BLACK BOX IN AUTOMOBILE

INDUSTRIAL PROJECT REPORT

by

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ABSTRACT

The main objective of the project is to design and develop a prototype for Black box in automobile for safety concerns which can be installed in any vehicle. This prototype can be designed with minimum number of circuits .This project also focuses on finding the cause of the accident. We have developed the model especially for cars.

The Black box allows the car to move, only if the seatbelt is fastened by the driver, it then records whether the driver has pressed the brake pedal, made any sudden left/right turns, parameters like speed, brake, clutch, accelerator, gear, stress, etc. vibration from the engine, video captured inside the car.

Once if the vibration sensor detects a peak in its reading, which confirms that the accident has happened, the emergency alarm and the indication light is turned ON. It keeps on alarming until the seatbelt is removed, that is, if the driver is rescued.

The black box helps in investigation of the accident, that is, in reconstructing the events before the collision. Also if there were any technical malfunctions with the vehicle before the accident can also be found.

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LIST OF NOMENCLATURE

ABBREVIATIONS	EXPANSION
ADC	**A**nalog to **D**igital **C**onverter
DVR	**D**igital **V**ideo **R**ecorder
GPIO	**G**eneral **P**urpose **I**nput **O**utput
GUI	**G**raphical **U**ser **I**nterface
I2C	**I**nter **I**ntegrated **C**ircuit
IR	**I**nfra **R**ed
LAN	**L**ocal **A**rea **N**etwork
LED	**L**ight **E**mitting **D**iode
OS	**O**perating **S**ystem
RJ45	**R**egister **J**ack
RPI	**R**aspberry **P**i
RTC	**R**eal **T**ime **C**lock
USB	**U**niversal **S**erial **B**us

CHAPTER 1

INTRODUCTION

A flight recorder, commonly known as a black box, is an electronic recording device placed in an aircraft for the purpose of facilitating the investigation of aviation accidents and incidents.

The flight data recorder (FDR) is a device that preserves the recent history of the flight through the recording of dozens of parameters collected several times per second. The cockpit voice recorder (CVR) preserves the recent history of the sounds in the cockpit including the conversation of the pilots. The two recorders give an accurate testimony, narrating the aircraft's flight history, to assist in any later investigation.

Airplanes are equipped with sensors that gather data such as acceleration, airspeed, altitude, outside temperature, engine performance, and cabin temperature and pressure. Magnetic-tape recorders can track about 100 parameters, while solid-state recorders can track a lot more.

Older black boxes used magnetic tape but these days, black boxes use solid-state memory boards. Data from both the CVR and FDR is stored on stacked memory boards inside the crash-survivable memory unit (CSMU). The memory boards have enough digital storage space to accommodate two hours of audio data for CVRs and 25 hours of flight data for FDRs.

All of the data collected by the airplane's sensors is sent to the flight-data acquisition unit (FDAU) at the front of the aircraft. This device often is found in the electronic equipment bay under the cockpit. It takes the information from the sensors and sends it on to the black boxes. Both black boxes are powered by one of two power generators that draw their power from the plane's engines. One generator is a 28-volt DC power source, and the other is a 115-volt, 400-hertz (Hz) AC power source.

The event data recorder (EDR) as the black box is officially called is slowly gaining an important role in investigation of car accidents as well. Despite the fact that some people have expressed concerns about privacy issues, car black boxes are not helpful for car accident investigators and insurance companies only. By recording the events and actions of the driver including speed, braking, turning, etc. before the collision, the car black box will undoubtedly help both the police and insurance companies in reconstruction of the events before the accident but it will also bring a number of benefits for the car's owner.

The event data recorders are already installed in cars although many people are unaware of having such device installed. These are not visible because they are under the seat or dashboard and activate about 5 seconds before the senses trigger activation of the airbags. Car black boxes were originally created to determine the cause of airbag's activation but they collect several data of the driver's actions including the speed which has made them very useful for reconstruction of accidents. The black box typically records 5 to 10 seconds before the collision.

There is also another type of car black boxes, also known as video data event recorder which are used by the drivers voluntarily. These are installed on the windshield and feature a camera as well as a GPS unit and collects the performance data such as accelerating, braking and turning. The data is stored automatically to a secure digital (SD) card similar to those that are used in digital cameras and can be reviewed on a computer. This type of car black boxes is even more accurate than those that are currently being installed in vehicles because it also records the time, location and direction of the driving as well as the driver's view.

In this project, two raspberry-pi are used. One raspberry pi connects four cameras and the other connects all the sensors and an RTC (Real time clock). A vibration sensor is used to detect vibrations from engine. Three IR sensor are used. One to detect whether the brake is pressed or not, the second one for the accelerator and the third one for the clutch. Let the raspberry pi connected to four USB cameras be rpi-1 and the one that connects the vibration sensors, IR sensors and the real time clock be rpi-2.

The rpi-1 has motion eye installed in it, which is an Operating system that interfaces all the cameras. Once turned ON, it keeps on capturing the video and stores it in the path specified/configured in the motion eye configuration. A video backup of 15 minutes is provided for rpi-1.

The rpi-2 has raspbian OS installed which is the operating system for raspberry pi-3.The Vibration sensors, IR sensors and an RTC are connected to this rpi. It has a backup of one hour which stores video files from rpi-1 and all sensor readings. The router connects two raspberry pi-3's using LAN protocol so it is easy to share the data from one raspberry pi to the other; this helps gathering data from the entire circuit for table creation

CHAPTER 2

2.1 BLOCK DIAGRAM

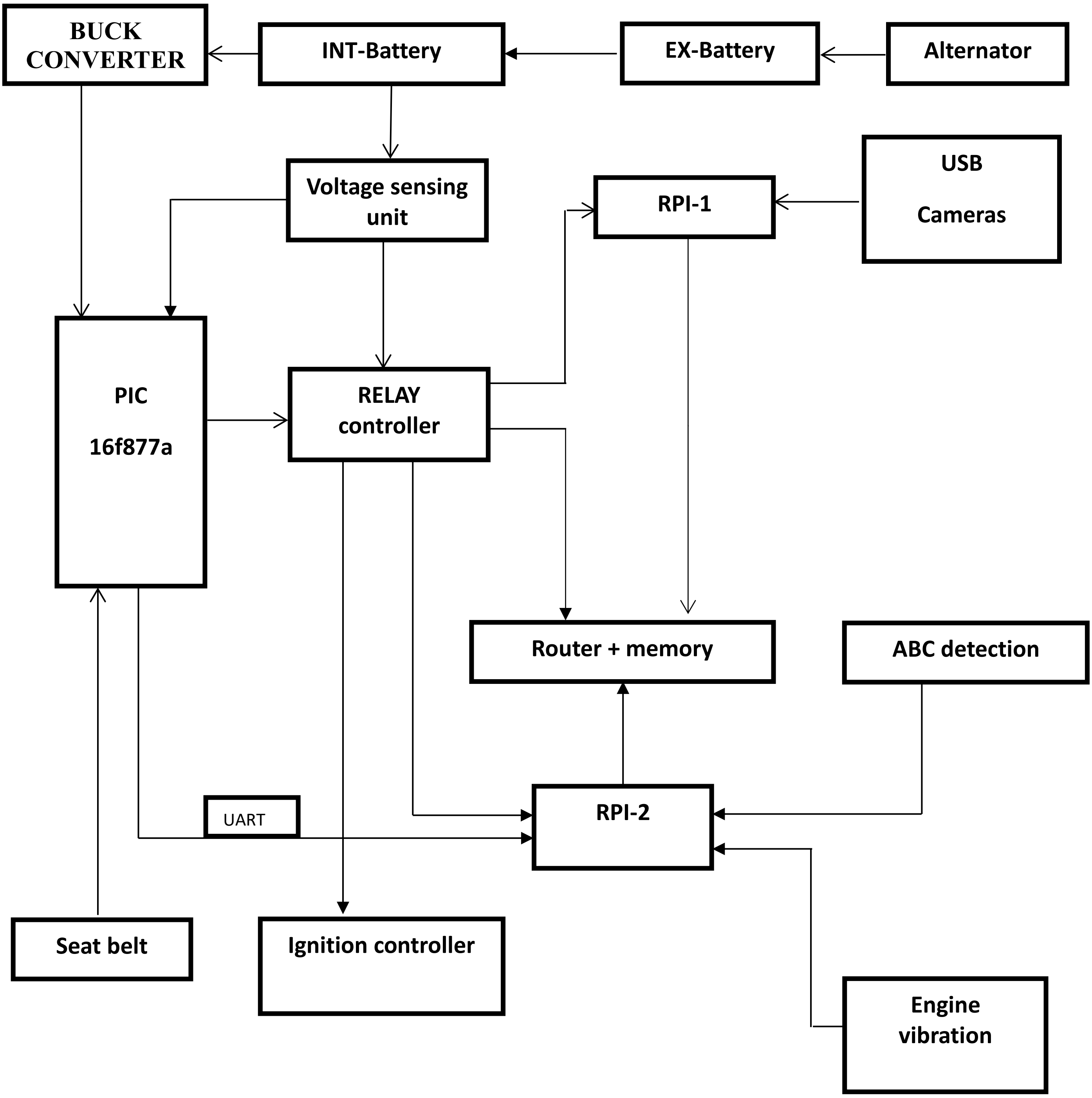


Fig 2.1 **Overall block diagram**

2.2 VOLTAGE SENSING UNIT

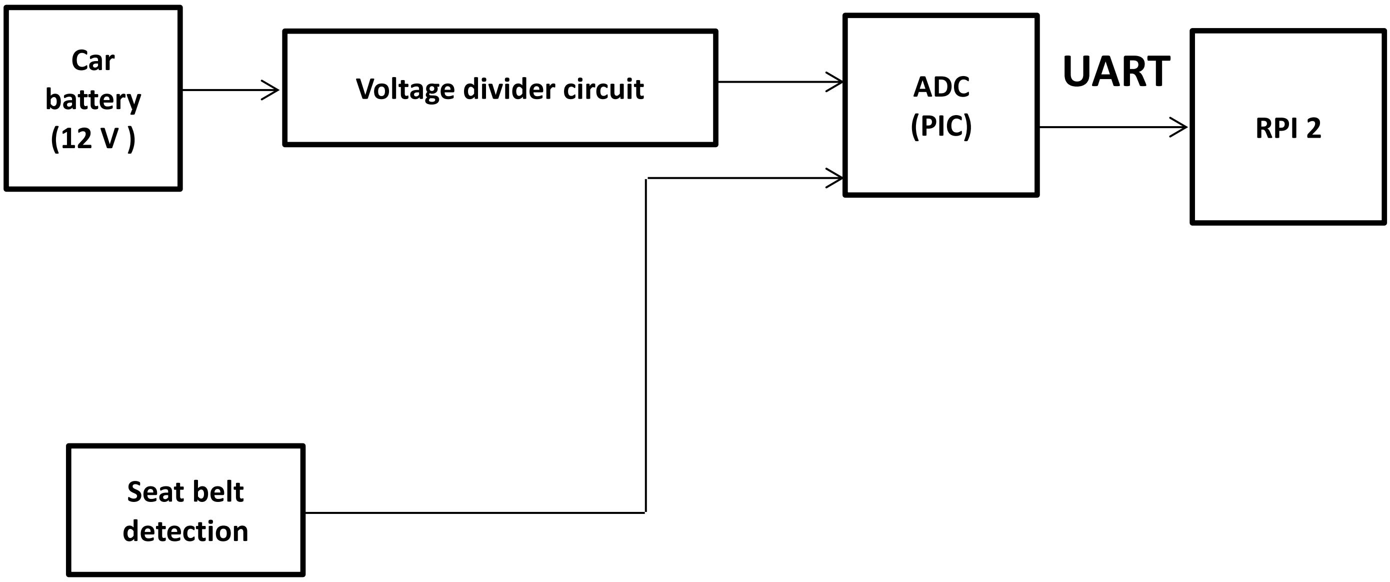


Fig 2.2 **Voltage sensing circuit**

The voltage sensing circuit measures the voltage level of the battery and sends it to the raspberry pi-2 via the PIC microcontroller. This block of the blackbox model contains a voltage divider circuit, an analog to digital converter which is connected to PIC microcontroller board.

The voltage divider circuit receives voltage from the internal battery of the blackbox and it gives output according to the incoming varying voltages from the battery. This value is analog in nature. Since raspberry pi has no analog pins, these values are sent to an ADC connected to the PIC microcontroller board which then converts analog values to digital.

This converted value is sent to the raspberry pi-2 and then to the router via the LAN protocol for entering the values in the table. Thus the voltage level of the battery is monitored in regular and one if the battery drains below a threshold value an LED is programmed to blink to alert.

The Black box which is an event data recorder is powered by the internal battery. The Internal battery is connected to the car's battery which we call here as external battery. The internal battery is charged by the external battery which is powered by the alternator in the car. The buck converter supplies the PIC microcontroller, the voltage sensing unit and the relay controller. The internal battery supplies four buck converters out of which two are connected to a two-channel relay, one is connected to the PIC microcontroller and the fourth one is connected to the voltage sensing unit. The Voltage sensing unit is used here to monitor the internal battery.

The Blackbox working starts with PIC microcontroller (PIC16F877A) controlling the relay controller which in turn turns ON the ignition controller to start the engine. First of all, the seatbelt status is checked by the microcontroller. The PIC microcontroller attempts to start the engine only when the driver wears the seatbelt. The relay controller then turns ON the engine with the help of ignition controller. Also the two raspberry pi’s are turned ON which then starts recording the events associated with the car functioning. The engine will never start if the seatbelt is not worn. If the seatbelt is removed after starting engine ignition or if removed after sometime (this happens in case of long journey), a buzzer alarms for about 10 seconds to alert the driver and it is up to the driver to wear the seatbelt.

The relay controller has the control over the engine. Once if the relay controller is turned ON, both the Pi's and the router are turned ON.

The Raspberry pi-1 to which the cameras are connected starts live video streaming with the help of motion eye OS. Two cameras are used for front and rear view, one for recording odometer reading and one for driver actions which records the audio. All the four cameras are configured to operate at the same time thus recording videos with the backup of 15 minutes which means that each video file has the time duration of 15 minutes. The four separate videos are then stored in the memory connected to the router. A sound card is used to send the audio recorded along with the video to the raspberry pi-2.

The Raspberry pi-2 has three digital IR sensors for monitoring the status of ABC (Accelerator, brake and clutch), two vibration sensors for recording the vibration of engine and the vibration of the car’s body. Using Rasbian OS, the sensors are programmed to read the status of ABC and engine vibration. The data that are read are then stored in a table which is created for reference purpose. All the sensor readings is recorded in the table for every second, that is, sensor readings are taken per second and stored in the table.

The table is created in the memory connected to the router. The filename of the recorded video is the time and date at which it is recorded; this is done for convenience while referring the table. The columns named Accelerator, brake, clutch and vibration has the data read from the IR sensors used for reading ABC status and the vibration sensor status. To store the video files in the table, the names of the video files stored in the memory is used which is inserted in the video column.

2.3 COMPONENTS USED

S.No	Component name	Specification	Quantity
1.	Raspberry pi	Model B Version-2	2
2.	USB camera	-	4
3.	Vibration sensor	SW-420	2
4.	IR sensor	TCRT5000	3
5.	Battery	12V, 12A	1
6.	Emergency Indication Light	-	4
7.	Emergency alarm	-	1
8.	RTC	DS - 3231	1
9.	PIC microcontroller	16F877A	1
10.	Sound card	Channel 7.1	1
11.	Microphone	-	1
12.	Modem cum router		1
13.	USB female cable	-	2
14.	USB female connector	-	2
15.	SD card	8GB, 4GB	1 each
16.	Pen drive	8GB	1
17.	DC motor		1
18.	IC base	-	1

19.	Transistor	BC547	6
20.	Connecting wires	-	As required
21.	Sugar cube relay	-	4
22.	Buck converter	-	4
23.	Two channel relay	-	2
25.	Copper clad board	-	1
26.	Diode	1N4007	
27.	Resistor	500,100k,1k	
28.	Toggle Switch	-	1
29.	Connector pins	Header Pin Male L-Type 10mm (1 x 40)	2
30.	SPST push button	-	1
31.	Buzzer	-	1
32.	LED	10mm	4

CHAPTER 3

HARDWARE DESCRIPTION

3.1 RASPBERRY PI-3

Fig 3.1 **Raspberry pi 3 model**

The Raspberry Pi is a series of credit card-sized single-board computers which includes an ARM compatible central processing unit (CPU) and an on chip graphics processing unit (GPU, a Video-Core IV). CPU speed ranges from 700 MHz to 1.2 GHz for the Pi 3 and on board memory range from 256 MB to 1 GB RAM. Secure Digital (SD) cards are used to store the operating system and program memory in either the SDHC or Micro-SDHC sizes.

Most boards have between one and four USB slots, HDMI and composite video output, and a 3.5 mm phone jack for audio. Lower level output is provided by a number of GPIO pins which support common protocols like I²C. The B-models have an 8P8C Ethernet port and the Pi 3 has on board Wi-Fi 802.11n and Bluetooth.

The Raspberry Pi 3 uses a Broadcom BCM2837 SoC with a 1.2 GHz 64-bit quad-core ARM Cortex-A53 processor, with 512 KB shared L2 cache.

The Raspberry Pi 3, with a quad-core Cortex-A53 processor, is described as 10 times the performance of a Raspberry Pi 1. This was suggested to be highly dependent upon task threading and instruction set use. Benchmarks showed the Raspberry Pi 3 to be approximately 80% faster than the Raspberry Pi 2 in parallelized tasks.

The Raspberry Pi 3 is equipped with 2.4 GHz WiFi 802.11n (150 Mbit/s) and Bluetooth 4.1 (24 Mbit/s) in addition to the 10/100 Ethernet port.

3.2 TCRT5000 INFRARED SENSOR MODULE

Fig 3.2 **IR sensor module**

- Compatible with Arduino, Raspberry PI, ARM, AVR, PIC, 8051, etc.
- Useful for various robotic applications, room visitor counter systems, etc.
- Adjustable range using preset (using potentiometer on board)
- Mounting hole of 2.5 mm diameter for easy mounting
- Operating Voltage: 5V DC
- Digital Output: Logic one (+3.5V DC) logic zero (0V DC)
- This can in turn be used for detecting white or black lines (in line follower Robots) or bright or dark objects (in object identification Robots)

3.3 VIBRATION SENSOR MODULE SW-420

- SW-420 Vibration Sensor is one of the most commonly used module for vibration or tilt detection above a particular threshold.
- This module consisting of vibration sensor SW-420 switch and comparator LM393.
- The comparator converts signals from switch to Digital Output.
- The module outputs logic LOW when there is no vibration.
- Compatible with Raspberry Pi- series.
- It is easy to detect vibration using SW-420 Vibration Sensor Module.

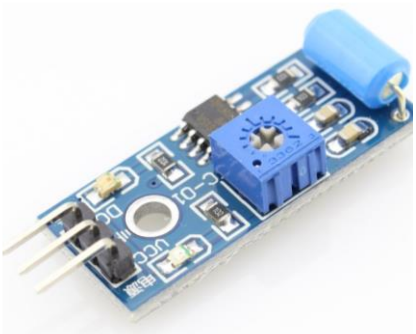


Fig 3.3 **Vibration sensor module**

Features

- The switch is closed in normal condition
- The comparator LM393 enables Digital Output
- Supply voltage: 3.3V – 5V
- Power Indicating LED
- Vibration Indicating LED
- Weight – 4g
- Dimensions – 32 * 14 mm

3.4 USB CAMERA

FEATURES

- Support external microphone
- Clear, sharp still picture & motion video
- 16 MP interpolated resolution
- True plug and play USB interface
- Excellent quality & fashionable style
- USB 2.0 I/O interface
- Frame rate up to 30 Fps
- Adjustable lens

Fig 3.4 **USB camera**

- Webcam driverless, can be setup directly with window XP SP2/Windows Vista
- 640x480 352x288 320x240 176x144 160x120 Image resolution
- True plug and play USB interface
- Support CC2000, Net meeting, VVQ, ICQ, Skype, MSN, AOL and YAHOO Messenger etc.
- Auto white balance & exposure
- Support external microphone
- High quality CMOS sensor

3.5 MEMORY DEVICES

Strontium 4GB & 8GB Micro SDHC Class-6 Memory Card

- Ultra-Portable with Small Physical Size
- Versatile: Convert to SD Card with Adaptor
- Easy Plug and Play
- Support SD System Specification Version 2.4
- Min Data Transfer Rate of: 6MB/s for Class 10
- Lifetime Strontium Limited Warranty

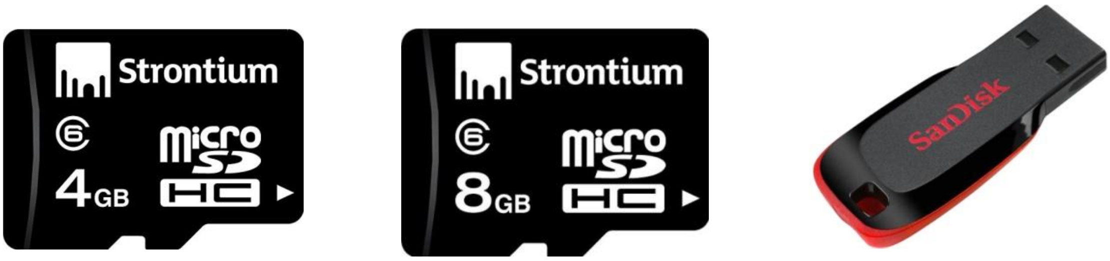


Fig 3.5 **Sandisk Cruzer Blade & strontium SD card**

3.6 RELAY

The relay used here is a PCB Power Relay; Model : HHC66A-1Z-12VDC(T73)

- Coil Voltage : DC 12V;Contact Capacity : 15A 125V AC/12V DC,10A 240V AC/28V DC
- Number of Pins : 5;Contact : SPDT
- Size (Approx.) : 1.9 x 1.4 x 2cm/0.7" x 0.6" x 0.8" (L*W*H);Color : Blue
- Weight : 41g;Package Content : 5 x PCB Power Relays

Fig 3.6 **Sugar cube relay**

- It is a 5 pin, SPDT type, PCB mount relay.
- Can adjust automatically, protect and transform the electric circuit.
- Used widely in the remote control, communication, automatic control system, electronic equipment, etc.

3.7 TWO CHANNEL RELAY

Mechanical life: >=1000 million times

Resistance (+/- 10%): 275 ohm

Coil power: 530mW

Rated Voltage: DC 12V

Fig 3.7 **Two channel relay**

Pull-in voltage: DC 9V

Release Voltage: DC 1.8V

Working temperature: -40'C~+70'C

Insulation resistance: >=1000M ohm

Coil and contact voltage: AC 5000V / 1 minute

Contacts and contact voltage: AC 1000V / 1 minute

3.8 LM2596 LOW RIPPLE DC CONVERTER STEP DOWN POWER

Fig 3.8 **Buck converter**

This LM2596 is a voltage switching regulator providing capable of driving a 2A (max.3A) load with excellent line and lad regulation. A assemble circuit with minimum components provides simple various output controlling with internal frequency compensation and a fixed-frequencyoscillator.

- This DC to DC Step-Down Adjustable Power Supply Module is based on the LM2596 switching regulator
- Input voltage: 4-40V
- Output Voltage: 1.5-35V (adjustable)
- Conversion efficiency: Up to 92% (the higher the voltage, the higher the efficiency)
- Compatible Devices:- Arduino UNO R3, Raspberry Pi, Arduino Mega, Arduino nano, Breadboard power
- Output current: Rated current 2A maximum 3A (Additional heat sink is required)
- Conversion efficiency: Up to 92% (O/P voltage higher the higher the efficiency)
- Potentiomenter adjustment direction: Clockwise (increase) Anti-clockwise (decrease)
- Switching Frequency: 150KHz
- Rectifier: Non-Synchronous Rectification
- **Module Properties**: Non-isolated step-down module (buck)
- Short circuit protection

3.9 DS3231 RTC AND EEPROM MODULE

PRODUCT DESCRIPTION

This is a module made using DS3231 RTC and AT24C32 EEPROM. DS3231 is an extremely accurate, low cost I2C RTC with integrated temperature compensated crystal oscillator. It also has a built in comparator which monitors the status of VCC to detect power failures and to automatically switch to backup power supply. It is extremely accurate when compared to commonly used DS1307 RTC. AT24C32 provides 32,768 bits of serial EEPROM organized as 4096 words of 8 bits each. This gives you 32Kb of non-volatile memory for your projects. This module can be easily interfaced with Arduino Boards, Raspberry Pi and all Microcontrollers.

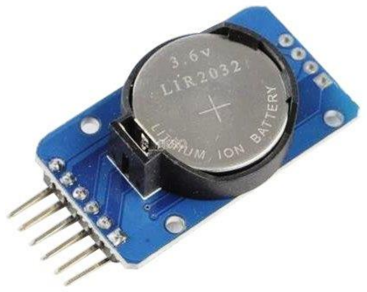


Fig 3.9 **RTC**

FEATURES

- Low Cost
- Extremely Accurate Real Time Clock (RTC)
- Temperature Compensated Crystal Oscillator
- 32Kb EEPROM
- Low Power Consumption
- Battery Backup (battery not included)
- I2C (IIC – Inter-Integrated Circuit) Interface
- Programmable Square Wave Output
- RTC counts Seconds, Minutes, Hours, Day, Date, Month and Year with Leap Year compensation up to 2100
- EEPROM Data Retention up to 100 years
- Two programmable Time-of-Day Alarms

SPECIFICATIONS

- Input Voltage Range : 3.3 ~ 5.5V
- Fast 400KHz I2C Interface

MICROCONTROLLER:

A microcontroller (or MCU for microcontroller unit) is a small computer on a single integrated circuit. In modern terminology, it is a System on a chip or SoC. A microcontroller contains one or more CPUs (processor cores) along with memory and programmable input/output peripherals. Program memory in the form of Ferroelectric RAM, NOR flash or OTP ROM is also often included on chip, as well as a small amount of RAM. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general purpose applications consisting of various discrete chips.

Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, implantable medical devices, remote controls, office machines, appliances, power tools, toys and other embedded systems. By reducing the size and cost compared to a design that uses a separate microprocessor, memory, and input/output devices, microcontrollers make it economical to digitally control even more devices and processes. Mixed signal microcontrollers are common, integrating analog components needed to control non-digital electronic systems.

Some microcontrollers may use four-bit words and operate at frequencies as low as 4 kHz, for low power consumption (single-digit milliwatts or microwatts). They will generally have the ability to retain functionality while waiting for an event such as a button press or other interrupt; power consumption while sleeping (CPU clock and most peripherals off) may be just nanowatts, making many of them well suited for long lasting battery applications. Other microcontrollers may serve performance-critical roles, where they may need to act more like a digital signal processor (DSP), with higher clock speeds and power consumption.

3.10 PIC16F877A

PIC (usually pronounced as "pick") is a family of microcontrollers made by Microchip Technology, derived from the PIC1650[1][2][3]originally developed by General Instrument's Microelectronics Division. The name PIC initially referred to Peripheral Interface Controller.[4][5] The first parts of the family were available in 1976; by 2013 the company had shipped more than twelve billion individual parts, used in a wide variety of embedded systems.

Early models of PIC had read-only memory (ROM) or field-programmable EPROM for program storage, some with provision for erasing memory. All current models use flash memory for program storage, and newer models allow the PIC to reprogram itself. Program memory and data memory are separated. Data memory is 8-bit, 16-bit, and, in latest models, 32-bit wide. Program instructions vary in bit-count by family of PIC, and may be 12, 14, 16, or 24 bits long. The instruction set also varies by model, with more powerful chips adding instructions for digital signal processing functions.

The hardware capabilities of PIC devices range from 6-pin SMD, 8-pin DIP chips up to 144-pin SMD chips, with discrete I/O pins, ADC and DAC modules, and communications ports such as UART, I2C, CAN, and even USB. Low-power and high-speed variations exist for many types.

The manufacturer supplies computer software for development known as MPLAB, assemblers and C/C++ compilers, and programmer/debugger hardware under the MPLAB and PICKit series. Third party and some open-source tools are also available. Some parts have in-circuit programming capability; low-cost development programmers are available as well has high-production programmers.

PIC devices are popular with both industrial developers and hobbyists due to their low cost, wide availability, large user base, extensive collection of application notes, availability of low cost or free development tools, serial programming, and re-programmable Flash-memory capability.

Fig 3.10 **PIC 16F877A microcontroller**

High-Performance, Enhanced PIC Flash Microcontroller in 40-pin PDIP

The PIC16F877A CMOS FLASH-based 8-bit microcontroller is upward compatible with the PIC16C5x, PIC12Cxxx and PIC16C7x devices. It features 200 ns instruction execution, 256 bytes of EEPROM data memory, self programming, an ICD, 2 Comparators, 8 channels of 10-bit Analog-to-Digital (A/D) converter, 2 capture/compare/PWM functions, a synchronous serial port that can be configured as either 3-wire SPI or 2-wire I2C bus, a USART, and a Parallel Slave Port.

FEATURES

High-Performance RISC CPU

- Lead-free; RoHS-compliant
- Operating speed: 20 MHz, 200 ns instruction cycle
- Operating voltage: 4.0-5.5V
- Industrial temperature range (-40° to +85°C)
- 15 Interrupt Sources
- 35 single-word instructions
- All single-cycle instructions except for program branches (two-cycle)

Special Microcontroller Features

- Flash Memory: 14.3 Kbytes (8192 words)
- Data SRAM: 368 bytes
- Data EEPROM: 256 bytes
- Self-reprogrammable under software control
- In-Circuit Serial Programming via two pins (5V)
- Watchdog Timer with on-chip RC oscillator
- Programmable code protection
- Power-saving Sleep mode
- Selectable oscillator options
- In-Circuit Debug via two pins

Peripheral Features

- 33 I/O pins; 5 I/O ports
- Timer0: 8-bit timer/counter with 8-bit prescaler
- Timer1: 16-bit timer/counter with prescaler
    - Can be incremented during Sleep via external crystal/clock
- Timer2: 8-bit timer/counter with 8-bit period register, prescaler and postscaler
- Two Capture, Compare, PWM modules
    - 16-bit Capture input; max resolution 12.5 ns
    - 16-bit Compare; max resolution 200 ns
    - 10-bit PWM
- Synchronous Serial Port with two modes:
    - SPI Master
    - I2C Master and Slave
- USART/SCI with 9-bit address detection
- Parallel Slave Port (PSP)
    - 8 bits wide with external RD, WR and CS controls
- Brown-out detection circuitry for Brown-Out Reset

Analog Features

- 10-bit, 8-channel A/D Converter
- Brown-Out Reset
- Analog Comparator module
    - 2 analog comparators
    - Programmable on-chip voltage reference module
    - Programmable input multiplexing from device inputs and internal VREF
    - Comparator outputs are externally accessible

3.11 USB 2.0 VIRTUAL 7.1 CHANNEL AUDIO 3D SOUND CARD CAR KIT ADAPTER WITH CABLE FOR NOTEBOOK LAPTOP PC

A sound card (also known as an audio card) is an internal expansion card that provides input and output of audio signals to and from a computer under control of computer programs. The term sound card is also applied to external audio interfaces used for professional audio applications. Typical uses of sound cards include providing the audio component for multimedia applications such as music composition, editing video or audio, presentation, education and entertainment (games) and video projection.

Sound functionality can also be integrated onto the motherboard, using components similar to those found on plug-in cards. The integrated sound system is often still referred to as a sound card. Sound processing hardware is also present on modern video cards with HDMI to output sound along with the video using that connector; previously they used a SPDIF connection to the motherboard or sound card.

- No driver required, fits for Win 7 / Win 2000 / Win XP / Win 3003
- Microphone recording and Cara OK function
- Multi-channel technology, dynamic 7.1-channel sound.
- Dynamic rotating sound field.
- Free switch between headphone and speaker.
- 16 kinds of rhythm preset modes.
- 23 kinds of sound field preset modes.
- Material: Plastic, Metal
- Plug Type: USB 2.0
- Socket Type: 1 x 3.5mm Microphone Jack, 1 x 3.5mm
- Earphone Jack

Fig 3.11 **Sound card**

3.12 USB FEMALE CONNECTOR

USB, short for Universal Serial Bus, is an industry standard initially developed in the mid-1990s that defines the cables, connectors and communications protocols used in a bus for connection, communication, and power supply between computers and electronic devices.[4] It is currently developed by the USB Implementers Forum (USB IF).

USB was designed to standardize the connection of computer peripherals (including keyboards, pointing devices, digital cameras, printers, portable media players, disk drives and network adapters) to personal computers, both to communicate and to supply electric power. It has become commonplace on other devices, such as smartphones, PDAs and video game consoles.[5] USB has effectively replaced a variety of earlier interfaces, such as parallel ports, as well as separate power chargers for portable devices.

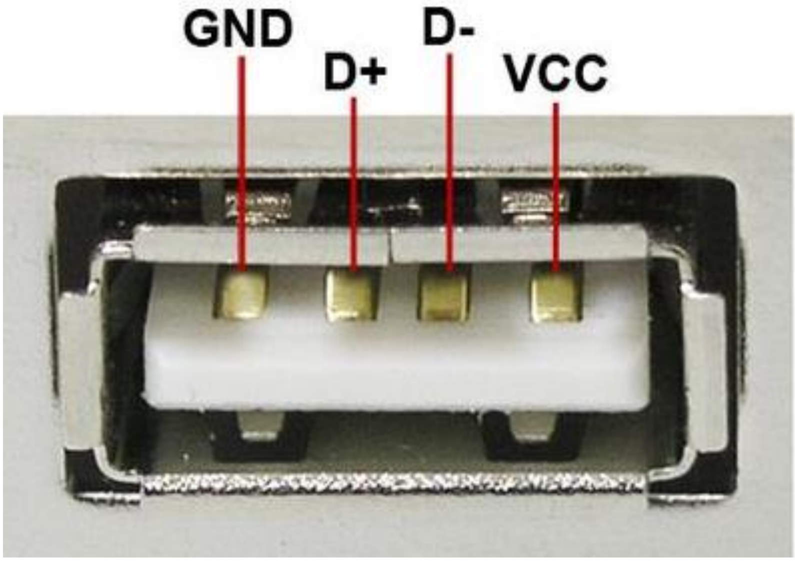


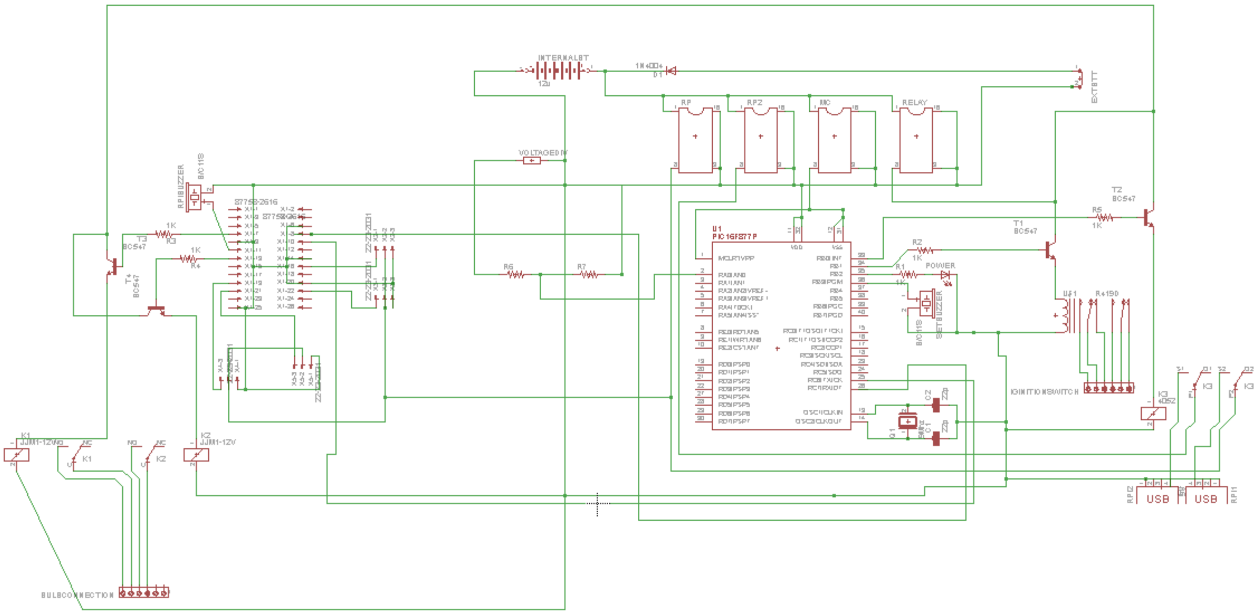
Fig3.12 **USB female connector**

- Mounting Type : Through Hole
- USB Type : Type A
- Mounting Orientation : Horizontal
- Size Class : Standard
- Contact Voltage : 30VAC
- Contact Current : 1A

CHAPTER 4

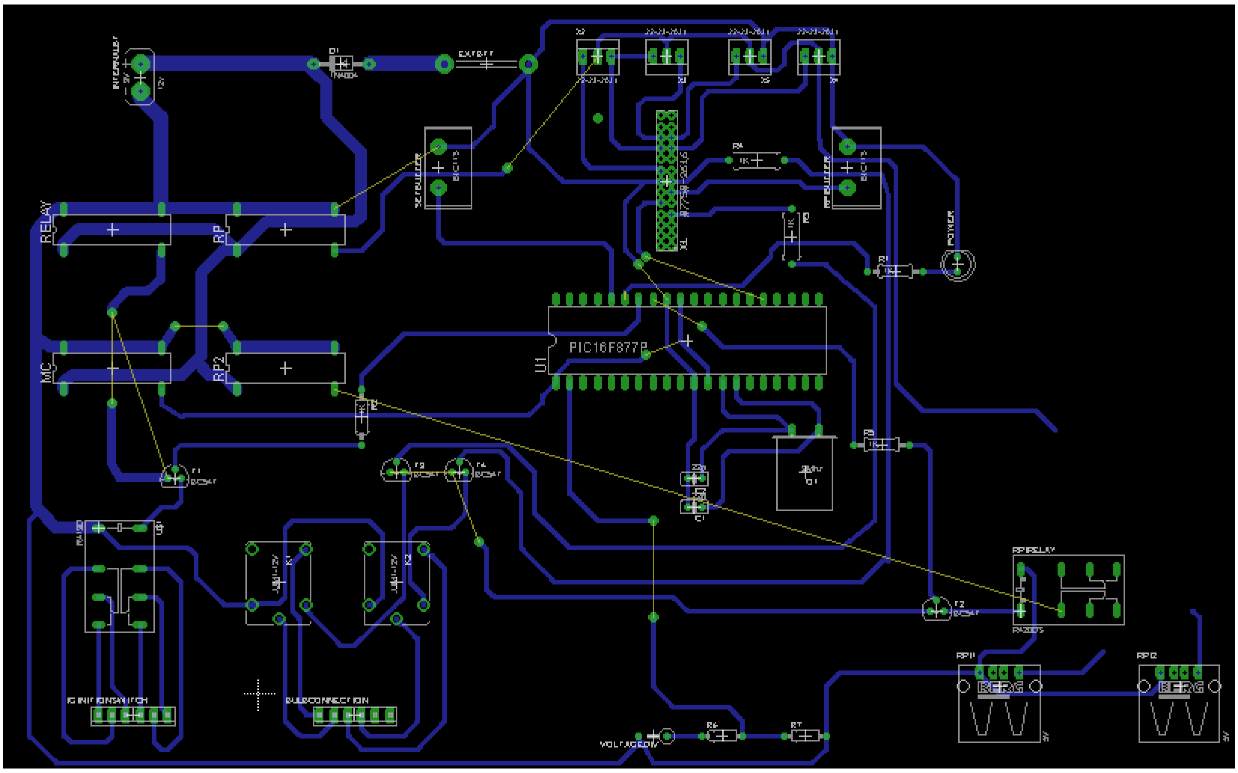
PCB DESIGNING

4.1 PCB SCHEMATIC



This schematic is drwan using a dedeicated software for PCB designing

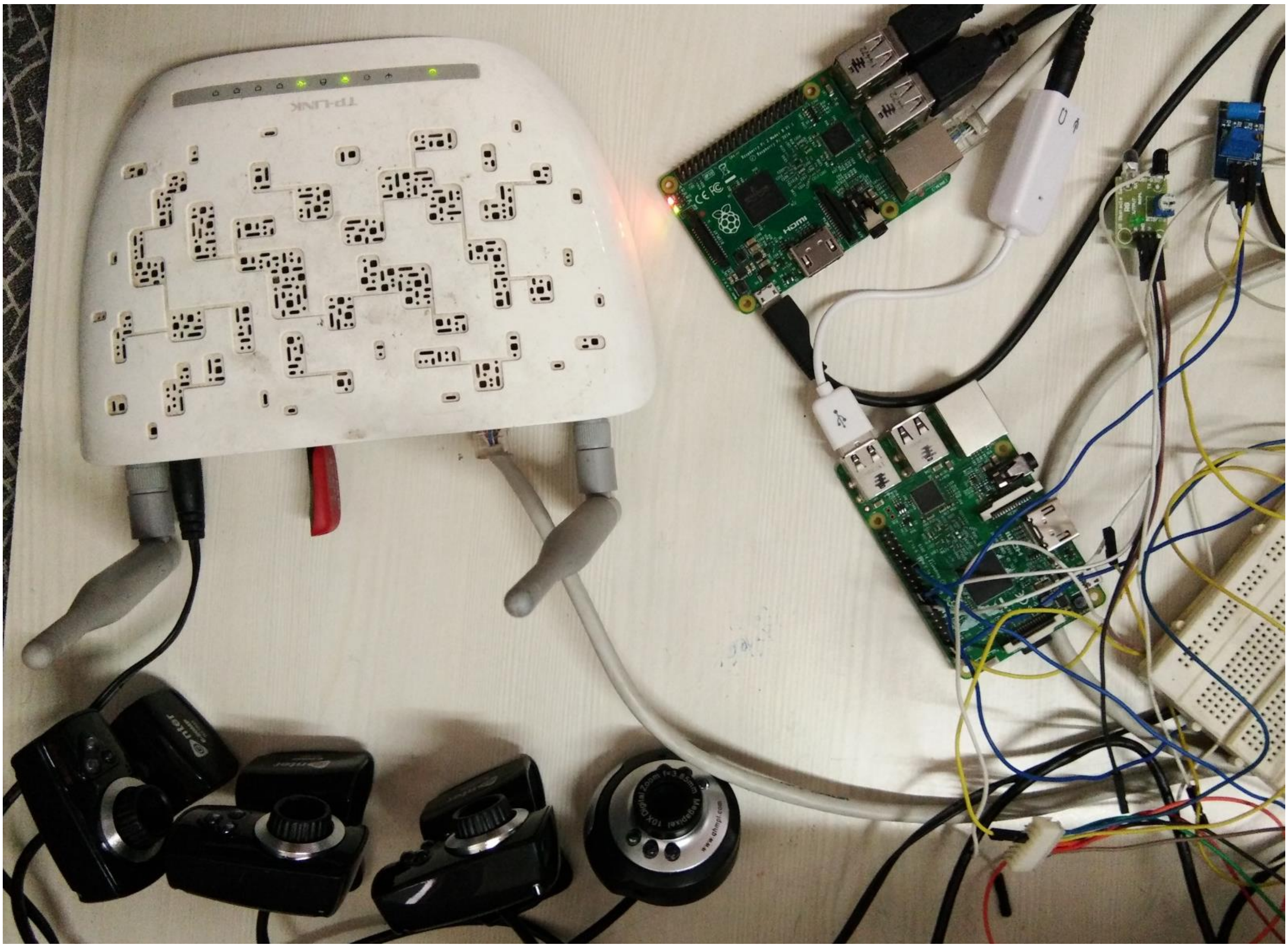
4.2 PCB LAYOUT



CHAPTER 5

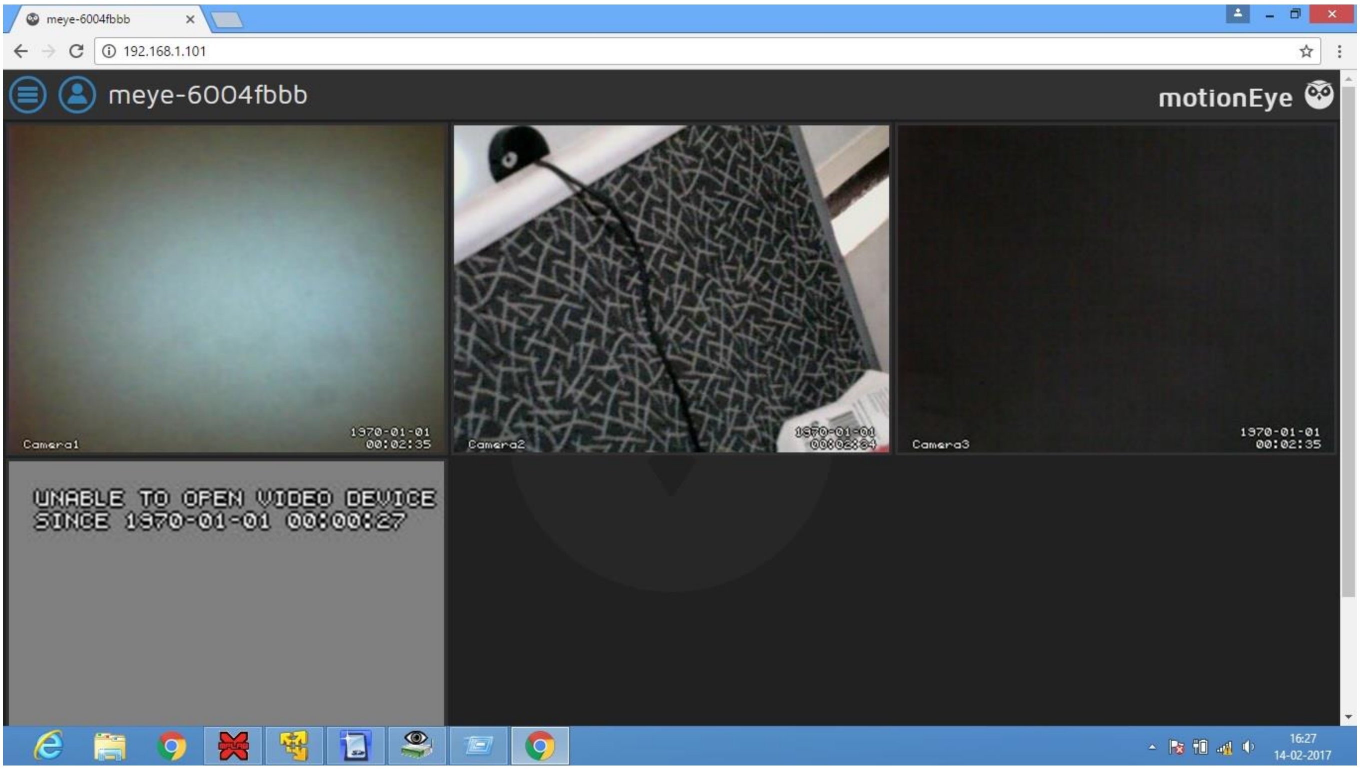
WORKING MODELS

5.1 INTERFACING SOUND CARD WITH RPI-2



The above picture shows raspberry pi – 1 to which all the four cameras are connected and raspberry pi – 2 having a sound card whose input is from one of the four cameras, that is, the one facing the driver. A router connecting the two raspberry pi's has a memory device in which the video recorded and the table created are saved.

5.2 MOTION EYE – FOUR CAMERA



The picture above shows the motion eye configuration in the network showing the live video streaming of all the four cameras. The recording time and the path to which the video should be saved can be configured

5.3 RECORDED VIDEO

5.4 RECORDED AUDIO FILE

This is the audio file recorded by the driver facing camera with the help of sound card

5.5 VIDEO FILES IN ROUTER

5.6 TABLE CREATION

SL NO	Date&Time	accelerator	brake	clutch	seatbelt	Engine Vib
1	01:07:41 03/04/17	0	0	0	HIGH	1073527
2	01:07:48 03/04/17	1	0	1	HIGH	0
3	01:07:49 03/04/17	0	1	0	HIGH	0
4	01:07:50 03/04/17	0	0	1	HIGH	0
5	01:07:51 03/04/17	0	0	1	HIGH	0
6	01:07:52 03/04/17	0	0	1	HIGH	0
7	01:07:53 03/04/17	1	0	0	HIGH	0
8	01:07:54 03/04/17	1	0	0	HIGH	955
9	01:07:55 03/04/17	1	0	0	HIGH	15405
10	01:07:58 03/04/17	1	0	0	HIGH	0

The outcome of the black box is the table created in the memory device connected to the router. Value 1 in the accelerator, brake and clutch means that these are pressed and value 0 for not pressed. HIGH in the seatbelt column indicates that the seatbelt have been worn by the driver. The vibration sensor column has analog values from it. The date and time column shows the time at which the data is recorded. For instance, from the :ninth row of the table, at time 01 hours 07 minutes 55 seconds on March 4th 2017, seatbelt has been worn, accelerator being pressed, the vibration sensor

CHAPTER 6

CONCLUSION

The proposed system would is an effective model that would help to generate the report of accident and about its causes. This model is user friendly to the analyser since the table created would be helpful in constructing the events before the accident. This model can be implemented in any vehicle. As soon as the driver starts the vehicle, the system will begin to collect the data from all the sensors and stores it in memory connected to the router with date and time in table format. The data saved can be retrieved after the accident for further investigation. A table is created once every 15 minutes and the blackbox is designed to have a backup of an hour.

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Thank You