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# Embedded System Product Development: Health Monitoring-1

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**Abstract**: Human foot takes a lot of weight, the actual mass of the human body and the downward force on the human feet due to the gravitational pull [1]. Most foot pain is the result of faulty relationship between the bones and the muscles of the foot caused by very high pressure exertions at particular points of the foot. It is very essential to monitor the actual pressure at points on the foot and there is a need for custom made orthotics. As the subjected feet rests on the orthotics it is gently and consistently directed in to the correct position during walking, running and standing. In this paper, we have briefly explained the concept of monitoring of pressure points of the foot using android application. Force sensors are used to monitor the force per unit area at different pressure points of interest on the foot. The region on the foot which has to be subjected to lesser pressure or corrected is noted and a custom made orthotics is used as the shoe sole. It is blessing in disguise to diabetic patients to monitor and correct every foot movement.

**Keywords**: Diabetic patients, EEPROM, Bluetooth module (HC-05) and monitoring of pressure points of the foot using android application

## I. INTRODUCTION

Human foot is the pillar of the human body. It bears all the weight of the human body. The force exerted by a person weighing an average of 70Kg is a mind boggling 686N [2]. The foot muscles and bones are the strongest in the human body. In animals the mass of the body is distributed on all 4 legs, but humans are two footed and the vector pointing downwards is of considerable importance. The pressure exerted on a particular pressure point on the foot can be reduced by custom made orthotics which at certain points absorb pressure due to a cushion-like material embedded on to it or by aligning the foot's position during different postures. Podiatry is a branch of medicine devoted to the study, diagnosis, and surgical treatment of disorders of foot, ankle and lower extremity. Diabetic patients are the most affected and prone to foot injuries, foot ulcers and internal bleeding. A subject suffering from Diabetes Mellitus have frequent complaints of foot ulcers and at the worst scenario the foot or a part of it needs to be amputated. Proper monitoring of foot pressures at the right time and a user friendly device for doing so can play an important role in prevention rather than cure or surgical amputation.

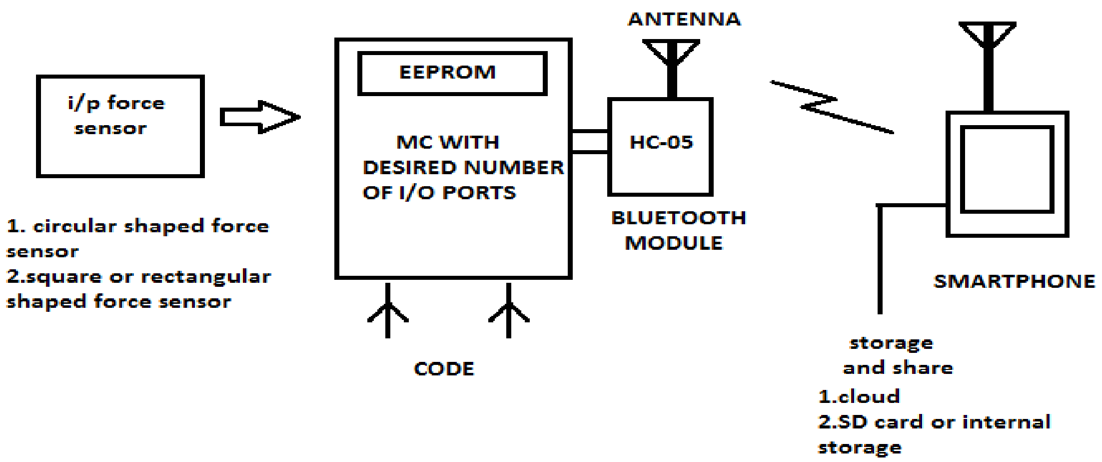


Figure 1shows the block diagram of the foot pressure monitoring system

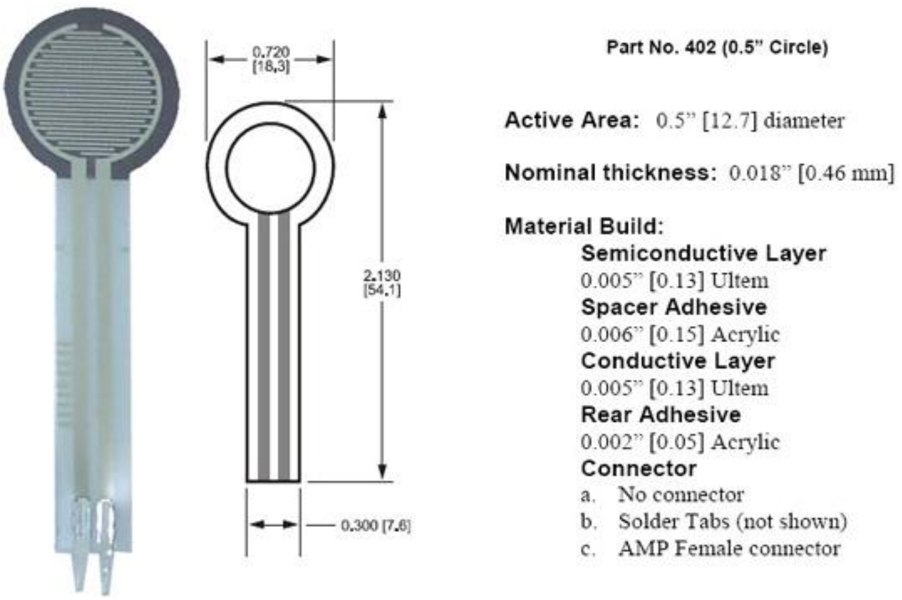


Figure 2 shows circular force sensor with diameter of the active area = 0.5"

## II. APPLICATIONS OF THE DEVICE

To measure/ monitor the foot pressures of

- Diabetic patients
- Athletes to improve their performance
- Subject suffering from knee or foot injuries
- Subjects in need of posture correction
- Also, in wireless monitoring of foot pressure and to compare the same with the parameters of a healthy foot.

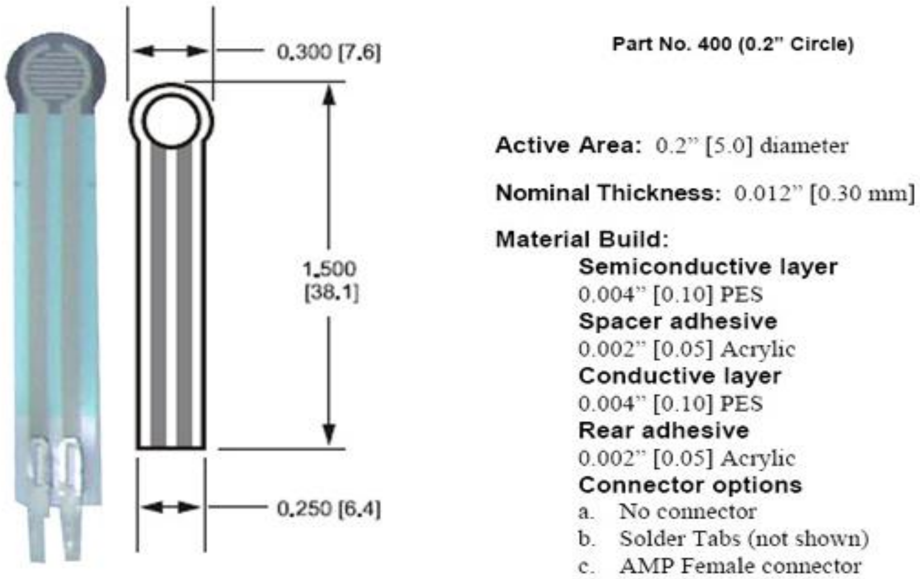


Figure 3 shows the circular force sensor with diameter of the active area = 0.2"

## III. BLOCK DIAGRAM

1. *Sensors*

The sensors for the human foot are selected based on the actual circumference, area and the shape of the foot. There are two types of force sensors classified on the basis of shape

- Circular [3]
- Square or rectangular [4]

Figure 2 shows circular force sensor with diameter of the active area = 0.5”. Figure 3 shows the circular force sensor with diameter of the active area = 0.2”. Force sensors can be classified on the basis of the material used and the principle of working.

- Resistive force sensors [5]
- Optical force sensors

Pressure (Pa) = Force (N)/ Area ($mm^2$)
For circular force sensor, $P_c$ = Force/$\pi r^2$
For square force sensor, $P_s$ = Force/$a^2$, where a= side length of the active area of the square sensor
For rectangular force sensor, $P_r$= Force/a*b, where a= length, b=breath

Figure 4 shows the working of resistive force sensors and figure 5 shows the working of optical force sensor. In case of a resistive force sensor, when a force is applied on the sensor per unit area, the current flowing in the coil is resisted. The change in the electrical parameters due to the applied force is processed by the microcontroller. Same is the case with the force sensor working on the optical principle. When the light transmitted along the waveguide is opposed due to the pressure or force exerted per unit area of the surface of the sensor. At the detector, the change in the intensity of light due to exerted pressure is decoded by the microcontroller into useful information.

2. *Microcontroller and connectivity element*

The microcontroller used must contain desired number of I/O ports. The code is dumped into the EEPROM. The digital data is processed by the ALU and may or may not be converted to analog signal before the output. A HC-05 module is used to transmit the data wirelessly to the smartphone. Figure 6 shows the layout of the microcontroller of interest.

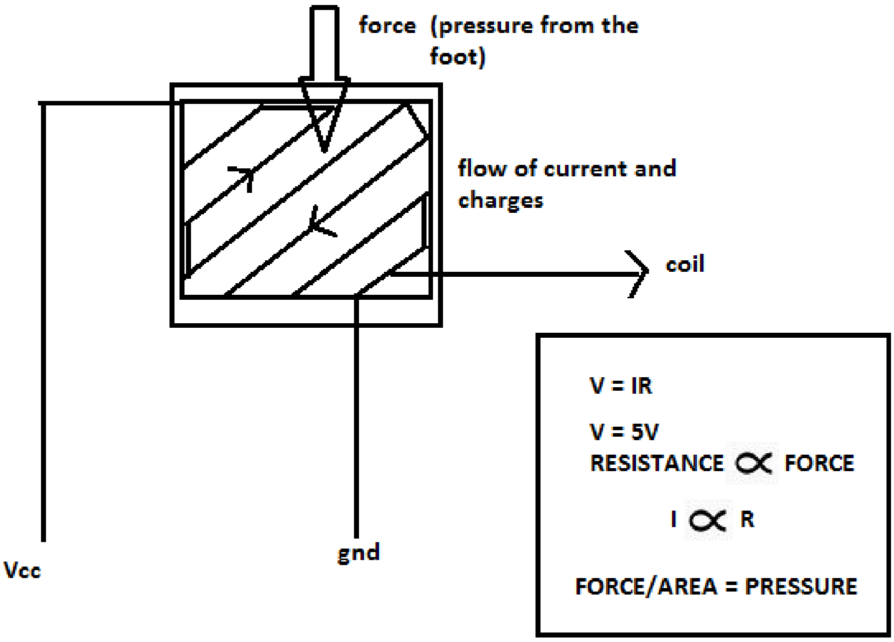


Figure 4 shows the working of resistive force sensors

## IV. SMARTPHONE APPLICATION

The analog output from the DAC unit [6], after being processed by the microcontroller is transmitted wirelessly to a smartphone application via a Bluetooth module (HC-05). We have developed a scientific application which is capable of monitoring the values of up to eight sensors. Figure 7 shows the android application. The application consists of the following visible components

- Buttons
- Labels
- Textbox
- Icons
- Canvas
- List picker

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And following non-visible components

- Clock
- Bluetooth client
- Notifiers
- Tiny DB

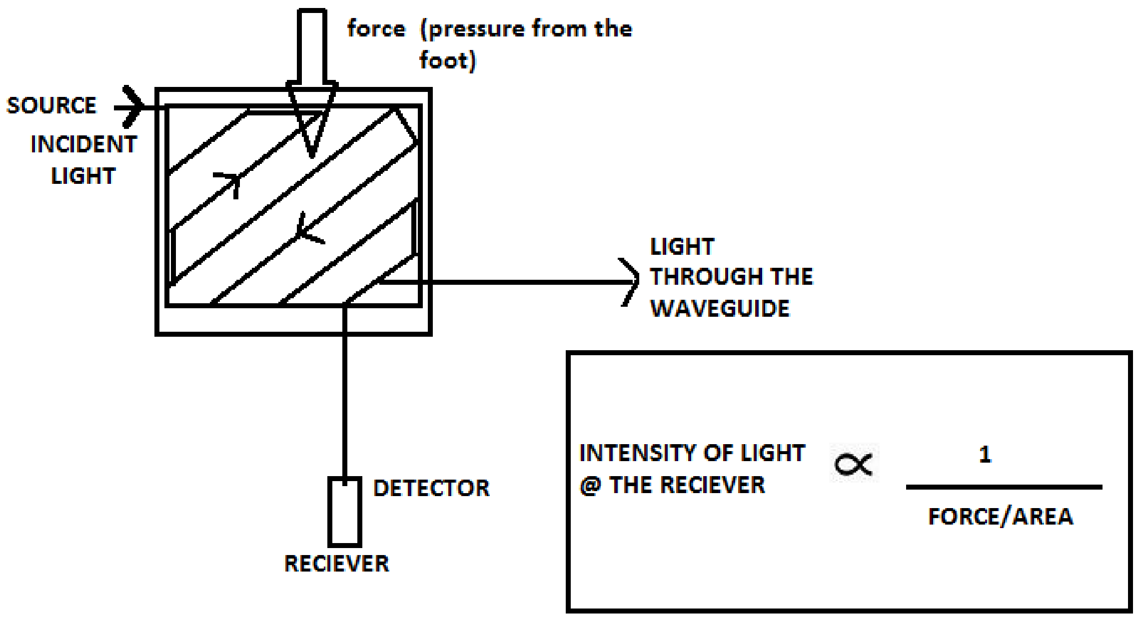


Figure 5 shows the working of optical force sensor

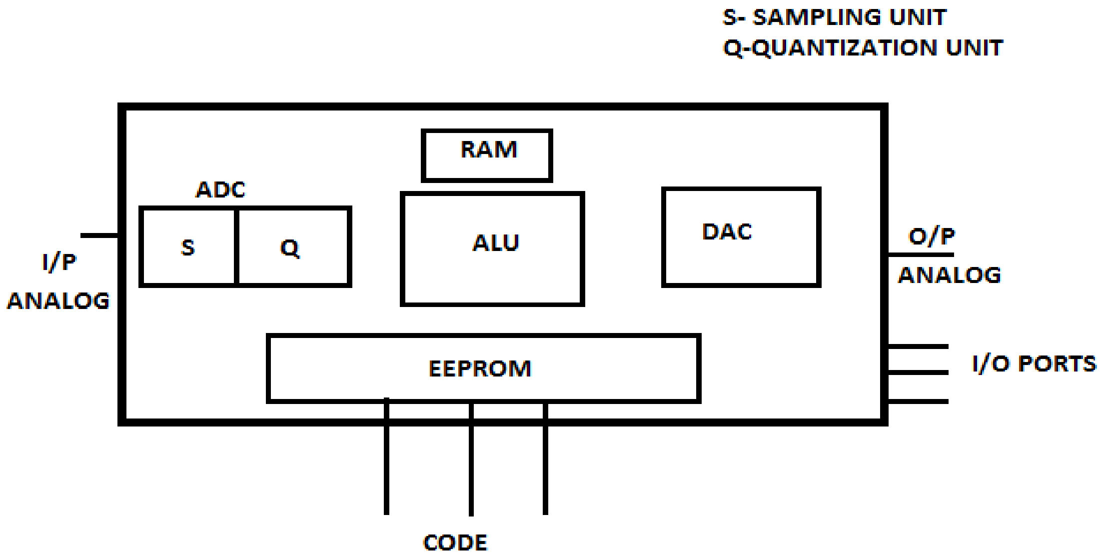


Figure 6 shows the microcontroller of interest

## V. CONCLUSIONS

The paper and the system built would bring about a drastic change in the field of podiatry. With this any subject will be able to analyse his or her gait on-the-go and whether he/she is exerting right amount of pressure on the foot. Also, monitoring lower part of the body can be achieved post injury or post-surgery. It would be a boon to diabetic patients to monitor their foot frequently. Athletics is an area where the system would be bang-on. We the engineers at Konigtronics have put in a lot of time and effort into this work, which emphasizes on the importance of podiatry in day to day human activities. This is because the entire body-weight is concentrated on the foot and the foot is the one which bears the maximum load and stress in the body.

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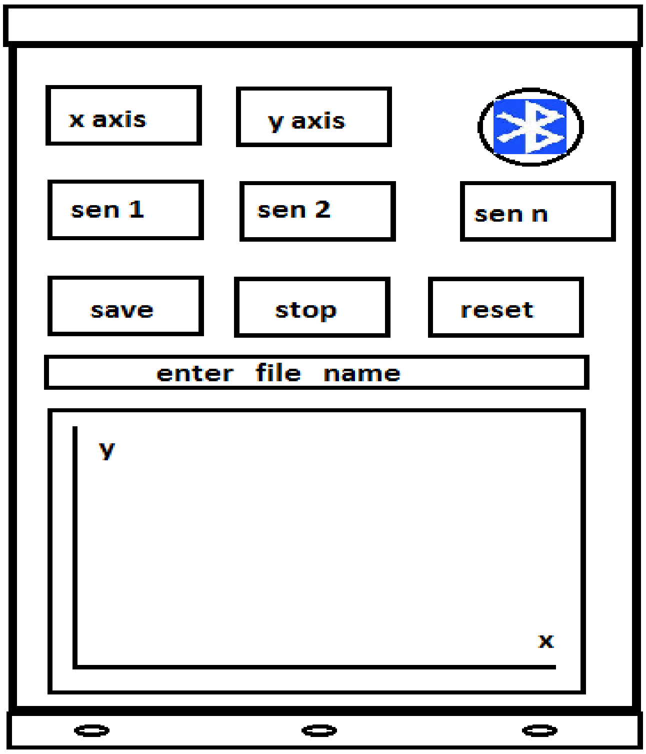


Figure 7 shows the smartphone application

## REFERENCES

[1] Muscle and forces- https://www.medicalphysics.org/documents/WebPOTB.pdf
[2] Stress distribution of the foot- http://www.mace.manchester.ac.uk/project/teaching/civil/structuralconcepts/StudentCoursework/contents/7.pdf
[3] FSR- https://www.sparkfun.com/datasheets/Sensors/Pressure/fsrguide.pdf
[4] IMAGES- scientific instruments-http://www.imagesco.com/sensors/force-sensors.html
[5] Mikrajuddin, A; Shi, F; Kim, H; Okuyama, K (24 April 2000). "Size-dependent electrical constriction resistance for contacts of arbitrary size: from Sharvin to Holm limits". Mat. Sci. Semicon. Proc. doi:10.1016/S1369-8001(99)00036-0.
[6] Garcia P., "A Methodology for the Deployment of Sensor Networks", IEEE Transactions On Knowledge And Data Engineering, vol. 11, no. 4, December 2011.

## BIOGRAPHY

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