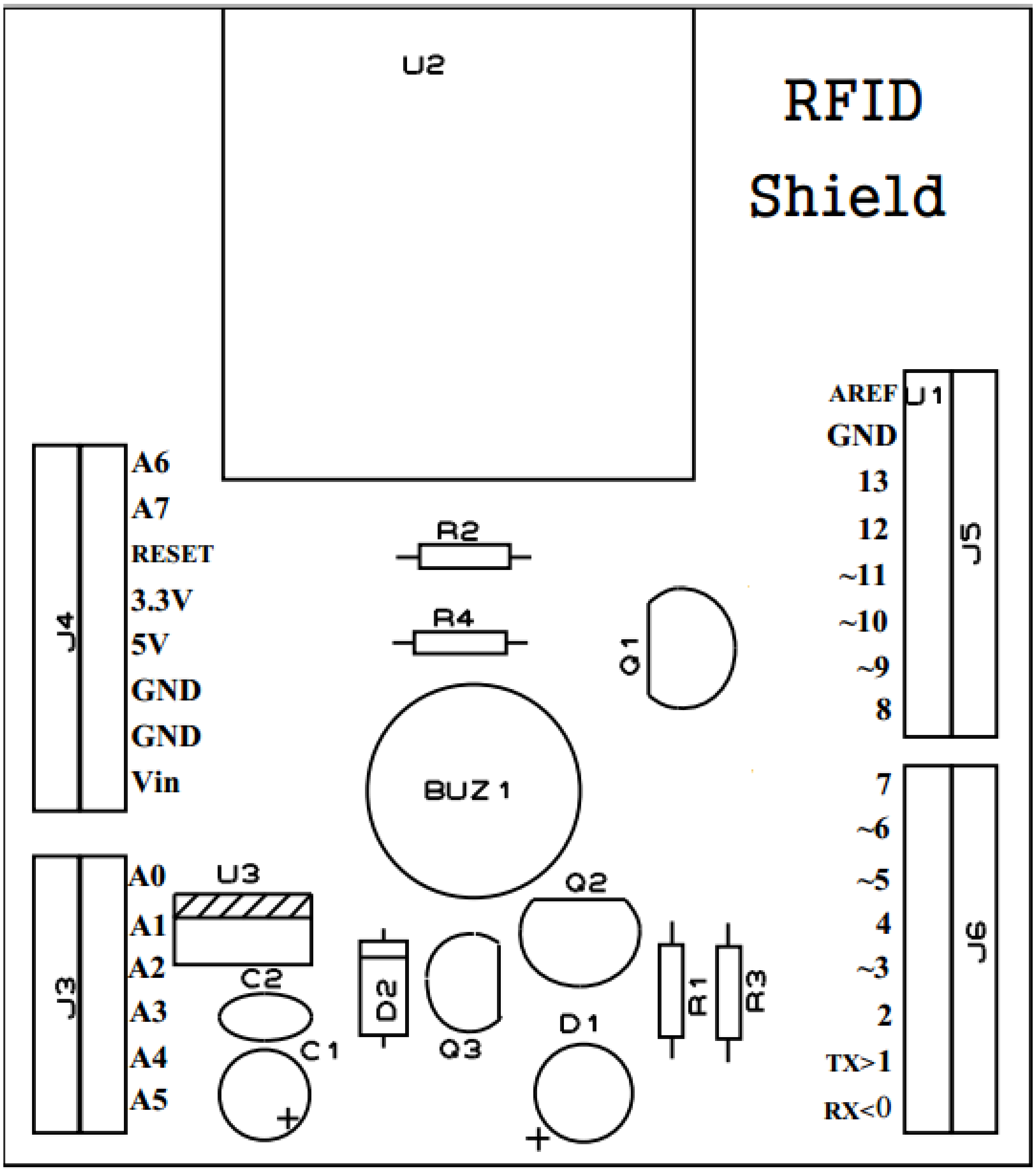


Fig: Layout of the RFID shield

Schematics

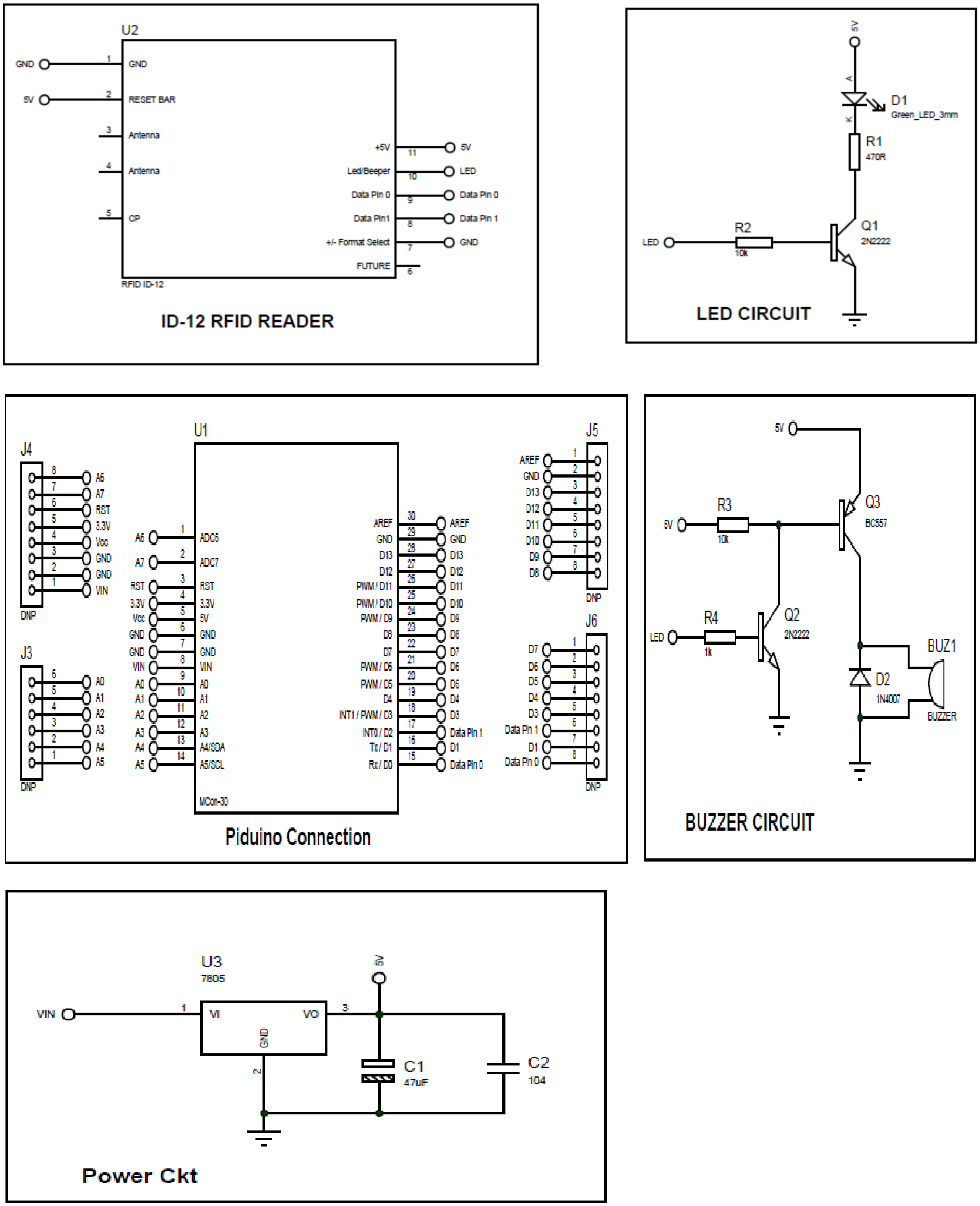


Fig: Schematics of RFID Shield

RGID Tag:

This is a basic RFID tag used for presence sensing, etc. Works in the 125kHz RF range. These tags come with a unique 32-bit ID and are not re-programmable. Card is blank on one side, smooth, and mildly flexible.

Features:

♦ EM4001 ISO based RFID IC

♦ 125kHz Carrier

♦ 2kbps ASK

♦ Manchester encoding

♦ 32-bit unique ID

♦ 64-bit data stream [Header+ID+Data+Parity]

Dimensions: 2.13 x 3.35 x 0.03" (54 x 85.5 x 0.8mm)

Development Board:

Piduino Uno has all of the hardware peripherals: 14 Digital I/O pins with 6 PWM pins, 8 Analog Inputs, UART, SPI and external interrupts. The board can be programmed over a USB Mini-B cable using the Arduino IDE. Works with all existing shields but can adapt to new shields which use these additional pins.

It can be powered over USB or through the barrel jack. The on-board power regulator can handle anything from 7 to 15VDC.

Features :

- ATmega328P microcontroller with Optiboot (UNO) Bootloader.
- USB Programming Facilitated by the Ubiquitous FTDI FT232RL.
- 8 Analog inputs.
- Double rail for ATmega328P.
- Easily accessible I2C and Serial Connector.
- Reset problem of Arduino Uno is fixed by a switch (for Mac & Linux user).
- ATmega328 can run both in 3.3V and 5V.

- Easily accessible Reset Switch.
- Mini USB connector.
- Evolved with SMD components.
- Improved on extensibility and convenience.

Specification:

Microcontroller	**ATmega328p**
Operating Voltage	**5V or 3.3V**
USB Supply Voltage	**5V**
Externtal Power Supply	**7-12V (lower is preferred)**
Externtal Power Supply(limits)	**6-20V**
Digital I/O Pins	**14 (of which 6 provide PWM output)**
Analog Input Pins	**8 (of which 2 are used for I2C communication)**
Flash Memory	**32KB**
SRAM	**2KB**
EEPROM	**1KB**
Clock Speed	**16MHz**

Schematics:

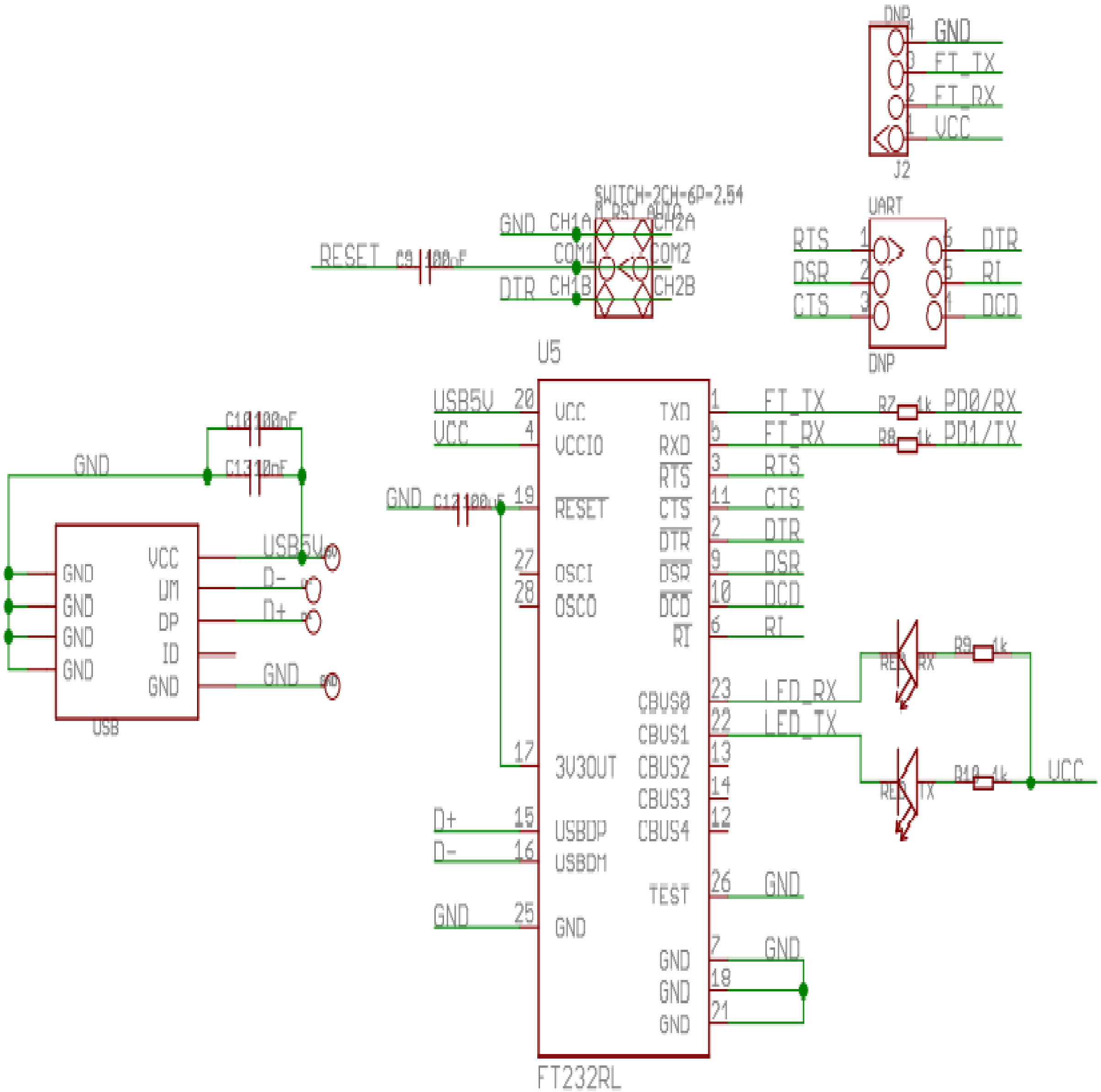


Fig: USB to Serial

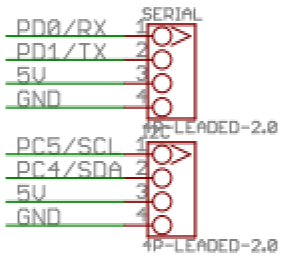


Fig: Grove

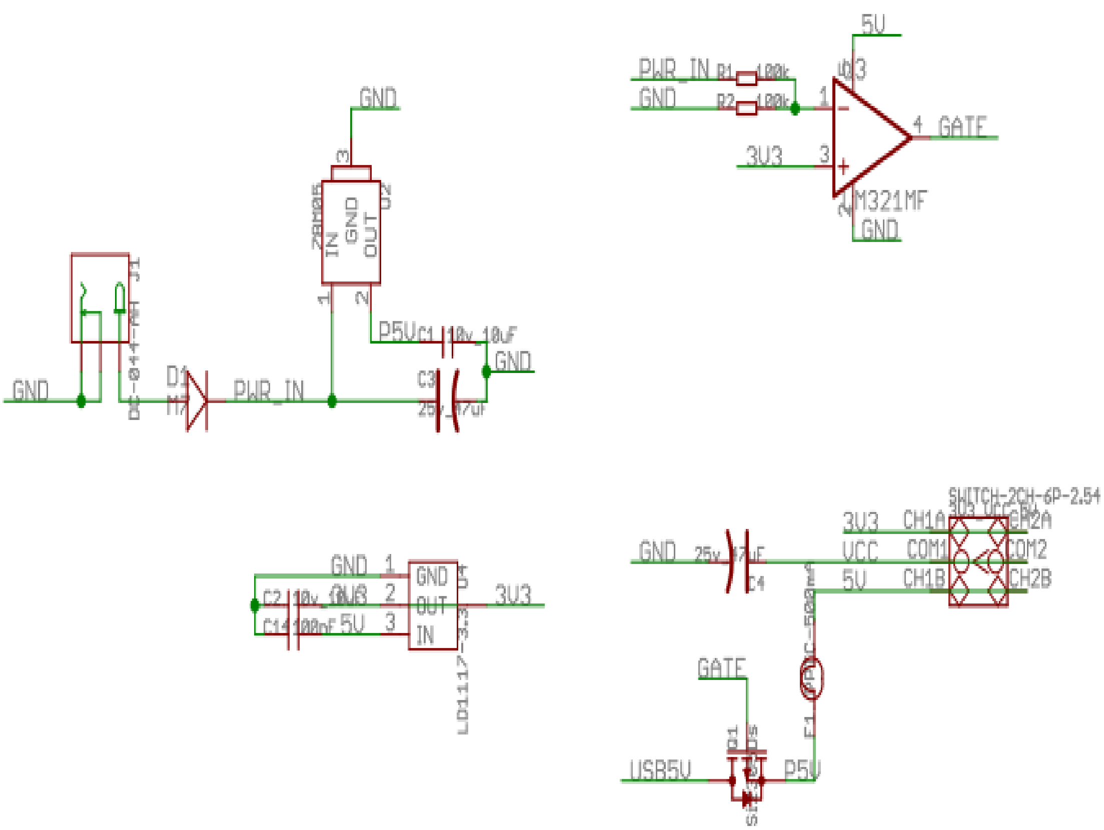


Fig: Power

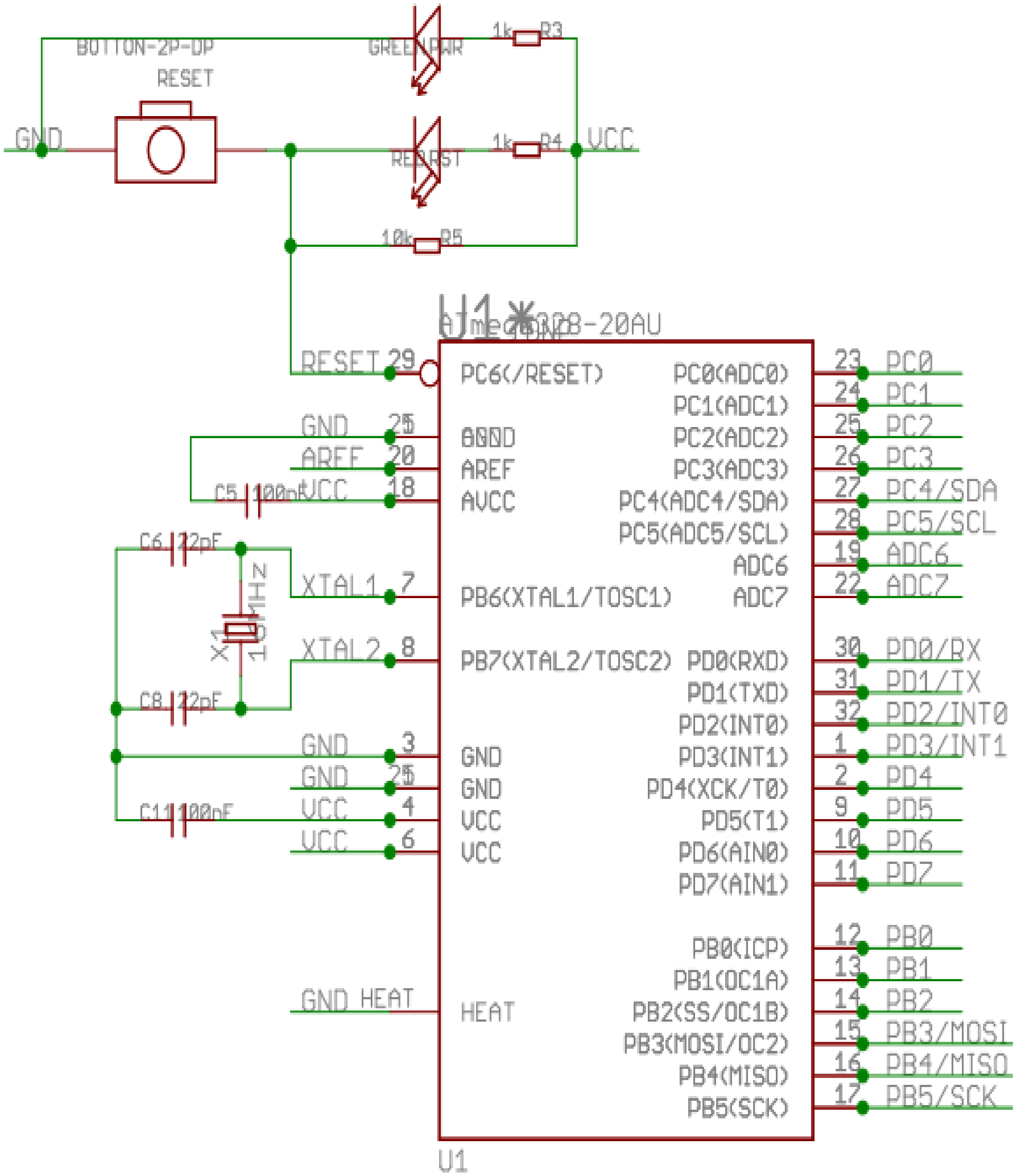


Fig: Microcontroller

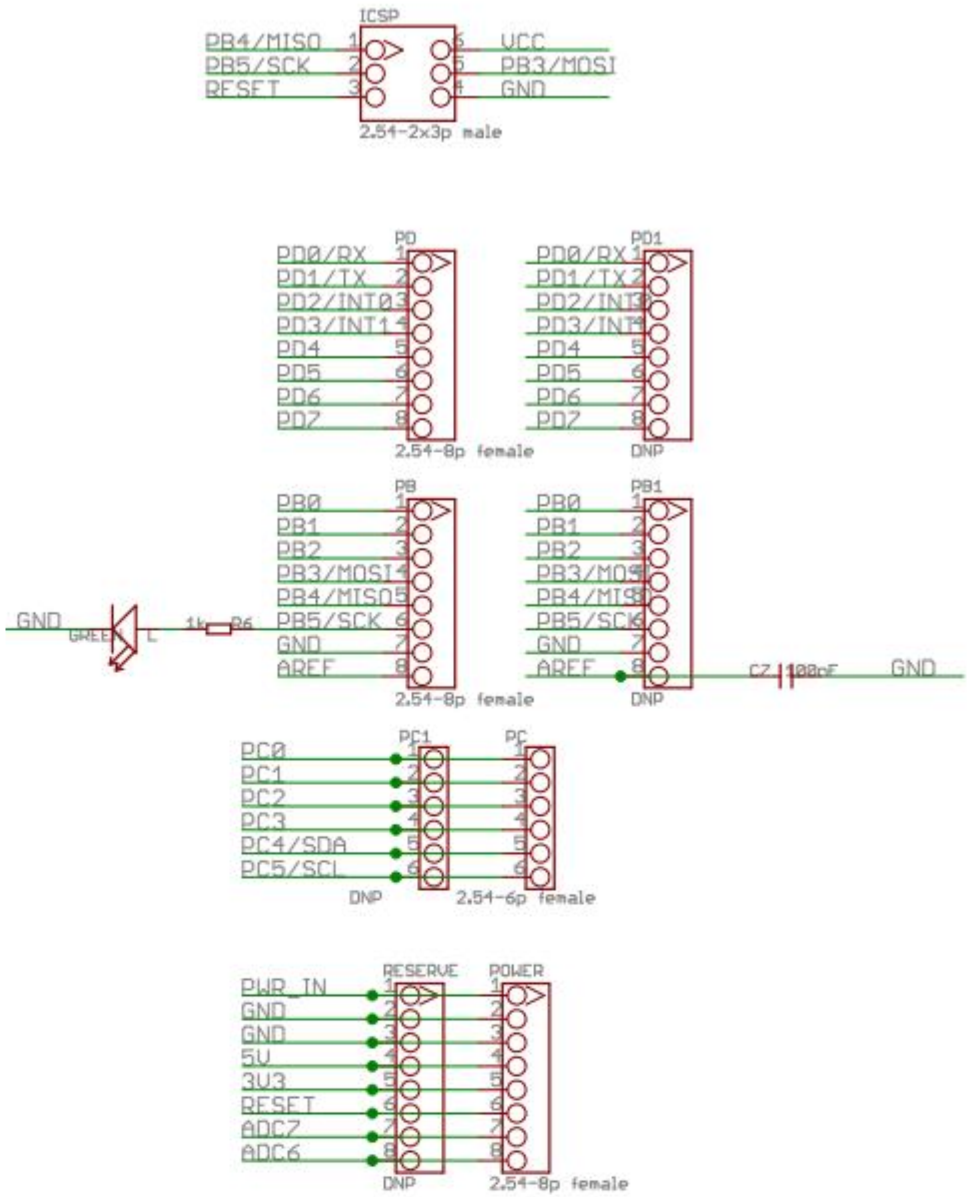


Fig: I/Os

LCD Display:

A Liquid crystal display (LCD) is a flat display that uses the light modulating properties of liquid display.They are common in consumer devices such as video players, gaming devices, clocks,telephones,computers,calculators etc.

A (16x2) LCD panel consists of 16 coulums and 2 rows.It can show upto 16 characters in 2 lines.

Schematics:

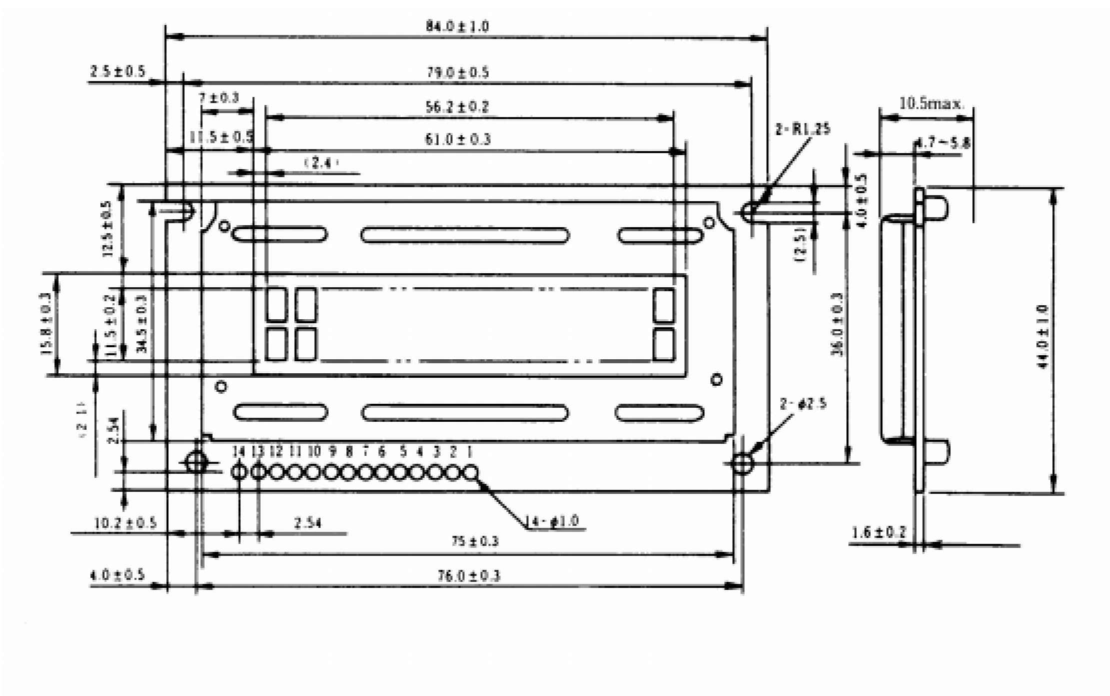


Fig. 2 External dimensions

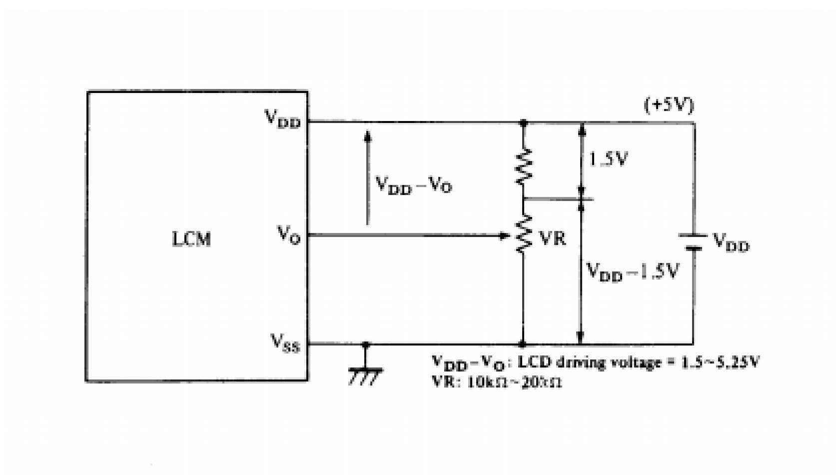


Fig. 4 Power supply

DC Motor Controller Board

It is suitable for controlling DC Motors from 6 to 24Vdc and with up to 5A load. This board features opto-isolated motor drivers for improved isolation and reliability. High quality MOSFET's are used as the drive transistors providing fast switching and minimal power loss. Our DC Motor Controller Board also includes speed and direction control directly on the board or via a standard TTL interface to an external controller such as a microcontroller or control board.

The board also included LED status control, easy to connect terminal interfaces for power connections and DC Motor connections. High quality heatsinking for the output MOSFET transistors. Excellent isolation with high performance opto-isolators. This board is ideal for cases where speed control of loads is essential, such as robots, servos and other DC Motor Applications.

Features

- Opto-Isolated For Improved Satefy and Reliability
- Heavy Duty, Suitable for DC Motors from 6-24Vdc and 5A
- LED Indication for Direction, Power Supply and Control
- Terminal Blocks Provided for Easy DC Motor Connection
- Direction and Adjustable Speed Control Provided On-Board
- Digital Input for External Control of Speed and Direction, Suitable for Connection to Most Microcontrollers or Control Boards

Board Dimensions: 130 x 57 mm

DC Motor:

Features:

- Brand new gearhead motor
- Operates on 4 – 18 VDC
- 6 RPM at 12V
- No load current at 12V: 98mA
- Speed is proportional with voltage (Speed range is 2RPM @ 4V to 9RPM @ 18V)
- Very high torque output, shaft can’t be stopped by fingers even at just 4V
- Can be operated in either direction, simply reverse power supply polarity

- D-Type Shaft dimensions: .39" L x .2" (5 mm) Diameter
- Motor dimensions (not including shaft): 2.43" L x 1.3" Diameter
- Metal gearhead has 3 tapped holes for easy mounting

Chapter 3

Power Supply

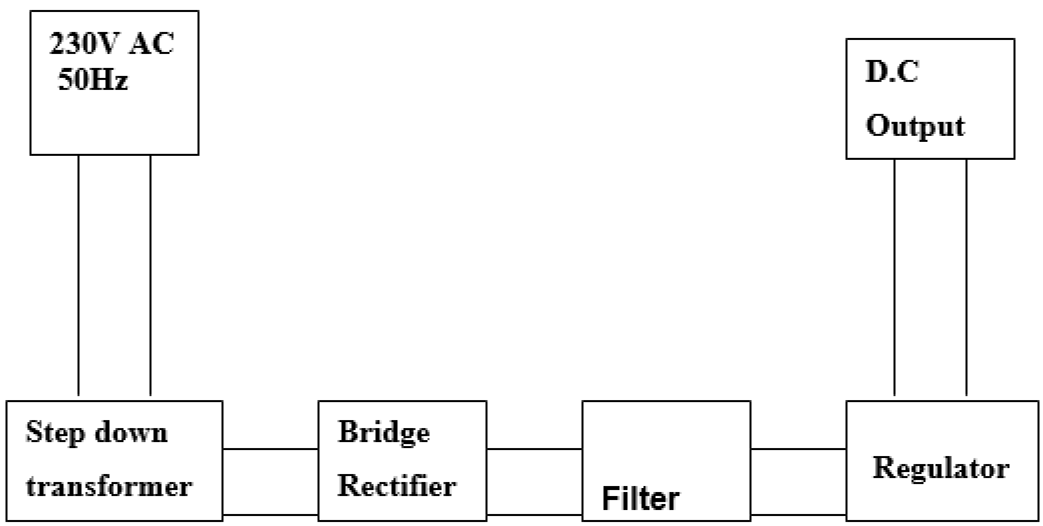


Fig: Flow Diagram of Power supply

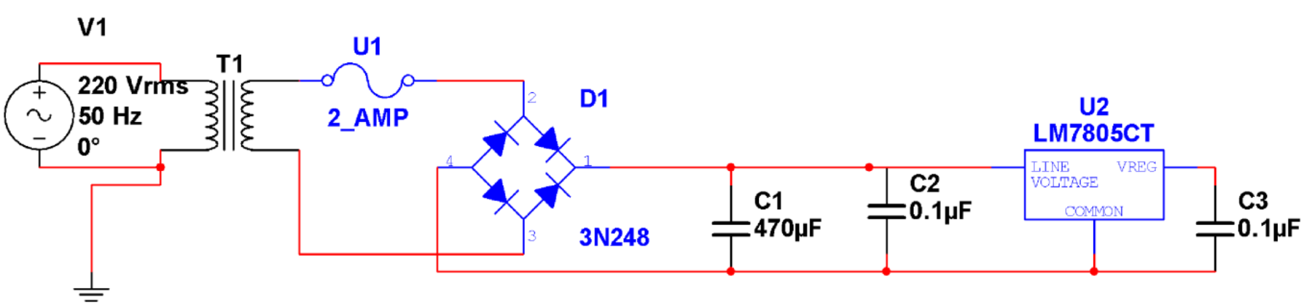


Fig: Circuit Diagram of the power supply

Step Down Transformer:

A transformer is a static electrical device that transfers energy by inductive coupling between its winding circuits. A varying current in the primary winding creates a varying magnetic flux in the transformer's core and thus a varying magnetic flux through the secondary winding. This varying magnetic flux induces a varying electromotive force (emf) or voltage in the secondary winding. Transformers can be used to vary the relative voltage of circuits or isolate them, or both.

Transformers range in size from thumbnail-sized used in microphones to units weighing hundreds of tons interconnecting the power grid. A wide range of transformer designs are used in electronic and electric power applications. Transformers are essential for the transmission, distribution, and utilization of electrical energy.

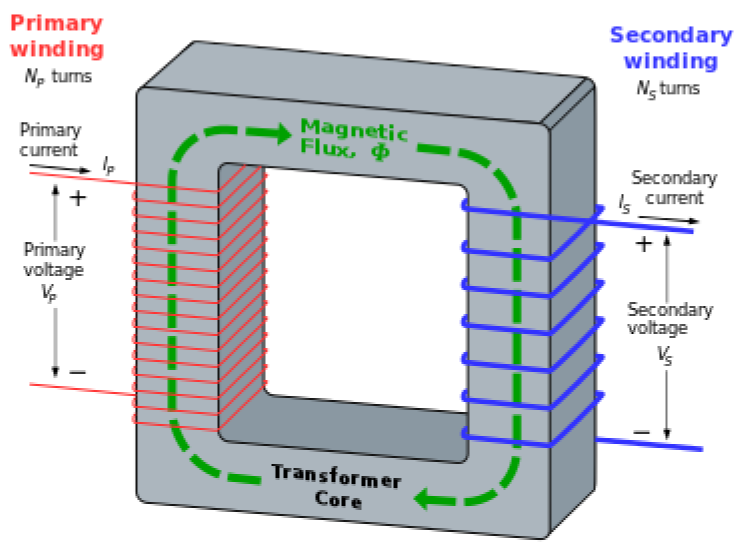


Fig: Transformer

Consider the ideal, lossless, perfectly-coupled transformer shown in the circuit diagram at right having primary and secondary windings with N_P and N_S turns, respectively.

The ideal transformer induces secondary voltage $E_S = V_S$ as a proportion of the primary voltage $V_P = E_P$ and respective winding turns as given by the equation

$$\frac{V_\text{P}}{V_\text{S}} = \frac{E_\text{P}}{E_\text{S}} = \frac{N_\text{P}}{N_\text{S}} = a$$,

where,

- $V_P/V_S = E_P/E_S = a$ is the *voltage ratio* and $N_P/N_S = a$ is the winding *turns ratio*, the value of these ratios being respectively higher and lower than unity for step-down and step-up transformers.

- V_P designates source impressed voltage,

- V_S designates output voltage, and,

- E_P & E_S designate respective emf induced voltages.

Any load impedance Z_L connected to the ideal transformer's secondary winding causes current to flow without losses from primary to secondary circuits, the resulting input and output apparent power therefore being equal as given by the equation

$$I_P \times V_P = I_S \times V_S.$$

Combining the two equations yields the following ideal transformer identity

$$\frac{V_P}{V_S} = \frac{I_S}{I_P} = \frac{N_P}{N_S} = a.$$

This formula is a reasonable approximation for the typical commercial transformer, with voltage ratio and winding turns ratio both being inversely proportional to the corresponding current ratio.

The load impedance Z_L is defined in terms of secondary circuit voltage and current as follows

$$Z_L = \frac{V_L}{I_L} = \frac{V_S}{I_S}.$$

The apparent impedance Z'_L of this secondary circuit load *referred* to the primary winding circuit is governed by a squared turns ratio multiplication factor relationship derived as follows.

$$Z'_L = \frac{V_P}{I_P} = \frac{aV_S}{I_S/a} = a^2 \times \frac{V_S}{I_S} = a^2 \times Z_L.$$

Bridge Rectifier:

A diode bridge is an arrangement of four (or more) diodes in a bridge circuit configuration that provides the same polarity of output for either polarity of input. When used in its most common application, for conversion of an alternating current (AC) input into a direct current (DC) output, it is known as a bridge rectifier. A bridge rectifier provides full-wave rectification from a two-wire AC input, resulting in lower cost and weight as compared to a rectifier with a 3-wire input from a transformer with a center-tapped secondary winding.

The essential feature of a diode bridge is that the polarity of the output is the same regardless of the polarity at the input. The diode bridge circuit was invented by Karol Pollak and patent was recorded in 14 Jan, 1896 under the number DRP[4] 96564. It was later published in Elektronische Zeitung, vol. 25 in 1897 with annotation that German physicist Leo Graetz also was researching this matter at that time. Today the circuit is still often referred as Graetz circuit.

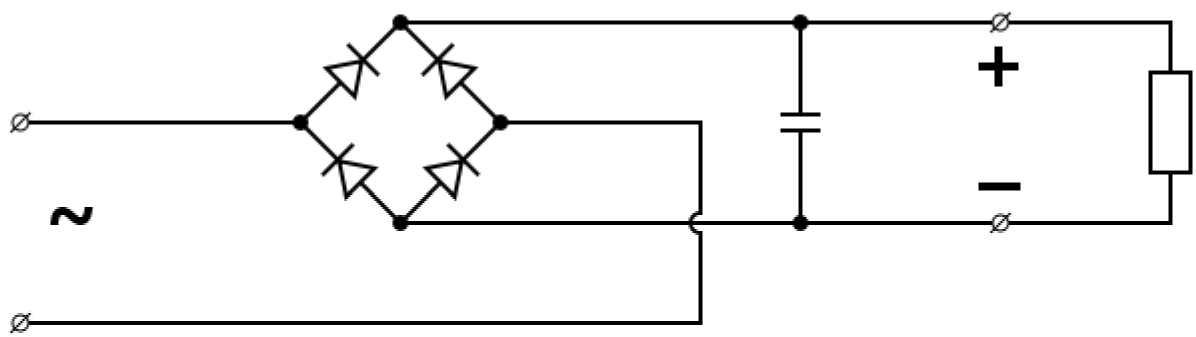


Fig: Bridge Rctifier

When the input connected to the left corner is negative, and the input connected to the right corner is positive, current flows from the lower supply terminal to the right along the red (positive) path to the output, and returns to the upper supply terminal via the blue (negative) path.

In each case, the upper right output remains positive and lower right output negative. Since this is true whether the input is AC or DC, this circuit not only produces a DC output from an AC input, it can also provide what is sometimes called "reverse polarity protection". That is, it permits normal functioning of DC-powered equipment when batteries have been installed backwards, or when the leads (wires) from a DC power source have been reversed, and protects the equipment from potential damage caused by reverse polarity.

Prior to the availability of integrated circuits, a bridge rectifier was constructed from "discrete components", i.e., separate diodes. Since about 1950, a single four-terminal component containing the four diodes connected in a bridge configuration became a standard commercial component and is now available with various voltage and current ratings.

Regulator:

A voltage regulator is designed to automatically maintain a constant voltage level. A voltage regulator may be a simple "feed-forward" design or may include negative feedback control loops. It may use an electromechanical mechanism, or electronic components. Depending on the design, it may be used to regulate one or more AC or DC voltages.

Electronic voltage regulators are found in devices such as computer power supplies where they stabilize the DC voltages used by the processor and other elements. In automobile alternators and central power station generator plants, voltage regulators control the output of the plant. In an electric power distribution system, voltage regulators may be installed at a substation or along distribution lines so that all customers receive steady voltage independent of how much power is drawn from the line.

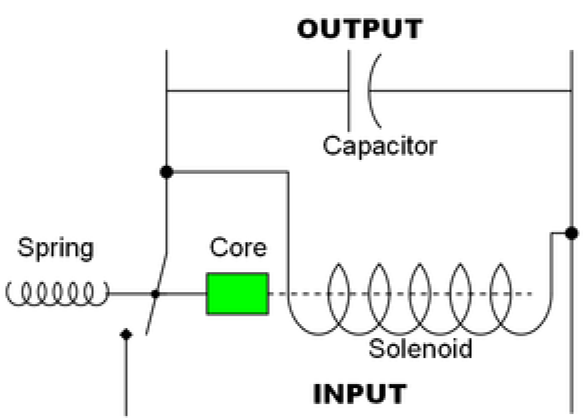


Fig: Circuit design for a simple electromechanical voltage regulator.

A simple voltage regulator can be made from a resistor in series with a diode (or series of diodes). Due to the logarithmic shape of diode V-I curves, the voltage across the diode changes only slightly due to changes in current drawn or changes in the input. When precise voltage control and efficiency are not important, this design may work fine.

Feedback voltage regulators operate by comparing the actual output voltage to some fixed reference voltage. Any difference is amplified and used to control the regulation element in such a way as to reduce the voltage error. This forms a negative feedback control loop; increasing the open-loop gain tends to increase regulation accuracy but reduce stability (avoidance of oscillation, or ringing during step changes). There will also be a trade-off between stability and the speed of the response to changes. If the output voltage is too low (perhaps due to input voltage reducing or load current increasing), the regulation element is commanded, up to a point, to produce a higher output voltage–by dropping less of the input voltage (for linear series regulators and buck switching regulators), or to draw input current for longer periods (boost-type switching regulators); if the output voltage is too high, the regulation element will normally be commanded to produce a lower voltage. However, many regulators have over-current protection, so that they will entirely stop sourcing current (or limit the current in some way) if the output current is too high, and some regulators may also shut down if the input voltage is outside a given range .

Conclusion:

We have successfully completed the mechanical design, electronic circuit & the programming of our RFID based car parking system for IUT. We have already developed the control & identification system but we couldn't establish in the parking area yet due to lack of budget & time. Our main objective was to establish RFID based car identification system in the parking area to avoid unauthorized parking.

Throughout our project, Dr. MD. Nurul Absar Chowdhury had been cordial & co-operative & tried to solve our problems & assist us in every possible way.

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