

COMPARATIVE ANALYSIS OF SECURED TRANSPORT SYSTEMS USING RFID TECHNOLOGY FOR SCHOOLS

Submitted in partial fulfilment of the requirement for the award of Bachelor of
Engineering degree in Electronics and Communication Engineering

by

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**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the Bonafide work **N VENKATA RAMU (40130150), M YUVARAJ PAVAN (40130144)**, who carried out the project entitled "**COMPARATIVE ANALYSIS OF SECURED TRANSPORT SYSTEMS USING RFID TECHNOLOGY FOR SCHOOLS**" under our supervision from Nov 2023 to Apr 2024.

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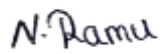
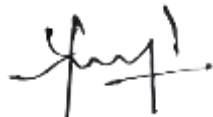
DECLARATION

We **N VENKATA RAMU, M Yuvaraj Pavan** hereby declare that the Project Report entitled “**Comparative Analysis of Secured Transport Systems using RFID Technology for Schools**” done by me under the guidance of **Dr V Vijayakumar, M.Tech., Ph.D.**, is submitted in partial fulfilment of the requirements for the award of Bachelor of Engineering Degree in Electronics and Communication Engineering.

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ABSTRACT

Parents place the highest priority on their children's protection. Even with the best safety precautions, children could find themselves in a dangerous scenario (such as crossing the road carelessly) since they lack the self-defense abilities to keep themselves safe. The bus unit and the school unit are the two primary components of the system. When a child boards or exits the bus, the bus unit system is used to identify their departure. The school unit receives this information, uses it to determine which kids got off the bus early, and sends out an alert message in response. To confirm that the suggested system functions as intended, a full prototype was put into practice and tested. The method appears promising for everyday transportation safety, according to the results. This comparative analysis investigates the deployment of Radio Frequency Identification (RFID) technology in securing transport systems tailored for educational institutions. By conducting a thorough examination spanning security attributes, authentication methodologies, tracking precision, integration capabilities, privacy protocols, cost-effectiveness, performance metrics, and future trajectories, this research endeavors to furnish vital insights pertinent to stakeholders engaged in school transportation management. The study meticulously assesses the strengths and limitations of various RFID-based systems, thereby facilitating judicious decision-making processes aimed at fortifying safety, enhancing efficiency, and optimizing user satisfaction within school transport networks. It emphasizes the necessity of striking a harmonious balance between robust security measures and user-centric functionalities. Furthermore, it illuminates potential avenues for future advancements including the integration of IoT technologies, predictive analytics, personalized services, and environmentally sustainable initiatives. By offering a comprehensive analysis of the multifaceted aspects associated with RFID-based transport systems, this study serves as a valuable resource for educational institutions seeking to implement and refine transport solutions tailored to the dynamic needs of their student body. Ultimately, it aims to foster an environment where students can commute safely, efficiently, and comfortably, thereby contributing to an enriched educational experience.

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CHAPTER 1

INTRODUCTION

1.1 Overview of Embedded Systems

An embedded system is a special-purpose computer system designed to perform one or a few dedicated functions, often with real-time computing constraints. It is usually embedded as part of a complete device including hardware and mechanical parts. In contrast, a general-purpose computer, such as a personal computer, can do many different tasks depending on programming. Embedded systems have become very important today as they control many of the common devices we use.

Since the embedded system is dedicated to specific tasks, design engineers can optimize it, reducing the size and cost of the product, or increasing the reliability and performance. Some embedded systems are mass-produced, benefiting from economies of scale.

Physically, embedded systems range from portable devices such as digital watches and MP3 players, to large stationary installations like traffic lights, factory controllers, or the systems controlling nuclear power plants. Complexity varies from low, with a single microcontroller chip, to very high with multiple units, peripherals and networks mounted inside a large chassis or enclosure.

In general, "embedded system" is not an exactly defined term, as many systems have some element of programmability. For example, Handheld computers share some elements with embedded systems — such as the operating systems and microprocessors which power them — but are not truly embedded systems, because they allow different applications to be loaded and peripherals to be connected.

Embedded systems provide several functions

➤ Monitor the environment; embedded systems read data from input sensors. This data is then processed and the results displayed in some format to a user or users

- Control the environment; embedded systems generate and transmit commands for actuators.
- Transform the information; embedded systems transform the data collected in some meaningful way, such as data compression/decompression

Although interaction with the external world via sensors and actuators is an important aspect of embedded systems, these systems also provide functionality specific to their applications. Embedded systems typically execute applications such as control laws, finite state machines, and signal processing algorithms. These systems must also detect and react to faults in both the internal computing environment as well as the surrounding electromechanical systems.

There are many categories of embedded systems, from communication devices to home appliances to control systems. Examples include;

- Communication devices

e. g.: modems, cellular phones

- Home Appliances

e. g.: CD player, VCR, microwave oven

- Control Systems

e. g.: Automobile anti-lock braking systems, robotics, satellite control

Characteristics of embedded systems

Embedded systems are characterized by a unique set of characteristics. Each of these characteristics imposed a specific set of design constraints on embedded systems designers. The challenge to designing embedded systems is to conform to the specific set of constraints for the application.

Application Specific Systems:

Embedded systems are not general-purpose computers. Embedded system designs are optimized for a specific application. Many of the job characteristics are known before the hardware is designed. This allows the designer to focus on the specific design constraints of a well-defined application. As such, there is

limited user reprogram ability. Some embedded systems, however, require the flexibility of reprogram ability. Programmable DSPs are common for such applications.

Reactive Systems

As mentioned earlier, a typical embedded systems model responds to the environment via sensors and control the environment using actuators. This requires embedded systems to run at the speed of the environment. This characteristic of embedded system is called “reactive”. Reactive computation means that the system (primarily the software component) executes in response to external events. External events can be either periodic or aperiodic. Periodic events make it easier to schedule processing to guarantee performance. Aperiodic events are harder to schedule. The maximum event arrival rate must be estimated in order to accommodate worst case situations. Most embedded systems have a significant reactive component. One of the biggest challenges for embedded system designers is performing an accurate worst case design analysis on systems with statistical performance characteristics (e.g., cache memory on a DSP or other embedded processor). Real time system operation means that the correctness of a computation depends, in part, on the time at which it is delivered. Systems with this requirement must often design to worst case performance. But accurately predicting the worst case may be difficult on complicated architectures. This often leads to overly pessimistic estimates erring on the side of caution. Many embedded systems have a significant requirement for real time operation in order to meet external I/O and control stability requirements. Many real-time systems are also reactive systems.

Distributed Systems

A common characteristic of an embedded system is one that consists of communicating processes executing on several CPUs or ASICs which are connected by communication links. The reason for this is economy. Economical 4 8-bit microcontrollers may be cheaper than a 32-bit processors. Even after adding the cost of the communication links, this approach may be preferable. In this approach, multiple processors are usually required to handle multiple time-

critical tasks. Devices under control of embedded systems may also be physically distributed.

Harsh environment

Many embedded systems do not operate in a controlled environment. Excessive heat is often a problem, especially in applications involving combustion (e.g., many transportation applications). Additional problems can be caused for embedded computing by a need for protection from vibration, shock, lightning, power supply fluctuations, water, corrosion, fire, and general physical abuse.

System safety and reliability

As embedded system complexity and computing power continue to grow, they are starting to control more and more of the safety aspects of the overall system. These safety measures may be in the form of software as well as hardware control. Mechanical safety backups are normally activated when the computer system loses control in order to safely shut down system operation. Software safety and reliability is a bigger issue. Software doesn't normally "break" in the sense of hardware. However software may be so complex that a set of unexpected circumstances can cause software failures leading to unsafe situations. Discussion of this topic is outside the scope of this book, but the challenges for embedded designers include designing reliable software and building cheap, available systems using unreliable components. The main challenge for embedded system designers is to obtain low-cost reliability with minimal redundancy.

Control of physical systems

One of the main reasons for embedding a computer is to interact with the environment. This is often done by monitoring and controlling external machinery. Embedded computers transform the analog signals from sensors into digital form for processing. Outputs must be transformed back to analog signal levels. When controlling physical equipment, large current loads may need to be switched in order to operate motors and other actuators. To meet these needs, embedded systems may need large computer circuit boards with many non-digital components. Embedded system designers must carefully balance system

tradeoffs among analog components, power, mechanical, network, and digital hardware with corresponding software.

Small and low weight

Many embedded computers are physically located within some larger system. The form factor for the embedded system may be dictated by aesthetics. For example, the form factor for a missile may have to fit inside the nose of the missile. One of the challenges for embedded systems designers is to develop non-rectangular geometries for certain solutions. Weight can also be a critical constraint. Embedded automobile control systems, for example, must be light weight for fuel economy. Portable CD players must be light weight for portability purposes.

Cost sensitivity

Cost is an issue in most systems, but the sensitivity to cost changes can vary dramatically in embedded systems. This is mainly due to the effect of computer costs have on profitability and is more a function of the proportion of cost changes compared to the total system cost.

Power management

Embedded systems have strict constraints on power. Given the portability requirements of many embedded systems, the need to conserve power is important to maintain battery life as long as possible. Minimization of heat production is another obvious concern for embedded systems.

1.2 Power Supply

All electronic circuits work only in low DC voltage, so we need a power supply unit to provide the appropriate voltage supply for their proper functioning. This unit consists of transformer, rectifier, filter & regulator. AC voltage of typically 230volts rms is connected to a transformer voltage down to the level to the desired ac voltage. A diode rectifier that provides the full wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation. A regulator circuit can use this dc input to provide dc voltage that not

only has much less ripple voltage but also remains the same dc value even the dc voltage varies some what, or the load connected to the output dc voltages changes.

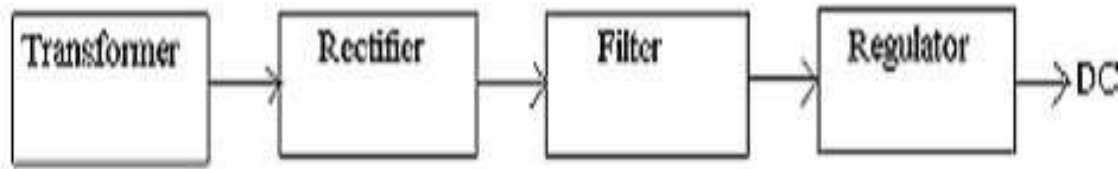


Fig 1.1: General Block of Power Supply Unit

1.3 Transformer:

A transformer is a static piece of which electric power in one circuit is transformed into electric power of same frequency in another circuit. It can raise or lower the voltage in the circuit, but with a corresponding decrease or increase in current. It works with the principle of mutual induction. In our project we are using a step down transformer to providing a necessary supply for the electronic circuits. Here we step down a 230volts ac into 12volts ac.

1.4 Rectifier:

A dc level obtained from a sinusoidal input can be improved 100% using a process called full wave rectification. Here in our project for full wave rectification we use bridge rectifier. From the basic bridge configuration we see that two diodes(say D2 & D3) are conducting while the other two diodes (D1 & D4) are in off state during the period $t = 0$ to $T/2$. Accordingly for the negative cycle of the input the conducting diodes are D1 & D4 .Thus the polarity across the load is the same.

In the bridge rectifier the diodes may be of variable types like 1N4001, 1N4003, 1N4004, 1N4005, 1N4007 etc.... can be used. But here we use 1N4007, because it can withstand up to 1000v.

1.5 Filters:

In order to obtain a dc voltage of 0 Hz, we have to use a low pass filter. So that a capacitive filter circuit is used where a capacitor is connected at the rectifier output & a dc is obtained across it. The filtered waveform is essentially a dc voltage with negligible ripples & it is ultimately fed to the load.

1.6 Registers:

The controller IC has two 8 bit registers, an instruction register (IR) and a data register (DR). The IR stores the instruction codes and address information for display data RAM (DD RAM) and character generator RAM (CG RAM). The IR can be written, but not read by the MPU.

The DR temporally stores data to be written to /read from the DD RAM or CG RAM. The data written to DR by the MPU, is automatically written to the DD RAM or CG RAM as an internal operation.

When an address code is written to IR, the data is automatically transferred from the DD RAM or CG RAM to the DR. data transfer between the MPU is then completed when the MPU reads the DR. likewise, for the next MPU read of the DR, data in DD RAM or CG RAM at the address is sent to the DR automatically. Similarly, for the MPU write of the DR, the next DD RAM or CG RAM address is selected for the write operation.

The dot-matrix liquid crystal display controller and driver LSI displays alphanumeric, Japanese kana characters, and symbols. It can be configured to drive a dot-matrix liquid crystal display under the control of a 4- or 8-bit microprocessor. Since all the functions such as display RAM, character generator, and liquid crystal driver, required for driving a dot-matrix liquid crystal display are internally provided on one chip, a minimal system can be interfaced with this controller/driver.

1.7 Regulators:

The output voltage from the capacitor is more filtered & finally regulated. The voltage regulator is a device, which maintains the output voltage constant

irrespective of the change in supply variations, load variations & temperature changes. Here we use fixed voltage regulator namely LM7805. The IC LM7805 is a +5V regulator which is used for microcontroller.

1.8 Features and Description of Regulators:

- Output Current up to 1A
- Output Voltages of 5, 6, 8, 9, 10, 12, 15, 18, 24V
- Thermal Overload Protection
- Short Circuit Protection
- Output Transistor Safe Operating Area Protection

CHAPTER 2

LITERATURE SURVEY

1. Child restraint systems: Problems related to the safety of children transported in booster seats (without integral safety belts), [P. Posuniak](#); [M. Jaśkiewicz](#); [K. Kowalski](#); [F. Dąbrowski](#), 2020

To reduce the risk of injury in the result of a road accident to children travelling by cars many factors should be considered before installing a child's restraint system such as weight, height and method of installing the system. Experimental tests were carried out using child dummies (anthropomorphic test device ATD) under simulated conditions of real road conditions to understand the impact on both the dynamics and kinematics of the system involved. The dynamic tests where the likely child body's behaviour during a road accident was represented were carried out in two different versions; in the tests, anthropomorphic test device with a mass of 22 kg and 32 kg were used. The dummies were seated on booster cushions. In two tests, the likely child body's behaviour was represented for the safety belt having been correctly fastened. In another two tests, a situation was arranged that the shoulder belt part was situated behind child's back, in result of which the child's body was only restrained by the lap belt part during the accident. The results of the tests carried out with the safety belt straps being incorrectly placed have shown that the said incorrect use of safety belts may cause a greater hazard for child's safety. At the same time, for the child restraint systems to be used, the vehicle user should have elementary knowledge of the functioning of safety belts and child restraint systems.

2. Road safety perspective of small children, [Marian Gogola](#); [Ján Ondruš](#), 2018

The current situation of road safety focus on the reduction of accidents, and mainly serious injury accidents in general. This paper focus on the topics of road safety of children and pupils from the perspective on their present in the transport network as side walk, etc. The paper presents the analysis from the parental perspective of small children road safety. There is significant change of children

behaviour under and without parental or adults supervising. In the 33% cases, the children are alone, the situation was dangerous or risky.

3. Analysis of the impact of a child seat mounting method on vertical vibrations affecting a child in a child seat, [Andrzej Zuska](#); [Emilia Szumska](#); [Damian Frej](#),2020

The article presents the results of research on the impact of mounting a child seat on vertical vibration courses when driving a Vehicle by the release speed bump. The work analyzes the influence of the child's mass and the speed of driving a Vehicle by the release speed bump on the course of vertical vibrations. The tested child seats were mounted rearward-facing on the rear seat of a passenger vehicle. The child seat A was fastened with an isofix base, while the child seat B was fastened with standard car seat belts. During the tests, the measured values were acceleration seat of child seats, vehicle rear seat and ISOfix base. As part of the research, crossings at the speed bump were carried out at different speeds and with different mass simulating the mass of the child. The test results were analyzed in order to determine the magnitude of vibrations generated during passing through the speed bump. Based on the results obtained, an assessment of the intensity of vibration transfer was made.

4. Is it safer to transport a three-year-old child in a forward-facing child restraint system or in a rear-facing one while head-on collision, [Edyta Rola](#); [Daniel Wdowicz](#),2018

Currently, it remains a contentious issue whether it is safer to transport children rear-facing or forward-facing - in Sweden, children are transported rear facing up to the age of 4 years and in Australia only up to 6 months. The aim of the study was to investigate whether it is safer to transport a three-year-old child in a forward-facing child restraint system or in a rear-facing one. In the study, a child dummy model of the Q-series representing a 3-year-old child was considered. Biomechanical injury criteria connected with the most important body regions and its critical value were defined. The frontal impact with several impact speeds were analyzed. For all tested configurations a higher risk of serious injury to head and neck was indicated for forward-facing child seat. On this basis, it could be concluded that it is safer to transport a child in the rear-facing child seat.

5. From user wishes to system architecture safety for children going to and from school by bus, [Anna Anund](#); [Tania Dukic](#),2015

Even though protecting the children - one of the most vulnerable transport system's users - is of great importance for all societies, bus transport to school is a highly under investigated area in many EU-countries. School transport by bus is not just about going by the school bus. It should be considered from a door-to-door perspective. A system that supports all involved stakeholders and take into account all wishes is most truly a way toward a more safe and secure school transport. The aim with this paper is to describe the process starting from user wishes ending up with system architecture. The work is based on the frame approach.

CHAPTER 3

AIM AND SCOPE OF THE PRESENT INVESTIGATION

3.1 Existing System:

Students are frequently observed waiting alone for their school bus at bus stops. It is not at all safe for children to wait at the bus stop by themselves in big cities where kidnappings, car crashes, and other disasters are frequent occurrences.

3.2 Proposed System:

This system uses RFID to detect students as they board the bus and uses GSM to deliver SMS to parents and the school server to update attendance during the daily ride to and from school. It is quite difficult to measure heart rate. The pulse sensor is a great tool for handling this issue. Arduino often uses a pulse sensor coupled with a heart-rate sensor.

3.3 Block Diagram:

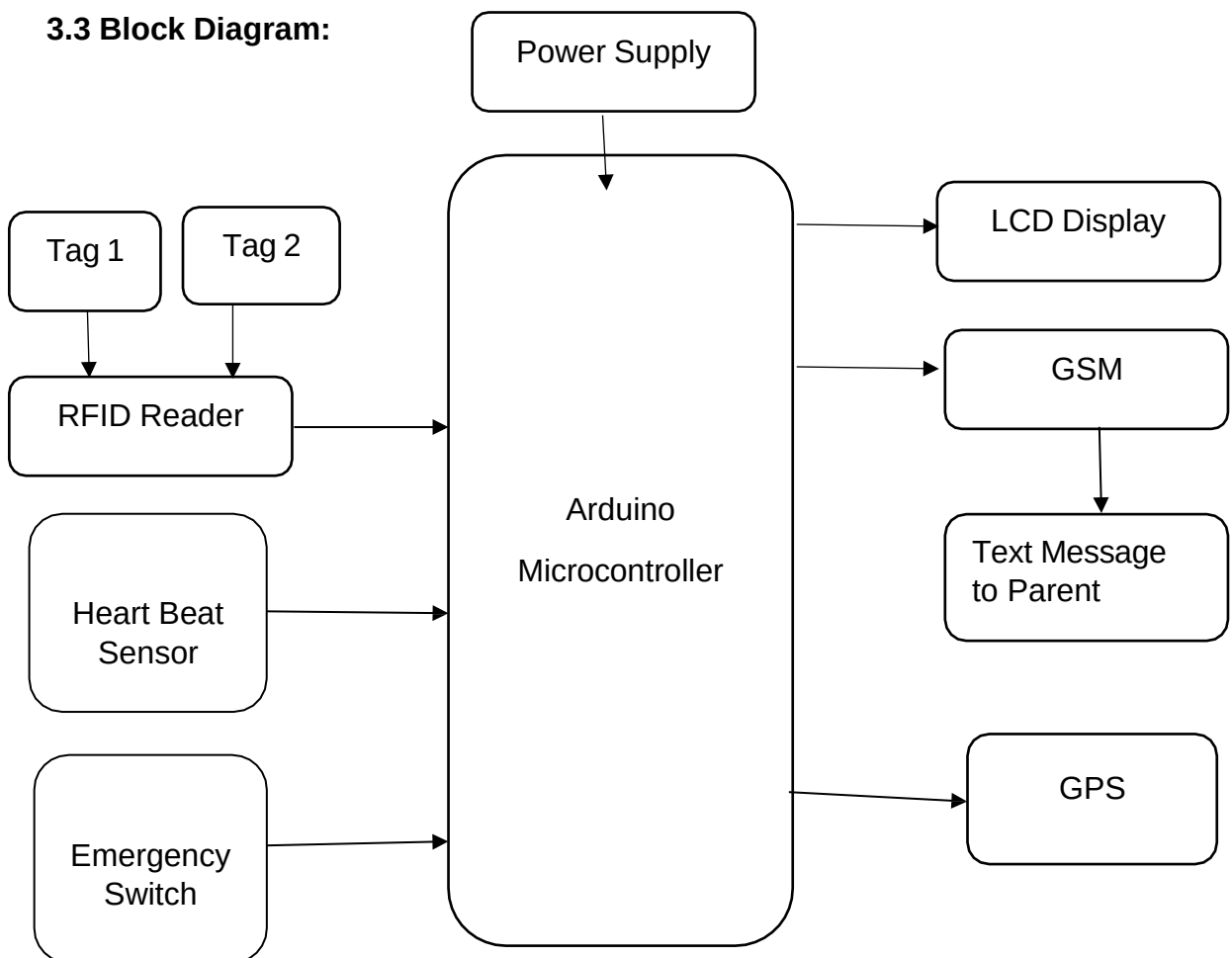


Fig 3.1: Block Diagram

Hardware Used:

- Arduino Microcontroller
- RFID Reader
- RFID Tag
- GSM
- LCD
- Switch

Software Used

- Embedded c

3.4 Standards:

The proposed system for secured transport systems in schools utilizing RFID technology adheres to several industry standards to ensure reliability, interoperability, and safety. These standards include ISO/IEC 14443 for RFID communication protocols, ensuring compatibility with widely adopted RFID systems. Additionally, GSM communication follows the standards set by the Global System for Mobile Communication (GSM), ensuring seamless integration with mobile networks. Furthermore, the system's hardware components, such as the RFID reader module and GSM modem, comply with relevant industry standards to guarantee optimal performance and reliability.

3.5 Constraints:

Despite its numerous advantages, the proposed system also faces several constraints that must be considered during implementation. One significant constraint is the potential for technical limitations in RFID and GSM communication range, which may affect the system's coverage area and reliability. Additionally, power constraints must be addressed to ensure continuous operation, particularly in remote or off-grid locations

where access to electricity may be limited. Furthermore, budgetary constraints may impact the selection of components and system scalability, requiring careful consideration of cost-effective solutions without compromising performance or security.

3.6 Trade-offs:

In designing the proposed system, several trade-offs were made to balance performance, cost, and complexity. One trade-off is the choice between active and passive RFID technology. While active RFID tags offer longer read ranges and real-time tracking capabilities, they also require additional power sources and incur higher costs compared to passive RFID tags. Another trade-off involves the selection of GSM communication protocols, balancing data transfer rates with power consumption and network coverage. Additionally, trade-offs were made in the system's architecture to prioritize simplicity and ease of implementation while ensuring sufficient functionality to meet safety and security requirements.

Overall, the proposed system navigates these standards, constraints, and trade-offs to provide a robust and effective solution for securing school transport systems using RFID technology, ultimately enhancing student safety and parental peace of mind.

CHAPTER 4

EXPERIMENTAL OR MATERIALS AND METHODS; ALGORITHMS USED

4.1 Arduino Uno and its Programming

Arduino is a tool for making computers that can sense and control more of the physical world than your desktop computer. It's an open-source physical computing platform based on a simple microcontroller board, and a development environment for writing software for the board.

Arduino can be used to develop interactive objects, taking inputs from a variety of switches or sensors, and controlling a variety of lights, motors, and other physical outputs. Arduino projects can be stand-alone, or they can be communicate with software running on your computer. The boards can be assembled by hand or purchased preassembled; the open-source IDE can be downloaded for free.

The Arduino programming language is an implementation of Wiring, a similar physical computing platform, which is based on the Processing multimedia programming environment.

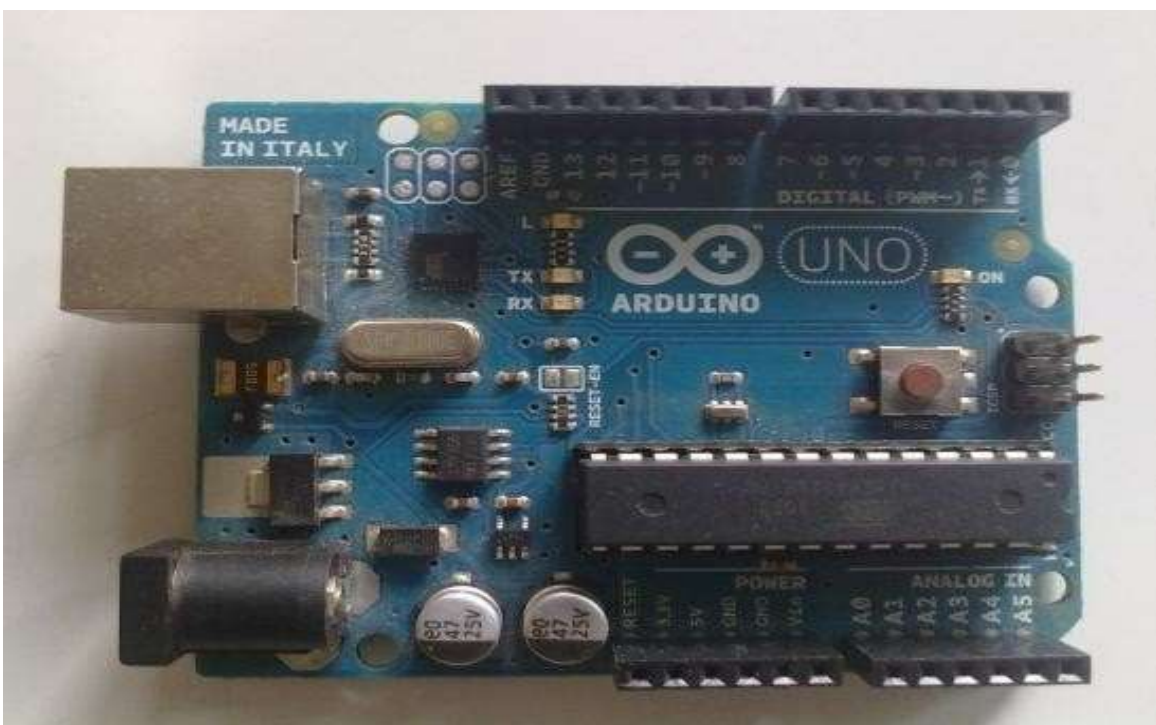


Fig 4.1: Arduino Uno

4.2 Overview Of Arduino

The Arduino microcontroller is an easy to use yet powerful single board computer that has gained considerable traction in the hobby and professional market. The Arduino is open-source, which means hardware is reasonably priced and development software is free. This guide is for students in ME 2011, or students anywhere who are confronting the Arduino for the first time. For advanced Arduino users, prowl the web; there are lots of resources.

This guide covers the Arduino Uno board (Spark fun DEV-09950, \$29.95), a good choice for students and educators. With the Arduino board, you can write programs and create interface circuits to read switches and other sensors, and to control motors and lights with very little effort. Many of the pictures and drawings in this guide were taken from the documentation

The Duemilanove board features an Atmel ATmega328 microcontroller operating at 5 V with 2 Kb of RAM, 32 Kb of flash memory for storing programs and 1 Kb of EEPROM for storing parameters. The clock speed is 16 MHz, which translates to about executing about 300,000 lines of C source code per second. The board has 14 digital I/O pins and 6 analog input pins. There is a USB connector for talking to the host computer and a DC power jack for connecting an external 6- 20 V power source, for example a 9 V battery, when running a program while not connected to the host computer. Headers are provided for interfacing to the I/O pins using 22 g solid wire or header connectors.

The Arduino programming language is a simplified version of C/C++. If you know C, programming the Arduino will be familiar. If you do not know C, no need to worry as only a few commands are needed to perform useful functions.

An important feature of the Arduino is that you can create a control program on the host PC, download it to the Arduino and it will run automatically. Remove the USB cable connection to the PC, and the program will still run from the top each time you push the reset button. Remove the battery and put the Arduino board in a closet for six months. When you reconnect the battery, the last program you stored will run. This means that you connect the board to the host PC to develop

and debug your program, but once that is done, you no longer need the PC to run the program.

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

4.3 Summary:

Microcontroller ATmega328

Operating Voltage 5V

Input Voltage (recommended) 7-12V

Input Voltage (limits) 6-20V

Digital I/O Pins 14 (of which 6 provide PWM output)

Analog Input Pins 6

DC Current per I/O Pin 40 mA

DC Current for 3.3V Pin 50 mA

Flash Memory 32 KB (ATmega328) of which 0.5 KB used by bootloader

SRAM 2 KB (ATmega328)

EEPROM 1 KB (ATmega328)

Clock Speed 16 MHz

4.4 Pin Configuration

The Arduino Uno can be powered via the USB connection or with an external power supply. The power source is selected automatically.

External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the Gnd and Vin pin headers of the POWER connector.

The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

The power pins are as follows:

- **VIN.** The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.
- **5V.** this pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 12V), the USB connector (5V), or the VIN pin of the board (7-12V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage your board.
- **3V3.** A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.
- **GND.** Ground pins.

IOREF. This pin on the Arduino board provides the voltage reference with which the microcontroller operates. A properly configured shield can read the IOREF pin voltage and select the appropriate power source or enable voltage translators on the outputs for working with the 5V or 3.3V.

Memory

The ATmega328 has 32 KB (with 0.5 KB used for the bootloader). It also has 2 KB of SRAM and 1 KB of EEPROM.

Input and Output

Each of the 14 digital pins on the Uno can be used as an input or output, using `pinMode()`, `digital Write()`, and `digital Read()` functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 kohms. In addition, some pins have specialized functions:

- **Serial: 0 (RX) and 1 (TX).** Used to receive (RX) and Transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.
- **External Interrupts: 2 and 3.** These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the `attach Interrupt()` function for details.
- **PWM: 3, 5, 6, 9, 10, and 11.** Provide 8-bit PWM output with the `analog Write()` function.
- **SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK).** These pins support SPI communication using the SPI library.
- **LED: 13.** There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

The Uno has 6 analog inputs, labeled A0 through A5, each of which provide 10 bits of resolution (i.e. 1024 different values). By default they measure from ground to 5 volts, though it is possible to change the upper end of their range using the AREF pin and the `analog Reference()` function. Additionally, some pins have specialized functionality:

- **I2C: A4 or SDA pin and A5 or SCL pin.** Support I2C communication using the Wire library.

There are a couple of other pins on the board:

- **AREF.** Reference voltage for the analog inputs. Used with analog Reference ().
- Reset.** Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

4.5 Communication

Microcontrollers depend on a host computer for developing and compiling programs. The software used on the host computer is known as an integrated development environment, or IDE. For the Arduino, the development environment is based on the open source Processing platform (www.processing.org) which is described by its creators as a “programming language and environment for people who want to program images, animation, and interactions.” The Arduino programming language leverages an open source project known as Wiring (wiring.org.co). The Arduino language is based on good old- fashioned C. If you are unfamiliar with this language, don't worry; it's not hard to learn, and the Arduino IDE provides some feedback when you make mistakes in your programs. The Arduino Uno has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers. The ATmega328 provides UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The '16U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, a inf file is required. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board. The RX and TX LEDs on the board will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (but not for serial communication on pins 0 and 1).

A Software Serial library allows for serial communication on any of the Uno's digital pins. The ATmega328 also supports I2C (TWI) and SPI communication. The Arduino software includes a Wire library to simplify use of the I2C bus; see the documentation for details. For SPI communication, use the SPI library.

As you go through the list of programming statements available in the Arduino IDE (choose Help->Reference), you might think there isn't much power for doing things like running servos, operating stepper motors, reading potentiometers, or displaying text on an LCD. Like most any language based on C, the Arduino supports the notion of "libraries" code

Repositories that extend core programming functionality. Libraries let you re-use code without having to physically copy and paste it into all your programs. The standard Arduino software installation comes with several libraries you may use, and you can download others from the Arduino support pages and from third-party websites that publish Arduino library code. A good example of a library you'll use with the Robot and likely many other robot projects is

Servo. This library allows you to connect one or more hobby R/C servos to the Arduino's digital I/O pins. The Servo library comes with the standard Arduino installation package Library->Servo. This adds the line

```
#include <Servo.h>
```

Which tells the Arduino IDE that you wish to include the Servo library in your sketch. With the functionality of the library now available to you, you can use its various functions to control one or more servos. For example, you can use the write function to rotate a servo to a specific position, from 0 to 180 degrees. The following code

```
myServo.write(90);
```

Moves a servo to its midpoint, or 90 degree position. Structurally, Arduino sketches are very straightforward and are pretty easy to read and understand. The Arduino program contains two main parts: setup () and loop (). These are programming functions that do what their names suggest: setup () sets up the Arduino hardware, such as specifying which I/O lines you plan to use, and whether They are inputs or outputs. The loop () function is repeated endlessly when the Arduino is operating. Arduino IDE (Integrated development environment) is used to write the program and dump into the Arduino board

4.6 ARDUINO SOFTWARE:

1. Write the sketch in Arduino IDE



Fig 4.2: Sketch in Arduino IDE

2. Compile and upload the Sketch to Arduino board

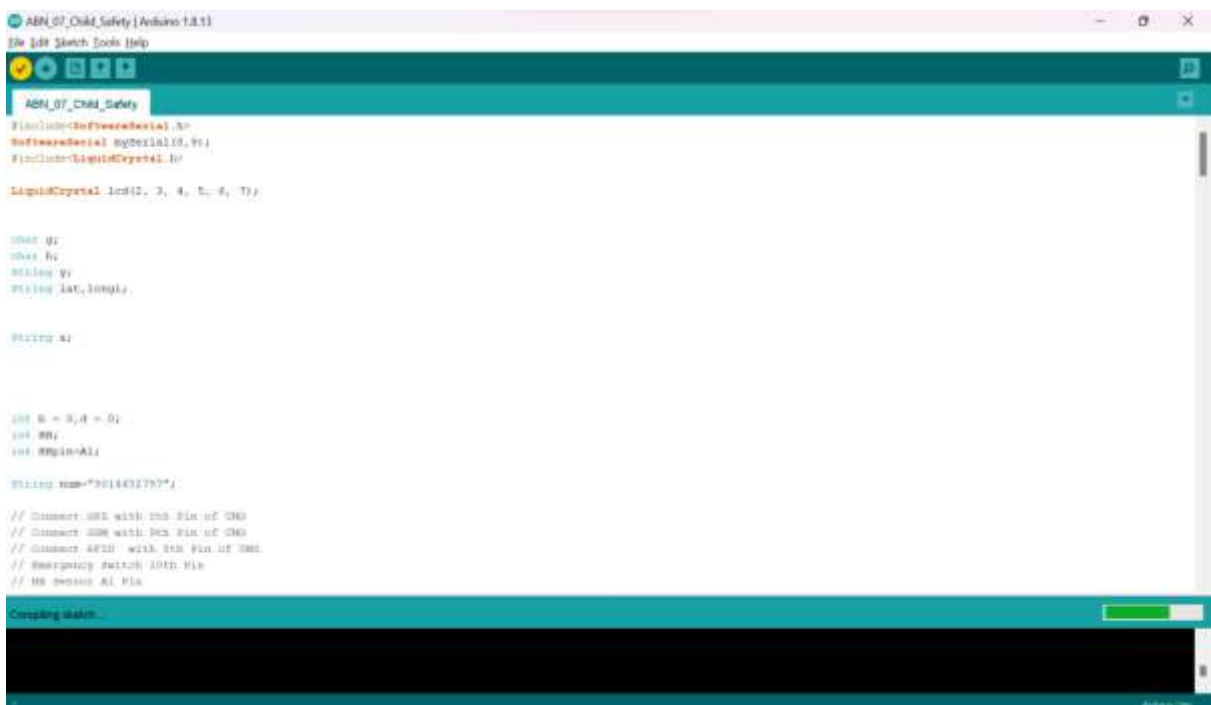


Fig 4.3: upload the Sketch to Arduino board

4.7 HEARTBEAT SENSOR

A person's heartbeat is the sound of the valves in his/her's heart contracting or expanding as they force blood from one region to another. The number of times the heart beats per minute (BPM), is the heart beat rate and the beat of the heart that can be felt in any artery that lies close to the skin is the pulse.

Two Ways to Measure a Heartbeat

- **Manual Way:** Heart beat can be checked manually by checking one's pulses at two locations- wrist (the **radial pulse**) and the neck (**carotid pulse**). The procedure is to place the two fingers (index and middle finger) on the wrist (or neck below the windpipe) and count the number of pulses for 30 seconds and then multiplying that number by 2 to get the heart beat rate. However pressure should be applied minimum and also fingers should be moved up and down till the pulse is felt.
- **Using a sensor:** Heart Beat can be measured based on optical power variation as light is scattered or absorbed during its path through the blood as the heart beat changes.

Principle of Heartbeat Sensor

The heartbeat sensor is based on the principle of photo plethysmography. It measures the change in volume of blood through any organ of the body which causes a change in the light intensity through that organ (a vascular region). In case of applications where heart pulse rate is to be monitored, the timing of the pulses is more important. The flow of blood volume is decided by the rate of heart pulses and since light is absorbed by blood, the signal pulses are equivalent to the heart beat pulses.

There are two types of photoplethysmography:

Transmission: Light emitted from the light emitting device is transmitted through any vascular region of the body like earlobe and received by the detector.

Reflection: Light emitted from the light emitting device is reflected by the regions.

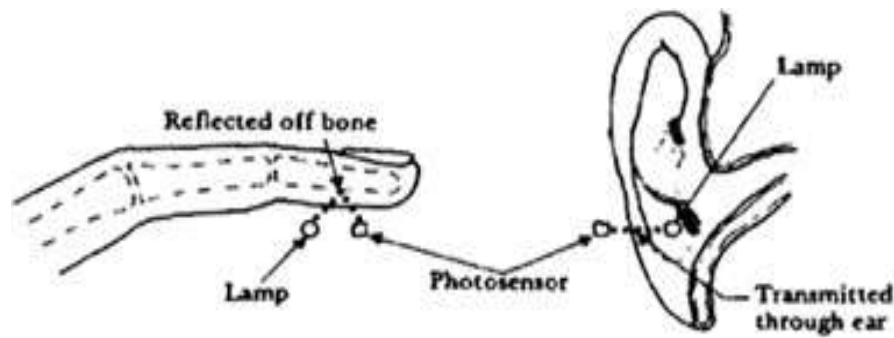


Fig 4.4: Working of a Heartbeat Sensor

The basic heartbeat sensor consists of a light emitting diode and a detector like a light detecting resistor or a photodiode. The heart beat pulses causes a variation in the flow of blood to different regions of the body. When a tissue is illuminated with the light source, i.e. light emitted by the led, it either reflects (a finger tissue) or transmits the light (earlobe). Some of the light is absorbed by the blood and the transmitted or the reflected light is received by the light detector. The amount of light absorbed depends on the blood volume in that tissue. The detector output is in form of electrical signal and is proportional to the heart beatrate.

This signal is actually a DC signal relating to the tissues and the blood volume and the AC component synchronous with the heart beat and caused by pulsatile changes in arterial blood volume is superimposed on the DC signal. Thus the major requirement is to isolate that AC component as it is of prime importance.

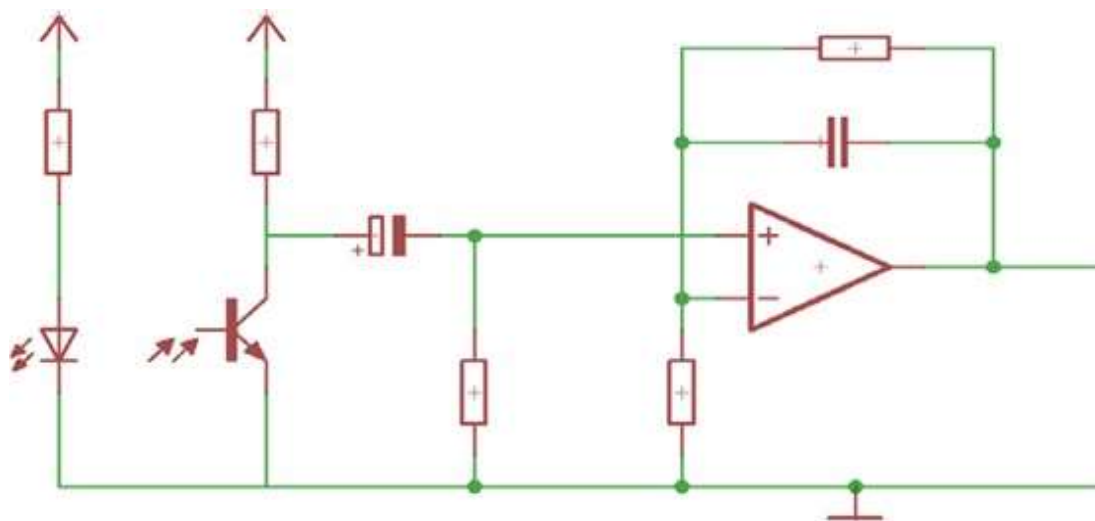


Fig 4.5: Sensor Circuit Diagram

To achieve the task of getting the AC signal, the output from the detector is first filtered using a 2 stage HP-LP circuit and is then converted to digital pulses using a comparator circuit or using simple ADC. The digital pulses are given to a microcontroller for calculating the heart beat rate, given by the formula-

$$\text{BPM(Beats per minute)} = 60 * f$$

Where f is the pulse frequency

Practical Heartbeat Sensor

Practical heartbeat Sensor examples are **Heart Rate Sensor (Product No PC-3147)**. It consists of an infrared led and an Idr embedded onto a clip like structure. The clip is attached to the organ (earlobe or the finger) with the detector part on the flesh.



Fig 4.6: Heart Rate Sensor (Product No PC-3147)

Another example is **TCRT1000**, having 4 pins-

Pin1: To give supply voltage to the LED

Pin2 and 3 are grounded. Pin 4 is the output. Pin 1 is also the enable pin and pulling it high turns the LED on and the sensor starts working. It is embedded on a wearable device which can be worn on the wrist and the output can be sent wirelessly (through Bluetooth) to the computer for processing.



Fig 4.7: Application Developing your own Heartbeat Sensor System

A basic Heartbeat Sensor system can also be built using basic components like a Ldr, comparator IC LM358 and a Microcontroller as given below

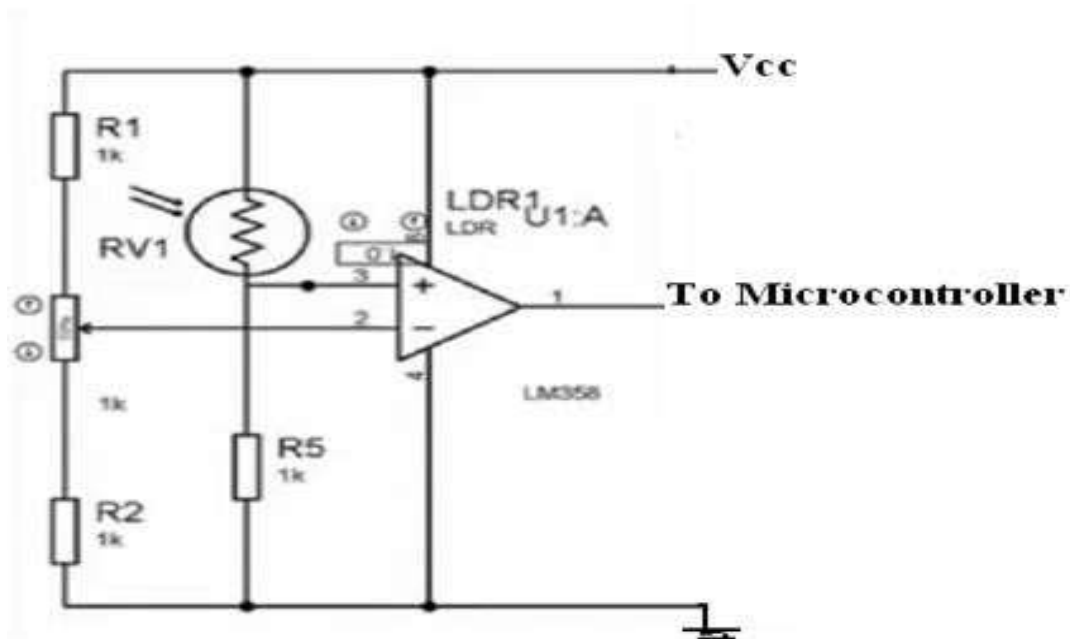


Fig 4.8: Circuit Diagram Using LDR

As described above regarding the principle of heart beat sensor, when the finger tissue or the earlobe tissue is illuminated using a light source, the light is transmitted after getting modulated i.e. a part getting absorbed by the blood and the rest being transmitted. This modulated light is received by the light detector.

Here a Light Dependent Resistor (LDR) is used as a light detector. It works on the principle that when light falls on the resistor, its resistance changes. As the light intensity increases, the resistance decreases. Thus the voltage drop across the resistor decreases.

Here a comparator is used which compares the output voltage from the LDR to that of the threshold voltage. The threshold voltage is the voltage drop across the LDR when the light with fixed intensity, from the light source falls directly on it. The inverting terminal of the comparator LM358 is connected to the potential divider arrangement which is set to the threshold voltage and the non-inverting terminal is connected to the LDR. When a human tissue is illuminated using the light source, the intensity of the light reduces. As this reduced light intensity falls on the LDR, the resistance increases and as a result the voltage drop increases. When the voltage drop across the LDR or the non-inverting input exceeds that of the inverting input, a logic high signal is developed at the output of the comparator and in case voltage drop being lesser a logic low output is developed. Thus the output is a series of pulses. These pulses can be fed to the Microcontroller which accordingly processes the information to get the heart beat rate and this is displayed on the Display interfaced to the Microcontroller.

CHAPTER 5

RESULTS AND DISCUSSION

In a comparative analysis of secured transport systems utilizing RFID technology for schools, discerning the most effective security measures emerges as paramount. By meticulously examining the robustness of security features across different systems, significant disparities may surface, highlighting the imperative of selecting systems adept at thwarting unauthorized access and safeguarding students' well-being.

Moreover, variations in user authentication methods, ranging from traditional RFID cards to emerging biometric solutions, underscore the importance of selecting systems that balance reliability and convenience. Systems offering seamless integration with existing school infrastructure hold immense promise, streamlining operations and enhancing data management efficiency.

The implementation of the system underwent comprehensive testing, revealing that it performed according to expectations. Initially, the system underwent simulation using Proteus software. Subsequently, the system was programmed through the Arduino IDE software and subjected to testing on the Easy Arduino development board. Following the simulation phase, practical testing involved employing a toy bus as a real-world scenario. The RFID reader was securely affixed to the bus door, and its functionality was verified by introducing RFID tags (cards) into the bus through the reader.

To assess the GSM component, the GSM modem was connected directly to a PC using a USB cable. Testing was conducted using an AT command tester program, where commands such as 'AT' were issued, and a positive response, such as 'ok,' confirmed the successful communication with the GSM modem. Several other fundamental AT commands were scrutinized to ensure the GSM modem's effective operation.

Furthermore, an LCD display was positioned at the front of the bus, and its performance was thoroughly evaluated to ascertain its seamless integration into the system's operations. The culmination of these testing phases affirmed the

overall success and functionality of the implemented system.



Fig 5.1: Hardware setup



Fig 5.2: Model setup

RESULTS:

The screenshot shows the Arduino IDE with the following code:

```

#include <SoftwareSerial.h>
SoftwareSerial mySerial(8, 9);
#include <LiquidCrystal.h>

LiquidCrystal lcd(2, 3, 4, 5, 6, 7);

char gr;
char hr;
String yr;
String lat, longit;

String ai;

int b = 0, d = 0;
int BB;
int Bpin=11;
  
```

The serial monitor window displays the following output:

```

Y22
Location:LAT= 1252.56304 N , LONGI= 08013.78587 E
Y22
Location:LAT= 1252.56310 N , LONGI= 08013.78617 E
736
Location:LAT= 1252.58308 N , LONGI= 08013.78561 E
725
Location:LAT= 1252.58319 N , LONGI= 08013.78557 E
725
Location:LAT= 1252.58276 N , LONGI= 08013.78699 E
11:04:37.535 -> 726
11:04:38.550 -> Location:LAT= 1252.58288 N , LONGI= 08013.78596 E
11:04:39.546 -> 727
11:04:40.552 -> Location:LAT= 1252.58298 N , LONGI= 08013.78527 E
11:04:41.540 -> 751
11:04:42.575 -> Location:LAT= 1252.58408 N , LONGI= 08013.78407 E
  
```

Fig 5.3: Software Outcome

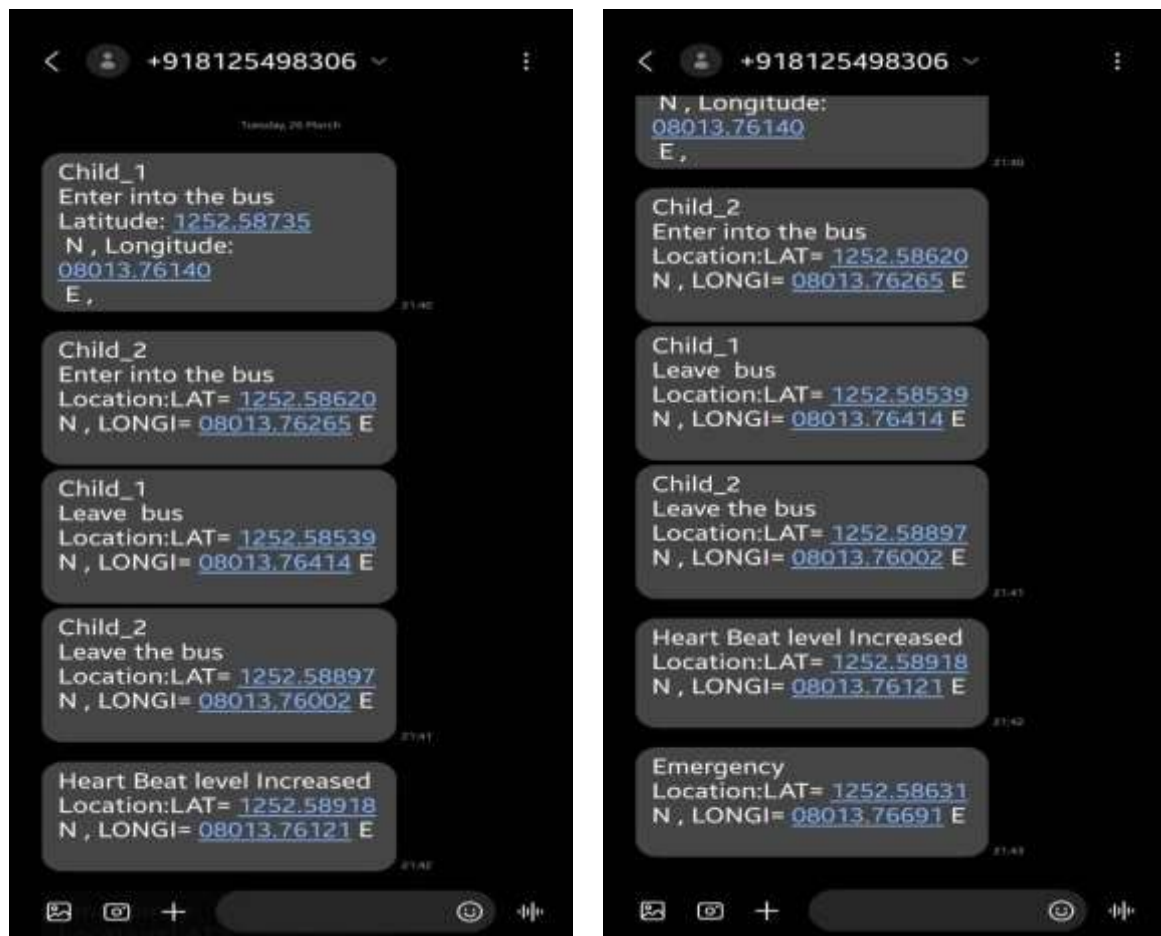


Fig 5.4: Outputs

CHAPTER 6

CONCLUSION

In conclusion, the comparative analysis of secured transport systems utilizing RFID technology for schools reveals nuanced differences across various dimensions, including security features, user authentication methods, integration capabilities, cost-effectiveness, and performance. The examination highlights the importance of selecting systems that strike a balance between robust security measures and user-friendly functionalities. While some systems excel in security effectiveness and data accuracy, others may offer superior integration with existing infrastructure and scalability for future needs.

Moreover, considerations such as privacy implications and user satisfaction play a crucial role in system selection and implementation. Ultimately, by leveraging insights gained from this analysis, stakeholders can make informed decisions to deploy RFID-based transport systems that prioritize safety, efficiency, and user satisfaction within school transportation operations.

the multifaceted nature of decision-making in selecting optimal solutions. Beyond mere security features and operational efficiency, considerations such as adaptability to evolving needs, continuous improvement, and risk mitigation strategies emerge as pivotal factors shaping system effectiveness. The increasing number of child suffocation deaths resulting from missing the bus makes it necessary to incorporate RFID and GSM technologies for security and safety. This technology allows the bus driver and concerned authorities to be notified because it is visible from the RFID card. In the event that a student is on the bus at the same time, the system will send an SMS to the school's administration, allowing them to decide what to do. According to the study, using an RFID-based tracker device is still one of the best strategies to increase bus safety and reduce the amount of instances in which students are left inside the vehicle without being accounted for.

FUTURE SCOPE

Looking to the future, secured transport systems utilizing RFID technology for schools hold significant promise for further innovation and advancement. One area of future development lies in enhancing security measures through the integration of advanced authentication technologies such as biometrics and artificial intelligence algorithms, fortifying systems against unauthorized access and ensuring student safety. Additionally, the integration of RFID technology with the Internet of Things (IoT) could enable real-time monitoring and management of school transport fleets, leading to more efficient and safer transportation operations. Predictive analytics algorithms could leverage RFID data to anticipate transportation challenges, optimizing route planning and minimizing delays.

Furthermore, personalized services tailored to individual student needs and preferences may become a reality through the use of RFID-enabled smart cards or mobile apps, enhancing the overall user experience. As cities embrace smart city initiatives, RFID-based transport systems for schools could seamlessly integrate with broader urban mobility solutions, contributing to more efficient and sustainable transportation practices.

Emerging technologies like augmented reality (AR) and virtual reality (VR) have the potential to revolutionize student interactions with school transport systems, offering immersive safety training experiences and navigation aids. Integrating blockchain technology with RFID systems could enhance data security and integrity, ensuring privacy protections and trustworthiness in transportation-related information management. By exploring these avenues for future development, RFID-based transport systems for schools can continue to evolve, delivering safer, more efficient, and personalized transportation experiences for students, parents, and school staff alike. It can be implemented widely and simultaneously in several schools. Depending on how far it is from school to home or the other way around, we can establish a time limit for rescanning cards to get off the bus after they have entered. Using OTP verification will improve the security of our login and signup processes.

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