

Smart Medical ATM for Rural Healthcare Using IoT

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Abstract – Access to quality healthcare remains a significant challenge in many rural and remote areas due to the lack of medical infrastructure and professional availability. This project presents a Smart Medical ATM system powered by the Internet of Things (IoT), designed to bridge the healthcare gap in underserved communities. The system functions as a self-service health kiosk, equipped with essential medical sensors to monitor vital parameters such as body temperature, blood pressure, heart rate, and oxygen saturation. Data collected is transmitted in real-time to a cloud-based platform, where remote doctors can access and provide timely consultations. The Medical ATM also facilitates basic medication dispensing and health record maintenance, ensuring continuity of care. By leveraging IoT and automation, this solution offers a scalable, cost-effective approach to improving primary healthcare delivery in rural areas.

Index Terms – Automated Tele-Medicine dispenser system, GSM Module, medical support area, Medical ATM system, Rural IoT, PIC Microcontroller.

1. INTRODUCTION

Medical care includes diagnosing, prognosing, preventing, treating, palliating, and promoting the health of the patient. Medicine is the prevention and treatment of illness through the application of various healthcare practices [1]. Using biomedical research, genetics, modern medicine diagnoses, biomedical science, medical technology, treats, and prevents injuries and diseases, typically by way of drugs or surgery, but also by using psychotherapy, external splints, medical devices, biologics, and radiation, among others [2]. Nowadays the availability of medical support is quite rich in cities and towns. Advancement of medical technologies helps to diagnose and cure vital diseases within the stipulated time. Some minor diseases can be cured easily by early diagnosis [3].

Healthcare is essential for preventing disease, diagnosing and treating illness, improving quality of life, avoiding preventable deaths, and extending life expectancy, according to Healthy People. The healthcare system in rural areas is often obstructed by barriers [4]. A timely availability and attainable availability of healthcare services are necessary for rural residents. Healthcare access factors must be considered even when adequate healthcare services are available in the community [5].

Work, home, and recreational activities will all be redefined by remote patient monitoring. With these new technologies, we can monitor patients regularly, replacing recurring visits to the doctor [6]. Blood pressure, blood oxygen saturation, and temperature are vital signs. We need nurse or doctor advice to check vital signs data to determine whether they are healthy or unhealthy. Data collection, recording, and analysis are enabled by advances in sensor and connectivity technology [7].

2. RELATED WORKS

Health issues were prevalent in rural areas 11.2% of the time. There were 15% of people who knew enough about health issues. 57.2% of the population acknowledged genetics as a risk factor and 46.9% recognized nutrition as a risk factor [8].

This study was conducted on the knowledge and awareness of adolescents about diabetic issues, specifically insulin resistance, in Kuwait. In this study, the aim was to identify the levels of awareness and knowledge of health problems in adolescents regarding the disease, which would prove to be a great help in preventing the development of health problems and their complications in the future [9].

This study of chronic health issues patients attending a Tertiary Care Teaching Hospital in India examined the knowledge of health issues and self-care practices of patients with chronic health issues. The study consisted of a total of 100 patients, of which 100 were included in the analysis [10][11].

According to the study, there is a need for improvements in knowledge and awareness both among the general population and among the health issues subjects in general [12]. It is important to prevent health issues as well as the complications that could result from them as well as control them better [13].

An investigation was conducted into the prevalence of diabetes mellitus in rural Tamaka, Kolar, and the level of awareness about the disease [14]. The researchers concluded that the results of this study reflect the insufficient knowledge and awareness of Indian rural residents about health-related issues. Accordingly, there is a need for the development of mass campaigns for health issues awareness in both urban and rural areas of the country to increase awareness of health issues [15].

This study was to determine and compare the level of awareness regarding Health issues Mellitus, its complications, and management in male & female health issues patients, which concluded that overall awareness of health issues for men and women is low; and compared to male patients, female patients were found to be less aware of health issues [16].

To plan health programs for patients, it is crucial to identify, investigate and assess the patient's knowledge of health issues, which can be beneficial in identifying which health programs should be put in place for them. A study conducted in this study reveals that several issues in healthcare need to be addressed in community health centers to improve patients' health issues knowledge [17].

3. PROPOSED METHOD

The proposed system is an **Automated Telemedicine Support Platform** designed to assist patients in diagnosing diseases by monitoring vital signs. It is a user-friendly medical kiosk embedded with **Internet of Things (IoT)** technology, specifically developed for deployment in rural areas to enhance accessibility to basic healthcare services. The model supports a wide range of connectivity options and ensures quick, uninterrupted response times.

To accurately sense and monitor various physical parameters of the human body, the system integrates multiple sensors, including a **heartbeat sensor, respiratory sensor, load sensor, temperature sensor, ultrasonic sensor, glucose sensor, and blood pressure sensor**. These sensors are interfaced with a **PIC 16F877A microcontroller**, enabling efficient data collection and processing as shown in Fig 1.

This proposal outlines a **wireless healthcare monitoring system** leveraging IoT modules to enable real-time patient monitoring. Such remote monitoring provides continuous and emergency health updates to doctors or healthcare providers, allowing for immediate medical intervention. The impact of this system extends beyond hospitals—improving healthcare responsiveness in workplaces, homes, and even during recreational activities.

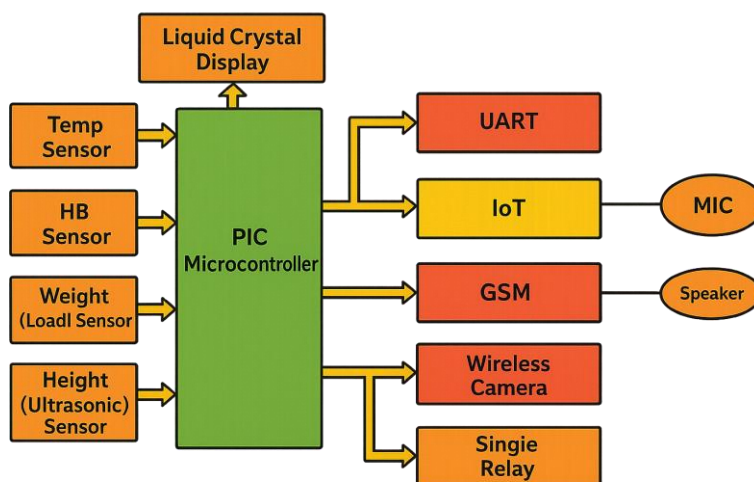


Figure 1 Block Diagram of Proposed System

Health management systems are designed to offer a low-cost, integrated solution for continuous patient monitoring, enabling accurate and real-time measurement of vital physiological parameters such as body temperature and pulse rate. In recent years, the adoption of wearable sensors for personal healthcare, fitness tracking, and activity monitoring has grown significantly, reflecting an increased interest in proactive health management.

Healthcare systems powered by the **Internet of Things (IoT)** operate through a network of interconnected devices that communicate directly with each other. These systems rely on **sensors, microcontrollers, and gateways** to collect, transmit, and analyze critical health data. This interconnected infrastructure facilitates seamless data sharing, which is essential for timely and effective patient care.

By applying **data mining techniques**, the collected sensor data can be processed to extract meaningful insights related to an individual's health status. These systems often utilize **classification models** that allow for the autonomous monitoring of vital signs without requiring constant nurse supervision. Medical professionals can then use this analyzed data—especially in chronic disease monitoring scenarios—to make informed diagnoses and recommend appropriate treatments. This approach enhances the efficiency of healthcare delivery through intelligent automation and real-time decision support.

3.1 Hardware Components of the Medical ATM System

This section outlines the key hardware components used in the proposed Medical ATM system:

i. Transformer

A single-phase step-down transformer is used to convert the 230V AC input from the main power supply to a lower voltage level suitable for the system. This step-down process ensures the safety and operability of the electronic components.

ii. Rectifier Unit

The rectifier circuit is responsible for converting AC voltage into DC voltage. It primarily uses diodes, which allow current to flow only when forward-biased and block it when reverse-biased. The system utilizes three types of rectifiers to ensure efficient conversion and power delivery to subsequent modules.

iii. Voltage Regulator

Voltage regulators are integrated to maintain a constant output voltage regardless of fluctuations in the AC input. This ensures the reliable operation of the system's electronic components by delivering stable DC voltage.

iv. Output Filter

An output filter circuit, typically composed of capacitors, is placed after the regulator unit to smooth the voltage output. Capacitors charge during the positive half-cycle and discharge during the negative half-cycle of the AC signal, helping to stabilize the DC supply.

v. PIC Microcontroller (PIC16F877A)

At the core of the system is the **PIC16F877A microcontroller**, which features 256 bytes of EEPROM, self-programming capability, in-circuit debugging (ICD), comparators, and eight A/D conversion channels. It also supports capture/compare/PWM functions and configurable serial ports for communication.

vi. Temperature Sensor (LM35)

The **LM35** is a linear temperature sensor that provides output proportional to temperature in Celsius. It offers precise measurements without requiring calibration or offsetting for Kelvin-to-Celsius conversion, making it ideal for clinical environments.

vii. Heartbeat Sensor (PCB Type)

This simple and compact sensor uses an infrared (IR) mechanism. After powering the board with a 3–5.5V supply and enabling the IR circuit, the user places a finger over the sensor to detect pulse rate via reflected IR light.

viii. Load Sensor

Also known as a **load cell**, this component measures tension and compression. It is widely used in applications like weighing scales and tension monitoring systems. In this setup, it helps determine body weight or applied force.

ix. Ultrasonic Sensor

The ultrasonic sensor emits sound waves and measures the time it takes for the echo to return after bouncing off an object. This time delay helps determine the distance between the object and the sensor. Ultrasonic waves travel faster than audible sound, allowing precise proximity measurements.

x. Blood Pressure Sensor

The blood pressure module operates within the **near-infrared (NIR) spectrum**, which falls between the visible and infrared regions. NIR is widely used in biomedical applications due to its high penetration capability and is often referred to as the "living-body window."

xi. GSM Module

The GSM module enables wireless communication between the Medical ATM and healthcare networks. It uses GSM mobile communication standards and connects via a SIM card, facilitating real-time data transmission to doctors or medical databases.

4. SIMULATION RESULTS AND DISCUSSIONS

With the help of the proteus software, the simulation results are analysed. It is a suite of software that can be used for designing schematics, simulations, and PCBs. Besides developing 3D drawings for the product, the designer also has the option of creating 2D drawings. In terms of software tools, Proteus is a proprietary tool suite that is used for electronic design automation and is marketed as a proprietary software suite. Software like this one is used primarily by electronic design engineers and technicians to help them create schematics and printed circuit board layouts that can later be used by manufacturers to manufacture the circuit boards.

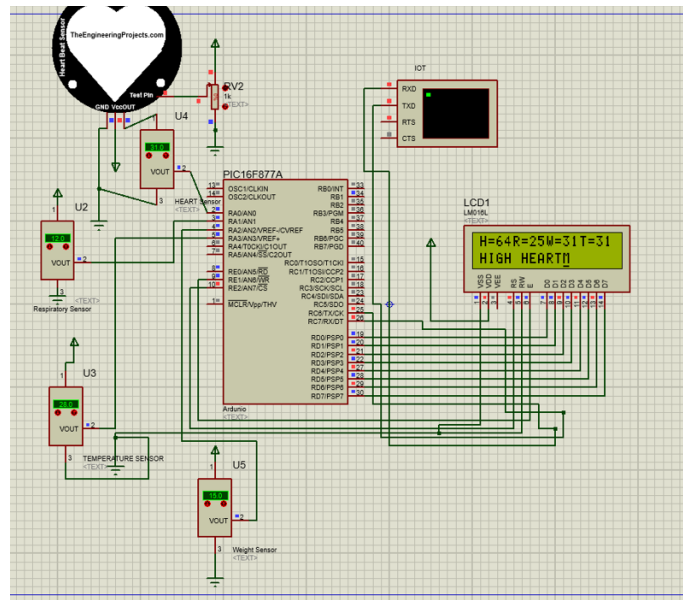


Figure 2 The schematic diagram for Simulation of Medical ATM

The Figure 2 is the simulation of a Medical ATM system interfaced with a PIC 16F877A Microcontroller using a Load sensor, Temperature, Blood pressure, Heartbeat sensor, and ultra-sonic sensor.

The interfacing of various components that correspond to the Medical ATM system is built with the help of various sensors to sense the real-time vital signs of the human body as shown in Fig 3. This hardware setup includes all the above-discussed sensors with their decoders as well.

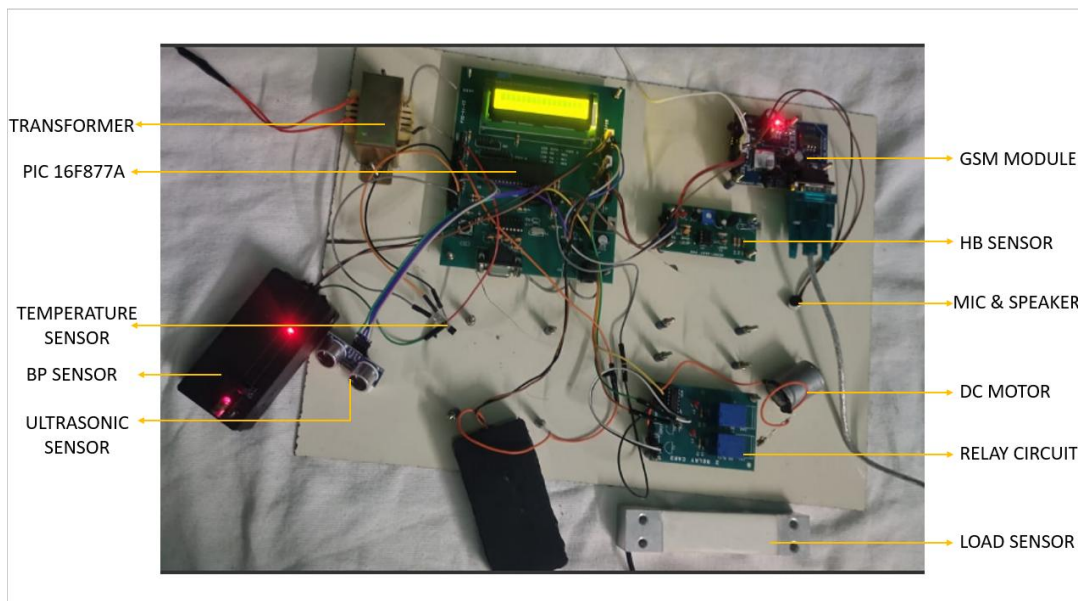


Figure 3 Hardware Interfacing of Medical ATM

4.1 User Interfaces of Medical ATM System



Figure 4 Patient's User Interface

From Fig 4, the User Interface of the Patient's End which is developed with the help of visual studio displays the sensed parameter of vital signs like Body Temperature, Weight, Height, Blood Pressure per Minute, and Heartbeat Rate with a medicine prescription based on the input will be displayed.

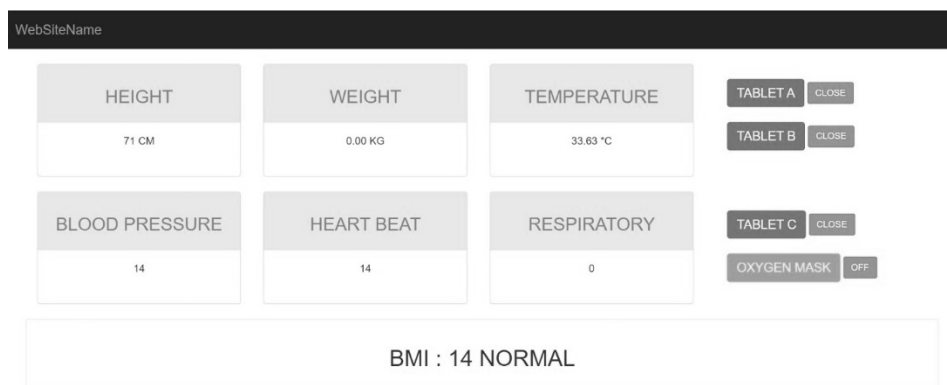


Figure 5 Doctor's User Interface

The User Interface of the Doctor's End will display all the sensed data which is designed and developed using Bootstrap (Frontend Framework Tool) as shown in Fig 5. These data will help the doctor while screening a patient.

For example, the system diagnoses the vital signs of the patient Body Weight=63kg, Body Height= 170 cm, Blood Pressure=125 mmHg, Heartbeat rate=70, Temperature = 33.6, and Respiratory rate = 12 bpm. So, with these data patients can consult with doctors. The doctor has the control to dispense the tablets to patients based on prescription.

5. CONCLUSION

The overall objective of the proposed system presents a novel IOT-based Medical ATM (Automated Tele-Medicine) System. It includes the interfacing, programming installation, and implementation of an Automated Tele-Medicine Dispenser in Rural areas. This will be an alternative for medical support in remote areas which is proposed to overcome the lack of medical facilities in rural areas. Approaching a sick patient from a remote area and diagnosing their illness is made even simpler with the help of IoT. Various vital signs of the human body are sensed and their results are discussed. The model of this proposed model is carried out in Proteus software and the results are discussed in detail. The proposed system has 2 modes of operation, which are chosen manually. Connecting a virtual call with the concerned doctor based on the user's request will develop a mutual interaction with the patient-physician relationship. Also, the hardware implementation of the medical ATM system is discussed which is integrated with two user interfaces namely, Doctor's UI and the Patient UI.

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