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Wearables and the Internet of Things for Health

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***Abstract*— The Internet of Things (IoT) is an emerging paradigm for the range of new capabilities brought about by pervasive connectivity. The concept involves situations where network connectivity and computing capability expand to objects, sensors, and everyday items that exchange data with little to no human involvement. The premise of the IoT is to build, operate, and manage the physical world by means of pervasive smart networking, data collection, predictive analytics, deep optimization, machine-to-machine methods, and other solutions. Its potential benefits can impact how individuals live and work. In the near future, corporate and government organizations, such as the U.S. Department of Defense, may be challenged by the inevitable addition of IoT devices to their networks and connected systems. This notion will serve as a source of innovative decision making.**

***Index Terms*— PIC16F877A MicroController, Temperature Sensor, Heart Beat Sensor, ESP8266 IOT Module, System, MEMS Sensor .**

I. INTRODUCTION

Wearable technology has made significant progress in recent years, with millions of devices being sold to consumers and steady advances being made in technological capabilities. Although the form and function of contemporary wearables have changed from Shannon and Thorpe's 1961 experiment, many of the same conflicting design issues have to be taken into consideration when developing modern technologies that are intended to be worn. Al- though wearables have benefited from advances in mobile technologies, functionality remains limited compared to smartphones. Additional- ly, smartphones do not need to be comfortable to wear while in motion, are less restricted by weight and size requirements, and have more well-defined aesthetic requirements. However, wearables present a tremendous opportunity for capturing a continuous stream of data about our physiology and kinesiology, which can empower consumers with self-knowledge.

Human health and fitness are areas in which wearables can offer insights that smartphones cannot. This is evident from the immense popularity of fitness trackers (e.g., the Fitbit Blaze, Jawbone UP, and Nike+ Fuel Band) and smart watches (e.g.,theApple Watch and Samsung Gear) being used by consumersto self-monitor physical activity. Additionally, wearables are being used for self-monitoring and preventing health conditions such as hypertension and stress. Donald Jones with the ScrippsTranslational Science Institutesays,"My favorite wearables today are those that measure blood pressure and that can be used to impute stress. I think these are some of the most interesting areas of feedback that we have today. Hypertension is a cause of many illnesses, and stress sis obviously a big contributor". Researchcontinuestoexplorehowwearablescanhelppatientsan dphysiciansbefore,during,and after medical procedures,such as surgery. For example, telemedicine can be performed by on-site paramedics wearing Google Glass, a head-mounted display with a camera and mi- crophone, and communicating with off-site medical doctors to provide expert care during disaster relief efforts. Ad- ditionally, wearables can pro- vide a more expedient means of monitoring a patient's vital signs during surgical procedures by reducing the size of equipment and the number of wires leading to external de- vices. Such applications could improve the quality of medical.

Even so, many issues need to be taken into considera- tion when deploying wearables for general health care. For example, John Feland, chief executive officer of Argus In- sights, says, "People get tired of the fitness bands and throw them in the sock drawer. They stop being useful, people lose their fitness momentum. Furthermore, data security and privacy are primary concerns for both patients and hospitals. Therefore, new technologies need to be integrated with devices and systems already in place, and approval by regulatory agencies can take years and millions of dollars before benefits are realized.

II. THE IOT AND WEARABLES IN ACTION

Wearables are steadily becoming the most prevalent personal devices, offering users the ability to interact with other tools and physical objects around them. Once the IoT becomes more widely adopted—creating a truly hyperconnected world—common interactions via the Internet and connected objects may shift to more active engagement of content and environment, specifically in health care. Let's take a look at a few case studies that showcase how wearables and other technologies integrate to form an IoT solution in different domains.

A. Augmented Reality Wearables for Medical Education

The IoT, augmented reality (AR), and wearables can create new paradigms that may potentially change the way people experience the world. In all aspects of life, AR is an emerging technology that can be implemented as a system of interactions to better serve human needs, especially in the field of health. For example, medical students from Case Western Reserve University and the Cleveland Clinic are using Microsoft Hololens, a holographic, head-worn

computer that enables learners interacting with high-definition holograms to better understand the body's organs and systems. These students examine and become familiar with details of the heart and specific functions of the body through a three-dimensional projection instead of in traditional, cadaver-filled laboratories. Through the combination of AR, wearable technology, and the IoT, environments will become more responsive and digitally manipulable.

B. Humber River Hospital: An All-Digital Hospital

Humber River Hospital in Toronto, Canada, opened its doors in 2015 and is the first state-of-the-art, all-digital hospital in North America. Humber River uses the IoT to provide hightech patient-centered care in a manner that is more efficient with regard to costs and operations. The IoT has been integrated as a solution to provide faster care and consequently reduce patient stays, provide more accurate diagnoses, improve the link between medical records and medical practitioners, and automate more than three-fourths of its supply chain.

The all-digital hospital experience begins with online appointment scheduling and check-in. Patients are empowered with bedside access to their medical records via monitors, and they can communicate with doctors, nurses, and family members using video chat and instant messaging. The hospital employs patient wristbands featuring real-time location technology for tracking wandering patients and improving security to prevent infant abduction. Additionally, Humber River has medical devices that automatically capture and store patient health metrics, which enables doctors and nurses to have a real-time view of a patient's health status from a distance. The hospital uses robots to mix drugs and transport goods; machines also process blood samples in minutes, then transmit the results electronically.

III. WORKING PRINCIPLE:

In this project we are introducing a new method for patient health monitoring. In this we are using a PIC16F877A Microcontroller for connecting the sensors like Temperature Sensor, Heart Beat Sensor, IOT module Temperature Sensor will calculate the room temperature which is very important for asthma patients whenever the temperature increases more than the room temperature then it will provide a buzzer sound in order to intimate that temperature is increases/decreases. Similarly we are also using Heart Beat Sensor in order to collect the heart rate and also the MEMS sensor in order to check the paralyzed condition or not. After collecting all the information from the patient the microcontroller will send the complete data to the doctor system based on that he will check and finalized the medicine for that particular patient.

A. Block Diagram

1. Circuit Design:

- **Regulated Power Supply:** Usually, we start with an unregulated power supply ranging from 9volt to 12volt DC. To make a 5volt power supply, KA8705 voltage regulator IC has been used. The KA8705 is simple to use. Simply connect the positive lead form unregulated DC power supply (anything from 9VDC to 24VDC) to the input pin,connect the negative lead to the common pin and Mathematical Methods and Optimization Techniques in Engineering ISBN: 978-960-474-339-1 93then turn on the power, a 5 volt supply from the output pin will be gotten**.**

- **PIC16F877A Microcontroller**: A microcontroller is a computer control system on a single chip. It has many electronic circuits built into it, which can decode written instructions and convert them to electrical signals. The microcontroller will then step through these instructions and execute them one by one. As an example of this a microcontroller we can use it to controller the lighting of a street by using the exact procedures.

Microcontrollers are now changing electronic designs. Instead of hard wiring a number of logic gates together to perform some function we now use instructions to wire the gates electronically. The list of these instructions given to the microcontroller is called a program. There are different types of microcontroller, this project focus only on the PIC16F877A Microcontroller where it's pins

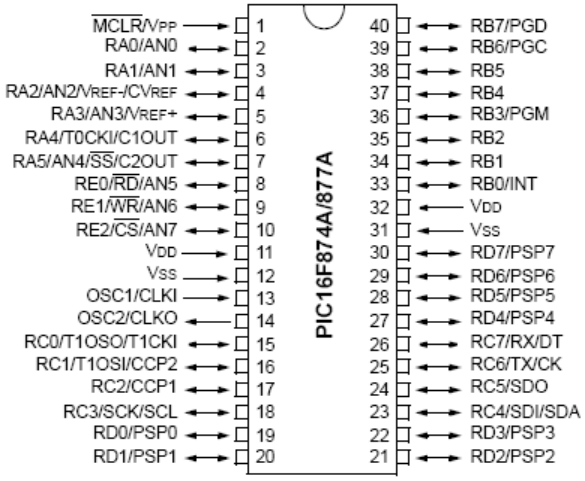


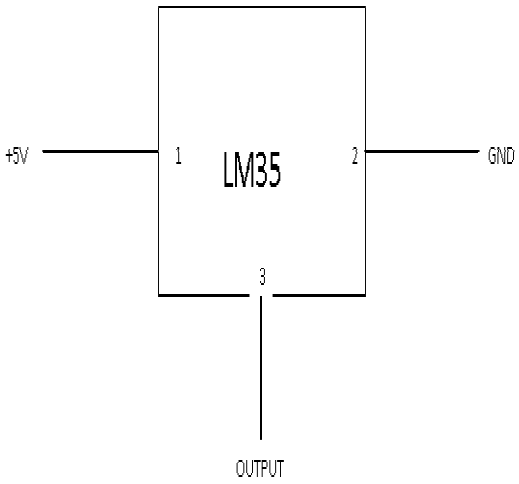
Figure: PIC16F877A PIN Diagram

- **LM-35 Sensor:**

You can measure temperature more accurately than a using a thermistor.

The sensor circuitry is sealed and not subject to oxidation, etc.

The LM35 generates a higher output voltage than thermocouples and may not require that the output voltage be amplified.



- **Heart beat sensor:**

Heart beat sensor is designed to give digital output of heat beat when a finger is placed on it. When the heart beat detector is working, the beat LED flashes in unison with each heart beat. This digital output can be connected to microcontroller directly to measure the Beats Per Minute (BPM) rate. It works on the principle of light modulation by blood flow through finger at each pulse.

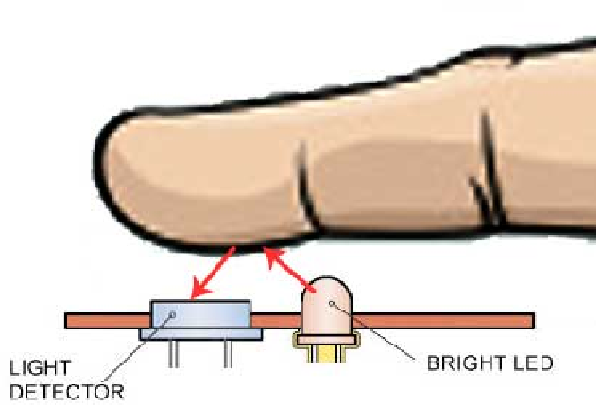
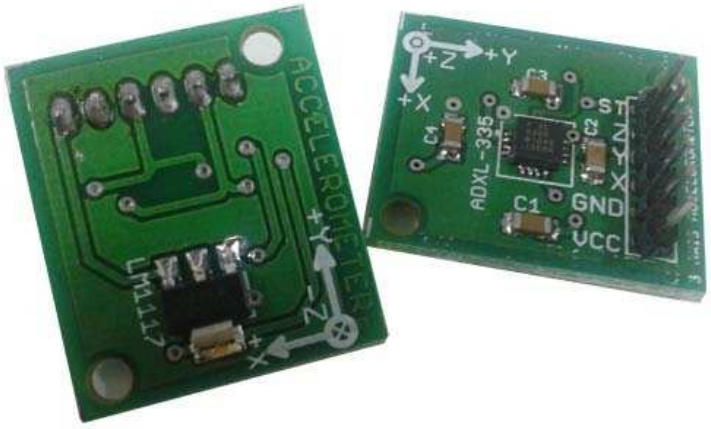


Figure: Heart Beat Sensor

- **MEMS Sensor:**

Microelectromechanical systems (**MEMS**) (also written as *micro-electro-mechanical*, *MicroElectroMechanical* or *microelectronic and microelectromechanical systems*) is the technology of very small devices; it merges at the nano-scale into nanoelectromechanical systems (NEMS) and nanotechnology. MEMS are also referred to as micromachines (in Japan), or *micro systems technology – MST* (in Europe).



IV. Result Analysis:

In this project we are introducing a new method for patient health monitoring. In this we are using a PIC16F877A Microcontroller for connecting the sensors like Temperature Sensor, Heart Beat Sensor, IOT module Temperature Sensor will calculate the room temperature which is very important for asthma patients whenever the temperature increases more than the room temperature then it will provide a buzzer sound in order to intimate that temperature is increases/decreases. Similarly we are also using Heart Beat Sensor in order to collect the heart rate and also the MEMS sensor in order to check the paralyzed condition or not. After collecting all the information from the patient the microcontroller will send the complete data to the doctor system based on that he will check and finalized the medicine for that particular patient.

Pattern	Bytes	Bitrate UL/DL
Pattern 1	206 / 140	1.648 / 1.12
Pattern 2	1036 / 66	8.288 / 0.528
Pattern 3	204 / 102	1.632 / 0.816
Pattern 4	420 / 564	3.36 / 4.512
Pattern 5	506 / 140	4.048 / 1.12
Pattern 6	66 / 66	0.528 / 0.528

V. Conclusion:

The IoT is a potential emerging solution that consists of interconnected devices. These networked devices offer better, faster, and cheaper customer-driven innovations in health care consumption as well as provision. Networked wearable devices and apps play an integral role, serving as the foundation to the ever-evolving practice of the IoT in health care.Daniel Kraft of the Aspen Institute believes that apps and their IoT connections may begin supporting clinicians' workflow. He says, "As the incentives are aligning and value-based care comes together, the future will be the IoT that blends with wearable devices, apps, and smart analytics on top of data. This is so the clinician and care team can get the right insights from the data at the right time and not be overwhelmed. Smart preventative decisions can be made for a more proactive individualized care and therapy" [1]. With the

wearables market still in its early phases of expansion and the IoT continuously changing, communications and electronic engineers will be at the forefront of building next-generation solutions. There may be a substantial increase in things like embeddables— small and easily powered microchip implants that can be placed anywhere within a person's body. In terms of the health care sector, they may be able to measure vital signs without invasive surgery. Embeddables, such as electronic tattoos, for example, may be equipped with sensors that can transmit through wireless technology. Also, three-dimensional printed medical devices are very promising additions to the IoT, in that every object implanted in the human body may be scannable or trackable through networks. Similar to what we see in science fiction movies, wearable devices that have electrostatic properties connected to various wireless systems could create new user experiences with the added capacity of artificial intelligence, making our future devices truly smart. With all of these looming innovations, the future seems to be very bright and electric.

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