International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075, Volume-4 Issue-9, February 2015

Utility of Interface Technology for Conversion of Hand Gestures to Digital Display – Voice Converter

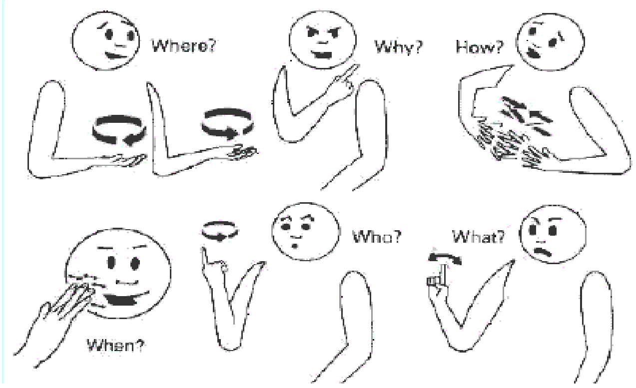
Surabhi Chetia, T. S. Muralidhar, Pedenla Lama, Juganta Das

Abstract* — the increase in human-machine interactions in our daily lives has made user interface technology progressively more important. Physical gestures as intuitive expressions will greatly ease the interaction process and enable humans to more naturally command computers or machines. Many kinds of existing devices can capture gestures, such as a "Wiimote," joystick, trackball and touch tablet. Some of them can also be employed to provide input to a gesture recognizer. But sometimes, the technology employed for capturing gestures can be relatively expensive, such as a vision system. In the proposed system, accelerometer based gesture recognition technique is used. The proposed system uses 3-Axes MEMS accelerometer with PIC16F877A Microcontroller. The accelerations of a hand in motion in three perpendicular directions are detected by three axes accelerometers respectively and based on the hand gestures appropriate voices are played through APR Voice which is also interfaced with the microcontroller. Objective of the project work to develop a device for conversion of sign language to suitable text and speech as output.

***Index Terms* — interface technology, Physical gestures, APR Voice, 3-Axes MEMS accelerometer, PIC16F877A Microcontroller**

I. INTRODUCTION

A **sign language** (also **signed language** or simply **signing**) is a language which, instead of acoustically conveyed sound patterns, uses manual communication and body language to convey meaning. This can involve simultaneously combining hand shapes, orientation and movement of the hands, arms or body, and facial expressions to fluidly express a speaker's thoughts. They share many similarities with spoken languages (sometimes called "oral languages", which depend primarily on sound), which is why linguists consider both to be natural languages, but there are also some significant differences between signed and spoken languages.



Wherever communities of deaf people exist, sign languages develop. Signing is also done by persons who can hear, but cannot physically speak. While they utilize space for grammar in a way that spoken languages do not, sign languages exhibit the same linguistic properties and use the same language faculty as do spoken languages. [Chambers, G.S.et al 2002][Cheok. A.D, et al 2002] Hundreds of sign languages are in use around the world and are at the cores of local deaf cultures. Some sign languages have obtained some form of legal recognition, while others have no status at all. A survey New York Times shows that the number of deaf and dumb is about 700,000-900,000 out of which 63 % are said to be born deaf by birth while others lose their hearing by accidents.

Existing system:

In the existing system, the gesture recognition is based on Joystick, track ball and touch tablet. Existing system uses vision based gesture recognition technique. These are cost expensive system. Hence we go for the proposed system.

Proposed system:

The main concept in designing this project is by sensing the variations in the x y z planes. The *MEMS accelerometer* will give analog voltage change, that change will be calculated by using the *adc* of the *microcontroller*. After calculating the *adc values* we will be comparing the adc values to detect the variations to represent the gesture. After finding the gesture we are going to produce

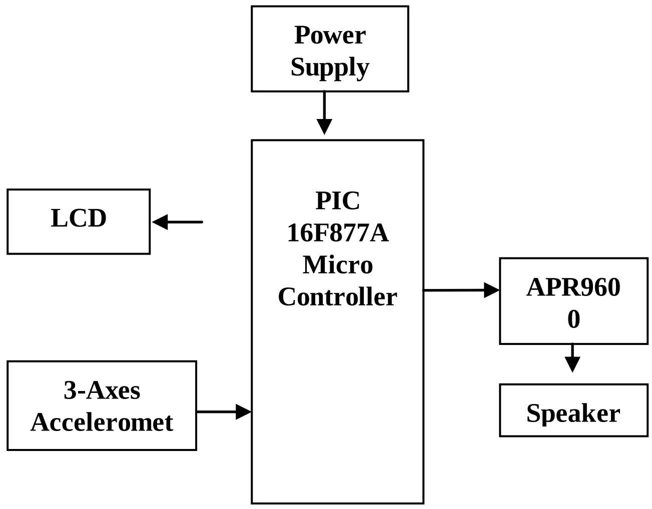
Manuscript Received on February 2015.
Surabhi Chetia, Department of Biomedical Engineering, SRM University, Kattankulathur Campus, Chennai -603203, India.
Dr. T. S. Muralidhar, Professor, P.G. Department of Biotechnology, R&D Center, Dayananda Sagar College of Biological Sciences, Kumaraswamy Layout, Bangalore-560078, India.
Pedenla Lama, M.Sc. Department of Biotechnology, R&D Center, Dayananda Sagar College of Biological Sciences, Kumaraswamy Layout, Bangalore-560078, India.
Juganta Das, M.Sc. Department of Biotechnology. R&D Center, Dayananda Sagar College of Biological Sciences, Kumaraswamy Layout, Bangalore-560078, India.

the sound by using a APR voice ic.

II. MATERIAL AND METHODS

- By sensing the xyz variations of the gesture the memes will give analog voltage change
- That change will be calculated by using the adc of the microcontroller.
- After calculating the adc values we will be comparing the adc values to detect the variations to represent the gesture
- After finding the gesture we are going to produce the sound by using an APR voice ic.

In the proposed system, accelerometer based gesture recognition technique is used. The proposed system uses 3-Axes MEMS accelerometer with PIC16F877A Microcontroller. The accelerations of a hand in motion in three perpendicular directions are detected by three axes accelerometers respectively and based on the hand gestures appropriate voices are played through APR Voice which is also interfaced with the microcontroller.



Power Supply for PIC16F877A Microcontroller

This section describes how to generate +5V DC power supply

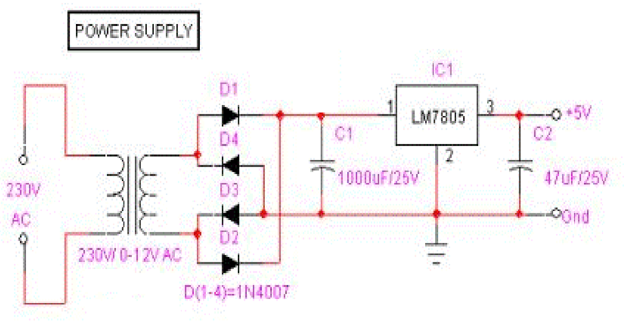


Figure 1: Power Supply for PIC16F877A Microcontroller

The power supply section is the important one. It should deliver constant output regulated power supply for successful working of the project. A 0-12V/1 mA transformer is used for this purpose. The primary of this transformer is connected in to main supply through on/off switch& fuse for protecting from overload and short circuit protection. The secondary is connected to the diodes to convert 12V AC to 12V DC voltage. And filtered by the capacitors, which is further regulated to +5v, by using IC 7805

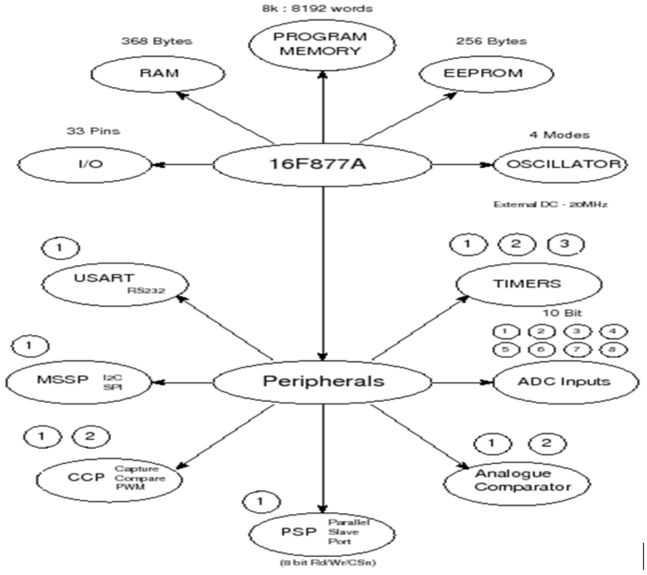


Figure 2: PIC Microcontroller:

Analog Applications:

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

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, Pinout compatible to other 28-pin or 40/44-pin PIC16CXXX and PIC16FXXX microcontrollers

Peripheral Details:

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).

Special Microcontroller Applications:

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 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.

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.

Figure 3: LCD

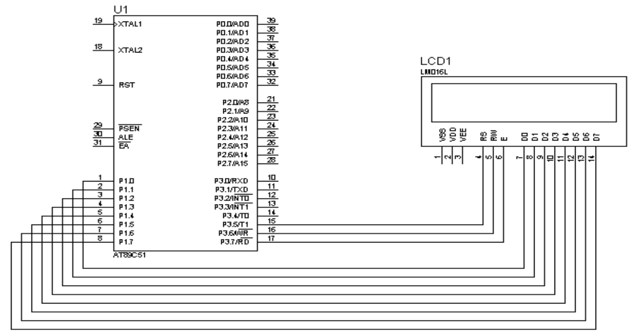


Figure 5.4 LCD architecture

The LCD standard requires 3 control lines and 8 I/O lines for the data bus.

• 8 data pins D7:D0

Bi-directional data/command pins.

Alphanumeric characters are sent in ASCII format.

• RS: Register Select

RS = 0 -> Command Register is selected

RS = 1 -> Data Register is selected

• R/W: Read or Write

0 -> Write, 1 -> Read

• E: Enable (Latch data)

Used to latch the data present on the data pins. A high-to-low edge is needed to latch the data.

The 8 data lines are connected to PORT 1 of 8051 microcontroller. The three control lines (RS, RW and EN) are connected to PORT 3.5, 3.6 and 3.7 respectively

APR 9600 VOICE IC:

APR9600 is a low-cost high performance sound record/replay IC incorporating flash analogue storage technique. Recorded sound is retained even after power supply is removed from the module. The replayed sound exhibits high quality with a low noise level. Sampling rate for a 60 second recording period is 4.2 kHz that gives a sound record/replay bandwidth of 20Hz to 2.1 kHz. However, by changing an oscillation resistor, a sampling rate as high as 8.0 kHz can be achieved. This shortens the total length of sound recording to 32 seconds. Total sound recording time can be varied from 32 seconds to 60 seconds by changing the value of a single resistor. The IC can operate in one of two modes: serial mode and parallel mode. In serial access mode, sound can be recorded in 256 sections. In parallel access mode, sound can be recorded in 2, 4 or 8 sections. The IC can be controlled simply using push button keys. It is also possible to control the IC using external digital circuitry such as micro-controllers and computers. The APR9600 has a 28 pin DIP package. Supply voltage is between 4.5V to 6.5V. During recording and replaying, current consumption is 25 mA. In idle mode, the current drops to 1 mA. The APR9600 experimental board is an assembled PCB board consisting of an APR9600 IC, an electrets microphone, support components and necessary switches to allow users to explore all functions of the APR9600 chip. The oscillation resistor is chosen so that the total recording period is 60 seconds with a sampling rate of 4.2 kHz. The board measures 80mm by 55mm.

III. RESULTS

x	Y	Z
281	310	369
284	308	365
285	307	366

Table 3.1 XYZ tabulation of 'what'

x	Y	Z
323	393	310
325	393	311
326	394	313

Table 3.2 XYZ tabulation of 'why'

x	Y	z
276	348	350
277	349	351
278	349	352

x	Y	z
301	307	379
296	311	380
294	312	381

IV. DISCUSSION

By the done trials and the findings we can conclude that this prototype will aid the communication abilities for the dumb and deaf by giving them an interface to interact by converting their sign language into text and speech. It will be tailor made to the person and will be able to be used in all fields for communication as it will be based on the internationally recognized codes for the dumb and deaf language. To increase the storage capacity, higher bit processors can be interfaced and used e.g.: 64 bit micro controllers and micro processor, DSP, etc. the MEMS sensor can be upgraded to a 9 axis accelometer. Also higher end compilers like can be used to increase the compressing ability in order to increase storage area. The aim of sign language recognition research is to let the computer to understand what a deaf "said" using the sign language so that the computer can output the recognition results in the form of text and/ or speaking language and help us to communicate with the deaf. The characteristics of Chinese Sign Language (CSL) are analyzed in the view of sign language recognition. The analysis and comparison of the two existing sign language recognition methods, the machine-vision-based method and the body - instrumentation-based method, are also done and a new clarification method for the CSL is also proposed. (Yang Quan 2010). In this research paper, the application of microelectronic mechanical system (MEMS) accelerometers for recognizing postures in Vietnamese Sign Language (VSL) were discussed as they develop a similar device to the Accele Glove for the recognition of VSL. In addition to the five sensors as in the Accele Glove, they placed one more sensor on the back of the hand to improve the recognition process. The data obtained from the sensing device is transformed to relative angles between fingers and the palm. Each character is recognized by a fuzzy rule-based classification system, which allows the concept of vagueness in recognition. In addition, a set of Vietnamese spelling rules has been applied to improve the classification results. The recognition rate is high even when the postures are not performed perfectly, e.g., the finger is not bended completely or the palm is not straight. (Bui, T.D 2007). In one of the research article an apparatus for instantaneously translating sign language in to voice and video is explained, by using accelerometer sensors to compute the position and movement of each finger, thereby instantaneously determining the posture of the hand. The location of fingers with respect to body is accurately determined by placing RFID tags at different parts of the body while a single RFID reader is placed on the index finger. Data from accelerometer sensors and RFID reader are multiplexed and sent wirelessly via a controller to a laptop processor where ultimate conversion of sign language to text/voice is achieved. Further, various characteristics of sign language comprising hand position, hand posture, hand orientation and hand movement are detected based on the accelerometer data and RFID data. **(**Dharma P. Agrawal, 2013). The focus on challenges for vision based and sign language interpretation system with an objective, to give an overall glimpse of SL interpretation need, existing image processing and pattern recognition techniques available in the literature. It will be a great contribution to the Indian hearing impaired through working on Indian sign language, so that they are enabled to become self-respecting citizens and despite their deafness and muteness can play a useful role in the society (Archana S et al 2014). A viewpoint invariant sign language recognition approach with only one camera, the proposed method converts the temporal–spatial recognition task as a verification task of a virtual stereo vision system. The Dempster–Shafer method is used to improve the recognition accuracy. Besides, incorporating multiple templates is necessary since the performance of the same sign varies from time to time even for the same signer. As a next step, as they will apply a statistical method to measure the differences between the observation and templates. Typically, the Linear Discriminant Analysis will be utilized. Meanwhile, automatic segmentation of the sign from the video stream is also a key issue in our future work (Qi Wang a et al 2007). To recognize speech, handwriting or sign language, many hybrid approaches have been proposed that combine Dynamic Time Warping (DTW) or Hidden Markov Models (HMM) with discriminative classifiers. However, all methods rely directly on the likelihood models of DTW/HMM. Both using a selection of discriminative features (DF), and are shown to outperform HMM and Statistical DTW (SDTW). However, they were found that combining likelihoods of multiple models in a second classification stage degrades performance of the proposed classifiers, while improving performance with HMM and SDTW. A proof-of-concept experiment, combining DFFM mappings of multiple SDTW models with SDTW likelihoods, shows that also for model-combining, hybrid classification can provide significant improvement over SDTW. Although recognition is mainly based on 3D hand motion features, their results can be expected to generalize to recognition with more detailed measurements such as hand/body pose and facial expression (Jeroen F. Lichtenauer, et al 2008).

Future research in sign language recognition:

ƒ Current systems are mainly focused on static signs/ manual signs/ alphabets/ numerals. ƒ Standard dataset not available for all countries/sub continents / languages, ƒ a need for large vocabulary database is the demand for current scenario. ƒ Focus should be on continuous or dynamic signs and nonverbal type of communication. ƒ Sign language recognition systems should adopt data acquisition in any situation (not restricted to laboratory data). ƒ Systems should be able to distinguish face, hand (right/left) and other parts of body simultaneously. ƒ Systems should perform recognition task in a convenient and faster manner. (Ashok K Sahoo et al 2014). Bosch Sensortec is sampling the absolute orientation sensor BMX055, the first 9-axis sensor in the market with all components – accelerometer, gyroscope and geomagnetic sensor in a 3.0x4.5x0.95mm 20-pin LGA package. The BMX055 contains three highly accurate and versatile 3-axis sensors: a 12-bit low-noise accelerometer, a gyroscope with a resolution of 16 bit and programmable measurement ranges, and a low noise, wide-range geomagnetic sensor optimized for the best performance / power consumption ratio. With these devices, the absolute orientation sensor BMX055 provides accurate acceleration, angular rate and geomagnetic measurement data. The BMX055 is fully supported by Bosch Sensortec's sensor fusion software FusionLib, which leverages the company's deep know-how of its proprietary MEMS sensor technologies. The FusionLib Software combines the sensor data outputs and generates robust virtual sensor outputs such as quaternion, linear acceleration, rotation, gravity. Thus, developers can quickly and with little effort create advanced solutions with comprehensive 9-axis functionality. Possible use cases for the new 9-axis sensor can be found in the field of Augmented Reality, Human-Machine Interface (HMI), Location-Based Services, in-door navigation systems for smartphones and HMI for remote controls. The accelerometer unit of the BMX055 offers a selection of g-ranges from ±2 to ±16g with a sensitivity of 1024 to 128 LSB/g. It excels with a noise density of 150µg/√Hz. The gyroscope features a wide measurement range with angular rates between ±125°/s and ±2000°/s. At the same time it offers a very stable zero-rate offset temperature behavior. The geomagnetic sensor is characterized through a wide measurement range of ±1300µT in x and y axis and ±2500µT in z axis. Heading accuracy is 2.5°.

V. CONCLUSION

In the proposed system, with interface technology for conversion of hand gestures to Digital display – Voice converter accelerometer based gesture recognition technique is used. The proposed system uses 3-Axes MEMS accelerometer with PIC16F877A Microcontroller. The hand gestures appropriate voices are played through APR Voice which is also interfaced with the microcontroller. This module or device will be efficiently work for conversion of sign language to suitable text and speech as output.

ACKNOWLEDGMENT

The researchers are extremely grateful to Dimple Roy and Ankita Singh, with Department of Biomedical Engineering, SRM University, Kattankulathur campus, Chennai for their immense guidance and support for this project

REFERENCES

1. Chambers, G.S. Venkatesh, S., West, G.A.W., Bui. H.H, "Hierarchical recognition of intentional human gestures for sports video annotation' In: Proceedings. 16th International Conference on Pattern Recognition, vol. 2, pp. 2002, 1082–1085.
2. Cheok. A.D, Ganesh Kumar. K., Prince. S, "Micro-accelerometer based hardware interfaces for wearable computer mixed reality applications" In: Proceedings. Sixth International Symposium on Wearable Computers, 2002, pp. 223–230.
3. Deng. J.W, Tsui. H.T, "An HMM-based approach for gesture segmentation and recognition" In: Proceedings. 15th International Conference on Pattern Recognition. vol. 3, 2000, pp. 679–682.
4. Kelly. D, McDonald. J, Markham. C, "A person independent system for recognition of hand postures used in sign language" Pattern Recogn. Lett. 31(11), 2010, 1359–1368.
5. LIS3LV02DQ Datasheet, 'MEMS Inertial Sensor', 3-Axis-±2g/±6g Digital Output Low Voltage Linear Accelerometer.
6. Reifinger. S, Wallhoff. F, Ablassmeier. M, Poitschke. T, Rigoll. G, "Static and Dynamic Hand-Gesture Recognition for Augmented Reality Applications. In: Human-Computer Interaction". HCI Intelligent Multimodal Interaction Environments. LNCS, vol. 4552, 2007, pp. 728–737. Springer, Heidelberg.
7. Zaki. M.M, Shaheen. S.I, "Sign language recognition using a combination of new vision based features". Pattern Recogn. Lett. 32(4), 2011, 572–577.
8. Yang Quan, "A Classification Method for Chinese Sign Language Recognition" Industrial Electronics and Applications (ICIEA), 2010 the 5th IEEE Conference. 15-17 June 2010, 1537 – 1542.
9. Bui. T.D, "Recognizing Postures in Vietnamese Sign Language with MEMS Accelerometers Sensors". Journal IEEE. Volume: 7, Issue: 5. May 2007, page 707 – 712.
10. Dharma P. Agrawal, "Apparatus for instantaneous translation of sign language". Publication number US 8493174 B2, Application number US 12/831,230. Publication date. 23 Jul 2013
11. Archana. S. Ghotkar and Dr. Gajanan K. Kharate. "Study of vision based hand gesture recognition using Indian sign language". International Journal on Smart Sensing and intelligent systems, March 2014, vol.7, no.1.
12. Qi Wang a, Xilin Chen b, Liang-Guo Zhang, Chunli Wang, Wen Gao. "Viewpoint invariant sign language recognition". Computer Vision and Image Understanding 108, 2007, 87–97.
13. Jeroen F. Lichtenauer , Emile A. Hendriks , Marcel J.T. Reinders , "Sign Language Recognition by Combining Statistical DTW and Independent Classification" , IEEE Transactions on Pattern Analysis & Machine Intelligence .Issue No.11, vol.30, November 2008, pp: 2040-2046.
14. Ashok K Sahoo, Gouri Sankar Mishra and Kiran Kumar Ravulakollu, "Sign Language Recognition: State of Art". ARPN Journal of Engineering and Applied Sciences. feb 2014, vol. 9, no. 2,

AUTHOR PROFILE

Surabhi Chetia, Completed B.Tech in Biomedical Engineering. Department of Biomedical Engineering, SRM University, Kattankulathur campus, Chennai -603203.

Dr. T. S. Muralidhar, Has completed his PhD from Bangalore University, working as a professor and Head, Post Graduate Dept of Biotechnology. Dayananda Sagar College of biological Sciences. Bangalore. His fields of expertise were Biotechnology, Phyto-Pharmacology and Toxicology which renders a competitive organizational Growth in teaching, R&D & New Herbal Drug Development. He has published more than 35 papers in reputed journals and serving as an editorial board member of repute.

Pedenla Lama. She has completed her Masters in Biotechnology from our Institutions, affiliated to Bangalore University. She is a dedicated researcher.

Juganta Das, He has completed his Masters in Biotechnology, and a specialization in System Biology and metabolic Engineering.