

DESIGN AND IMPLEMENTATION OF AN IOT BASED AUTOMATED AGRICULTURAL MONITORING AND CONTROL SYSTEM

Submitted in partial fulfillment of the requirements for the award of
Bachelor Degree in Computer Science

By

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SCHOOL OF COMPUTING**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
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APRIL 2021



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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **Ronald.F (Reg.No:38290073)** and **Rohit Kumar Singh (Reg.No:38290071)** who carried out the project entitled “**DESIGN AND IMPLEMENTATION OF AN IOT BASED AUTOMATED AGRICULTURAL MONITORING AND CONTROL SYSTEM**” under our supervision from November 2020 to April 2021.

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I, **Ronald.F (Reg.No:38290073) and Rohit Kumar Singh (Reg.No:38290071)** hereby declare that the project Report on “**DESIGN AND IMPLEMENTATION OF AN IOT BASED AUTOMATED AGRICULTURAL MONITORING AND CONTROL SYSTEM**” done by me under the guidance of **Dr. J. ALBERT MAYAN Ph.D.**, at Sathyabama Institute of Science and Technology is submitted in partial fulfillment of the requirements for the award of Bachelor degree in Computer Science.

DATE:

PLACE:CHENNAI

SIGNATURE OF THE CANDIDATE

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TABLE OF CONTENTS

CHAPTER NO.	TITLE	PAGE NO.
	ABSTRACT	i
	LIST OF FIGURES	ii
	LIST OF TABLES	iii
1	INTRODUCTION	1
2	LITERATURE SURVEY	2
3	METHODOLOGY	7
	3.1 SYSTEM ANALYSIS	7
	3.1.1 WATERFALL MODEL	8
	3.1.2 RAD MODEL	9
	3.1.3 EXISITING SYSTEM	12
	3.1.4 PROPOSED SYSTEM	13
	3.2 LANGUAGE DESCRIPTION	16
	3.2.1 PYTHON LINE STRUCTURE	17
	3.2.2 PYTHON DATATYPES	20
	3.2.3 SELECTION OF REQUIREMENTS	21
	3.2.4 MACHINE LEARNING	27
	3.3 TESTING	29
4	RESULTS AND DISCUSSION	35
5	CONCLUSION AND FUTURE WORK	38
	5.1 CONCLUSION	38
	REFERENCES	39
	APPENDIX	40
	A. SOURCE CODE	40
	B. SCREEN SHOT	46
	C. PAPER WORK	47

ABSTRACT

Agriculture is the basic source of food supply for all countries in the world. Water is the Essential resources for agriculture. The automated irrigation and crop field monitoring system is used to optimize the use of water resource for agriculture. The system consists of sensor network for humidity, temperature, soil moisture, colour and water level sensors. soil moisture, temperature, water level ,colour sensor are placed in the root zone of the crops. The microcontroller of the controller unit is programmed with threshold values of the temperature and moisture content. The controller unit is used to control the irrigation motor thereby controlling the water flow to the field. In addition to that water level sensor is placed in this field, if it is excess water the motor gets automatically pumps the water into the outer area. Microcontroller is used in the controller mode. Internet of the things(IOT) is an ecosystem of connected physical objects that are accessible through the internet. Real time monitoring data can be utilized and the performance can be tracked. Hence high yield can be achieved. This project is mainly focused on improving the agricultural fields yield by providing a monitoring system with effective and efficient usage of water resource. Thus further development in this project will lead to a greater efficiency in the field of agriculture.

LIST OF FIGURES

FIGURE No.	FIGURE NAME	PAGE No.
3.1	WATERFALL MODEL	8
3.2	RAD MODEL	10
3.3	ARCHITECTURE DIAGRAM	14
3.4	MODULES	15
3.5	USECASE MODEL	15
3.8	PYTHON STRUCTURE	16
3.7	PYTHON LIBRARIES	16
3.9	UNIT TESTING	33
3.10	TESTING	35

LIST OF TABLES

TABLE NO	TABLE NAME	PAGENO
2.1	Literature Survey 1	2
2.2	Literature Survey 2	3
2.3	Literature Survey 3	4
2.4	Literature Survey 4	5
2.5	Literature Survey 5	6

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Agriculture is one of the most important components of our society. Farmers produce a food every day. Water is the critical part of successful agriculture. Technology has played a big role in developing agriculture. Agriculture sector uses maximum water in world. Indian economy mainly based on agriculture field and water is vanishing day by day due to its immense use. Irrigation is one solution to this problem because in drip irrigation water is supplied to plants. Irrigation saves a large amount of water. Water feeding to the agricultural field has to be done regularly with continuous monitoring. Manual irrigation is traditional method in the world for water supply in agriculture form. So it is hard to take decision to save water and get maximum profit from field. For sensor based networks are making huge process in agriculture and networks, varieties of terminologies now in use like Precision Agriculture, crop monitoring, automated irrigation system etc.

Agriculture in India has a significant history. India is ranking second in farm output. monitoring and controlling the agriculture is an important task for the farmers as they have to regularly feed water days and nights. Sensors are used to collect the data from environment like soil moisture, temperature, humidity, water level, colour etc. Different communication technology has been developed for communication between network and element.

CHAPTER 2

EXISTING SYSTEM

In an existing automated water management system we cannot take decision at that instance by taking different attribute of agriculture soil. Current automated irrigation system only works on one parameter at one time. Soil have different attribute like soil moisture and temperature, humidity etc. Soil moisture is below threshold value then water valve is open for water supply and after proper water supply if it goes above threshold value water valve is get close. Existing system does not concern about available water in reservoir and requirement of water to particular crop. So system does not have decision power. It only works on one condition at one time. In the system send the information about the growth of paddy plant and sugarcane in the field. The data are send details about the every stage in the plant growth in the field.

DISADVANTAGE

- Existing system does not concern about available water in reservoir and requirement of water to particular crop.
- It only works on one condition at one time.

CHAPTER 4

PROPOSED SYSTEM

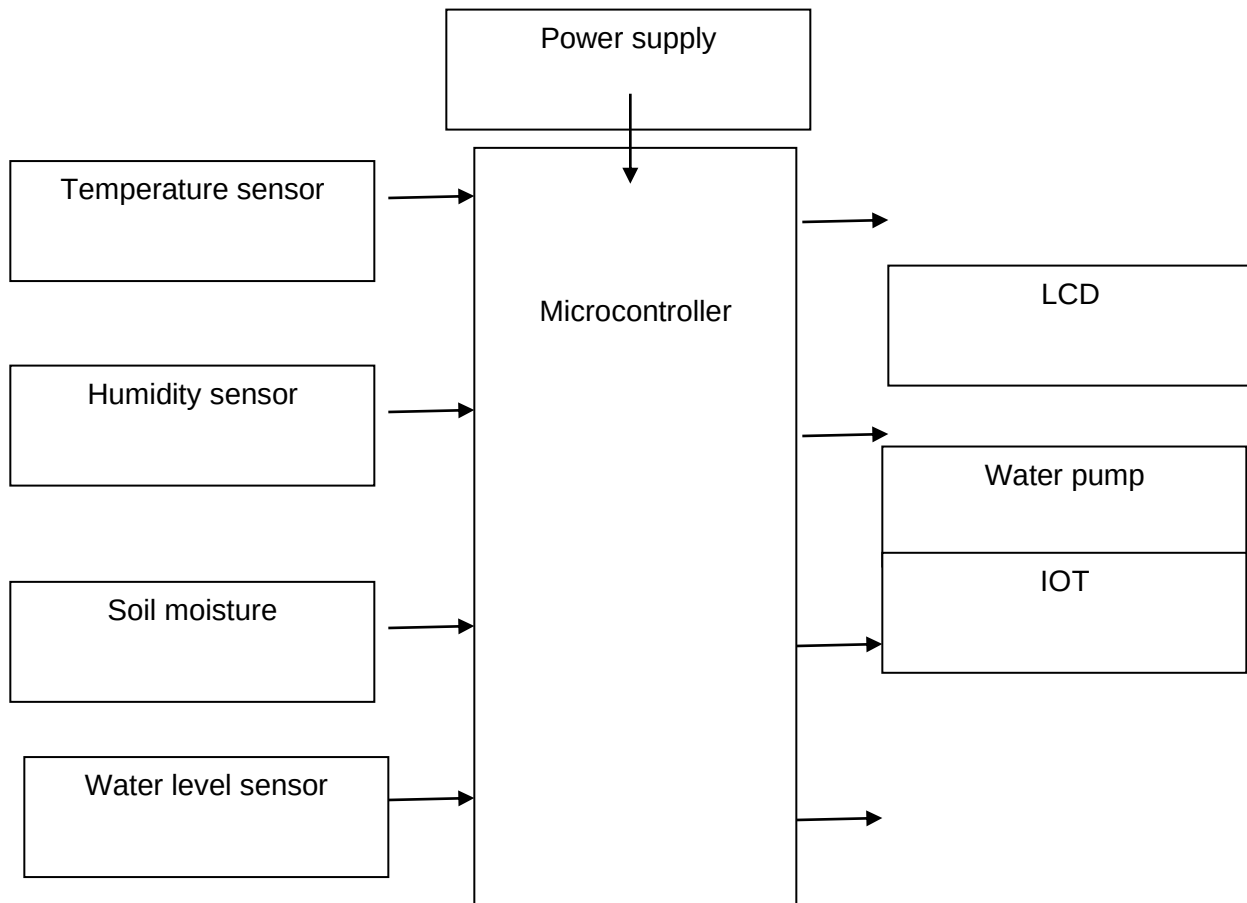
In this work, the automated irrigation system based on low power microcontroller was developed and deployed. To overcome the drawbacks of existing system like high cost, difficult in maintenance and wired connection, we introduce a new system which will have wireless connection between server and nodes. We introduce a new design of embedded web server making use of microcontroller technology and internet of things. The automated irrigation system consists of distributed sensor network built using soil moisture sensor, temperature sensor, humidity sensor and water level sensor. Water level sensor senses the excess water in the field and the motor automatically pumps the water to the outer area. Irrigation system uses valves to turn irrigation ON and OFF. Earlier, farmer faced the problem of sending SMS and making calls, overcoming which we are designing a desired application which does the work by button clicks, here the hardware works in three modes of operation viz.

ADVANTAGE

- We can sense the level of the soil, temperature and water.
- It is full of automated system.

CHAPTER 5

5.1 BLOCK DIAGRAM



5.2 HARDWARE REQUIREMENTS

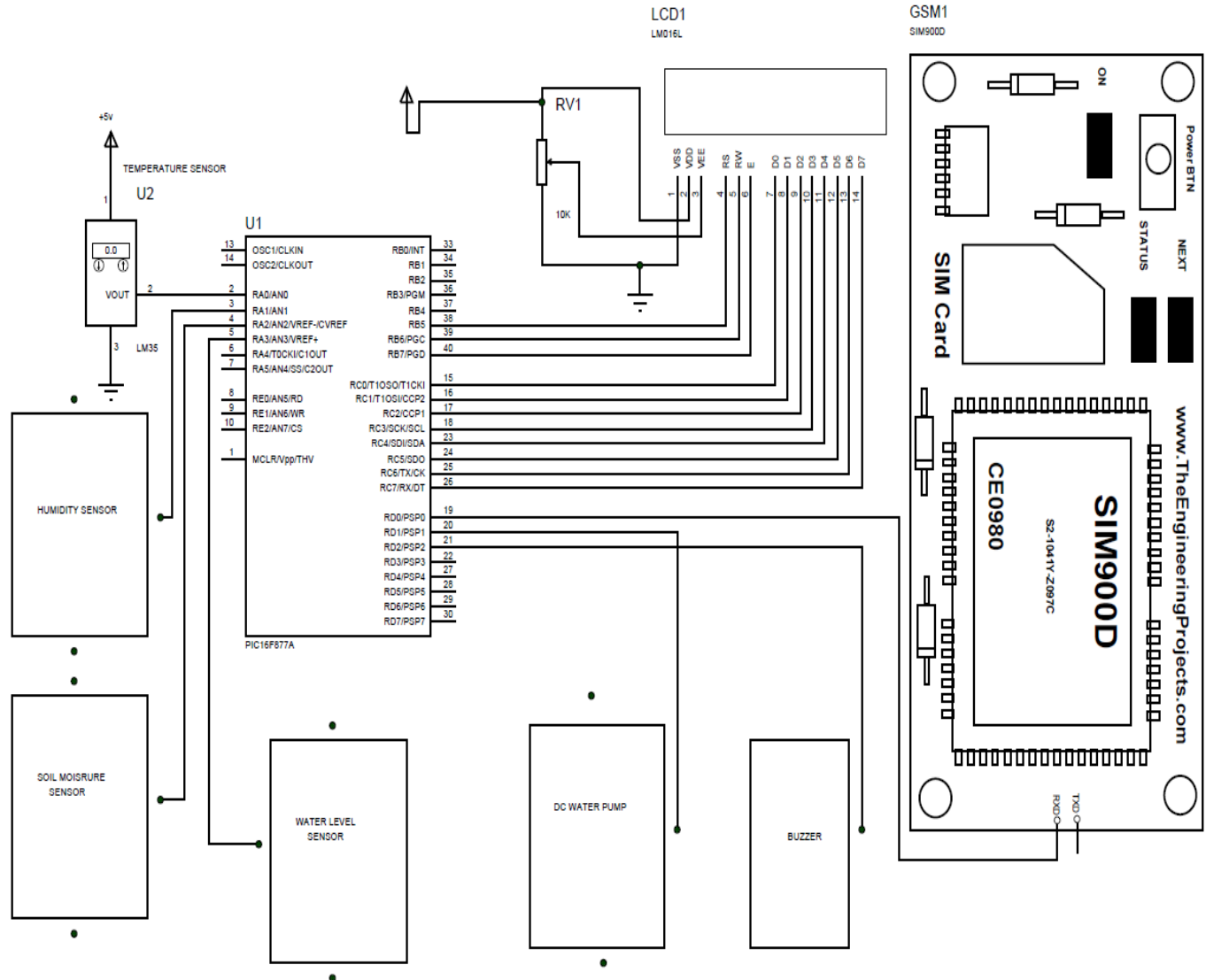
- Power supply.
- Microcontroller.
- Temperature sensor.
- Humidity sensor. / Soil moisture
- Water level sensor
- Buzzer
- Water pump

5.3 SOFTWARE REQUIREMENTS

- MPLAB-IDE.
- EMBEDDED C.

CHAPTER 6

6.1 CIRCUIT DIAGRAM



6.2 EXPLANATION

The automated irrigation and crop field monitoring system is used to optimize the use of water resource for agriculture. The system consists of sensor network for humidity, temperature, soil moisture, and water level sensors. soil moisture, temperature, water level sensor are placed in the root zone of the crops. The microcontroller of the controller unit is programmed with threshold values of the temperature and moisture content. The controller unit is used to control the irrigation motor thereby controlling the water flow to the field. In addition

to that water level sensor is placed in this field, if it is excess water the motor gets automatically pumps the water into the outer area. Real time monitoring data can be utilized and the performance can be tracked. Hence high yield can be achieved. This project is mainly focused on improving the agricultural fields yield by providing a monitoring system with effective and efficient usage of water resource.

CHAPTER 7

HARDWARE DESCRIPTION

7.1 PIC MICROCONTROLLER

The PIC microcontroller used here is 16F877A. This performs the key role of processing the received data from the sensors and transmitting them to the Li-Fi module. The advantage of microcontroller such as low power consumption and flexibility to connect other devices makes it as the best choice among other processors. The features of this microcontroller include the following.

- RISC architecture
- Operating frequency 0-20 MHz
- Power supply voltage 2.0-5.5V
- 8K ROM memory in FLASH technology
- 256 bytes EEPROM memory
- 368 bytes RAM memory
- A/D converter:
 - 14-channels
 - 10-bit resolution
- 3 independent timers/counters
- Watch-dog timer

PIC (usually pronounced as "pick") is a family of microcontrollers made by Microchip Technology, derived from the PIC1650 originally developed by General Instrument's Microelectronics Division. The name PIC initially referred to Peripheral Interface Controller and is currently expanded as Programmable Intelligent Computer. 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 X, 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 as 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, and availability of low cost or free development tools, serial programming, and re-programmable flash-memory capability.

7.2 FEATURES

7.2.1 High-Performance RISC CPU

- Only 35 single-word instructions to learn
- All single-cycle instructions except for program branches, which are two-cycle
- Operating speed: DC – 20 MHz clock input DC – 200 ns instruction cycle
- Up to 8K x 14 words of Flash Program Memory, Up to 368 x 8 bytes of Data Memory (RAM), Up to 256 x 8 bytes of EEPROM Data Memory
- Pin out compatible to other 28-pin or 40/44-pin
- PIC16CXXX and PIC16FXXX microcontrollers

7.2.2 Peripheral Features

- 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
 - Capture is 16-bit, max. resolution is 12.5 ns
 - Compare is 16-bit, max. resolution is 200 ns
- PWM max. resolution is 10-bit
- Synchronous Serial Port (SSP) with SPI™ (Master mode) and I2C™ (Master/Slave)
- Universal Synchronous Asynchronous Receiver Transmitter (USART/SCI) with 9-bit address detection
- Parallel Slave Port (PSP) – 8 bits wide with external RD, WR and CS controls (40/44-pin only)
- Brown-out detection circuitry for Brown-out Reset (BOR)

7.2.3 Analog Features

- 10-bit, up to 8-channel Analog-to-Digital Converter (A/D)
- Brown-out Reset (BOR)
- Analog Comparator module with:
 - Two analog comparators
 - Programmable on-chip voltage reference (VREF) module

- Programmable input multiplexing from device inputs and internal voltage reference
- Comparator outputs are externally accessible

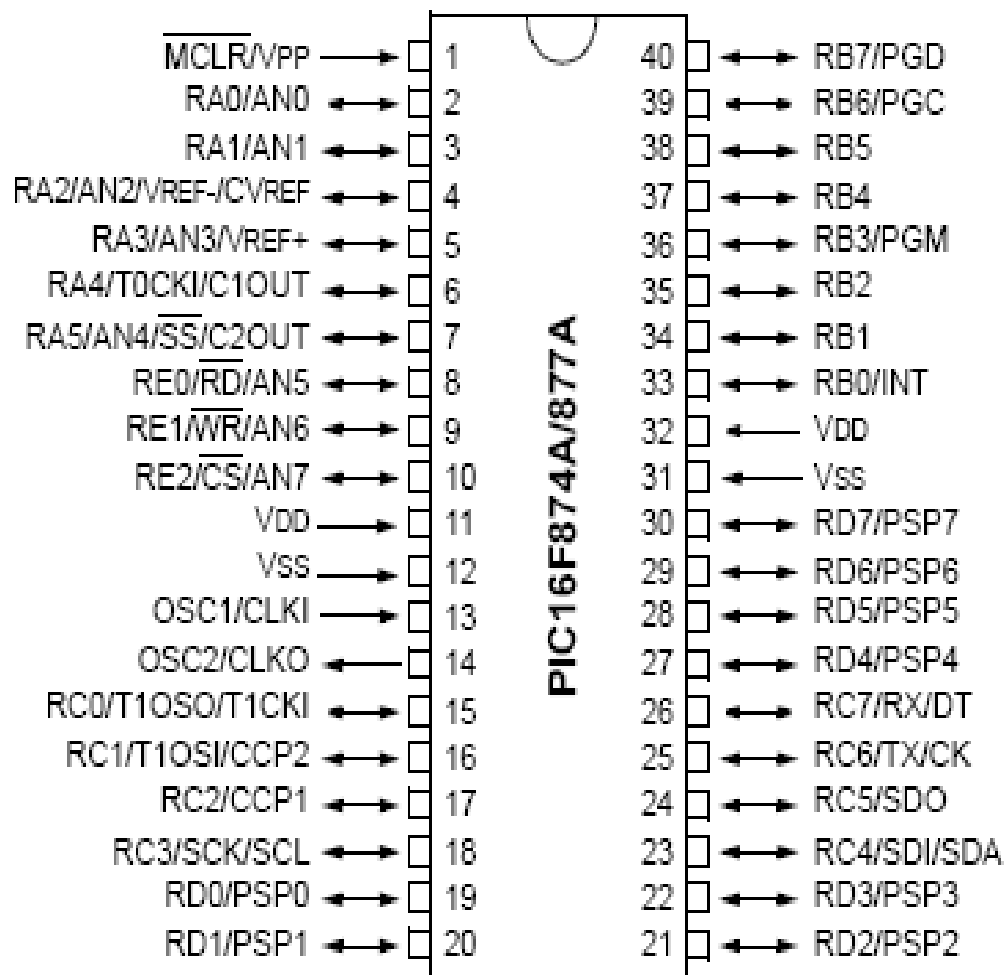
7.2.4 Special Microcontroller Features

- 100,000 erase/write cycle Enhanced Flash program memory typical
- 1,000,000 erase/write cycle Data EEPROM memory typical
- Data EEPROM Retention > 40 years
- Self-reprogrammable under software control
- In-Circuit Serial Programming™ (ICSP™) via two pins
- Single-supply 5V In-Circuit Serial Programming
- Watchdog Timer (WDT) with its own on-chip RC oscillator for reliable operation
- Programmable code protection
- Power saving Sleep mode
- Selectable oscillator options
- In-Circuit Debug (ICD) via two pins

7.2.5 CMOS Technology

- Low-power, high-speed Flash/EEPROM technology
- Fully static design
- Wide operating voltage range (2.0V to 5.5V)
- Commercial and Industrial temperature ranges
- Low-power consumption

7.2.6 Pin Diagram



7.2.7 DEVICE OVERVIEW:

This document contains device specific information about the following devices:

- PIC16F873A
- PIC16F874A
- PIC16F876A
- PIC16F877A

PIC16F873A/876A devices are available only in 28-pin packages, while PIC16F874A/877A devices are available in 40-pin and 44-pin packages. All devices in the PIC16F87XA family share common architecture with the following differences:

- The PIC16F873A and PIC16F874A have one-half of the total on-chip memory of the PIC16F876A and PIC16F877A
- The 28-pin devices have three I/O ports, while the 40/44-pin devices have five
- The 28-pin devices have fourteen interrupts, while the 40/44-pin devices have fifteen
- The 28-pin devices have five A/D input channels, while the 40/44-pin devices have eight
- The Parallel Slave Port is implemented only on the 40/44-pin devices

The available features are summarized in Table 1-1. Block diagrams of the PIC16F873A/876A and PIC16F874A/877A devices are provided in Figure 1-1 and Figure 1-2, respectively. The pin outs for these device families are listed in Table 1-2 and Table 1-3. Additional information may be found in the PICmicro® Mid-Range Reference Manual (DS33023), which may be obtained from your local Microchip Sales Representative or downloaded from the Microchip web site. The Reference Manual should be considered a complementary document to this data sheet and is highly recommended reading for a better understanding of the device architecture and operation of the peripheral modules.

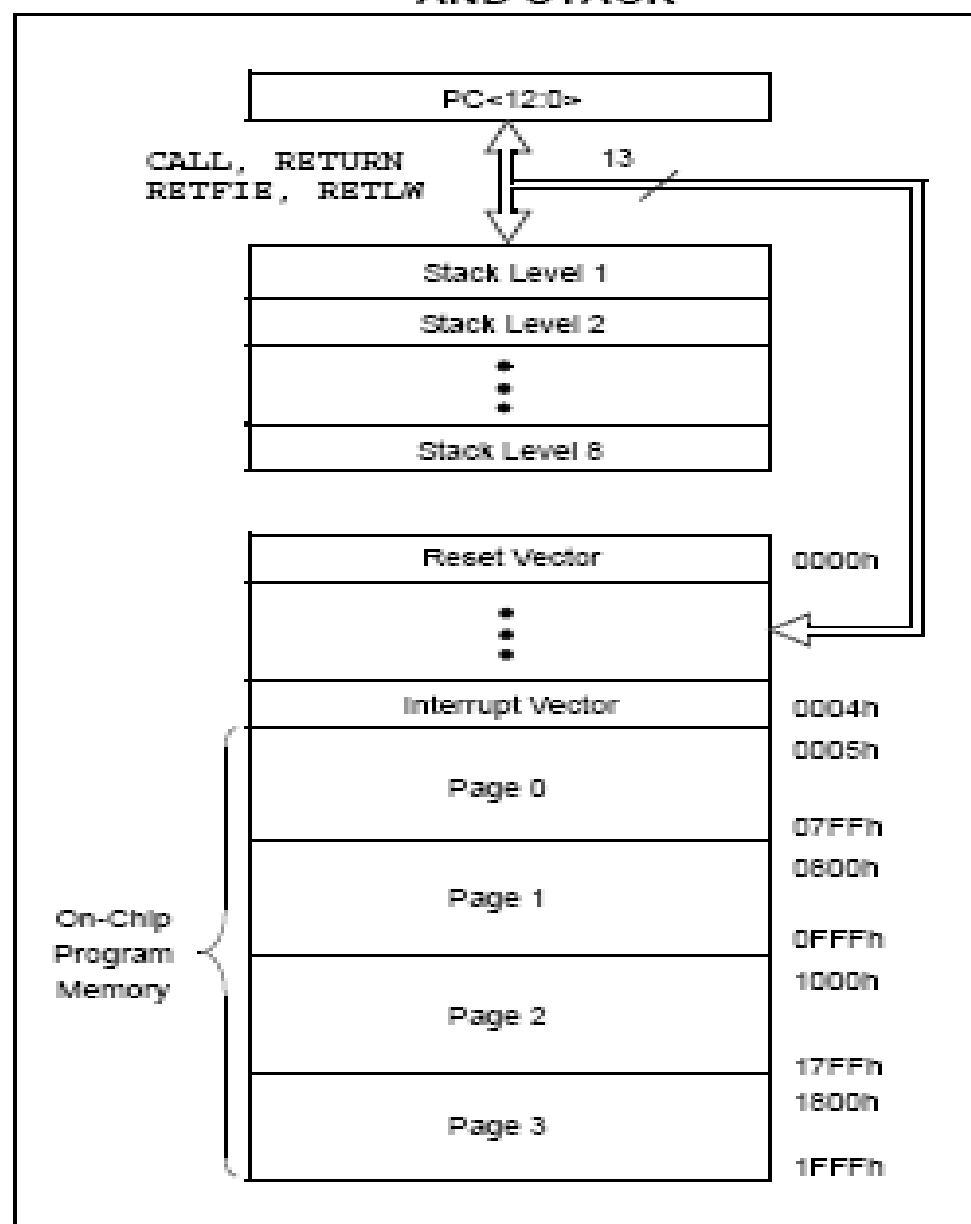
7.2.8 Memory Organization

There are three memory blocks in each of the PIC16F87XA devices. The program memory and data memory have separate buses so that concurrent access can occur and is detailed in this section. The EEPROM data memory block is detailed in **Section 3.0 “Data EEPROM and Flash Program Memory”**. Additional information on device memory may be found in the PICmicro® Mid-Range MCU Family Reference Manual (DS33023).

7.2.9 Program Memory Organization

The PIC16F87XA devices have a 13-bit program counter capable of addressing an 8K word x 14 bit program memory space. The PIC16F876A/877A devices have 8K words x 14 bits of Flash program memory, while PIC16F873A/874A devices have 4K words x 14 bits. Accessing a location above the physically implemented address will cause a wraparound. The Reset vector is at 0000h and the interrupt vector is at 0004h.

PROGRAM MEMORY MAP AND STACK



7.2.10 Data Memory Organization

The data memory is partitioned into multiple banks which contain the General Purpose Registers and the Special Function Registers. Bits RP1 (Status<6>) and RP0 (Status<5>) are the bank select bits. Each bank extends up to 7Fh (128 bytes). The lower locations of each bank are reserved for the Special Function Registers. Above the Special Function Registers are General Purpose Registers, implemented as static RAM. All implemented banks contain Special Function Registers. Some frequently used Special

Function Registers from one bank may be mirrored in another bank for code reduction and quicker access.

7.2.11 I/O PORTS

Some pins for these I/O ports are multiplexed with an alternate function for the peripheral features on the device. In general, when a peripheral is enabled, that pin may not be used as a general purpose I/O pin. Additional information on I/O ports may be found in the PICmicro™ Mid-Range Reference Manual (DS33023).

7.2.12 PORTA and the TRISA Register:

PORTA is a 6-bit wide, bidirectional port. The corresponding data direction register is TRISA. Setting a TRISA bit (= 1) will make the corresponding PORTA pin an input (i.e., put the corresponding output driver in a High-Impedance mode). Clearing a TRISA bit (= 0) will make the corresponding PORTA pin an output (i.e., put the contents of the output latch on the selected pin). Reading the PORTA register reads the status of the pins, whereas writing to it will write to the port latch. All write operations are read-modify-write operations. Therefore, a write to a port implies that the port pins are read; the value is modified and then written to the port data latch. Pin RA4 is multiplexed with the Timer0 module clock input to become the RA4/T0CKI pin. The RA4/T0CKI pin is a Schmitt Trigger input and an open-drain output. All other PORTA pins have TTL input levels and full CMOS output drivers. Other PORTA pins are multiplexed with analog inputs and the analog VREF input for both the A/D converters and the comparators. The operation of each pin is selected by clearing/setting the appropriate control bits in the ADCON1 and/or CMCON registers. The TRISA register controls the direction of the port pins even when they are being used as analog inputs. The user must ensure the bits in the TRISA register are maintained set when using them as analog inputs.

7.2.13 PORTB and the TRISB Register

PORTB is an 8-bit wide, bidirectional port. The corresponding data direction register is TRISB. Setting a TRISB bit (= 1) will make the corresponding PORTB pin an input (i.e., put the corresponding output driver in a High-Impedance mode). Clearing a TRISB bit (= 0) will make

the corresponding PORTB pin an output (i.e., put the contents of the output latch on the selected pin). Three pins of PORTB are multiplexed with the In-Circuit Debugger and Low-Voltage Programming function: RB3/PGM, RB6/PGC and RB7/PGD. The alternate functions of these pins are described in “**Special Features of the CPU**”. Each of the PORTB pins has a weak internal pull-up. A single control bit can turn on all the pull-ups. This is performed by clearing bit RBPU (OPTION_REG<7>). The weak pull-up is automatically turned off when the port pin is configured as an output. The pull-ups are disabled on a Power-on Reset.

This interrupt can wake the device from Sleep. The user, in the Interrupt Service Routine, can clear the interrupt in the following manner:

- a) Any read or write of PORTB. This will end the mismatch condition.
- b) Clear flag bit RBIF.

A mismatch condition will continue to set flag bit RBIF. Reading PORTB will end the mismatch condition and allow flag bit RBIF to be cleared. The interrupt-on-change feature is recommended for wake-up on key depression operation and operations where PORTB is only used for the interrupt-on-change feature. Polling of PORTB is not recommended while using the interrupt-on-change feature. This interrupt-on-mismatch feature, together with software configurable pull-ups on these four pins, allow easy interface to a keypad and make it possible for wake-up on key depression.

7.2.14 PORTC and the TRISC Register

PORTC is an 8-bit wide, bidirectional port. The corresponding data direction register is TRISC. Setting a TRISC bit (= 1) will make the corresponding PORTC pin an input (i.e., put the corresponding output driver in a High-Impedance mode). Clearing a TRISC bit (= 0) will make the corresponding PORTC pin an output (i.e., put the contents of the output latch on the selected pin). PORTC is multiplexed with several peripheral functions (Table 4-5). PORTC pins have Schmitt Trigger input buffers. When the I2C module is enabled, the PORTC<4:3> pins can be configured with normal I2C levels, or with SMBus levels, by using the CKE bit (SSPSTAT<6>). When enabling peripheral functions, care should be taken in defining TRIS bits for each PORTC pin. Some peripherals override the TRIS bit to make a pin an output, while other peripherals override the TRIS bit to make a pin an input. Since the TRIS bit override is in effect while the peripheral is enabled, read-modify write instructions (BSF, BCF,

and XORWF) with TRISC as the destination, should be avoided. The user should refer to the corresponding peripheral section for the correct TRIS bit settings.

7.2.15 PORTD and TRISD Registers:

PORTD is an 8-bit port with Schmitt Trigger input buffers. Each pin is individually configurable as an input or output. PORTD can be configured as an 8-bit wide microprocessor port (Parallel Slave Port) by setting control bit, PSPMODE (TRISE<4>). In this mode, the input buffers are TTL.

7.2.16 PORTD Functions:

Name	Bit#	Buffer Type	Function
RD0/PSP0	bit 0	ST/TTL ⁽¹⁾	Input/output port pin or Parallel Slave Port bit 0.
RD1/PSP1	bit 1	ST/TTL ⁽¹⁾	Input/output port pin or Parallel Slave Port bit 1.
RD2/PSP2	bit2	ST/TTL ⁽¹⁾	Input/output port pin or Parallel Slave Port bit 2.
RD3/PSP3	bit 3	ST/TTL ⁽¹⁾	Input/output port pin or Parallel Slave Port bit 3.
RD4/PSP4	bit 4	ST/TTL ⁽¹⁾	Input/output port pin or Parallel Slave Port bit 4.
RD5/PSP5	bit 5	ST/TTL ⁽¹⁾	Input/output port pin or Parallel Slave Port bit 5.
RD6/PSP6	bit 6	ST/TTL ⁽¹⁾	Input/output port pin or Parallel Slave Port bit 6.
RD7/PSP7	bit 7	ST/TTL ⁽¹⁾	Input/output port pin or Parallel Slave Port bit 7.

7.2.17 PORTE and TRISE Register:

PORTE has three pins (RE0/RD/AN5, RE1/WR/AN6 and RE2/CS/AN7) which are individually configurable as inputs or outputs. These pins have Schmitt Trigger input buffers. The PORTE pins become the I/O control inputs for the microprocessor port when bit PSPMODE (TRISE<4>) is set. In this mode, the user must make certain that the TRISE<2:0> bits are set and that the pins are configured as digital inputs. Also, ensure that ADCON1 is configured for digital I/O. In this mode, the input buffers are TTL. Register 4-1 shows the TRISE register which also controls the Parallel Slave Port operation. PORTE pins are multiplexed with analog inputs. When selected for analog input, these pins will read as '0's. TRISE controls the direction of the RE pins, even when they are being used as analog inputs. The user must make sure to keep the pins configured as inputs when using as analog inputs.

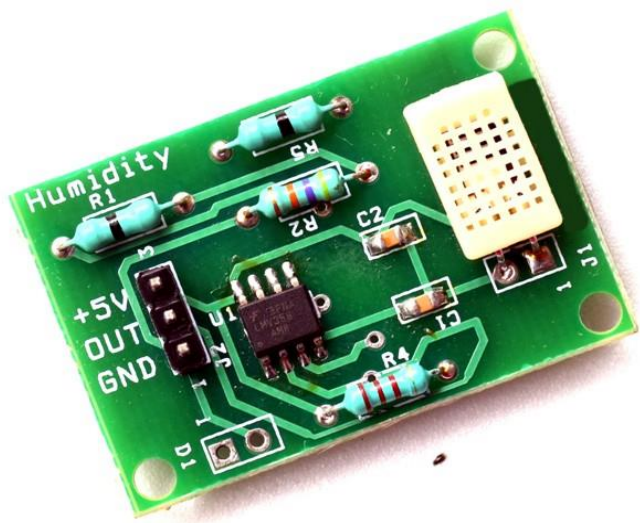
7.3 HUMIDITY SENSOR

7.3.1 GENERAL DESCRIPTION

A humidity sensor senses, measures both moisture and air temperature. The sensor is composed of two metal plates and contains a non-conductive polymer film between them. This film collects moisture from the air, which causes the voltage between the two plates to change. These voltage changes are converted into digital readings showing the level of moisture in the air.

7.3.2 PRODUCT DESCRIPTION

Humidity measurement can be done using electronic hygrometers. Electronic type hygrometers or humidity sensors can be broadly divided into two categories namely capacitive sensing effects and resistive sensing effects. Resistive type humidity sensors pick up changes in the resistance value of the sensor element in response to the change in the humidity. Thick film conductor of precious metals like gold, ruthenium oxide is printed and culminated in the shape of the comb to form an electrode. Then a polymeric film is applied on the electrode; the film acts as a humidity sensing film due to the existence of movable ions. Change in impedance occurs due to the change in the number of movable ions.



7.3.3 FEATURES

- Input Voltage: 5v
- Output: Analog (0-5v)
- High Performance
- Long Term Stability
- Close tolerances
- Low cost

7.3.4 APPLICATIONS

- Air conditioners
- Climate control for green houses
- Storage and warehouses
- Meteorological applications

7.4 LCD

16×2 LCD



7.4.1 GENERAL DESCRIPTION

LCD stands for liquid crystal display. They come in many sizes 8x1 , 8x2 , 10x2 , 16x1 , 16x2 , 16x4 , 20x2 , 20x4 , 24x2 , 30x2 , 32x2 , 40x2 etc . Many multinational companies like Philips Hitachi Panasonic make their own special kind of LCD'S to be used in their products. All the LCD'S performs the same functions (display characters numbers special characters ASCII characters etc). Their programming is also same and they all have same 14 pins (0-13) or 16 pins (0 to 15). Alphanumeric displays are used in a wide range of applications, including

palmtop computers, word processors, photocopiers, point of sale terminals, medical instruments, cellular phones, etc.

7.4.2 PRODUCT DESCRIPTION

This is an LCD Display designed for E-blocks. It is a 16 character, 2-line alphanumeric LCD display connected to a single 9-way D-type connector. This allows the device to be connected to most E-Block I/O ports. The LCD display requires data in a serial format, which is detailed in the user guide below. The display also requires a 5V power supply. Please take care not to exceed 5V, as this will cause damage to the device. The 5V is best generated from the E-blocks Multi programmer or a 5V fixed regulated power supply.

The 16 x 2 intelligent alphanumeric dot matrix displays is capable of displaying 224 different characters and symbols. A full list of the characters and symbols is printed on pages 7/8 (note these symbols can vary between brand of LCD used). This booklet provides all the technical specifications for connecting the unit, which requires a single power supply (+5V).

7.4.3 FEATURES

- Input voltage: 5v
- E-blocks compatible
- Low cost
- Compatible with most I/O ports in the E-Block range
- Ease to develop programming code using Flow code

7.5 TEMPERATURE SENSOR

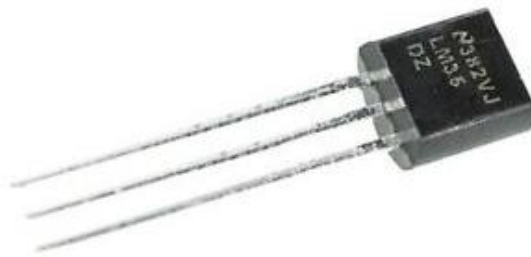
7.5.1 GENERAL DESCRIPTION

The LM35 series are precision integrated-circuit temperature devices with an output voltage linearly-proportional to the Centigrade temperature. The LM35 device has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling. The LM35 device does not require any external calibration or trimming to provide typical accuracies of $\pm 1/4^{\circ}\text{C}$ at room temperature and $\pm 3/4^{\circ}\text{C}$ over a full -55°C to 150°C temperature range. The

low-output impedance, linear output, and precise inherent calibration of the LM35 device makes interfacing to readout or control circuitry especially easy.

7.5.2 PRODUCT DESCRIPTION

LM35 is a precision IC temperature sensor with its output proportional to the temperature (in °C). The sensor circuitry is sealed and therefore it is not subjected to oxidation and other processes. With LM35, temperature can be measured more accurately than with a thermistor. It also possesses low self heating and does not cause more than 0.1 °C temperature rise in still air. The device is used with single power supplies, or with plus and minus supplies. As the LM35 device draws only 60 μ A from the supply, it has very low self-heating of less than 0.1°C in still air. The LM35 device is rated to operate over a -55°C to 150°C temperature range.



7.5.3 FEATURES

- Calibrated Directly in Celsius (Centigrade)
- Linear + 10-mV/°C Scale Factor
- 0.5°C Ensured Accuracy (at 25°C)
- Rated for Full -55°C to 150°C Range
- Suitable for Remote Applications

7.5.4 APPLICATIONS

- Power Supplies
- Battery Management
- HVAC
- Appliances

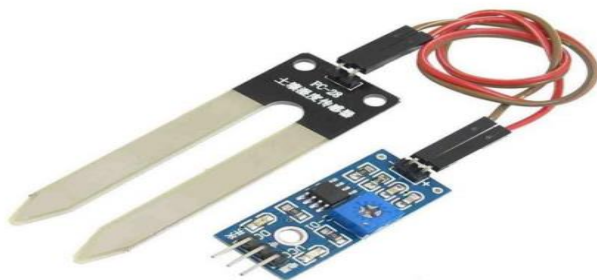
7.6 SOIL MOISTURE SENSOR

7.6.1 GENERAL DESCRIPTION

This sensor can be used to test the moisture of soil, when the soil is having water shortage, the module output is at high level, and else the output is at low level. By using this sensor one can automatically water the flower plant, or any other plants requiring automatic watering technique. Module dual output mode, digital output is simple, analog output more accurate. Soil moisture sensors measure the volumetric water content indirectly by using some other property of the soil, such as electrical resistance, dielectric constant, or interaction with neutrons, as a proxy for the moisture content.

7.6.2 PRODUCT DESCRIPTION

Soil moisture sensors measure the volumetric water content in soil. Since the direct gravimetric measurement of free soil moisture requires removing, drying, and weighting of a sample, soil moisture sensors measure the volumetric water content indirectly by using some other property of the soil, such as electrical resistance, dielectric constant, or interaction with neutrons, as a proxy for the moisture content. The relation between the measured property and soil moisture must be calibrated and may vary depending on environmental factors such as soil type, temperature, or electric conductivity. Reflected microwave radiation is affected by the soil moisture and is used for remote sensing in hydrology and agriculture. Portable probe instruments can be used by farmers or gardeners.



SOIL MOISTURE SENSOR

7.6.3 FEATURES

- Input voltage: 5v / Output voltage:0-5v
- Output: Analog.
- Sensitivity adjustable.
- Threshold level can be configured.
- Module triple output mode, digital, analog, serial outputs.

7.6.4 APPLICATIONS

- Agriculture.
- Landscape irrigation.
- Research
- Simple sensor for Gardeners.

7.7 WATER PUMP

7.7.1 GENERAL DESCRIPTION

As the name implies, water pumps pump water. Whether that be in a vehicle, at a business, in the home, or in a well, shoppers can probably find a water pump to fit their vehicle or to help them draw water from the ground in a self-dug well to be used in pressure tanks within the location. Vehicle water pumps help regulate the flow of water through a vehicle's cooling system; when the seal on these go bad, the whole pump must be replaced. Located within the home or business, pressure water pumps regulate the water pressure year round, controlling water flow to different areas of the location.

7.7.2 PRODUCT DESCRIPTION

A pump motor is a DC motor device that moves fluids. A DC motor converts direct current electrical power into mechanical power. DC or direct current motor works on the principal, when a current carrying conductor is placed in a magnetic field, it experiences a torque and has a tendency to move. This is known as motoring action. Pumps operate by some mechanism (typically reciprocating or rotary), and consume energy to perform mechanical work by moving the fluid. Pumps operate via many energy sources, including manual operation, electricity, engines, or wind power, come in many sizes, from microscopic for use in medical applications to large industrial pumps.



Water pump motor

7.7.3 FEATURES

- Reduced noise
- Available in DC and AC
- Supply voltage: +12VDC
- Supply voltage: 230V AC

7.7.4 APPLICATIONS

- Priming a pump
- To pump water supply, including pneumatic systems and in places where no suction lift is required
- Pump motor as public water supply
- In domestic water supply system

7.8 GSM

7.8.1 GENERAL DESCRIPTION

SIMCom Wireless Solutions is a subsidiary of SIM Technology Group Ltd (stock code: 2000. H.K). It is a fast-growing wireless M2M company, designing and offering a variety of wireless modules based on GSM/GPRS/EDGE, WCDMA/HSDPA and TD-SCDMA technical platforms. By partnering with third parties, SIMCom Wireless provides customized design solutions in M2M, WLL, Mobile Computing, GPS and other applications. SIMCom Wireless also provides ODM services for customers. According to ABI Insight report, SIMCom Cellular Module was number two provider of wireless modules worldwide in 2008 with 20% acquisition of global market share.

7.8.2 PRODUCT DESCRIPTION

This GSM Modem can accept any GSM network act as SIM card and just like a mobile phone with its own unique phone number. Advantage of using this modem will be that you can use its RS232 port to communicate and develop embedded applications. The SIM900A is a complete Dual-band GSM/GPRS solution in a SMT module featuring an industry-standard interface; the SIM800 delivers GSM/GPRS 900/1800MHz performance for voice, SMS, Data, and Fax in a small form factor and with low power consumption. With a tiny configuration of 24mm x 24mm x 3 mm, SIM800 can fit almost all the space requirements in your applications, especially for slim and compact demand of design.



7.8.3 FEATURES

- High Quality Product
- RS232 interface @ RMC Connector for direct communication with computer or MCU kit
- Configurable baud rate
- SMA connector with GSM Antenna / SIM Card holder.
- Built in Network Status LED
- Inbuilt Powerful TCP/IP protocol stack for internet data transfer over GPRS.
- Audio interface Connector
- Normal operation temperature: -20 °C to +55 °C
- Input Voltage: 4.5V-12V DC

7.8.4 APPLICATIONS

- Short Message Service(SMS)
- Internet
- Incoming /outgoing calls

CHAPTER 8

SOFTWARE DESCRIPTION

8.1 MP LAB

MPLAB is a proprietary freeware integrated development environment for the development of embedded applications on PIC and dsPIC microcontrollers, and is developed by Microchip Technology. MPLAB and MPLAB X support project management, code editing, debugging and programming of Microchip 8-bit PIC and AVR (including ATMEGA) microcontrollers, 16-bit PIC24 and dsPIC microcontrollers, as well as 32-bit SAM (ARM) and PIC32 (MIPS) microcontrollers.

MPLAB is designed to work with MPLAB-certified devices such as the MPLAB ICD 3 and MPLAB REAL ICE, for programming and debugging PIC microcontrollers using a personal computer. PICKit programmers are also supported by MPLAB.

MPLAB X supports automatic code generation with the MPLAB Code Configurator and the MPLAB Harmony Configurator plugins.

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 X, 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 as 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.

8.2 EMBEDDED C

Embedded C is a set of language extensions for the C programming language by the C Standards Committee to address commonality issues that exist between C extensions for different embedded systems.

Historically, embedded C programming requires nonstandard extensions to the C language in order to support exotic features such as fixed-point arithmetic, multiple distinct memory banks, and basic I/O operations. In 2008, the C Standards Committee extended the C language to address these issues by providing a common standard for all implementations to adhere to. It includes a number of features not available in normal C, such as fixed-point arithmetic, named address spaces and basic I/O hardware addressing. Embedded C uses most of the syntax and semantics of standard C, e.g., `main()` function, variable definition, data type declaration, conditional statements (`if`, `switch case`), loops (`while`, `for`), functions, arrays and strings, structures and union, bit operations, macros, etc

CHAPTER 10

CONCLUSION

Thus monitoring process in agricultural fields will be an effective method that will be useful in situations where usage of water resources is limited. By implementing this project, there will be an effective and efficient usage of water resources. It will be an indirect mean for the proper development of agricultural yield. The performance measures obtained can be maintained in database which will be useful for comparing different yields at different climatic conditions.

REFERENCES

- (1) "A Crop Water Stress Index For Accessing Irrigation Scheduling Of Drip Irrigation Broccoli" by Erdem,L.Arın,T.Erdem,S.Polat in the year 2013.
- (2) "A Comparative Study Of Wireless Protocols : Bluetooth, Zigbee and WIFI" by J.S. Lee, Y.W.Su, and C.C. Shen in the year 2007.
- (3) "A Survey Of MAC Protocols For Mission-Critical Applications In Wireless Sensor Networks" by P. Suriyachai, U. Roedig and A. Scott in the year 2012.
- (4) "Automatic Irrigation System Using a Wireless Sensor Network and GPRS Module" by Joaquin G2utierrez, Juan Francisco Villa –Medina , Alejandra Nieto- Garibay in the year 2014.
- (5) "Energy Management is Wireless sensor Networks with Energy-Hungrysensor" by C. Alippi, G. Anastasi, D. Francesco in the year 2010.
- (6) "Irrigation scheduling and Irrigation system: Optimising Irrigation container Ornamentalshrubs" by O.M. Grant,.M.J. Davies, H.I. ongbottom in the year 2009.
- (7) "Microcontroller Based Drip Irrigation System Using Smart Sensor" by Nilesh, R. Patel, Rahul B. Lanjewar in the year 2013.
- (8) "PC-Based Automatic Drip Irrigation System" by M. Guerbaoui in the year 2013.
- (9) "Remote Sensing And Control of An Irrigation System Using a Distributed Wireless Sensor Network" by Y. Kim, R.G. Evans, and W.M.Iversen in the year 2008.
- (10) "Wireless Sensor Network for Conservation And Monitoring Cultural Assets" by M.C. Redriguez, S. Borromeo and J.A. Hernandez - Tamames in the year 2011.
- (11) "Wireless sensor Forin-Site Monitoring of Debris Flows" by H.C. Lee, Y-M. Fang, B-J Lee and C-T. King in the year 2012.

APPENDIX

A.SOURCE CODE

```
#include<pic.h>
#include<htc.h>
#include<stdio.h>

void UART_INIT();
void uart_sendstring( char *str);
void uart_sendchar( char a);
int i,j,count=0,flag=0,n1,n2,n3,n4,l,d1,d2,d3,d4,d5,d6;
float hu;
char UART_getchar();
void Delay1();
void delay();
void Delay2();

////LCD
#define lcd PORTB    // data of lcd at port B
#define rs RD6
#define en RD7

void lcd_data(char a);
void lcd_com( char a);
void lcd_str( char *a);
void lcd_init();

//RELAY

//// ADC
void ADC_Init();
unsigned int ADC_Read( char channel);
void val( int re);
void val1( int re);
void val2(int re);
void val3(int re);
void Delay(int s)
{
for(i=0;i<s;i++)
for(j=0;j<10555;j++);
}
```

```

void Delay1()
{
for(i=0;i<20;i++)
for(j=0;j<1075;j++);
}
void Delay2()
{
for(i=0;i<50000;i++);
}

void main()
{
TRISB=0X00;
PORTB=0X00;
TRISC=0x80;
PORTC=0X00;
TRISD=0X00;
PORTD=0X00;
UART_INIT();
lcd_init();
ADC_Init();
lcd_str("  WELCOME");
Delay(50);
lcd_com(0x01);
lcd_str(" AGRI MONITORING");
lcd_com(0xC0);
lcd_str(" AND CONTROLLING");
Delay(50);
lcd_com(0x01);
lcd_str("  GSM ");
lcd_com(0xC0);
lcd_str(" INITIALIZATION");
Delay(10);
uart_sendstring("AT\r"); //Replies with OK for Acknowledgement
Delay(20);
uart_sendstring("AT+CMGF=1\r");
Delay(20);
uart_sendstring("AT+CLIP=1\r");
Delay(10);
uart_sendstring("AT+CNMI=2,2\r\n");
Delay(10);
uart_sendstring("AT+CIPSHUT\r"); //To close TCP connection, meaning to disconnect form internet
Delay(5);
uart_sendstring("AT+CIPSTATUS\r"); //IP status
Delay(5);

```

```

uart_sendstring("AT+CSTT=\"internet\\",\"\\",\"\\r"); //TCP connection profile
Delay(10);
uart_sendstring("AT+CIICR\r");          //Bring up GPRS Connection...
Delay(10);
uart_sendstring("AT+CGATT=1\r"); //Check if Simcom module is attached to the network
Delay(10);
uart_sendstring("AT+CIFSR\r"); //Get the local IP address
Delay(10);
uart_sendstring("AT+CGDCONT=1,\"IP\\",\"internet\\r"); //Read the PDP context profile of Simcom
module
Delay(10);
uart_sendstring("AT+CGACT=1,1\r"); //Connecting to PDP profile 1..
Delay(10);
uart_sendstring("AT+CREG=2\r"); //GPRS NETWORK REGISTRATION STATUS
Delay(10);
uart_sendstring("AT+CIPHEAD=1\r"); //IP Header configuration
Delay(10);
uart_sendstring("AT+SAPBR=3,1,\"contype\\",\"GPRS\\r"); //Querying bearer
Delay(10);
uart_sendstring("AT+SAPBR=3,1,\"APN\\",\"internet\\r"); //Querying bearer
Delay(10);
lcd_com(0x01);
lcd_com(0x80);
while(1)
{
    lcd_com(0x80);
    lcd_str("T=");
    n1=ADC_Read(0);
    n1=(n1*90)/300;
    val2(n1);
    lcd_data(0xdf);
    lcd_str("C");
    lcd_com(0x87);
    lcd_str("H=");
    n2=ADC_Read(1);
    hu=n2*9.77;
    val3(hu);
    lcd_str("%RH");
    lcd_com(0xc0);
    lcd_str("W=");
    n3=ADC_Read(2);
    val(n3);
    lcd_com(0xc7);
    lcd_str("S=");
    n4=ADC_Read(3);

```

```

n4=1022-n4;
val(n4);
if(n3>500)
{
RD0=1;
}
else
{
RD0=0;
}
if(n4>500)
{
RD1=1;
}
else
{
RD1=0;
}
//////////
if(l>500)
{
lcd_com(0x01);
lcd_str("  SENDING ");
lcd_com(0xC0);
lcd_str(" IOT ");
Delay(10);
uart_sendstring("AT+SAPBR=1,1\r\n"); //Querying bearer
Delay(5);
uart_sendstring("AT+HTTPINIT\r\n");  ///Initializing HTTP service.
Delay(30);
//http://vehicleiot.in/gas/get.php?gas=100&load=100
uart_sendstring("AT+HTTPPARA=\"URL\", \"http://vehicleiot.in/agrimonitoring/get.php?T=");
//Setting up HTTP parameters..
val1(n1);
uart_sendstring("&H=");
val1(hu);
uart_sendstring("&W=");
val1(n3);
uart_sendstring("&S=");
val1(n4);
uart_sendstring("\r\n");
Delay(20);
uart_sendstring("AT+HTTPPARA=\"CID\",1\r\n"); //Set the CID
Delay(30);
uart_sendstring("AT+HTTPACTION=0\r\n"); //HTTP action is read

```

```

Delay(100);
uart_sendstring("AT+HTTPREAD\r\n"); //Read the HTTP response
Delay(50);
uart_sendstring("AT+HTTPTERM\r\n"); //Terminating HTTP session..
Delay(50);
l=0;
lcd_com(0x01);
}
l++;
}
}

```

```

void UART_INIT()
{
TXSTA=0X24;
RCSTA=0X90;
TXREG=0X00;
RCREG=0X00;
SPBRG=0X81;
//SPBRG=25;
//PEIE=1;
}

```

```

void uart_sendstring( char *str)
{
while(*str)
{
uart_sendchar(*str++);
for(i=0;i<2000;i++);
}
}

```

```

void uart_sendchar( char a)
{
while(!TXIF);
TXREG=a;
}

```

```

char UART_getchar()
{
while(RCIF == 0);
return RCREG;
}

```

```

void lcd_init()
{
  lcd_com(0x38);
  lcd_com(0x0c);
  lcd_com(0x06);
  lcd_com(0x80);
  lcd_com(0x01);
}

```

```

void lcd_com( char com)
{
  lcd=com;
  rs=0;
  en=1;
  delay();
  en=0;
  delay();
}

```

```

void lcd_data( char dat)
{
  lcd=dat;
  rs=1;
  en=1;
  delay();
  en=0;
  delay();
}

```

```

void lcd_str(char *a)
{
  while(*a)
  {
    lcd_data(*a++);
  }
}

```

```

void lcd_strf(char *a)
{
  for(int i=0;i<2;i++)
  {
    lcd_data(*a++);
  }
}

```

```

void delay()

```

```

{
    char i;
    for(i=0;i<255;i++);
}

void ADC_Init()
{
    ADCON0 = 0x41; //ADC Module Turned ON and Clock is selected
    ADCON1 = 0xC0; //All pins as Analog Input
                //With reference voltages VDD and VSS
}
unsigned int ADC_Read(char channel)
{
    if(channel > 7)    //If Invalid channel selected
    return 0;
    ADCON0 &= 0xC5;    //Clearing the Channel Selection Bits
    ADCON0 |= channel<<3; //Setting the required Bits
    __delay_ms(10);    //Acquisition time to charge hold capacitor
    GO_nDONE = 1;    //Initializes A/D Conversion
    while(GO_nDONE);    //Wait for A/D Conversion to complete
    return ((ADRESH<<8)+ADRESL);    //Returns Result
}

void val(int re)
{
    delay(200);
    d1=(re/1000);
    d2=((re-d1*1000)/100);
    d3=((re-(d1*1000+d2*100))/10);
    d4=(re-(d1*1000+d2*100+d3*10));
    //lcd_display(d1+0x30);
    //lcd_display(d2+0x30);
    lcd_data(d1+0x30);
    lcd_data(d2+0x30);
    lcd_data(d3+0x30);
    lcd_data(d4+0x30);
    delay(50);
}
void val2(int re)
{
    delay(200);
    d1=(re/1000);
    d2=((re-d1*1000)/100);
    d3=((re-(d1*1000+d2*100))/10);
    d4=(re-(d1*1000+d2*100+d3*10));

```

```

//lcd_data(d1+0x30);
//lcd_data(d2+0x30);
lcd_data(d3+0x30);
lcd_data(d4+0x30);
delay(50);
}
void val3(int re)
{
delay(200);
d1=(re/1000);
d2=((re-d1*1000)/100);
d3=((re-(d1*1000+d2*100))/10);
lcd_data('.');
lcd_data(d3+0x30);
//lcd_data(d4+0x30);
delay(50);
}
void val1(int re)
{
delay(200);
d1=(re/1000);
d4=(re-(d1*1000+d2*100+d3*10));

uart_sendchar(d1+0x30);
uart_sendchar(d2+0x30);
uart_sendchar(d3+0x30);
uart_sendchar(d4+0x30);
delay(50);
}

```

APPENDIX

B. PUBLICATION

Forecasting Hospital Admissions in Emergency Department using Data Mining

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Abstract- The recent study carried out by Institute of Medicine stated that crowding in emergency department (ED) stands as a barrier to provide safe medical services at the right time. Overcrowding in the emergency departments may have serious negative impacts for patients. So there is a need for the emergency departments to consider the usage of innovative techniques for improving the patient flow and to prevent the overcrowding. One possible methodology is the usage of machine learning techniques for the prediction of admissions in ED. This paper uses the regulatory information of (120600 records) customarily collected from two significant hospitals in Ireland for comparing various machine learning algorithms for the prediction of admission risk in the ED. Generally, 3 algorithms are mostly used to develop the predictive models: (1) Logistic regression, (2) Decision trees and (3) Gradient Boosted Machines (GBM). Drawing on logistic regression, we have a tendency to determine many factors associated with hospital admissions, as well as hospital website, age, admission mode, sorting class, past admission within last month, and former admissions within past year. In this paper, we highlight the utilization of three algorithms of machine learning for predicting the victim admissions. Implementing the models will offer a snap of foretold admissions in the ED in a certain time, letting advancement in resource designing and also reducing the crowding. Once interpretability may be a principal thought, EDs thought to adopt logistic regression model, though GBM is helpful wherever accuracy is predominant.

Keywords - Emergency Department, Gradient Boosted Machines, Mean Absolute Percentage Error, Multi-Layer Perceptron, Fuzzy Min-Max.

1. INTRODUCTION

Crowding in Emergency departments (EDs) may show serious negative effects on patients, employees like multiplied waiting periods, auto deviation, reduction of employees morale, detrimental outcomes of patients like multiplied death rate, and abolition of elective methods. Prior analysis shows disfunction situation to be a major global downside, creating it crucial that progressive measures are to be taken to handle the problem. There is scope of doable cause of disfunction situation looking forward to the context, with variety of the foremost reasons together with multiplied disfunction attendances, unsuitable attendances, a deficiency of different medication choices, lack of effective bed allocation, disfunction inadequate staffs, and closing different native disfunction departments. An effective mechanism that might facilitate to control disfunction situation and improvising the patient flow is implementing Data mining to detect patients of higher risks of admission, thus allowing the measures to be adopted to prevent crowding at intervals of the system.

Cameron et al. proposed that the application of the system might facilitate to boost the satisfaction of the patients by providing them with prior notice that admissions are going. Development of such model can be done by exploiting processing methods, that consists inspects, persue information for obtaining useful information and skills on which selections are typically taken. Thus, this includes describing and distinctive patterns in information and creating past patterns that supports prediction.

The current study focuses on developing models for the prediction of admissions by the utilization of machine learning algorithms, and thus the segregation of the performance of varied approaches to model development. There is a tendency to coach and check the model's exploitation info from the managers system of two dreadful hospitals in the European countries. The operation of Emergency Departments has been a specific challenge for the European country's health care divisions in recent few years.

Ed's in European countries are being pressured from an increment of demand that has been due to poor

performances over the region when compared to a different areas of the UK. For instance, in Gregorian calendar month 2015 only one European country disfunction department reached the four hour wait time target, with more than two hundred patients all over the region waiting over 10-12 hours for admission or sent home. Patients who attend the disfunction usually endure many stages from the time of arrival to time of discharge looking forward to selections created at earlier stages. The attenders will arrive by the foremost reception space or by an ambulance.

2.RELATED WORK

By utilizing a wide range of clinical and demographic information of aged patients. LaMantia et al. used to predict hospital admissions and ED re-attendance using logistic regression. predicted admissions are of decent precision, but not able to precise ED re-attendance accurately. We have few vital factors for predicting admissions like age, pulse rate, stress, and chief complaint. Evaluation of model performance are done using mean absolute percentage error (MAPE), we get around 7% for using best attendance achieving model MAPE and 2% for using best admission achieving model MAPE for monthly admissions.

By collecting historical data it is useful for predicting future events and thus helps to predict further closure to the future but this has some problem of not incorporating data recorded at entry and respond, this might increase the accuracy of small prediction of admissions. sun et al. used two years of routinely collected administrative data and developed a logistic regression model. Even though their insight indicated the affirmation of a ton of females than guys, sex wasn't significant at interims the final model. Likewise, Cameron et al. built up a provision regression model to anticipate the opportunity of affirmations at arranging, exploitation 2 years of routine organization information gathered from emergency clinics in the city.

Wang et al. utilized an assortment of ML calculations to foresee affirmations from the ED, assessment the intensity of fluffy min-max neural systems to elective standard handling calculations together with Multi-Layer Perceptron and Ada Boost. In general, MLP is the first right, foreseeing essentially over 78% of cases accurately, with FMM (hereditary calculation) anticipating 77.98% of cases appropriately. So also, Peck et al. created 3 models to anticipate ED confirmations exploitation arrangement relapse models, guileless mathematician, and gifted supposition. Each of the three procedures was useful in foreseeing ED confirmations. Factors inside the model encased age, appearance mode, crisis seriousness list, assignment, essential analysis, and ED provider. Their arrangement relapse model was the first right in anticipating ED affirmations.

The utilization of arrangement relapse to foresee affirmation was a while later saw as generalizable to elective emergency clinics. exploitation reproduction models, Peck et al. have demonstrated that the utilization of the prognostic models to rate release or treatment of patients will curtail its measure moderate the patient spends at interims the ED office. The model had a partner degree by and large precision of 91.9% with an AUC of 0.825. Be that as it may, the precision of anticipating the objective ward shifted by ward and by the possibility edge utilized.

Lucini et al. utilized eight basic ML calculations to foresee confirmations from the ED office upheld choices got from content recorded on the patient's record. Adopting a one of a kind strategy Cameron et al. analyzed the precision of medical care takers forecasts of ED confirmations with those of partner degree target score. They find medical caretakers to be a great deal of right in cases any place they're bound the patient are going to be conceded. The writing features the apparatus of the scope of antiquated and MLways to deal with the forecast of ED affirmations in numerous settings utilizing a type of data.

3.METHODOLOGY USED

This study involves seven data processing steps for the method to be implemented .They are : (1) Extraction of Data (2) Cleansing of Data (3) Data Visualization (4) Data Splitting (5) Model tuning (6) Predicting admission and (7) Evaluating the model's performance based on the predictions made. All these steps help to develop an ideal model that prevents over fitting. The collected data includes the information of ED attendances of two major hospitals located in northers part of Ireland.

The belief offers a full scope of intense, network, and social consideration administrations conveyed during the scope of settings including two significant intense emergency departments which were the setting for this examination. The medical services by both the hospitals offered a full scope of crisis benefits and have close connections to different territories of the human services framework like network and social administrations. Hospital one is bigger, treating over 45000 inpatients in a day and up to 70000 outpatients, while the emergency clinic treats roughly 20000 inpatients in a day and 48000 outpatients. The information used in the model structure was recorded on the most authoritative figuring framework at each phase of the patient excursion at the time the occasion happens. An assortment of factors was considered inside the model structure, with the final factors settled on bolstered past investigations and the effect of consideration on the presentation.

A. MACHINE LEARNING ALGORITHMS AND PERFORMANCE

Three ML methodologies were applied to the training data to make the models: (1) logistic regression, (2) decision tree, and (3) GBM. The first algorithm utilized for foreseeing a twofold factor, similar to positive/negative, dead/alive; or during this investigation, admitted or not. The method utilizes a logit connect capacity to empower the figuring of the odds of a result happening. The second calculation that was utilized was the decision tree. This calculation parts the data at every node. The decision tree will be able to be pruned to forestall over fitting and to get the first exact model for the forecast. The third calculation utilized is GBM, which makes various feebly related decision trees that are joined to supply the final forecast this framework alluded to as it can frequently presents more exact prediction.

The selection of the three algorithms additionally permits us to contrast the execution of two novels with the territory models with a better customary model. The three algorithmic methods fluctuate regarding how the demonstration is done. The probability of a practical model of the appropriate response was additionally considered. Dataset characteristics are also mandatory within the choice.

4. ARCHITECTURAL DESIGN

Label Encoding: It is necessary to ensure that the data is prepared for the model before running the model. Usage of Label Encoder class is necessary for converting of any kind of category specific text data into numerical data that the model can understand. For this, the first column is to be label encoded i.e., the first column of the data provided is to be transformed, and then the present text data will be replaced with a new encoded data.

OneHot Encoding: This Encoding process performs 'binarization' of the categorical variables and provide it to the ML Algorithm for better prediction.

Scaling: We are fitting and transforming Standard Scaler method on the train data. We must standardize our scaling so that we can use the same fitted method to scale the test data.

Extraction and Engineering: To check the relation of the extracted features to the output, they are generally plotted against the output.

Training data and test data: In Machine Learning, the data are usually splitted into two subsets: (1) Training data and (2) Test data. Usually 70-80% of the dataset is split into Training data and the remaining 20-30% of data is split into test data. Then our model is trained using training data inorder to make predictions on the test data.

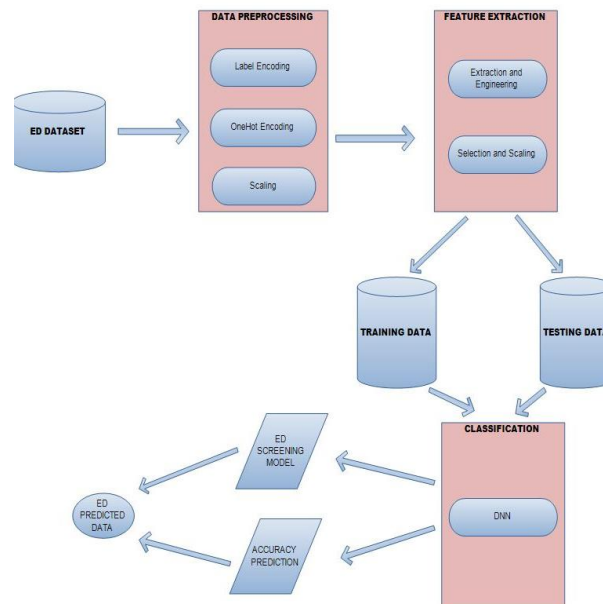


Fig 1 : System design

Deep neural network: Deep neural networks is a network that has one or many hidden layers in between one input layer and output layer which carries out certain types of ordering and sorting. It uses complicated mathematical modeling for process the data. To make sure that the algorithm efficiently learns the function for which they are developed, it uses randomness by design.

Accuracy prediction: The Accuracy prediction result will give you probability of patient admitting in the hospital. This will convert that probability into binary 0 and 1. 1 for attending in the hospital and 0 for not attending the hospital. This is the final step where the model performance is evaluated. For checking the accuracy of model, we use Confusion matrix.

Table:1 Statistical reports

Variables	Categories	Attendances	Admissions	% Admitted
Admitted	Yes	29804	n/a	24.7
	No	90796	n/a	75.3
Gender	Male	61089	14210	23.3
	Female	59511	15594	26.2
Arrival day	Monday	19681	4846	24.6
	Tuesday	17596	4400	25.0
	Wednesday	17262	4349	25.2
	Thursday	17196	4240	24.7
	Friday	16857	4438	26.3
	Saturday	15699	3732	23.8
	Sunday	16339	3799	23.3
Hour	11am	8791	2061	23.4
	Midday	8421	1931	22.9
	Lpm	8231	1917	23.3
	3pm	8004	2063	25.8
	4pm	7912	2072	26.2
	6pm	7865	1935	24.6
Week	40	2653	713	26.9
	12	2509	571	22.8
	30	2505	636	25.4
	27	2494	549	22.0
	32	2477	568	22.9
	6	2484	566	22.8
Month	Oct	10608	2559	24.1
	Jun	10482	2519	24.0
	May	10384	2571	24.8
	Aug	10327	2502	24.2
	Apr	10251	2520	24.6
	Jul	10207	2495	24.4
Arrival mode	Ambulance	29386	15467	52.6
	Foot	4156	659	16.6
	Own Transport	85828	13353	15.6
	Police	508	109	21.5
	Public Transport	400	38	9.5
	St Johns Ambulance	210	111	52.9
Triage category	Non-Urgent	1465	30	2.0
	Standard	46969	3238	6.9
	Urgent	53484	117423	32.6
	Very Urgent	15247	8786	57.6
	Immediate	458	289	63.1
	Not Known	2977	38	1.3
Care groups	Minors	56713	3316	5.8
	Majors	55191	23650	42.9
	Resuscitation	3457	2664	77.1
	Emergency Nurse	1894	8	0.4
	Practitioner			
	Primary Care	1048	11	1.0
	Assessment Unit	604	13	2.2
	Triage	240	9	3.8
	Other	944	44	4.7
	Missing	1353		0.0
Admitted in last year	Yes	22281	10779	48.4
	No	98319	19025	19.4
Admitted in last month	Yes	5403	3139	58.1
	No	115197	26665	23.1
Admitted in last week	Yes	1346	725	53.9
	No	119254	29079	24.4
Hospital site	1	77069	20530	26.6

Patient age	2	43531 Mean = 43.22 Median = 42 SD=26.1	9274 Mean = 56.48 Median = 62 SD= 26.94	21.3
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5. RESULTS AND DISCUSSION

A. DESCRIPTIVE STATISTICS

Across the two emergency clinics, 26% of the ED attendances brought about an admission to a medical clinic, with 28.5% of attendances bringing about an affirmation at hospital one and 19.87% at hospital two. This looks at correspondingly to different medical clinics in Ireland and UK. Comparative confirmation rates likewise can be seen at emergency clinics globally with examines directed. Still, some of these investigations depended on single hospital locales or a few emergency clinics, which may be odd of national confirmation rates.

While the confirmation date was disaggregated into the day, week, and month, the seven day stretch of the year wasn't encased inside the final models since it diminished the presentation of the model. Generally, attendances and confirmations were higher on weekdays than at ends of the week with the absolute best assortment of affirmations being on Mondays. Pastry specialist watches a comparable pattern in UK, with absolute best recurrence of attendance on Monday and diminishing attendance down to Friday. In any case, Baker shows that attendance marginally augmented at the end of the week with Sunday being the second busiest day. Brokenness attendances are most minimal inside the winter month and most noteworthy with or without over spring and summer from the top in participation in Gregorian schedule month.

Over the United Kingdom, Baker notices higher attendances in pre-summer and late-spring, with fewer attendances in August and January. Inpatients in the two emergency clinics are nearly predictable throughout the year, with a little increment inside the late spring at a medical clinic a couple of, which can be because of the expansion in occasion creators in the region during. week, month, and year.

B. MULTIVARIABLE RELATIONSHIPS

Interpreting this model additionally helps with building a great deal of cutting edge and less reasonable models. providing relapse shows the association between each factor amount and along these lines the chances of affirmation while holding every single elective variable consistent. In spite of the fact that the elucidating insights showed that females are conceded at a superior recurrence than males, the effect isn't measurably significant inside. Yet, Cameron et al. discovered that females are bound to be conceded than guys, however, they decided not to remember sexual orientation for their final model in light of a small low chances size connection.

Compared with patients inbound by machine, confirmations are in short apparently for patients inbound walk possess cop vehicle and open vehicle. True to form, sufferers with an extra basic arranging score additionally are all the apparent to be admitted to an emergency clinic. This supports with the consequences of Cameron et al. who also find that confirmation is extra apparently with increasingly extreme arranging classes. Contrasted with patients with a considerable group of 'minor', patients with a consideration bunch of majors evaluation unit rejuvenation arranging and other are extra apparently to be conceded

C. MODEL PERFORMANCE

Kappa, AUC-ROC are used to gauge the model's prognostic performance by creating predictions on the take a look at knowledge. Performance wise, GBM functions better than other models.

```

...: print('Accuracy' + str(accuracy_score(y_test, y_pred)))
...: print(classification_report (y_test, y_pred))
...:
...:
[[ 584 176]
 [ 203 2895]]
Accuracy0.9017625712804562
      precision    recall  f1-score   support

     0       0.74      0.77      0.76       760
     1       0.94      0.93      0.94      3098

 avg / total       0.90      0.90      0.90      3858

```

Fig.2 Accuracy prediction

Identical level of prognostic executions have been shown by models, with the decision tree acting exclusively marginally higher than the providing regression model as far as exactness and letter, and subsequently the providing regression model acting higher regarding AUC-ROC effectiveness.

Name	Type	Size	Value
X	float64	(804, 31)	[[1. 40. 0. ... 0. 0. 0.] [1. 66. 0. ... 0. 0. 0.]
X_test	float64	(161, 31)	[[-0.91782726 1.73972251 0.63537298 ... 5.19196704 -0.15974461 -0 ...
X_train	float64	(643, 31)	[[-0.91782726 -1.41124183 0.63537298 ... -0.19260523 -0.15974461 -0 ...
dataset	DataFrame	(804, 35)	Column names: id, dep_name, esi, age, gender, ethnicity, maritalstatus ...
y	int64	(804,)	[0 0 0 ... 1 0 0]
y_test	int64	(161,)	[0 0 0 ... 1 0 1]
y_train	int64	(643,)	[0 0 0 ... 0 0 0]

Transformed data

As a result of the classification unevenness, specificity is fundamentally on affectability over every one of the three models

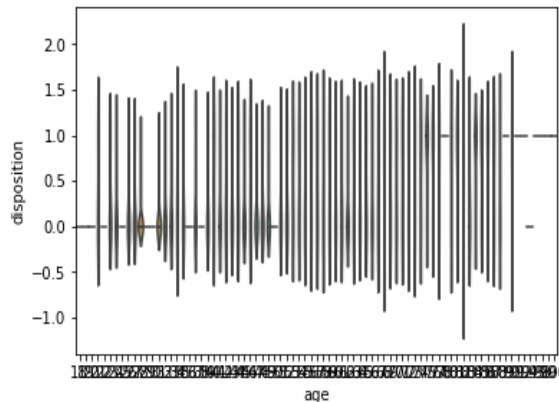


Fig.4 Age vs Disposition

This examination use information handling way to deal with creating and survey 3 ML algorithms to anticipate the probability of affirmation at the motivation behind arranging. Generally speaking, the outcomes show that the GBM performed best, however, the other two models exclusively performed somewhat less well, so making each of the three models potential possibility for execution even though the GBM was the preeminent right of the 3 models, in outcomes, is a significant strategic relapse model. It is likewise the principal promising contender for execution because of its simpleness and basic translation.

For developing a model that can be nursing implementable, three steps were proposed, (1) Assemble the conceivably most precise model utilizing mind-boggling and less responsible models. (2) Assemble fewer complex models and many logical calculations. (3) If the precision of the less complex model is sufficient contrasted with plenty of convoluted models consider this model for usage. During this investigation, the less confounded models contrast very well with the much complicated GBM.

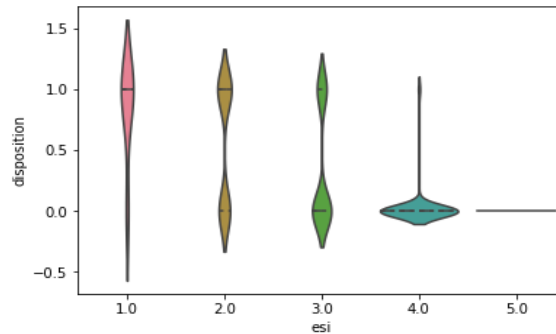


Fig.5 Esi vs Disposition

The logistic regression is furthermore uncomplicated to see how various variables are adding to the forecast, which may help with the management of the hospitals. While decision trees might be comprehended, it is unsteady with small changes inside the data most likely everchanging the tree's structure. Nonetheless, exactness is vital, the GBM would be the ideal option for execution.

The models offered during this research have more elevated levels of precision in contrast with a wide range of studies introduced in the writing. For instance, utilizing logistic regression to show data proceeded with the emergency service information frameworks concerning patients matured more than 74, LaMantia et al. accomplished an AUC-ROC of 0.74. They hypothesize that the model they use isn't right enough without anyone else to frame a private level affirmation call. Exploitation supply relapse Sun et al. accomplished comparable precision to the models presented. Outstandingly, Sun et al. tried not to convey the merchandise higher exactness than the models offered here despite together with data concerning previous conditions.

It was found that affirmation was plenty of opportunities for patients with polygenic ailment, cardiovascular sickness, and dyslipidemia. For example, clinical information like previous conditions, pulse, test results, and the pulse is additionally useful in up exactness. Some past examination has incorporated a confined fluctuate of social consideration information, with blended outcomes. Camaron et al. daily exercises are identified with the threat of medical affirmation. Social consideration ordinarily holds information on more clinically focused factors still as information in regards to social care information. The data typically lives in storehouses among or over the associations concerned with the arrangement of care. This could build access and blending the data attain to achieve and observe, contingent upon the development of the IT associations foundation.

6. CONCLUSION

This study concerned the event and comparison of the machine learning methods geared towards prediction of hospital admissions from the dysfunction. Every model is trained victimization habitually collected dysfunction knowledge using 3 totally distinct data processing algorithms. Overall, performance of GBM was the most effective compared to other algorithms. The 3 models given during this study produces comparable, and in few instances increase in performance related to models given in different studies. Usage of these models can help the hospital managers for effective arrangement of the sources to support the anticipated inflow of the patients from the dysfunction.

It might facilitate to enhance the flow of patients and cut back dysfunction state of affairs, so reducing the adverse effects of dysfunction state of affairs and raise up the patient's satisfaction. These developed models even have the potential application in performance observation. However, while the model may well be accustomed support designing and higher cognitive process, choices for individual level admissions still need clinical judgement.

REFERENCES

- [1] J. S. Olshaker and N. K. Rathlev, "Emergency department overcrowding and ambulance diversion: The impact and potential solutions of extended boarding of admitted patients in the emergency department," *J. Emerg. Med.*, vol. 30, pp. 351–356, Apr. 2006, doi: 10.1016/j.jemermed.2005.05.023.
- [2] R. Julian Menezes, Dr. P. Jesu Jeyarin and J. Albert Mayan, "A Scholarly Audit on the Traits of Enciphering, Deciphering Algorithms bifurcated under Symmetric, Assymetric for Wired cum Wireless Environment", Vol. 11, pp.: 1443-1454, 2019
- [3] J. Boyle et al., "Predicting emergency department admissions," *Emerg. Med. J.*, vol. 29, pp. 358–365, May 2012, doi: 10.1136/emj.2010.103531.
- [4] Eswar V. O. S., Vinil. B., Anayarkanni B and Albert, "Integrated Collective Node Behavior Analysis with Onion Protocol for Best and Secured Data Transmission", *International Conference on Communication & Signal Processing 2018*, pp. 0918-0921.

- [5] S.L. Bernstein et al., "The effect of emergency department crowding on clinically oriented outcomes," *Acad. Emerg. Med.*, vol. 16, no. 1, pp. 1–10, 2009, doi: 10.1111/j.1553-2712.2008.00295.x.
- [6] Julian Menezes .R, Albert Mayan .J, M. Breezely George," Development of a Functionality Testing Tool for Windows Phones", *Indian Journal of Science and Technology*, Vol:8, No:22, pp: 1-7, 2015.
- [7] D. M. Fatovich, Y. Nagree, and P. Sprivulis, "Access block causes emergency department overcrowding and ambulance diversion in Perth, Western Australia," *Emerg. Med. J.*, vol. 22, no. 5, pp. 351–354, 2005, doi: 10.1136/emj.2004.018002.
- [8] Mayan, J.A., Priya, K.L., " Novel approach to reuse unused test cases in a GUI based application", *IEEE International Conference on Circuit, Power and Computing Technologies, ICCPCT 2015*, pp.1-7.
- [9] D. B. Richardson, "Increase in patient mortality at 10 days associated with emergency department overcrowding," *Med. J. Aust.*, vol. 184, no. 5, pp. 213–216, 2006.
- [10] N.R. Hootan and D. Aronsky, "Systematic review of emergency department crowding: Causes, effects, and solutions," *Ann. Emerg. Med.*, vol. 52, no. 2, pp. 126–136, 2008, doi: 10.1016/j.annemergmed.2008.03.014.
- [11] Y. Sun, B.H. Heng, S.Y. Tay, and E. Seow, "Predicting hospital admissions at emergency department triage using routine administrative data," *Acad. Emerg. Med.*, vol. 18, no. 8, pp. 844–850, 2011.